Base Aquatic Inventory of the Mussel and Fish Populations of the Beaverhead – Deerlodge National Forest Acquisition Reach of Selway Creek; 2008

Report Prepared for Beaverhead – Deerlodge National Forest Fisheries Staff and Dillon Ranger District

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ABSTRACT

Baseline biologic and physical parameters were measured in Selway Creek within a stream reach recently acquired as a part of a private land purchase by the Beaverhead – Deerlodge National Forest of southwest Montana. A Western Pearlshell Mussel population was surveyed in order to define its distribution, age structure, relative abundance, and habitat niche selection. The mussel population of Selway Creek was found within a reach bounded by the C.L. Cow Camp at its upstream terminus and the downstream boundary of the newly acquired property and exhibited a moderate abundance compared with other known area populations. The mussel population exhibited a very high length frequency distribution indicative of a very old age structure and an apparent lack of successful recruitment for many decades. Pearlshell Mussels in Selway Creek selected habitats exhibiting a relatively narrow range in flow velocity, depth, distance from near bank, and substrate size reflective of a relatively stable hydrology and similar to those observed in other populations. Trout populations were dominated by nonnative, fall spawning brook and brown trout with the brown trout appearing to be relatively recent immigrants into the study reach. Trout density ranged from relatively moderate to extremely high between two Study Sections which also exhibited large differences in growth rate, length at age, ultimate size, and condition. The brook trout population of an upstream study section that was located within a reach affected by a flood irrigation system was thought to reflect symptoms of a stunted population when compared with the population of a study section that was located downstream from irrigation withdrawal and return. Management recommendations were suggested for future aquatic studies and projects within the Selway Creek acquisition.

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INTRODUCTION and STUDY AREA

The Selway Creek mainstem and adjacent properties were acquired from the Dragging Y Cattle Company by the Beaverhead – Deerlodge National Forest (BDNF) over 2006 and 2007 through LWCF funding and the Montana Trust for Public Lands. The acquisition brought approximately 2,200 acres (T8S, R15W) into public ownership under BDNF management. Prior to public acquisition, the montane meadow and riparian stream corridor complex was used as private summer pasture to provide support for about 450 cow - calf pairs. The property was flood irrigated to increase green summer forage for cattle and also supported a base cow camp that currently remains under private management. Both the historic cattle grazing system and irrigation practices have temporarily been incorporated into existing adjacent summer pasture systems to be managed under Beaverhead - Deerlodge National Forest Grazing Standards as an interim management practice.

In 2007, BDNF staff met with fisheries staff from the Montana Department of Fish, Wildlife, and Parks (MFWP) in order to assess the current status of aquatic resources and determine future data needs to assist in the management of aquatic and riparian habitats in the Selway Creek drainage. As a result of those meetings, FWP staff planned efforts to assess the base status of fish populations and the status of a known population of Western Pearlshell Mussel (*Margaritifera falcata)* in the mainstem of Selway Creek during August 2008.

Selway Creek is a headwater tributary of Horse Prairie Creek, one of the two major drainages that form the Beaverhead River in southwest Montana. The Selway Creek mainstem reach represents approximately 6.1 stream miles from its upstream confluence with Ore Creek to its downstream confluence with Bloody Dick Creek (Map Figure 1). Major tributaries to Selway Creek include Ore, Hidden, Short, C.L., Surveyor, East, and Camp Creeks. The meadows adjacent to the mainstem of Selway Creek and sample sections discussed in this report represent an elevational range of approximately 7,000 to 7,200 feet.

A limited set of physical parameters was measured at base summer flow during biotic sampling efforts in August, 2008. Base summer flow ranged between 2.70 cfs below the confluence of Hidden Creek in Section 12 (N45.15776, W113.39339) to 8.60 cfs near the downstream boundary of the acquisition in Section 28 (N45.11305, W113.21840). The higher discharge was measured downstream from all of the major tributaries except East and Camp Creeks within the downstream reach selected for fisheries and mussel sampling and designated as the Rock Crib Study Section. The channel within the Rock Crib Section conformed to an E or C configuration as defined by Rosgen. Wetted channel width within the reach ranged from 7.0 to 23.0 feet with a mean width of 12.2 feet generated from 32 representative measurements. Maximum pool depths were in the 3.0 to 4.0 foot range while most pools were in the 1.5 to 2.5 foot depth range. Riffle and run (glide) habitat types generally ranged from 0.5 to 1.5 feet with maximum depths of approximately 2.5 feet. Mean stream depth throughout a range of all representative habitat forms was 1.14 feet. Point flow velocities along the streambed generally ranged from 0.3 to 2.5 fps averaging 0.80 fps. The stream appeared to exhibit a very limited productive potential with a specific conductance ranging from 30 to 43 *u*mhos/cm and pH ranging from 7.83 to 7.99 at the two flow measurement sites. Water temperatures observed during sampling efforts ranged from 10.0 to 15.2 degrees C. depending upon diurnal fluctuation.

While Selway Creek represents a small stream fishery of some significance, no specific sampling efforts had been directed at the fisheries resource by FWP prior to this sampling effort. Some qualitative sampling effort in search of presence/absence data and genetic description for native westslope cutthroat trout had been directed within the drainage by BDNF fisheries staff within recent years but the effort did not reveal the presence of any native cutthroat trout populations (BDNF Fisheries Data Files). Fishing pressure estimates for Selway Creek reveal a mean angler use of 150 angler days per year over the 1991 – 2007 sampling period (McFarland 1991 – 2007) but probably underestimate use due to sample size limitations. This is still a relatively large amount of detected angling pressure and a very consistent appearance in the sampling effort for a small, remote stream such as Selway Creek. Bloody Dick Creek immediately downstream supported a mean angler use of 1,271 angler days per year over the same period despite limited accessibility via private lands adjacent to the stream. It is also possible that some of the pressure expended on Selway Creek has been reported as Bloody Dick Creek during pressure surveys by anglers confused by the proximity and confluence of the two streams. A relatively aggressive fisheries sampling effort was also directed at Bloody Dick Creek in the mid 1970's and early 1980's through the Instream Flow Reservation process (MFWP 1989). This effort resulted in fish population estimates and the calculation of a Minimum Instream Flow Reservation of 20 cfs to maintain existing fish populations and aquatic and riparian habitats.

METHODS

Trout populations in two study sections were sampled through the use of electrofishing techniques based on mark-recapture methodologies described by Vincent (1971). The Rock Crib Study Section was 2,000 long and located at the downstream boundary of the newly acquired property in T8S, R15W Sections 27 and 22 (N45.11305, W114.21840). The Dead Wood Study Section was 1,050 feet long and was located at the upstream boundary of the C.L. Cow Camp pasture fence in T8S, R15W Section 14 (N45.14594 W113.39717). The up and downstream terminus of each Section was also located and marked with a GPS unit. Electrofishing in the Rock Crib Section was conducted via boat mounted, mobile anode techniques which utilize a 3500 watt generator and Coffelt rectifying box. A straight or continuous wave DC current was used at approximately 500 watts. Fish captured within the field were drawn to the anode, netted, and deposited into a live car. The boat consisted of a modified Coleman Crawdad that was used as a transport base for equipment and the cathode. Due to smaller channel size, fish in the Dead Wood Section were captured through the use of a Smith - Root LR 24 Backpack Electrofisher unit. Backpack electrofishing efforts were conducted by two teams of two individuals operating simultaneously within the study section. Individual fish captured were anesthetized, segregated by species, measured for length and weight, marked with a small identifying fin clip, and released. Scale samples for age determination were collected from a representative subsample by length. A single Marking run was made through each study section followed by a single Recapture run approximately 12 to 14 days later.

Trout population statistics were analyzed under a log-likelihood methodology developed and described by Montana Fish, Wildlife and Parks under guidelines presented by Brittain, Lere, and McFarland (1997). Population estimates were calculated for brook, brown, and rainbow trout from August samples to avoid population estimate bias due to spawning movements and migrations and to maximize sampling efficiency at base flow regime.

Mussel surveys were conducted throughout the acquisition reach of Selway Creek in 2007 and 2008. Presence – absence and distribution surveys were begun in August 2007 within the reach between Hidden Creek and the downstream property boundary. An additional distribution survey was conducted in a 1,350 foot reach downstream from the confluence of Ore Creek in T8S, R15W Section 12 (N45.09290, W113.23362) in August 2008. Quantitative measurements were collected from the mussel population within a 1,600 foot sub-reach of the Rock Crib Section in August 2008 (N45.11289, W113.42200). Aquatic viewing scopes fabricated after the Fieldmaster Aquaview were employed to locate mussels which were individually flagged using standard red wire field flags. A total estimate of mussel abundance was attempted by having two personnel scoping the channel as an adjacent pair and flagging all mussels at their location. A third investigator followed with a scope and verified flagged locations for additional measurement. If additional unflagged mussels were located, all three investigators worked through the immediate reach for a second sample replicate. Length frequency measurements were taken with a standard Vernier Caliper and quantitative measurements of mussel density and habitat selection followed methods described in Johnson et al 2003, Stone et al 2004, and Nedeau et al 2005.

Limited physical measurements were gathered using GPS, standard measuring tapes, stadia rods, and hand held glass thermometers. Flow measurements and discharges were made with a Marsh – McBirney 2000 Flow Meter. Specific conductance and pH were measured with a portable electronic meter by Hanna.

RESULTS

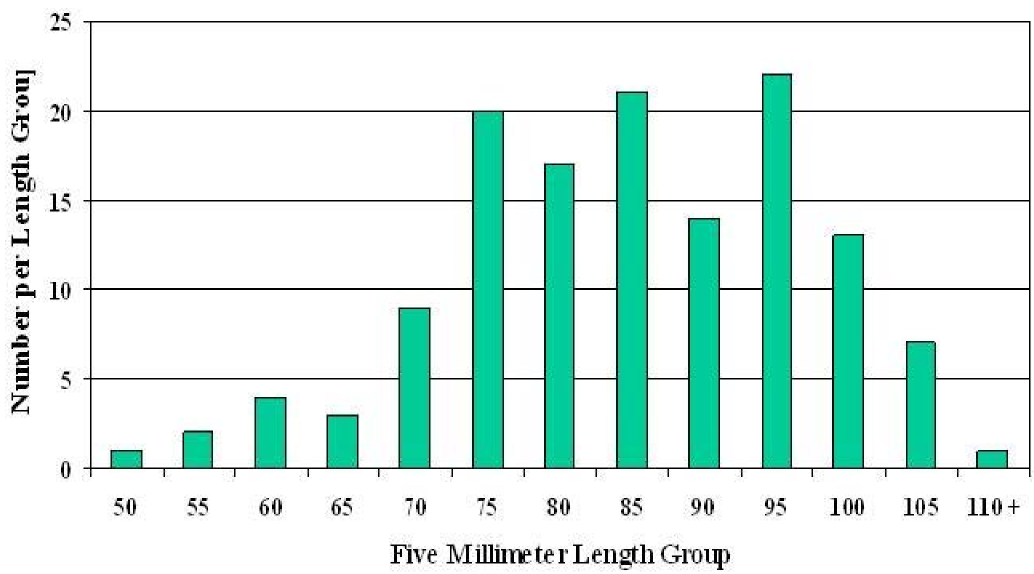
Western Pearlshell Mussel Population Sampling Efforts

Selway Creek supports a population of Western Pearlshell Mussel within the reach between the lower boundary of the CL Cow Camp and the downstream terminus of the Rock Crib Study Section. No live mussels or residual shell evidence of past occupation were found in survey reaches upstream from the Cow Camp and no live mussels were found in backwatered stream reaches at the lower canyon downstream from the Rock Crib Section.

The Selway Creek Pearlshell population appears to be moderately abundant within the occupied reach. The surveyed density within the Rock Crib Section was estimated at 167 mussels per 1,000 lineal feet of stream reach. A surface quantification of two relatively large mussel beds within the Study Section revealed estimated densities ranging between 0.50 and 3.4 mussels per square yard of streambed. The upper measured value, however, should not be construed to represent the maximum mussel surface density observed within the study section on a smaller, more focused scale.

The Selway Creek mussel population is currently limited to very old, large individuals (Figure 1) between 54 and 110 millimeters in total length and exhibiting a mean total length of 87 millimeters. The population exhibits multiple modes in length frequency distribution at the 75, 85, and 95 mm length groups suggesting that major age aggregates occur in very old age classes. A very small potential mode at 60 mm possibly represents the youngest age aggregate in the population. No indication that successful recruitment has occurred in recent history was detected through live individuals or in observed shell litter. Deep Creek, a nearby stream that also supports a Western Pearlshell population, exhibited a length frequency distribution with major modes at 45, 55 and 60, and 70 mm with the single largest specimen occupying the 85 mm length group in a 2006 survey (D. McGuire, Big Hole Watershed Committee Training Workshop 2006). The Deep Creek population also exhibited young individuals in the 30 and 35 mm length groups indicating that successful recruitment was occurring to the present.

Figure 1. Length frequency distribution of Western Pearlshell Mussels Sampled in the Rock Crib Section of Selway Creek, August 2008 (N = 134).



Several physical habitat parameters were also measured in association with the niche selection of individual mussels. The selected parameters were representative of habitat features commonly measured in Pearlshell studies (Johnson 2003, Stone et al 2004, and Nedeau et al 2005) and included current velocity, depth, distance from bank, dominant habitat feature, and substrate size at the point of the imbedded mussel.

Point flow velocities selected for mussel colonization ranged from 0.0 to 2.22 fps and averaged 0.80 fps indicative of a preference for relatively moderate flow velocities. While an empirical mean can often be relatively meaningless in the evaluation of habitat features, the distribution of mussels as a function of flow velocity in Selway Creek

(Figure 2) exhibited a major mode around the mean value as well as a second mode at lower velocities. The bimodal arrangement with current velocity was of interest as one might expect that a filter feeder would exhibit a normal distribution around an optimum range of flows. The bimodal distribution might be a response to a broad range of optimum conditions surrounding high and low discharge regimes or might merely be an artifact of sample size. Under either circumstance, the preferred range was relatively narrow and reflected relatively stable conditions at about 0.2 and 1.25 fps. Point flow velocities at individual mussels were generally lower than those surrounding the immediate niche and clearly showed the affect of bed roughness and substrate large enough to provide a velocity shelter. The distribution of mussels as a function of point flow velocity was further analyzed for correlation under a polynomial equation due to the bimodal distribution (Figure 3). The correlation of mussel distribution with point flow velocity was highly significant ($P<.01$) and yielded a relatively moderate correlation coefficient ($r = 0.56$).This analysis confirmed an optimal distribution between about 0.2 and 1.25 fps and a rapid decline in mussel occupation as flow velocities approached and exceeded 1.50 fps. While the Coefficient of Determination (R^2) was relatively low at 0.31, it can be interpreted to suggest that 31% of the selected mussel location can be attributed to flow velocity.

Figure 2. Distribution of Western Pearlshell Mussels by point flow velocity (fps) in the Rock Crib Section of Selway Creek, August 2008 (N = 267).

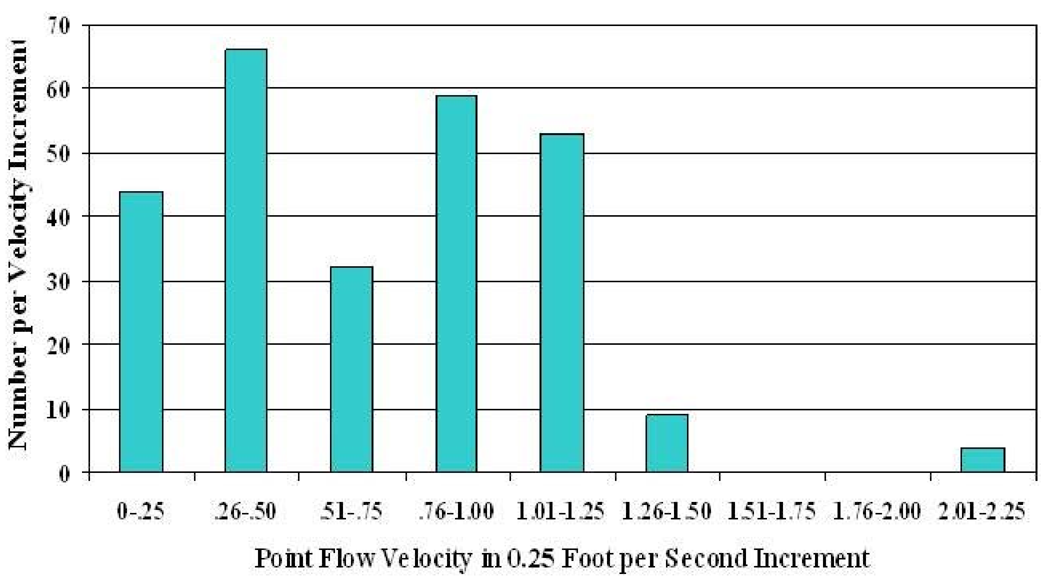
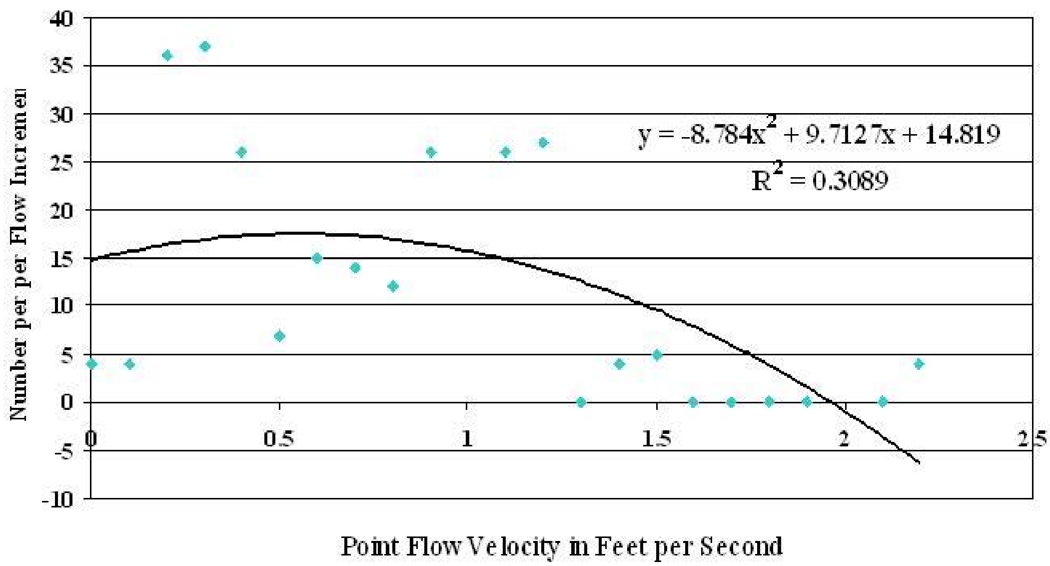


Figure 3. Polynomial distribution of Western Pearlshell Mussels by point flow velocity (fps) in the Rock Crib Section of Selway Creek, August 2008 (N=267).



Water column depths were also analyzed as a factor in determining mussel distribution in Selway Creek (Figure 4) and ranged from 0.5 to 2.5 feet with a mean depth of 1.14 feet. Similar to the observation for point flow velocity the empirical mean for depth was represented by a major mode in the poly-modal distribution for depth. Mussel distribution as a function of depth was also correlated in a highly significant ($P<.01$) manner and exhibited a relatively moderate r value of 0.60 in the study reach. Depth selection for mussel colonization also represented a relatively narrow and moderate range of approximately 0.7 to 1.7 feet under a polynomial analysis (Figure 5) exhibiting a R^2 of 0.36, slightly more powerful than that calculated for velocity.

Figure 4. Distribution of Western Pearlshell Mussels by depth (feet) in the Rock Crib Section of Selway Creek, August 2008 (N=267).

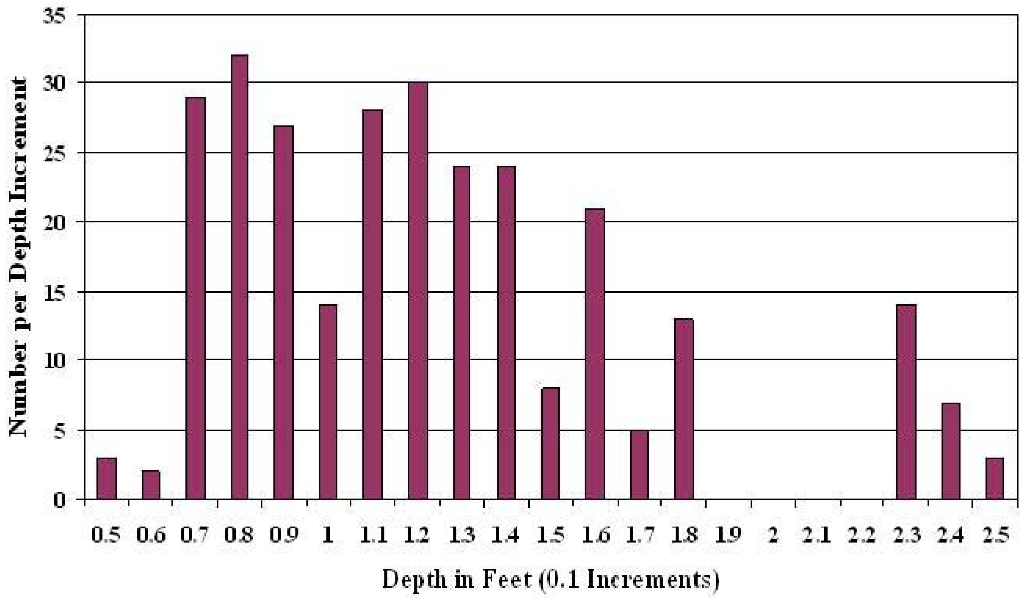
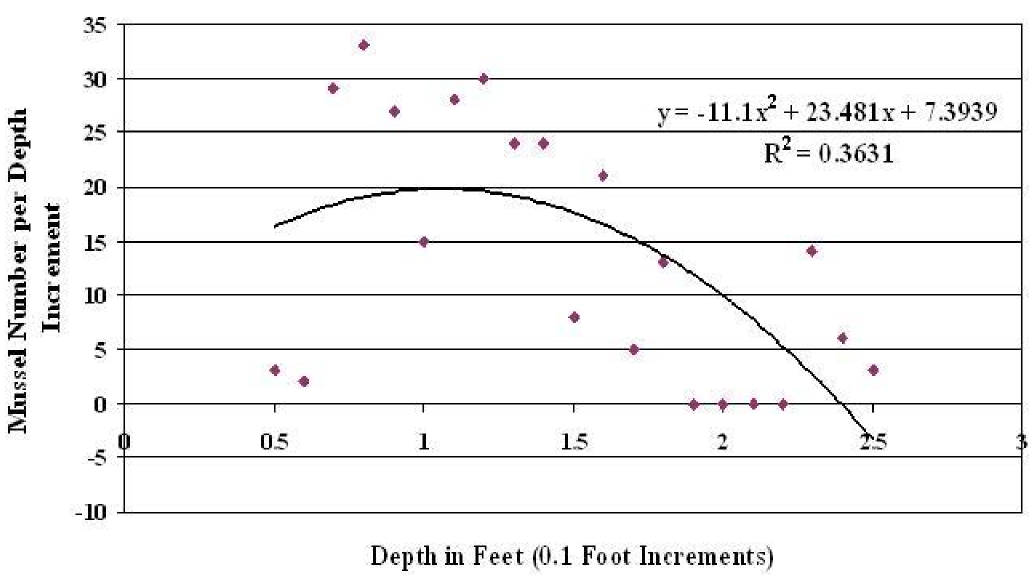


Figure 5. Polynomial distribution of Western Pearlshell Mussels as a function of depth in the Rock crib Section of Selway Creek, August 2008 (N=267).



Distance from the near stream bank was also analyzed as a potential determinant for mussel distribution in Selway Creek (Figure 6). Similar to depth, mussel distribution with distance from bank was poly-modal but was even less clustered than the depth modes. The correlation of mussel distribution with distance to near bank was, again, relatively moderate ($r = 0.57$) but also was found to be statistically significant ($P<.05$). Despite the multiple modes, however, distance from bank was limited to a relatively narrow and moderate optimal range of about 0.5 to 5.5 feet (Figure 7) under a polynomial analysis and similar Coefficient of Determination, at 0.32, to the analyses for velocity and depth.

Figure 6. Distribution of Western Pearlshell Mussels by distance (ft) from nearest bank in the Rock Crib Section of Selway Creek, August 2008 (N=267).

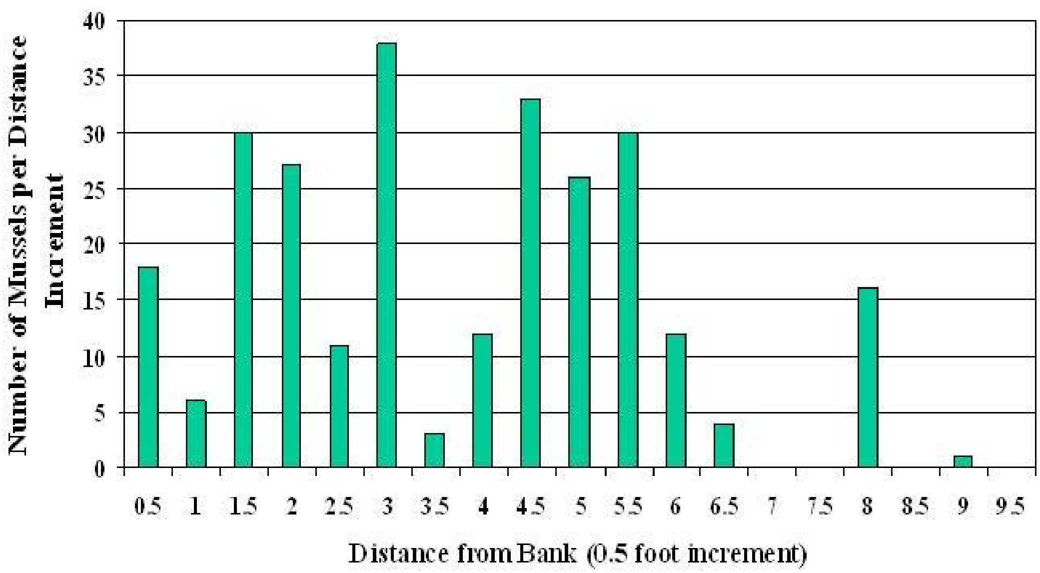
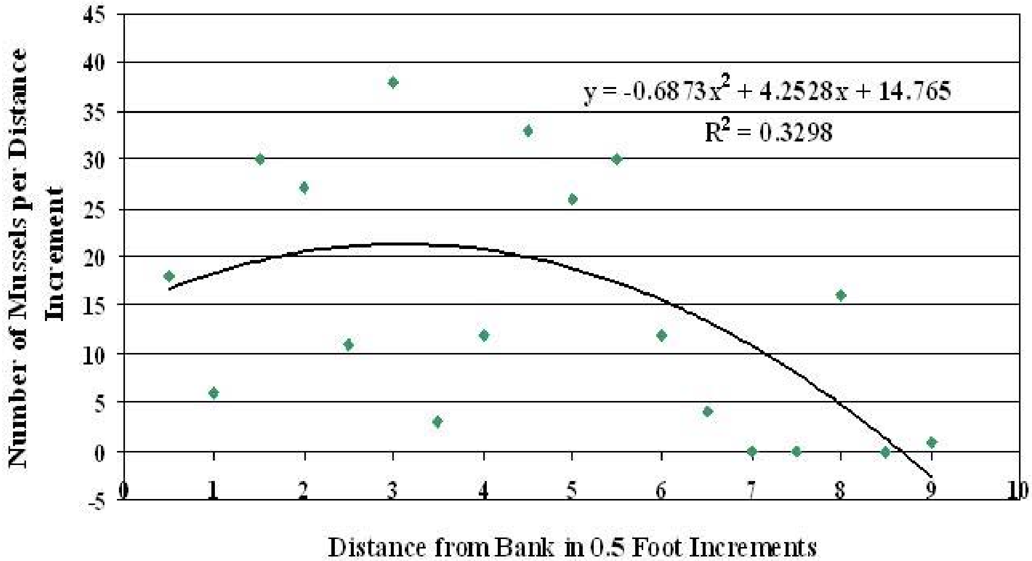


Figure 7. Polynomial distribution of Western Pearshell Mussels by lineal distance (0.5 foot increment) from nearest bank in the Rock crib Section of Selway Creek, August 2008 (N=267).



A crude ocular estimate of dominant substrate size was also recorded for the immediate point at which each mussel was imbedded. Dominant particle size was segregated from sand to 12 inch plus cobble with distribution modes clearly clustered at the maximum 2 to 3 inch gravel size (Figure 8). While a second mode can be observed at the five inch increment, the polynomial distribution (Figure 9) exhibited a very weak and relatively nondescript curve and a very weak R^2 of 0.11 as contrasted with those for velocity, depth, and distance from bank. Analysis of the relationship between mussel distribution and coarse substrate size failed to yield a significant ($P<.05$) correlation. While the relationship for substrate size appears somewhat nondescript, the results might be associated with the ocular, rather than quantitative, method of substrate classification that was employed. Despite the results of the polynomial analysis, the strength of the distribution modes at the 2 and 3 inch dominant gravel size increments (Figure 8) represented the vast majority of mussel locations in the survey. All of the mussel locations from the 1 through 6 inch gravel size increments also included sand particles in the imbedded substrate mix.

Figure 8. Distribution of Western Pearlshell Mussels by substrate size selection in the Rock Crib Section of Selway Creek, August 2008 (N=267).

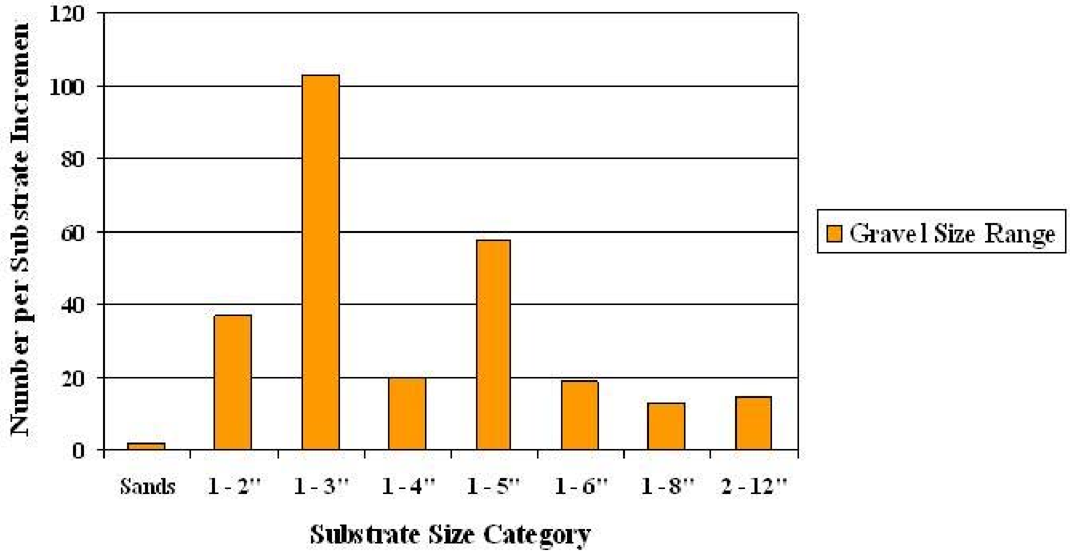
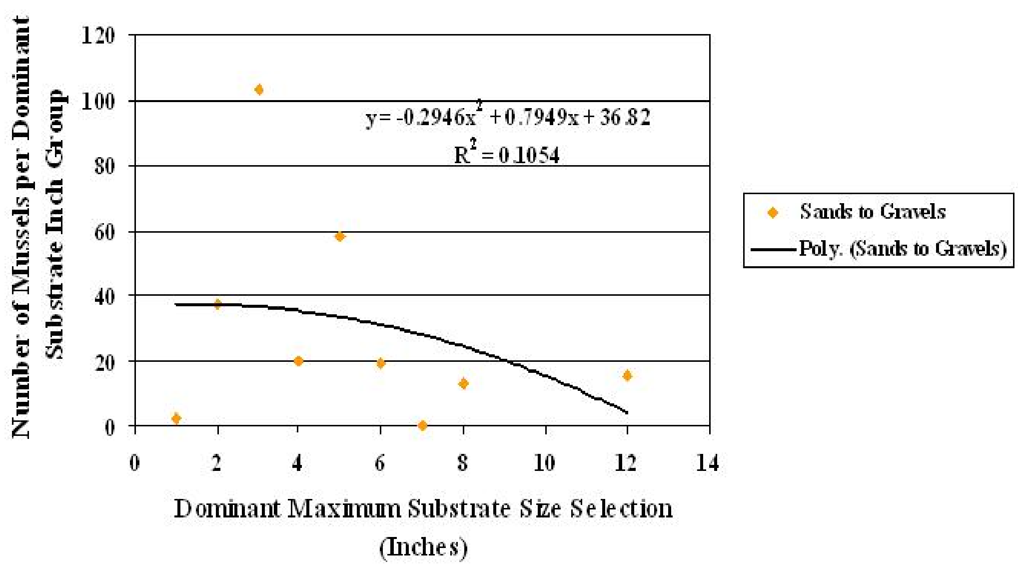


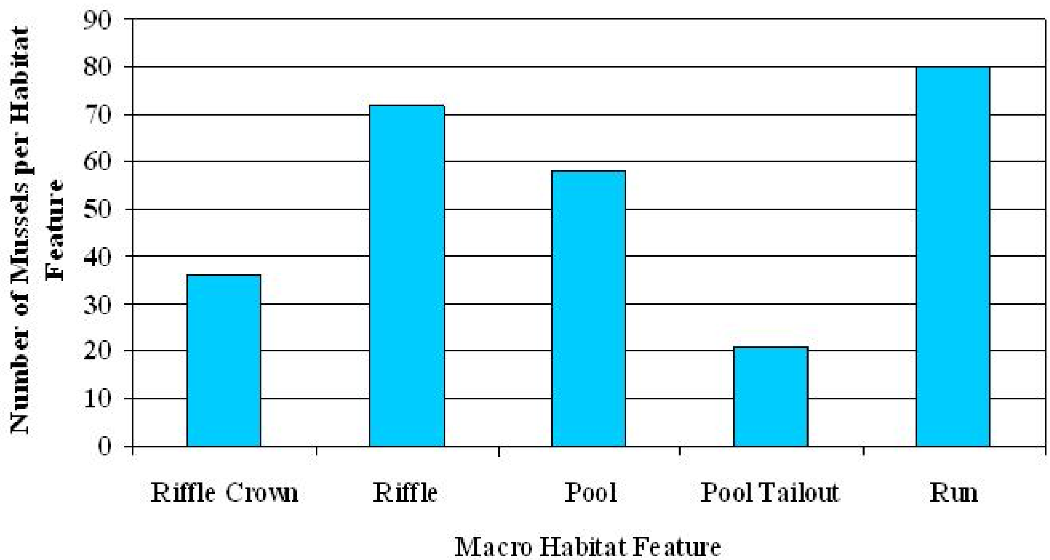
Figure 9. Polynomial distribution of Western Pearlshell Mussels by dominant maximum gravel size selection in the Rock Crib Section of Selway Creek, August 2008 (N=266).



Finally, mussel distribution was also classified on the basis of dominant macrohabitat feature (Figure 10). Habitats were classified as the standard set of riffle, pool, and run (glide) (Johnson et al 2003) but also segregated into the somewhat less stable configurations defined as riffle crown (knickpoint) and pool tailout. While mussel distribution among the three major stable features was relatively even with a slight advantage to riffles and runs over pools, all three features were much preferred to the less stable riffle crowns and pool tailouts. While stable riffles, runs, and pools provide relatively ample depths, laminar flows, and consistent flow velocities through a defined thalweg, riffle crowns or knickpoints and pool tailouts are subject to alluvial outwash and avulsion though migrating headcuts. These destabilizing processes could lead to erosional displacement or alluvial blanketing of mussel beds.

While wetted width or perimeter and canopy have both been incorporated into surveys as important determinants in mussel distribution (Stone et al 2004), those parameters were not measured and recorded as point distribution data during this study. Wetted width was measured across a range of channel features to gain a range and mean for the stream channel through the mussel survey reach. No attempt was made to quantify canopy, however, due to the relative scarcity of woody riparian plants throughout the Rock Crib Section.

Figure 10. Distribution of Western Pearlshell Mussels by macro - habitat type in the Rock Crib Section of Selway Creek, August 2008 (N=267).



Fish Population Sampling Efforts

Salmonid populations were sampled in the Rock Crib Study Section near the lower acquisition boundary, and in the Dead Wood Study Section immediately upstream from the Cow Camp pasture fence. The two sections differed markedly in flow regime, and channel type and size with the Rock Creek Section exemplifying a larger stream environment than the Dead Wood Section. The Dead Wood Section was also located within a reach that was under the influence of active flood irrigation during the sampling effort. The species composition of the Rock Crib and Dead Wood Sections are presented in Figures 11 and 12. The Rock Crib Section was dominated by brook trout but also supported a population of brown trout and a small presence of rainbow trout. The Dead Wood Section was heavily dominated by brook trout with a small presence of brown trout. Both study sections supported what appeared to be moderate numbers of mottled sculpin that were not captured for inclusion in the samples. A 1974 fish population survey in Bloody Dick Creek, in a study section located approximately 7 miles downstream from the Rock Crib Section, resulted in a sample that was 69.6% brook trout and 20.6% rainbow trout (MFWP 1989). That sample also exhibited a 9.8% presence of mountain whitefish but failed to reveal the presence of brown trout. As was the case in the present Selway Creek samples, the only nongame native species observed in Bloody Dick Creek was the mottled sculpin.

Figure 11. Percent composition, by species, of the salmonid populations in the Rock Crib Section of Selway Creek; August 2008.

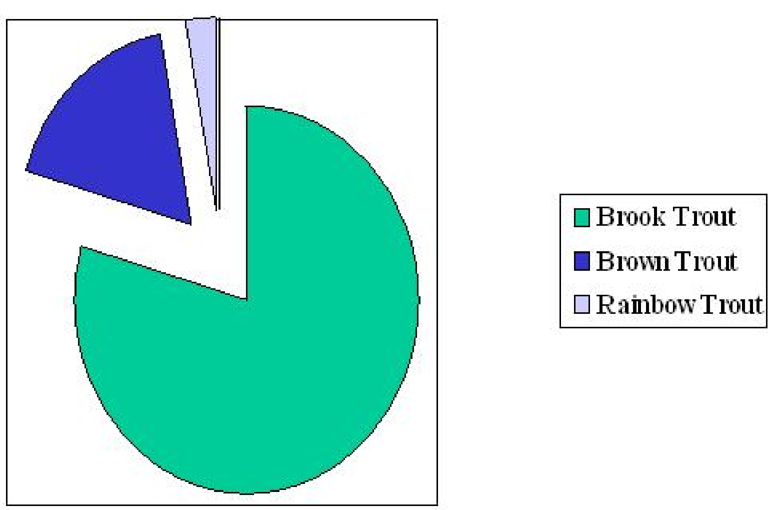
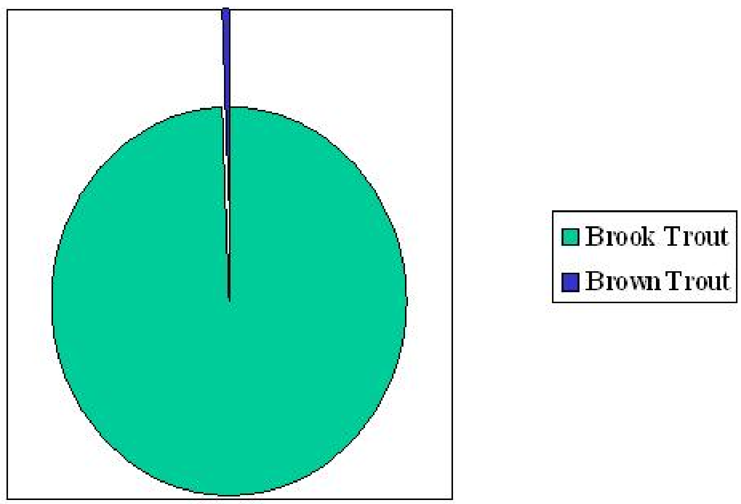


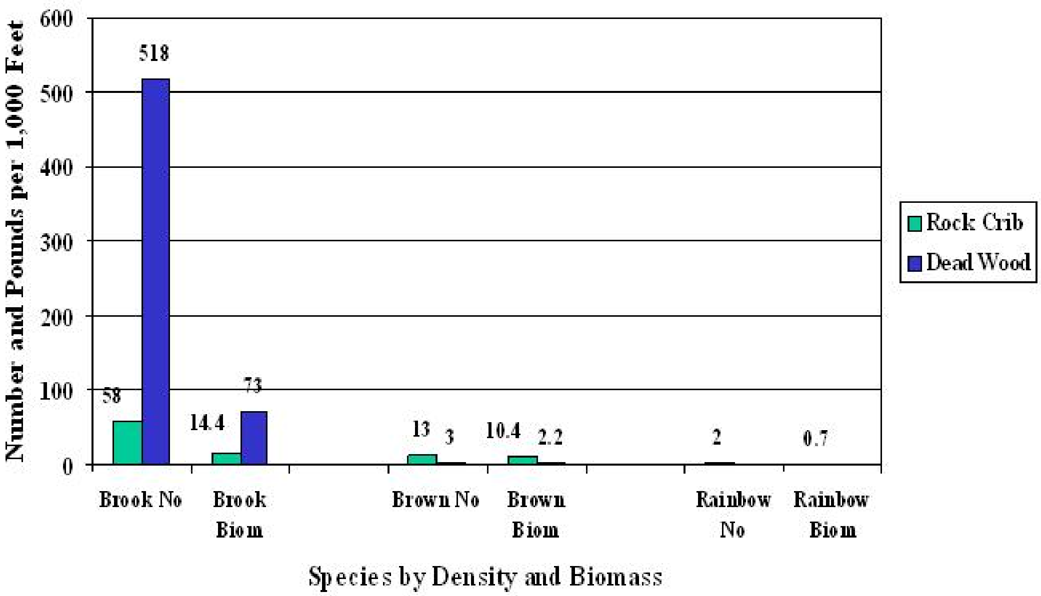
Figure 12. Percent composition, by species, of the salmonid population of the Dead Wood Section of Selway Creek; August 2008.



Trout population estimates for Age I and older fish in the Rock Crib and Dead Wood Study Sections are presented in Figure 13. Population estimates for brook trout, the most abundant sport species, exhibited Standard Deviations of 4.1% of the point estimate in the Dead Wood Section and 5.8% of the point estimate in the Rock Crib Section at the 95% Confidence Interval. Mean Recapture / Capture efficiencies were also relatively high at 48.5% in the Dead Wood Section and 65.2% in the Rock Crib Section. Differences in efficiencies between the two study sections were likely associated with differences in electrofishing method, fish density, and relative size of the fish between the two study reaches. The brook trout population of the Dead Wood Section was extremely abundant at 518 Age I and older fish per 1,000 feet of stream and of much higher density than that of the Rock Crib Section, however the standing crop of the Rock Crib Section exhibited a much higher comparative ratio with the Dead Wood Section than density. This was indicative of the presence of comparatively larger fish, at lower density, in the Rock Crib Section. A limited population of brown trout occupied the Rock Crib Section at a density of 13 Age I and older fish per 1,000 feet as compared with a very limited presence at 3 per 1,000 feet in the Dead Wood Section. The Rock Crib Section also supported a very limited presence of rainbow trout, all of which appeared to be Age I and II fish, at a density of 2 per 1,000 feet. The total trout standing crop in the Rock Crib

Section was 25.5 pounds per 1,000 feet compared with that of 75.2 pounds per 1,000 in the Dead Wood Section. The comparative ratios of density to standing crop between the study sections resulted in a mean trout weight of 0.35 pounds in the Rock Crib Section compared with a mean weight of 0.14 pounds in the Dead Wood Section. The 1974 population estimates in Bloody Dick Creek revealed densities of 481 brook trout, 100 rainbow trout, and 37 mountain whitefish per 1,000 feet in a substantially larger stream environment than Selway Creek (MFWP 1989). Base August flow in the Bloody Dick Creek study reach was 20 cfs as compared with 8.5 cfs in the Rock Crib Section. The majority of both the brook and rainbow trout populations appeared to be Age I fish in the 1974 study. The Bloody Dick Creek Section also supported an estimated total salmonid standing crop of 102 pounds per 1,000 feet.

Figure 13. Estimated desnity and standing crop of Age I and older brook, brown and rainbow trout in the Rock Crib and Dead Wood Sections of Selway Creek; August 2008.



The length frequency distributions of the Rock Crib and Dead Wood brook trout samples are given in Figures 14 and 15. The Rock Crib sample clearly exhibits strong modes or modal segregation at the 6.0, 8.5, 9.5, and 11.5 inch increments. These modes appear to correspond to Age I, II, III, and IV and older classes and appear to exhibit relatively good growth for a small stream, high elevation environment. The Dead Wood brook trout sample population, however, exhibited a clear modal definition of the Age I cohort at 5.0 inches followed by a unimodal distribution across the older age classes. A major mode at the 6.5 inch increment is probably indicative of the modal length of the

Age II brook trout class in the Dead Wood Section. A direct comparison of the brook trout length frequency distribution for both study sections (Figure 16) strongly suggests that brook trout growth rate and ultimate length at age were significantly superior in the Rock Crib Section. Although they were not included in population estimate calculations, a representative sample of young of the year brook trout was measured for length from each study section. All of the young of the year fish fell within the 2.0 to 3.0 inch range which appeared typical for a small stream environment at that elevation in late summer. Brown trout length frequency distribution (Figure 17) exhibited strong modal segregation of Age I (8.0 inches), Age II (10.0 - 12.4 inches), Age III (13.5 – 14.9 inches) and Age IV and older (17.0+ inches) cohorts in the Rock Crib Section. The limited brown trout sample from the Dead Wood Section appeared to consist of Age II and III fish. Brown trout growth and length at age appeared to be vigorous for a small stream environment and almost as rapid as growth for much larger streams in the drainage (Oswald 2006).

Figure 14. Length frequency distribution of Age I and older brook trout captured in the Rock Crib Section of Selway Creek ; August 2008 (N = 97).

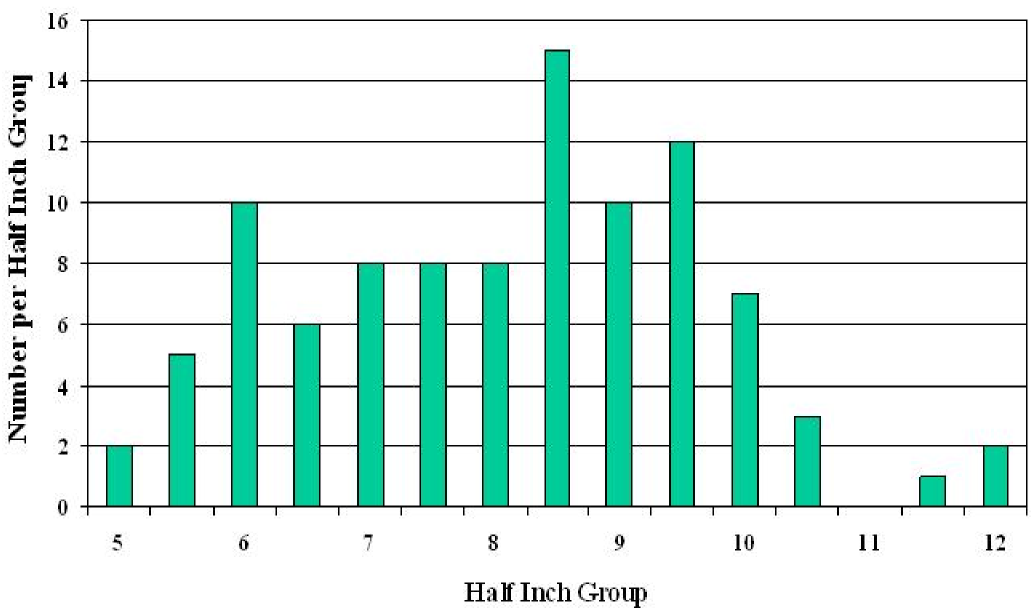


Figure 15. Length frequency distribution of Age I and older brook trout captured in the Dead Wood Section of Selway Creek; August 2008 (N = 384).

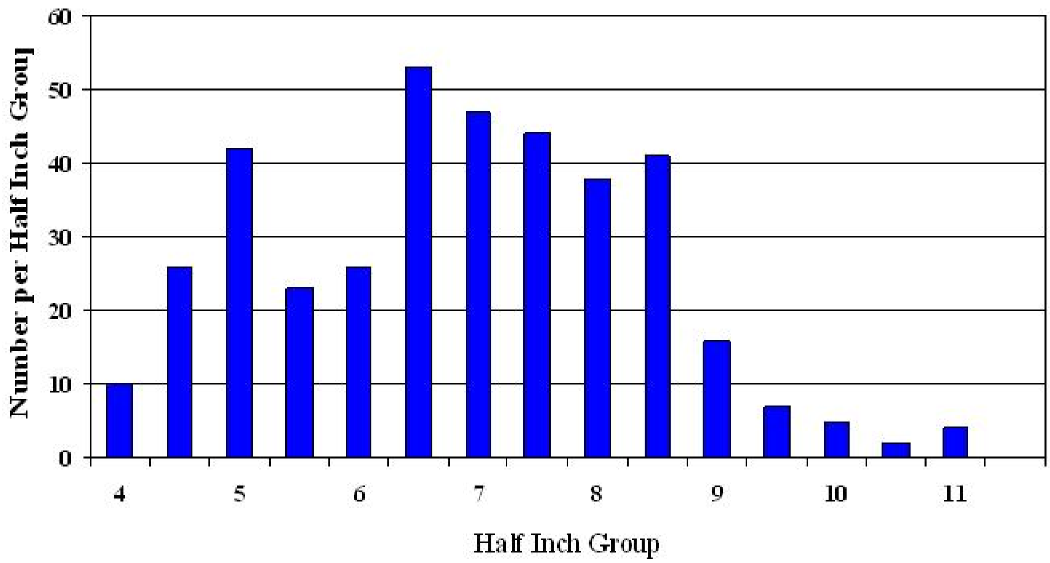


Figure 16. Combined length frequency distribution of Age I and older brook trout captured in the Rock Crib (N = 97) and Dead Wood (N = 384) Sections of Selway Creek; August 2008.

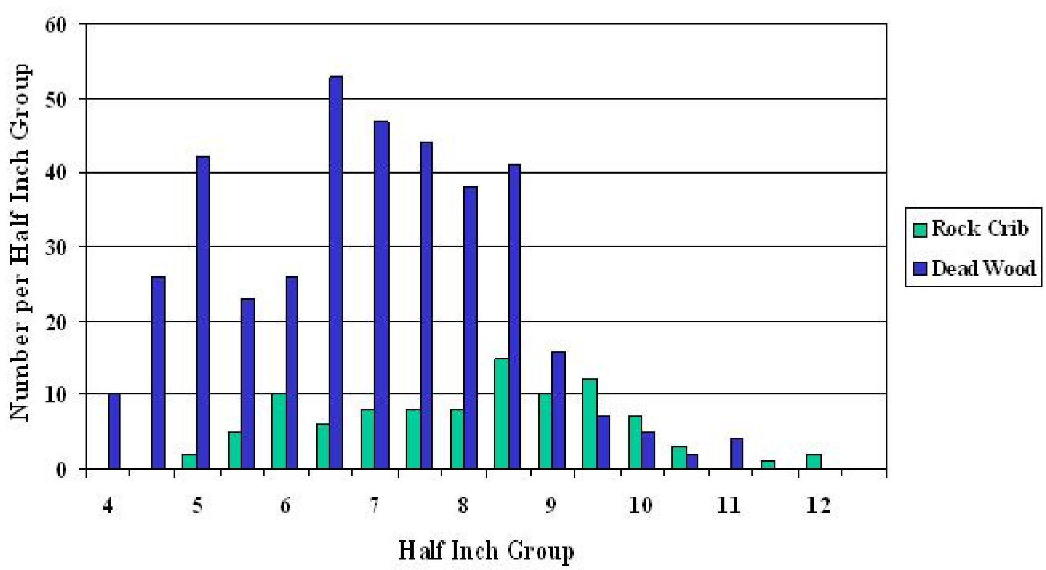
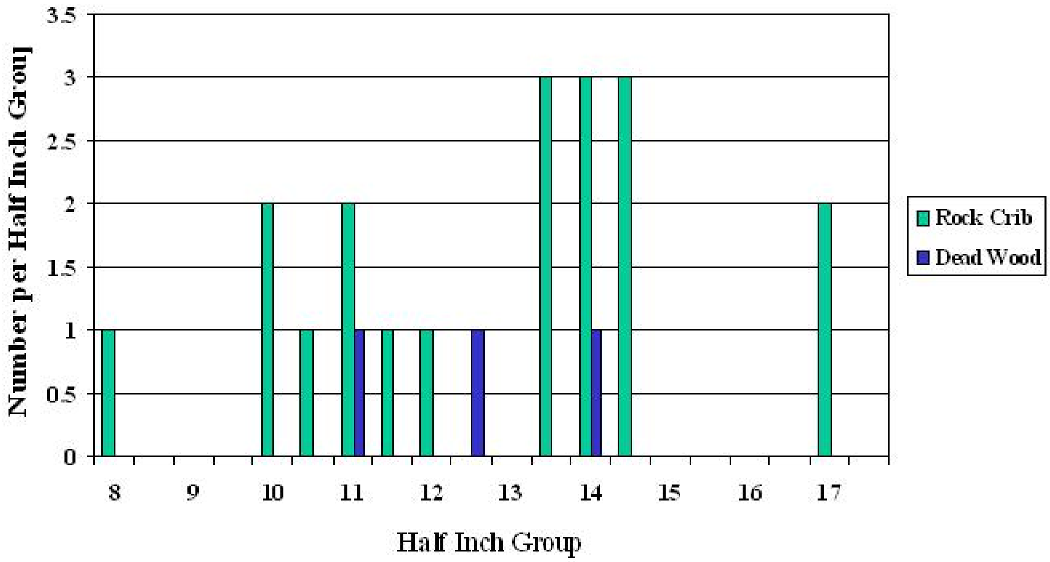
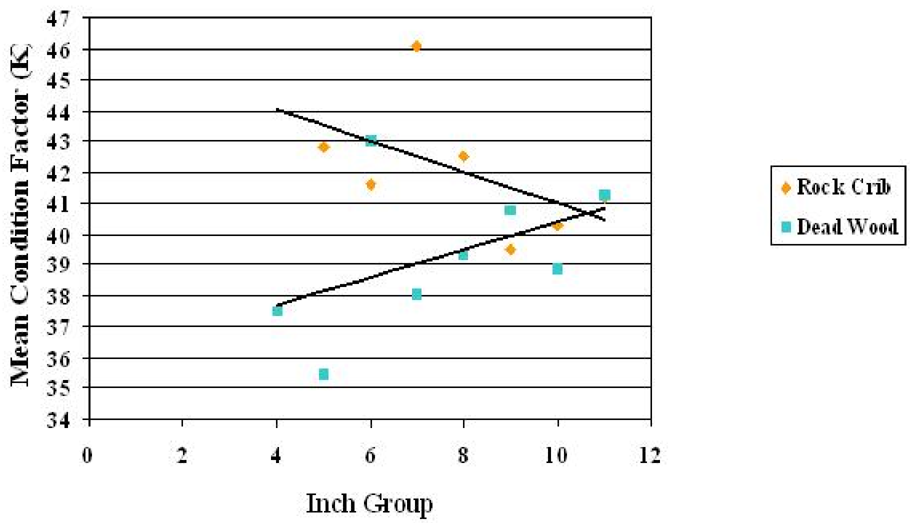


Figure 17. Length frequency disribution of Age I and older brown trout captured in the Rock Crib (N = 19) and Dead Wood (N = 3) Sections of Selway Creek; August 2008.



Brook trout Condition Factor (K) was significantly higher in the Rock Crib Section at a mean of 41.99 than that observed in the Dead Wood Section at a mean of 39.05 for the Age I and older population. Figure 18 depicts a comparative linear analysis of the brook trout K values across all sizes and ages for the Rock Crib and Dead Wood Sections and exhibits two highly deviant and very interesting trends. Brook trout condition in the Rock Crib Section began at much higher mean values than those of the Dead Wood Section at the smaller, younger segment of the population and declined in a linear pattern as age and size advanced. This decline in K value with age and size is typical of trout populations in southwest Montana and is exacerbated as reproductive maturity is advanced (Oswald 2005 and 2006). Brook trout condition in the Dead Wood Section, however, exhibited a positive correlation with length and age across the population until K values for the oldest, largest fish in both populations were virtually equal and the linear regression lines merged at maximum size for the two study sections. While the sample size for brown trout was extremely limited for the Dead Wood Section, the sample K values for brown trout averaged 1.24 less than those observed in the Rock Crib Section despite the lack of any fully mature (Age IV+) fish in the Dead Wood Section sample.

Figure 18. Linear regression of the Mean Condition factor (K) by inch group for Age I and older brook trout captured in the Rock Crib (Mean = 41.99) and Dead Wood (Mean = 39.05) Sections of Selway Creek; August 2008.



DISCUSSION

Western Pearlshell Population

Selway Creek is one of the few streams in southwest Montana known to support a population of Western Pearlshell Mussels. Other known populations within the immediate vicinity of Selway Creek in the Beaverhead River drainage include a relatively robust population in immediate downstream environs in Bloody Dick Creek and very limited populations in Horse Prairie Creek, Grasshopper Creek and the upper Beaverhead River. While quantitative mussel data from Montana streams is extremely sparce, the Selway Creek population appeared relatively robust at about 167 mussels per 1,000 feet of surveyed reach and a maximum surface occupancy of 3.4 mussels per square yard over one of two surveyed beds. Western Pearlshell sample densities in downstream habitats in Bloody Dick Creek ranged between minimum and maximum values of 24 and 210 mussels per 1,000 feet and sample densities in Deep Creek in the Big Hole River drainage were estimated at 86 mussels per 1,000 feet in recent surveys (Stagliano, Montana Natural Heritage Survey Data Files, 2009). Nedeau et al (2005) reported maximum densities of Western Pearlshell of about 300 mussels per square yard in streams where native host fish remain abundant and human habitat alteration was minimal. Native North American freshwater mussels are one of the most endangered animal groups on earth (Nedeau et al, 2005) and the Western Pearlshell is classified as a Species of Concern (S2) in Montana.

The Western Pearlshell population of Selway Creek is clearly a very old population consisting of extremely large individuals and lacking any evidence of successful recruitment for decades. This is commonly observed in many of the relict Pearlshell populations throughout its range (Nedeau et al 2005). The Western Pearlshell is capable of maintaining a very long life span, averaging 60 to 70 years with some populations exhibiting life spans exceeding 100 years (Nedeau et al, 2005). While no mussels were collected for age determination in 2008, comparative length frequency analysis with other populations suggest that the smallest mussels collected in the survey could be 40 to 50 years old. This indicates that minimal recruitment has not occurred for at least that long and stronger modes of older, larger individuals suggest that viable cohorts have not been recruited for an even longer time interval. While mussels can exhibit extreme sensitivity to siltation, dewatering, or toxicants in their environment, those factors might logically be investigated to explain declines in mussel abundance or distribution within, or extirpation from, a specific stream reach or system. The presence of a relatively robust adult population in Selway Creek however, is suggestive that these factors should not be responsible for a complete lack of recruitment over a substantial time period. Like most freshwater mussels, the Western Pearlshell requires an intermediate fish host to incubate its larval glochidia and provide a dispersal mechanism for a largely sessile animal. Dispersal of glochidia via westslope cutthroat trout is theorized to be the mechanism under which the Western Pearlshell is found in suitable aquatic habitats on both sides of the Continental Divide (Nedeau et al 2005). The westslope cutthroat trout has been displaced from Selway Creek by the nonnative brook and brown trout, both of which spawn and undergo major spawning movements in the fall while the Western Pearlshell spawns in spring or early summer. While brook and brown trout have been known to act as surrogate hosts for Pearlshell glochidia, it is not known if they can function as effectively for mussel recruitment as the native species, particularly over time and a broad range of environmental conditions (Nedeau et al 2005). It is also possible that the mussels co-evolved with unique characteristics of native host fish in specific areas of habitat niche selection, behavior, or immune response to parasitism. While FWP records do not chronicle any intentional brook trout plants into Bloody Dick or Selway Creeks, it is likely that the brook trout was introduced into streams in the area in the 1930's or early 1940's. The brown trout is a very recent invader into the Bloody Dick and Selway Creek drainage because it was not detected in Bloody Dick Creek fish population samples as recently as 1974 (MFWP 1989).

The Western Pearlshell population of Selway Creek was limited in distribution to stream reaches between the downstream boundary of the acquisition parcel and the downstream boundary of the Cow Camp. Surveys near the headwater confluences of Ore and Hidden Creeks also failed to reveal any mussels or relict shells. Reasons for this attenuated distribution are unclear but could include past dewatering events associated with the flood irrigation system, fine sediment deposition from beaver dams or human development, an acute toxic chemical treatment associated with pasture development, or a combination of natural factors. Natural factors limiting mussel occupation of the upper drainage could include high flow velocities, turbulence, shallow depths, or large substrate composition associated with steep stream gradient (Stone et al 2004, Nedeau et al 2005).

Western Pearlshell Mussels in the Rock Crib Study Section exhibited clear habitat preferences similar to those observed by Stone et al (2002) who determined that the mussels exhibited highly contagious non-random distribution patterns across both large and small scale stream reaches. The Selway Creek Pearlshells aggregated at relatively narrow optimum bands of flow velocity (0.20 – 1.25 fps), depth (0.5 – 1.5) feet, and distances from the near bank (0.5 – 5.5 feet). Mussel distribution in Selway Creek was positively correlated with these three parameters, r = 0.56, r = 0.60, and r = 0.58 respectively, in a highly significant or significant manner. Nedeau et al (2005) emphasized the importance of relatively stable flow and substrate determinants of mussel distribution and noted the important function of near bank habitats as a source of those determinants. While polynomial regression analyses of these three parameters yielded Coefficients of Determination of 0.31 to 0.36, it can be interpreted that approximately one-third of the spatial variation of mussel distribution was attributable to each of these parameters taken independently. Stone et al (2004) observed similar results in a western Washington stream finding Pealshell Mussels selecting current velocities within a 0.75 – 1.00 fps range and depths within a 0.7 to 2.0 foot range. Similarly, Johnson et al (2003) found Western Pearlshells occupying depths averaging 0.7 foot ranging to 2.5 feet in Church Creek Washington. While the ocular estimate of substrate size was not well correlated (R^2 = 0.11) with mussel distribution in Selway Creek, the substantial majority of mussel niches were found in 2 to 3 inch gravels mixed with sands. This was an abundant particle distribution in Selway Creek and was commonly provided throughout the thalweg. Stone et al (2004) and Johnson et al (2003) found similar substrate preferences where small gravels and sands formed a relatively stable heterogeneous mixture. Johnson et al (2003) noted that small gravels were associated with the presence of 83% of the mussels in Church Creek however, that niche was often provided immediately downstream from larger boulders which substantially increased bed roughness in another western Washington stream (Stone et al 2002). On a coarser scale, Pearlshells in Selway Creek appeared to exhibit only a slight preference for run and pool habitat types over riffle habitats while Johnson et al (2003) observed a distinct preference for run (41%) and pool (40%) habitats over riffles in Church Creek. This broader habitat preference in Selway Creek might be associated with a lower stream gradient and resultant lower flow velocity and turbulence in riffle habitats than those in Church Creek. It could also be associated with a relatively equal distribution in riffle, pool, and run habitats associated with a C (Rosgen) channel configuration. All of the features found to determine or be associated with Western Pearlshell distribution in Selway Creek were related to or dependant upon a relatively stable and consistent flow regime.

Despite the inherent stability and relatively narrow range of selection of the preferred habitat niches of the Western Pearlshell, destabilizing events can occur to the detriment of individual mussel. As a nearly sessile organism, freshwater mussels often spend their entire lives, from when the glochidia drop off the host fish, within a 1 – 2 meter reach of stream (Nedeau et al 2005). The 2008 survey in Selway Creek, however, revealed a large Pearlshell bed that had apparently been displaced by active fluvial dynamics during the 2008 spring runoff. The bed, that had been located and flagged during the fall 2007 distribution survey, had been displaced as an erosional head cut migrated upstream though a riffle-pool interface. The resultant displacement located individual mussels into the shallowest and deepest niche extremes recorded throughout the study section and produced the only substrate selections composed entirely of sands in a counter-current eddy pocket. This displacement into a shallow point bar configuration also resultant in the only observed trampling and crushing of several individual mussels, possibly by cattle that had recently been in the pasture.

Fisheries

The fishery of Selway Creek exhibited a very low diversity, composed of three nonnative salmonids and the native mottled sculpin. The nonnative sport fishery was dominated by the brook trout with much smaller numbers of brown and rainbow trout contributing to the species mix. The dominance of the brook trout was more heavily skewed in an upstream direction while the rainbow trout were only found in the Rock Crib Section near the downstream terminus of the acquisition reach. A 1974 fisheries inventory in Bloody Dick Creek, approximately 7 miles downstream, revealed a much higher contribution to the fishery by rainbow trout and a presence of the native mountain whitefish at a density higher than that observed for either the brown or rainbow trout in Selway Creek (MFWP 1989). No brown trout were captured in the 1974 survey indicating that they are a relatively recent immigrant into the upper Bloody Dick Creek drainage. The trend in Both Bloody Dick and Selway Creeks appears to be one that favors nonnative species over natives and fall spawning species over spring spawners.

Fisheries characteristics were compared between two study sections through Mark – Recapture methodologies that yielded very strong population estimates with very low standard deviations and very high R/C efficiencies at the 95% Confidence Interval. The Rock Crib Section, near the downstream terminus of the acquisition property, was a larger stream environment than that of the Dead Wood Section upstream from the C.L. Cow Camp. Both sections exhibited a slightly alkaline pH, relatively low productivity, and similar thermal regime but differed in channel size, channel type, and flow regime. Trout populations, particularly those estimated for brook trout, exhibited marked differences in density, growth rate, ultimate size, and condition. Differences as large as those observed would not be expected or explained by the small differences observed in Specific Conductance, pH, elevation or distance between the up and downstream environments. The Rock Crib Section was downstream from all active flood irrigation and exhibited a base flow of 8.60 cfs while the Dead Wood Section was located in a reach of active flood irrigation diversion and accretion and was proximal to the 2.70 cfs headwater flow measurement site.

Brook trout density in the Rock Crib Section was relatively low when compared with other tributaries in the Big Hole, Beaverhead, and Red Rock River drainages (MFWP 1989) but exhibited a relatively high standing crop for the number of fish supported. The standing crop for total trout was also increased substantially by the contribution of the brown and rainbow trout populations compared with the ratio of standing crop to density in the Dead Wood Section. Brook trout density in the Dead Wood Section was very high compared with other brook trout streams in the region (MFWP 1989) and representative of near maximum observed densities at more than 500 fish per 1,000 feet of stream (Oswald 1981 and 1982). The 1974 population estimate in Bloody Dick Creek as well as high density brook trout populations in the upper Big Hole and Clark Fork drainages have generally been dominated (50% - 60%) by juvenile brook trout at Age I or less (MFWP 1979, Oswald 1981). The Dead Wood population, however, was composed of 175 Age I fish per 1,000 feet of stream, or only 33.8% of the population by contrast.

Comparative length frequency analysis of brook trout samples from both Selway Creek study sections strongly indicate that brook trout growth rate, length at age, and ultimate size were significantly greater in the Rock Crib Section than those observed in the Dead Wood Section. Growth rate and length at age for brook trout in the Rock Crib Section were comparable to those observed in other regional tributary streams (MFWP 1979, Oswald 1981) and those observed for brown trout were slightly less than those observed for much larger, more productive streams at lower elevations (Oswald 2006).

Comparative brook trout Condition Factor analysis for both study sections also revealed a significantly higher mean K value for the Rock Crib Section population and higher K values across all length groups with the exception of the largest fish in the population. Comparative linear regression of K values with brook trout length between the two study sections revealed a normal pattern in the Rock Crib Section contrasted with an inverse relationship in the Dead Wood Section. In normal salmonid populations, Condition Factor generally declines with, fish length, age, and reproductive maturity (Oswald 2005, 2006). In the Dead Wood Section, however, mean K values actually increased with length and age to the point at which both regression lines crossed, or formed an apex at approximately equal values for the largest fish in the population. This suggests that the largest fish in the dead Wood population could have been recent in – migrants from downstream environments or been the result of highly successful piscivory on the abundant smaller fish in the reach. Despite comparatively high population densities in some small stream brook trout populations with similar flow regimes, Oswald (1981) reported Condition Factors comparable with other proximal Big Hole River tributaries with much lower population densities. Thus, the relatively weak and comparatively lower K values observed in the Dead Wood Section cannot necessarily be assumed to be a product of population density alone.

The data strongly suggest that the fish populations, particularly the brook trout populations, of the Dead Wood Section have undergone some attenuation in growth and ultimate size, i.e. stunting, relative to the Rock Crib Section. Proximity of the two sections and measurements of temperature, TDS, and Specific Conductance should eliminate differences in base productivity as a major factor. Possible explanations for these differences could include angler harvest and predation by brown trout as factors reducing brook trout population density and contributing to accelerated growth rates observed in the Rock Crib reach. Relatively robust brown trout length at age and Condition Factor could be related to population founder affects at low pioneering densities and an abundant prey base. Physical factors such as increased channel size, pool depth, wetted perimeter, and flow regime could also be major factors contributing to larger fish size in the Rock Crib reach and limiting factors in the Dead Wood reach. This condition would only be exacerbated if irrigation withdrawals have reduced or continue to limit wetted perimeter below minimum instream requirements or have limited dominant channel maintenance discharges in the upper reaches of Selway Creek. Oswald (2005, 2006, 2009) has consistently demonstrated that summer or winter flow reductions below Minimum Instream Flow requirements under the Wetted Perimeter Method

(MFWP 1979) can result in diminished trout standing crops, densities of older, larger fish in the population, and Condition Factor in a wide variety of aquatic environments.

MANAGEMENT RECOMMENDATIONS

1) The data strongly suggest that the Western Pearlshell Mussel population of Selway Creek is a very old population. This should be confirmed, and an actual age profile established as soon as possible. Funding should be established for collections in 2009.

2) The data strongly suggest that the Western Pearshell Mussel population of Selway Creek is not a functioning reproducing population despite relatively large densities of adults and what is an apparently stable set of preferred habitat parameters within their range of distribution. It is recommended that studies to determine if reduction in brook trout numbers and restoration of native westslope cutthroat trout into Selway Creek can restore Pearlshell recuitment. Due to the apparent old age of the population and a reasonable expectation of time required to determine results, this project should be endeavored as soon as possible.

3) Pearlshell distribution data strongly suggest that a limited range of very stable and moderate parameters related to channel configuration, current velocity, wetted perimeter, and substrate sorting define acceptable habitat in Selway creek and other occupied streams. Similarly, fish population data strongly suggest that improved trout growth, length at age, ultimate size, and condition are all being affected within the study reach located within the range of irrigation withdrawal and accretion. For these reasons, it is imperative that Minimum Instream Flow Requirements be determined under the Wetted perimeter Method for Selway Creek during the summer of 2009. It is further recommended that B-D fisheries and hydrology staff conduct a complete quantification and status assessment of all irrigation structures and delivery systems concurrent with synoptic flow determinations through the acquisition reach.

4) While it was not under the review of this study, it was noted that woody riparian development was somewhat limited through most of the acquisition reach. Forest staff should endeavor to determine limiting factors for the current riparian condition and plan, if necessary, to adjust livestock grazing management to improve the current condition.

5) Finally, irrigation withdrawal from Selway Creek could be reducing base summer flows below desired levels within discreet reaches of Selway Creek and is most certainly resulting in hyper saturation of riparian soils in zones of accretion. Because of the rare status, limited distribution, and high risk of extinction of the Western Pearlshell population and the current status of the sport fishery in upper stream reaches, it is recommended that all irrigation withdrawal from Selway Creek be suspended until instream flow needs are defined and ceased entirely if aquatic habitat needs are not being fully met.

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