Unfortunately, many of the historic wild rice stands have been lost. Although a number of factors can harm rice, it is particularly sensitive to water level changes (Vennum 1988). Many lakes and rivers have been dammed, and even small water level changes can destroy wild rice habitat. A number of interagency efforts are underway to try and reverse this decline in wild rice populations. These include abundance and harvest monitoring, restoration and enhancement, and research.

Wild Rice

To Chippewa tribes around the Lake Superior basin, wild rice (*manoomin*) is "the food that grows on water." It fulfilled a prophesy in the story of the Chippewa tribe's migration from the east – they would know that they had found their new home when they found the food growing on water. Wild rice has been a vital part of Chippewa culture and religion ever since. It was also significant in the lives of the Dakota and Menominee tribes, and provided food for early European explorers.

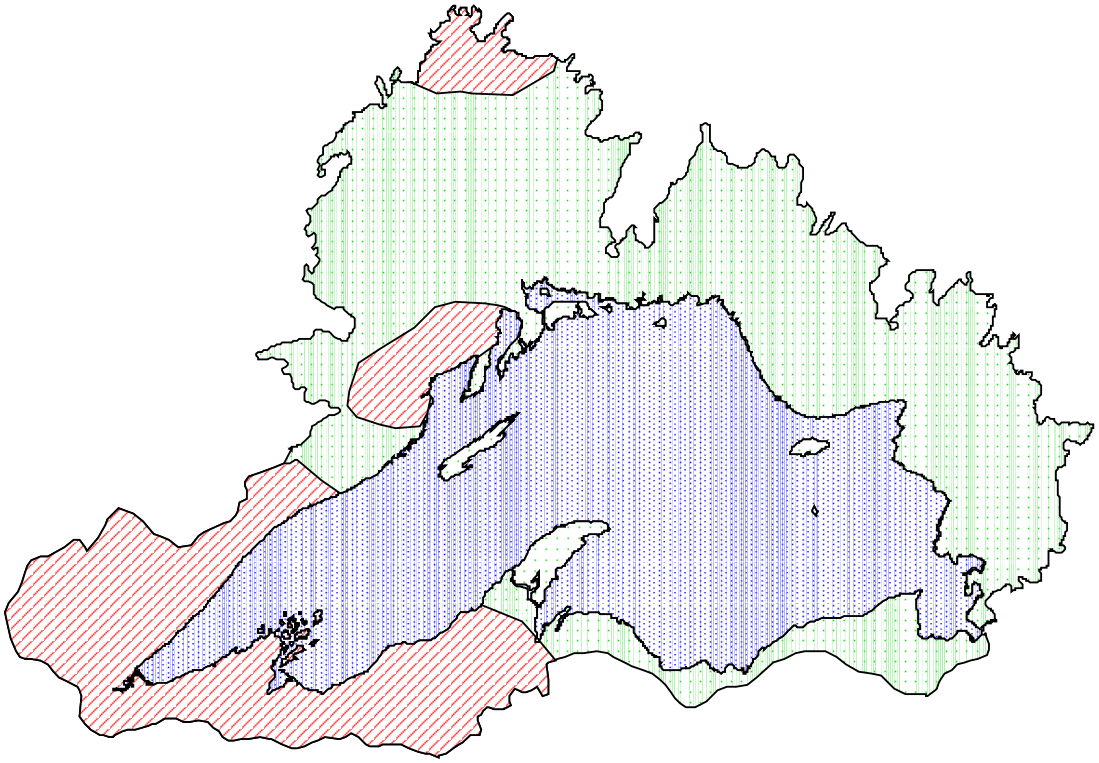

Figure 6-56. Distribution of wild rice in the Lake Superior basin (Based on Aitken and others 1988, Voss 1972)

6.1.11.2 Walleye

Historically, walleye was an important member of shallow-water (<3 m) fish communities in large bays, estuaries and tributaries of Lake Superior (Hoffe and Bronte 2000). Walleye have been caught in at least 73 Lake Superior tributaries since 1950, and spawning has been documented at 33 areas. During the late 1800s and first half of this century, walleye populations declined due to habitat degradation and overharvest (Hoff 1996). Walleye habitats in Lake Superior have been impaired by:

- reduction or elimination of fish passage in spawning tributaries,
- reduction in water quality caused by sedimentation and discharge of contaminants into the lake, and
- degradation of spawning and nursery habitats in six areas.

Six bays and ten rivers have been identified where walleye populations and/or habitats are in need of rehabilitation. The status of walleye habitat in Lake Superior and spawning tributaries is summarized below by jurisdiction.

Most walleye in the Minnesota waters of Lake Superior spawn within the 22 miles stretch of the St Louis River, below the hydroelectric dam near the village of Fond du Lac (Geving and others 1999). Spawning and nursery habitats in the St. Louis River have been negatively impacted since the turn of the century by water pollution from the upstream discharge of untreated domestic and industrial waste. In particular, chorophenolics and choro-organics from pulp and paper mills caused oxygen deficiencies and reduced the palatability in walleye (Schram and others 1999). Improvements in waste treatment initiated by the Western Lake Superior Sanitary District in 1978 has curtailed obvious widespread habitat degradation caused by inadequately treated organic compounds and biological oxygen demand. It has also dramatically improved walleye palatability and consequently, angling pressure. Persistent toxic contaminants remain a problem in walleye in the St. Louis River however, and further water quality improvements in the St. Louis River basin has been recommended to enhance walleye populations (Geving and others 1999). Key spawning areas in the St. Louis River are strongly influenced by manipulated water levels caused by hydroelectric dam operations. Fish kills and stranding of spawning walleye have been caused by bypassing water from the natural river channels to hydroelectric plants or from shutting down flows to recharge reservoirs. Recent licenses for dam operations have stipulated more favorable flow regimes, thereby increasing available walleye habitat.
The protection and enhancement of shallow nursery habitats within the St Louis River estuary has been aided by the purchase of waterfront property adjacent to the main spawning area by the Wisconsin DNR (Schram and others 1991).

In Wisconsin, there were historically three separate spawning populations:

- western lake Superior stocks that spawned primarily in the St. Louis River,
- Chequamegon Bay stocks that primarily spawn in the Kakagon River,
- Bad River spawning population (Schram and others 1999).

Poor forestry and agricultural practices (e.g. management of livestock and associated wastes) in the Bad River watershed have degraded riparian habitats and increased sedimentation at some locations, and contributed to increased flooding and reduced water quality. Contaminants may also have negatively affected spawning walleye populations in the Bad River (Schram and others 1999) and consumption advisories remain for both the Kakagon and Bad Rivers.

Habitat for four of the five major walleye populations in Michigan waters of Lake Superior has been impacted. The Victoria Dam and Bond Falls Dam have impeded upstream migration to traditional spawning areas in the Ontonagon River. Peak flows from hydroelectric facilities at those dams have also caused bank erosion. Development, poor land use practices (e.g. logging), and poorly constructed road crossings have increased bank erosion and sedimentation, and likely affected spawning habitats and wetlands throughout the Ontonagon River, the Huron Bay Watershed (Silver, Ravine, and Slate rivers), and the lower Tahquamenon River. Sedimentation and loss of vegetation due to winter navigation and shipping have negatively affected walleye spawning and nursery habitat in the upper St Marys River. Habitat loss from past logging-related shipping has also occurred in Sherman Park, Izaak Walton Bay, Cedar Point and Waishkey Bay (Hoff and others 1999). Habitat degradation does not appear to be significantly impacting the other major Michigan populations, Lac La Belle.

Black Bay and Nipigon Bay in Ontario historically had the largest population of walleye in Lake Superior, and Thunder Bay and Whitefish Bay also supported large fisheries (Ryder 1968; Schneider and Leach 1977; Kelso and others 1996). Impaired water quality from paper mill effluent downstream of spawning areas on the Nipigon River has been identified as a major cause in the decline of the Nipigon Bay population in the 1960s (Ryder 1968), although overfishing is also thought to have contributed (MacCallum and Selgeby 1987). Electrical barriers operated by the Sea Lamprey Control Centre during the 1950s and 1960s caused direct mortality of walleye in Lake Superior tributaries (including the Jackfish River) and prevented upstream migration to spawning grounds (Schram and others 1999). The Goulais Bay and Goulais River of the Whitefish Bay area, supported a commercial walleye fishery until the mid 1960s. Current use of TFB-Bayer 73 lampricide treatments and low alkalinities in spawning areas are thought to be reducing survival of walleye eggs and larvae (Rose and Kruppert 1984). Hydroelectric dams on the Michipocoten and Magpie rivers have restricted access to upstream spawning grounds. Habitat loss along the shoreline within the city of Thunder Bay may be limiting walleye stocks (Schram and others 1991). Concentrations of persistent toxic chemicals in walleyes from Goulais, Batchawana, and Nipigon bays remain above consumption advisories so further rehabilitation of water and sediment quality in walleye habitats is needed.

The Walleye Subcommittee of the Lake Superior Technical Committee has reported on the status of walleye populations (Hoff 1996) and drafted rehabilitation plan (Hoffe 1999). They recommend that:

> *The Lake Superior fish community will be managed to maintain, enhance, and rehabilitate habitat for, and self-sustaining populations of, walleye in areas where the species historically maintained populations.*

Objectives for rehabilitation of walleye habitats included (Hoff 1999):

- creating or maintaining spawning and nursery habitats (St. Marys River, Ontonagon River, Huron Bay Watershed, Bad River),
- enhancing fish passage pas a dam in the Ontonagon River,
- reducing sedimentation by 50 percent in the St Marys River, Tahquamenon River, and the Huron Bay Watershed,
- eliminate point source discharge of persistent toxic chemicals into the lake to reduce contaminant concentrations in walleyes, and
- improve land and water use practices in the St Marys River, Ontonagon River, Huron Bay Watershed, and the Bad River.

6.1.11.3 Coaster Brook Trout

Coaster brook trout are a large form of anadromous or lake dwelling brook trout (*Salvelinus fontinalis*) spend at least part of their life in Lake Superior (Becker 1983). They were historically common and widespread in the nearshore waters of Lake Superior and were often referred to as "coasters" or "rock trout" because of their preference for rocky, shallow coastal areas. Coaster brook trout typically spawn in tributaries in the fall before returning to the lake; fry remain in-stream during early development before descending to the lake. Shoal spawning coasters may spend their entire life cycle in Lake Superior, whereas others make many movements between stream and lake habitats (Newman and others 1998).

There is little information on Lake Superior brook trout before 1900 because early catch records did not distinguish brook trout from lake trout. In the early 1800s, lake-dwelling brook trout were found in most Lake Superior waters within 50 feet of shore, or about islets and shoals close to shore (Shiras 1935). They were less common along sandy beaches and steep, wave-washed cliffs. Coasters historically spawned in at least 106 Lake Superior tributaries, including 61 in Ontario, 25 in Michigan, 12 in Wisconsin and nine in Minnesota. They were probably present below the first barrier in all streams along Lake Superior's north shore (Waters 1983) and most coldwater streams along the south shore.

Overexploitation, particularly by anglers, is considered the primary cause for the abrupt decline of coaster brook trout populations after the 1860s. Brook trout are very vulnerable to angling, and coasters particularly so because they inhabit shallow shoreline areas and congregate at stream mouths for feeding and spawning. Incidental catch of brook trout in nearshore gill nets increased as fishing effort for lake trout and whitefish expanded in the early 1900s. In some areas, spawning fish were netted at stream mouths, which led to extirpation of local populations (Newman and Dubois 1997). During the late 1800s and early 1900s, anglers from across North America fished for large brook trout in Lake Superior's waters and tributaries, particularly the Nipigon, St. Mary's, Bois Brule and Salmon Trout rivers (Newman and Dubois 1997). By the early to mid 1900s, coaster brook trout were reduced to the small, scattered populations which have persisted in less accessible areas.

Habitat loss contributed to the decline in coaster populations and may be responsible for suppressing the recovery of stocks. Most destruction of habitat resulted from logging in the Lake Superior watershed, which accelerated in late 1800s. Critical spawning areas were degraded by sedimentation from increased erosion and deposition of bark debris from log drives. Coarse woody material essential for fish habitat was removed from stream banks and bottoms during log drives. Elimination of riparian cover, clear-cutting of watersheds and resulting wildfires may have increased water temperatures and affected groundwater movement. Finally, dam construction blocked migration routes and altered natural stream flow, sometimes resulting in exposure of eggs during draw down for hydroelectric production (Newman and Dubois 1997). At about the same time, introduction of non-native salmonids such as the rainbow trout, brown trout, coho salmon and chinook salmon may have represented an additional stress.

Assessment of the current distribution and abundance of coaster brook trout is difficult due to the presence of introduced hatchery fish and incidental occurrence of non-migratory stream fish. Interbreeding with domestic strains of brook trout may also have altered the genetic composition of native brook trout and reduced their migratory tendency (Newman and Dubois 1997). Coaster brook trout now persist as scattered remnant populations and have been eliminated from many areas, especially along the south shore of the lake. They persist where there is suitable habitat and some measure of protection from overexploitation by angling.

In Ontario, small numbers of coaster brook trout are caught at numerous locations in the lake and in many tributaries. The most important remaining spawning location is the Nipigon River (Newman and Dubois 1997) which may offer some degree of protection from overharvest due to its large water volume and flow. The relatively remote Cypress, Gravel and Little Gravel River also support consistent spawning runs. A number of shoal-spawning coaster brook trout populations persist near Isle Royale, as well as stream spawning stocks in Washington and Grace Creeks. Coaster brook trout numbers are occasionally reported at numerous locations along the south shore of Lake Superior, but abundance is considered very low. In mainland Michigan, only the privately managed Salmon Trout River still has a spawning run of coaster brook trout, and that population may be imperiled. In Minnesota, the Little Marais River may have spawning coaster brook trout, and reintroduced coaster brook trout appear to be spawning in two tributary streams on the Grand Portage Indian Reservation. No reproducing coaster populations are known from Wisconsin.

Recovery efforts for Lake Superior coaster populations have focused on identifying, protecting, and rehabilitating historical spawning streams. Efforts involve angling regulation (seasons, bag limits, size restrictions) and water level regulation (Newman and others 1998). Stocking brook trout in U.S. waters of Lake Superior has taken place since at least the 1940's, but return rates have been low and no natural reproduction has been recorded. Stocking of Nipigon Bay on the Canadian side has not been extensive and is poorly documented. A number of Nipigon Bay tributaries were stocked in the early 1980s (Cullis and others 1991). Invariably, brood stock has originated from Lake Nipigon or other sources, rather than native Lake Superior strains. Attempts are currently underway in Michigan to establish native Isle Royale hatchery stock (Newman and Dubois 1997).

6.1.11.4 Lake Trout

Lake trout were historically the dominant predator in Lake Superior until the 1950s, when they declined rapidly due to commercial fishing pressure and sea lamprey predation (Hansen 1994). Lake trout numbers are dependent on a complex combination of fishing pressure, prey abundance, competition with introduced salmonids and other species, stocking, and predation, especially by sea lamprey. Figure 6-57 shows commercial fisheries management units in Lake Superior. Despite stocking efforts, lake trout populations have not recovered to historical levels. With a few exceptions, habitat loss and degradation is not considered a major factor in lake trout decline, nor as a limiting factor for their recovery.

Lake trout are well adapted to cold, clear, oligotrophic condition and most of offshore and nearshore areas of Lake Superior comprises important habitat for lake trout at some life stage. Lake trout historically spawned at an estimated 337 sites in the main basin of Lake Superior, of which 210 were along the mainland and 127 offshore or along island shorelines (Table 6-27).

Approximately one-half of the total sites were in Canadian waters, with a greater proportion of the offshore sites. Lake trout typically spawn over coarse substrates (e.g. boulder and cobble) with little or no fine material on offshore reefs and shoals or on points extending into deep water (Marsden and others 1995). In Minnesota, shallow water habitats (<20 m) had a greater proportion of good spawning habitat with coarse substrate than deeper habitats which tended to have more fine materials (Richards and others 1999).

Lake Superior lake trout consist of a number of reproductively isolated stocks distinguished from each other by differences in the shape of the snout, body shape, coloration, fat content, size of the eye, and thickness of the abdominal wall. Although up to 12 variants have been identified, three main forms are recognised, leans, siscowets, and humpers (Goodier 1981).

Lean lake trout typically inhabit nearshore waters less than 80 m deep, shallow offshore reefs, and the nearshore waters around the islands in Lake Superior. Lean lake trout spawning grounds are found in both nearshore and offshore areas in <80 m of water. Approximately 23 percent or 1.9 million ha of Lake Superior is less than about 80 m deep, but in U.S. waters only 12 percent of the area <40 fa should be considered as lean lake trout spawning habitat (Ebener 1998). A similar proportion may be suitable in Canadian waters. Lean lake trout spawn offshore at the Gull Islands, Superior Shoal Stannard Rock, Caribou Island, Michipicoten Bay, and the area north of Whitefish Bay.

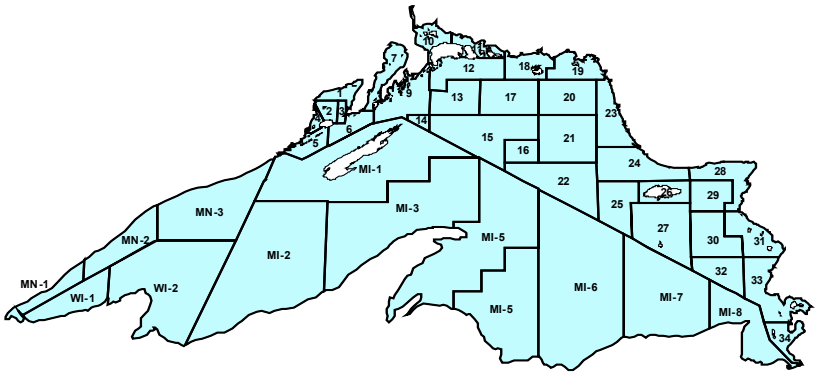

Figure 6-57. Commercial fisheries

Nearshore spawning habitats in most of the lake are associated with the main shoreline, with the exception of Wisconsin where almost all lean lake trout spawning habitat in the nearshore zone is located along the outer periphery of the Apostle Islands since most of the mainland shore is sand or clay and (MacCallum and Selgeby 1987). The Gull-Michigan Island Reef, approximately 30 km offshore is the main site of wild reproduction in Wisconsin, although limited natural reproduction occurs at numerous other locations in Wisconsin (Swanson and Swedberg 1980).

Lean lake trout spawning habitat in harbours-bays-estuaries is found in Keweenaw, Whitefish, Thunder, and Nipigon bays as well. Lean lake trout historically spawned in nine tributaries in eastern Lake Superior (Goodier 1981; Ebener 1998) from the Steel to Montreal rivers. Wild lean lake trout have been recently found in spawning condition inside the mouths of the Montreal and Dog rivers, but spawning has not been confirmed (Ebener 1998). Lake trout also use these rivers during the non-spawning season.

Siscowets usually are found in deep (50-150 m), offshore waters, but they are also abundant in nearshore waters. All water <50 fa, and much that is deeper, is considered spawning habitat for siscowets. They spawn in deep water around offshore reefs. Siscowets appear to be more abundant in nearshore areas relative to lean lake trout than was observed in the past.

Humpers are less common and live predominately on isolated shoals surrounded by deep waters around Isle Royale and in eastern waters of the lake around Caribou Island (Hansen 1996). They spawn at the most of the same offshore sites as leans, with the potential exception of Stannard Rock.

Table 6-27 summarizes critical and important habitats for leans, siscowets and humpers (Ebener 1998). Most of the identified important habitat is in offshore areas such as Superior Shoal, Caribou Island, Isle Royale and Stannard Rock where remnant stocks of native lake trout persisted. Offshore habitats were critical since abundance, especially of mature wild fish never fell as low as it did in the inshore region (MacCallum and Selgeby 1987). Stocks of lean lake trout occupying many offshore reefs or shoals are probably genetically distinct (Ebener 1998). In addition, they are less vulnerable to impacts from human activities than nearshore areas. Although much of the focus has been on spawning sites, optimal habitat for other life history stages of lake trout is also essential. However, the distribution of larval lake trout in Lake Superior is too poorly known to accurately quantify nursery habitat for lake trout. It estimated that about 40 percent of the waters less than 50 fa would be suitable nursery habitat for lean lake trout.

Table 6-27 Critical and important habitat in Lake Superior for lake trout

STRAIN	LIFE STAGE	IMPORTANT HABITAT	CRITICAL HABITAT
Offshore(>80 m)			
lean	juvenile	all water <91 m	Stannard Rk. , Superior Sh., Caribou I.
	non-spawning adult	all water <146 m	Stannard Rk. , Superior Sh., Caribou I.
siscowet	egg	all water > 110 m	unknown
	juvenile	all water 80-128 m	none
	non-spawning adult	all water >110 m	none
	spawning adult	all water >110 m	unknown
humper	egg	rock substrate <60 m in offshore areas	Caribou I., Isle Royale, Superior Sh.
	juvenile	unknown	none
	non-spawning adult	unknown	none
	spawning adult	rock substrate <60 m in offshore areas	Caribou I., Isle Royale, Superior Sh.

Table 6-27 Critical and important habitat in Lake Superior for lake trout

STRAIN	LIFE STAGE	IMPORTANT HABITAT	CRITICAL HABITAT
Nearshore (<80 m)			
lean	egg	rock substrates 0.5-30 m	rock substrates 0.5-30 m, DO>6mg/l
	juvenile	all water 35-80 m	none
	non-spawning adult	all water 35-80 m	none
	spawning adult	rock areas 0.5-30 m	rock substrates 0.5-30 m
siscowet	egg	unknown	unknown
	juvenile	all water <80 m	none
	non-spawning adult	water 36-80 m	none
	spawning adult	unknown, probably very little	unknown
humper	egg	rock substrate <60 m	water <60 m Caribou I., Isle Royale, Superior Sh.
	juvenile	offshore banks Isle Royale, Caribou Is.	none
	non-spawning adult	offshore banks Isle Royale, Caribou Is.	none
	spawning adult	rock substrate < 60 m	water <60 m Caribou I., Isle Royale, Superior Sh.
Tributaries			
lean	egg	eastern Lake Superior tributaries	Montreal & Dog (University) rivers
	juvenile	eastern Lake Superior tributaries	Montreal & Dog (University) rivers

However, the effects have not been thoroughly evaluated in Lake Superior fish. Lake trout habitat can be adversely affected by toxic pollutants, poor water quality, watershed misuse, sedimentation, eutrophication, and residential and commercial development (Hansen 1996). Industrial pollution in the form of low-level contamination by organic pollutants and metals may have had effects on the health and reproduction of lake trout (especially fatty siscowets) (Busiahn 1990), however, the effects have not been thoroughly evaluated in Lake Superior fishes. Relatively shallow water directly adjacent to the shore is important as potential spawning areas for lake trout but such areas are frequently impacted by upland land uses (Richards and others 1999), at least on the American side. Wood fibre effluent from a mill negatively impacts of lake trout spawning grounds in Terrace Bay and mine tailing at the North & South degrade lake trout habitat (Ebener 1998). The Montreal river population of lake trout may currently be limited by habitat due to fluctuating water levels caused by a hydroelectric facility (Ebener 1998).

The Lake Trout Restoration Plan for Lake Superior (Hansen 1996) recommended that an atlas of lake trout spawning grounds be developed. General locations of lake trout spawning habitats

were mapped by Coberly and others (1980), Goodier (1981), and Goodyear and others (1981) but need to be ground-truthed. Habitat that is essential for lake trout reproduction and survival should be identified, mapped and protected (Busiahn 1990). Progress has been made in Minnesota, where lake trout spawning habitat along 65 km^2 of waters less than 30 m deep Minnesota's North Shore has been surveyed using remote hydro-acoustic techniques coupled with a GPS and GIS (Richards and others 1999).

Number of spawning sites taken from Coberly and Horrall (1980), Goodyear and others (1981) and Goodier (1981) and includes present day as well as historically important areas. Spawning habitat is considered to be <5 fa deep. Average CPUE, wild fish, and mortality for U. S. and Canadian waters adjusted for area <40 fa and <50 fa deep, respectively.

Table 6-28 Estimated quantity of total, spawning, and nursery habitat, and biological parameters for lake trout in each management unit in Lake Superior

Mgt unit	Total habitat (ha)		No. spawning sites		Spawning habitat		Nursery habitat		Biological parameters			
									Years	Survey CPUE[3]	Wild fish[4] (%)	Annual mortality[5] (%)
	total	<40 fa[1]	onshore	offshore	(ha)	% area[2]	(ha)	% area[2]				
MI-1	573,003	49,645	18	2	13,600	27	1,200	2	1993-95	16	98	29
MI-2	636,599	87,786	7	0	4800	5	1,200	1	1996	34	87	45
MI-3	620,654	64,674	10	0	4625	7	1,200	2	1996	7	91	41
MI-4	622,657	132,146	15	7	15,213	12	2,300	2	1996	14	88	51
MI-5	367,935	76,385	13	0	4,290	6	14,500	19	1996	32	83	42
MI-6	761,196	74,934	7	3	36,600	49	71,500	95	1996	45	90	58
MI-7	411,881	81,697	1	5	31,300	38	42,800	52	1996	18	94	54
MI-8	179,626	176,868	2	1	14,300	8	40,100	23	1996	10	17	68
WI-1	107,408	48,513	1	0	12	0	0	0	1995 & 97	20	42	36
WI-2	400,703	231,797	12	23	7,773	3	266,131	115	1995 & 97	18	71	37
MN-1	107,723	57,185	8	0	5,700	10	1,190	2	1996	34	45	45
MN-2	173,567	7,955	9	0	400	5	430	5	1996	7	20	40
MN-3	358,789	14,899	21	0	1,200	8	4,500	30	1996	26	70	45
Subtot.	5,321,741	1,104,485	124	41	139,813	13	447,051	40	1993-97	21	69	48
1	33,366	33,046	4	2					1992-96	90		<45
2	22,451	22,440	0	4					1992-96	47		<45
3	10,922	9,765	1	1					1992-96	100		<45
4	13,871	13,871	3	3					1992-96	44		
5	41,614	25,361	5	1						22		
6	46,285	5,875	3	2					1992-96	46		
7	60,139	60,139	2	0					1992-96	16		
8	4,431	3,409										
9	101,191	28,759	11	3					1992-96	37		
10	39,818	39,818	3	6								
11	35,627	31,229	1	6					1992-96	34		
12	105,284	14,218	0	10					1992-96	36		
13	91,264	0										
14	27,415	2,784	0	3					1992-96	185		

Table 6-28 Estimated quantity of total, spawning, and nursery habitat, and biological parameters for lake trout in each management unit in Lake Superior

Mgt unit	Total habitat (ha)		No. spawning sites		Spawning habitat		Nursery habitat		Biological parameters			
									Years	Survey CPUE[3]	Wild fish[4] (%)	Annual mortality[5] (%)
	total	<40 fa[1]	onshore	offshore	(ha)	% area[2]	(ha)	% area[2]				
15	209,058	0										
16	45632	2,192	0	4					1992-96	318		
17	119784	919										
18	67,572	17,485	9	8						110		
19	72,227	26,510	9	0					1992-96	27		
20	119,784	13,209										
21	159,712	23										
22	204,436	0										
23	99,844	10,240	8	0					1992-96	68		<45
24	137,912	26,158	5	0					1992-96	51		<45
25	109,766	6,347										
26	49,287	15,657	0	15						291		
27	182,150	57,232	0	3					1992-96	270		
28	88,909	43,661	10	0					1992-96	52		23
29	79,856	10,681	0	0						280		
30	114,080	0	0	0					1992-96	229		<45
31	90,303	51,997	2	11					1987-92	11	45	42
32	77,099	2,552	0	0					1992-96	273		<45
33	131,729	90,707	4	3					1987-92	8	35	69
34	47,452	44,409	6	1					1987-92	7	2	63
Subtot	2,840,270	710,693	86	86	0	0	0	0	1992-96	61		<45
Total	**8,162,011**	**1,815,178**	**210**	**127**	**139,813**	**0**	**447,051**	**0**				

[1]Canadian waters is < 50 fa deep
[2]Percent of areas < 40 fa deep in U. S. waters
[3]CPUE is fish per 1,000 ft. of survey gill net in U. S. waters and in Canada CPUE is based on commercial catches and expressed as kg/km
[4]In MN-1, MN-2, and MN-2 is percent of fish ≤635 mm total length.
[5]Mortality rates are for ages 5-9 in 1996-97 for MI-8, whereas ages 9-12 MI-3 through MI-7.

6.1.11.5 Lake Whitefish

Lake whitefish are not generally habitat-limited in Lake Superior. Lake whitefish spawn on sand, gravel and rock substrates in 2-23 m (usually <5m) of water from late October to early December at water temperatures of 0.5-5.5°C (Ebener 1998). Upon hatching in the spring, the pelagic larvae float with the currents and often accumulate in embayments (Reckahn 1970). During the first summer, young lake whitefish (age-0) are believed to be associated with the 17°C isotherm in bays and estuaries until they switch from a planktivorous to a benthic diet and move to colder and deeper water in the fall. Juvenile and adult lake trout feed primarily on feeding on benthic

invertebrates over soft bottom areas (primarily sand and silt) from the nearshore to offshore waters <73 m deep. Adult lake whitefish often return to shallower waters in the spring to feed on emerging mayflies (Goodier 1982). Most adult whitefish remain within 40 km of natal spawning grounds, which has led to the differentiation of semi-discrete stocks (Lawrie and Rahrer 1973).

Coberly and Horrall (1980), Goodier (1981) and Goodyear and others (1981) have summarized the general location of lake whitefish spawning grounds in Lake Superior. These areas are considered critical spawning habitat, and are generally restricted to nearshore and harbour-bays-estuaries habitats. Current whitefish spawning grounds are located in the Apostle Islands, along the Keweenaw Peninsula, and in Whitefish Bay. Lake whitefish spawn off Isle Royale but there is very little whitefish spawning habitat in western Wisconsin waters, Minnesota waters and along the northeastern Canadian shoreline.

Approximately 123,000 ha or 11 percent of the water <40 fa deep is considered lake whitefish spawning habitat. As much as 300,000 ha of suitable lake whitefish nursery habitat may be available in Lake Superior, but this estimate is very unreliable (Ebener 1998). Lake whitefish historically spawned at 106 sites, 60 of which were in nearshore areas and the remainder on the outside of islands. Ten sites were located in harbour-bays-estuaries habitats. Most (90) sites were in U.S. waters. Lake whitefish historically spawned in the St. Louis estuary, the Michipicoten, White, University (Dog) and Kaminstiquia rivers, and St. Mary's River above the rapids (Lawrie and Rahrere 1972, Goodier 1982). Spawning populations are still known from the Anna River near Munising (Ebener 1998).

Nearshore habitat bordered by beaches and sandy bays are critical both as spawning habitat and food sources for adults. These areas require protection from dredging, shoreline development, contaminants, and localized increase in nutrients. Illegal dredging of spawning grounds in Whitefish Bay negatively affects lake whitefish eggs. Mine tailing from the North and South Entry negatively impact lake whitefish populations. Lake whitefish have been reported to contain a wide variety of organic and metallic contaminants, such as PCBs in whitefish from Peninsula Harbour near Marathon (ULRG 1977). Lake whitefish habitat has been degraded by the deposition of woody debris in rivers and nearshore areas. The lake whitefish stock that historically spawned in the St. Louis estuary was extirpated in the late 1800s because of habitat destruction. Dredging and dumping of grain screening degraded spawning grounds in the Kaministiquia River (Goodier 1982). Fish community objectives for Lake Superior include restoring the presence of lake whitefish to historic spawning sites in the lake and historic spawning tributaries (Ebener 1998).

Number of spawning sites taken from Coberly and Horrall (1980), Goodyear and others (1981) and includes present day as well as historically important areas. Spawning habitat is considered to be <5 fa deep. Average CPUE and mortality in U. S. and Canadian waters adjusted for area <40 fa and <50 fa deep, respectively.

Table 6-29. Estimated quantity of total, spawning, and nursery habitat, and biological parameters for lake whitefish in each management of Lake Superior

Mgt unit	Total habitat (ha)		No. spawning sites		Spawning habitat		Nursery habitat		Biological parameters		
									Years	CPUE[1]	Annual mortality
	total	<40 fa[1]	on shore	off shore	(ha)	% area[2]	(ha)	% area[2]			
MI-1	573,003	49,645	9	0	628	1			1978-81		55
MI-2	636,599	87,786	0	0	300	0	700	1	1996	160	45
MI-3	620,654	64,674	7	0	400	1	600	1	1996	130	78
MI-4	622,657	132,146	14	2	500	0	800	1	1996	72	73
MI-5	367,935	76,385	2	1	18,600	24	4,700	6	1994-96	71	30
MI-6	761,196	74,934	9	0	52,500	70	37,000	49	1996	57	50
MI-7	411,881	81,697	1	0	13,000	16	20,000	24	1996	156	53
MI-8	179,626	176,868	6	0	25,500	14	39,500	22	1996	93	57
WI-1	107,408	48,513	2	0	162	0	0	0		20	
WI-2	400,703	231,797	4	35	8,500	4	187,023	81	1996	126	73
MN-1	107,723	57,185	0	0	0	0	0	0			
MN-2	173,567	7,955	5	0	0	0	7,955	100			
MN-3	358,789	14,899	2	0	3,000	20	0	0			
Subtot.	5,321,741	1,104,485	61	38	123,090	11	298,278	27		104	63
1	33,366	33,046	1	0					1992-96	427	<45
2	22,451	22,440	1	0					1992-96	184	
3	10,922	9,765							1992-96	102	
4	13,871	13,871							1992-96	132	
5	41,614	25,361							1992-96	129	
6	46,285	5,875							1992-96	88	
7	60,139	60,139							1992-96	88	<45
8	4,431	3,409									
9	101,191	28,759							1992-96	140	
10	39,818	39,818									
11	35,627	31,229							1992-96	74	
12	105,284	14,218							1992-96	200	
13	91,264	0									
14	27,415	2,784							1992-96	5	
15	209,058	0									
16	45,632	2,192							1992-96	0	
17	119,784	919									
18	67,572	17,485							1992-96	59	
19	72,227	26,510							1992-96	79	
20	119,784	13,209									
21	159,712	23									
22	204,436	0									
23	99,844	10,240							1992-96	143	<45
24	137,912	26,158							1992-96	76	<45
25	109,766	6,347									

Table 6-29. Estimated quantity of total, spawning, and nursery habitat, and biological parameters for lake whitefish in each management of Lake Superior

Mgt unit	Total habitat (ha)		No. spawning sites		Spawning habitat		Nursery habitat		Biological parameters		
									Years	CPUE[1]	Annual mortality
	total	<40 fa[1]	on shore	off shore	(ha)	% area[2]	(ha)	% area[2]			
26	49,287	15,657							1992-96	109	
27	182,150	57,232									
28	88,909	43,661							1992-96	152	<45
29	79,856	10,681									
30	114,080	0									
31	90,303	51,997							1992-96	108	68
32	77,099	2,552									
33	131,729	90,707	2	1					1992-96	99	39
34	47,452	44,409	1	1					1992-96	151	36
Subtot.	2,840,270	710,693	5	2					1992-96	131	<45
Total	8,162,011	1,815,178	66	40	123,090	0	298,278	0		114	

[1]Canadian waters is < 50 fa deep.
[2]Percent of areas < 40 fa deep in U. S. waters
[3]CPUE is expressed as kilograms per kilometer of gill net.

6.1.11.6 Woodland Caribou

Woodland caribou formerly inhabited most of the Lake Superior Basin. By the late 1800's, their numbers were declining and their range was receding northward. Caribou disappeared from the US part of the basin by the early 1940's (Hazard 1982) and they are now extirpated from Michigan, Wisconsin and Minnesota. In Ontario, the southern limit of caribou range receded from the northshore of Lake Superior in 1900 to northern Lake Nipigon at present (Figure 6-58). North of this line, caribou are more or less continuously distributed. Remnant populations are on the Slate Islands (several hundred animals), Pic Island, Neys Provincial Park, Pukaskwa National Park and Michipicoten Island (introduced) (Harris 1999). Status is under review in Ontario (Harris 1999).

Caribou range recession is due to increased human activity. Logging and human settlement caused forest fragmentation and loss of mature coniferous forest cover. Populations of moose and white-tailed deer increased with the changes in forest landscape. In Ontario, at least, wolves increased in response to the increased prey availability. Increased wolf predation, combined with increased hunting pressure, caused greater mortality for caribou. Their relatively low reproductive rate meant that caribou could not compensate for the increased mortality. Today, caribou within the Lake Superior Basin are restricted islands and other areas where they can avoid wolves, and where logging has not fragmented the landscape.

Forest management guidelines have recently been implemented in Ontario to protect caribou habitat by reducing forest fragmentation, protecting calving areas and minimizing human disturbance (Racey and others 1999).

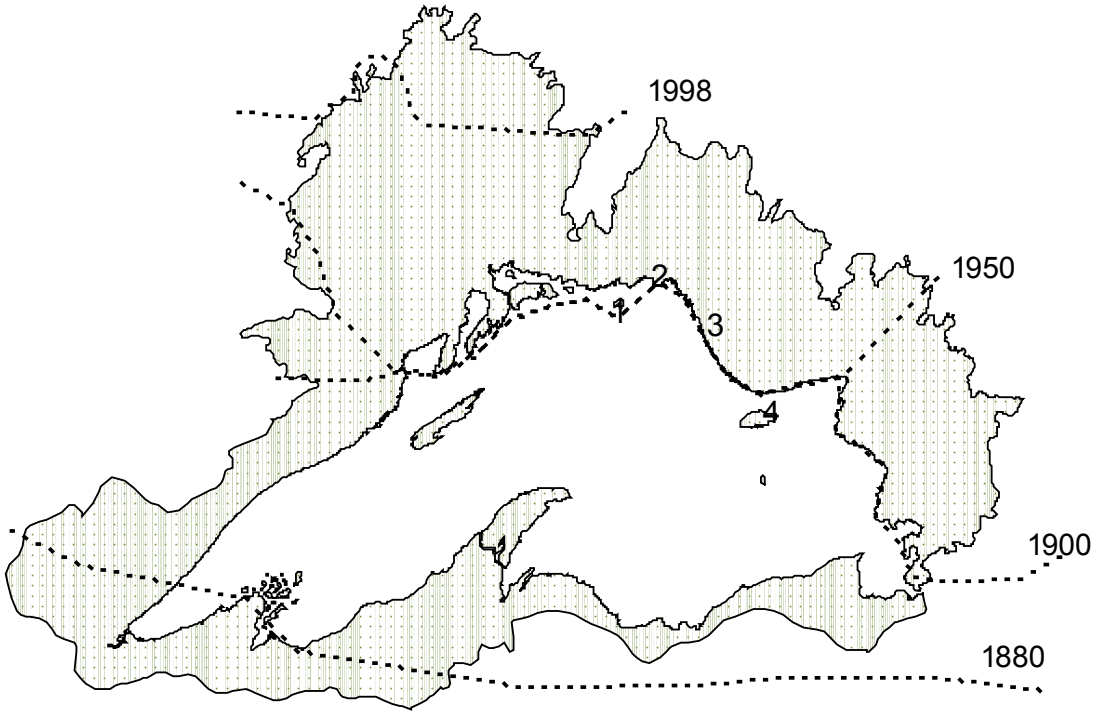

Figure 6-58. Historical and present distribution of woodland caribou in the Lake Superior basin.
Dotted lines indicate southern limits of caribou distribution at various periods. Numbers indicate remnant herds: 1 – Slate Islands, 2 – Neys, Pic Island, 3 – Pukaskwa, 4 – Michipicoten Island (adapted from Darby and others 1989 and Armstrong 1998).

6.1.11.7 Trumpeter Swan

Trumpeter swan (*Cygnus buccinator*) is Threatened in Michigan and Endangered in Wisconsin. Their historic breeding range may have included most of the Lake Superior Basin, but there is little documentation. Trumpeter swans nested in Minnesota and Wisconsin until the 1880s (WI DNR 1999b). There is no conclusive evidence that they ever nested in Ontario (Austen and others 1994).

Trumpeter swans were extirpated from much of their former range due to market hunting and the millinery trade. Restoration efforts since the late 1960's have lead to the establishment of a several flocks.

Important habitats are large shallow water wetlands with interspersion of open water and emergent vegetation. Isolation from human disturbance is important. Rivers that maintain open water throughout the winter are critical for over-wintering flocks (WI DNR 1999b).

Habitat-related threats to restoration include draining and filling wetlands and degradation of wetland habitat by invasions of exotic species such as mute swans, carp and purple loosestrife (WI DNR 1999b). Variations in outflow from hydroelectric dams in winter may threaten overwintering birds by reducing open water habitat (WI DNR 1999b). Recovery plans are in place for Minnesota, Wisconsin, Michigan and Ontario and focus on release of captive birds (WI DNR 1999b).

6.1.11.8 Neotropical Migrant Birds

Neotropical migrant landbirds include 143 species that breed in North America and winter south of the United States (Thomson and others 1992). Approximately 70 percent of these species breed within the Lake Superior basin. Many neotropical migrant landbirds are declining markedly, and the following species have experienced the most significant declines in the basin: yellow-billed cuckoo, bank swallow, bobolink, whip-poor-will, Nashville warbler and wood thrush (Thomson and others 1992). Various factors have been implicated in the decline, including changes in forest structure in breeding habitat in North America, deforestation on neotropical wintering grounds, increased levels of brood parasitism by cowbirds (linked with habitat fragmentation) (Terborgh 1989). Many area-sensitive neotropical migrants that are found in the basin e.g., veery, black-and-white warbler, ovenbird, and northern waterthrush, are particularly vulnerable to forest fragmentation (Robbins and others 1989).

Thomson and others (1992) evaluated the status of neotropical migrants from the midwest (3 provinces and 14 states) based on breeding ground threats, population trends and the importance of the region to the species. The species of most management concern whose ranges encompass most or all of the basin included the chestnut-sided, bay-breasted, Connecticut, Nashville and Canada warblers. The Lake Superior basin represents a significant portion of the breeding habitat, and although they are still relatively common in the basin (Cadman and others 1987), their populations show a long-term decline. Current and past timber extraction may be differentially affecting the breeding success of these and other neotropical migrants. Connecticut and Nashville warblers are most abundant in mature conifer forests, whereas chestnut-sided, bay-breasted and Canada warblers commonly use younger successional hardwood and mixedwood forests, which have increased in extent within the basin. In a northern hardwood forest in New York, numbers of both chestnut-sided and Canada warblers increased in response to logging. (Webb and others1977)

Although the Lake Superior basin is not on a major migratory flyway, significant numbers of birds migrate through the basin. Lake Superior represents a considerable obstacle, so many birds follow either the eastern or western shore, or use the Slate Islands, Isle Royale, Michipicoten and Caribou islands as they hop cross from the north to south shore (particularly the Keweenaw

Peninsula). Bird observatories at Thunder Cape (on the Sibley Peninsula) and Whitefish Point (50 km NW of Sault St. Marie) are well-located for monitoring migrating songbirds, raptors, owls and waterbirds. At Thunder Cape, the most commonly banded species include black-capped chickadee, dark-eyed junco, yellow-rumped warbler, Swainson's thrush and palm warbler. Good numbers of sharp-shinned hawks and northern saw-whet owls are also banded. Black-capped chickadee, Swainson's thrush, golden-crowned kinglet, yellow-rumped warbler, Nashville warbler, and Tennessee warbler are commonly sampled at Whitefish Point. Nine sites along the north shore of Lake Superior have been identified as potential IBA's (important bird area) by Birdlife International. Many of these sites are important migration staging or stopover areas (e.g. Thunder Cape, Whitefish Point).

6.1.12 Areas of Quality

The Binational Program's Habitat Committee has developed ecological criteria for identifying components of the Lake Superior system that warrant special attention. Areas of quality include significant ecosystems, communities and species habitat.

Addendum 6-D is an inventory of important habitat sites in the Lake Superior basin.

6.1.13 Stresses on the Ecosystem

6.1.13.1 Changes in Forest Composition

Not only has the total area of forests in the Lake Superior basin been reduced since historical times, the species composition is different. Pre-settlement forests on the U.S. side of the basin were predominately spruce-fir (41 percent) particularly in Minnesota, or northern hardwood (39 percent) in Wisconsin and Michigan (Figure 6-59). Fire-dependent forests of white, red, jack pine combined accounted for 14.8 percent and aspen-birch represented only 1.4 percent. In the U.S. portion of the basin, pioneer species such as aspen are now more abundant than before settlement (Frelich 1995). For example, in the protected Porcupine Mountains and Sylvania Wilderness northern hardwoods predominate as in historical times, and aspen-birch stands represent only about 1.4 percent of the forest. However in surrounding commercial forests, approximately 23 percent is aspen-birch dominated (Frelich 1995). Increased browsing of hemlock by deer has contributed recruitment failure and a gradual conversion of hemlock stands to northern hardwoods and spruce-fir where white-tailed deer numbers are well above historic levels (Frelich and Lorimer 1985).

Red and white pine have been much reduced in abundance on both sides of the border due to selective timber harvest near the turn of the century, blister rust, and fire suppression (see White Pine). In Canadian boreal forests, no comprehensive data are available describing the pre-settlement forests of the basin. However, it appears that balsam fir, balsam poplar, and aspen have increased due to fire suppression and extensive selective harvesting of the spruce, pine, and cedar component.

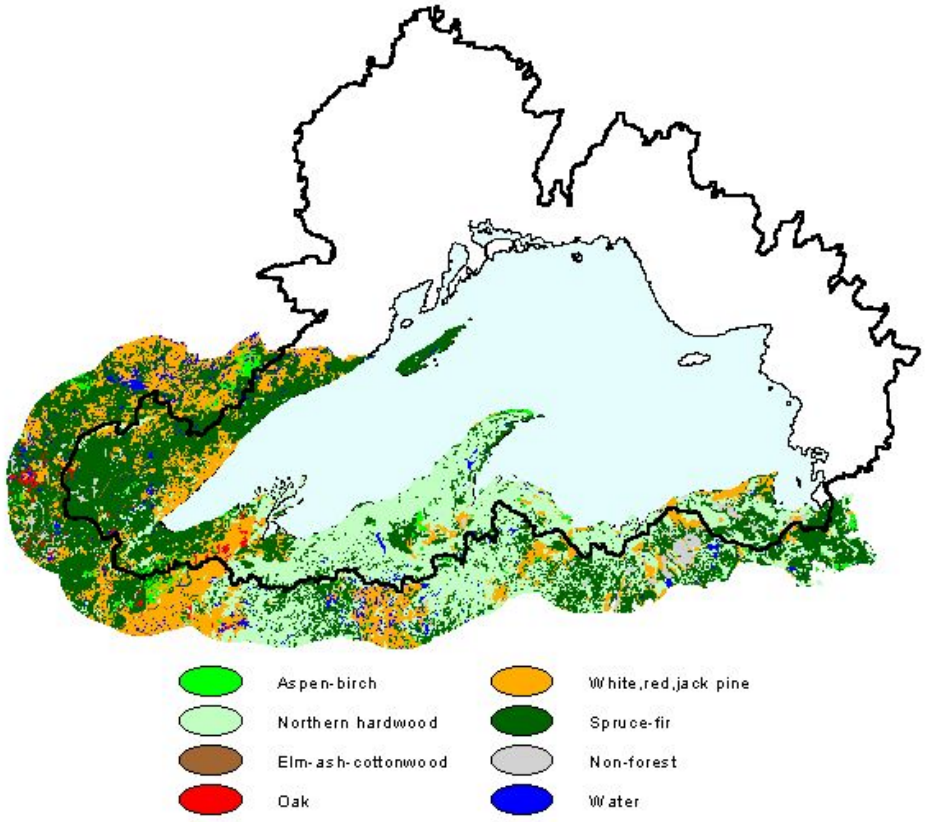

Figure 6-59. Historic forest cover in the U.S. portion of the Lake Superior Basin

The age structure of forests in the Lake Superior basin has also changed with respect to pre-settlement forests. In the predominately boreal forests of the Canadian portion of the Lake Superior basin, there are fewer very young forests than expected under natural conditions. Commercial forests for all of Ontario are dominated by 40- to 80-year age classes (Figure 6-60) (OMNR 1986), and this pattern is expected to hold true for those of the Lake Superior basin. Under natural fire regimes, a more or less negative exponential age class distribution is expected on a landscape scale, with most of the area in very young age classes i.e,. <20 years (Van Wagner 1978). The lengthening of the fire interval from approximately 65 years to over 500 years due to active fire suppression in this century is primarily responsible for this shift in age class distribution (Ward and Tithecott 1993). At the same time, there is less old growth red and white pine in fire-driven Great Lake St. Lawrence forests on both sides of the basin, primarily due to selective harvesting (see Old Growth/White Pine). In comparison, there is less old forest, and more young and mature northern hardwood, hemlock and oak forests within the Lake Superior basin than in pre-settlement times. This is as a direct result of the clearing of forests for timber, agriculture and development.

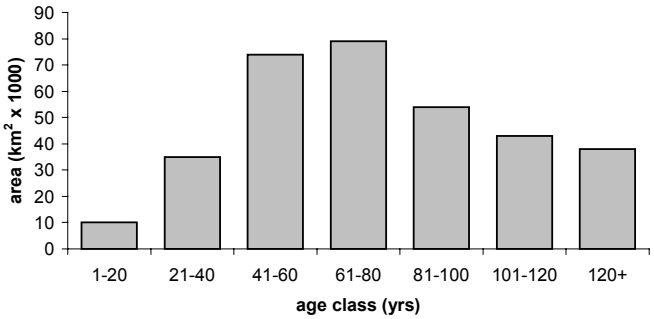

Figure 6-60. Age class structure of the Ontario commercial forest (OMNR 1986).

6.1.13.2 White Pine

White pine are of special significant in the Lake Superior basin due to concerns about logging in "old growth" stands, its commercial importance, biodiversity, decline, cultural significance (historical, aesthetics). The present white pine range in the Lake Superior basin includes all of the lake states and areas of predominately Great Lakes St. Lawrence forest along the border with Minnesota and north of Sault Ste Marie. Approximately 3,500,000 ha or 1.9 percent of the forest in northwestern Ontario has at least 10 percent white pine in the overstory (Simson 1993). Approximately 65 percent of the white pine occur as a 10 percent component in stands

In much of the basin, white pine is an uncommon component of the forest and found in small, widely distributed stands that are isolated from each other and vulnerable to loss (Simpson 1996). The vast majority of the white pine in northwestern Ontario is not found in pure stands but as mixed woods in association with black spruce, balsam fir, jack pine, trembling aspen, white birch and red pine (Perera and Baldwin 1993). Only 13 percent of all the white pine in northwestern Ontario are in stands defined as white pine by the Ontario white pine working group. In 65 percent of stands with white pine, the species accounts for only 10 percent of the basal area (Bowling and Niznowski 1996). Carlton and Arnup (1993) have suggested that red and white pine forests are generally restricted to four physiographic site groups:

1) Conifer-dominated stands on dry, infertile, very shallow soils over bedrock, with low white pine site index.
2) Conifer-dominated stands on dry to fresh, deep, sandy soils of glaciofluvial origin, with medium white pine site index.
3) Mixed conifer-hardwood stands on dry to moist shallow coarse loamy soils of morainal origin, often on slopes, with medium to high white pine site index.
4) Mixed conifer-hardwood stands on deep, coarse loamy, fine loamy or silty soils of morainal or lacustrine origin, usually with level topography, with high white pine site index.

Mature white pine forests have been replaced by spruce-fir forests due to selective harvesting of white pine in the early 20th century and fire suppression. White pine harvest reached a peak

between 1890 and 1910. For example, white pine has decreased from 37.5 percent of the presettlement forests in BWCA to 10.2 percent currently, and from 29.5 percent to 5.9 percent in adjacent commercial forests (Heinselman 1973; Frelich 1995). The age class distribution of white pine in white pine working group stands in northwestern Ontario is skewed to the older age classes. For example, all 1177 ha (excluding barren and scattered) of white pine on the Thunder Bay Crown Unit were >80 years, with 3 percent greater than 121 years of age (Bowling and Niznowski 1996). The low abundance of younger age classes is a result of poor regeneration due to fire suppression. Replacement of old white pine as they die of old age, by fir, spruce, and shade tolerant hardwoods has occurred in northern Minnesota (Heinselman 1973) due to fire suppression activities. The lack of forest fires discourages successful white pine regeneration and is a major factor in its slow recovery in Ontario mixedwoods (Bowling and Niznowski 1996). In the absence of major disturbance, the pine component is expected to decline and be replaced by hardwoods and shade-tolerant conifers such as balsam fir and white spruce.

6.1.13.3 Forest Fragmentation

Forest fragmentation is a landscape-level process in which forested areas are subdivided into smaller, geometrically more complex, and increasingly isolated patches (Harris 1984). Forest fragmentation results from natural processes such as wildfire, wind, insects and climate effects, in combination with human land use activities e.g., urbanization and deforestation due to timber extraction and clearing for agriculture. Human activities may also affect patterns of natural disturbances, as in the case of fire suppression.

Forest fragmentation is one of the most prevalent landscape change occurring within the Lake superior basin. It is recognized as a major cause in declining biodiversity (Whitcome and others 1981). For example, habitat loss as a result of forest fragmentation was a factor in the extirpation species such bison, elk, cougar, wolverine and black bear from all or much of their range in the Lake Superior basin (Matthiae and Stearns 1981). The target for forest fragmentation identified in Ecosystem Principles and Objectives is:

> *No further increase in forest fragmentation in the Lake Superior basin as measured by several complementary indices of landscape composition and pattern. A decrease from the current level of fragmentation is desirable*

Landscape indices or metrics that are typically calculated to determine the degree of forest fragmentation include:

- **Class area** is the amount (percent or ha) of watershed comprised by the class, in this case closed-canopy forest. It is equivalent to a measure of habitat loss or grain.

- **Mean patch size** is the average size of patches (ha). Smaller habitat patches indicate and increase in forest fragmentation.

- **Total Forest Edge** is the total length of forest edge on the landscape. It may be a critical measurement of forest fragmentation since many of the adverse effects of fragmentation area related to edge effects (McGarigal and Marks 1993). Edge effects caused by the differences in wind and light intensity along the edge of forest patches affect vegetation and the juxtaposition of different habitat types are considered of great importance to wildlife species.

- **Mean core area** is the average size of disjunct core area patches in ha. Core areas are the interior area of a landscape patch defined by a core area buffer distance (width of the edge effects). Core buffer distances are species dependent, but 200 m is often considered the distance at which edge effects are attenuated. Core areas are particularly important for forest interior species such as hermit thrushes that are adversely affected by edge effects like increased predation and brood parasitism (Wilcove 1985). It differentiates between forest patches with similar overall area but different shapes since patches that are more circular in shape have a higher amount of core area than more linear or irregular-shaped patches.

- **Core Area Standard Deviation** is a measure of patch size variability that indicates whether only a patch size is evenly distributed, or rather there are a few very large and many small patches. This can be reported as a statistic and/or presented as a frequency distribution

- **Mean nearest-neighbour distance** is the average distance between forest patches. It can affect mea-population dynamics of spatially divided populations and plays an important role in the conservation of endangered species.

A spatial pattern analysis program Patch Analyst (Rempel and others 1999) that is based on FRAGSTATS (McGarigal and Marks 1993) was used to analyse forest distribution in the Lake Superior Basin. Landsat TM satellite coverage classified by land use was used to derive metrics separately for mature, closed canopy forest cover for conifer, mixedwood and hardwood forests. At this level of resolution (200 x 200 m pixel), it appears the forests of the Lake Superior basin are not very fragmented. A total of 10,687,872 ha or 85 percent of the land base of the Lake Superior basin (excluding Lake Nipigon and Lake Superior itself) is classed as either conifer, hardwood or a combination. The 2393 patches averaged 4466 ha in area (median 8 ha), indicating that a few large patches comprised the vast majority of the total area. Total edge was 111,273 km for an edge density of 5.29 m/ha. However, at this scale of resolution, fragmentation metrics do not account for the effect of roads, and the landscape appears less fragmented than it is when roads are considered.

Forests in the basin are often fragmented by roads, which create an edge environment and often pose a barrier to movement of smaller animal species. Roadless wilderness, i.e. forest that is at least 1 km from all roads, accounts for 3,444,635 ha or approximately 44 percent of the Canadian portion of the basin (excluding Lake Nipigon). Most of the patches of the 1960 roadless wilderness are less than 1000 ha, but the vast majority (80 percent) of the total area is comprised in several large patches >10,000 ha each. These tracts are located around Pukaskwa National Park, east of Lake Superior Provincial Park, in the Schreiber Highlands, and west of Lake Nipigon (Figure 6-62). Mean and median patch size is 1750 ha and 20 ha respectively, indicating a disproportionate amount of area in large patches. There are approximately 25,265 km of edge

and an edge density 7.3 m/ha. Much of the forest has primarily been fragmented by recent clear cuts and tertiary roads associated with timber harvesting which encompass at least 1,229,416 ha (Figure 6-61). Much of the forest around the city of Thunder Bay that has historically been logged and/or is privately owned is not reflected in Figure 6-61.

No estimates are currently available for roadless wilderness on the American side, but the area (ha) and proportion of roadless wilderness are expected to be considerably less.

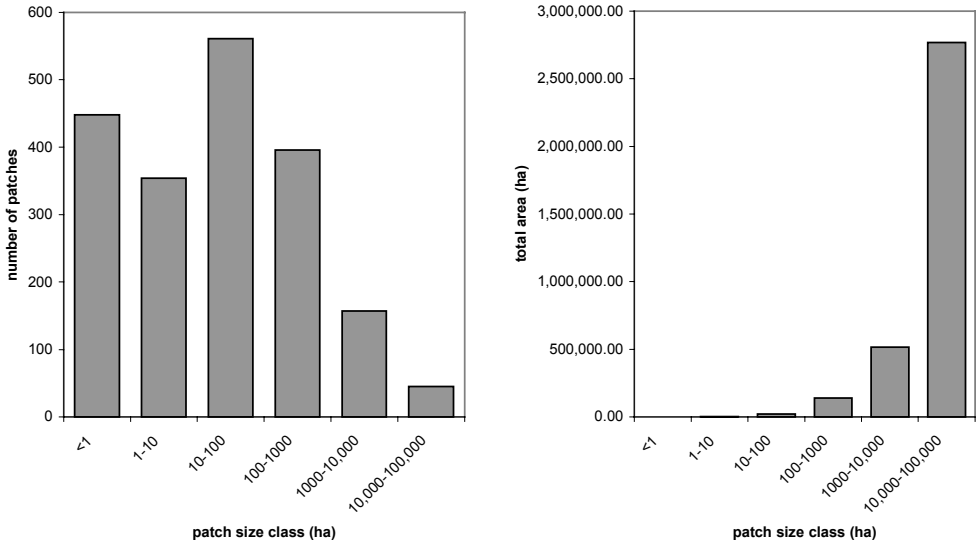

Figure 6-61. Number and area of roadless wilderness patches (>1 km from nearest road) in the Canadian portion of the Lake Superior basin

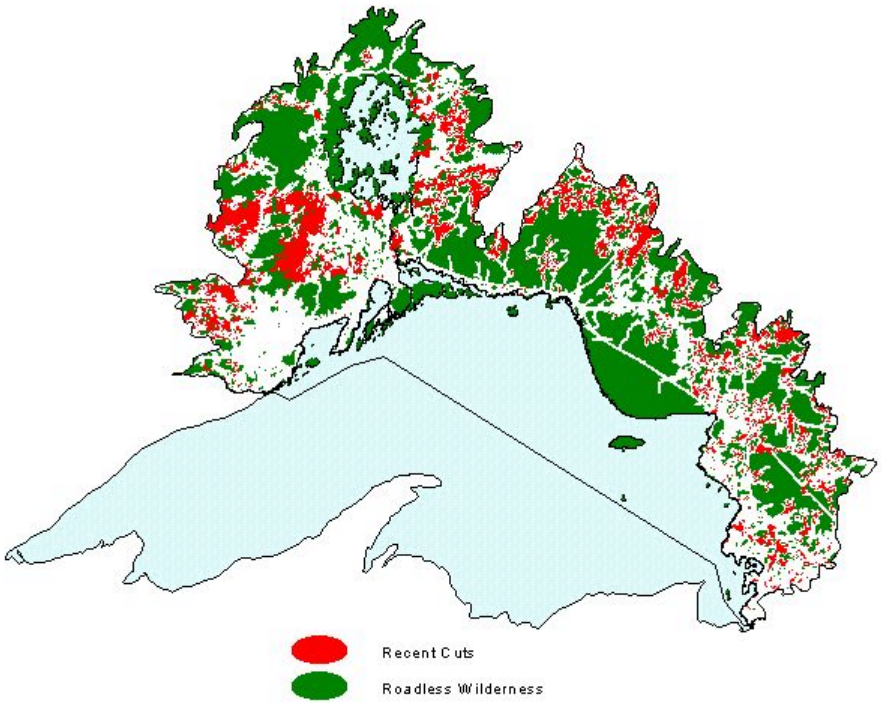

Figure 6-62. Roadless wilderness (>1 km from nearest road) and recent cuts in the Canadian portion of the Lake Superior basin

6.1.13.4 Pollution and Nutrient Loading

Pollution and nutrient loading have severely degraded some harbours, streams and wetlands. While less extensive than other Great Lakes, pollution has degraded habitat on Lake Superior.

Pollutants in Lake Superior originate from a variety of sources, including point sources, non-point sources and tributary discharge. Point sources are those originating at an identifiable point, such as industrial effluent, waste dumping, and spills (Table 6-30). Non-point sources are more diffuse and may originate from outside the Lake Superior Basin. Atmospheric deposition in the form of contaminated rain, snow or dust is a major sources of some pollutants. Others include agricultural and urban surface runoff and release of pollutants from contaminated sediments. Tributary discharge refers to pollutants entering the lake through tributary streams transported from elsewhere in the watershed, although ultimately these pollutants originated from point or non-point sources.

Table 6-30 Point sources of pollutants in the Lake Superior watershed (LSBP 1995)

	Water Sources	Air Sources	Dumps
Ontario	20	27	190
Michigan	36	14	na
Minnesota	72	216	40
Wisconsin	40	5	105
Total	168	262	145

Nutrient loading is increased input of plant nutrients, such as phosphorus. While these nutrients are not harmful at normal levels, excessive levels can have negative effects. Agricultural and urban runoff, sewage treatment plants and faulty septic systems are sources of nutrients.

Pollutants and nutrient loading can result in loss of habitat. In addition to toxic effects, water pollution can act as barrier to migratory fish. Point sources also have local effects on aquatic life through thermal pollution, biological oxygen demand, turbidity and bacterial contamination.

Nutrient loading can cause shifts in wetland vegetation. By encouraging species tolerant of high fertility (such as cattails), nutrient enrichment can cause reduced diversity of plant communities and loss of rare species and (Maynard and Wilcox 1997). Enhanced growth of algae and submergent plants, can cause oxygen depletion as the plants die and decompose.

Loss of fish and wildlife habitat due to pollution and nutrient enrichment is a local problem on Lake Superior. Habitat loss due to contamination has been identified at six of the seven Areas of Concern. However, these sites are typically at bays and estuaries, among the richest and most diverse habitats on the lake, and the consequences extend throughout the lake.

6.1.13.5 Sedimentation

Natural sedimentation processes of erosion, transport and deposition are essential for maintaining healthy coastal wetlands and sand dunes (Wilcox and Whillans 1999). Sediments can form barrier beaches and sand spits that protect wetlands. Some wetlands depend on sediment inputs to maintain vegetation. Active sand dunes are in a continuous state of flux as sand is deposited and eroded.

Man-made structures disrupt these processes. Breakwalls and revetments are structures placed parallel with the shoreline to enclose a harbour. Unintended side effects include scouring of sediments on the lakeside and increased erosion down wind as wave energy is transferred parallel with the wall. During high water levels, marshes inside the breakwall can be flooded out (Maynard and Wilcox 1997).

Groins are low walls constructed perpendicular to the shore. They are installed to protect beaches by intercepting longshore and beach drift. However, marshes and dunes that are eroded

by storms may not be replenished if the supply of sediments is trapped by man-made structures (Maynard and Wilcox 1997). Similarly, dams on tributary rivers trap sediment that previously nourished estuarine wetlands. Wilcox and Whillans (1999) recommend improved designs for breakwalls and other erosion protection structures that incorporate the principles of sedimentation processes.

Excessive sedimentation from upland sources can also impair aquatic habitats. Increased erosion from agriculture, lake-level changes, logging, and urban land use can increase sediment deposition in streams, smothering fish spawning substrate and causing excessive turbidity.

The extent and magnitude of these impacts on Lake Superior habitats are unknown, but they are probably greater on the south shore than the north.

6.1.13.6 Exotic Species

Exotic species of plants and animals threaten habitat in a number of ways. Although there are hundreds of exotic species in the Basin, only a few are invasive enough to threaten natural habitats. This section discusses a few species with actual or potential impacts on habitat in the Lake Superior Basin, especially wetlands, aquatic and shoreline environments.

The risk of introduction of exotics to Lake Superior continues to be high. Increased ship traffic represents an enormous risk for the introduction of exotics. Trans-Atlantic ships are increasingly fast, increasing the likelihood that exotic organisms picked up in foreign ballast water will survive the passage. With improving water quality in Lake Superior harbors, recently arrived exotics are more likely to survive and reproduce. Currently, Canada and the United States only have voluntary guidelines in place regulating ballast water discharge. Effective legislation and compliance monitoring is required to regulate discharge of tanker ballast water. In addition, public education programs are essential to minimize further spread of introduced exotics. Most introduced species are impossible to eradicate, so prevention is the best measure.

Purple Loosestrife

Purple loosestrife is a well-known invasive plant of wetlands. Impacts of purple loosestrife can be severe. It has displaced up to 50 percent of the native plant biomass in some wetlands. Impacts on wildlife are not well understood, but some studies suggest serious declines in waterfowl and furbearers productivity in loosestrife infested wetlands (Thompson and others 1987). Competition with rare plant species is also a concern.

In the Lake Superior Basin, purple loosestrife is found around Thunder Bay, Duluth / Superior, Sault Ste. Marie and scattered other locations (Figure 6-63). It grows extensively along the Kaministiquia River and at number of other areas around Thunder Bay and north to Hurkett (David Ellingwood, LRCA, personal communication). Purple loosestrife is prevalent in the Sault Ste Marie area and the St. Mary's River (Sue Greenwood, OMNR personal communication). In

Wisconsin, purple loosestrife is widespread, but still at low density in most areas, occurring in only about 5 percent of the total wetland area statewide (WI DNR 1999).

Control efforts have been introduced by At Thunder Bay, the Lakehead Region Conservation Authority has implemented control by digging plants and the introduction of beetles (*Galerucella* spp) that feed on loosestrife. The use of beetles has had mixed results (David Ellingwood personal communication). Minnesota has a statewide control program using herbicides and biological control (Skinner and others 1994). In Wisconsin, there are limited control programs in place by the Bad River Indian Reserve and the Apostle Islands Nationals Seashore (Gary Czypinski, personal communication).

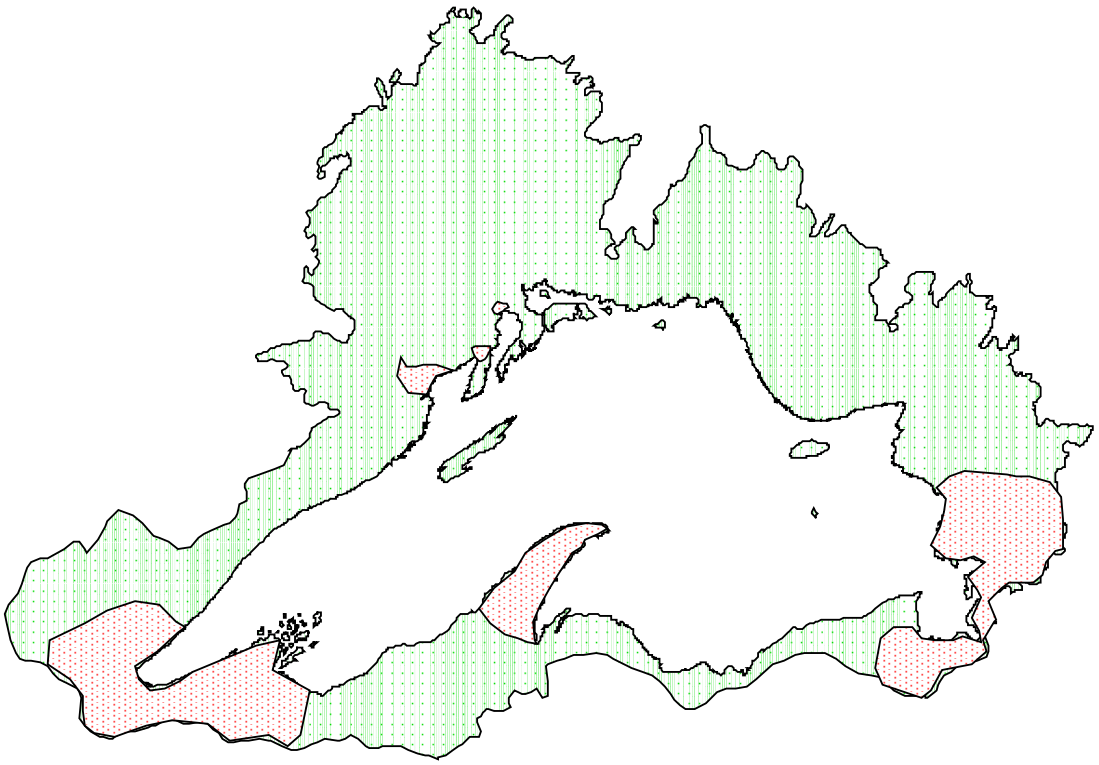

Figure 6-63. Approximate distribution of purple loosestrife in the Lake Superior basin Local occurences exist outside the shaded zones (Skinner and others 1994, Voss 1985, White and others 1993, WI DNR 1999)

Eurasian Water Milfoil

Eurasian water milfoil (*Myriophyllum spicatum*) is an extremely aggressive submergent plant native to Eurasia and Africa. It spread to inland lakes in the Wisconsin Basin by the 1980s, and was present in shallow bays of Lake Superior by 1993 (WI DNR 1999). In 1999 it was discovered in Lake Superior at Thunder Bay, but is suspected of being present for a number of years. It is not known elsewhere in the Ontario Basin (A.G. Harris personal observation).

Its preferred habitat is fertile, mineral sediments in eutrophic, nutrient-rich lakes. It is an opportunistic species that prefers highly disturbed lake beds, lakes receiving nitrogen and phosphorous-laden runoff (WI DNR 1999).

Dense stands of Eurasian water milfoil can alter nutrient cycling from the sediments to the water column and may lead to low oxygen levels and algae blooms. It displaces native plants. Some stands are dense enough to obstruct water intakes and inhibit swimming, boating, and fishing (WI DNR 1999).

Eurasian milfoil is unlikely to become widespread in Lake Superior due to its oligotrophic nature and fast water of most of its tributaries, but warmer, nutrient-rich bays and inland waters are vulnerable.

It reproduces from vegetative fragments and can be inadvertently transported between water bodies by boats. Control measures have focused on increasing public awareness of the necessity to remove weed fragments at boat landings. Mechanical and biological controls are being attempted in Wisconsin (WI DNR 1999)

Other Plants

Other potentially invasive exotic plants include reed canary grass (*Phalaris arundinacea*) (WI DNR 1999), giant reed (*Phragmites australis*), glossy buckthorm (*Rhamnus frangula*), queen of the meadow (*Filipendula ulmaria*), valarian (*Valeriana officinalis*) (Epstein and others 1997). These species are found in the Basin, but are not yet wide spread.

Gypsy Moth

Gypsy moth (*Lymantria dispar*) is one of North America's most devastating forest pests (USDA 1998). It was deliberately introduced to the US in the late 1800's and had spread to the eastern part of the Lake Superior Basin by the early 1990's (USDA 1998).

Widespread defoliation of forest stands occurs in peak years. Oaks are the preferred larval food, but other hardwood trees are also eaten. The impacts of defoliation on the forest ecosystem are not well understood, but probably cause reduce growth and survival of oaks, perhaps eventually leading to a shift in forest composition to less vulnerable species (USDA 1998).

Gypsy moths have been recorded in all of the Lake States and have infested the Upper Peninsula of Michigan. In Minnesota and Wisconsin, infestation is restricted to mainly urban areas but is now spreading to rural forests (Joe Meating personal communication.). There was a major outbreak in the Sault Ste. Marie, Ontario area in the late 1990s. Oaks are absent in most of the Ontario Basin, and extensive infestation is unlikely north and west of Sault Ste. Marie. All the states have monitoring programs. Control efforts have focused on slowing the spread by eradicating isolated colonies with pesticides and biological control methods (USDA 1998).

Zebra Mussels

Zebra mussels (*Dreissena polymorpha*) were introduced into the Great Lakes in the mid 1980's through ballast water discharge from transoceanic ships (Minnesota Sea Grant 1998).

Zebra mussels alter habitat by filtering particulate matter, including phytoplankton and some small forms of zooplankton from the water column. This reduces the food base for many small fish, increases water clarity and alters the nutrient flow of the lake. They also densely cover any hard substrate, including the shells of native mollusks.

They can become established over a wide range of depth, light intensity, and temperatures, but are rare in wave-washed zones, except for sheltered nooks and crevices.

Zebra mussels are confirmed at only a few sites on Lake Superior, including Duluth/Superior Harbor, Chequamegon Bay and most recently Whitefish Bay (Gary Czypinski personal communication). They are apparently not yet established on the Ontario side of Lake Superior, but have been observed attached to ships at the Thunder Bay Port and at Indian Harbour, Lake Superior Provincial Park (Jeff Black, personal communication, Sue Greenwood, personal communication).

The spread of zebra mussels in Lake Superior might be limited by low calcium availability and low summer water temperatures (below 12 degrees Celsius). As with other exotic aquatic species, controlling the spread by increasing public awareness is key.

Rusty Crayfish

Rusty crayfish (*Orconectes rusticus*) is native to the southern Great Lakes states, but has spread to lakes and streams in the Lake Superior Basin, probably by anglers using them as bait (Gunderson 1995).

Rusty crayfish alter habitat by reducing the abundance and diversity of aquatic plants, with consequent results on the fish, invertebrates and other species that depend on submergent vegetation for food and cover. They also feed on aquatic invertebrates and can displace native crayfish species (Gunderson 1995).

Rusty crayfish were discovered in 1985 in Pounsford Lake, Ontario and have since been found in the Neebing-McIntyre, Kaministiquia, Pigeon, and Little Pine rivers. They have invaded Pigeon Bay on Lake Superior, and are probably now in Black Bay (Momot 1995, W.Momot, personal communication). They are present in the Duluth/ Superior Harbor and other inland sites in Michigan and Wisconsin (Gary Czypinski personal communication).

Control efforts have included angler education to reducing the spread of crayfish to uninfested lakes and streams.

6.1.13.7 Recreational Use

The waters and shoreline of Lake Superior have witnesses a significant growth in the volume and range of water and land based recreational activities. There is however a paucity of empirical data that quantities the impacts of leisure and recreational pursuits on water quality and shoreline habitat. This assessment of habitat stress related to recreational activities is drawn from anecdotal evidence from park and resource managers and members of the academic communities within the Lake Superior basin.

Commercial and private shoreline development, specifically for holiday and leisure retreats has significantly changed the complexion and composition of natural habitats along extended sections of the Lake Superior shoreline. Developments, together with access roads and associated leisure facilities are the most visible consequences of leisure and recreational use of the lake.

The development and/or expansion of marina facilities (Redrock, Nipigon and Michipocoten Harbour in Ontario; Silver Bay and others on the Minnesota shore in various stages of advanced planning) reflect increases or anticipated increases in motor and sail boat traffic. Marina facilities inevitably concentrate boating activity and may amplify the impacts of fuel spillage, jetsam and unsanitary discharge of solid wastes. Conversely, if used as intended, marina facilities could help mitigate some of the impacts of increased boat traffic on the lake.

Sea kayaking is one of the fastest growing recreational activity in Apostle Islands National Lakeshore, Pukaskwa National Park and along the Rossport/ Nipigon island archipelago. Four sea kayak symposiums are conducted annually on Lake Superior. Kayakers have the ability and a preference to visit and camp in secluded bays and inlets. Pictured Rocks National Lakeshore as well as other high use kayak areas have expressed a concern regarding the concentration of debris and the unsanitary disposal of human waste in backcountry campgrounds. Monitoring plots have been located within the Pictured Rocks area however no long-term data is yet available.

Research regarding the effects of air emissions and gas and oil leaching from two cycle engines as found in snowmobiles and personal water craft has been conduced in some U.S national parks (Yellowstone) however no data was located for the Lake Superior basin. Both sledding and personal watercraft are popular recreational activities on or near Lake Superior. Aside from emissions that may impact air and water quality, the excessive noise of these activities and the pattern of repetitive use of trails or near shore waters may disrupt wildlife (terrestrial and aquatic) use of otherwise suitable habitats.

Off road 4X4 trucks and all-terrain vehicles have invaded and is some instances significantly impacted shoreline habitats. Blow outs and denuded sandscapes in the Pic River dune complex and to a lesser extent in the Michipocten Bay area (ON) are the scars of random and repetitive use by vehicular traffic. Similar impacts have been reported in areas within and adjacent to the Picture Rocks National Shoreline (MI). 'Off roading' disrupts and dissects inland and shoreline

habitats, or prompt debris accumulation and careless and disruptive use of shoreline areas for recreational purposes.

The return of commercial cruise ships with national and international guests is a recent phenomenon on Lake Superior. For example, The MS Columbus, carrying about 350 visitors will make 4 cruses on Lake Superior in the summer of 2000. The docking schedule for the Columbus is limited to major ports; however the ship does carry small watercraft that would allow guests to disembark and explore remote and secluded shorelines. This eventuality could see repetitive, large group use of off shore islands or otherwise secluded bays and coves.

Evaluated individually, recreational activities would appear to have an overall marginal impact or, at worst a measurable localized impacts on the near shore and shoreline habitats of Lake Superior. It is however the cumulative effects of the major recreational activities and the multiplicity of associated services and facilities that supports the major recreational activities that may erode or fracture the integrity of natural patterns and processes. For example, the activity of deer feeding common to many property owners along the northern Minnesota shoreline will inevitably effect some changes in white tailed deer and possibly moose distribution and concentrations. The subtleties and extended time frame of these changes make it impossible to link a recreational activity that is perceived to be beneficial or benign to a change or stress in the natural habitat.

6.1.13.8 Shoreline Development

In comparison to other Great Lakes, the Lake Superior shoreline is relatively undeveloped. On the U.S. side, substantial portions of the eastern shoreline and some sizable tracts in the western basin are under federal or state ownership. About 90 percent of the Ontario shoreline is owned by the provincial government. A significant portion of the Lake Superior shoreline is protected in parks and protected areas. Despite the relatively low human population and a large degree of protection, the success in protecting or restoring shoreline habitats varies tremendously among the jurisdictions.

In recent years the impact of shoreline development on Lake Superior habitat has been a primary focus in many management forums. At both the 1996 and 1998 State of Lake Ecosystem Conferences (SOLEC), papers were presented that described shoreline processes and explored stresses on these habitats. Although there are few standards to mark the limit or extent for shoreline considerations, they generally include lands extending up to a kilometer from Lake Superior.

Shoreline habitats represent the fragile interface between land and the lake and are particularly sensitive to human stresses. Stresses associated with shoreline development include disruption of natural erosions and sedimentation processes by groins, filling wetlands, increased human disturbance of wildlife, and increased pollution from wastewater, stormwater runoff and septic fields (Thorp and others 1997).

In some areas, shoreline development on Lake Superior has been substantial and is expected to continue to increase. Uncontrolled development takes many forms, including industrial, agricultural, commercial, and residential, and can lead to significant cumulative impacts for natural shoreline habitats. Land use along Lake Superior is generally connected to the Basin's economy, the movement towards industrial restructuring, and the proximity of urban centres which facilitate sprawl. Although proximity to water for transportation and industrial purposes were the early factors in shoreline development on Lake Superior, many new trends appear to be emerging.

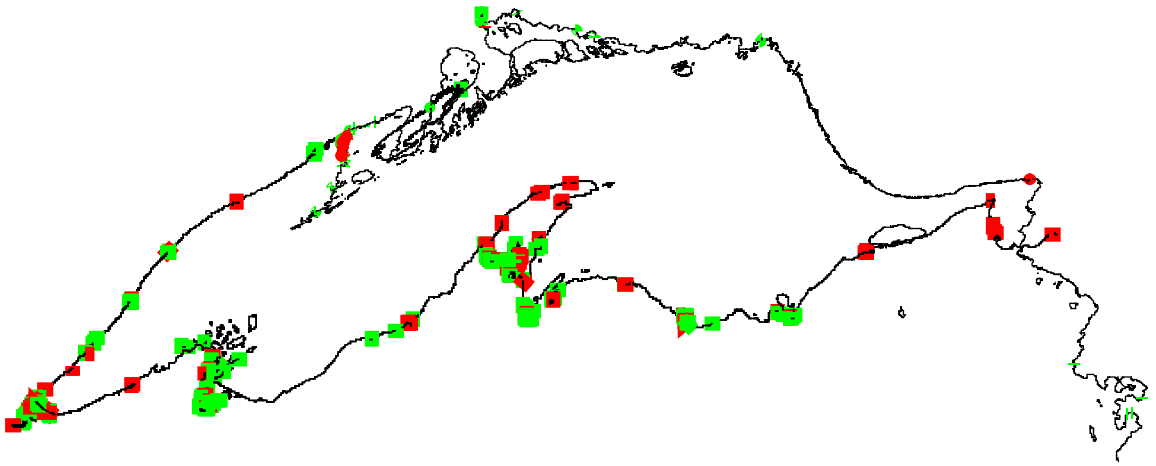

Figure 6-64. Man-made shorelines: red is retaining walls, harbour structure, and breakwater; green is rip-rap
(Compiled from U.S. EPA 1994 and Environment Canada 1993).

In recent years, development of seasonal second homes and cottages has increased significantly. Lake Superior is increasingly viewed has a desirable location for residential use in both rural and urban settings. Large parcels of privately owned land are now regularly subdivided for potential residential development as the market demand increases for waterfront homes. For example, over 50 percent of the homes in Keweenaw County on Michigan's Upper Peninsula are now classified as second homes. As the baby boom generation approaches retirement age, there appears to be a trend towards more permanent shoreline residences. The increase in residential and cottage development and the associated infrastructure, can dramatically impact sensitive shoreline habitats. These impacts include the: construction of access roads that fragment wildlife travel corridors; removal of native shoreline vegetation; construction of harbours and marinas in sensitive estuaries; lake filling; and erosion control structures or breakwalls that impair natural sediment transport processes. In some cases residential developments permitted in areas of shallow soil or rocky headlands, can also lead to temporary or long-term contamination of land and water resources through faulty septic systems.

Approximately 5 percent of the Lake Superior shoreline consists of artificial, made-made structures (Figure 6-64) (Much of the artificial shorelines is concentrated near cities at the mouths of the larger rivers (Nipigon, Kaministiquia, St. Louis), and in many cases is probably replacing wetland habitat. Other areas with significant artificial shoreline are the Bayfield Peninsula (presumably associated with erodable red clays) and the Keweenaw Peninsula.

Among the areas with the greatest growth in human population are the Keweenaw Peninsula, Bayfield Peninsula, northeastern Minnesota and eastern Michigan. The Keweenaw Peninsula has seen unprecedented growth in the past 20 years, mainly as recreational homes. A coalition of residents who felt frustrated by the increasing level of shoreline development they witnessed along the peninsula. They had noticed that some of the most scenic lakeshores, home to unique ecological communities and rare plants, were the same areas frequently being subdivided or subject to other development proposals. The placement of raised sand septic fields in shallow soiled rocky headlands and the filling of sensitive wetland habitats were specific concerns.

Population growth in the eastern Michigan counties may threaten the basin's many endangered species and communities associated with the sand dunes.

Shoreline Regulation

There is no comprehensive data on the extent, distribution, or trends in shoreline development on Lake Superior. Information of this type would need to be obtained from individual municipal offices and through other land use control sources.

From a regulatory perspective the issue of land-use planning along Lake Superior's shoreline is complex. The responsibility for land-use decisions is fragmented among many government regulatory agencies. Often the decision-making authority rests with small local municipalities or county governments that are ill-equipped to handle thorough environmental assessments. In many cases, these local governments encourage shoreline development as a mechanism for increasing their tax base.

Overall there does not appear to be a comprehensive mechanism in place to determine the annual shoreline development approvals. Nor does there appear to be a process for the implementation of uniform development standards (i.e. set back requirements) for new shoreline developments in the Lake Superior Basin (Thorp and others 1997). Although some regions may be making individual efforts to compile statistics on the subdivision of shoreline properties, this appears to be one area where significant data gaps exist. There needs to be a better understanding of the cumulative consequences of local land-use decisions in relation to shoreline habitat impacts.

Shoreline Development

While there are many initiatives underway dealing with water quality on Lake Superior we are aware of no concerted effort to look at current and potential housing development trends on the Lake Superior shores... Memo from Lake Superior Cooperative to Environment Canada & U.S. EPA 1997

Larger populations and easier access to the south shores of Lake Superior and the surrounding states are probably driving an unprecedented desire to purchase waterfront property and expand recreational opportunities. There seems to be a "ripple effect" with development pressure moving out from large metropolitan areas to the inland lakes and rivers of the Great Lakes states to the shores of Lake Superior. This appetite for "being on the water" may be moving a little faster on the south shores of Lake Superior than on Canada's Superior shores.

Demand has driven land use, riparian development and recreational use conflicts to the top of "issues of concern" piles across the Great Lakes region. In northeastern Wisconsin, inland lake properties were commonly selling at $200 (U.S.) per front foot in 1990. Nine years later some waterfront properties are selling for as much as $6000 per front foot. Choice property is gone… smaller lakes with wetland shores, steep slopes, erodable soils and prime wildlife habitat are all that is left. Rising prices drive up property taxes and encourage the splitting of larger parcels. Some predict that if current rates of development continue wild lakes and shoreline in Wisconsin will disappear in the next ten to twenty years.

Lake Superior shores in the U.S. are receiving the same type of pressure. In Michigan, Wisconsin and Minnesota small communities on Lake Superior are experiencing an influx of people building recreational homes or buying condos. Most of Superior's shores are rocky and exposed to heavy wave action; only about 17 percent are protected well enough to provide habitat for wildlife (estuaries, shore wetlands, river mouths, and protected bays). The majority of these protected areas are where cities and marinas are located. Prime building spots are rare. Rocky bluffs sport rows of huge steel and wood stair complexes giving recreational homeowners the ability to reach the water. They construct piers of stone, rock and concrete to protect their boats from the lake. Homeowners tend to remove trees, shrubs and vegetation to gain a "better view of the lake." The result… loss of habitat and, from the lake, a view of homes.

Highways also hug many miles of Superior's shore, and often new homes are squeezed into the ribbon of land between the road and shore. Homes allowed too close to the shore areas of Lake Superior are exposed to flooding during high water or storm events, causing erosion, property damage and shore edge destruction.

The land use planning practices of the Provincial Government have kept much of the north shore of Lake Superior "intact." These wise policies will leave an irreplaceable and formidable legacy for the people of Canada and those who visit.

Communities struggle with the issues of economy vs. environment but new solutions are being found. Responding to requests from the local officials concerned with the explosive growth, Wisconsin has spent $2 million in the past three years to help local governments develop a lake classification system. The idea is to guide development in sensitive lakeshore areas on inland lakes. Twenty-seven northern counties are developing stronger land use strategies and rules on their shorelands..
Protection of the world's lake ecosystems is a global responsibility and Lake Superior is a lake with linkages that are truly global in scope. As long as there are people here, there will be changes, but we can work to make development less stressful on the lake environment. There are many areas that need more work. They include:

- Inventorying current educational programs and materials regarding shoreland development.
- Reviewing current zoning and land use ordinances and their enforcement.
- Continuing research on the impacts of shoreline development.
- Working with and bringing together local communities, government units and concerned individuals to develop long- term solutions and visions for the Lake Superior shorelands.
- Discussing the possibility of developing a Lake Superior-wide set of building standards.

Lake Superior is distinctive in another way… it is teaching us that the consequences of our activities anywhere in this basin can affect all who enjoy the benefits of the lake. As more new development appears, centuries old aquatic habitats, the creatures that live there, aesthetics, and the wild character that draw people to Lake Superior will continue to disappear.

We who live here have an opportunity to think of ourselves as a community instead of a state, province or nation. We can find ways to work together as governments, industries and individuals to integrate environmental and economic issues. We can adopt the type of policies that follow natural processes rather than resist them. If we are willing to persist on these issues and recognize our shortfalls, then the future of Lake Superior looks bright.

One positive trend has been the reclamation of former industrial lands in some urban communities. Recent shifts in markets, has in some waterfront cities, reduced the industrial demand for shoreline sites. As a result many urban centres have recently focused their attention on developing strategic waterfront plans that encourage the acquisition of former industrial lands in an effort to improve public waterfront access or to encourage the restoration of green space along the shore. It is expected that this trend may continue in many centers within the Lake Superior basin. This renewed public appreciation of the aesthetic and recreational attractions of the Lake Superiors shoreline has unfortunately also served to increase development pressures in many previously remote regions of the lake.

6.1.13.9 Dams and Water Diversion

Hydroelectric Generation

There are major 15 hydroelectric generating stations in the Ontario Lake Superior drainage basin on the Aguasabon, Kaministiquia, Michipicoten, Montreal, Nipigon and Wolf rivers (Cheng 1987). Numerous smaller projects are also present.

Ontario Hydro identified ten undeveloped major sites (>10 megawatt potential) within the Basin, including the Pic, University and White rivers (Cheng 1987). An additional 28 sites with 2.0 - 10.0 avg. megawat potential have been identified on the Agawa, Aguasabon, Black Sturgeon, Magpie, University, Pukaskwa, Pic, Steel, Namewaminikan, Kopka, Gull, Kaministiquia, Pigeon, and Ogoki rivers (Cheng 1987).

In the U.S. basin, the number of hydroelectric dams is limited by the small watersheds. The St. Louis River watershed has five hydroelectric dams, but the 1930 Shipstead-Nolan Act of Congress prohibits construction of dams or other water-fluctuation structures in St. Louis, Lake and Cook counties Minnesota (MPCA 1997). Wisconsin has five active hydroelectric dams in the Basin. There is potential for future developments at a number of sites (Turville-Heitz 1999).

A landslide on the Nipigon River in 1990 was partly attributed to water level fluctuations caused by a hydroelectric dam. Heavy siltation caused by the slide damaged fish habitat and forced the Town of Nipigon to relocate its water intake (Atria Engineering Hydraulics Inc. 1993). Rapid draw down for hydroelectric generation contributed to the initial slide on the riverbank, which was followed by failure of the land behind the bank (Atria Engineering Hydraulics 1993). Other factors were the naturally susceptible soils, high soil moisture due to sudden thaw, natural erosion by river water, removal of tree cover by logging and disruption of drainage patterns by a pipeline right of way. Smaller slides are common on the river. A sudden drawdown on the Nipigon River in 1998 caused spawning salmon to be stranded (Rosemary Hartley, Nipigon District OMNR, personal communication).

Other potential impacts of hydroelectric developments on the Lake Superior ecosystem include elevated levels of methylmercury associated with reservoirs, altered water regimes resulting in disrupted spawning cycles (e.g. brook trout in the Nipigon River), and barriers to fish migration.

The number of potential hydroelectric sites that will eventually be developed depends on supply-and-demand for electricity and initiatives by local businesses and communities. Environmental assessments are required for new hydroelectric projects. However, it is difficult to determine the cumulative impacts on the Lake Superior ecosystem if numerous small projects are established.

Water Diversion Projects

Waters from the Albany River Basin, which formerly flowed into Hudson Bay, have been diverted from the Ogoki and Kenogami rivers and now flow into Lake Superior. The purpose of the diversions was to increase flows at hydroelectric dams and improve log drives.

The Long Lac diversion was established in 1939. It consists of a concrete overflow dam on the Kenogami River at Long Lac. The diverted water passes through a channel built across the watershed divide and into the Aguasabon River, which drains into Lake Superior. A concrete dam at the end of the channel regulates flows. Since 1940, an average of 1,400 cubic feet per second (cfs) has been diverted to Lake Superior (IJC 1976). Electricity is generated at a power plant near the mouth of the Aguasabon River in Terrace Bay. This diversion was also used for the transport of pulpwood logs southward.

The Ogoki diversion was established in 1943. It redirects water from the Ogoki River into Lake Nipigon, which flows into Lake Superior via the Nipigon river system. The Waboose Dam on the Ogoki raises water levels so that most of the flow is redirected across the watershed divide, and then through a number of small lakes into the Jackfish River and into Lake Nipigon. The Summit Dam controls the amount of diverted water. The diversion discharges an average of 4000 cfs (IJC 1976). Since 1943 the diversion has had closures and reduced flows on at least 25 occasions for a variety of reasons. A generating station at Pine Portage at the top of the Nipigon River controls the outflow. Pine Portage generating station is the first of three hydroelectric plants on the Nipigon River. A minimum flow of 8000 cfs is required to ensure appropriate water levels for the town of Nipigon's water supply system. Flows in excess of 20,000 cfs would endanger the railway and highway bridges at Nipigon.

In 1951-53, the volume diverted from the Ogoki River was reduced during a period of high water. Diversion of water was stopped for a numbers of months in each of these high water years. Ontario Hydro reduced water diversions again during 1972-74. During this period the outflow through the Nipigon River was reduced to natural levels and diversion waters were stored in Lake Nipigon. Once Lake Nipigon reached peak levels water diversion was completely halted and Ogoki flows were temporarily diverted north again.

The Long Lac and Ogoki diversions have had significant local environmental effects resulting from the initial construction and operation of the diversion structures, channels and reservoirs. Greatly altered flow regimes and the accumulation of bark and other woody debris from log drives represent a continuing stress on the local environment and negatively impact upon fish spawning habitat. Lower reaches of the Little Jackfish River on the Ogoki Diversion experience severe erosion of unconsolidated glaciolacustrine sediments which has resulted in increased siltation and turbidity stresses of the Obamika Bay on Lake Nipigon. This has contributed to the

decline of the walleye fishery, and may also be responsible for the increase in sauger compared to walleye (Bridger and Day 1978).

The Long Lac and Ogoki diversions have also had significant hydrological effects on the Great Lakes. The mean water level of Lake Superior has increased by 6.4 cm, Lakes Migichan-Huron by 11.3 cm, Lake Erie by 7.6 cm and Lake Ontario by 6.7 cm. The changes in water level attributed to the diversions result in an estimated annual loss of $4.8 million due to erosion and flooding. However, direct benefits to the pulp and paper industry (located on the Aguasabon River), navigation (higher water levels permit greater loads), and power generation are estimated to exceed the calculated losses by $57 million annually. The effects of water level increase on recreational boating and beach use have not been quantified for Lake Superior, but generally raising water levels benefits boating and harms beaches. No basin-wide negative environmental effects have been documented for these two diversions (IJC 1985). No introductions of aquatic species from the Arctic watershed have been reported.

6.1.13.10 Lake Level Management

For over 150 years, the outflow of Lake Superior at Sault Ste. Marie has been modified to improve navigation and hydroelectric generation (Environment Canada 1993). Power canals and navigation channels increased the amount of water that could be discharged. The increased capacity required the construction of control works to compensate for the increased outflow capacity from Lake Superior.

The Lake Superior Board of Control was established to supervise the operation of all control works, canals, headgates, and bypasses and to formulate rules for them. The Board's goal is to regulate the level of Lake Superior in such a matter as not to interfere with navigation, protect the sport fishery in the rapids of the St. Mary's River and ensure adequate flow for hydroelectric generation. Flow regulations also help prevent ice jams in the St. Mary's River.

Regulation of Lake Superior also depends on water levels in the lower Great Lakes. In its 1976 report to U.S. and Canadian Governments the IJC advised that regulating the levels of Lake Superior could provide benefits throughout the Great Lake system if the regulation took the levels of lake Michigan-Huron into account. When Lake Superior's levels are much higher than average and Lakes Michigan- Huron are only slightly above average, the outflow from Lake Superior is increased to ease high water levels. If Lake Superior is very much below average and Lakes Michigan-Huron are only slightly below average, the outflow from Lake Superior is reduced in order to raise its level. Similarly, regulating outflow from Lake Superior can compensate for extreme high or low water levels on Lakes Michigan and Huron.

One of the main objectives of the IJC's 1914 order was to maintain Lake Superior levels within a more narrow range than was recorded through past monitoring history. However, this objective soon proved impossible when record high and low water levels occurred in later years. In the 1950s, the maximum water level as prescribed in the 1914 Order was exceeded. During the mid-1950s to the 1960s, water levels were also frequently below the minimum level.

In the mid-1960s, when water levels were extremely low on Lakes Michigan-Huron, Lake Superior was used to help alleviate the situation on these lakes. Permission was granted to discharge outflows greater than the regulation plan. Then in the early 1970s, Lake Superior flows were reduced as part of an emergency action since water levels were critically high in the lower Great Lakes.

In the spring of 1985, Lake Superior's outflows were again reduced because of high water levels in the lower Great Lakes. However after four months of flow reductions it became necessary to reverse procedure and increase outflows since large amounts of precipitation on the Superior basin had caused the Lake to climb to a record high level. Continued rains saw Lake Superior levels exceed the level of 603.2 feet (186.86 meters) for a period of two months despite allowing the largest outflow on record.

The presence of Lake Superior compensating facilities does not mean that full control of Lake Superior's water level is attainable or desirable. Lake Superior levels are greatly effected by natural conditions that cannot be controlled such as evaporation, run-off, and over-lake precipitation. Since these factors cannot be accurately predicted, levels on Lake Superior remain largely a product of natural occurrences (IJC 1993, Tushingham 1992).

The effects of water level regulation on the lake ecosystem are not well understood. The reduced range of high and low water levels influences wetland and shoreline plant communities, but site-specific studies are needed to evaluate the effects of fluctuating water levels on the Great Lakes fishery. Wilcox and Whillans (1999) call for the restoration of natural lake level fluctuations on Lake Superior to restore wetland hydrological processes.

6.1.13.11 Dredging

In Lake Superior, dredging has been taking place since the early 1900s. Dredging involves removal of lake bottom sediments to maintain shipping and recreational boating channels. In the period 1937 - 72, 68.7 million m^3 were dredged from Lake Superior (Edsall and Charlton 1997).

Dredging can have harmful impacts on wetlands. In addition to loss of wetland area, dredging in shallow waters near wetlands can create new channels, altering water movements and changing nutrient regimes and plant communities (Maynard and Wilcox 1997). Dredging can also cause lower water tables and increased sediment loading in the rest of the marsh. Deepening the water adjacent to the marsh can prevent the natural migration of the marsh boundary during low water years.

Disposal of dredged material can also alter habitats. Dredge spoils are sometimes deposited in shorelines, filling wetlands or burying other shoreline communities (Thorp and others 1997). Depositing dredge spoils in nearshore habitats can bury spawning areas, but carefully planned open water disposal can have only temporary or minor impacts if spawning areas and other

significant benthic habitat is avoided (Edsall and Charlton 1997). Most dredge spoils are now deposited in confined disposal facilities due to concerns about contaminants.

Dredging operations on Lake Superior regularly take place at the Thunder Bay harbour and the St. Louis River estuary at Duluth / Superior, with smaller operations at recreational marinas.

6.1.14 Information Gaps / Data Needs

While many studies have been completed at local scales, compiling information at the scale of the Lake Superior watershed is often hampered by incomplete information. Additionally, while comprehensive survey or inventory data is typically available in the more southerly portions of the states and province, similar information is often lacking for areas within the Lake Superior watershed. Filling these information gaps and compiling the data at the scale of the watershed are important to determine larger scale trends in the quality and quantity of habitat. Critical information needs and data gaps include but are not limited to:

- Complete stream classification and inventory
- Database of dams, loss of accessible stream length due to man-made structures
- Maintain a database of inland lakes
- Mapping rare community types
- Quantify shoreline development (no. houses/km for various sections, etc.)
- Lack of data on historical vegetation cover in Ontario

6.2 STRATEGIES, ACTIONS AND PROJECTS TO PROTECT AND RESTORE HABITAT

This section of the LaMP for Habitat recognizes “Strategies”, “Actions,” and “Projects” that will help identify, protect or restore habitat features and the ecological processes that sustain them. These draft strategies, actions and projects are presented for public comment and to develop a broader consensus of priorities among resource managers around the watershed. The numbered items are "Strategies" that target specific categories of activity that are recognized as essential to achieving the goals of identification, protection or restoration of habitat. Numbers do not imply priority rankings in any way. They merely provide a tool for referencing individual Strategies. In some cases, Strategies have more specific necessary "Actions" described that delineate components of the broader strategy. Actions that target individual jurisdictions or agencies indicate where the LSBP has identified information gaps that need to be filled or where there are regional differences in habitat needs.

Included in this chapter are also projects that have been developed by one or more of the LSBP partner agencies. These projects are underlined below and the lead agency working to implement the project is identified in parentheses. Where an agency is identified in association with a

project, a level of commitment is indicated. The term "commitment" indicates that funding has been secured for the project and that it has either just begun or will begin in the next year. "Exploratory" indicates that the agency has proposed the project and is in the process of securing funding or other key support before beginning. "Future possibility" refers to projects that agencies feel are important, but which have not yet been formally proposed and additional work needs to be done before a project proposal is developed.

Partner agencies have committed to achieving the goals of habitat protection and restoration identified below. In addition, agencies have committed to the specific actions and projects in this LaMP document as identified in the sections that follow based on local or regional priorities and needs, organizational mission, and available funding or staff expertise. This list of strategies is not intended to commit agencies to complete each of the specific actions listed below. Instead it represents a long term planning approach to identifying management needs. Committed projects may, in some cases, be completed in one or two years. Others will be completed over several years. Strategies may have either fixed endpoints or, more often, represent priorities for work that needs to be initiated and continued over many years or decades. The scale of the Lake Superior basin and its importance as habitat for plants, animals and human communities necessitates long term commitments in management and coordination.

The goals that the habitat committee has established for habitat in the basin are the following:

1. To protect and maintain existing high-quality habitat sites in the Lake Superior basin and the ecosystem processes that sustain them.
2. To restore degraded plant and animal habitat in the Lake Superior basin.

Several principles guide the committee's work toward these goals. They are:

- The ecological well being of Lake Superior is determined in large part by the condition of its tributary lakes and rivers. Land use planning and regulation in the Lake Superior ecosystem should eliminate or avoid destructive land-water linkages (e.g. erosion of agricultural land, urban storm water, point and non-point sources of persistent contaminants), and foster healthy land-water linkages (e.g. continuous stream side vegetation buffers, on-site treatment of runoff).

- The long-term consequences of incremental or cumulative landscape change, habitat destruction, and habitat fragmentation should be anticipated and avoided in the Lake Superior basin through research and planning at appropriate spatial and temporal scales.

- The crucial importance of nearshore, shoreline and wetland aquatic habitats in Lake Superior should be addressed through efforts to identify, protect and restore key sites for reproduction and rearing of fish, water birds, mammals, and other wildlife and plants.

- It is vital to coordinate and support restoration/rehabilitation and protection efforts for priority sites. The committee would communicate with agencies and groups involved in habitat protection and restoration/rehabilitation around the basin to provide information about

and encourage consistency with the habitat objectives of the Lake Superior Binational Program.

- Through outreach and education, promote partnerships in maintenance and restoration/rehabilitation activities in the basin, including strong participation from non-governmental organizations, stakeholders and other public groups.

Abbreviations found in this chapter are as follows:

Bad River Band of Lake Superior Chippewa	BR
Bay Mills Indian Community	BMIC
Chippewa-Ottawa Treaty Fisheries Management Authority	COTFMA
Fond du Lac Band of Lake Superior Chippewa	FdL
Grand Portage Band of Lake Superior Chippewa	GP
Great Lakes Indian Fish and Wildlife Commission	GLIFWC
Keweenaw Bay Indian Community	KBIC
Natural Resource Conservation Service of the U.S. Geological Survey	NRCS
Ontario Ministry of Natural Resources	OMNR
Red Cliff Band of Lake Superior Chippewa	RC
State Departments of Natural Resources	State's initials (MI, WI or MN) and DNR
U.S. Environmental Protection Agency	EPA
U.S. Fish and Wildlife Service	FWS
U.S. Forest Service	USFS followed by the name of the National Forest proposing the project
1854 Authority	1854 Auth.

A project proposed by a Remedial Action Plan working group is signified by the name of the Plan, followed by "RAP."

Strategies, Actions and Specific Projects

1. Complete comprehensive, systematic Natural Heritage Inventory/biological surveys in the watershed to identify remaining high-quality natural communities and locations of rare plants and animals.

- Survey two sites on the Fond du Lac reservation. (FdL - commitment)
- Suzie Islands survey. (GP - commitment)
- Biological survey of the North Shore highlands subsection. (MN DNR - commitment)

2. Complete comprehensive substrate mapping for nearshore waters, harbors, bays and estuaries of Lake Superior to identify important fish habitat.

- Classify physical habitat in nearshore waters of Lake Superior in Michigan. (MI DNR - exploratory)
- Lake trout spawning habitat mapping. (GLIFWC - exploratory)

- Comprehensive substrate mapping in nearshore reservation shoreline in Lake Superior and in on-reservation tributaries. (GP - commitment) (RC - commitment)
- Physical Habitat Classification of Nearshore Waters of Thunder Bay and Black Bay. (OMNR - exploratory)

3. Develop and maintain a complete, comprehensive database of important habitat information including Geographic Information System (GIS) data to ensure basinwide access to data.

- Develop a GIS database of mid-scale geographic and habitat data for use in mapping habitat conditions. (MN DNR - commitment)
- Utilize existing data, prepare a GIS map identifying known spawning locations of native fish species in Lake Superior and its tributaries. (GLIFWC - exploratory)
- Distribute draft habitat database to managers in the basin to fill data gaps and identify additional sites.
- Incorporate data on habitat impairments into GIS database for Lake Superior.
- Map identified Endangered Species Act mandated designated critical habitat in the Lake Superior watershed for all federally listed species.
- Piping plover critical habitat mapping. (FWS - commitment)
- Map locations of threatened and endangered species in the 1854 ceded territory in Minnesota. (1854Auth. - commitment)
- Identify and map habitat for native species of economic and cultural importance, including lake sturgeon, lake trout, lake whitefish, wild rice, ginseng and others where appropriate.
- Develop and distribute decision support tools using geographic information systems (GIS) data and models. (MN DNR - commitment)
- GIS map and database relating fish communities to habitat for eastern Lake Superior. (COTFMA - commitment)
- Develop two display kiosks through the Lake Superior Decision Support System project to provide information about Lake Superior habitat status, trends, stressors and restoration/remediation/maintenance activities. (MN DNR)
- Develop and distribute county- scale GIS data for land use planning in Marquette Co. (MI DNR - commitment)
- Establish a spatial information resource center in Marquette. (MI - commitment)
- Identify and map wetlands on the reservation. (KBIC - commitment)

4. Complete comprehensive habitat assessment and aquatic community surveys to identify important habitat sites in tributary streams, and inland lakes of the watershed.

- Conduct a comprehensive hydrologic assessment of the Whittlesey Creek watershed.
- Little Rapids biotic study would assess biological conditions in a remnant rapids system in the St. Marys River. (St. Marys RAP - exploratory)
- Aquatic community survey in Michigan tributaries. (MI - commitment)
- Regional Environmental Monitoring and Assessment Project (REMAP) in coastal wetlands on the U.S. side. (EPA - commitment)
- St. Louis River habitat plan. (St. Louis River RAP - commitment)

5. Identify sites that meet the criteria for important habitat. This includes integrating cooperative, long-term habitat inventory and assessment efforts.

- Inventory and assessment on the Fond du Lac reservation. (FdL - commitment)
- Identify areas with the hydrologic and physical characteristics to support creation of new wetlands and rapids in the St. Marys River. (St. Marys River RAP - exploratory)
- Duluth Area Natural Resources Inventory. (City of Duluth - commitment)

6. Identify additional important habitat sites in areas where data is lacking, utilizing expert knowledge.

- Conduct expert surveys in Michigan to identify additional important habitat sites.
- Conduct expert surveys in Ontario to identify additional important habitat sites.

7. Utilize NOAA/Coast Guard ESI maps to determine whether sites meet criteria for important habitat.

8. Implement conservation actions to maintain and restore habitat function and structure at sites that meet the criteria for -important habitat sites.-

- Pine barrens management/sharp tailed grouse habitat in Wisconsin. (WI DNR, GLIFWC - commitment)
- Protect remnant old growth forest and restore/rehabilitate high potential old growth areas.
- Protect remnant rapids in the St. Marys River from further reduction and degradation and maximize the productive capacity of rapids habitat. (St. Marys River RAP - exploratory)

9. Evaluate Natural Heritage inventory techniques and develop appropriate methods to address differences in techniques.

10. Assess impacts to habitat at a basinwide scale from current and historic sources of degradation.

- Review the list of degraded waters on the Clean Water Act, Section 303D list (waters that do not meet the standards of fishable, swimmable, drinkable) for areas with habitat impacts. Assess impacts to habitat on a basinwide scale.
- Inventory and review Superfund sites in the basin for habitat impacts; assess impacts to habitat on a basinwide scale.
- Review RAP Areas of Concern for habitat degradation impairments; assess impacts to habitat on a basinwide scale.
- Mission Creek waste dump assessment would include a hydrogeological and waste characterization study and a feasibility study for waste removal. (St. Marys River RAP - exploratory)
- Review and revise where necessary, report on habitat impacts of major dischargers for sites that have documented degradation of habitat.
- Investigate additional sources of information for habitat impairments such as identified minor dischargers and historical dischargers. Conduct bioassessments in areas with suspected habitat impairments.
- Conduct bioassessments in areas with suspected habitat impairments based on information from 303(d), Superfund, RAPs, major and minor discharger sites, and other sources.

- Bioassessments in the Waishkey River Watershed of the St. Marys River Area of Concern. (BMIC - commitment)
- Assess the impact of beaver dams as part of the bioassessments conducted in wadeable streams of the basin (MDEQ - commitment)

11. Design and implement projects to address lost ecosystem functions at degraded sites identified by the actions under Strategy 10.

- Michigan stamp sands restoration locate and stabilize stamp sand deposits in the Keweenaw peninsula. (Houghton/Keweenaw NRCS - exploratory)
- Dam removal or installation of fish passage facilities where appropriate.
- Ensure that habitat projects at degraded sites promote citizen stewardship of areas of important habitat where appropriate.
- Little Rapids Habitat restoration in the St. Marys River. (St. Marys River RAP - exploratory)
- Twenty-first Avenue Channel habitat restoration, St. Louis River. (MN DNR - exploratory)
- Total Maximum Daily Load (TMDL) allocations for water bodies that are not attaining designated uses (303[d]). (MDEQ - exploratory)

12. Implement actions to reduce stressors and eliminate sources of stress to important terrestrial and aquatic habitat sites.

- Identify the primary stressors and sources of stress to important habitat sites in tributaries and inland lakes.
- Deer herbivory impacts in Lake Superior forests. (GLIFWC - exploratory)
- Feasibility study for a lamprey barrier on the Bad River. (BR, FWS - commitment)
- Quantify impact of shoreline development and develop a tool for local governments to monitor and assess impacts.
- Western Upper Peninsula Sediment Reduction project would reduce runoff through bridge replacement, establishment of runoff ditches, stabilization of banks etc. (USFS, Ottawa - exploratory)
- Woody debris project on the Middle Branch of the Ontonagon River to improve trout habitat (USFS, Ottawa - exploratory)
- Encourage walleye recovery in the Bar River by mitigating effects of land use practices upstream of historic spawning grounds. (St. Marys River RAP - exploratory)

13. Participate in activities to develop an understanding and encourage agreement on the status and trends of habitat conditions in the basin.

14. Participate in activities to develop an agreed upon set of goals and targets for sustainable, landscape scale habitat conditions in the basin.

15. Maintain a list of potential grant sources that apply to the Lake Superior basin and develop a network of support for funding habitat projects.

16. Develop habitat protection plans for sites of important fisheries habitat based on rehabilitation plans developed by the Great Lakes Fishery Commission (Lake Trout, Lake Sturgeon, Coaster Brook Trout, and Walleye).

- Habitat Requirements of Coaster Brook Trout in Nipigon Bay. (OMNR - commitment)
- Status of Walleye Stocks and Habitat Quality in Batchawana Bay and the St. Marys River. (OMNR - exploratory)

17. Implement habitat recommendations contained in the Great Lakes Fishery Commission-s fish community objectives and rehabilitation plans.

18. Develop riparian guidelines for long term ecological maintenance, incorporating information about potential vegetation and best management practices, and addressing regionally important habitat considerations.
- Distribute, promote and train local governments, industries and certification groups in the use of the guidelines.

19. Identify important riparian and nearshore terrestrial habitats and develop and implement plans to protect and restore riparian zones, environmental corridors, and buffer zones.
- Little Two Hearted River restoration would stabilize stream banks and realign a roadway. (Luce County Road Commission - exploratory)
- Ashmun Creek bioreserve. (St. Marys RAP - exploratory)
- Shoreline riparian assessment in Marquette County. (MI DNR, Central Lake Superior Watershed Partnership - commitment)
- Whittlesey Creek restoration would complete collection of hydrologic information for use in groundwater models of the watershed. (FWS - commitment)
- Tree planting project in the riparian zone along Fond du Lac creek. (FdL - commitment)
- Acquisition of Lake Superior shoreline, connected wetlands, riparian areas and associated uplands. (USFS, Ottawa - exploratory)
- Miller Creek watershed restoration. (MN DNR - commitment)
- Cypress River Rehabilitation. (OMNR - commitment)
- McIntyre River Habitat Inventory. (OMNR - commitment)
- Marathon Marina Development - Habitat Enhancement/Sediment Remediation. (OMNR - exploratory)
- Thunder Bay Hospital Site Development - McIntyre River. (OMNR - commitment)

20. Apply special designations protections for areas of identified important habitat.
- Evaluate public lands for potential special designations, incorporate recommendations into management plans as plans are revised.
- Assess tributary watersheds for suitability for special designations including Natural Rivers designation, Natural Heritage Rivers, Wild and Scenic Rivers, State Natural Area, Research Natural Area, Outstanding Reservation Resource Waters, etc.
- Assess terrestrial areas for suitability for special designations including State Natural Area, Research Natural Area, etc.
- Develop recommendations for designation of most significant habitat sites.
- Plan and implement a network of protected representative ecosystems across the Lake Superior basin in order to establish baseline areas for terrestrial wildlife monitoring and research (U.S. side) (USFS - exploratory)

- Protecting small, significant areas of ecological significance in the central Lake Superior basin. (Central Lake Superior Land Conservancy - exploratory).
- Develop and implement a designation -Area of Quality- to complement the -Area of Concern- designation in the Great Lakes Water Quality Agreement.
- Keweenaw Bay Indian Community will establish the reservation as a Conservation District. (KBIC - commitment)

21. Incorporate protection and restoration of important habitat into land use plans.

22. Participate in the development of Great Lakes basin wide ecological classifications (i.e., Ecological Classification Systems / Environmental Land Classifications, aquatic community classification, lake ecosystem section classification) where they do not already exist to ensure that the unique character of Lake Superior is represented.

23. Restore and protect conifer forests in appropriate upland and stream corridors.
- Re-establish cedar trees along the Bad River and evaluate the use of enclosures to keep deer from browsing the young trees. (BR - commitment)

24. Implement habitat recommendations contained in the North American Waterfowl Management Plan.
- Landscape scale coastal wetland project in MN. (FWS - exploratory)
- Reconstruct the Sylvester dam and enhance the associated impoundment. (USFS, Hiawatha - exploratory)
- Northern Wood Marsh Rehabilitation. (OMNR - commitment)

25. Restore and protect habitat for native species of economic and cultural importance, including lake sturgeon, lake trout, lake whitefish, wild rice, ginseng and others where appropriate.
- Rice Portage restoration project includes aquatic plant management and water control activities to enhance wild rice. (FdL - commitment)
- Install a water control structure to enhance wild rice and waterfowl habitat at Roubillard Creek. (KBIC - commitment)
- Waterfowl and wild rice enhancement projects at Sand Point Sloughs and Pinery Lakes. (KBIC - commitment)

26. Implement habitat recommendations of the Great Lakes Panel on Aquatic Nuisance Species.
- Purple loosestrife and exotic plant control. (GLIFWC - commitment)
- Purple loosestrife control program. (MN DNR - commitment)

27. Implement conservation actions recommended in watershed plans, reservation Integrated Resource Management Plans, Lake Management plans and ecoregional conservation plans.
- Develop watershed management plans for Lake Superior drainages that include "Best Management Practices" for restoring and maintaining ecological function and structure.

- Develop habitat components of Lake Superior guidance for watershed management planning.
- Anna River restoration would identify and prioritize critical areas and identify best management practices for remediation. (Munising Bay Watershed Council - exploratory)
- Creation of Mission Creek Watershed Association. (St. Marys River RAP - exploratory)
- Develop inland lake watershed management plans for inland lakes supporting significant biological diversity or important habitat. Plans should include habitat restoration/rehabilitation/ protection for important habitat features and processes.
- Develop Integrated Resource Management Plans for reservation lands. (FdL - commitment), (KBIC - commitment), (RC - commitment)
- Develop and implement site conservation plans for known sites of important habitat.
- Red Clay Plain Soil Restoration and Erosion Reduction would reduce flow and stabilize red clay soils by converting cover types from hardwood or popple to conifer. (WI DNR - exploratory)
- Work with local partners to develop ecoregional conservation plans for each sub-section in the Lake Superior watershed.
- Chocolay River restoration would include stream restoration, stream crossing improvements, erosion control and public education. (MIDNR - exploratory)
- Yellow Dog River restoration would map critical areas in the watershed where erosion control is necessary. (Yellow dog River Preservation Society - exploratory)
- Munuscong River watershed plan implementation would stabilize stream banks in eroded areas and study sediment removal options. (St. Marys River RAP - exploratory)
- Dead River watershed plan implementation.
- Identify conservation priority areas within the Stony Brook watershed and implement projects to protect and enhance the watershed. (FdL - commitment)
- Reduce sedimentation in Zepa Creek and conduct water quality monitoring to verify results. (KBIC - commitment)
- Implement remedial recommendations contained in the Watershed Development Plan for Bennett and West Davignon Creeks. (St. Marys River RAP - exploratory)

28. Identify priority research needs and research gaps, and develop appropriate projects to address those needs and gaps.

- Evaluate restoration projects and restoration ecology research to link successes to specific restoration actions.
- Identify disturbance regimes and ranges of natural variation within disturbance regimes.

29. Participate in activities to develop a regional set of best management practices for forestry.

- Review compliance with Best Management Practices for forestry, road building and recreation and recommend corrective actions where needed.
- Engage citizens and loggers in cooperative learning about forestry practices. (Michigan State University - commitment)

30. Implement the habitat recommendations contained in federal threatened and endangered species recovery plans. Restore and protect habitat for state, tribal, and provincially listed species.

- Inventory Endangered Species Act (ESA) mandated -Recovery Plans- that need to be completed for threatened and endangered species in the Lake Superior Basin.
- Complete ESA mandated -Recovery Plans- for federally listed (U.S.) species where those plans do not already exist.
- Restore and protect colonial waterbird habitat where appropriate throughout the basin.
- Conservation plan for terns and plovers - acquisition and restoration. (WI DNR - exploratory)

31. Institute a long-term, basin wide sampling program to implement habitat indicators.

- Develop and coordinate monitoring protocols, sampling procedures, and data handling processes for selected "Best Bet" indicators.
- Test monitoring protocols in basin-wide indicator applications.
- Evaluate monitoring protocols and revise based on test results.
- Participate in activities to develop agency support for basin-wide implementation of indicators.
- Participate in the development of methodologies to incorporate Great Lakes indicators into Lake Superior monitoring programs.
- Inventory and assessment of snapping turtle populations, habitat and evaluation of use as an indicator, using GIS. (GLIFWC - exploratory)

32. Provide information to local governments and landowners about the linkages between land use and ecosystem health.

- Inventory the information available to landowners and local governments on the impacts of land use on streams and lakes.
- Identify existing information publications related to impacts of landscape change and assess the effectiveness of these publications.
- Develop and distribute an information/communications piece to summarize the linkages between and use and aquatic community well being in the basin. This piece will include contact information for landowners and local decision makers as well as directions for getting more information.
- Develop an informational land use brochure targeted to landowners on the Fond du Lac reservation. (FdL - commitment)
- Develop and distribute a series of information publications focusing on providing information to landowners/managers and local governments about how to assess long-term effects and plan for reducing the negative effects of these changes.
- Identify a potential suite of incentives to implement that will encourage local governments and landowners to foster healthier land-water linkages.

- Identify the audiences most in need of information related to cumulative impacts of landscape change, habitat fragmentation and habitat destruction.

33. Focus attention on environmental issues through education related to restoration, rehabilitation and maintenance.

- Develop an information fact sheet on improving public participation in restoration/rehabilitation projects and distribute to practitioners in the basin.
- Provide interactive education at the Northern Great Lakes Visitor Center. (FWS - exploratory)
- Conduct a natural history speaker series at the Northern Great Lakes Visitor Center. (FWS - exploratory)

34. Hold workshops on public participation in environmental issues in the basin. (See also, Community Awareness Review under the Sustainability tab)

35. Produce a motion picture or IMAX film on Lake Superior.

36. Provide opportunities for researchers and resource managers in the Lake Superior basin to identify restoration/rehabilitation goals and priorities, network, learn from each other and generate new ideas and develop strategies for real problems and issues.

- Hold a Lake Superior Restoration/rehabilitation and Protection conference geared at ecological restoration/rehabilitation.

6.2.1 Habitat Committee Next Steps

The previous portion of this chapter sets out a number of goals and principles, strategies, actions and projects that will be important for governments, communities and individuals to undertake in order to adequately restore and protect habitat in the Lake Superior basin. There are also actions that the Habitat Committee of the Lake Superior Binational Program (LSBP) proposes to undertake for the next two years and beyond that support these goals and principles.

An important role for the Habitat Committee is to facilitate discussion about habitat status, trends, stresses and sources of stress to the Lake Superior basin in order to achieve consensus for coordinated action. These discussions should include the diversity of natural resource professionals and the growing number of citizens and environmental groups focused on habitat issues. Basin wide consensus on these issues will provide a basis for resource managers and the public to prioritize and balance actions that will protect and restore habitat and the ecological health of the watershed. For example, land management for white-tailed deer and land management for regrowth of northern white cedar must be balanced so that deer and cedar are represented on the landscape in a way that reflects a healthy and productive ecological system. Priority activities to reach the desired conditions can then begin.

To begin developing the necessary basin wide consensus, the Habitat Committee proposes using the habitat sections of LaMP 2000 (along with the terrestrial, and aquatic sections as appropriate) as a starting point for discussion to develop consensus among natural resources professional for

regional status, trends, stresses and sources, monitoring and indicators. Actions to accomplish this may include workshops, presentations or other meetings and discussion forums.

It will be, over the next two years, crucial to communicate to the public the broad range, impact and cumulative effects of the habitat protection and restoration efforts under way throughout the basin. This will be accomplished by magazine articles, video and other media outlets. This action necessitates continuing to develop and maintain a comprehensive database of projects that are ongoing, proposed and completed and maintaining and expanding the committee?s web site (http://www.d.umn.edu/~pcollins/lsbp).

The Committee has developed an important information resource with the Lake Superior Decision Support project (http://oden.nrri.umn.edu/lsgis). This resource will require work to expand and continue to deliver important geographic information about the watershed at scales that enable basin wide assessment, mapping and coordination across agency and geographic borders.

Ensuring a thorough and comprehensive public review and comment on the LAMP 2000 report, effectively and efficiently responding to public comments and integrating necessary improvements into LaMP 2002 will be a priority for the Committee over the next 2 years. Several actions are necessary to ensure that public comments are integrated in the LaMP process at the same time as agency consensus is being developed. Coordination between the LSBP and other organizations such as the Lake Superior Ecosystem Cooperative, and the Great Lakes Fishery Commission, for example will be important for ensuring that regional priorities are developed in a way that maximizes the effectiveness of their implementation.

6.3 PROJECTS AND RESULTS

There have been, and continue to be many projects to identify, protect and restore habitat in the Lake Superior watershed. Compiling and summarizing these projects is a daunting challenge. This portion of the LaMP for Habitat represents the results of that challenge to date. This compilation of project summaries was developed to document the work being done throughout the watershed that furthers the goals and strategies identified in the previous chapter of this LaMP. Where information was available, project summaries were developed. Following the project summaries is a list of projects for which summary information is still needed. This report provides an encouraging picture of the many local and basin-wide efforts that have been undertaken. It is not a complete listing of all such projects. Development of this information will continue and can serve to provide a reference to natural resource managers and the Lake Superior community.

Projects have been placed into one of 5 categories. They are 1) Habitat Restoration and Rehabilitation, 2) Special Designations and Acquisition, 3)Watershed Management and Forest Stewardship, 4) Monitoring, Assessment and Inventory, and 5) Education and Public Involvement.

Habitat restoration and rehabilitation projects include those projects that implement physical activities that improve habitat features or processes and benefit native plant or animal communities or species as the result of direct management actions.

Special designations and acquisition projects include activities that protect habitat features or processes through designating lands as protected areas, management areas, or other formal designation. Projects that acquire private lands for public agency management (or in some cases, private conservancy management) for the purposes of protecting or restoring important habitat are also included.

Watershed management projects and forest stewardship projects include efforts on a broad, landscape scale to establish and implement watershed wide or landscape level goals, prioritize actions and protect important habitat. Often these efforts include habitat restoration, designations, monitoring, inventory and public involvement actions that are critical to the success of the management projects.

Monitoring, assessment and inventory projects include a wide variety of efforts to provide key information that enables improvements in management decisions, prioritization of actions, and identification of important habitat areas. Key research questions may also be addressed by projects in this category.

Education and public involvement is often included as part of the necessary set of actions undertaken in all projects. Because human decisions are responsible for both positive and negative changes in habitat conditions, education and public involvement may be the best way to protect or restore habitat. Projects that focus primarily on these activities are listed under this category.

Habitat Restoration and Rehabilitation

1. Munuscong Lake Dike Restoration, St. Marys River
2. Stirlingville Bridge Clean Up, Munuscong River
3. Wild Rice Seeding (Spectacle Lake and Back Bay, Bay Mills Res.)
4. Hearding Island Native Plant Community Restoration, Duluth, MN
5. Grassy Point Wetland Restoration, Duluth, MN
6. Sugarloaf Cove Wetland Restoration, MN
7. Conifer Restoration Project, Bad River, WI
8. Boreal Forest Restoration Demonstration Project, WI
9. Dam Removal Project on Iron River, Iron River, WI
10. Rehabilitation of degraded walleye spawning habitat -Thunder Bay, Ontario
11. Revival of spring-fed tributary stream - Nipigon, Ontario
12. Creation of embayments to restore productive littoral habitat - Thunder Bay, Ontario
13. Building a better breakwall - Red Rock, Ontario
14. Cypress River Rehabilitation
15. Northern Wood Marsh Rehabilitation Marsh reclamation - Thunder Bay, Ontario
16. Restoring productive habitat at a creek mouth - Thunder Bay, Ontario
17. Shoreline alteration to restore habitat diversity at a floodway - Thunder Bay, Ontario

18. Redesign of waterfront park to protect and enhance shoreline - Thunder Bay, Ontario
19. Improving salmonid access to spawning habitat - Thunder Bay, Ontario
20. Treatment of bacterial contamination at local beach - Thunder Bay, Ontario
21. Enhancing aquatic habitat to bring back walleye - Nipigon, Ontario
22. Restoration of Biological Diversity in Forests of Two Great Lakes National Parks
23. Incorporating habitat protection into development plans - Thunder Bay, Ontario

Special Designations and Acquisition

24. Keweenaw Threatened, Keweenaw Preserved
25. St. Louis River Stream Bank Protection Project, Oliver, WI
26. Park Point Scientific and Natural Area
27. St. Louis River Management Plan and Land Acquisition Project, MN

Watershed Management and Forest Stewardship

28. Miller Creek Restoration
29. Chocolay River Watershed
30. Central Lake Superior Watershed Partnership
31. Torch Lake Remedial Action Plan (RAP)
32. Whetstone Brook Watershed
33. Clay Lake Plain Ecosystem Project
34. Knife River Watershed Education Project, Two Harbors, MN
35. Northern Rivers Initiative, WI
36. Two-Hearted River Watershed Landscape Management Project
37. Shoreline Management Plan for Lake Superior Sault Ste. Marie District
38. Nemadji River Watershed Project
39. Midway River Watershed Project
40. Sucker/French/Talmadge/Lester Watershed Forest Stewardship Project
41. Skunk Creek Watershed
42. Grand Marais Watershed
43. Flute Reed River Watershed Forest Stewardship Project
44. Miller Creek Watershed Project
45. Development of a Water Management Plan " Nipigon, Ontario
46. Watershed Management Plans " Thunder Bay and Sault Ste. Marie, Ontario
47. Minnesota Point Protection Project
48. Lake Superior Decision Support Project
49. Goulai's River Watershed Project
50. Michigan Upper Peninsula Coastal Wetland Project

Monitoring, Assessment and Inventory

51. Fish Habitat Mapping Project for Whitefish Bay/Upper St. Marys River
52. Quantification and distribution of bottom substrates in Tahquamenon Bay, Lake Superior, and use of the substrates by several fish species
53. Mapping Lake Trout Spawning Habitat Along Minnesota's North Shore, MN

54. Duluth Area Natural Resources Inventory, Duluth, MN
55. Habitat Plan for the St. Louis River RAP AOC, Duluth, MN
56. Shoreline Habitat Survey of Batchawana Bay
57. Marsh Monitoring Program, Basin wide
58. Habitat survey of heavily fished rainbow trout stream " Thunder Bay, Ontario
59. Habitat requirements of coaster brook trout in Lake Superior " Nipigon, Ontario
60. Sea Lamprey control efforts in St. Marys River
61. Risk Analysis of the Aquatic Resources in Pictured Rocks National Lakeshore
62. Superior Coastal Wetland Initiative Phase I
63. Habitat requirements of lake sturgeon in the Kaministiquia River - Thunder Bay, Ontario

Education and Public Involvement

64. Keeping Nature in Your Community Workshop, Duluth, MN
65. Adopt-A-River Program, MN
66. Minnesota's Lake Superior Coastal Program (MLSCP)
67. Community Education about Nonpoint Pollution and Exotic Species
68. Community cleanup of waterfront property " Thunder Bay, Ontario
69. Deer Marsh Wetland Protection and Public ed. MI
70. HabCARES
71. Partners for Fish and Wildlife

1 Title: Munuscong Lake Dike Restoration, St. Mary's River

Strategy: 11

Objective: A 4-mile long dike system with three impoundments totaling 750 acres was constructed by the Michigan Department of Natural Resources Wildlife Division in 1965-66 to restore an emergent marsh in Munuscong Bay along the shore of Munuscong Lake. This effort was not measurably successful as it prevented exchange of water and nutrients between the bay and the lake, blocked access to diked areas by spawning fish, and provided predatory furbearers enhanced access to the coastal marsh. To correct this situation a new project was undertaken to modify the dike system to increase water exchange between the Munuscong Bay and Munuscong Lake.

Results: The dike system was contoured to lower and widen the tops and sides. Three 400-foot spillways and five 100-foot spillways were installed at an elevation to allow water exchange during high-water periods. Although water levels have been low since the project was completed, water and nutrient exchange has occurred during periodic seiche events. The increased supply of oxygenated water should accelerate detritus breakdown and further nutrient exchange. No empirical evaluation has been done but observers report increased usage of the restored area by fish and waterbirds. Future high water cycles are expected to naturally erode the remnant dikes and create islands that will provide safer nesting sites for waterbirds.

Contact: Rex Ainslie, Michigan Dept. of Natural Resources, Wildlife Division, Sault Ste. Marie, MI. (906-635-6161)

Partners: Michigan Department of Natural Resources, Tri-County Wildlife Unlimited

Funding: Michigan Department of Natural Resources - $4,000

Status: Completed

2 Title: Stirlingville Bridge Clean Up, Munuscong River

Strategy: 11

Objective: Remove bridge pilings in the river at three acute locations. The pilings had been in the river since 1909 and had collected a great deal of debris over the course of the years and almost completely blocked the river in several locations. The river had been undercutting the banks in those areas sending clay down the river and into the mouth of the Munuscong Bay. In the Bay the clay has collected to form an underwater island in an area that at one time had a water depth of 8 feet. The water depth as a result of the clay intrusion is now only 2 feet deep.

Results: The Munuscong River Watershed Association (MRWA) sponsored a volunteer clean up of the river and the Chippewa County Road Commission used heavy equipment to clean up three sites, removing the pilings and collected debris and sediment islands. The MRWA temporarily planted seed on raw banks at three sites. In the future, riprap, geothermal blanket and gravel will be placed at the site. This will help prevent further bank erosion during spring floods and the gravel will act as an inducement to fish for spawning.

Contact: Diane Serra, Chairperson, Munuscong River Watershed Association at (906) 647-6108 or kodie1@sault.com.

Partners: Pickford Public Schools, Chippewa County Road Commission, Pickford Feeds and Farmer Charlie Pennington.

Funding: Seeking funds to place geo-thermal blanket, rip rap and gravel to stabilize banks at the three bridge-piling sites.

Status: Ongoing until stabilization funds are secured to complete the project.

3 Title: Wild Rice Seeding

Strategy: 11

Objective: Wild rice seeding of local areas was initiated in 1993 on the Bay Mills Indian Reservation. Although there is very little historical documentation of wild rice on the Reservation, wild rice is a very important plant “culturally, as well as nutritionally” for the Ojibwe people. Community members are interested in establishing local rice beds for waterfowl use and eventually for tribal use.

Results: Two areas on the reservation have been seeded: Spectacle Lake in 1993-1998 and Back Bay since 1995. Seeding in Spectacle Lake has been discontinued because of the poor growth observed there. The wild rice beds in Back Bay appear to be improving and expanding.

Contact: Bay Mills web site bmic.net under the Biological Services heading. Ken or Ann Gebhardt, 12140 West Lakeshore Drive, Brimley, MI 49715. (906) 248-3241.

Funding: Bureau of Indian Affair's Circle of Flight Program

Status: ongoing until rice bed are established, possibly 4-8 years

4 Title: Hearding Island Native Plant Community Restoration, Duluth, MN

Strategy: 11

Objective: Hearding Island is a 32acre island created from the sandy material dredged from the shipping channels in the estuary during the early 1930's. The island was important for colonial waterbirds such as Common Terns and Piping Plovers after it was created. As vegetation encroached on the open, sandy nesting habitat preferred by the terns and plovers, they moved to other, more recently created islands or points. The objective of this project was to help establish or maintain White Pine/Red Pine forest with scattered tamarack in some lower and wetter areas, aspen-birch forest or dry alder shrub land, and beach dune plant communities.

Results: Volunteers helped plant 800 white pine trees, 700 red pine trees and 400 tamarack trees in the areas to become conifer dominated forest. In addition, volunteers helped control exotic plants by pulling tansy, an invasive weed of European origin, from the dune community and removing litter and debris form the island.

Partners: Park Point Community Club, St. Louis River Citizens Action Committee, Minnesota DNR, and community volunteers.

Contact: Pat Collins, MnDNR, 218-834-6612, patcollins@dnr.state.mn.us

Funding: $7,000 grant from U.S. Environmental Protection Agency's Great Lakes National Program Office. This was matched by a substantial volunteer effort in management planning and tree planting.

Status: Completed 1996

5 Title: Grassy Point Wetland Restoration, Duluth, MN

Strategy: 11

Objective: Grassy Point has long been identified as an important habitat area in the Duluth Superior Harbor. Bird monitoring reports and long-term fisheries monitoring stations in the harbor recorded its importance for a variety of species due to its complex mosaic of wetland

habitat types. Historically, the site served as a location for turn-of-the-century saw mills that left a legacy of waste wood throughout the wetland. In places this wood waste was more than 16 feet deep and hindered the movement of fish into a trout stream that feeds the wetland. In other places the wood was preventing the growth of aquatic vegetation.

Results: Approximately 11,000 cubic yards of waste wood was removed from the wetland to improve hydrology and conditions for wetland vegetation, fish and waterfowl. Access to the site was improved through upgrades to the roadway, providing a parking area and extending a bike trail from a nearby park.

Partners: U.S. EPA, Minnesota Department of Natural Resources, City of Duluth, St. Louis River Citizens Action Committee.

Contact: Pat Collins, MnDNR, 218-834-6612, patcollins@dnr.state.mn.us
http://www.dnr.state.mn.us/ebm/ebm_works/lakesup1.htm,
http://www.d.umn.edu/~pcollins/grassy.html

Funding: Grant from U.S. Environmental Protection Agency's Great Lakes National Program Office for $170,000. Matching funds form the City of Duluth and the Minnesota DNR.

Status of the project: Completed March 1996

6 Title: Sugarloaf Cove Wetland Restoration, MN

Strategy: 11

Objective: Sugarloaf Cove is a unique site on the Lake Superior shore. Part of the site was purchased in 1987 from The Nature Conservancy for a Scientific and Natural Area (SNA) in recognition of the outstanding bedrock shore geological features. Development and land modifications have resulted in a land cover that is very different from that of pre-settlement times.

Coastal wetlands along Minnesota's Lake Superior shore tend to be small and uncommon. Historical records indicate that a 2-3 acre coastal wetland existed at the Sugarloaf site before being filled in to provide better access to the beach and a larger log landing area. Native vegetation communities have been converted to communities dominated by non-native species, younger age classes or have been greatly simplified.

A recent land transaction has enlarged the size of the SNA and transferred other lands to the Sugarloaf Interpretive Center Association (SICA). This provides an opportunity to combine a unique habitat restoration project with an emerging educational and interpretation program.

Results: Restoration of a wetland filled in the 1930s and the associated upland plant community. Excavation of a 1+ acre wetland basin, removal of building debris, closure and filling of old

access road and regrading of upland areas completed in fall of 1999. Planting of native species is scheduled for May 2000.

Partners: Minnesota Department of Natural Resources, Sugarloaf Interpretive Center Association.

Contact: Pat Collins, MnDNR, 218-834-6612, patcollins@dnr.state.mn.us

Funding: $138,500 grant from U.S. Environmental Protection Agency's Great Lakes National Program Office, match from, Minnesota Department of Natural Resources, Minnesota Conservation Partners Grant Program, and Sugarloaf Interpretive Center Association.

Status: Ongoing. Scheduled for completion in September, 2000.

7 Title: Conifer Restoration in the Bad River Watershed

Strategy: 11

Objective: This two-year project engaged work study students, volunteers, and internship crews in conifer (white cedar, hemlock, and white pine) planting and enclosure-building. Five methods of conifer regeneration were tested at sites across the Chequamegon region. As a small pilot study, enclosures were built to assess deer browse damage to conifers.

Results: The results were the establishment of a tree planting program and assessment of success as part of Northland"s regular curricular activities. A program for Northland College undergraduates was begun to implement a multi-year conifer restoration project. Although ongoing, the project is expected to help restore the biological integrity and ecological functioning in headwater streams throughout the watershed. This will be a model for student and volunteer-based conservation efforts.

Partners: Bad River Tribe, Wisconsin Department of Natural Resources, The Nature Conservancy

Contact Information: Northland College, Ashland, WI 54806, 715-682-1550

Funding: $46,700 grant from EPA Great Lakes National Program Office; $11,400 Northland College

Status: Grant work is completed, however, studies are continuing and interpretable results will not be available for 3-4 years.

8 Title: Boreal Forest Restoration Demonstration Project

Strategy: 11

Objective: This project delineated a fifty square kilometers demonstration area and three separate sixteen square kilometers sub-demonstration areas, which are the largest blocks of boreal forest or second growth with boreal characteristics left on the reservation, as part of a long-term terrestrial monitoring program to be maintained by the Bad River Tribe of Lake Superior Chippewa. In addition to a long-term monitoring plan, the objectives of this project are to protect wolf den and rendezvous sites, to determine wolf movement patterns, to enhance coniferous vegetation in order to spread deer back out to a larger range in order to lessen the impacts on herbivory, and to maintain an educational/outreach program to communicate about the project.

Results: This project is in progress.

Partners: National Wildlife Federation

Contact Information: Bad River Band of Lake Superior Chippewa, Natural Resource Department, P.O. Box 67, Odanah, Wisconsin, 715-682-7123

Funding: $100,000 grant from EPA Great Lakes National Program Office; $28,353 Bad River Tribe

Status: In progress.

9 Title: Dam Removal on Iron River

Strategy: 11

Objective: This project concerns the regulation of the Orienta Falls Dam near the mouth of the Iron River, specifically the regulatory approval of a request by the dam owner to remove the dam. The present owner considers the costs to repair and upgrade the facility not justifiable in terms of economic benefit and they have been unable to find a new owner. The Wisconsin Department of Natural Resources has approved the permit and the dam is expected to be removed during the summer of 2000.

Results: Restore both natural scenic beauty to the site and a free flowing river system to allow migration of anadromous fish into the river system.

Contact: Ted R. Smith, Water Program Supervisor, Lake Superior Basin, 1401 Tower Avenue, Superior, Wisconsin 54880, (715) 395-6911

Funding: not applicable

Status: Ongoing, once the dam is removed, WI DNR will begin construction of a lamprey barrier to protect the Iron River watershed from undesirable exotic species and to protect Lake Superior from increased reproduction of parasitic sea lamprey.

10 Title: Rehabilitation of degraded walleye spawning habitat - Thunder Bay, Ontario

Strategy: 11

Objective: The mouth of the Current River has been identified as exceptionally valuable fish habitat in the Thunder Bay area as it provides both spawning and nursery grounds for one of the few remaining, naturally reproducing walleye stocks in Lake Superior. Over the past 130 years, spawning habitat has been lost or modified in the Current River by the effects of a silver stamp mill (1870s), saw mill (late 19th century), road and railway construction (late 19th to early 20th century), river impoundment for water management (~1905), and through the construction of a boat launch and docking facility (1984). This rehabilitation project was designed to compensate for habitat removed during dredging activities by augmenting remnant, and creating new walleye spawning areas.

Three sites were selected for enhancement in the Current River estuary covering an area (1,700 m^2) of approximately half the size of that destroyed by previous dredging activities. Two of these sites were downstream extensions of remnant spawning areas in faster flowing sections of the estuary. A third site was created closer to the river mouth where walleye spawning has been observed in the past. Each area was cleared of debris and clean substrate, in the form of gravel, cobble, and boulders, was added without disturbing existing spawning habitat.

With the completion of this project in December 1991, a monitoring program was established to estimate walleye abundance, levels of spawning activity, and the frequency of successful spawning events. Although there was no initial change in abundance of adult walleye, the area of habitat over which walleye successfully spawned increased. Viable eggs were found in both the historic and newly created lotic spawning habitat. Further assessments have been scheduled for the years 1999 to 2000 to evaluate the success of this rehabilitation project.

Partners: Environment Canada, Ontario Ministry of Natural Resources, Department of Fisheries and Oceans, Ontario Ministry of the Environment, Lake Superior Programs Office, and the Great Lakes 2000 Cleanup Fund.

Contact: Ken Cullis, Ontario Ministry of Natural Resources, Lake Superior Management Unit, (807) 475-1375, ken.cullis@mnr.gov.on.ca

Funding: $37,500 construction, $42,000 assessment

Status: Completed

11 Title: Revival of spring-fed tributary stream - Nipigon, Ontario

Strategy: 11

Objective: Clearwater Creek is a small, spring-fed stream that flows through the Town of Nipigon and drains into the Nipigon River on Lake Superior. Over the years, the growth of the Nipigon township led to encroachment on the stream valley and degradation of the creek. The downstream end of the creek was diverted and storm water runoff from the town was discharged into the water system. A deep ravine formed by the stream channel acted as a garbage collector and over the years had become an unofficial dump site. Further bank destabilization and erosion resulted in impaired water quality, loss of habitat diversity, and the decline of a once viable brook trout fishery.

The Clearwater Creek rehabilitation strategy outlined a number of recommendations to be implemented on a watershed basis. The plan included removing debris from the creek system, diversifying instream habitat, stabilizing banks, and controlling storm water. A settling pond to remove contaminants from the urban runoff carried by this creek to Nipigon Bay and the redirection of storm sewers with step/detention pools were also part of the design.

The St. Edward's School property, situated on the banks of Clearwater Creek, was a priority site for rehabilitation as the eroding stream valley posed a safety hazard and liability concern. The proximity of the creek to the school afforded opportunities to implement educational and recreational amenities within a project aimed initially at achieving environmental objectives. With construction complete, the school is no longer in danger of tumbling into the ravine and now has an environmental park and ready made science classroom in its backyard.

Partners: Great Lakes 2000 Cleanup Fund, Ontario Ministry of Natural Resources, Ontario Ministry of the Environment, Environmental Partners Program, Nipigon Bay Remedial Action Plan, Ontario Ministry of Education and Training, North of Superior District Roman Catholic Separate School Board, and St. Edward Separate School.

Contact: Ken Cullis, Ontario Ministry of Natural Resources, Lake Superior Management Unit, (807) 475-1375, ken.cullis@mnr.gov.on.ca

Funding: $270,000

Status: completed

12 Title: Creation of embayments to restore productive littoral habitat - Thunder Bay, Ontario

Strategy: 11

Objective: The McKellar River is the middle of three short channels comprising the Kaministiquia River delta which flows into the Thunder Bay harbour. Decades of dredging for commercial ship traffic produced a straight, deep channel and a shoreline partly armoured with

steel sheet piling and concrete. While the McKellar River is no longer used for commercial shipping, most of the shallow littoral zone has been eliminated leaving little in the way of habitat productivity or diversity.

Two shallow embayments were created near the mouth of the McKellar River adjacent to the Mission Marsh Conservation Area in order to increase the littoral zone and provide an additional three hectares of wetland habitat. Diverse habitats were provided with detailed bottom grading, gravel shoals, sand spits, root wads, and pocket wetlands. Additional habitat features include a mud flat for songbirds, a sand bluff for nesting bank swallows, and shallow woodland pools for amphibians. Constant circulation from wind, wave, and Lake Superior's seiche action maintains oxygen levels throughout the embayments. Trees and shrubs were also planted in areas disturbed by construction to provide soil and bank stabilization as well as food and cover for wildlife. Walking trails connect the embayments to conservation property, creating a popular recreational area on the waterfront.

Partners: City of Thunder Bay, Lakehead Region Conservation Authority, Environment Canada, Ontario Ministry of Natural Resources, Department of Fisheries and Oceans, Ontario Ministry of the Environment, Lake Superior Programs Office, and the Great Lakes 2000 Cleanup Fund.

Contact: Ken Cullis, Ontario Ministry of Natural Resources, Lake Superior Management Unit, (807) 475-1375, ken.cullis@mnr.gov.on.ca

Funding: $607,800 construction, $74,830 assessment

Status: completed

13 Title: Building a better breakwall - Red Rock, Ontario

Strategy: 11

Objective: As with many communities along the north shore of Lake Superior, the town of Red Rock is turning to its waterfront for new economic opportunities. Located on the scenic shore of Nipigon Bay about 100 km northeast of Thunder Bay, this small town has built a new kind of marina.

The standard armour stone breakwall at the Red Rock Marina was constructed with the dual purpose of providing protection for boats and increasing habitat for fish and wildlife. The berm is overlain with trees and shrubs and a walking trail winds its way along the crest. Instream structures along the inner breakwall have increased habitat diversity in the littoral zone. Shoreline works, such as log crib shelters, shallow areas for aquatic plants, boulder edgings, gravel shoals, and tree shelters, do not interfere with the operation of the marina, but enhance biological production. A gap in the breakwall, spanned by a pedestrian bridge, enhances water circulation and ensures the passage of fish. Two small islands surrounded by underwater shoals were constructed on the outside of the breakwall. The islands were planted with native trees and shrubs including white birch, white spruce, red-osier dogwood, and eastern white cedar.

Incorporating habitat features into the design of the marina demonstrates how a normally hard shoreline structure with low biological production capabilities can be transformed into a productive and connected part of the natural system.

Partners: Environment Canada, Ontario Ministry of Natural Resources, Ontario Ministry of the Environment, Great Lakes 2000 Cleanup Fund, and the Township of Red Rock.

Funding: $230,000 (cost of converting breakwall into a green parkway and enhancing the ecological productivity of the structure)

Status: completed

14 Title: Cypress River Rehabilitation

Strategy: 11

Objective: The Cypress River, which flows into Lake Superior approximately 40 km east of the township of Nipigon, provides significant spawning and nursery habitat for Lake Superior coaster brook trout and rainbow trout. In terms of fishing opportunities and quality of fishing, anglers consider this system to be one of the more important river systems along the North Shore of Lake Superior. In addition, the Lake Superior Technical Committee of the GLFC has identified this river as a key system to support implementation of the Lake Superior Brook Trout Rehabilitation Plan. Since the Cypress River supports one of the few remnant coaster brook trout stocks in Lake Superior, information collected on critical habitat and behavior patterns of this species could be critical to successful rehabilitation efforts in other Lake Superior tributaries in Ontario and the United States.

Anglers and agency representatives have been concerned with the recent erosion and river realignment that has occurred in the reach upstream of the Trans Canada Highway crossing. As a result of log jams over the last five years, the river has forged a new channel which intersects the highway approximately 40 meters from the bridge. The river currently flows parallel to the highway over this 40 meter distance. During high water events the new channel has eroded the Highway 17 embankment and has caused sediment deposition in downstream locations. The Ministry of Transportation has indicated that the highway embankment would have to be shored up with a considerable quantity of rock to prevent a major washout of the highway next spring.

Considering that the MTO proposal was a short term solution, the Thunder Bay Fly Fishing Club, in partnership with the North Shore Salmonid Work Group and MNR, developed an alternate concept to create a new 100 meter natural channel upstream from the highway. The completed channel not only improved fish habitat and reduced erosion, but relocated the river away from the highway and improved the angle at which the river flows under the Highway 17 bridge.

Phase 1, the construction of the channel, was completed in August 1999. Final bank stabilization and planting of vegetation is scheduled for July 2000.

This project directly supports the goals and objectives of the Draft Lake Superior Brook Trout Rehabilitation Plan, 1998(GLFC) and the Draft Lake Superior Rainbow Trout Management Plan, 1998 (MNR).

Partners: Thunder Bay Fly Fishing Club, North Shore Salmonid Work Group, Ministry of Transportation, Ontario Ministry of Natural Resources Nipigon District, OMNR Lake Superior Management Unit.

Contact: Ken Cullis, Ontario Ministry of Natural Resources, Lake Superior Management Unit, (807) 475-1375, ken.cullis@mnr.gov.on.ca

Funding: $30,000

Status: Ongoing

15 Title: Northern Wood Marsh reclamation - Thunder Bay, Ontario

Strategy: 11

Objective: Sediment contamination around a sawmill (Northern Sawmills, formerly Northern Wood Preservers) situated on the shoreline of Thunder Bay Harbour contributed to the International Joint Commission's identification of this location as an Area of Concern. As a result of long term seepage of wood preservatives, such as creosote and pentachlorophenol (PCP), pollutants have migrated into harbour sediments, sometimes appearing as "blankets" over the sediments or as surface slicks. Elevated concentrations of polycyclic aromatic hydrocarbons (PAHs), dioxins, and furans in the sediment have also affected water quality, degraded benthic community structure, and impaired sediment and aquatic habitat. A remediation project, referred to as the Northern Wood Preservers Alternative Remediation Concept (NOWPARC), was developed to isolate the contaminant source, remediate sediments, and enhance fish habitat in this portion of the harbour.

With this remediation plan, approximately 150,000 m^2 of lake area will be filled including a major portion of the contaminated site. To compensate for loss of lake area, wetland reclamation and sculpturing of a berm, designed to contain the contaminated sediments, will provide varied wetland habitat. Revitalizing 11,000 m^2 of land adjacent to an existing wetland (5 ha) located directly north of the sawmill will produce contours between 0-3 m in depth and provide valuable spawning, nursery, and forage habitat for a variety of fish species. In addition, a chain of small islands will be built offshore of the sawmill site creating an intercoastal wetland. The containment berm itself will incorporate a variety of embayments and other structures to provide habitat of varying depth and substrate.

Partners: Lake Superior Programs Office, Ontario Ministry of the Environment, Environment Canada, Abitibi Price Inc., Canadian National Railway Co., and Northern Wood Preservers Inc.

Contact: Ken Cullis, Ontario Ministry of Natural Resources, Lake Superior Management Unit, (807) 475-1375, ken.cullis@mnr.gov.on.ca

Funding: $210,000

Status: ongoing

16 Title: Restoring productive habitat at a creek mouth - Thunder Bay, Ontario

Strategy: 11

Objective: McVicar Creek winds through the north side of the City of Thunder Bay and empties into the harbour near a waterfront park and municipal marina. A road overpass was constructed in 1985 beside the lower 120 m of McVicar Creek as part of the park and marina complex. As a result, sand and debris eroded from the embankments, settled on the creek bottom, and accreted in the estuary. Interstices in the creek bed were filled and passage of anadromous fish to the upper reaches of this water system was impeded. A small wetland area adjacent to the creek mouth was also destroyed in the process.

Bank stabilization, substrate enhancement, and terracing of the lower portion of the road embankment were completed in 1992 to restore this urban fisheries habitat. In addition, a small crescent-shaped island was constructed in 1993 just offshore of the creek mouth. The shape of the island was designed to trap sediments transported by the creek and by lake currents in order to foster the natural development of a wetland. At the same time, the island protects the banks of the overpass from erosion. Eight rock shoals were also installed underwater in the lee of the island to provide cover, shelter, and diversity.

A “Name the Island” contest was held in local schools to raise public awareness of the project. Sanctuary Island was chosen as the winning name to reflect the role of this newly created habitat.

Monitoring efforts have indicated an increase in fish community abundance and diversity in this area. The shallow waters of the inner bay have been colonized by a variety of aquatic macrophytes and smallmouth bass have spawned in the lee of the island. Herring gulls and least sandpipers have nested on the island crest and, in the spring and fall, waterfowl are commonly seen in the sheltered inner bay as they move through on their annual migrations.

Partners: Environment Canada, Ontario Ministry of Natural Resources, Department of Fisheries and Oceans, Ontario Ministry of the Environment, Lake Superior Programs Office, and the Great Lakes 2000 Cleanup Fund.

Contact: Ken Cullis, Ontario Ministry of Natural Resources, Lake Superior Management Unit, (807) 475-1375, ken.cullis@mnr.gov.on.ca

Cost: $595,000 construction, $23,300 assessment

Status: completed

17 Title: Shoreline alteration to restore habitat diversity at a floodway - Thunder Bay, Ontario

Strategy: 11

Objective: Until 1993, the Neebing and McIntyre Rivers entered Lake Superior within one kilometre of each other. Because occasional flooding damaged adjacent residential areas, the narrow, meandering lower portions of the two rivers were filled and replaced with a single straight, wide (~35 m) channel devoid of instream structure. The littoral zone was restricted to a very narrow (<1.5 m) strip along either bank and shoreline and aquatic vegetation was sparse. Upstream portions of both rivers, however, were known for spring and fall rainbow trout spawning runs and resident brook trout populations. Walleye and yellow perch were also present in both river systems. Therefore, this project was designed to create refugia and restore a portion of the original instream habitat diversity in order to benefit both migratory and resident fish populations.

Four embayments (30 m X 2 m) and a collection of wood pilings, log mats, and boulder piles were added to a 1.25 km section of the floodway. The embayment structures were designed to reduce flow rates locally and to diversify littoral habitat in the floodway. Overhead vegetative cover provided shaded resting areas for fish and some degree of protection from predation by birds and mammals. Biological assessment indicated that fish abundance and diversity was greater in the embayment areas than in unaltered sections of the floodway. Habitat enhancement of the Neebing-McIntyre floodway demonstrates the potential for improving aquatic habitat while maintaining the function of flood control within an urban environment.

Partners: Environment Canada, Ontario Ministry of Natural Resources, Department of Fisheries and Oceans, Ontario Ministry of the Environment, Lake Superior Programs Office, and the Great Lakes 2000 Cleanup Fund.

Contact: Ken Cullis, Ontario Ministry of Natural Resources, Lake Superior Management Unit, (807) 475-1375, ken.cullis@mnr.gov.on.ca

Funding: $109,889 construction, $24,200 assessment

Status: Completed

18 Title: Redesign of waterfront park to protect and enhance shoreline - Thunder Bay, Ontario

Strategy: 11

Objective: The City of Thunder Bay has begun the task of revitalizing its waterfront property with the Kaministiquia River Heritage Park. Industrial development and shoreline degradation have left the area devoid of ecological, recreational, and aesthetic value. The Heritage Park was developed to restore the environmental integrity and natural history of the region.

The park was completed in three distinct phases. Phase one included a 25 m wide semi-circular overlook constructed of steel sheet piling and concrete. The soft shoreline was eliminated in this area leaving only a hard straight edge with little cover. In the second phase, a 60 m riverfront promenade was built on steel piles away the river bank thus maintaining the natural shoreline of the area. The boardwalk was extended another 500 m along the shoreline in the final phase of the project. The open pile construction of the boardwalk maximizes the development of aquatic habitat by providing instream cover and enhanced substrate diversity.

The City of Thunder Bay is continuing to work towards a more ecologically productive, aesthetically pleasing, and commercially vital waterfront for the future.

Partners: Great Lakes 2000 Cleanup Fund, Lake Superior Programs Office, Ontario Ministry of Natural Resources, Environment Canada, and the Ontario Ministry of the Environment.

Contact: Ken Cullis, Ontario Ministry of Natural Resources, Lake Superior Management Unit, (807) 475-1375, ken.cullis@mnr.gov.on.ca

Funding: Phase I: $1.3 million, Phase II: $550,000, Phase III: $1.5 million

Status: completed

19 Title: Improving salmonid access to spawning habitat - Thunder Bay, Ontario

Strategy: 11

Objective: The Current River, a Lake Superior tributary stream, has approximately 50 km of potential spawning and nursery habitat available to rainbow trout. Passage of rainbow trout up this river system, however, was blocked by a dam situated approximately 600 m upstream from the mouth of the river.

Access to productive spawning habitat in the Current River was restored in the fall of 1992 with the construction of a fish ladder and step pools at the Boulevard Lake dam. Additional resting pools were excavated below the fishway to expedite upstream passage. A fish transfer program was initiated in 1993 to accelerate the colonization of rainbow trout in the upper reaches of the Current River. It is anticipated that spawning adults, collected from adjacent streams and transplanted to the headwaters of the Current River, will produce a self-sustaining rainbow trout population over time.

Partners: Lakehead Region Conservation Authority, Lake Superior Programs Office, Environment Canada, Ontario Ministry of Natural Resources, Ontario Ministry of the Environment, and the North Shore Steelhead Association.

Contact: Ken Cullis, Ontario Ministry of Natural Resources, Lake Superior Management Unit, (807) 475-1375, ken.cullis@mnr.gov.on.ca

Funding: $407,000

Status: completed

20 Title: Treatment of bacterial contamination at local beach - Thunder Bay, Ontario

Strategy: 12

Objective: The public bathing area at Chippewa Park in Thunder Bay, Ontario, is closed periodically each summer in response to elevated levels of faecal coliform bacteria. Studies at the park have indicated that droppings from Canada geese and seagulls significantly contribute to the problem. Bird droppings, containing extremely high faecal coliform levels, are washed into the bathing area by precipitation events. Drainage from the wildlife exhibit at the Chippewa Zoo flows into a ditch running alongside the beach and enters the bay via the main ditch outfall. Although faecal coliform levels decline with increased distance from the zoo, levels are still high enough to suggest that the zoo ditch contributes to this problem. The situation is exacerbated by a lack of sufficient water circulation in the bay, which limits the ability of the system to flush bacteria from the swimming area.

To date, some improvements have been made to reduce bacterial levels in the Chippewa Beach area. Low-flow fixtures have been installed in the public washrooms, drainage has been improved along the highway and the playing fields, and a new septic system has been constructed to serve the beach and amusement park area.

Partners: Lake Superior Programs Office, Environment Canada, Ontario Ministry of Natural Resources, Ontario Ministry of the Environment, City of Thunder Bay, and the Thunder Bay District Health Unit.

Contact: Ken Cullis, Ontario Ministry of Natural Resources, Lake Superior Management Unit, (807) 475-1375, ken.cullis@mnr.gov.on.ca

Funding: $30,000 (Concept Development and Assessment)

Status: ongoing

21 Title: Enhancing aquatic habitat to bring back walleye " Nipigon, Ontario

Strategy: 11

Objective: Once considered a coarse fish, Nipigon Bay walleye, along with lake sturgeon and northern pike, were deliberately destroyed in the early 1900s ostensibly to protect a failing brook trout fishery. Today, walleye are one of the protected species native to Lake Superior. However, the population is struggling to recover from the effects of overexploitation, pollution, sea lamprey predation, and habitat loss.

In the 1950s, the adult walleye population was estimated to be 41,000 for Nipigon Bay alone. Commercial catches were averaging 8,813 kg annually, but by 1966 the population had

collapsed. After two decades of negligible catches (~ 11 kg/year), the commercial fishery for walleye was closed in 1985. Four years later, the walleye sport fishery was also closed. Habitat enhancement and stocking programs were used to restore self-sustaining walleye populations to the Nipigon Bay area. Over 12,000 adult walleye from three different sources were introduced to the system. Since 1993, sampling efforts have revealed evidence of successful reproduction with larval, juvenile, and adult walleye located in this area. Habitat enhancement efforts included the rehabilitation of a wetland adjacent to the mouth of the Nipigon River and the removal of wood debris at walleye spawning sites in the lower Nipigon River.

Partners: Great Lakes 2000 Cleanup Fund, Department of Fisheries and Oceans, Ontario Ministry of Natural Resources, and the Ontario Ministry of the Environment.

Contact: Ken Cullis, Ontario Ministry of Natural Resources, Lake Superior Management Unit, (807) 475-1375, ken.cullis@mnr.gov.on.ca

Funding: $300,000 for stocking program, $100,000 for wetland and spawning habitat enhancement

Status: completed

22 Title: Restoration of Biological Diversity in Forests of Two Great Lakes National Park

Strategy: 8

Objective: Assess current forest structure for comparison with estimated pre-settlement conditions and determining the potential for restoration of pre-settlement conditions.

Results: Part of the project is to assess the use of Canada yew by ground nesting birds and determine the productivity of these bird species.

Partners: Pictured Rocks National Lakeshore, Sleeping Bear National Lakeshore, USGS-BRD Munising Biological Station, Michigan Technological University, Shelter Bay Forests, MI Department of Natural Resources

Contact: Bruce Leutscher, National Park Service, Ph: (906) 387-2607, E-mail: Bruce_ Leutscher@nps.gov

Funding: $363,500 from Natural Resource Preservation Program through National Park Service

Status: start date May 2000

23 Title: Incorporating habitat protection into development plans – Thunder Bay, Ontario

Strategy:

Objective: The Ministry of Natural Resources and an local environmental action group (Thunder Bay 2002) have joined forces to address environmental issues surrounding the development of a new regional health care facility in the City of Thunder Bay. The proposed site borders on the shoreline of the McIntyre River, a tributary to Lake Superior. Both organizations share the view that development in the near shore area can co-exist with the natural environment.

The Thunder Bay Regional Hospital has the potential to set a new standard in ecologically sound development, as the proposed site possesses a wide range of existing natural attributes. The site development plan will provide for the protection of existing streams and wetlands as part of the McIntyre River watershed, protection and potential enhancement of existing aquatic and terrestrial habitat, and proper management of site run-off and snow removal. A landscaping plan that minimizes erosion and/or destruction of natural landscape features, while utilizing and highlighting native plant species will also be included. Suggestions to further minimize environmental impact by maximizing on-site energy and water conservation and waste reduction fixtures and facilities will be considered.

Partners: Ontario Ministry of Natural Resources, Environment Canada, City of Thunder Bay, and Thunder Bay 2002.

Contact: Ken Cullis, Ontario Ministry of Natural Resources, Lake Superior Management Unit. Phone: (807) 475-1375 email: ken.cullis@mnr.gov.on.ca

Funding:

Status: ongoing

Special Designations and Acquisition

24 Title: Keweenaw Threatened, Keweenaw Preserved

Strategy: 5

Objective: Raise awareness of the unique qualities of habitat found on the Keweenaw Peninsula and the importance of preserving these areas.

Results: The Friends of the Land of Keweenaw (FOLK) developed a web site focusing on these areas as a tool to raise public awareness about the threatened sites and aid protection efforts. The web site provides FOLK with a source of easily disseminated information for people who either need an introduction to the issue or want to know more. FOLK also added another location to the web site, Bete Grise, when development was proposed there. Bete Grise is an outstanding example of a Great Lakes Marsh with patterned beach ridge/wetland swale topography. A

subsequent “Lake Superior Shoreline Awareness” event (July 4, 1999) was sponsored by FOLK at Bete Grise and attended by hundreds of people.
Partners: FOLK, Great Lakes Aquatic Habitat Fund

Contact: Linda Rulison, President, FOLK (906) 334-2553, www.portup.com/~folk. The web site, "Keweenaw Threatened, Keweenaw Preserved" is accessible at www.portup.com/~folk/keweenaw

Funding: A grant ($1,800) from the Great Lakes Aquatic Habitat Protection Fund was given to create the web site. FOLK paid an additional $700 to expand the web site and to conduct water quality testing at Bete Grise. Substantial donations were received at a shoreline awareness event.

Status: Ongoing. The web site is complete, but needs periodic updating to stay current.

25 Title: St. Louis River Streambank Protection Area

Strategy: 5

Objective: The objective was to acquire up to 6,823 acres of land to protect the highly erosive red clay watershed of the Red River from further erosion, thereby protecting valuable wetlands bordering the St. Louis River.

Results: Approximately 6,200 acres have been purchased; this is about 91 percent of the 6,823 that were targeted for purchase. This transaction has been well received locally, partly because Wisconsin law specifies payments to local units of government, in lieu of property taxes.

Partners: Wisconsin DNR (WDNR), Douglas Co., City of Superior, St. Louis River Remedial Action Plan, St. Louis River Citizens Action Committee, plus the North American Wetland Conservation Act (NAWCA). The NAWCA grant [“Lake Superior Coastal Wetlands Initiative, Phase 1”] had, as partners: the U.S. Fish and Wildlife Service, WDNR, Ashland-Bayfield-Douglas-Iron Land Conservation Dept., Bad River and Red Cliff Bands of Lake Superior Chippewa, Great Lakes Indian Fisheries and Wildlife Commission, Trout Unlimited, Ducks Unlimited, Audubon Society [Ashland Chapter], and others

Contact: Dale Rochon, WDNR, (715) 399-3100, rochod@dnr.state.wi.us, www.dnr.state.wi.us

Funding: $887,145 ($737,145 from the Wisconsin Stewardship Fund and $150,000 from a NAWCA grant)

Status: Ongoing

26 Title: Park Point Scientific and Natural Area

Strategy:

Objective: To protect a high quality example of Great Lakes Pine forest in the City of Duluth.

Through a donation of land from Superior Water Light and Power, The Minnesota Department of Natural Resources is designating more than 17 acres of Great Lakes Pine forest as a Scientific and Natural Area. The pine forest is a mix of red and white pines established on a stabilized beach dune system. The forest is unusual in that it is comprised of trees of many age classes owing to the harsh conditions and numerous natural disturbances at the site. The site also includes sand beach and fore dune plant communities representative of the Lake Superior Ecosystem, but found only in this location in Minnesota.

Results: Seventeen acres of pine forest and dune habitat were donated by Superior Water Power and Light for designation as a State Scientific and Natural Area. Work is on-going to remove an existing cabin from the area and implement the designation.

Partners: Superior Water Power and Light, Park Point Community Club, Minnesota Land Trust, Minnesota Department of Natural Resources.

Contact: Pat Collins, MN DNR, 1568 Hwy 2, Two Harbors, MN 55616

Funding: A grant from the Legislative Commission on Minnesota Resources to the Park Point Community Club helped facilitate the donation. Other projects costs were borne by the partners.

Status: Donation complete. Designation has been approved by the DNR Commissioner's Advisory Committee and is in progress.

27 Title: St. Louis River Management Plan and Land Acquisition Project

Strategy:

Objective: To maintain, through management planning and land acquisition, the existing high quality habitat, recreational opportunities and character of the St. Louis river corridor and its two largest tributaries, the Cloquet, and Whiteface rivers .

The rivers flow through a landscape that is largely undeveloped and are bounded for much of their length by aspen and conifer forests. The wild nature of much of the river corridors and the many rapids provide ideal opportunities for canoeing and fishing. Residents and local government officials desired to maintain the character of the river corridors. A Joint Powers Board of local elected officials and a Citizens Advisory Committee worked to develop a St. Louis River Management Plan that implemented, through adoption in local zoning ordinances, management practices to protect the river system. County recreation plans were developed as part of this effort. An important recommendation to arise from the plan was for the State of

Minnesota to acquire riparian land for sale by Minnesota Power Inc. The purpose of the recommendation was to preserve the character of the river and its water quality and habitat.

Results: A St. Louis River Management Plan or "river plan" was developed and aspects of this plan were adopted by local units of government in the affected area. The Minnesota DNR acquired 22,600 acres of riparian land through purchase and donation from Minnesota Power. This includes approximately 150 miles of river frontage on the main stems of the three rivers. A DNR management plan was developed by an "Integrated Resource Management Team" to guide management of the acquired land in accordance with the "river plan". A cooperative project with the Fond du Lac Tribal and Community College established two "Environmental Study Areas" on the river system for research and education.

Partners: St. Louis River Board, local citizens, MN DNR, Legislative Commission on Minnesota Resources, Fond du Lac Tribal and Community College.

Contact, Pat Collins, MN DNR, 1568 Hwy 2, Two Harbors, MN 55616

Funding, The acquired land was worth about $5.5 million. Approximately 20 percent of this value was donated by Minnesota Power. Additional funding to the St. Louis River Board was provided through the MN DNR.

Status. Land Acquisition and management planning is complete. Implementation of plan recommendations including recreation planning and land management actions is on-going.

Watershed Management and Forest Stewardship

28 Title: Miller Creek Restoration

Strategy:

Objective: To sustain the wild brook trout population in the Creek; preserve and restore the ecological functions of the riparian areas through activities such as tree planting, improve the quality and temperature of water entering the stream; support the aesthetic value of the stream and riparian areas; influence planning for future land uses by advising local government on wetland protection and zoning issues.

Miller Creek runs through a highly developed urban area. Highways, an airport and retail development dominate much of the watershed. These sources of stress result in increased stream temperature, higher peak runoff, and increased inputs of salt and sediment (such as sand from winter road maintenance) that degrade habitat for trout and other creatures that live in the cold water system.

Results: Several project have been completed including tree planting, removal of an old bridge that once blocked the stream, public education and involvement of local businesses that own riparian land, clean up of leaking underground storage tanks, and the installation of trout habitat

structures. Additional work is on-going and includes the installation of a sediment trap to remove sand from the stream and in-stream habitat improvements.

Partners: Miller Creek Task Force made up of citizens, City of Duluth, City of Hermantown, local sportsman's groups, MN DNR and Minnesota Pollution Control Agency

Contact: Pat Collins, MN DNR, 1568 Hwy 2, Two Harbors, MN 55616.

Funding: Several grants have been recieved through the Clean Water Partnership (MPCA), The Legislative Commission on MN Resources, and others. Thousands of hours of volunteer time has gone into development of the project and implementing restoration actiions.

Status: Ongoing since 1994

29 Title: Chocolay River Watershed Project

Strategy: 25

Objective: Control non-point source pollution and restore degraded habitat important to the Chocolay Watershed (160 sq. miles) in the Lake Superior basin. Over 100 non-point source control projects have been completed including erosion control and storm water management addressing sources such as construction, stream crossings, logging sites and agriculture. The Project has also completed several high profile stream restorations have improved aquatic habitat and have documented dramatic increases in populations of trout and Lake Superior salmon. Restoration efforts have also included two highly publicized dam removals. The project includes an aggressive public education component to prevent future impacts to the watershed.

Results: In 1996, restoration efforts were accomplished on 1.5 miles of Big Creek, a Chocolay River tributary. This involved removal of fallen trees and blocking side channels to allow the original stream channel to reform. Some bank stabilization at stream crossings upstream was done to control sedimentation. As a result of these efforts, the percentage of the substrate that was spawning gravel in the 1.5 miles increased from 3 percent to 46 percent. Some species of trout and salmon nearly doubled in numbers. A dam at K. I. Sawyer Air Force Base was removed restoring flow to the headwaters of another Chocolay tributary, Silver Lead Creek.

Partners: Michigan Department of Environmental Quality, Michigan Department of Natural Resources, U.S. Fish and Wildlife, Trout Unlimited, local townships, Northern Michigan University, Marquette County Conservation District and others.

Contact: Carl Lindquist, 1030 Wright Street, Marquette, MI 49855, Ph: (906) 226-9460, Fax: (906) 228-4484, E-mail: lind@mail.portup.com

Funding: 319 funding, Great Lakes Commission, DNR Fisheries Grant, EPA Coastal Environmental Management Grant and local townships.

Status: ongoing. The Chocolay River Watershed Project was initiated in 1993. Work on this project continues but as part of the Central Lake Superior Watershed Partnership since 1998.

30 Title: Central Lake Superior Watershed Partnership

Strategy: 25

Objective: This unique initiative involves stakeholders from nine Lake Superior watersheds, and is designed to prioritize critical watershed needs and secure funding to complete projects. The Central Lake Superior Watershed Partnership has begun inventory assessments and prioritized non-point source projects. In addition, a comprehensive inventory of critical Lake Superior habitat has begun and will incorporate this information into watershed management plans as well as provide habitat protection information to local planning units and related organizations.

Results: The Central Lake Superior Watershed Partnership provides assistance to a variety of watersheds including: forested, agricultural, urban, and a Great Lakes Area of Concern (AOC) Deer Lake/ Carp River. A priority watershed in the partnership is the Salmon Trout River Watershed which contains the last naturally reproducing population of Coaster Brook Trout (*Salvelinus fontinalis*) on the south shore of Lake Superior.

Partners: Marquette Community Foundation, Northern Michigan University, Central Lake Superior Land Conservancy, local townships, Marquette County, Marquette Conservation District and others.

Contact: Carl Lindquist, Director, 1030 Wright Street, Marquette, MI 49855, Ph: (906) 226-9460, Fax: (906) 228-4484, E-mail: lind@mail.portup.com

Funding: Marquette Community Foundation, Marquette County, local townships, Michigan Department of Envriornmental Quality Coastal Management Grant

Status: ongoing. Formed in 1998, this regional collaborative continues to grow each year. A twenty member advisory council meets monthly. The Central Lake Superior Watershed Partnership is a 501 c 3 non-profit.

31 Title: Torch Lake Remedial Action Plan (RAP)

Strategy: 25

Objective: To achieve the RAP update addressing the 14 beneficial use impairment, support the funding and initiation of currently planned remediation projects, and define the issues and closure requirements of the Torch Lake Watershed in Houghton County, Michigan. The grantee coordinated the efforts of the USDA-Natural Resources Conservation Service in completing the engineering work for the remediation of exposed mine tailings (the sands) along the shore of Torch Lake and adjoining areas of Portage Lake and the Keweenaw Canal.

Results: The grantee completed the initial review and prepared a new draft for the RAP 14 beneficial use impairments. As part of their educational outreach program, a website has been created to provide relevant information about Torch Lake AOC. The grantee participated in the Adopt-a-Stream Program sponsored by the Michigan Technological University about a broad range of educational programs focused on water quality for both teachers of environmental related subjects as well as direct workshops and seminars for students for the benefits and improvement of the Lake Superior Watershed.

Contact: Gary Aho, USDA Natural Resources Conservation Service, (906) 482-1648, gaho@mi.nrcs.usda.gov

Partners: USDA-Natural Resources Conservation Service, Michigan Technological University

Funding: Funded through Coastal Environmental Management funds - $12,000

Status: Phase 1 was completed in 1999. Phases 2-5 will be completed during 2000-04.

32 Title: Whetstone Brook Watershed

Strategy: 25

Objective: Develop a strategy for dealing with sedimentation/water quality problems from construction and stormwater discharge that affect designated cold water fisheries. The Whetstone Brook Watershed Project is approximately 1,400 acres located in the City of Marquette and Marquette Township, Michigan.

In 1990, the Marquette Conservation District formed the Whetstone Brook Watershed Council to deal with these concerns.

Results: Over the last eight years, the council has addressed these concerns through restoration and preventative measures. These measures included installation of two stormwater detention basins, streambank stabilization at several sites, installation of rock chutes, tree planting along streambanks, and annual stream cleanups. Development of a Stormwater Utility & Master Plan has helped the Council utilize local funding mechanisms, build partnerships, and use technology and education as primary methods to implement positive improvements. Public perception of the stream is as a resource instead of a storm sewer.

Partners: City of Marquette, USDI Fish and Wildlife, Marquette Co. Conservation District, Concerned Citizens, WalMart, USDA Forest Service, Northern Michigan University.

Contact: Michael LaPointe, USDA, Natural Resources Conservation Service, (906) 226-9460

Funding: Grant through EPA 319 program that spanned from 1991 through 1996.

Status: Formed in 1991, the Whetstone Brook Watershed Project is continuing through the Central Lake Superior Watershed Partnership. The Whetstone Brook Watershed Council

continues to meet on a regular basis and field projects are prioritized and implemented as funding becomes available.

33 Title: Clay Lake Plain Ecosystem

Strategy: 25

Objective: The Michigan Department of Natural Resources Forest Management Division, in agreement with the Upper Peninsula Resources Conservation and Development Council, initiated a USDA forest stewardship project that incorporates non-industrial landowners into ecosystem management at the landscape level. The area selected for the project is the Clay Lake Plain (CLP) of the eastern Upper Peninsula. CLP Ecosystem Advisory Committee has been established to assist in planning and implementing the project. The committee is composed of nineteen members representing landowners, various interest groups and public interests. The advisory committee established the following mission statement for the project, " to promote a cooperative effort to maintain and/or enhance the biodiversity of sustainable ecosystems on private lands in the Eastern upper peninsula through information and education", and identified twelve objectives that should be addressed when planning or applying ecosystem management concepts to lands within the project area.

Results: The most notable result of the project has been the number of individual landowners that have enrolled in the Forest Stewardship Program (FSP) and the extensive number of cost share practices that have been installed on the lands. To date, there are 132 landowners and 23,943 acres enrolled under FSP. That represents 7 percent of the non-industrial private acres within the CLP. The project has been successful in reaching the larger acreage class, average acres of ownership is at 181 acres. Although this ownership class has shown that they are most likely to follow up on their stewardship plan and install practices, we have not attracted those smaller ownerships. The project has been successful in reaching the larger acreage class with properties between 20 and 1,620 acres. The average acreage ownership is at 181 acres. This ownership class has been found to be most likely to follow up on their stewardship plan and implement the conservation practices. We have not attracted smaller ownerships.

Partners: Upper Peninsula Resource Conservation & Development Council, Michigan Department of Natural Resources, USDA, Chippewa Soil Conservation District.

Contact: DeVillez, Michigan Dept. of Natural Resources, (906) 293-5131, deviller@state.mi.us; or Seldon Collins, USDA, Natural Resource Conservation Service, (906) 632-9611 ext 3, scollins@mi.nrcs.usda.gov

Funding: supported in part by a grant from the Michigan Department of Natural Resources, USDA Forest Service and the State Forest Stewardship Committee.

Status: Ongoing

34 Title: Knife River Watershed Forest Stewardship Project

Strategy: 25

Objective: To educate landowners and the public regarding ways to minimize and prevent soil erosion and sedimentation, and how to protect water quality and wildlife and fish habitat in the Knife River and Lake Superior Watersheds.

Results: This stewardship project produced ten "Edge of the Knife" newsletters to educate over 650 landowners and interested persons about good conservation practices to conserve soil and water resources (the Knife River Watershed encompasses 55,000 acres of private and public land). The project completed Forest Stewardship Plans for 79 landowners and encompassing 6,077 acres of land (70 percent of the private land base in the watershed); sponsored cost-share programs that include tree planting, riparian forest buffer establishment, flood control structures, and pasture management practices; distributed fact sheets to educate landowners and the public about the watershed; and produced and placed education signs in the watershed to educate the landowners and the public about the watershed and good conservation practices. In addition, three successful public meetings were held and one tour of the Knife River Watershed for landowners and interested persons was conducted. A compilation of a Geographic Information System database that encompasses information from several county and state agencies and departments was compiled. Currently, a bio-engineering demonstration project is being prepared to be conducted in Spring 2000 using volunteer labor, with the goal of educating landowners and others in methods they can use to prevent or decrease soil erosion on their property.

Partners: Laurentian Resource Conservation & Development (RC&D) Council, Inc., USDA Natural Resources Conservation Service (Natural Resources Conservation Service), Minnesota Department of Natural Resources (DNR), Lake County Soil and Water Conservation District (SWCD), St. Louis County SWCD, Lake Superior Steelhead Association (LSSA), Board of Water and Soil Resources (BWSR), U.S. Environmental Protection Agency (U.S. EPA), Potlatch Company, and Interested Landowners.

Contact: Laurentian RC&D Council, Inc., 4850 Miller Trunk Highway, Ste 3B, Duluth, MN 55811, phone - 218-720-5225 fax - 218-720-3129, kim.samuelson@mn.usda.gov, www.mn.nrcs.usda.gov/rcd/laurentian/

Funding: Great Lakes Basin Program for Soil Erosion and Sediment Control (Grant) 1999-2000 $10,230.00, Education Grant Program for EQIP in Minnesota: USDA Environmental Quality Incentives Program (Grant)1998-1999 $8,550.00, Great Lakes Basin Program for Soil Erosion and Sediment Control (Grant)1996-1998 $10,415.00, Lake Superior Steelhead Association (match for grant)1996 $6,500.00, Lake Superior Steelhead Association (donation for tree-cost share) 1999-2000 $1,500.

Status Ongoing since 1992. The Knife River Stewardship Committee (comprised of representatives from the listed partners) has been meeting at least six times a year and is very

active in working with, and educating, landowners to implement Best Management Practices in the watershed. The project will continue as long as funding is available.

35 Title: Northern Rivers Initiative

Strategy: 25

Objective: A prioritized list of stream corridors will be developed in the 20 northern-most Wisconsin counties that warrant additional protection against the pressures that threaten them, based on their high ecological significance, outstanding natural scenic beauty, and exceptional recreational opportunities. A wide range of options to provide additional protection to high-quality streams would be made available.

Results: Participants reviewed the existing alternatives for protecting rivers and stream shorelands. The range of options includes education, voluntary conservation through landowner stewardship, financial incentives, technical assistance to local decision makers, and public acquisition.

Partners: The current mailing list for the Northern Rivers Initiative includes approximately 240 interested groups and individuals, representing federal, state, tribal and local units of government, industry, landowners, educators and conservation organizations.

Contact: Wisconsin Department of Natural Resources, P.O. Box 220, Park Falls, WI 54552. Answers to FAQs about the Northern Rivers Initiative are currently posted on the Department's web site (www.dnr.state.wi.us)

Funding: In FY 2000, the Northern Rivers Initiative received $11,500 of General Program Revenue funding from the Department's Watershed Program. In addition, the Department's Lands Program in the Upper Chippewa River Basin provide cooperative support for implementation of stream protection, i.e. landowner contacts, educational presentations, etc. Production, duplication, and distribution of the videotape were jointly funded by the Ashland and Bayfield County Land and Water Conservation Department, the Minnesota Arrowhead Water Quality Group, the St. Croix Basin Partners Team, Wisconsin's Northern Initiatives, Parthe Productions, and a grant from the Wisconsin Environmental Education Board.

Status: A preliminary draft for the prioritized list of streams and an educational videotape on river protection should be completed in 2000. Participants will meet in 2000 to decide how to reorganize the subcommittees and carry out specific recommendations for stream protection.

36 Title: Two-Hearted River Watershed Landscape Management Project

Strategy: 25

Objective: The Two-Hearted River watershed is located in northern Luce County in the Upper Peninsula and is identified as an Important Habitat Area due to the extensive area of undisturbed wetland complexes. The river itself is also designated by the State of Michigan as a Natural

River. Using the example of similar successful land conservancy plans, this project has the goal of developing a strategy for identifying ecological units within a landscape, defining appropriate management activities within an ecological unit, and targeting of non-industrial private landowners withing the project area in order to: inform and educate landowners to the concept, the progress, and the success of landscape management. Additional goals include: increasing public awareness and support for landscape strategies and the right to voluntarily participate in any plans to manage those landscapes; providing landowner with information on voluntary technical and incentive-driven programs to accomplish landscape management; gathering and sharing broad-based inventories; researching data; and demonstrating and applying landscape management concepts with the landowner. The U.P. Resource Conservation and Development Council has been working to disseminate information on the project to the landowners in the Two-Hearted River watershed.

Partners: The Luce-West Mackinac Conservation District, the Michigan Department of Natural Resources, the Michigan Natural Resources Forest Stewardship Program, The Eastern Upper Peninsula Partners in Ecosystem management, and the Upper Peninsula Resource Conservation & Development Endowment Fund.

Funding: $12,500

37 Title: Shoreline Management Plan for Lake Superior

Strategy: 25

Objective: The shoreline management plan for the Lake superior waters of the Sault Ste. Marie District was completed in the late 1980s. The database for the plan involved extensive surveys of the gross physical shoreline structures, including video taping the entire shoreline by helicopter. Detailed maps of the shoreline are kept at the Sault St. Marie District Office. The plan involved public participation through open-houses for the collection of information, as well as developing planning options The shoreline from Sault Ste. Marie to Lake Superior Provincial Park was divided into reaches for specific management prescriptions.

The shoreline management plan for south-eastern Lake Superior was designed to: facilitate the orderly development and conservation of Ontario"s land and water resources for continuous social and economic benefits of Ontario, prevent loss of life, and minimize social disruption, property damage and loss of natural resource values from floods erosion and earth slippage; and, minimize the detrimental effects of development, and preserve and enhance the natural functions of sensitive shore ecosystems.

Results: Implementation of the plan resulted in an improved coastal environment and understanding of its associated elements, including; shore processes, such as sediment transport and erosion, the natural environment, including wetland areas and associated plants, fish and wildlife, fluctuations in water levels; and, the social, aesthetic, and related land and water uses of this area.

Contact:

Funding: $40,000

38 Title: Nemadji River Watershed Project

Strategy: 11

Objective: To form federal, state, and local partnerships to reduce erosion and sedimentation impacts to the Duluth Superior Harbor and Lake Superior.

Results: Forest harvest management planning process begun on a watershed scale. U.S. Army Corp. of Engineers sediment model under development, Forest Stewardship and Conservation plans and practices applied. Watershed Geographic Information System developed.

Status: Ongoing

Contact: Joanne Rosberg, University of MN Extension, P O Box 307, Carlton MN 55718- 0307 (218) 384-3511, jrosberg@extension.umn.edu

Funding: USDA EQIP, EPA 319, Minnesota Clean Water Partnership, Minnesota Department of Natural Resources Forest Stewardship Program, U.S. Army Corps of Engineers, Carlton County

Partners: Carlton County Soil and Water Conservation District, Carlton County Minnesota, Douglas County Wisconsin, Minnesota Department of Natural Resources, Minnesota Pollution Control Agency, Minnesota BOWSR, Saint Louis River Citizen Action Committee, Metropolitan Interstate Committee, U.S. Army Corps of Engineers, Natural Resources Conservation Service, U.S. Forest Service, U.S. Environmental Protection Agency

39 Title: Midway River Watershed Project

Strategy: 11

Objective: Reduce sediment and nutrient loading to the Midway River, Thompson Reservoir, and the St. Louis River.

Results: Developed an organization to direct efforts. Prepared application for funding received through Minnesota Pollution Control Agency 319 program.

Status: Beginning

Contact: R. C. Boheim, District Manager, South Saint Louis Soil and Water Conservation District, 4850 Miller Trunk Hwy, Suite 2-B, Duluth MN 55811, (218) 723-4867, rboheim@mn.usda.gov

Funding: Minnesota Pollution Control Agency 319 NPS Program

Partners: South St. Louis County Soil and Water Conservation District, Esko School District, Minnesota Department of Natural Resources, Minnesota Pollution Control Agency, Minnesota Board of Water and Soil Resources, Natural Resources Conservation Service, Minnesota Power, DM&IR Railroad, Isaak Walton League, Trout Unlimited

40 Title: Sucker/French/Talmadge/Lester Watershed Forest Stewardship Project

Stragegy: 25

Objective: Federal, state, and local partnership effort to use soil and water conservation practices that will reduce flooding and erosion to improve water quality and fish habitat.

Results: Developed an organization to direct efforts. Prepared application for funding received through Minnesota Department of Natural Resources Forest Stewardship Program.

Status: Beginning

Contact: R. C. Boheim, District Manager, South Saint Louis Soil and Water Conservation District, 4850 Miller Trunk Hwy, Suite 2-B, Duluth MN 55811, (218) 723-4867, rboheim@mn.usda.gov

Funding: Minnesota Department of Natural Resources Forest Stewardship Program

Partners: South Saint Louis County Soil and Water Conservation District, Minnesota Department of Natural Resources, Minnesota Board of Water and Soil Resources, Natural Resources Conservation Service

41 Title: Skunk Creek Watershed Project

Strategy: 25

Objective: Control flooding and erosion resulting from storm water runoff generated by increasing development in the watershed which encompasses part of the City of Two Harbors. Skunk Creek discharges into Lake Superior within one-quarter mile of the municipal water supply intake.

Results: A local citizens group has organized and led the effort to date resulting in the completion of a land use inventory, stream clean-up efforts completed and a community trail system developed along the creek. A storm water management plan is currently being developed by the City of Two Harbors.

Partners: Lake County, City of Two Harbors, Lake County SWCD, Lake County Water Plan, Skunk Creek Citizens Group

Contact: Wayne Seidel, Conservation Specialist, Lake SWCD, P.O. Box #14, 601 Third Avenue, Two Harbors, MN 55616, (218) 834-8370, Wseidel@extension.umn.edu

Funding: City of Two Harbors and Lake County

Status: This is an active ongoing project.

42 Title: Grand Marais Watershed

Strategy: 25

Objective: Federal, State and local partnership effort to reduce flooding and erosion to protect property and improve water quality in Lake Superior.

Results: Developed an organization to coordinate efforts, prepared and submitted an application for a Great Lakes Commission Erosion and Sediment Control grant.

Partners: Cook Soil and Water Conservation District, Cook County, City of Grand Marais, Minnesota Board of Water and Soil Resources, Natural Resources Conservation Service

Contact: Rebecca Wiinanen, Cook County Soil and Water Conservation District, Box 1150, Grand Marais, MN 55604, (218) 387-3000 x147, rebecca.wiinanen@co.cook.mn.us

Funding: None at this time - application to Great Lake Commission pending

Status: Beginning

43 Title: Flute Reed River Watershed Forest Stewardship Project

Strategy: 25

Objective: Federal, State and Local partnership effort to use soil and water conservation practices that will reduce flooding and erosion to improve water quality and fish habitat.

Results: over 2,000 acres of Forest Stewardship plans have been completed on private land.

Partners: Cook County Soil and Water Conservation District, Cook County, Minnesota Department of Natural Resources, Minnesota Board of Water and Soil Resources, Natural Resources Conservation Service, Laurentian Resource Conservation & Development, Lake Superior Steelhead Association

Contact: Rebecca Wiinanen, Cook County Soil and Water Conservation District, Box 1150, Grand Marais MN 55604, (218) 387-3000 x147, rebecca.wiinanen@co.cook.mn.us

Funding: Minnesota Department of Natural Resources Forest Stewardship Program, Lake Superior Steelhead Association

Status: Ongoing

44 Title: Miller Creek Watershed Project

Strategy: 25

Objective: Restore and protect an urbanized trout stream sustaining a wild population of brook trout.

Results: Forest riparian buffer establishment through tree planting, annual volunteer stream clean up, watershed diagnostic study completed, water quality model completed. Watershed Geographic Information System developed.

Partners: City of Duluth, City of Hermantown, Isaak Walton League, Trout Unlimited, Together Reach Out and Upgrade Trout, South St. Louis Soil and Water Conservation District, Minnesota Pollution Control Agency, Minnesota Board of Water and Soil Resources, Natural Resources Research Institute, Lake Superior College, Hermantown High School, U.S. Air Force National Guard, Natural Resources Conservation Service, Saint Louis River Citizens Action Committee

Contact: R. C. Boheim, District Manager, South Saint Louis Soil and Water Conservation District, 4850 Miller Trunk Hwy, Suite 2-B, Duluth MN 55811, (218) 723-4867, rboheim@mn.usda.gov

Funding: Minnesota Pollution Control Agency Clean Water Partnership, EPA 319 NPS Program, Watershed Guardian program,
MN LCMR

Status: Ongoing

45 Title: Development of a Water Management Plan " Nipigon, Ontario

Objective: The Nipigon River flows southward from Lake Nipigon, through Lake Helen, and discharges into the northwestern portion of Nipigon Bay on Lake Superior. The river is the largest Lake Superior tributary, with a mean annual flow of 365.3 m^3/s.

Hydroelectric development downstream of Lake Nipigon consists of the Pine Portage, Cameron Falls, and Alexander Generating Stations, producing 275 megawatts of power under maximum flow conditions. Alteration of flows, particularly dramatic daily fluctuations, led to widespread problems in the system. Owners of shoreline lands on Lake Nipigon and the Nipigon River suffered property damage and boaters in the system complained of adverse conditions. The lake and river fishery was also affected by unnatural water level fluctuations. Brook trout redds were found high and dry in the winter and the groundwater supply, crucial to embryo survival, was being affected. In the interim, the Ministry of Natural Resources developed an agreement with Ontario Hydro to maintain a minimum flow in the Nipigon River, when possible, of 270 m^3/s or greater from October to May and 170 m^3/s or greater for the remainder of the year. A longer term solution, however, was needed.

The Nipigon River Management Committee was formed in 1990 in response to increasing recreational, industrial, and commercial demands being placed on the Nipigon River watershed and to deal with conflicts among water resource users. Their overall goal was to establish, through public involvement, a management option that would reduce the impacts Ontario Hydro"s hydroelectric dams have on the Lake Nipigon/ Nipigon River watershed, particularly the Nipigon River fishery. An optimization computer model, which employed historical water level and flow data, was used to develop a range of management options. The preferred option considers the target level or flow desired by each stakeholder, given appropriate weighting factors, and determines the Lake Nipigon water level and Nipigon River flow that best suits everyone collectively throughout the year. Controlling water level fluctuations should significantly improve conditions for brook trout in the lower river while making a marginal difference in the value of hydroelectric power generated.

Partners: Great Lakes 2000 Cleanup Fund, Environment Canada, Department of Fisheries and Oceans, Ontario Hydro, Ontario Ministry of Natural Resources, Nipigon Bay Remedial Action Plan, and the Ontario Ministry of the Environment.

Contact:

Funding: $400,000

Status: completed

46 Title: Watershed Management Plans -Thunder Bay and Sault Ste. Marie, Ontario

Strategy: 25

Objective: Watershed management that addresses urban, rural, and industrial development is a proactive approach to the application of pollution prevention concepts in Lake Superior. Habitat degradation caused by water management practices along rivers and streams is a significant problem in each of the Great Lakes Areas of Concern (AOC). Pilot watershed management plans have been developed in two Remedial Action Plan areas: the Slate River in Thunder Bay and the Bennett-Davignon River system in Sault Ste. Marie, Ontario. These watersheds best reflect stresses common to Northern Ontario AOCs.

The Slate River Watershed Management Plan addresses physical degradation and aesthetic impairment associated with agricultural practices in this area. Nutrient enrichment and erosion have resulted in the physical degradation of benthic habitat downstream in the Kaministiquia River. The plan recommends improved water management practices in order to reduce the impact of organic enrichment, turbidity, and sedimentation on the stability of benthic habitat and levels of productivity in this portion of the AOC.

The Bennett-Davignon River system has its headwaters to the north of Sault Ste. Marie atop a largely undisturbed area of Precambrian Shield. Both streams flow over the edge of the Shield and into the municipality of Sault Ste. Marie where they flow through the main groundwater recharge and aggregate extraction zone for the city. They continue southward through rural

residential and agricultural lands before entering an urban residential area. From here, the stream courses have been altered and combined such that they flow through active industrial land (Algoma Steel Inc.) and discharge into the St. Marys River at the Algoma Steel boat slip.

The Bennett-Davignon Watershed Management Plan identifies the range of disturbances present within this system and recommends possible mechanisms for the protection of remaining environmental values. The plan outlines specific remedial options to rehabilitate aquatic and terrestrial habitat, reduce erosion, improve aesthetic and recreational opportunities, enhance water quality within the streams and subsequently, the St. Marys River, and to protect streamside property values.

Partners: Great Lakes 2000 Cleanup Fund, Lake Superior Programs Office, Environment Canada, Ontario Ministry of Natural Resources, Ontario Ministry of the Environment, and the Department of Fisheries and Oceans.

Contact:

Funding: $120,000 for each plan

Status: completed

47 Title: Minnesota Point Protection Project

Strategy: 25

Objective: Protect a unique ecosystem, including a 45 acre stand of old growth white and red pine forest, a bird sanctuary, beach dunes and other habitats from partial destruction by the Duluth Airport Authority, as authorized by the City of Duluth (Ordinance 9215). This objective will be met by establishing permanent conservation easements, development of a binding management plan that will provide a level of protection sufficient to ensure the continued ecological integrity of the area and to prohibit further cutting of the old growth forest area. Furthermore, the management plan and communications products will document the value of this unique habitat in a scientific manner for decision-makers at municipal and state levels of government and informing the general public regarding this state treasure. (Statement from the Work Program)

Results: Planted 6,000 culms of American Beach grass, 3,000 trees and shrubs, and fenced off 2 square blocks of severely eroded dunes. Placed 24.6 acres of unique habitat into protected status. Developed an Environmental Management Plan for Minnesota Point. Established a web site for dissemination of information including the Management Plan.

Partners: The Park Point Community Club, Minnesota Department of Natural Resources, City of Duluth, Minnesota Land Trust, Duluth Airport Authority, and the U.S. Army Corps of Engineers.

Contact: Project Manager; Kinnan Stauber 4139 Lake Ave S., Duluth MN 55802, 218/722-6255, kkstauber@aol.com. Website: www.parkpoint.org

Funding: Biennial Project Budget $75,000

Status of the project:
Completed June 31, 1999

48 Title: Lake Superior Decision Support Project

Strategy: 3

Objective: The Project is an effort to develop Geographic Information System (GIS) based decision support applications focused on the Lake Superior Basin. These applications are designed for use by a wide audience, including local governments, regional planning agencies, resource management groups, educational and interpretive organizations, advocacy groups, and individual citizens. The primary goal of the project is to provide users with practical tools they can apply to local land and resource decisions in a context of basin-wide objectives for long-term sustainability and stewardship. The second goal is to provide tools to interpretive and educational institutions to foster public awareness and support of Geographic Information System-based land use decision support. Together, the Geographic Information System applications and databases will provide for analysis, assessment and policy development at local and regional scales simultaneous consideration of ecological, economic, resource and other phenomena prediction of future conditions, based on computer models and extrapolation of current trends. This last capability will be key in focusing efforts on critical locales and situations where the decision support mechanisms developed in this project can be most effectively applied.

Results: Data and maps have been developed and are available from the Internet at:
HTTP://oden.nrri.umn.edu/lsgis/

Partners: Lake Superior Binational Program, Lake Superior Ecosystem Cooperative, Minnesota Department of Natural Resources, Natural Resources Research Institute, and Michael Koutnik

Contact: Pat Collins, MnDNR, 218-834-6612, patcollins@dnr.state.mn.us

Funding: Project funding has been provided by U.S. Environmental Protection Agency‟s Coastal Environmental Management fund, Minnesota Department of Natural Resources and The University of Minnesota‟s Natural Resources Research Institute.

Status: Ongoing. Phase 1 is scheduled for completion in October, 2000.

49 Title: Goulais River Watershed Project

Strategy: 25

Objective: Launched in 1999, this is a two year project focused on converging different views on what makes the area and its resources valuable and how the areas beauty can be protected and used to develop greater prosperity for the local area. Activities will include developing a

watershed map, campsite and trail clean-up, promotional materials community meetings to encourage watershed stewardship and tours of important habitats and resources of the watershed.

Results:

Contact: Goulais River Watershed Project, 736A Queen St. E., Sault Ste. Marie, ON, P6A 2A9

Partners:

Funding:

Status: Ongoing

Monitoring, Assessment and Inventory

50 Title: Michigan Upper Peninsula Coastal Wetland Project

Strategy: 14

Objective: This is a multi-phase landscape scale project to protect, restore, and manage coastal wetlands and associated uplands in the Lake Superior and St.Mary=s River watersheds in Michigan. The partnership anticipates three additional phases. This Phase I proposal includes 9 focus areas throughout the project area. The peninsula has not seen the same great wetland losses as lower Michigan, with the exception of the Rudyard Clay Plain. For this reason, this project focuses on preventing destruction of coastal wetland areas and associated uplands with habitat restoration/enhancement as a secondary objective. The best way to ensure perpetual protection is through fee title or easement acquisition of these properties by government agencies and conservation organizations. Activities conducted during the performance period will preserve 1,237 acres of wetlands and 1,573 acres of associated uplands. Seven thousand eight hundred forty-seven feet of Lake Superior shoreline will be protected from development, 3,347 feet of which is identified as Aessential breeding habitat@ in the draft Piping Plover Recovery Plan.

Results: To date 135 acres have been purchased on the Whitefish peninsula.

Contact: David Brakhage,Waterfowl Biologist, Ducks Unlimited, 331 Metty Drive, Ann Arbor, MI, 48103, 734-623-2000, fax 734-623-2035,dbrakhage@ducks.org

Partners: Ducks Unlimited, Michigan Department of Natural Resources, Keweenaw Bay Indian Community, Bay Mills Indian Community, Great Lakes Indian Fish & Wildlife Commission, The Nature Conservancy, Whitefish Point Bird Observatory, Village of L=Anse, U.S. Forest Service - Ottawa National Forest, Natural Resources Conservation Service, U.S. Fish and Wildlife Service, private landowners, Upper Peninsula Resource, Conservation & Development

Funding: $2.7 million in partner funds and $1 million in funds from a North American Wetland Conservation Act grant

Status: Performance period ends in September 2002.

51 Title: Fish Habitat Mapping Project in Whitefish Bay - Eastern Upper Peninsula

Strategy: 2

Objective: Whitefish Bay supports an important fishery in the eastern part of Lake Superior. In addition to whitefish, indigenous species like the emerald shiner, the spottail shiner, the white sucker, and the yellow perch spawn in the different habitats encompassing Whitefish Bay. Little has been known regarding the distribution of lifestages of the fish in Whitefish Bay in relation to the different habitats of the lake bed. Understanding the spatial distribution of habitat types and their use by different life stages of whitefish and other indigenous fish species is a requisite for protecting the habitat.

In 1998-1999, the Ashland Biological Station of the United States Geological Service-Biological Resources Division (USGS-BRD) in partnership with the Chippewa-Ottawa Treaty Fishery Management Authority (COTFMA), used sonar technology to map the substrate of the bay and then combined biological information to form a Geographic Information System data base. The electronic mapping of bottom substrates involved integrating the echo from the depth sounder with a sea bed classification sensor and a differential Global Positioning System (GPS) along a transect that was run perpendicular to shore. A RoxAnn sea bed sensor was used to interpret the signals from the echo sounder as smooth or rough and hard or soft. Ponar dredge samples and a video camera were then used to ground truth the values recorded by the RoxAnn. Biological data on fish species, age and reproductive information was collected using seines and trawls during the same time period as the geographical mapping was taking place.

Results: The final product will be an accessible tool for resource managers and environmental decision makers in the Great Lakes in order to protect or enhance the fisheries resources.

Partners: Ashland Biological Station of the USGS-BRD, Chippewa-Ottawa Treaty Fishery Management Authority and the U.S. Environmental Protection Agency, Region V Water Division.

Funding: $82,800

Status: Completed

52 Title: Quantification and Distribution of Bottom Substrates and Fish Utilization in Tahquamenon Bay, Lake Superior

Strategy: 2

Objective: The objective is to gather information that can be used to both identify critical habitats for Lake Superior fishes, and to protect the critical habitat from development or destruction. This is achieved by 1), describing the spatial distribution and quantity of various

bottom substrates from the interface of the shoreline with the water to depths of 10m; 2) describing the spatial distribution and abundance of different life stages of several fish species in relation to the various bottom substrates; and 3) identifying bottom substrates that are critical for reproduction and survival of several fish species.

Results: Mapping of the bottom substrates and sampling fish populations in lower Whitefish Bay from the mouth of the Tahquamenon River to Cedar Point has been done. Most of the bottom substrates are either hard sand or cobble and rubble. Little bedrock exists in the entire area. Spatial distributions and abundance of larval lake whitefish have been defined in relation to the bottom substrates. Larval whitefish are found almost solely in shallow, flat, open, sandy areas in lower Whitefish Bay. Larval whitefish are found most commonly in southern Whitefish Bay and the upper St. Mary"s River in the shallow sandy areas. The most common species caught in beach seines were spottail shiners, lake whitefish, and sand shiners. The common species caught in bottom trawls were johnny darters and scuplins in the open, sandy bottomed, deeper areas of Whitefish Bay in waters less than 60 ft. In the rocky deeper areas sculpins and crayfish were the most commonly captured species.

Partners: U.S. EPA, Chippewa/Ottawa Treaty Fishery Management Authority, USGS Biological Resources Division, USFWS Sea Lamprey Control Center

Contacts: Mike Ripley or Mark Ebener, Inter-Tribal Fisheries & Assessment Program, 179 W. Three Mile Road, Sault Ste.Marie, MI 49783, Ph: (906) 632-0072 or 0073, Fax: (906) 632-1141, E-mail: Mark Ebener - mebener@northernway.net or Mike Ripley - mripley@northernway.net

Funding: $38,000 - $46,000 annually from U.S. EPA

Status: Completed sampling of bottom substrates in lower Whitefish Bay. Completed sampling fish populations in lower Whitefish Bay. Have not finished creating maps. Will begin mapping substrates and sampling fish populations in northern Lake Huron in 2000.

53 Title: Mapping Lake Trout Spawning Habitat Along the North Shore of Lake Superior

Strategy: 2

Objective: To map substrate used by lake trout for spawning activity along the Minnesota shoreline. To produce a Geographical Information System (GIS) based atlas with location and substrate type depicted from 3-30 m in depth parallel to the shoreline.

Results: The atlas and report have been produced and used by decision makers when determining potential consequences of their decisions. Also it has been used to prioritize funding for a variety of projects (erosion control, septic assistance, shoreline development, etc.). Available as Natural Resources Research Institute Technical Report No. Natural Resources Research Institute/TR-99-01

Partners: Minnesota Department of Natural Resources, Natural Resources Research Institute - University of MN, USGS-Ashland Field Station

Contacts: Don Schreiner, MNDNR Lake Superior Fisheries, 5351 North Shore Drive, Duluth, MN 55804 (218) 723-4785 email - don.schreiner@dnr.state.mn.us; Carl Richards, Natural Resources Research Institute, 5013 Miller Trunk Hwy., Duluth, MN 55811; See Natural Resources Research Institute web-site.

Funding: $250,000 from LTV Steel through the Minnesota Pollution Control Agency

Status: Completed February 1999

54 Title: Duluth Area Natural Resources Inventory

Strategy: 1

Objective: The City and surrounding area has an abundance of undeveloped space consisting of a variety of natural environments ranging from steep hillsides with bedrock outcroppings to a myriad of stream courses, tree stands some of which are old growth or near old growth as well as wetlands. Such areas support a whole host of wildlife in these habitats not common in similar sized cities elsewhere in the country.

In recent years, a number of development projects have become very contentious over the impact on natural conditions. There is no reason to believe this situation will change in the foreseeable future. Such struggles occur in the absence of reliable commonly accepted environmental data that can be used as the clear basis for decision-making and are most often settled strictly on a political basis or referendum.

The development of a Comprehensive Plan for the city will depend heavily on the base data provided by such an inventory. The objective is to define sensitive areas to be retained in their natural state for protection from future development or significant alteration. It will also identify areas where it may be possible to develop with certain precautions without harming the more fragile environmental portions and areas where significant protection beyond the normal attention is not necessary. A rating system for each natural resource is one of the goals to be used as a tool.

Results: The first phase of the project, compilation of existing data and an analysis of the adequacy of the information and its capability of being converted to a Geographical Information System, has recently gotten underway. To date the effort to develop the natural resources inventory, initiated by the City Environmental Advisory Council, has not encountered any opposition. To the contrary, a great deal of moral support has been received to the effect that "this only makes sense when trying to determine impacts of development on Greenfield sites".

Partners: Local Audubon Society Chapter, the City Tree Commission, the Minnesota Department of Natural Resources, Minnesota Pollution Control Agency, the University of Minnesota's Natural Resources Research Institute and the Sustainable Development Partnership, the Park Point Community Club, City of Duluth Stormwater Utility, the City Planning Office, the Public Works Department, the Western Lake Superior Sanitary District, The Nature

Conservancy, the Natural Resources Conservation Service, several members of the EAC and citizens from various walks of life with environmental interests. Additional representation from other elements of the community will soon be invited to join those already involved such as the Chamber of Commerce, development groups and the Building Trades.

Contact: William C. Majewski, Business Developer, City Planning Division, 409 City Hall, Duluth, MN 55802, (218) 723-3328 FAX 218-723-3400, E-mail - bmajewski@ci.duluth.mn.us

Funding: Total cost = $200,000. $7,300 from the Minnesota Department of Natural Resources Conservation Partnership Program. $2,000 from the City of Duluth.

Status: Ongoing

55 Title: Habitat Plan for the Lower St. Louis River

Strategy: 8

Objective: Develop a comprehensive AOC wide plan for habitat protection and restoration that includes both general zones of shared ecological management objectives and specific habitat projects.

Results: Geographic Information System maps have been developed and contractors have met with local land managers.

Partners: St. Louis River Citizens Action Committee, U.S. Environmental Protection Agency (U.S. EPA), Minnesota Department of Natural Resources (MN DNR), Wisconsin Department of Natural Resources, The Nature Conservancy, U.S. Fish and Wildlife Service, City of Duluth, U.S. Coast Guard, and others.

Contact: Karen Plass, St. Louis River Citizens Action Committee, 218-733-9520, slrcac@stlouisriver.org, www.stlouisriver.org

Funding level: $59,711 ($49,711 from EPA, plus $10,000 from MN DNR). In addition, $7,000 has been requested from The Nature Conservancy.

Status of the project: Projected completion date of May 2001

56 Title: Shoreline Habitat Survey

Strategy: 2

Objective: Habitat modification in the near-shore (<1 m water depth) zone of Batchawana Bay, Lake Superior, has occurred through the removal of emergent aquatic vegetation for the purpose of creating "clean" beach areas, and secondly, through the removal of cobble and rubble to create groynes for boat protection and possible beach creation. The purpose of this study was to quantify the impact that removals of aquatic vegetation and cobble have on fish in Batchawana Bay. Inferences from this study could be used to facilitate shoreline management planning as well as assist in the prosecution of those guilty of destroying fish habitat. A survey was conducted in the summers of 1994 and 1995 to compare species composition and abundance between disturbed and undisturbed habitat. In the 1994 survey, two types of habitat were examined: vegetated sites and cobble sites, with two disturbance categories (disturbed, undisturbed).

The 1995 survey on vegetated sites (55 electrofishing pairs, 45 fyke net pairs) indicated significantly lower fish abundance on the disturbed sites: The losses were distributed over most species, including fish of recreational value such as yellow perch and smallmouth bass. Many of the disturbed cobble sites appeared to have been subjected to a superficial rearrangement of material. A future experiment should be conducted on sites of extreme disturbance in which the substrate has been scraped down to sand or gravel.

The results of the survey were embraced by the Batchawana Bay Working Group, and a pamphlet on the importance of shoreline habitat was distributed throughout the community with the assistance of the working group partner.

Contact:

Funding: $7000

Partners: Batchawana Bay Working Group, Ontario Ministry of Natural Resources
Status: completed

57 Title: Marsh Monitoring Program

Strategy: 1

Objective: Through the efforts of hundreds of volunteers throughout the Great Lakes region, the Marsh Monitoring Program (MMP) provides information on the population trends and habitat associations of marsh-dependant amphibians and birds. This information makes an important contribution to the conservation and management of Great Lakes basin wetlands and their wildlife.

Results: By communicating the results of standardized, volunteer-based, and geographically extensive surveys, the Marsh Monitoring Program makes a unique contribution to the stewardship, management, and understanding of Great Lakes wetland amphibians, birds and habitats. The contributions and achievements of the MMP include; assessment of amphibian and marsh bird abundance and diversity in Great Lakes basin wetlands, status of prominent marsh-dependent communities, especially in Great Lakes Areas of Concern, scientifically rigorous surveys and analysis methods for volunteer-based marsh species monitoring and habitat assessment, important habitats and potential management directions are being identified for species of conservation concern, a long-term, geographically extensive set of data, essential to measuring wetland and species' responses to management approaches and natural events (e.g. water level control, climate change), and building the capacity and concern of the region's citizens for conservation science.

Information gained through MMP surveys is conveyed to the region's citizens through public presentations, interviews and articles in newspapers, newsletters and magazines. Results are also provided to governments, wetland managers, and the wetland restoration and scientific communities through reports, presentations and papers in the scientific literature.

Partners: The MMP is delivered by Bird Studies Canada (formerly Long Point Bird Observatory) in partnership with Environment Canada and with support from the U.S. Environmental Protection Agency, Great Lakes Protection Fund.

Contact: Russ Weeber (Aquatic Surveys Coordinator), Bird Studies Canada, P.O. Box 160, Port Rowan, Ontario, Canada N0E 1M0, (519)586-3531 fax (519)586-3532, rweeber@bsc-eoc.org, website: www.bsc-eoc.org or Kathy Jones Aquatics Survey Officer, Bird Studies Canada/Etudes d'Oiseaux Canada, P.O. Box 160, Port Rowan, ON; N0E 1M0, (519)586-3531 or 1-888-448-BIRD fax (519)586-3532, aqsurvey@bsc-eoc.org, website: www.bsc-eoc.org

Funding: The MMP has been funded since its beginning from a variety of sources. These sources are Great Lakes Protection Fund, Environment Canada, and the United States Environmental Protection Agency and Environment Canada.

Status: Ongoing.

58 Title: Habitat survey of heavily fished rainbow trout stream - Thunder Bay, Ontario

Stragegy: 4

Objective: The McIntyre River originates northwest of the City of Thunder Bay and flows 47.5 km to Lake Superior. Its lower third runs through the city before emptying into the Thunder Bay harbour. The river contains native brook trout in the upper reaches and is considered an excellent rainbow trout stream. In fact, it is one of the most heavily fished rainbow trout streams in the Canadian waters of Lake Superior largely because of its urban setting.

Since the completion of original aquatic habitat surveys in the mid-1970s, considerable urbanization and rural development has occurred in the McIntyre River corridor. Over the years,

damage from physical disturbance of the aquatic and riparian environment and the infiltration of contaminants into the river system have affected this body of water. While some of this damage has occurred naturally, man-made disturbance has been more destructive. Several housing subdivisions have been completed or are in progress, with subsequent problems of storm water runoff, excessive sedimentation, and clearing of the river bank. The extent of habitat alteration associated with development and its affect on this important urban fishery, however, are not yet known. For this reason, existing habitat conditions and land use practices were recorded along the main channel of the McIntyre River to determine the biological health of the river and the surrounding land. The survey provides baseline information against which the results of remediation or the effects of further development in the nearshore area can be measured. Ultimately, the goal is to protect the productive capacity of existing fish habitat by regulating water and land use activities that affect the quality and quantity of the resource.

Partners: Ontario Ministry of Natural Resources, Fish and Wildlife Enhancement and Protection Fund.

Contact:

Funding: $20,000

Status: ongoing

59 Title: Habitat requirements of coaster brook trout in Lake Superior - Nipigon, Ontario

Strategy: 4

Objective: Lake dwelling brook trout (Salvelinus fontinalis) were historically widespread and common in the near shore waters of Lake Superior. These “coasters”, described as those brook trout that spend part of their life cycle in the Great Lakes, once provided a highly valued and productive fishery along the Lake Superior shoreline and in tributary streams. However, the population has declined over the years as a result of exploitation by angling, vulnerability to commercial fishing, and habitat loss and degradation.

A Brook Trout Rehabilitation Plan for Lake Superior was developed to maintain widely distributed, self-sustaining brook trout populations in areas that historically held viable populations. One of the objectives of the plan is to protect and restore riverine and lake habitat that supports coaster brook trout populations. To do this, a survey to quantify habitat use by brook trout and identify locations with suitable coaster habitat was needed.

A radio telemetry system will be used to document habitat use by coaster brook trout in Nipigon Bay and surrounding tributaries. In the spring of 1999, forty radio transmitters were implanted into the body cavity of adult brook trout captured in the Nipigon Bay area. The seasonal movement and location of radio tagged fish in the bay and in tributary streams will be recorded. Additional surveys to characterize lake and stream habitat will also be conducted.

Partners: Ontario Ministry of Natural Resources (Lake Superior Management Unit and Nipigon District), Centre for Northern Forest Ecosystem Research, U.S. Fish and Wildlife Service, Fish and Wildlife Enhancement and Protection Fund, and the Great Lakes Renewal Fund.

Contact:

Funding: $60,000

Status: ongoing

60 Title: Sea Lamprey control efforts in St. Marys River

Strategy:

Objective: Attempts to suppress Lake Superior's population of nonindigenous sea lamprey began with the creation of the Great Lakes Fishery Commission in 1955 which was formed, specifically, to control sea lamprey in the Great Lakes. Since then, the Commission has suppressed sea lamprey populations in most areas by 90 percent, paving the way for successful stocking, rehabilitation of native fisheries, and the resurgence of sport and commercial fishing. Despite this success, the St. Marys River remained a major trouble spot in the Great Lakes, producing more sea lampreys than all of the other Great Lakes combined. Sea Lampreys currently kill more fish in Lake Huron and northern Lake Michigan than commercial and sport fishing combined.

In order to determine the density of sea lamprey larvae in the substrates of the St. Marys River, an extensive habitat mapping project was completed and over 12,000 sites were sampled across the river during 1993 - 1996. The mapping was preparation for an ambitious plan, with the goal of reducing the river's sea lamprey production by 92 percent, by application of a granular, bottom -release formulation of the lampricide Bayluscide in the areas of highest larval concentration. This portion of the plan took place in 1998 and 1999. In addition, other efforts, including trapping and sterile-male-release were stepped up.

Estimates of the effectiveness of lampricide treatments in the river indicate that 45 percent of sea lamprey larvae have been eliminated. Lamprey traps located within the river, and on tributaries to the river, have removed 56 percent of the estimated 20,000 spawning sea lampreys while the sterile-male-release program has achieved a rate of 4.7 sterile males for every fertile male. Together, the integrated trapping and sterile-male-release efforts are estimated to have reduced the sea lamprey reproductive potential of the St. Marys by 92 percent.

Partners: Fisheries and Oceans Canada, the U.S. Fish and Wildlife Service, U.S. Geological Survey, the Chippewa-Ottawa Treaty Fisheries Management Authority, Michigan Department of Natural Resources and the Ontario Ministry of Environment.

Cost: Millions

Status: Ongoing

61 Title: Risk Analysis of the Aquatic Resources in Pictured Rocks National Lakeshore: An Ecologically Based Inventory and Estimation of the effects of Land Use Practices

Strategy:

Objective: Assess the impact that land use practices in and around the park affect park resources, keying in on aquatic systems.

Results: The project will help determine if there are any major problems arising from harmful land use practices and will also identify sensitive areas that should be protected to preserve the integrity of natural systems within the park.

Partners: USGS-BRD, Pictured Rocks National Lakeshore

Contact: Terence Boyle, USGS-BRD, Ph: (970) 491-1452, E-mail: tpboyle@cnr.colostate.edu

Funding: not applicable

Status: completed 1998

62 Title: Superior Coastal Wetland Initiative Phase I

Strategy: 14

Objective: This proposal is phase one of four projected phases of this landscape scale coastal wetland preservation and restoration initiative. The project emphasizes land stewardship combined with protection and restoration of 8,180 acres of wetlands and 6,359 acres of uplands in the Lake Superior watershed in Wisconsin. The two most critical threats to coastal wetlands in Lake Superior are development and non-point source pollution, particularly sedimentation. This initiative has brought together all of the major natural resource entities in the basin to begin breaking down old barriers in working relationships to combine technical, biological, and cultural expertise to create the most efficient working group to address the resource needs of the basin. Unlike many places in the United States, many of the coastal wetland acres remain intact, and if preserved through easement or fee title acquisition, the basins themselves will remain protected from development. A far greater threat remains in the form of non-point source pollution. It is essential to reduce the sediment load into tributary streams and thus the emphasis on upland activities in this proposal. No component can be singled out, all of the players and elements must work together to preserve the greatest concentration of coastal wetlands, dunes and bottomland forest in the Upper Great Lakes and the migratory birds and other wildlife these habitats support.

Results: 1,049 acres have been purchased and placed into protective status. Over 4,000 acres of uplands are under management agreement ensuring stewardship of agricultural lands in the Lake Superior watershed. Twenty-nine acres of wetlands have been restored.

Contact: Pam Dryer, Wildlife Biologist, U.S. Fish and Wildlife Service, 2800 Lakeshore Dr. E., Ashland, WI, 54806, 715-682-6185 ext 215, pam_dryer@fws.gov.

Partners: U.S. Fish & Wildlife Service, Bad River Band of Lake Superior Chippewa, Red Cliff Band of Lake Superior Chippewa, Wisconsin Department of Natural Resources, The Nature Conservancy, Ducks Unlimited, Trout Unlimited, Douglas, Bayfield, Ashland, Iron Counties, private landowners, Great Lakes Indian Fish & Wildlife Commission, and Chequamegon Chapter of the Audubon Society

Funding: $3.2 million from partners and $878,000 from a North American Wetland Conservation Act grant

Status: Performance period for this phase will end September 2001. The partnership is developing a Phase II grant application.

63 Title: Habitat requirements of lake sturgeon in the Kaministiquia River – Thunder Bay, Ontario

Objective: Lake sturgeon (*Acipenser fulvescens*) are distributed throughout the Lake Superior basin with concentrations found near spawning tributaries in the United States and Canada. Lake Superior stocks were decimated during the development of the commercial fishery in the early part of the 19th century. Initially, low commercial value of lake sturgeon, coupled with the tendency of these fish to destroy fishing nets, prompted most fishermen to regard lake sturgeon as a nuisance that should be removed and eliminated. However, by 1860, lake sturgeon had begun to command high prices and fishermen targeted the species, hastening their decline. The construction of dams blocking access to traditional spawning grounds, log drives in large rivers and streams causing scouring of the bottom or littering of substrates with bark, shoreline development, dredging of river channels for shipping, and the effects of pollution have also impacted lake sturgeon populations.

The goal for lake sturgeon rehabilitation in Lake Superior is to maintain, enhance, and rehabilitate self-sustaining populations where the species historically occurred basin wide. Working towards this goal, the Lake Superior Management Unit is conducting a survey to quantify spawning, nursery, rearing, and foraging habitat and migration routes of lake sturgeon in the Kaministiquia River, a tributary to Lake Superior. The survey will also be used to document seasonal distribution and movement patterns of adult and juvenile sturgeon in order to identify critical habitat sites within the Kaministiquia River system.

Partners: Ontario Ministry of Natural Resources, Environment Canada, and the Ontario Federation of Anglers and Hunters.

Contact: Ken Cullis, Ontario Ministry of Natural Resources, Lake Superior Management Unit. Phone: (807) 475-1375 email: ken.cullis@mnr.gov.on.ca

Funding: $30,000

Status: ongoing

Education and Public Involvement

64 Title: "Keeping Nature in Your Community: Using Ecosystem-based Processes to Restore Our Communities" workshops

Strategy: 34

Objective: "Keeping Nature in Your Community" is a two-day training program designed to provide tools for the creation of healthy, vibrant and sustainable communities. This program has been developed over the last six years and has been presented in various formats to public and private agencies and individuals in over 30 states throughout the country and abroad. Workshop objectives include; creating a framework for decision making that builds upon a public visioning and participation process, Create an awareness of the economic and social values associated with healthy ecosystems, demonstrate the importance of community participation in establishing a vision to guide future growth and development, improve decision-making using environmental information to meld growth with natural patterns, increase effective partnerships combining state and local financial and technical resources with grass roots activism to resolve local problems ? locally, and provide incentives for participants to initiate a comprehensive strategy for natural resources stewardship in their jurisdiction and with adjoining jurisdictions as needed.

Results: In 1998 and 1999 a series of seven "Keeping Nature in Your Community" workshops were held in Minnesota provided hands-on training to 171 participants. The workbook at the core of the curriculum (which previously focused on community forestry) was updated to be more inclusive of all community natural resource concerns. New materials were also added to the workshop and workbook on urban sprawl as well as land protection practices during development processes.

The workshop actively demonstrated an innovative planning framework, built upon a natural systems foundation. In two full days of training the workshop provides: brief presentations on ecosystem process vocabulary, concepts, and practical tools, local & national case studies - stories of how ecosystem approaches have been used successfully in a range of project types and scales, hands-on exercises demonstrating techniques for involving the community, ideas on local planning & natural resource issues, displays, handout materials, & useful resource list on land use planning, natural resources, etc., and a copy for each participant of the workshop manual - "Using Ecosystem-Based Processes to Restore Our Communities" - a step-by-step guide for applying techniques in local projects

Partners: Minnesota Department of Natural Resources, Tree Trust, Minnesota Legislature, 4 Red River Resource Conservation and Development Councils, various local cooperators (including the City of Duluth)

Contact: Peggy Sand, Minnesota Department of Natural Resources, 1200 Warner Road, St. Paul, MN 55106, (651)772-7562, peggy.sand@dnr.state.mn.us

Funding: $50,000 general fund appropriation from the Minnesota Legislature, $9,000 from Department of Natural Resources, Metro Region, Community Technical Assistance funds, $1,000 from 4 Red River Resource Conservation and Development Councils, $9,600 in registration fees from recipients ($130 per person for full registration, $30 per person for community volunteers receiving scholarships), significant in kind contributions (staff time and materials) from Minnesota Department of Natural Resources, Metro Region, Division of Forestry.

Status: Completed

The 1998-99 workshops were completed. Additional workshops in the northwestern part of Minnesota are being planned. Additional workshops can be given upon request pending local sponsorship and funding availability.

65 Title: Adopt-a-River Program, MN

Strategy: 33

Objective: Increase public awareness of watershed issues, stressing that "the river begins on your street" and "it matters what the water is like" as it flows off your property. Sponsors cleanup events annually for purposes of advancing public awareness through service. It is also involved in environmental education either in the classroom, river boat or water festivals, and at the state fair. Communication also takes place in a newsletter.

Results: 250 groups registered on 900 miles of shoreline, with 2/3 of the donated hours on a 2,000-mile network of canoe and boating routes. 50 percent of rubbish removed is from these same routes. In 1998, 5,000 volunteers worked 13,000 hours to remove 270,000 pounds of rubbish.

Partners: Government partners include Sentencing-to-Service (Department of Corrections), Minnesota Department of Natural Resources, Minnesota Conservation Corps/Americorps, Minnesota Pollution Control Agency, Minnesota National Guard, Soil and Water Conservation Districts, county solid waste/environmental and water plan offices, and the Minnesota River Basin Joint Powers Board. In addition, various corporate sponsors provide supplies, funding and/or services in kind.

Contact: Paul E. Nordell, Coordinator, Minnesota Department of Natural Resources, 500 Lafayette Road, Saint Paul, Minnesota 55155-4052, 651-297-5476, e-mail: paul.nordell@dnr.state.mn.us; Website: http://www.dnr.state.us/trails_and_waterways/adopt_river.html

Funding: Operating budget of $10,000, with staff of 1.8 persons, including an Americorps member. In addition, corporate partnerships exist for supplies and certain in-kind services

Status: Ongoing.

66 Title: Minnesota's Lake Superior Coastal Program (MLSCP)

Strategy: 32

Objective/need: To balance competing economic development pressures and natural resource conservation and protection needs of the Minnesota's Lake Superior shoreline, St. Louis River estuary and Duluth Harbor. The MLSCP is a federally approved Coastal Zone Management Program through the Coastal Zone Management Act. In Minnesota, this program will be operated primarily as a pass-through grant program to local municipalities, state agencies, organizations, universities, etc. The program is just beginning implementation and is waiting for the Coastal Council to be approved by Governor Ventura before the program can begin its first grant cycle.

Results: None to date.

Partners Eligible partners include state agencies, local units of government within the coastal boundary, school districts, universities, soil and water conservation districts, non profit organizations, and regional planning agencies.

Contact: Tricia Ryan, Program Coordinator, MLSCP, Minnesota Department of Natural Resources Waters Division,1568 Highway 2, Two Harbors, MN 55616, 218-834-6625 phone 218-834-6639 fax, tricia.ryan@dnr.state.mn.us

Funding: $450,000-480,000 federal funds to be matched 50/50 with non-federal funds.

Status: ongoing

67 Title: Community Education about Nonpoint Pollution and Exotic Species

Strategy: 32

Objective: Working together to restore, protect and enhance the St. Louis River. Raise awareness and educate people about nonpoint pollution, and purple loosestrife and its control. This project will focus on the St. Louis River Area of Concern implementing high priority recommendations from the St. Louis River Remedial Action Plan.

Results: None to date. Most of this work will take place in the year 2000.

Partners: St. Louis River Citizens Action Committee Minnesota Sea Grant, the Natural Resources Conservation Service, Soil and Water Conservation Districts, Miller Creek Joint Powers Board, city government, golf course managers, plant nurseries, area schools and others.

Contact: Karen Plass, St. Louis River Citizens Action Committee, 218-733-9520, slrcac@stlouisriver.org, www.stlouisriver.org or www.epa.gov/glnpo/aoc/stlouis.html

Funding: $13,001 ($12,288 from U.S. EPA, matched with $712 from the St. Louis River Citizens Action).

Status of the project: Estimated completion date, May 2000.

68 Title: Community cleanup of waterfront property - Thunder Bay, Ontario

Strategy: 33

Objective: "Wake Up to Your Waterfront" is a community based cleanup of Thunder Bay harbour and its tributaries. Since the development of this project in 1993, the commitment and dedication of numerous volunteers has demonstrated that there is a high level of public interest in preserving the waterfront environment. In 1997, the cleanup was incorporated into the City"s "Spring-up to Clean-up" campaign.

The success of this annual event has served as a demonstration model for similar community based cleanups. As a result, municipal shoreline cleanups were expanded to include the entire Lake Superior shoreline. To co-ordinate cleanup activities the "Great Lake Superior Cleanup" project was developed in 1995 under the Lake Superior Binational Program. These events are designed to enhance public awareness of the significance of Lake Superior and the long-term impact of careless waste disposal and littering.

Partners: City of Thunder Bay, Lake Superior Programs Office, Ontario Ministry of Natural Resources, Environment Canada, Ontario Ministry of the Environment, Lake Superior Binational Program, and the Great Lakes 2000 Cleanup Fund.

Contact: Ken Cullis, Ontario Ministry of Natural Resources, Lake Superior Management Unit, (807) 475-1375, ken.cullis@mnr.gov.on.ca

Funding: $20,000/year

Status: ongoing

69 Title: Deer Marsh Wetland Protection and Public Education

Stragegy: 33

Objective: Trail work to accomplish several goals: reduce grade to make trail more accessible, clear brush and fallen trees from trail, provide wildlife viewing opportunities and enhance wildlife habitat, educate the public on importance of wetland preservation and wetland associated communities. Relocate road away from wetlands to eliminate sediment runoff.

Results: Increased public understanding of wetland communities and importance

Partners: USFS Ottawa NF, MI DNR, National Heritage Program, Ottawa Interpretive Association, Trale UP, Sierra Club

Contact: Dave Pickford or Joann Thurber, USFS Ottawa NF, Ph: (906) 852-3500, E-mail: dpickford/r9_ottawa@fs.fed.us

Funding: Multi-funded partnership involving volunteers, non-profit/appropriated dollars and in-kind labor and materials

Status: completed

70 Title: HabCARES

Stragegy: 14

The International Workshop on the Science and Management for Habitat Conservation and Restoration Strategies (HabCARES) brought a diverse group of participants together in 1994 to investigate the effect of human intervention on terrestrial and aquatic habitat. Through implementation of the Lake Superior Remedial Action Plans and Lake Superior Binational Program, it became apparent that an international symposium focused on current resource management issues, was timely. As a result, symposium participants were challenged to assess and synthesize the understanding of the linkages between habitat, production, and structure of aquatic and wetland communities, identify successful habitat restorations and enhancements, identify and fill important gaps in scientific knowledge and provide recommendations to resource managers to effectively conserve, restore, and enhance aquatic habitat.

Results: Products of HabCARES included the publications of workshop proceedings in the Canadian Journal of Fisheries and Aquatic Sciences (Vol 53, Sup.1, 1996) and publication of the methods manual "Methods of Modifying Habitat to Benefit the Great Lakes Ecosystem" in Canadian Institute for Scientific and Technical Information, Occasional Paper No. 1, 1995. In addition, a number of technical transfer sessions were successfully organized following the workshop.

Partners: Canada Department of Fisheries and Oceans, Environment Canada's Great Lakes 2000 Cleanup Fund, Habitat Advisory Board of the Great Lakes Fisheries Commission, Ontario Ministry of Natural Resources, U. S. Environmental Protection Agency, and U. S. Fish and Wildlife Service.

Status: Complete

71 Title: Partners for Fish and Wildlife

Strategy: 11

Objective: This program can increase fish and wildlife populations on private lands through habitat restoration and management projects that will blend wildlife conservation with profitable land use. Most of the habitat work entails the restoration of shallow, depressional wetlands by plugging ditches or breaking subsurface drainage tile. Other habitat projects consist of planting upland areas next to wetlands to native vegetation to encourage wildlife nesting and to provide ground cover, as well as streambank stabilization and in-stream habitat improvement.

Results: To date 4,715 acres of wetlands have been restored in the Lake Superior basin through this program.

Contact: Pam Dryer, Wildlife Biologist, U.S. Fish and Wildlife Service, 2800 Lakeshore Dr. E., Ashland, WI, 54806, 715-682-6185 ext 215, pam_dryer@fws.gov.

Partners: Landowners, local conservation groups

Funding: Variable

Status: Ongoing

Other Projects

Information about important projects is still being collected. Some contact people have submitted information that has yet to be summarized. In other cases, contacts with lead agency personell need to be made. Projects for which information has not yet been summarized includes the following:

Habitat Restoration and Rehabilitation

72. Little Rapids Restoration
73. Munuscong River Restoration Project
74. St. Louis River Wild Rice Restoration, Fond du Lac, MN
75. Waishkey Bay Wild Rice Restoration
76. Lake Superior College Riparian Forest Restoration, Duluth, MN
77. Scales Creek Project, Houghton, MI
78. Torch Lake Project, MI
79. Big Creek Stream Restoration, MI
80. Lincoln Park Improvement, Duluth, MN
81. Purple Loosestrife Project, MN
82. Mined Land Reclamation, Duluth, MN
83. Brule River Habitat and Stream Improvement, Brule, WI
84. Chequamegon Bay Aquatic Vegetation Restoration, WI

85. Whittlesey Creek Stabilization and Rehabilitation Demonstration, Bayfield, WI
86. Lake Superior Basin Brook Trout Brood Stock Facility, WI
87. Marathon Marina Development - Habitat Enhancement/Sediment Remediation
88. Stream Habitat improvement Completed. Sue Reinke.
89. Wilson Flowage Dam Restoration
90. Sandy Beach (Wawa, ON) Sand Dune Restoration Project
91. St. Marys River Spoils Islands Armoring
92. Tahquameonon River Restoration
93. Sucker River Restoration

Special Designations and Acquisition

94. Keweenaw Shoreline Protection, MI
95. Icelandite Coastal Fen Scientific and Natural Area, MN
96. Wetlands Reserve Program, WI
97. Wildlife Habitat Incentives Program, WI

Watershed Management and Forest Stewardship

98. Whetstone Creek Project, Marquette County, MI
99. Brule River State Forest, Brule, WI
100. Kakagon Sloughs Plan Implementation and Sustainability Analysis, WI
101. Forest -wide Sediment Reduction/interception
102. National Forest Master Planning

Monitoring, Assessment and Inventory

103. Whitefish Bay, MI (substrate map)
104. Biological Survey of the North Shore Highlands Subsection, MN
105. Coaster Brook Trout Habitat in Grand Portage Area, MN
106. Stream Restoration Tech study
107. Comprehensive hydrologic assessment of the Whittlesey Creek watershed
108. Thunder Bay Waterfront Development Plan - Habitat Enhancement Strategy
109. Physical Habitat Classification of Nearshore Waters of Thunder Bay and Black Bay
110. Status of Walleye Stocks and Habitat Quality in Batchawana Bay and the St. Mary"s River
111. Identifying and Protecting Priority Aquatic Sites

Education and Public Involvement

112. Isle Royale National Park, MI
113. Great Lakes Aquarium, Duluth, MN
114. Citizen Lake Monitoring Program, MN
115. Northern Great Lakes Visitors Center, Ashland, WI

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