RELATIVE ABUNDANCE OF SPINEY SOFTSHELL TURTLES (*Apalone spinifera*) ON THE MISSOURI AND YELLOWSTONE RIVERS IN MONTANA

FINAL REPORT

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Abstract

In 2003, the Missouri River Natural Resources Committee (MRNRC) Wildlife Section advocated developing a survey for the relative abundance of softshell turtles (*Apalone sp.*) on the Missouri River system. Softshell turtles were selected because they occur throughout the system and there was some information suggesting that they may have been impacted by system operations. As a common riverine species, there were possibilities that softshell turtles may have been impacted because of the timing, level, and temperature of river flows as well as by dam construction and bank stabilization. In addition, there were reports from other areas in the species range that they may be especially sensitive to human disturbance. From 2004 through 2008, State and Federal agencies and Pacific Power and Light in Montana sampled the Missouri River from Great Falls, MT, to the confluence of the Missouri and Yellowstone (except Fort Peck Reservoir) as well as they Yellowstone River from above Billings to the confluence. Sampling consisted of setting turtle traps every two river miles and checking for three days. Turtles captured were measured, marked, and released. Results of the sampling efforts indicated high relative densities above Fort Peck Reservoir and variable densities on the Yellowstone. No spiny softshells were found below Fort Peck or on the Yellowstone below Sidney, MT. Possible reasons are presented and recommendations for future program direction as well as potential system modifications to benefit this species are discussed. Fundamentally providing for warm water releases below Fort Peck Dam has the potential to allow turtles to reoccupy that stretch as well as benefit a variety of other species and people.

Introduction

During 2003, the member states of the Missouri River Natural Resources Committee (MRNRC) Wildlife Subcommittee agreed to document the relative abundance of softshell turtles (*Apalone*

sp.) on the Missouri River. This project was a cooperative effort between the MRNRC Fisheries and Wildlife Subcommittees as well as the state and federal agencies working on the Missouri River.

From 2004-2008, the Montana Department of Fish, Wildlife & Parks, along with the U.S. Fish and Wildlife Service, Bureau of Reclamation, Pacific Power and Light, and other cooperators assessed the relative abundance of softshell turtles in Montana.

Two species of softshell turtles inhabit the Missouri River system: The Spiny Softshell (*Apalone spinofera*) and the Smooth Softshell turtle (*Apalone mutila*), however only the spiney softshell is found in Montana. It is a state species of concern and Tier 1 species (highest priority) on the State Conservation Plan.

The following species description of spiney softshells in Amphibians and Reptiles of Montana by J. Kirwin Werner et al. Distribution maps are from the Peterson Guide to Western Reptiles and Amphibians by Robert C. Stebbins (1985).

Spiny Softshell (Apalone spinifera) *Apalone* comes from the Latin *apalos*, "soft." Also in Latin, *spinifera* means "thorn bearing."

Spiney softshells are uniquely shaped with flat bodies, pointed snouts, and a flexible, oval upper carapace, or shell. The carapace lacks bony plates; instead, it is covered with a rough, leathery, sandpaper-like skin. Conical spines stud the front edge of the carapace, which is olive green to tan and dotted with prominent eye-like spots called ocelli. The ocelli are very noticeable in males and juveniles, but less so in females, where a series of blotches may override them. The spiny softshell's long neck ends in a narrow snout and sharp, yellowish jaws. Beginning at the nostril, a yellow stripe with a black border runs through the eye onto the side of the neck. Another dark line runs from the jaw back along the neck. The ventral shell, or plastron, is cream-colored, lacks a hinge, and is somewhat translucent, revealing the underlying bones. The feet are extensively webbed, and the tail is short. In males, the vent opening extends beyond the edge of the carapace. In females, it is within the margin of the carapace. Females are much larger than males, with a carapace length of 7 to 18 inches (18 to 46 centimeters) compared to the male carapace length of 5 to 7 inches (12 to 18 centimeters).

Hatchlings: Hatchlings resemble adults in shape and color except that the snout is more upturned, the carapace is smoother, and the spines on the front of the carapace are not fully developed. Hatchling carapace length is 1.2 to 1.7 inches (30 to 44 millimeters).

Eggs: Spiny softshell eggs are white, round, brittle, and about 1.1 inches (30 millimeters) in length. Clutch size varies from four to thirty-nine eggs with a norm of twelve to eighteen.

Taxonomy/Distribution

Six subspecies of spiny softshells range across Mexico and North America. The subspecies in Montana, the Western Spiny Softshell (*Apalone spinifera hartwegi*), occurs primarily in the Midwestern United States. Montana populations of spiny softshells occur along the Missouri and Yellowstone Rivers and their immediate tributaries. The apparent absence of spiney softshells along the Missouri River in the Dakotas indicates that populations in Montana may be isolated from those in the central United States. Further fragmentation and isolation may be occurring among the populations along the Missouri River in Montana. The highest elevation in

the state at which spiny softshells have been documented is 3,600 feet (1,097 meters) on a tributary of the Tongue River in Big Horn County.

Habitat/Behavior

The first glimpse of a spiny softshell is usually of its snout which looks like a floating twig or bubble on the surface of water. An inhabitant of larger rivers and reservoirs, the spiny softshell becomes active in late April or May, basking on the edges or wading in shallow water in search of such food as clams or crayfish. Studies in other states indicate that adults may forage along a mile (1.6 kilometers) of river. Most feeding occurs during the day, but the turtles remain active during the night. Because spiny softshells dehydrate much faster than hardshell turtles, they are rarely found far from water. They respire both with their lungs and through the skin, the latter allowing them to stay underwater for long periods. Spiny softshells bask alone or in small groups and are extremely wary of approaching individuals, dashing into the water at first notice. When handled, they may stay calm or they may hiss, bite, scratch vigorously, or emit cloacal secretions. Skunks and raccoons prey on the eggs, and wading birds and some mammals eat the young turtles. Individuals probably overwinter in the same area in which they are active during the summer.

Reproduction/Development

Spiny softshells mate in May or June. Sperm can remain viable in the female's oviduct for an extended period. About a month after mating, the female seeks out an area of sand or sand and gravel in which to build a nest, usually 100 yards (91 meters) or less from water. If conditions turn out to be unsuitable in one place, she tries another. With her hind feet, she digs a flask-shaped nest about 10 inches (25 centimeters) deep, excreting fluid from the bladder to loosen up the soil. Digging the nest, laying eggs, and covering them takes an hour or more. If disturbed in the process, the spiny softshell female may flee back into the water, abandoning the attempt altogether. Females produce one or two clutches of eggs per year; eggs incubate in the nest for fifty-two to ninety-five days. Some hatchlings may overwinter in the nest, but this is not the norm. Sex of spiny softshell offspring is not temperature dependent; usually a one-to-one sex ratio is seen in hatchlings. Males reach sexual maturity when their ventral shells measure about 4 inches (10 centimeters); females, at about 8 inches (20 centimeters). In captivity, spiny softshells lived to over twenty-five years.

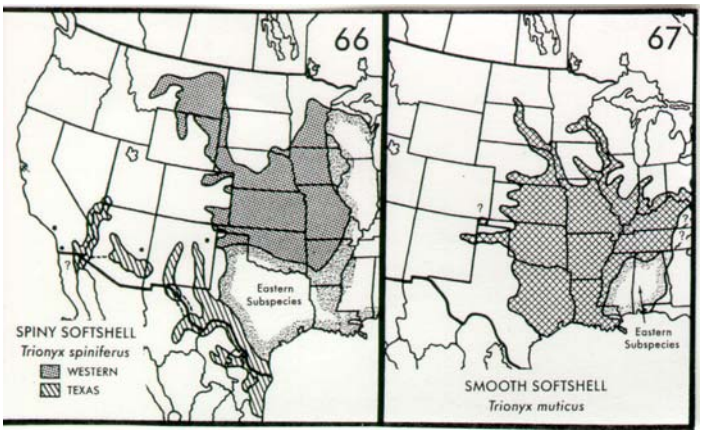

Figure 1. Distribution of spiny and smooth softshell turles in the Unites States.

Soft-shelled turtles were surveyed because they were known to occur throughout the Missouri system and information on the species could prove valuable in future management decisions. There is currently very little known about the relative abundance of these two species on the Missouri River system. This project was an attempt to gather baseline information on their relative abundance to assist with future management changes which may occur on the system and to guide current management to ensure that these species don't become threatened or endangered in the future. There is reason to believe that these species may be affected by changes which have occurred to the Missouri and Yellowstone Rivers. As was noted in the species description, softshells are seldom far from water and likely overland dispersal distances are limited. Therefore, major dams on the Missouri have potentially blocked connections between river segments and fragmented populations (Fig 2).

Figure 2. Fort Peck Dam on the Missouri River.

Current information indicates these species are generally riverine, and their use of reservoirs on the Missouri is probably limited but currently unknown. In addition, the major reservoirs have the added potential to isolate populations of these species (Fig. 3).

Figure 3. Fort Peck Reservoir.

Because turtles are reptiles and need warm water to be active, forage, reproduce, and ultimately survive cold water flows below dams have probably also restricted their distribution (Fig. 4).

Figure 4. Powerhouse at Fort Peck Dam with coldwater discharges.

When nesting, they need banks which are sufficiently soft so they can dig their nest burrows, and bank stabilization programs have probably impacted this species by changing these areas to rock or other substrates unsuitable for softshell turtle nesting (Fig 5).

Figure 5. Bank stabilization on Fort Peck Dam.

And finally, flow management has the potential to impact these species by flooding nests with high summer flows or dewatering areas the turtles are using to survive the winter (Fig. 6).

Figure 6. Island showing wetted area as a result of flow fluctuations.

An understanding of where these species occur and their relative abundance will help us address these and other issues in the future.

Methods

From 2004-2008, the Missouri River in Montana was sampled from Great Falls to the confluence of the Missouri and Yellowstone Rivers and the Yellowstone River from the mouth of the Clark's Fork River above Billings to the confluence. Sample sections generally consisted of 50 mile stretches of river modified (longer or shorter segments) as logistical considerations dictated.

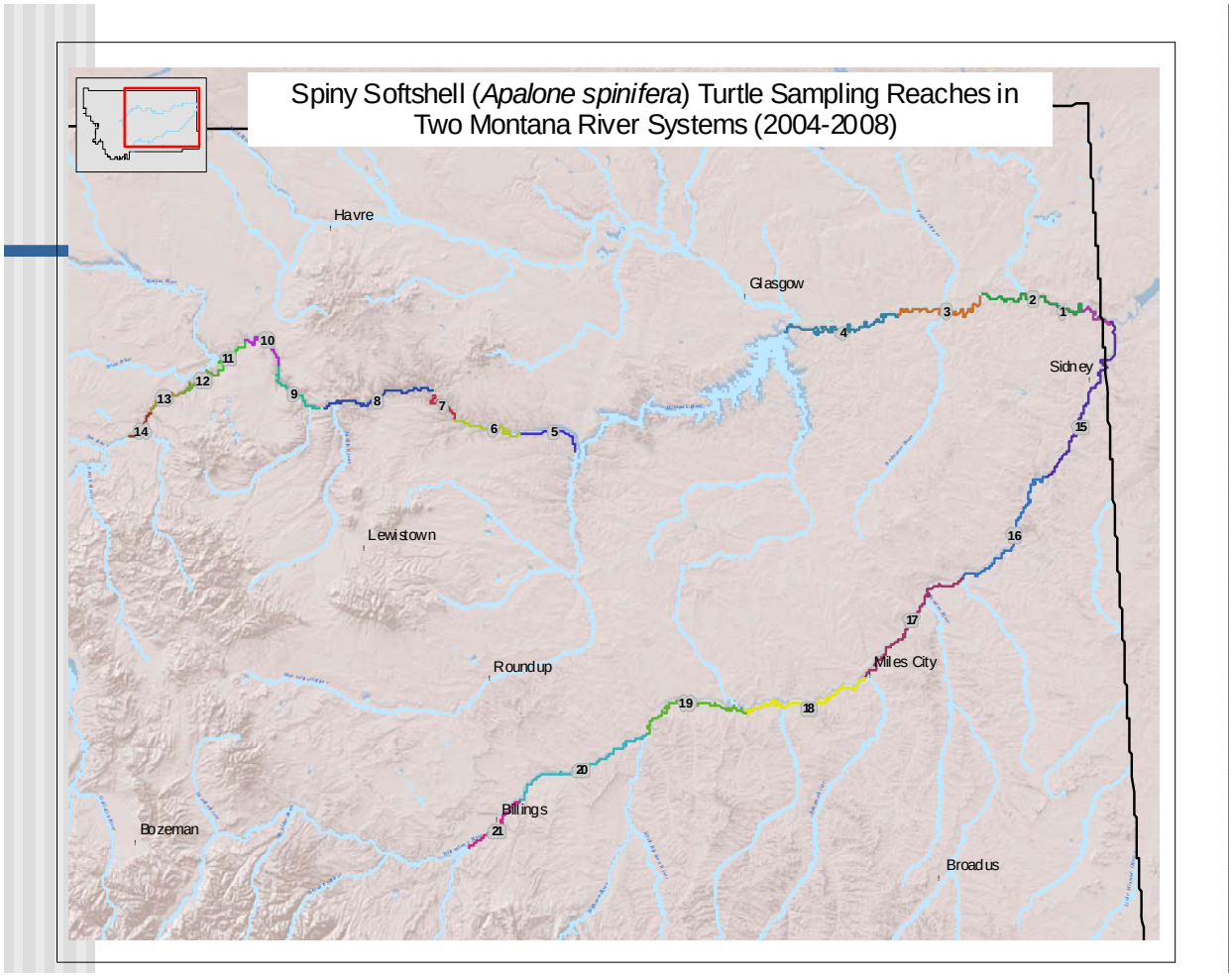

Figure 7. Spiny softshell turtle sampling reaches in two Montana river system (2004-2008).

Seven foot turtle traps with 3 foot hoops and 1 or 2 inch mesh (Memphis Net and Twin Co., Inc.) were set at 2-mile intervals on the selected stretch. Traps were set in the nearest suitable habitat (for example, upstream of deep holes, adjacent to side channels, above shallow sandbars, etc.) and GPS location recorded. Each trap was baited with fresh or previously frozen fish (generally carp and carp pieces). Bait was contained in a three-pound metal can with holes punched in to prevent turtles from accessing the bait. Bait cans were secured to the forward hoop inside the trap with a short piece of chain which allowed the can to be positioned approximately half submerged. Traps were secured with a metal fence post on the up current end and with two 4-foot rebar posts on the down current end. The traps were set in such a manner that accounted for possible fluctuations in river levels and with sufficient netting exposed so turtles could obtain air and avoid drowning.

Figure 8. Turtle trap.

Figure 9. Bait can.

Traps remained in place for three nights and were checked each morning. Additional bait was added to the can after the second night. Traps were set from mid-July to late August to coincide with the periods of greatest turtle activity. Each day when traps were checked, the number and species of turtles caught was recorded. Each softshell turtle was measured (carapace length and width), weighed, and the sex recorded.

Figure 10. Measuring a soft shell. A damp burlap sack kept the animals calm.

Figure 11. Weighing a soft shell

Animals were individually marked using metal monel tags from National Band and Tag Company (3/4 inch for small turtles and 1-1/8 for larger specimens). The tags were individually numbered and placed on the rear of the carapace punching them through the carapace with tagging pliers.

Figure 11. Softshell showing monel tag on the rear of the carapace.

All animals were then released at their capture sites. All handling and tagging procedures were reviewed and approved by the Montana Department of Fish, Wildlife & Parks Institutional Animal Care and Use Committee (IACAC #4-2007).

The index of relative abundance developed was as follows:

$$\text{Index} = \frac{\text{no softshells caught}}{\text{Number of Trap Nights}}$$

(one trap for one night = 1 trap night)

for each stretch of river sampled. Traps which were non-functional due to holes (probably as a result of raccoon, beaver, or muskrat activities) or some other reason were not considered as part of the index.

This allowed for comparison of relative abundance for the river reaches sampled. It also provided some valuable information on other species of turtles in different reaches. These in turn will provide baseline information for future monitoring, identify reaches and tributaries for more detailed study, and allow monitoring changes if river management should change.

Results

Relative density by reach and a summary of captures are presented on Figure 12 and Table 1. The highest relative densities were found above Fort Peck Reservoir and on the Yellowstone River between the mouth of the Bighorn River and Forsyth, Montana. No softshell turtles were captured below Fort Peck Dam and the confluence. Also, no softshell turtles were captured below Sidney, Montana, to the confluence on the Yellowstone.

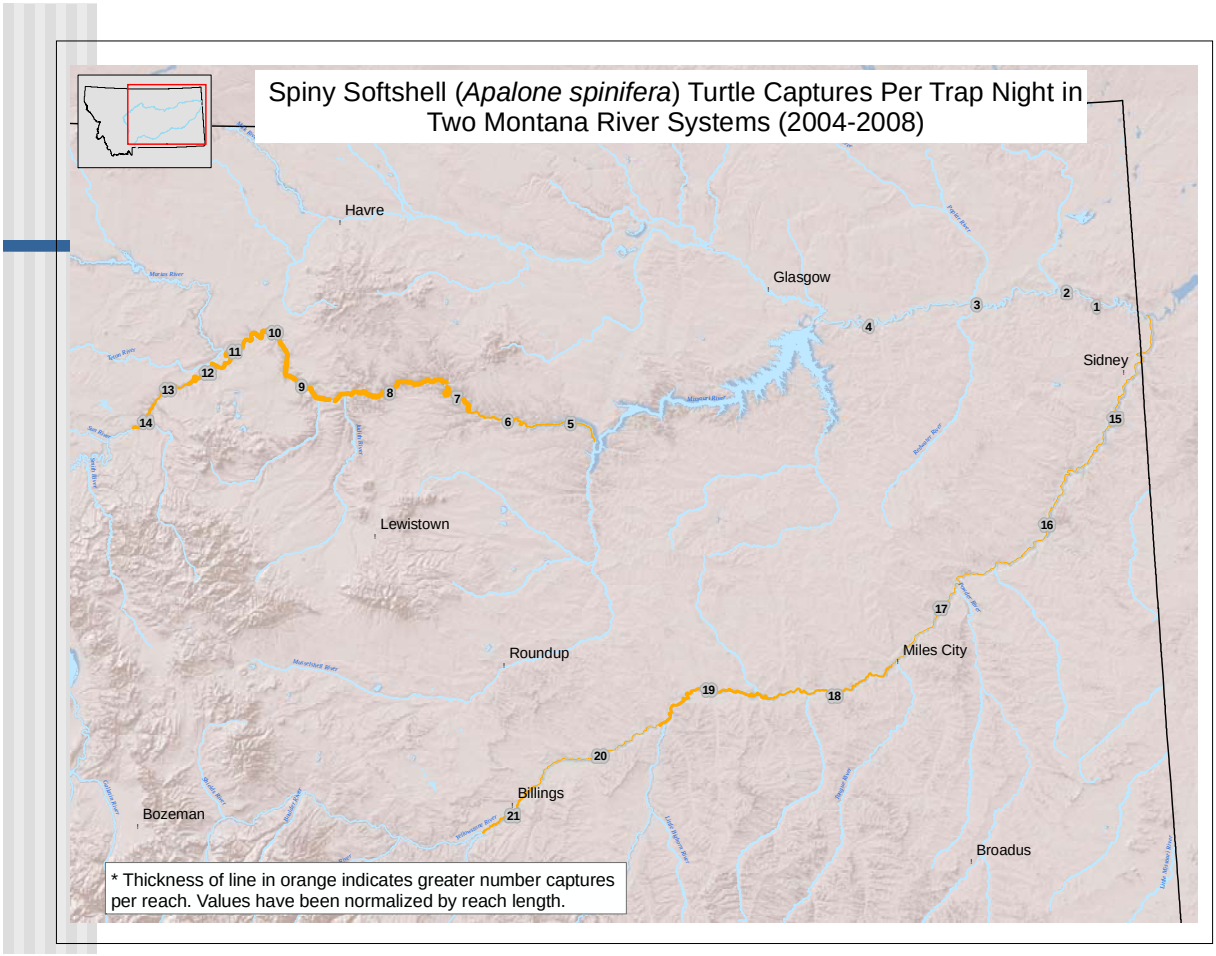

Figure 12. Spiny softshell turtle captures per trap night in two Montana river systems (2004-2008).

Reach Table

Reach ID	ReachDescription	Year	Trap Nights	# Turtles	Turtles/ Trap Night	Turtles/Trap Night (Normalized by Reach Length)
1	Yellowstone confluence to Culbertson	2005	78	0	0.00	0.000
2	Bainville to Brockton	2004	75	0	0.00	0.000
3	Brockton to Wolf Point	2007	75	0	0.00	0.000
4	Wolf Point to Confluence with Milk	2006	90	0	0.00	0.000
5	Mouth of Musselshell River to Nichols Coulee	2007	36	16	0.44	0.019
6	Nichols Coulee to Robinson Bridge	2006	51	21	0.41	0.013
7	Robinson Bridge to Power Plant area	2006	24	46	1.92	0.128
8	Power Plant area to Judith River	2008	69	423	6.10	0.139
9	Judith River to Hole-In-the-Wall	2007	39	223	5.71	0.228
10	Hole-In-The-Wall to Coalbanks Coulee	2007	30	94	3.13	0.149
11	Coalbanks Coulee to Marias River	2006	30	55	1.83	0.087
12	Marias River to Fort Benton	2006	36	48	1.33	0.060
13	Fort Benton to Carter Ferry	2006	24	9	0.38	0.024
14	Carter Ferry to Widow Coulee FAS	2007	21	11	0.52	0.040
15	Confluence to Intake Diversion	2005	96	7	0.07	0.001
16	Intake Diversion to Fallon Bridge	2004	75	24	0.32	0.006
17	Fallon Bridge to Miles City	2006	84	37	0.44	0.008
18	Miles City to Forsyth	2007	81	97	1.19	0.022
19	Forsyth to Ranchers Ditch	2008	87	149	1.71	0.030
20	Ranchers Ditch Diversion to Huntley Diversion	2008	108	19	0.18	0.003
21	Huntley Diversion to Clarks Fork Confluence	2007	42	17	0.40	0.015

Table 1. River reaches sampled and numbers of trap nights, turtles caught, and relative abundance index.

Turtles captured ranged from individuals estimated to be one year old and weighing a few ounces to adults weighing in at 15.5 pounds (Figs. 13 and 14). The technique as applied did not detect hatchlings, probably as a result of them being able to escape through the mesh or they were located in different habitats and not sampled (possibly found in tributaries or other shallow waters). The technique was efficient at detecting relative densities, and no turtle mortalities occurred during the entire effort.

Figure 13. Large adult female softshell.

Figure 14. Hatchling softshell

Sexing turtles proved to be problematic initially (Figs. 15 and 16). However, utilizing a combination of characteristics improve accuracy as the project progressed. During the first years, there were probably significant errors in sex determination.

Figure 15. Differing coloration of females and males.

Figure 16. Vent inside carapace edge on females, outside carapace on males.

Because we now have a significant sample of marked individuals (1296 individuals from this project alone), we are starting to detect some amazing movements of these animals (Figs. 17 and 18). One individual marked in 2006 was recaptured by a fisherman on hook and line in 2008 after moving 50 miles downstream on the Missouri from the capture location and then 51 miles upstream on the Musselshell River for a total of 101 miles.

A 6.7 lb. Female moved 10 miles downstream in 2 days. One male moved 2 miles upstream in 2 days. Remarkably, one male moved 58 miles downstream in one year.

Limited data on growth and movements of turtles was also obtained from individuals tagged by Dennis Flath for PPL 6 years ago during a previous project on the Missouri River above Fort Peck. We recaptured four of these animals. One female moved 82 miles downriver in that time. The growth information from this limited sample shows that males grew very little and females grew more. Two males tagged 6 years ago grew 12-23 mm and gained almost zero weight. Two females tagged 6 years ago grew 61-88 mm and gained 3.0-4.2 pounds.

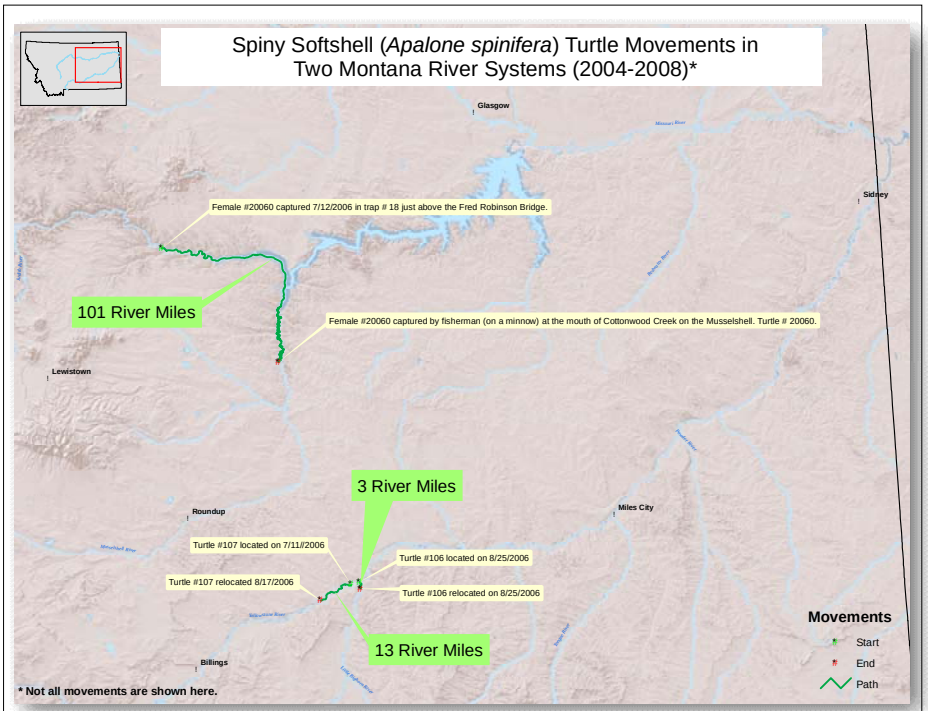

Figure 17. Sample movements of spiny softshells.

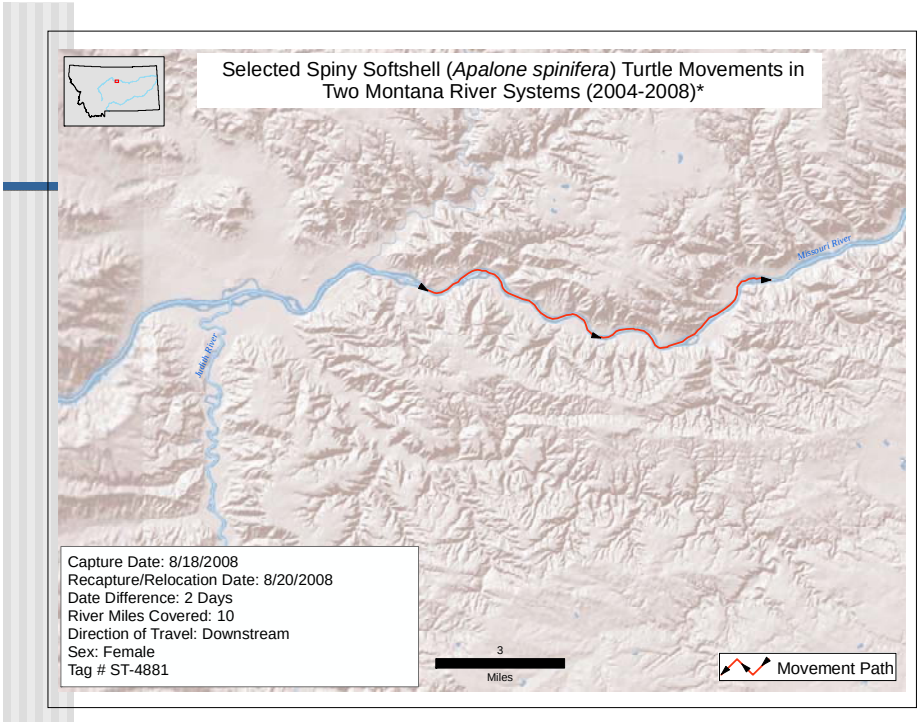

Figure 18. Short term movement of a 6.7 pound spiny softshell female.

There was one interesting side-by-side comparison of male vs. female growth. Flath tagged a male and a female of identical size (197 mm; 1.56 lb) at the same spot (RM1939.8). Six years

later, the male grew 12 mm while the female grew 88 mm. The male gained no weight; the female gained 3 pounds.

Hopefully we will continue to obtain additional information as a result of these marked individuals in future years. While the animals tagged by Flath had been carrying tags for 6 years with no apparent ill effects. We did catch a few animals tagged during the index sampling effort who may have experienced loss of their mark (Fig. 19).

Figure 19. Softshell turtle with possible tag loss.

Discussion

Very little is known of the life history of this species. Questions as to seasonal use patterns of the system, nesting areas, wintering areas, longevity, mortality factors, etc. persist. Also, the importance of tributary streams to their survival is unknown. It is apparent that there has been some impacts from the changes in the system, particularly below Fort Peck. While there have undoubtedly been impacts from bank stabilization which has made areas unsuitable for turtles, the lack of detection below Fort Peck dam is probably tied to cold water releases from Fort Peck Reservoir. For softshell turtles to be active at levels which allow them to meet their survival needs current indications are they need to be in water temperatures above 65° F during summer months. Cold water releases have lowered water temperatures all the way to the confluence and keep temperatures at that level or slightly above for most of the period turtles were active (June-August). While current data doesn't allow for possible differences in habitat suitability to be determined, it is unlikely that all of the areas inundated by Fort Peck Reservoir and those below the dam were unsuitable habitat. It is reasonable to identify cold water discharges as a potential impact.

Finally, some of the turtles captured showed carapace damage. Some of these could clearly be related to direct damage due to predator attack. However, other damage appears to be related to disease. It is also possible that pollution of some sort may be impacting turtles, at least in some areas.

Figure 20. Softshell turtle with carapace damage.

Figure 21. Softshell turtle with severe carapace damage.

Recommendations

The Missouri River management agencies would benefit from the following:

1. More detailed information on the life history of this species could help in fine tuning the management of the system. Because we know so little about this species, it would be beneficial to move forward with more detailed investigations into their lift history utilizing radio telemetry. Knowledge of movement patterns, use of tributaries, etc., from telemetry could all be beneficial in allowing for more effective management of these rivers. For example, if tributary streams are critical for reproduction, it would be important to maintain sufficient water flows to allow for continued use by turtles. Meeting this same need would benefit native fisheries as well.

Figure 21. Softshell with radio transmitter attached.

2. Because this species is sensitive to human disturbance, understanding how it uses habitats, especially those for nesting would assist in locating future developments such as public access sites to avoid impacts. Very few softshell turtle nests have ever been located in Montana. Whether or not nesting is concentrated in a few areas or

widely dispersed is unknown. This information if available would assist in locating public recreation sites, river crossings, and so forth.

Figure 22. Nesting softshell on the Missouri River.

Figure 23. Softshell turtle nest.

3. By better understanding their use of bank habitats, we can get a more complete picture of the negative impacts of bank stabilization and provide recommendations as to which areas would be inappropriate to modify. Significant portions of the banks of these rivers have been modified by human activities. The impacts of these may be more apparent on how they impact softshells, but understanding those impacts and mitigating them should benefit many other species as well.
4. And by understanding the impacts of cold water releases, we can more fully evaluate the effects of these on other species (warm water fish, piping plover, etc.) and potentially modify the system to benefit turtles and ultimately make these river reaches more desirable for people. It is very possible that by running warmer water through the Fort Peck powerhouse, softshell turtles could recapture their habitats below the dam.

Figure 23. The last trap checked on this project in August 2008.

Acknowledgements

This project was funded by Montana Fish, Wildlife & Parks using State Wildlife Grant (SWG) funds as well as Federal funds from the U.S. Fish and Wildlife Service, Bureau of Reclamation, and private funds from Pacific Power and Light. In addition, the Army Corps of Engineers and other agencies provided in kind support. Thank yous are due to all the fish and wildlife colleagues as well as numerous family and friends for all of their hard work that made this project possible.