Geomorphic and Geological Soil Characteristics of Bank-Erosion Sites Along the Upper Mississippi River Between St. Paul, Minnesota and Cairo, Illinois

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The Mississippi River

- The MR trickles from Lake Itaska and empties into the Gulf of Mexico, 2,350 miles (3,710 km) later
- The Upper MR extend from St. Paul, MN to Cairo, IL (~1,400 km)
- The UMR basin is about 491,900 km²





The Upper Mississippi River

- There are 485 species of fish, mussels, birds, mammals, amphibians, and reptiles
- 27 lock & dam installations
- 126 million tons of cargo a year on the UMR alone









Longitudinal Profile of UMR Pools







Quiescent Mississippi River



Flooded Mississippi River/Missouri River Confluence during the Flood of '93



Upper Mississippi River





Source: UMESC Web Site

Upper Mississippi River





Source: UMESC Web Site



Hydroscience & Engineering

Boat Reconnaissance Survey Bank Erosion Mapping

Lock & Dam 12 Tail Water

- Scarp Height > 4 feet
- Scarp Height < 4 feet</p>
- Moderate to Minor Erosion
- Stable
- Riprap / River Wall / Rock Outcrop



Geological & Soil Investigations: Objectives

- 1. Evaluate the recent historical deposits
- 2. Identify relative ages of depositional units below historical deposit
- 3. Identify buried soils (paleosols) of older Holocene age
- 4. Describe soil deposits using Unified Soil Classification System (USCS)
- 5. Discuss relative impacts to cultural resources



Soil History: Definitions

- Late Wisconsinan
- Early Holocene
- Mid Holocene
- Late Holocene
- Very Late Holocene → Less than 1,000 yrs old
- Historical

- → 20,000 to 9,500 yrs old
- → 9,500 to 7,500 yrs old
- → 7,500 to 5,000 yrs old
- ➔ 5,000 to present
- Since AD 1830 (Euro-American Settlement)





Buried native soil below historical alluvium observed at Site 4, RM 751.1 (the lighter colored upper unit is the historical deposit)





Bank face showing a profile composed entirely of recent historical alluvium at Site 39, RM 112.4





Thick historical alluvium overlying the native soil observed at Observation Site, RM 194.0 (the bottom of stadia rod indicates the native soil surface)



Bank Section Showing Rework-Transport Zone





Conclusions

- Much of the bank erosion in the upper reach of the UMR in the St. Paul District was found at dredged material placement locations and along Holocene-aged landscapes – coarser materials than those found in the downstream reaches.
- Historical deposits were thicker along the channel margin in the middle reach of the UMR. Erosion of Holocene surfaces was most severe in the upper portion of Pools.



Conclusions – cont'd

- Downstream from St. Louis, significant reworking along the channel margins was evident. Scarps are as high as 6 m.
- Flood effects appeared to be much more significant than other erosion mechanisms
- Among 75 erosion sites within the MR pools, about 43% were located in the upper quarter pool; 27% in the upper middle quarter pool; 16% in the lower middle pool; and 14% in the lower quarter pool.
- Approximately 14% of the UMR banks were estimated to be actively eroded as of 1995.



Virtual Tour of the Upper Mississippi River





Sec. And

St. Paul, MN RM 848/RK 1364



Small Town in MN





RM 825.5 RDB









RM 763.4 LDB







RM 763.0 LDB – Chippewa River Confluence





RM 746.5 LDB In-Channel Erosion







RM 728.7 RDB Just U/S of L&D 5A



RM 728.7 RDB Toe Failure

RM 728.7 RDB Resting Crew





Lock & Dam 8 @ RM 679.1

La Crosse Queen







RM 677.5 LDB









RM 669.5 RDB











Lock & Dam 11 at RM 583.0 at Bellevue, IA









RM 576.0 LDB



Fleeting Activity





Savana Depot at RM 549.6 LDB







Zebra Mussels







Beaver's Art Work







L&D 19 in Keokuk, IA at RM 576.0



Zebra Mussels in Lock-Wall Recess at L&D 19 in Keokuk

> L&D 26 in Alton, IL at RM 202.9







RM 357.6







RM 322.8 RDB







Bank Surface Scraped by Barge at RM 322.8 RDB







RM 293.0 LDB

Heavy Sand Deposit after Flood of '93 RM 293.0 LDB







RM 238.0 RDB









St. Louis Arch Near RM 180.0

Eads Highway & RR Bridge









RM 175.2 LDB







RM 168.5 LDB

RM 168.5 LDB







RM 112.4 LDB

RM 112.4 LDB







RM 112.4 LDB



RM 112.4 LDB





RM 80.0 Tower Rock





RM 53.2 LDB



RM 53.2 LDB







RM 45.3 LDB









RM 26.0 RDB









Jubilant Crew Members as the Field Trip was Coming Close to End









Sunset over the Mississippi River @ RM 0 (10-17-95)



SIZE AND AGE DISTRIBUTIONS OF FRESHWATER MUSSELS CONSUMED BY MUSKRATS IN THE MISSISSIPPI RIVER NEAR FAIRPORT, IOWA

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INTRODUCTION

While investigating the diversity in mussel species and searching for Higginsi mussel shells around a small deltaic island formed at a small creek outlet along the right bank of the Mississippi River (MR) near IA DNR Fairport Fish Hatchery (RM 463.7), we discovered abundant empty freshwater mussel shells on top of a large drift log wedged into the river bed approximately 250 ft from the bank on 17 November 2004.





Drift log and small island



Empty shells on drift log on 17 Nov 04





Empty shells on river bed



OBSERVATIONS

We cleared out all the shells on the drift log on 17 November 2004, and went back to the site the next day to find a considerable number of freshwater mussel shells on top of the log that were consumed by muskrats overnight. Since 18 November 2004 we have collected seven 1-day harvest data, four 2-days harvest, one 3-days harvest, and three 4-days harvest until the river froze on 18 December 2004.





Dinner table on 21 Nov 2004

> *Rocks and mussel shells collected on 20 Nov 2004*



We found **TEN** freshwater mussel species:

- Black sandshell (Ligumia recto);
- Butterfly (*Ellipsaria lineolata*);
- Hickorynut (Obovaria olivaria);
- Mapleleaf (*Quadrula quadrula*);
- Monkeyface (*Quadrula metanevra*);
- Pimple back (*Quadrula pustulosa*);
- Threehorn wartyback (Obliquaria reflexa);
- Threeridge (Amblema plicato);
- Wabash pigtoe (Fusconaia flava); and,
- Wartyback (*Quadrula nodulata*)





10 rocks, sticks, and barks

Leftover of Sago Pondweed salads

Sample Analysis of Rocks and Mussel Shells

Date = 11-20-04 (8 species)																	
Time Per	iod = 2	days	5														
Species	s Rocks B		Black S	lack Sandshell		Butterfly		Hickorynut		Mapleleaf		Monkeyface		Pimpleback		Threehorn	
ID	Length	Age	Length	Age	Length	Age	Length	Age	Length	Age	Length	Age	Length	Age	Length	Age	
	(mm)		(mm)		(mm)		(mm)		(mm)		(mm)		(mm)		(mm)		
1	70		71	5	76	5	54	4	61	7	58	8	52	9	41	4	
2	70				64	7	48	4	53	6	73	8	46	8	48	5	
3	65				67	7	61	10	60	6	70	8	47	9	48	5	
4	60				76	7	58	8			51	5	55	9	49	5	
5	52				74	7	65	11			62	8	50	6	49	5	
6	68				67	6	50	4			64	7	48	7	49	5	
7	68				66	6	48	5			58	5	53	7	48	4	
8	60				56	6	44	7			71	8	45	6	47	4	
9	51				68	6	57	10					55	8	52	5	
10	44				68	6							45	5	54	7	
11	53				71	6							42	5	47	3	
12	49				70	7							39	5	45	4	
13	95				65	6									45	6	
14	50				66	6									45	6	
15	56				59	5									39	6	
16	47				58	5									45	4	
17	47				62	6									46	4	
18	59														44	4	
19	54														49	7	
20	40																
21	44																
22	44																
23	35																
Average	55.7		71.0	5.0	66.6	6.1	53.9	7.0	58.0	6.3	63.4	7.1	48.1	7.0	46.8	4.9	

Mussel Species

Distribution of mussel species

Among those harvested by muskrats from the river bed there was a high percentage of **rocks** that were similar in shape and size.

Correlation between numbers of rocks and mussels harvested by muskrats

Average lengths of mussels and their ages

Frosty dinner table and a pile of empty shells on 17 Dec 2004

Sago Pondweed at the site

A pearl found on dinner table

SUMMARY OF OBSERVATIONS

• The observation site appears to be an ideal mussel habitat with sand and gravel bed material, and good food supplies from a small creek.

• *Muskrats in the observation site are likely feeding on mussels due to a lack of desirable plant food sources such as cattail and arrowhead.*

• The size of mussels harvested by muskrats appears to be limited to about 47 mm (Wabash pigtoe) to 65 mm (butterfly) and their ages are about 6 to 7 years old, indicating that years 1997-1998 were productive years for these species.

• Empty mussel shells were found to be very clean inside, indicating that muskrats are able to open mussel shells after harvesting and consume all the meat overnight.

• Approximately 27% of muskrat's harvests are rocks whose sizes are similar to mussels harvested.

• The maximum weight of rocks harvested was 197 grams.

• Although there are many plain pocketbooks in the habitat, muskrats appear not to be able to harvest them due to their size and weight – one large black sandshell (133 mm) was harvested, but it was not able to be opened.

• Muskrats appear to bring Sago Pondweed up to the log and consume them as salad with mussels.

• A pearl was found on the log unconsumed, apparently left discarded by the muskrats unconsumed because of its hard substance.

• Our immediate target was to videotape muskrats bringing their harvest and opening shells. Particularly, we are interested in understanding how they crack hard shells open. Unfortunately, the log was washed downstream by 100 ft during the spring flood of 2005 and eventually broken to several pieces and washed away. We hoped that they would come back to the same log so that we could document the mighty power muskrats demonstrate when opening freshwater mussel shells.

Thank you

