Western Range Expansion of the Black Sandshell Mussel in Montana

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Abstract

Newly discovered populations of the black sandshell mussel (*Ligumia recta*) from the Missouri and Marias Rivers in east-central Montana extend the species known range to its farthest western point in the United States and North America (west of 110° longitude). The black sandshell is an introduced mussel in Montana and has become common and abundant in the Missouri River drainage since its establishment in Fort Peck Reservoir in the 1940's. Despite the increased distribution of the black sandshell westward across the prairie rivers of Montana, elsewhere in their native range, the species is declining. This is a species of conservation concern in 21 states. Habitat conditions and host fish abundances that are allowing this species to thrive in Montana's rivers might provide valuable information for the conservation needs of this species in native states where it is now in decline.

Keywords: *Ligumia recta*, Black Sandshell, Freshwater Mussels, Unionidae, Montana

Introduction

The decline of freshwater mussels (Unionidae) in North America and worldwide has caused this family to be listed as one of the most imperiled on the planet (Williams et al. 1993, Allen and Flecker 1993, Stein et al. 2000). The conservation status of the black sandshell mussel, *Ligumia recta* (Lamarck, 1819) is listed as G4G5 "apparently secure" globally (G5 is globally common), because declines appear to be localized and the species maintains a wide distribution with many stable populations (Nature Serve 2013). The black sandshell is a wide-ranging species native to the eastern and central U.S. and Canada, occurring from the Great Lakes basin south into Mississippi River drainages to Louisiana and in some Gulf Coast drainages (Cummins and Meyer 1992). However, throughout much of its native distribution, the black sandshell is a species of conservation concern in 21 of the 24 states (two states [Nebraska and Georgia] report this species as possibly extirpated) in the United States and two of the four provinces in Canada (Nature Serve 2013). The American Fisheries Society also classifies the black sandshell as a North American species of special concern (Williams et al. 1993). Lately, many states are reporting that the black sandshell is becoming increasingly more difficult to find with occurrences represented by fewer individuals, and often without evidence of recruitment (Angelo and Cringan 2003, NatureServe 2013).

The black sandshell is an introduced species in Montana and has become common and abundant in the Missouri River drainage since its dispersal from glochidia (mussel propagules) attached on the gills of game fish introduced into Fort Peck Reservoir in the 1940's, as postulated by Gangloff and Gustafson (2000). Prior to the 1940's, the presence of this large (up to 20 cm) distinctive mussel was not mentioned in the extensive Missouri River collections of Henderson (1924, 1936) across Montana where there are now currently known populations. Nor have they been reported in the Missouri River downstream of Fort Peck Reservoir in North Dakota (Cvancara 1983) or in the lower Yellowstone River (Gangloff and Gustafson 2000, Stagliano 2010) (Fig. 1).

In the case of the black sandshell, suitable habitat and the presence of multiple host fish species (Percidae) in Montana's Missouri River reaches are likely two

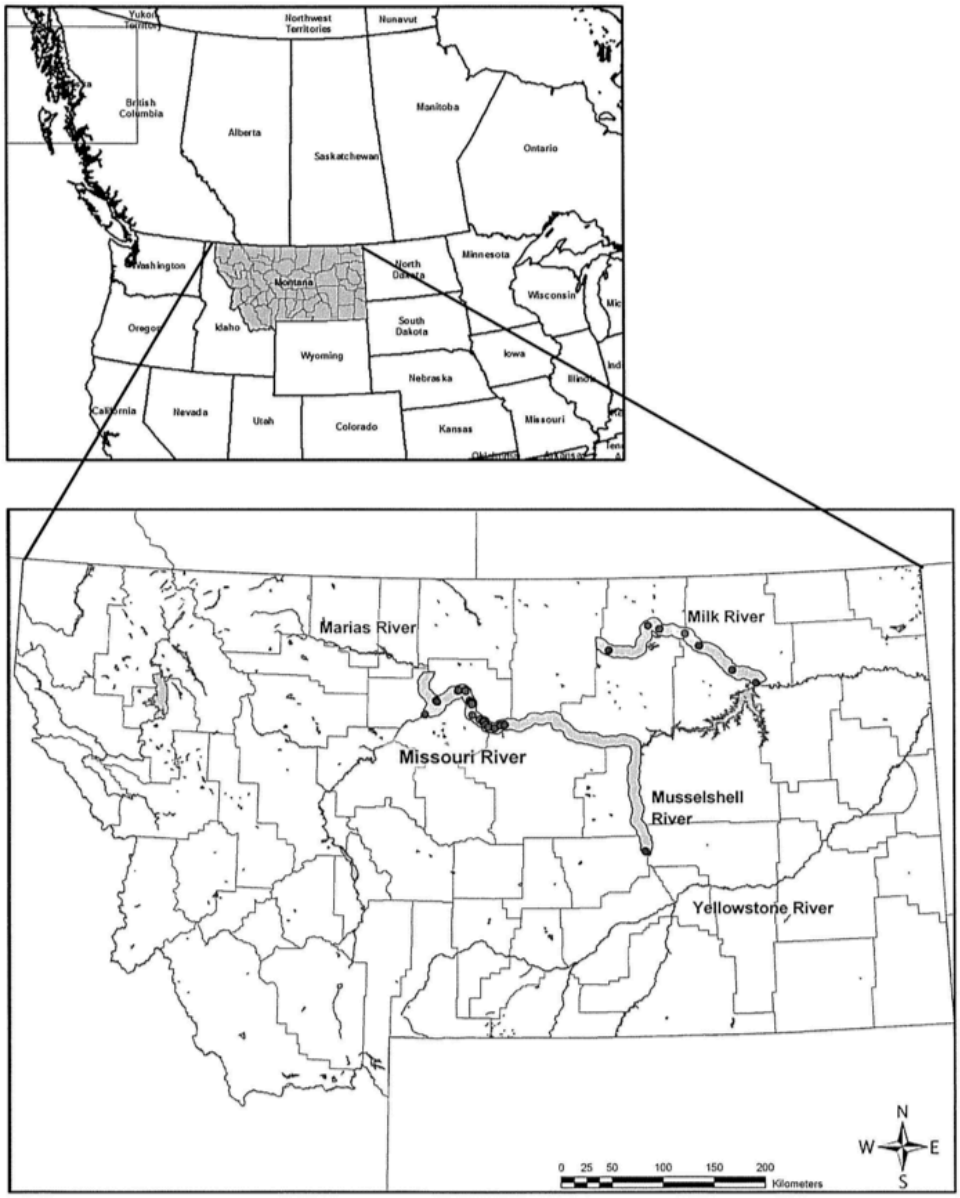

Figure 1. Black sandshell mussel records (dots) and distribution (shading) in Montana's rivers.

conditions responsible for supporting more robust and viable populations than in its native sections of the Missouri River hundreds of miles downstream in South Dakota and Iowa where it is listed as imperiled (S1) (Nature Serve 2013). Three of the known host fish species (walleye, sauger and yellow perch) (Cummins and Mayer 1992, Khym and Layzer 2000) for this mussel occur in the Missouri and Marias Rivers (MFISH 2013) which is a contributing factor to the mussel's persistence. Gangloff and Gustafson (2000) proposed that large portions of Montana's warm-water river reaches may serve as nursery refuges for non-native mussel species that are imperiled elsewhere. More recently, a newly discovered black sandshell

population in Canada has extended its range further north and west in the province of Saskatchewan (latitude 53°4 N, longitude 106°00W) (Phillips et al. 2009), but the authors do not speculate if this is an introduced population or undetected in prior surveys. Here, we report collections of the black sandshell from three locations on the Missouri (latitude 47°7 N, longitude 110°8 W) and Marias Rivers (latitude 47°9 N, longitude 110°5 W), that are approximately 26 river kilometers west (upstream) of any previously documented Missouri River occurrences and newly reported for the Marias River watershed (Table 1, Fig. 1).

Table 1. Location and collection information for the westernmost black sandshell records in Montana.

Stream	4th Code HUC	Latitude	Longitude	County	Date	Observer	Site Location
Marias River	10030203	47.9442	-110.5197	Liberty	19-Aug-09	Stagliano, David	Marias River, 0.7 km upstream of Loma Bridge
Marias River	10030203	47.9323	-110.5092	Liberty	19-Aug-09	Stagliano, David	Marias River, 0.25 km upstream of Loma Bridge
Missouri River	10040101	47.7626	-110.8689	Fergus	19-Aug-09	Stagliano, David	Missouri River downstream of Carter Ferry Crossing
Missouri River	10040101	47.7633	-110.8700	Fergus	07-Sep-11	Leathe, Steven	Missouri River downstream of Carter Ferry Crossing

Methods

From 2007-2010 the Montana Natural Heritage Program (MNHP) lead a statewide mussel survey to update historic records and determine population and distributional status of the six mussel species reported in the state (Stagliano 2010). The survey was not randomized. We targeted rivers within watersheds that had prior documented mussel records (Gangloff and Gustafson 2000) or incidental reports from anglers or biologists. We sampled at publically accessible river locations, usually highway bridges, BLM owned land or Montana Fish Wildlife and Parks Fishing Access Sites (FAS) within drainages where mussels were documented in previous reports. We used aquascopes (glass-bottomed buckets) and snorkeling along longitudinal transects moving in an upstream direction within preferred habitats of streams and rivers (Young et al. 2001). We recorded initial transect survey start and end points with a Garmin 60S GPS handheld unit, so site location and distance effort could be replicated. Time per search was recorded so that numbers of mussels could be represented as catch per unit effort (CPUE) in man-hours, as well as in mussels per unit distance (meters). Typically, we devoted at least one man-hour of search time to a site, while transect distance was determined by habitat suitability. We identified, measured and photographed live individual mussels encountered during survey transects. We placed live mussels back into the substrate as close as possible to where they were extracted. Empty shells encountered during the surveys were kept for vouchers and represented a record of species presence at the site, if live individuals were not found. Specimens of black sandshell were identified with keys (Clarke 1973, Clarke 1981, Cummings and Mayer 1992) and empty shells were sent for verification by outside malacologists. We deposited voucher specimens in the malacology collections of North Carolina State

University (Durham, NC) and the Montana Natural Heritage Program Voucher Series (Helena, MT).

Results

This study documented 32 new occurrences of the black sandshell across Montana (Fig. 1). We revisited eight of the nine previously known populations and found them viable and persisting. We found the highest black sandshell catch rates (averaging 4 individuals per hour, n = 14 sites) in the Missouri River Designated Wild and Scenic reach between Coal Banks Landing and the Judith River (3237-3163 River kilometers, rkm). In the expanding edge of the population in the Marias River (2 rkm) we found 1.5 individuals per hour of search (n = 2 sites). The identification of black sandshell mussels from Carter Ferry Crossing on the Missouri River (3282 rkm) in 2009 and 2011 increased the known distribution in that river approximately 26 kilometers further upstream than previously known from 2006 (Table 1). We also found robust populations in the Milk River, a tributary to the Missouri River whose confluence with the Missouri River is below Fort Peck Dam. These populations were from near Dodson, MT (437 rkm) downstream to Malta, MT (376 rkm), and also represent an upstream (westward) expansion of this species (Stagliano 2010) (Figure 1). The black sandshell population on the Musselshell River reported in 1998 (Gangloff and Gustafson 2000, Figure 1) was not revisited, but other Musselshell River sites upstream have been surveyed without finding black sandshell.

We collected six paired valves (shells) of the black sandshell along the stream margins of the Missouri and Marias River sites. We found four live specimens which we measured, photographed and returned to the Marias River (Table 1, Figure 1).

Montana Collections include: *Ligumia recta* (Lamarck, 1819): Marias River upstream of Loma Bridge: (47.9442 N, -110.5197 W), 19.viii.2009, D.M. Stagliano (2 live individuals, 95-100 mm). Marias River upstream of Loma Bridge: (47.93233 N, -110.50923 W), 19.viii.2009, D.M. Stagliano (2 live individuals, 100-105mm; 2 recent shells, 75 and 110 mm). Missouri River at Carter Ferry Crossing: (47.76329 N, -110.87001 W), 19.viii.2009, D.M. Stagliano (0 live individuals; 4 recent shells 90-120mm) and 7.ix.2011, S. Leathe (0 live individuals; 8 recent shells 90-140 mm). Other mussels collected in the Marias River reach were the giant floater (*Pyganodon grandis* [Say]) and the fatmucket (*Lampsilis siliquoidea* [Barnes]); while just the fatmucket was found at the Missouri River reach. The Marias River in this survey area flows through river bottom gallery forest dominated by cottonwoods, green ash and boxelders. At the time of our survey, turbidity was 8 NTUs, water temperature was 20.5°C, specific conductivity was 563µS, maximum depth was 1.5 m, and wetted width averaged 45 m. The 300m riffle, run, pool survey reach was dominated by gravels and pebbles (75%), with cobble beds in the riffle (15%) and silt depositional areas (10%). The Missouri River at Carters Ferry Crossing is a wide shallow channel (~100 m wetted width) dominated by run/glide habitat flowing through a dry valley bottom, with sparse riparian forest dominated by shrubs, green ash and few cottonwoods. At the time of our surveys, turbidity was 5 NTUs, water temperature was 21.0°C, specific conductivity was 565µS, and maximum depth in the thalwag was 2.0 m. The study reach was dominated by large cobbles (60%), with smaller sections of gravel and pebbles (25%) and silt depositional areas (15%).

Discussion

Prior to this study, only nine black sandshell occurrence records were in the MNHP database and none were reported from the Marias River (Gangloff and Gustafson 2000). The current study added 32 population records extending the range further west (upstream in the Missouri River) and north (upstream into the Marias) into east-central Montana. Including this 26 km expansion, the black sandshell currently occupies approximately 218 river kilometers

of the Missouri River and 2 km of the Marias River. This upstream expansion may be even larger as we only found empty shells at the Missouri River Carter Ferry Site, no live individuals. The next Missouri River site that surveys produced no evidence of the black sandshell was 20 km further upstream.

To understand what river conditions are allowing the black sandshell to expand in Montana while the species is significantly reducing its river occupancy in native states, we evaluated two population expansion sites (Marias and Missouri Rivers). The Marias and Missouri Rivers are both large, warm-water prairie rivers that flow through sparsely and undeveloped rural ranching country of central and eastern Montana. Though largely undeveloped, both river systems experience dam-mediated, hydrologic effects from upstream reservoirs, and can be substantially affected by agricultural activities, especially irrigation. Habitat disturbance, increased siltation and environmental stresses induced by low-flow discharge and dam-flow fluctuations are cited by Pip (2000) as major causes of mussel population declines in western Canada. Dams and channelization have been casually linked to black sandshell declines in Kansas (Angelo and Cringan 2003) and Alabama (Williams et al. 1992).

Combes and Edds (2005) found mussel species richness and densities upstream of reservoirs in Kansas significantly higher than those found below the dam due to benthic habitat differences. Another indirect dam-effect occurs as mussels inhabiting shallow side channel areas in the Missouri River are left stranded during dam repair draw-down operations (author, personal observations, 2012) leaving them vulnerable to desiccation and predation. Fortunately, the Missouri River retains more natural channel characteristics and appears less impacted by dam-related effects as the river approaches the Designated Wild and Scenic Reach below Coal Banks Landing, a reach with the highest reported density of black sandshells. Preferred stable sand and gravel mussel habitats and abundant host fish populations in these Missouri River reaches are conditions that support Montana's expanding robust and viable introduced black sandshell populations compared to its native sections of the Missouri River downstream in both South Dakota and Iowa where it is state listed as imperiled (S1) (Nature Serve 2013). The main stem Missouri River flowing through southeast South Dakota and Iowa has been so severely altered by dams, diking and channelization (Funk and Robinson 1974) that few reaches retain the natural river geomorphology with stable sand and gravel runs preferred by the black sandshell (Cummins and Mayer 1992). Additionally, fish communities inhabiting these "between-the-dam" reaches of the Missouri have lost many of the native or introduced lithophilic spawners, such as walleye and sauger (Hughes et al. 2005), host fish of the black sandshell (Cummins and Mayer 1992, Khym and Layzer 2000). The presumed extirpation of the black sandshell in Kansas was partially blamed on the loss of sauger as their host fish in two watersheds where sandshells were historically abundant (Angelo and Cringan 2003). Therefore, although dams are present in Montana and can have hydrologic effects on the Missouri and Marias Rivers, natural geomorphology and abundant populations of sauger and walleye in these reaches (MFISH 2013) are overarching factors contributing to the successful colonization and expansion of the black sandshell.

The black sandshell presently occupies approximately 218 kilometers of the Missouri River with the possibility of expansion upstream by another 73 km based on habitat and host fish, while the population in the Marias River could potentially expand upstream 140 km. Thus, Montana's introduced black sandshell populations are robust and have even more potential habitat to expand into, while their distribution continues to decline in most of other states in its native range. It may, in fact, come to fruition as predicted by Gangloff and Gustafson (2000) that large portions of Montana's warm water river reaches with suitable habitat and host fish serve as viable

conservation refuges for non-native mussel species that are imperiled elsewhere.

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