Erosion on the Flathead River

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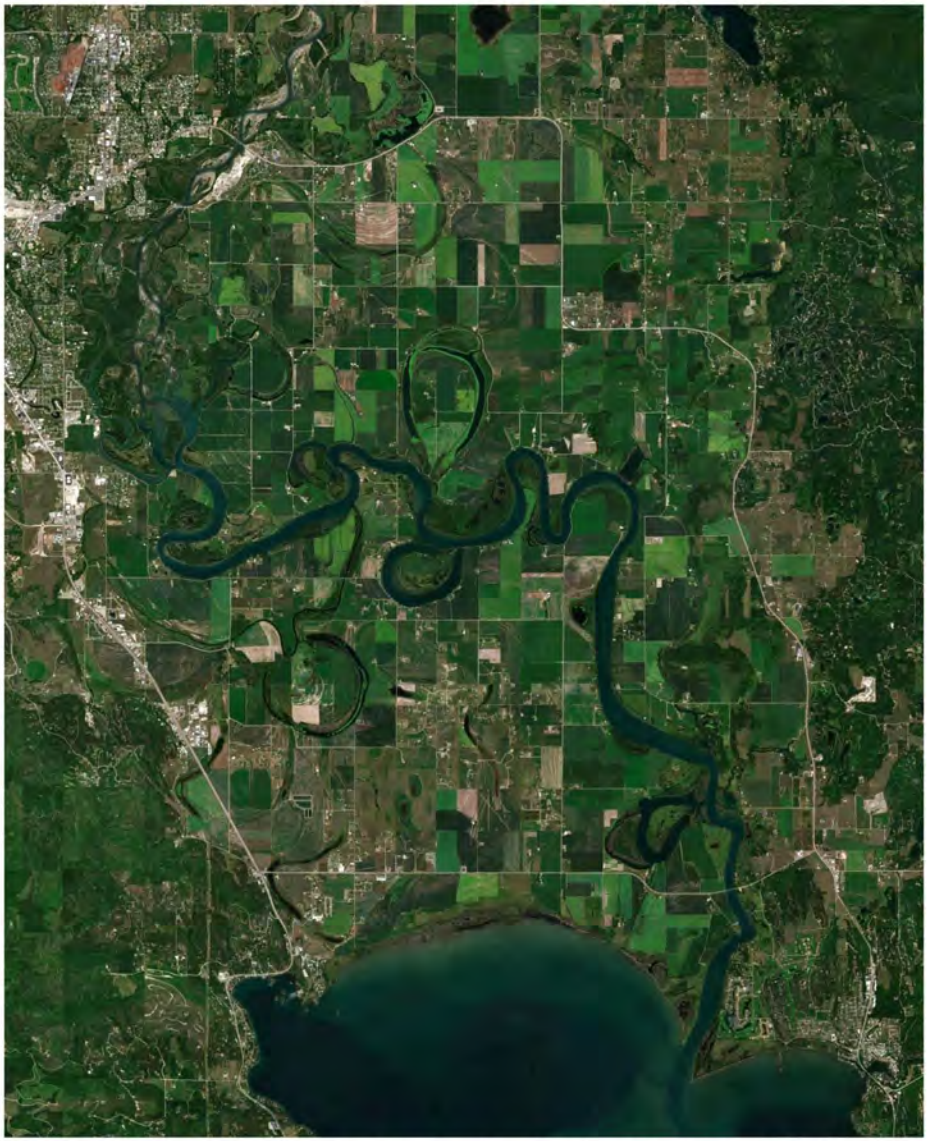
Description of the drainage

- The Flathead River drainage above Flathead Lake drains approxm7,000 square miles.
- The Flathead River Valley between Old Steel Bridge and Flathead Lake is comprised of alluvial sediments.
- Twenty two river miles upstream of the lake are inundated by the Seli’š Ksanka Qlispe’ Dam at full pool.



Mercator Projection
WGS84
USNG Zone 11UQP
CALTOPO

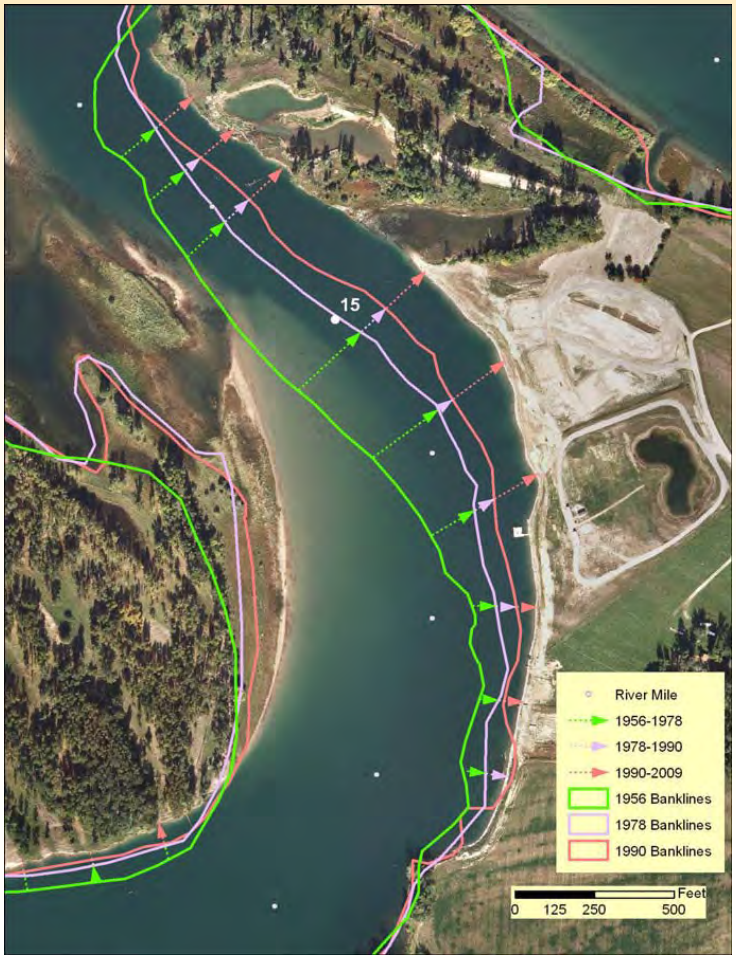
1 2 3 4 5 6 7 8 9 10 km
1 2 3 4 5 6 mi
Scale **1:92742** 1 inch = 1.5 miles

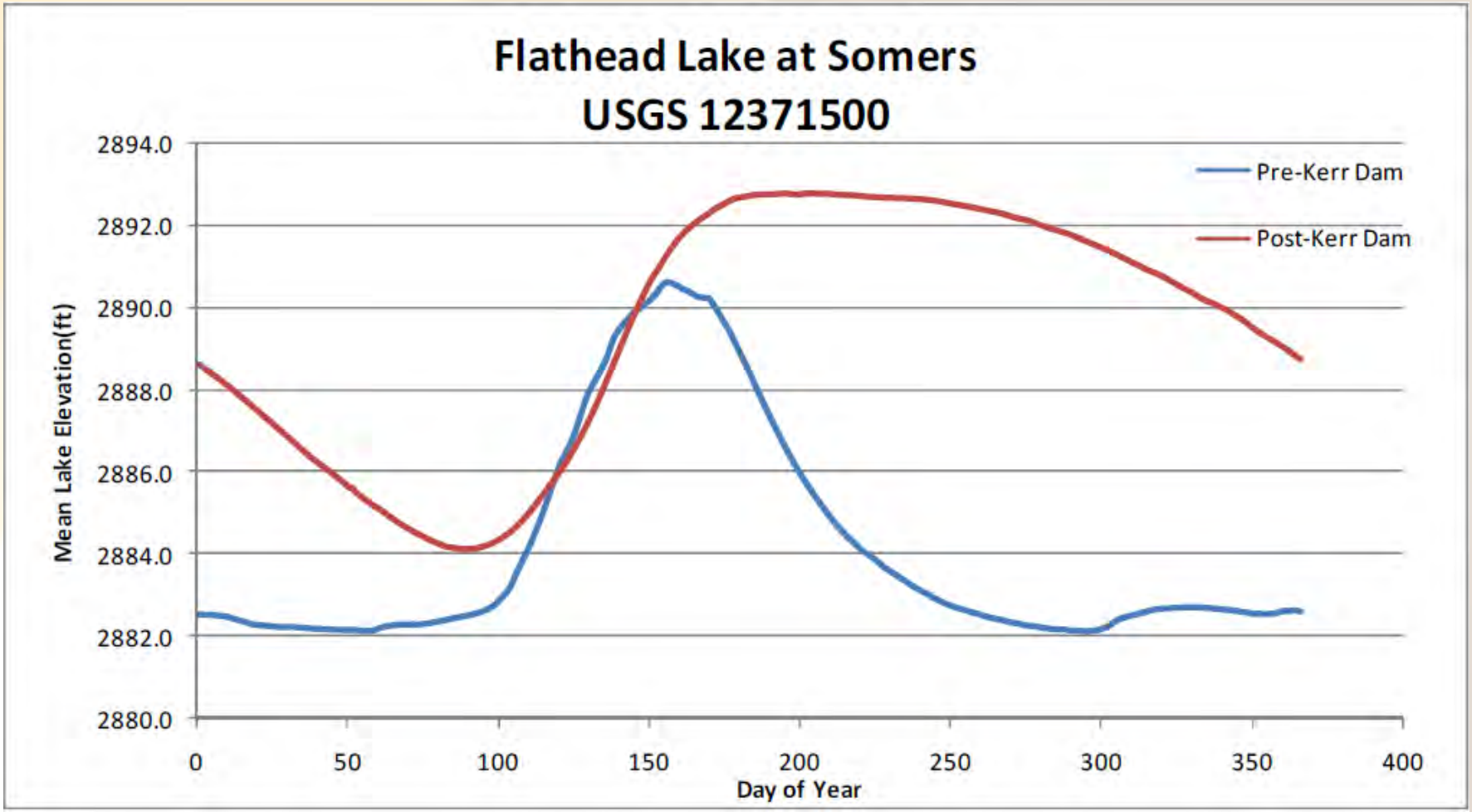
N
MN
13°

Causes of Erosion

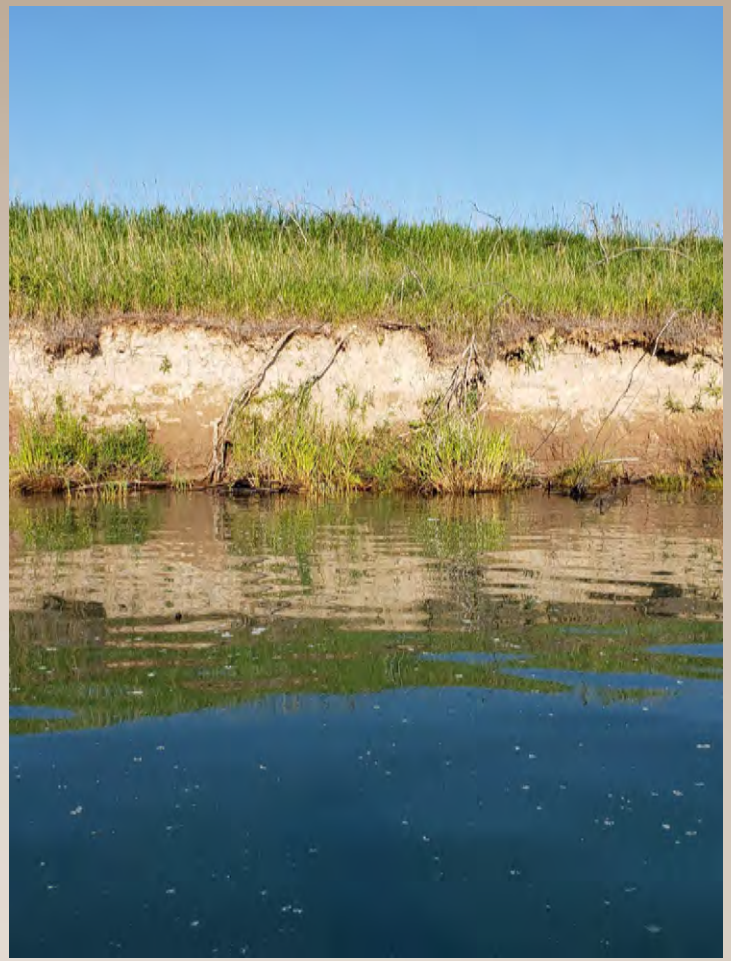
- Naturally occurring.
- Stream bank development and grazing.
- Streambank saturation.
- Erosion control structures.
- Wakes from boat traffic and naturally occurring waves.
- Inundation from the Salish, Kootenai, Pend d’Oreille Dam.

Erosion Rates on the Flathead River




Flathead Lake at Somers
USGS 12371500
Mean Lake Elevation(ft)
2894.0
2892.0
2890.0
2888.0
2886.0
2884.0
2882.0
2880.0
0
50
100
150
200
250
300
350
400
Day of Year
Pre-Kerr Dam
Post-Kerr Dam

Erosion on the Lower Flathead River



Boat wakes, turbidity and erosion

Boating Survey on the Flathead River and Sloughs Upstream of Flathead Lake, 2008

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Montana Fish Wildlife and Parks
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February, 2009

INTRODUCTION

Over time as the human population in the Flathead Valley grew, the popularity of boating on the Flathead River immediately upstream from Flathead Lake grew. Historically, a bottleneck at the outlet of Flathead Lake caused lake levels to rise 10 feet to full pool during spring runoff but then drop to low pool within 6 to 8 weeks. With the completion of Kerr Dam in 1938, the pool level of Flathead Lake was held at full pool all summer and into fall. Flathead Lake fills to within three feet of full pool by Memorial Day and to full pool by June 15. The Flathead River runs into the lake at the northern end and the increased elevation of the lake surface backed up water in the Flathead River approximately 22 miles to just above the confluence with the Stillwater River. The deeper depths and reduced current speed improved motor boating opportunities in these river miles. Landowners along the river believe that boat wakes impact stream banks by increasing the rate of bank erosion beyond what is caused by stream currents and wind waves. Montana Fish Wildlife and Parks conducted angler creel surveys on this reach of the Flathead River in 1992 and 2002 (Hanzel 1995; Deleray 2004). In doing so, FWP estimated the number of boating trips on the river and sloughs. The highest boating levels were observed in the four summer months. In the summer of 2008, FWP Fisheries and Enforcement Divisions conducted a partial survey to again estimate boating use. This report assesses the current status of and recent changes to boating numbers on the Flathead River over a 16-year period.

DESCRIPTION OF PROJECT AREA

The Flathead River System is a tributary to the Clarks Fork of the Columbia River, originating in northwest Montana and southern British Columbia. Three forks of the Flathead River flow from mostly public lands, including Glacier National Park, the Bob Marshall and Great Bear Wilderness Areas and other Flathead National Forest lands. Hungry Horse Dam impounds the South Fork of the Flathead River near its mouth. The North and Middle Forks are free-flowing rivers. The three forks of the Flathead River supply roughly 80 percent of the annual discharge (9 million acre-feet) in the Flathead System (Zackheim 1983). Near the town of Columbia Falls, mean peak river flows of roughly 32,000 ft3/sec occur near the end of May or early June.

The project area for the 2008 boating survey was smaller than that of the 1992-1993 or the 2002-2003 creel surveys. This survey did not include the three forks of the Flathead River, as did the 1992-1993 survey, nor the main stem river above the confluence of the Stillwater River as in both earlier surveys. For the 2008 survey, the project area began at the confluence of the Stillwater and Flathead rivers and continued to the inlet at Flathead Lake, 22 miles downstream. All three surveys also included the connected river sloughs along this reach.

In 2002 and 2008, we split the project area into two river reaches, the main stem river section (Section 1) and the river sloughs (Section 5). This was not done in the 1992-1993 survey, when the two were combined. The river reach includes the popular and public Sportsman's Bridge Fishing Access at the Highway 82 crossing about 2.5 miles upstream

of Flathead Lake and the Flathead County access near the River Ranchettes subdivision, about 6.5 miles upstream. During summer months when the lake pool elevation raises the river surface elevation, the section becomes popular with motor boaters. There are also numerous private boat access points and a few other less used public access sites along this reach. A private marina was opened on the river about one mile upstream of Flathead Lake in 1993. Also boaters can motor upstream into this reach from Flathead Lake.

There are seven larger connected river sloughs adjacent to the main stem river. The sloughs are Church (196 surface acres), Fennon (215 surface acres) and Halfmoon (32 surface acres), which are old oxbow channels. Other sloughs included those at the confluences with tributaries, such as Rose Creek (46 surface acres), Mill Creek (52 surface acres), and Brenneman (43 surface acres) sloughs. All of these sloughs have very slow moving or no current and warm summer temperatures characteristic of lake rather than river habitat. Boaters accessed these from the main stem river or from private access points in the sloughs.

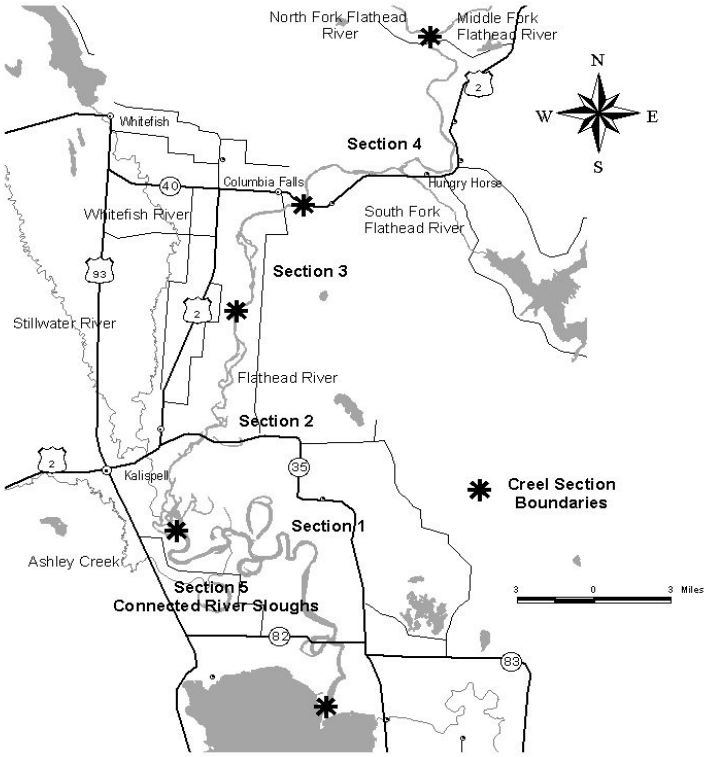

Figure 1. Map of study area showing five river sections in the 2002-2003 survey. Asterisks depict river section boundaries. Section 5 was comprised of sloughs adjacent and connected to the river Section 1. The 2008 survey consisted of only Sections 1 and 5.

METHODS

Methodologies used in this survey were similar to those used in the 1992-1993 survey (Hanzel 1995) and to those presented in detail in the 1992 Flathead Lake survey (Evarts et al 1994). The survey consisted of stratified simple random sampling. We stratified survey data by month, river reach (see above section describing the sampling area), and day types (weekend and week days). We expanded data on a monthly basis to allow for adequate sample sizes without extending into periods with dissimilar characteristics. Days were the primary sample units. Holidays were grouped with weekend days. Daily boating hours were defined by one half hour before sunrise and one half hour after sunset (Table 1), assuming no boating occurred at night.

Table 1. Daily fishing hours used to estimate fishing pressure in the Flathead River creel survey, 2002-2003. The 15th day of each month was used to represent sunrise and sunset times for the month. The 2008 survey used the same numbers of hours for the summer months.

MONTH	SUNRISE	SUNSET	HRS	HRS + 1 HR
JAN	8:23	17:11	8.8	9.8
FEB	7:44	18:00	10.3	11.3
MAR	6:51	18:43	11.9	12.9
APR	6:48	20:29	13.7	14.7
MAY	5:58	21:11	15.2	16.2
JUN	5:37	21:40	16.1	17.1
JUL	5:53	21:34	15.7	16.7
AUG	6:32	20:51	14.3	15.3
SEP	7:15	19:50	12.6	13.6
OCT	7:57	18:49	10.9	11.9
NOV	7:45	16:59	9.2	10.2
DEC	8:22	16:44	8.4	9.4

Boating estimates were based on random instantaneous boat counts. River survey flights coincided with flights of a Flathead Lake angler creel survey being conducted at the same time. Counts were conducted from a fixed-wing aircraft. Sample days and times were randomly selected during two-week intervals. The flight schedule was stratified to sample 60 percent of weekend days and 40 percent of weekdays. Boats were counted in each section. MFWP developed a computer program from formulas of Neuhold and Lu (1957) that was used to calculate boating hours. For each month, we calculated the number of boating hours by multiplying the mean boat counts in aerial flights by the number of hours in a day and then by the number of either weekend or weekdays in that month. This gave us an estimate for the total number of boating hours in each month.

RESULTS AND DISCUSSION

Aerial Boat Counts

In 2008, we conducted 72 flights in the four month period. As expected, boater numbers were higher on weekends. For the Flathead River Section 1, monthly mean number of boats counted per flight in 2008 ranged from 2.7 to 12.1 on weekends and 1.1 to 4.1 boats per flight on weekdays (Table 2). June had the lowest weekend and weekday mean counts and August had the highest. The 2008 mean numbers of boats counted were greater than 2002 means in some months (Table 2). For weekends, 2008 counts were greater in June, July and August and similar to 2002 counts in September. The June and August 2008 means were about three times larger than those in 2002. Weekdays in 2008 showed slightly different results. July and August means were larger in 2008 than in 2002, but June and September values were similar between years.

The 2002 and 2008 means are directly comparable, but the 1992 means (Table 3) are not directly comparable to 2002 and 2008 means. In the 1992 survey, the river section and slough section were not separated during aerial counts.

Table 2. Mean boat counts per flight by day type and month for the lower main stem Flathead River Section 1 in 2002 and 2008.

Weekend	2002			2008		
	Mean	SD	N	Mean	SD	N
June	1.0	0.6	6	2.7	2.9	7
July	7.0	1.3	6	8.5	6.2	6
August	3.6	2.4	7	12.1	5.4	8
Sept	5.7	4.1	6	5.3	3.6	6
Weekday	2002			2008		
	Mean	SD	N	Mean	SD	N
June	1.1	1.4	10	1.1	1.4	12
July	0.9	2.1	11	2.7	2.7	12
August	2.1	3.1	9	4.1	3.5	10
Sept	2.0	1.8	12	2.4	2.1	10

For the slough Section 5, mean monthly number of boats counted per flight ranged from 3.5 to 8.0 on weekends and 0.8 to 2.7 boats per flight on weekdays (Table 4). As in the river section, the boater numbers on the sloughs were also higher on weekends. For sloughs during weekends, September had the lowest mean number of boats counted per flight and August had the highest. For sloughs during weekdays, June had the lowest mean number and July and August had the highest. When comparing 2002 to 2008, the 2008 means for weekends showed a large increase over the 2002 values (Table 4). The June 2008 mean was 14 times larger than the June 2002 mean. The July and August values were two to three times larger in 2008. However, we did not observe the same relationships for weekday means between years. Weekdays in 2008 did not show a large increase over the 2002 level (Table 4).

Table 3. Combined mean boat counts per flight by day type and month for the lower main stem Flathead River Section 1 and the Slough Section 5 in 1992.

Weekend	1992 (Sections 1 and 5 combined)		
	Mean	SD	N
June	2.6	1.7	6
July	3.0	2.1	5
August	3.6	2.3	7
Sept	1.4	1.2	4
Weekday	1992 (Sections 1 and 5 combined)		
	Mean	SD	N
June	1.0	0.7	8
July	1.4	1.0	9
August	1.3	0.9	9
Sept	0.9	0.8	6

Table 4. Mean boat counts per flight by day type and month for the sloughs on the lower Flathead River Section 5, in 2002 and 2008.

Weekend	2002			2008		
	Mean	SD	N	Mean	SD	N
June	0.5	0.5	6.0	7.0	4.0	7
July	3.3	3.1	6.0	6.8	4.2	6
August	2.4	1.6	7.0	8.0	3.5	8
September	2.1	1.7	6.0	3.5	1.9	6

Weekday	2002			2008		
	Mean	SD	N	Mean	SD	N
June	0.8	0.9	10.0	0.8	0.9	12
July	1.8	2.2	11.0	2.4	1.5	12
August	1.0	0.7	9.0	2.7	2.7	10
September	1.8	0.9	12.0	1.6	1.6	10

Estimated Total Boating Hours

Based on these monthly mean boat counts, day length, and number of either weekdays or weekends we calculated the total number of boating hours per month on each section (Table 5). In the lower half of Table 5, we combined the two sections in 2002 and 2008 so as to be comparable to the 1992 values. Also, there is very limited boating access in the sloughs so most slough boaters start their trip from a river access and have thus motored in the river to the slough. In both sections 1 and 5, the 2008 boating levels were much greater in June, July and August than they were in 2002 (Figures 2 and 3). The September levels were similar between years.

Table 5. The estimated total boating hours per month in 1992, 2002 and 2008 in the lower Flathead River (Section 1) and adjacent river sloughs (Section 5). The 1992 survey did not distinguish between the two sections, so boating hours were combined for the two sections.

		Boating Hours		
Section	Month	1992	2002	2008
River 1	June		547	838
River 1	July		1386	2270
River 1	August		1202	3046
River 1	September		1288	1334
	Total		4424	7488
Slough 5	June		359	1471
Slough 5	July		1169	1904
Slough 5	August		769	2010
Slough 5	September		767	885
	Total		3065	6270
River and Slough	June	781	906	2309
River and Slough	July	968	2556	4173
River and Slough	August	949	1971	5057
River and Slough	September	422	2056	2220
	Total	3120	7488	13758

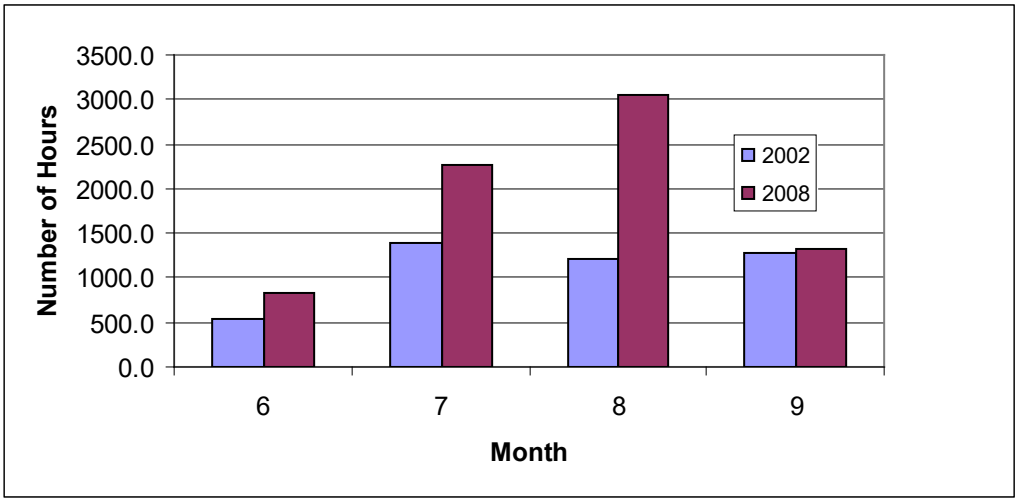

Figure 2. The estimated total number of boating hours per month on the lower Flathead River, Section 1 in 2002 and 2008.

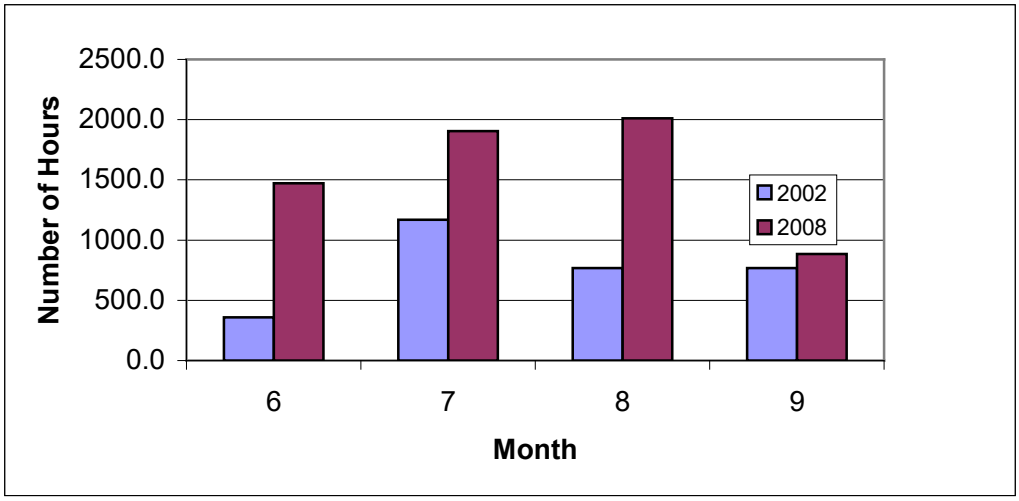

Figure 3. The estimated total number of boating hours per month on the sloughs, Section 5, adjacent to the Flathead River in 2002 and 2008.

Figure 4 depicts the combined boating hours for the river and sloughs for all three years. In all four months, the 2008 boating hours were higher than the 1992 values. Similarly, the 2002 boating hours were higher than the 1992 values in all months but June, when the two years showed similar hours. Over the 16 year period, there has been an increase in boating hours in all four months, with July and August showing the largest increases.

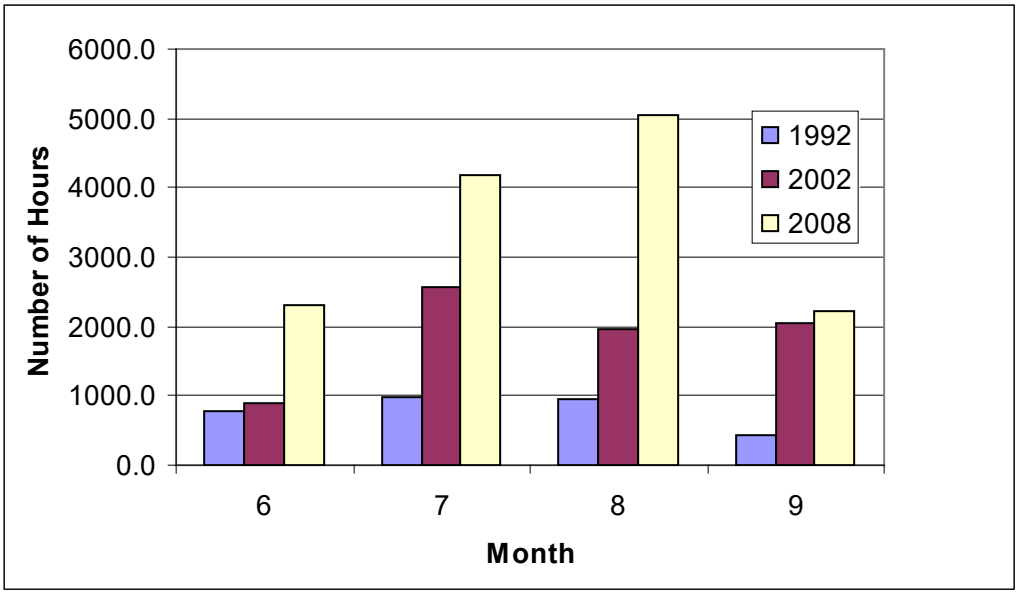

Figure 4. The estimated total number of boating hours per month on the lower Flathead River and associated sloughs, Sections 1 and 5, in 1992, 2002 and 2008.

Estimated Boat Numbers

To get a rough estimate for the number of boats using the Flathead River and sloughs we need to transform the estimates for boating hours. We can do this by determining the

average number of hours a boater spends on the water. We do not have empirical data for all of these years or for non-fishing boats. In 2002, the average fishing day for boat anglers was 4.1 hours. We did not measure the number of hours the average boater spends on the water if they are pursuing other recreational pursuits, such as cruising or waterskiing. So our estimates for boat numbers will be approximate and include certain assumptions.

In 1998, the U.S. Coast Guard conducted a National Recreational Boating Survey (U.S. Coast Guard 1999). In this survey they reported that boaters participated in a number of activities, 63% of boaters fished, closely followed by cruising (52%) and waterskiing (24%). Fishing was the most popular activity. They also reported that the average length of a motor boating trip was four hours per day. If we assume an average boating trip lasted four hours, based on our 2002 boat fishing day length and the national average of 1998 U.S. Coast Guard survey, we can divide our estimates for boating hours by four to estimate the number of boats using the Flathead River and sloughs (Table 6).

Table 6. The estimated number of boats per month using the lower Flathead River (Section 1) and adjacent river sloughs (Section 5) in 1992, 2002 and 2008. The 1992 survey did not distinguish between the two sections, so boating hours are not separated for the two sections. The numbers assume that the average boating day length is four hours.

		Boat Numbers		
Section	Month	1992	2002	2008
River 1	June		137	209
River 1	July		347	567
River 1	August		300	762
River 1	September		322	334
	Total		1106	1872
Slough 5	June		90	368
Slough 5	July		292	476
Slough 5	August		192	503
Slough 5	September		192	221
	Total		766	1568
River and Slough	June	195	227	577
River and Slough	July	242	639	1043
River and Slough	August	237	493	1264
River and Slough	September	105	514	555
	Total	780	1872	3440

Based on the above assumptions, there were 3,440 boat trips on the lower reach of the Flathead River and associated sloughs in the four summer months in 2008 (Table 6). The 2008 estimate is over 1.8 times higher than the 2002 estimate of 1,872 boat trips. That is, there were almost twice as many boat trips in 2008 than in 2002. Similarly, both the 2002 and the 2008 estimates were higher than the 1992 estimate of 780 boat trips. The

2002 and the 2008 estimates were 2.4 times and 4.4 times higher than the 1992 estimate. The three estimates show a rapidly increasing trend in boater use of the Flathead River and sloughs over the last 16 years during the summer months.

CONCLUSIONS

We estimated that boating has increased on the Flathead River and associated sloughs over the last 16 years. Estimated summer boat numbers almost doubled between 2002 and 2008 and more than quadrupled since 1992. This has likely contributed to an increased rate of bank erosion as noted by private landowners along the river. There are potentially other factors affecting the rate of bank erosion including dam operations, land management activities, wind waves, and river current. Also, as rivers migrate over time, natural bank erosion occurs generally on the outsides of bends in the river. Each river reach may have one or more of these processes in addition to boat wakes affecting the rate of bank erosion. To date there has not been a study to assess the contribution of each of these processes to the rate of erosion.

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