

MINNESOTA DEPARTMENT OF NATURAL RESOURCES
DIVISION OF FISH AND WILDLIFE
SECTION OF FISHERIES

**Quantification and description of shoreline habitat alterations on general development lakes in
Douglas County, Minnesota.**

June through August 2008

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Abstract.- Shoreline habitat alterations were quantified on 16 general development lakes in Douglas County, Minnesota from June 30 to September 23, 2008. Human induced alterations were categorized into 4 groups: Riprap, lawn, artificial sand, and retaining wall. Riprap was the most common type of alteration encountered, totaling 33.8 miles of shoreline or 2.1 miles (27.8%) per lake. Riprap also was the most common of four alterations used, occurring 70% of the time compared to artificial sand (18.7%), lawn (9.5%) and retaining wall (2.2%). For all study lakes combined, the amount of shore altered was 48.6 miles, or 37% of the total shoreline.

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Introduction

The impacts of human induced shoreline alterations on littoral fish habitat have been well documented (Barwick 2004, Bryan and Scarneccchia 1992, Craig and Black 1986, Christensen et al. 1996, Hanson and Margineau 1992, Jennings et al. 1999, Meyer et al. 1997, and Radomski and Goeman, 2001). Shoreline habitat important to many fish species has been, and continues to diminish due to riparian development. Alteration of natural littoral zone habitats has negative consequences to fish and wildlife (Perleberg et al. 2008). Shoreline habitat consisting of overhanging trees, submerged woody debris and submersed, floating-leaf and emergent vegetation has been replaced by rock riprap, artificial sand blankets, lawn and retaining walls on many lakes in the Glenwood Area. Minnesota DOW rules state that up to 200 feet of natural rock riprap extending up to six feet water-ward from the ordinary high water level can be installed without a DNR permit (M.R. 6115.0215). The Glenwood Area has no quantitative information on the amount of human induced shore alterations that have occurred on managed lakes. With increasing developmental pressures on Minnesota lakeshore and the forth-coming revised Minnesota Shoreland rules for Lake and River Conservation, data pertaining to the extent of current shoreline habitat alterations may help facilitate future measurements of habitat loss and the impacts it may have on fish and wildlife.

Methods

Shoreline habitat was evaluated from a boat while traversing the entire perimeter of each lake, parallel to shore. Artificially constructed coves and harbors were not included in the surveys because they were considered a unique alteration in of themselves. Beginning at the access point, a clockwise direction was usually chosen since it afforded an easier view of the shoreline while operating a tiller-style outboard motor. A hand-held Garmin 76 GPS unit was used to mark waypoints at the beginning and end

of each alteration type that included riprap, artificial sand, lawn or retaining wall. Waypoints were stored and later downloaded to the DNR Landview program for distance measurements. An effort to mark as close to shore as possible was made to improve measurement accuracy. In cases where navigational obstacles (e.g., heavy vegetation, shallow water) prevented waypoint marking close to shore, waypoints were marked further lakeward, but as perpendicular to the point of on-shore interest as possible (Figure 1). Alterations less than 100 feet in length were visually estimated and recorded.

Study lakes

General Development lakes ranged from 152 to 5,724 surface acres in size (Table 1) and are generally described as mesotrophic to meso-eutrophic, with diverse submergent littoral plant communities and sand/gravel to soft muck type bottom substrates. Fish communities are essentially comprised of centrarchids, esocids, percids, cyprinids and ictalurids. Based on overall lake quality attributes such as water clarity, depth, surface acreage and recreational fishery value, most of the 16 lakes represent the best in Douglas County.

Alteration Identification

Riprap (RR), artificial sand (AS), lawn (LA) and retaining wall (RW) was identified as such if it was the first alteration to occur from the waters edge (Figures 2-6). Natural sand or gravel occurring between RR, AS, LA and RW and the waters edge was ignored (Figure 3). In some instances, a narrow strip of riprap occurred at the waters edge, but gave way to a different alteration that comprised the majority of the bank. In these cases, major alteration type was used as the identifier. Artificial sand was identified if it was clearly the result of a constructed beach. Sand occurring naturally, but maintained by the landowner as a swimming beach was considered artificial, particularly if it backed up to developed property. Sand beach that had natural shoreline immediately behind it was considered natural and unaltered (Figure 7).

Habitat potential

Alterations were also ranked based on *habitat potential* the shoreline might provide if alteration/s had not occurred. Habitat potential (ranked as level 1, 2 or 3) was a subjective variable influenced solely by adjacent habitat quality (Figures 8-11). The higher the ranking, the more damaging the alteration was considered to be. Thus, an alteration type bordered or within hardstem bulrush for example, would receive a label of RR3 while a sand blanket or lawn flanked by neighboring riprap or retaining walls would receive a label of AS1 or LA1, respectively. This system was used to qualify the type or degree of fish and wildlife habitat lost.

Results and Discussion

Average length of human altered shoreline on 16 general development lakes in Douglas County was 16,026 feet or 37 percent of the shoreline. Percentage of shoreline altered ranged from 11% on Red Rock Lake to 74.7 % on Lake LeHommeDieu (Table 2). Riprap accounted for the majority (70 %) of alterations followed by artificial sand (18.7%), lawn (9.5%) and retaining walls (2.2%). Similarly, riprapped shoreline ranged from 1.8% on Red Rock Lake to 61.7% on Lake LeHommeDieu. Average amount of riprapped shore was 27.8 % and ranged from a total of 915 feet on Red Rock Lake to over 6 miles on Lake Carlos. Lakes Irene and Red Rock, two lakes with the least amount of shore alteration, had the highest percentage of LA compared to other alteration types, more than three times the average. Relatively small, modest cabins characterize residential development for both lakes. By contrast, lakes with the highest percentage of RR are characterized by a high number of luxury, year-round homes such as on Lakes LeHommeDieu, Darling and Carlos. Lakes Miltona and Mary had high percentages of naturally occurring sand shore that was identified as *AS* since it backed up to developed lakeshore property and was maintained as beach. While this effectively increased overall percentage of shore

altered; both lakes appeared to have less altered shore and occasionally looked more natural than other lakes containing less beach sand and more riprap.

Healthy riparian habitat was documented for all 16 lakes in this study, however, fragmentation of such habitat was common and while alterations occurring within natural habitat (high impact—level 3) were less common than alterations occurring as part of established shoreland development (lesser impact—level 1), qualifying habitat impacts represents a relative measure of the degree to which natural riparian features are currently being impacted and/or lost. The average ratio of level 1 to level 3 alterations was 5:1 (Figure 12). However, Lakes Geneva, Victoria, Ida and Irene had a higher percentage of level 3 alterations than level 1 alterations, indicating development practices on these lakes have resulted in more direct damage to remaining fish and wildlife habitat.

Number of single-family units counted ranged from 45 on Lake Louise to 530 on Lake Ida (Table 3). Lot width varied greatly between lakes and within the same lake, however, development density was similar for all lakes except for Red Rock Lake (Table 3).

Negative impacts to fish populations as a consequence of human induced shore alteration is difficult to ascertain. Reed and Pereira (*In Press*) found that black crappie had a strong preference for nesting adjacent to shorelines with emergent vegetation, and that largemouth bass preferred undeveloped shorelines to developed shorelines when choosing nest sites. Similarly, Miller and Kraemer (1971) and Annett et al. (1996) found that preferred spawning habitat for largemouth bass was shallow, protected sites in bays, among emergent vegetation or rocks, logs and stumps. On a heavily developed lake in Michigan, Wagner et al. (2006) found that 65% of largemouth bass nests occurred along undeveloped shore areas, habitat that comprised only 10% of the shoreline. Radomski and Goeman (2001) found that developed shorelines had substantially less emergent and floating-leaf vegetation than undeveloped

shorelines, and that northern pike biomass had a positive correlation with the occurrence of emergent and floating-leaf plants.

General Development lakes in Douglas County historically had fewer shore dwellings than today and thus, more natural shoreline habitat was available to fish and wildlife. Quantifying the amount of shoreline alteration that currently exists establishes a benchmark from which to compare future habitat loss and perhaps the relationship these impacts may have on fish and wildlife.

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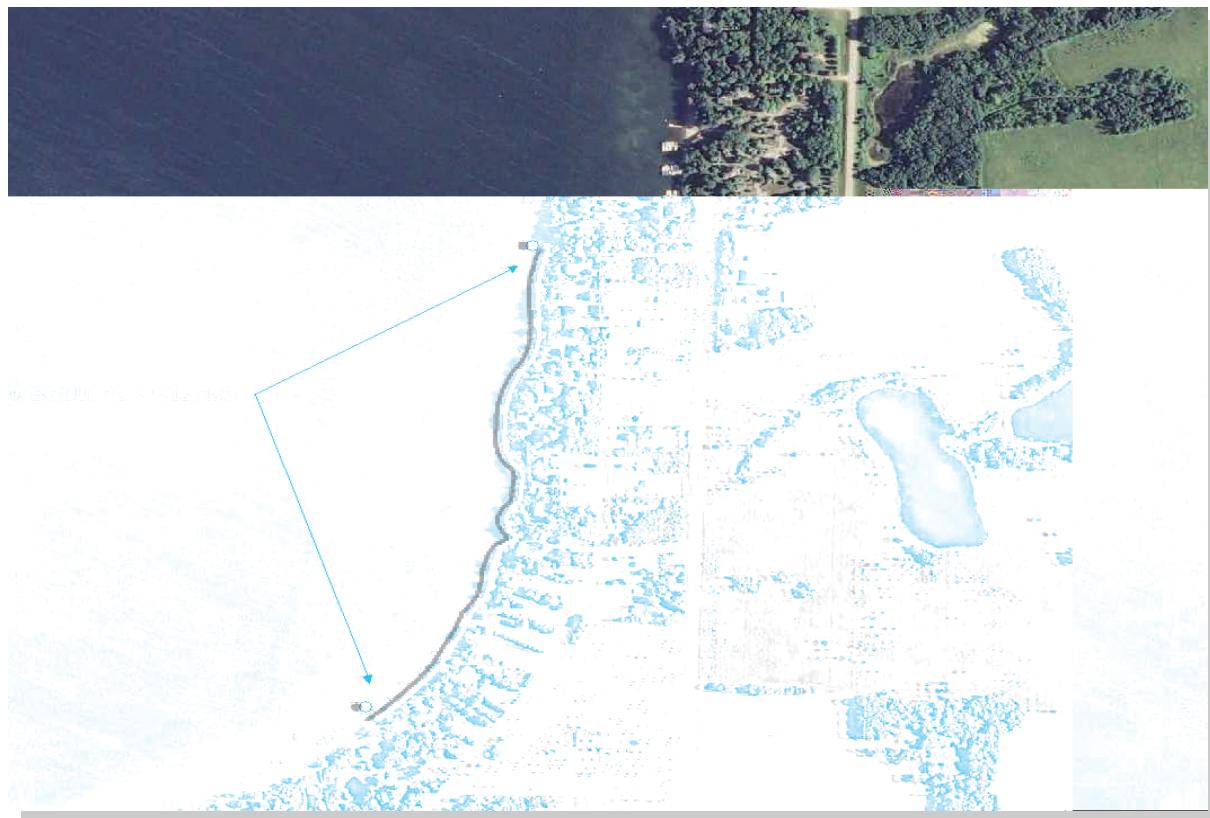


Figure 1. Measured shoreline using marked waypoints and ArchMap.



Figure 2. Riprap example (RR).



Figure 3. Sand/gravel giving way to riprap – recorded as RR.



Figure 4. Artificial sand example (AS).



Figure 5. Lawn example (LA).



Figure 6. Retaining wall example (RW) – low water conditions.



Figure 7. Natural sand example.



Figure 8. RR1 example.



Figure 9. RR2 example.



Figure 10. RR3 example.



Figure 11. SA3 example.

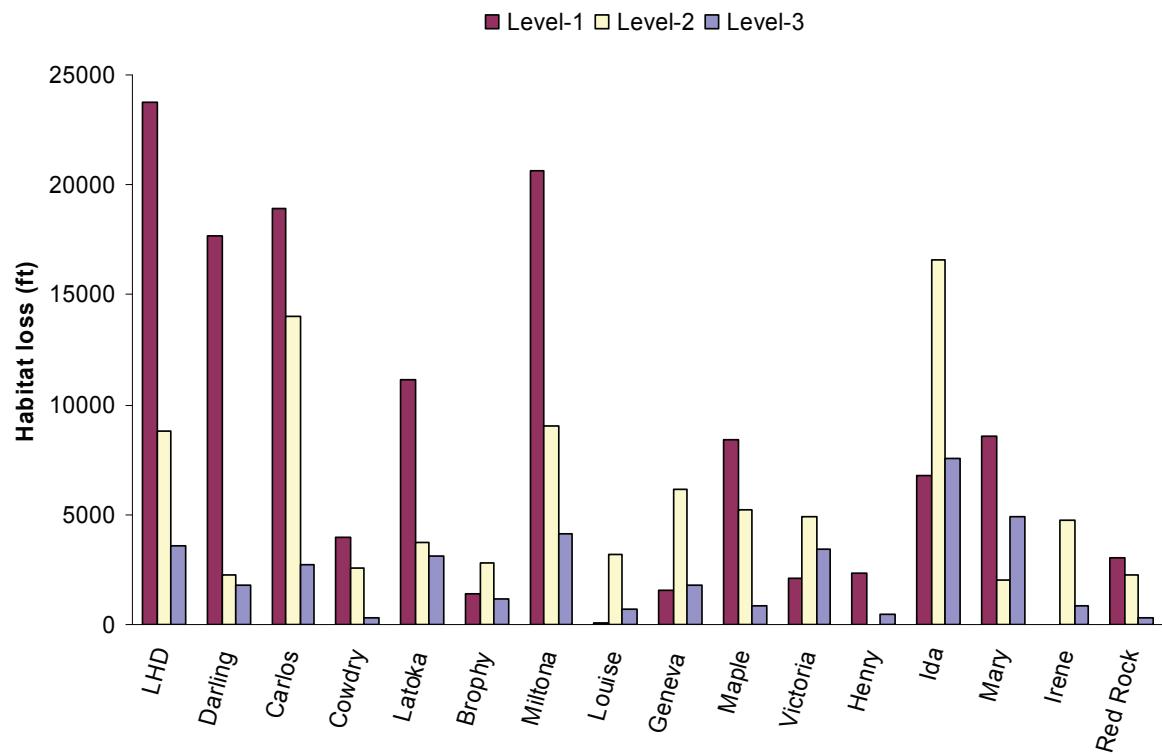


Figure 12. Habitat loss by type.

Table 1. Study Lakes, description/location.

Lake	Acres	Average Secchi depth (ft)	Miles from Alexandria*
Miltona	5,724	11.0	11.5
Ida	4,427	13.0	7.0
Carlos	2,520	10.5	6.5
Mary	2,371	6.8	7.0
LeHommeDieu	1,744	9.7	4.0
Darling	954	9.7	4.0
Red Rock	903	5.9	21.2
Maple	815	9.9	9.3
Latoka	776	14.4	3.2
Geneva	631	9.2	3.0
Irene	630	7.5	14.2
Victoria	419	8.6	2.3
Brophy	293	8.9	4.8
Cowdry	238	10.9	3.2
Louise	214	9.2	4.8
Henry	152	2.4	0.5

* Reference point from the intersection of 3rd Street and Nokomis to the nearest public access.

Table 2. Summary of shoreline alterations for 16 lakes in Douglas County, Minnesota, June-September, 2008

Percent	LeHommeDieu	Darling	Carlos	Cowdry	Latoka	Brophy	Miltona	Louise	Geneva	Maple	Victoria	Henry	Ida	Mary	Irene	Red Rock	Average
SHORELINE ALTERED	74.7	60.3	52.7	42.4	39.4	38.7	38.6	34.6	34.5	31.0	29.9	27.5	26.6	25.2	25.1	11.0	37.0
REMAINING NATURAL	25.3	39.7	47.3	57.6	60.6	61.3	61.4	65.4	65.5	69.0	70.1	72.5	73.4	74.8	74.9	89.0	63.0
SHORELINE RIPRAPPED	61.7	50.6	48.8	38.9	26.1	34.8	15.1	29.4	29.3	19.7	27.4	20.6	17.8	5.5	17.4	1.8	27.8
<u>ALTERATION COMPOSITION:</u>																	
RIPRAP	82.6	83.9	92.5	91.9	66.4	90.0	39.0	84.9	84.9	63.6	91.6	74.7	66.6	21.9	69.4	16.2	70.0
ARTIFICIAL SAND	12.1	7.8	6.1	3.7	14.1	1.7	51.7	11.3	9.2	27.4	1.6	8.3	23.1	69.4	1.4	50.8	18.7
LAWN	2.6	4.4	1.1	0.0	17.4	0.0	8.4	2.5	5.0	8.3	6.3	17.0	7.6	8.4	29.2	33.0	9.5
RETAINING WALL	2.6	3.9	<1	4.4	2.2	8.3	<1	1.3	<1	0.7	<1	0.0	2.6	0.3	0.0	0.0	2.2
<u>Totals (ft)</u>																	
SHORELINE ALTERED	36,174	21,680	35,713	6,850	17,934	5,407	33,810	3,980	9,515	14,465	10,436	2,825	30,985	15,449	5,625	5,570	16,026
REMAINING NATURAL	12,235	14,267	32,033	9,323	27,636	8,561	53,678	7,520	18,030	32,192	24,438	7,437	85,294	45,894	16,816	45,288	27,540
SHORELINE RIPRAPPED	29,868	18,189	33,060	6,291	11,894	4,861	13,211	3,381	8,071	9,191	9,555	2,114	20,698	3,374	3,905	915	11,161
<u>ALTERATION COMPOSITION:</u>																	
RIPRAP	29,880	18,180	33,028	6,295	11,904	4,867	13,200	3,380	8,080	9,205	9,556	2,110	20,647	3,377	3,905	900	11,157
ARTIFICIAL SAND	4,394	1,700	2,170	255	2,520	90	17,470	450	875	3,960	170	235	7,148	10,722	80	2,830	3,442
LAWN	950	960	390	0	3,120	0	2,840	100	480	1,200	660	480	2,370	1,300	1,640	1,840	1,146
RETAINING WALL	950	840	125	300	390	450	300	50	80	100	50	0	820	50	0	0	281

**Table 3. Residential counts for 16 lakes in Douglas County, Minnesota,
June-September, 2008.**

Lake	Single Family Units	Resorts	Multi Res Units	Development Density (Homes/mi)
Ida	530	1	7	24.07
Miltona	499	5	4	30.12
Carlos	395	6	2	30.79
LeHommeDieu	324	1	3	35.34
Latoka	261	2	0	30.24
Darling	252	2	2	37.01
Mary	193	7	2	16.61
Maple	182	3	0	20.60
Victoria	164	2	0	24.83
Geneva	147	2	1	28.18
Irene	120	0	0	28.23
Red Rock	95	0	0	9.86
Cowdry	80	1	3	26.12
Brophy	60	1	0	22.68
Henry	51	0	0	26.24
Louise	45	0	0	20.66

Appendix



