

University of Montana
ScholarWorks at University of Montana

Undergraduate Theses and Professional Papers

2016

The Effect of Hook Scarring on Angler Satisfaction on the West Fork of the Bitterroot River

Benjamin Rich

Let us know how access to this document benefits you.

Follow this and additional works at: <https://scholarworks.umt.edu/utpp>

Recommended Citation

Rich, Benjamin, "The Effect of Hook Scarring on Angler Satisfaction on the West Fork of the Bitterroot River" (2016). *Undergraduate Theses and Professional Papers*. 216.

<https://scholarworks.umt.edu/utpp/216>

This Thesis is brought to you for free and open access by ScholarWorks at University of Montana. It has been accepted for inclusion in Undergraduate Theses and Professional Papers by an authorized administrator of ScholarWorks at University of Montana. For more information, please contact scholarworks@mso.umt.edu.

Benjamin Rich

The Effect of Hook Scarring on Angler Satisfaction on the West Fork of the Bitterroot River

Benjamin Rich

*Wildlife Biology Program Senior Thesis
(in collaboration with Montana Fish Wildlife and Parks)*

May 13, 2016

Abstract:

Anglers in Montana are shifting towards a catch and release ethic. This shift is causing increased hook scarring in fish populations. Despite these increasing trends few studies have quantified the rate of hook scarring anglers observe, and their attitudes about hook scarring. We developed and conducted an angler survey on the West Fork of the Bitterroot, a section of river with over 30% scarring rates in Westslope Cutthroat in a 2014 Montana Fish, Wildlife and Parks (MFWP) electrofishing survey. We surveyed floating anglers as they pulled out at the end of the fishing day to get complete catch data, satisfaction information, observed hook scarring rates, attitudes about hook scarring, and equipment used. We surveyed 47 anglers of which 94% were fly-fishing and 72% were using barbless hooks. Anglers observed lower hook scarring rates than the previous MFWP electrofishing survey. On average anglers reported hook scarring rates to be very acceptable. There was no correlation between the rate of hook scarring anglers observed and satisfaction with their catch. As densities of anglers increase, more research is needed to understand the effects of angler gear type on hook scarring rates and the effect of hook scarring on angler satisfaction.

Key words:

Westslope Cutthroat, Hook Scarring, Angler Satisfaction, Barbless Hooks, Catch and Release

Introduction:

Recreational fishing in the United States is of great economic importance; in Montana alone recreational fishing brings 96 million dollars in to the economy annually (Lewis and King 2014). Catch and release has gained momentum in the last thirty years and is increasingly becoming a social norm in some angler groups in U.S. recreational fisheries (Kagervall et al. 2014). Catch and release is popular among anglers and valuable as a fisheries management tool because it increases the survival of captured fish allowing them to reproduce, and in some cases be recaptured (Cooke and Suski 2005). Catch and release angling has been known to cause injury and mortality in trout species, but the rate and severity of injury to released trout depends on several key factors. These factors include hook and tackle type, angler experience, and water temperature (Hunsaker et al. 1970, Dotson 1982, Muoneke et al. 1994, Meka 2004, Meka et al. 2005, Shreer et al. 2005, Bloom 2013).

Injury rates and mortality in trout that are caught and released are important to managing fisheries and setting regulations and restrictions. Researchers have conducted many studies targeting the gear type and angler behaviors that affect injury and mortality rates. Research suggests higher rates of release mortality and injury from spin fishing because of greater use of treble hooks and bait that can cause deep hooking (Hunsaker et al. 1970, Muoneke et al. 1994, Meka 2004). Hook type can also affect the rates of post release mortality and hook scarring in trout. A study of a catch and release trout fishery in Alaska determined that treble hooks had the highest injury rate, followed by barbed jay hooks, barbed circle hooks, barbless jay hooks, and barbless circle hooks (Meka 2004). However, a review by Muoneke and Childress (1994) found no significant difference in mortality between barbless and barbed hooks in the literature available at the time. Angler expertise and fight time can also have a significant effect on survival of released fish because prolonged periods of high stress associated with hooking and capture, as well as air exposure during handling by anglers, can significantly decrease survival of trout, especially when water temperatures are high (Dotson 1982, Meka et al. 2005, Shreer et al. 2005). Despite the literature addressing injury rates from different hook types there has been little research to monitor the type and size of hooks fishermen use voluntarily in catch and release fisheries.

In addition to the substantial literature detailing the effects of catch and release on trout with a variety of equipment types, considerable research has been conducted to measure angler satisfaction. This research is important to understand what fishermen are seeking in a fishing experience, and to maximize the enjoyment the public gains from recreational fisheries resources. Research measuring the satisfaction of fishermen is useful to inform management decisions and ensure that management decisions are not reducing public enjoyment of outdoor recreational opportunities. Multiple studies have identified key factors for angler satisfaction across fisheries including, catch rates and angler demographics, such as angler age, number and type of other anglers observed (e.g., Schoolmaster 1986, McCormick et al. 2014). McCormick et al. (2014) found that younger anglers in an Oregon trout

fishery were happier with catching fewer and smaller fish than their older counterparts, but both groups were more satisfied with their experience when they caught more and larger fish. Schoolmaster (1986) found that satisfaction of both guided and unguided anglers on the Madison River, MT, was sensitive to the numbers of other anglers they saw while fishing, and was especially sensitive to seeing float anglers. Significant research has been dedicated to analyzing the effects of catch and release angling on trout and the factors that affect angler satisfaction while little research has been done to analyze if hook scarring affects angler satisfaction. Studies of angler satisfaction that incorporate hook scarring are rare. McMichael (1998) found that although previous sampling had showed hook scarring rates in trout of 7 to 30% in Yakima River, Washington, only 8% of fishermen reporting catching a hook scarred fish. Of those that reported catching a scarred fish, 86% reported they did not mind a presence of hook scars, 14% had no opinion, and 0% reported minding hook scars. These data suggest that anglers are not bothered by hook scarring, but this could be unique to the Yakima River and not representative of other fisheries.

I collaborated with Montana Department of Fish, Wildlife and Parks (hereafter MFWP) to examine the effect of hook scarring in fish in the West Fork of the Bitterroot River (hereafter West Fork) on angler satisfaction. Hook scarring rates in Westslope Cutthroat Trout (*Oncorhynchus clarkii lewisi*) were 58%, with 38% missing mouth parts or permanently deformed in a 2014 MFWP electrofishing population survey. The West Fork is primarily known for its excellent fishing for Westslope Cutthroat Trout and beautiful scenery. MFWP rated all of the sections of the West Fork (except for a stretch of less than a half mile) as outstanding in terms of both fish habitat and sport fishing opportunity. MFWP manages the West Fork primarily as a catch and release fishery for Westslope Cutthroat Trout, Rainbow Trout (*Oncorhynchus mykiss*) and hybrids. The West Fork also supports a fishery for Brown Trout (*Salmo trutta*) and Mountain Whitefish (*Prosopium williamsoni*) that allows for limited take of both species (MFWP 2015 regulations). In my study, I investigated what gear types anglers used, the rate of hook scarring that anglers were observing, and whether hook scarring is reducing angler satisfaction in this area.

Methods:

Study Area

My survey covered a 20 mile stretch of the West Fork extending from Painted Rocks Dam downstream to W.W. White Fishing Access Site, 4 miles upstream of the West Fork's confluence with the East Fork (Appendix A). I surveyed anglers at Canoe, Applebury, Trapper/Job Corps (Trapper hereafter) and WW White access sites. The majority of floating angling pressure in this area comes from fishing guides who tend to fish the West Fork with clients primarily between mid May and mid July. During this period salmon flies (i.e., *Pteronarcys californica*) and other aquatic invertebrates hatch on the West Fork providing good fishing while many other rivers in the area experience high runoff. The fishing on the West Fork

attracts many clients and independent anglers that contribute to businesses in the surrounding communities (personal communication, C. Oschell MFWP 2015).

Data Collection

I selected anglers for surveys using a roving or convenience sampling design. I drove up and down the road adjacent to the West Fork and stopped to interview anglers when I spotted them taking out, interviewing every angler at the access. When traffic was slow I would check all of the boat ramps for empty trailers and wait at the site with the highest concentration of trailers to maximize my sample size. I interviewed floating anglers as they took out at boat ramps in the afternoon (between 12:00 and 18:00) to minimize interference with their angling experience and ensure that angling data from that day were complete. I sampled weekday and weekend days approximately equally. I entered data into the Trimble data application (2015) on my smart phone at time of collection. My survey (Appendix C) incorporated angler demographic questions from a previous survey conducted by MFWP on the West Fork, as well as new questions regarding catch, equipment type and satisfaction regarding hook scarring on a scale from -3 (highly dissatisfied) to 3 (highly satisfied) based on McMichael (1998) and Beardmore et al. (2014). On guided trips I would ask the client the fish Identification questions and guides the questions about the number of fish that were caught. Angling clients were often unable to count the number of fish, were poor at fish ID and or weren't able to get a good view of fish before they were released to notice hook scarring or even species. I asked clients, not guides, about angling satisfaction and opinions on hook scarring. I used linear regression to analyze the trend in hook size throughout the season, as well as Pearson significance test to determine if there was a significant relationship between hook scarring rates and angler satisfaction with their catch.

Results:

I collected 47 surveys over 8 days of surveying in the field between May 22, 2015 and July 1, 2015. The majority of surveyed fishermen were floating from Canoe or Applebury boat ramps down to Trapper/Job Corp. Therefore my data are dominated by surveys collected at Trapper take-out, with 73% of my surveys at Trapper, 15% at WW White, 6% at Canoe, and 6% at Applebury (see Appendix E). The average time anglers spent fishing was 5.5 hours (range 2.5 - 10 hours).

Angler Demographics

Angler experience level (beginner, somewhat experienced, experienced, or expert) was evenly distributed and expert anglers comprised 35% of the sample (Figure 1). Fifty Five percent of the anglers surveyed were professionally guided and Forty Five Percent were self guided.

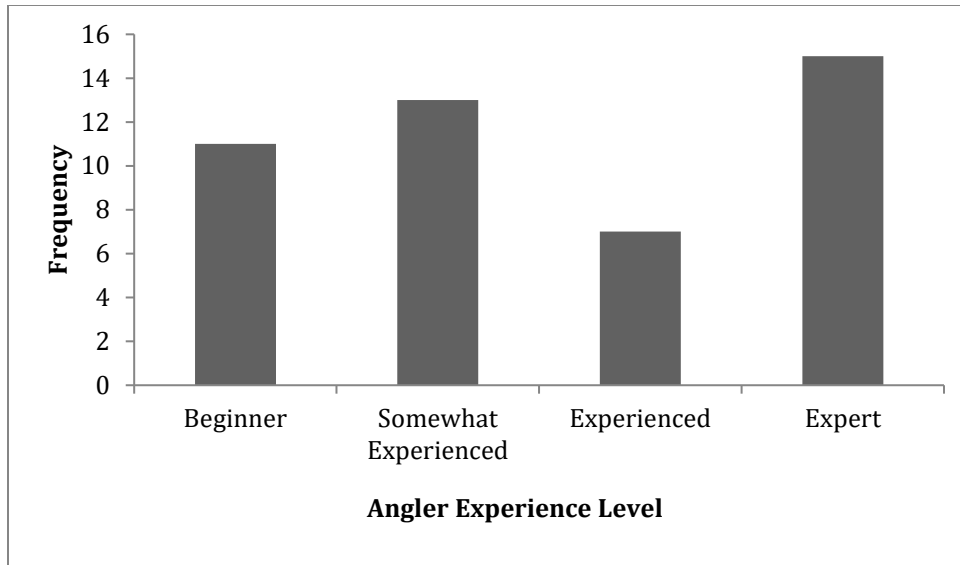


Figure 1. Self assessment of experience level in trout anglers on the West Fork of the Bitterroot during the survey period 5/22 to 7/1, 2015. n=46

Angler Gear Type

Of my survey participants, 93.6% used fly gear as their primary gear type and of those anglers 71.7% voluntarily used barbless or debarbed hooks. Only anglers from three boats in the survey were primarily using spinning gear (6.4% of total). Of these three boats two reported using barbed treble hooks (4.3% of total), and one reported using barbless treble hooks (2.2% of total). The majority of anglers (74.0%) using both spinning gear and fly gear were voluntarily using barbless hooks. The rate of barbless hook use was higher among guided fishermen (85%) then unguided (65%).

The hook size used by fly fishermen showed a downward trend through the survey period with an average of size 8.8.

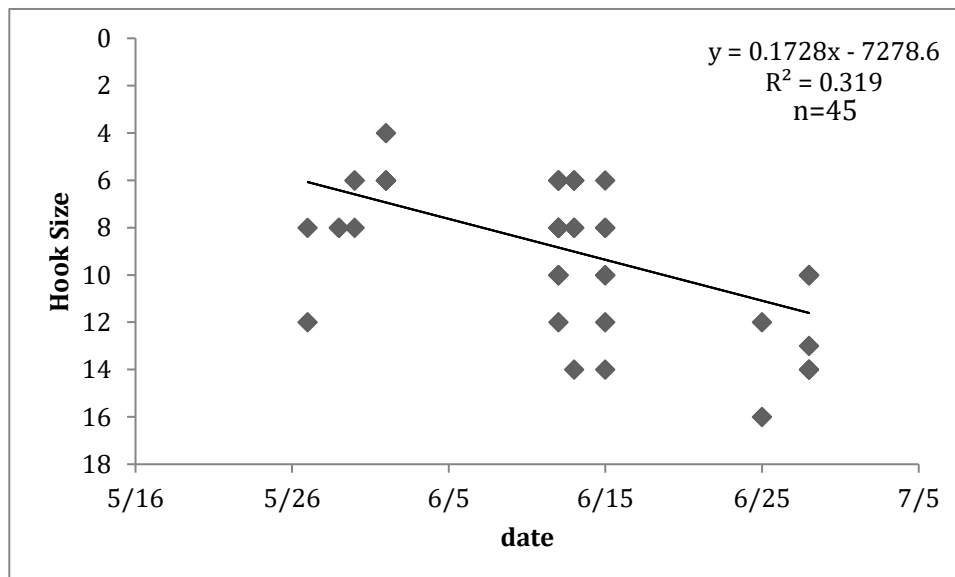


Figure 3. Hook size by date of fly fishermen on the West Fork of the Bitterroot during the survey period 5/22 to 7/1, 2015.

Catch and hook scarring

Westslope Cutthroat Trout made up the majority of the reported catch (82%). The Catch Per Unit Effort (CPUE) for Westslope Cutthroat was 1.7 fish per hour per boat. The average number of Westslope Cutthroat landed per boat per day was 9.8 (range 0-33). The rate of hook scarring observed varied among guided and unguided fly fishermen, but was approximately four times lower than the estimate for Westslope Cutthroat Trout from the previous MFWP population survey.

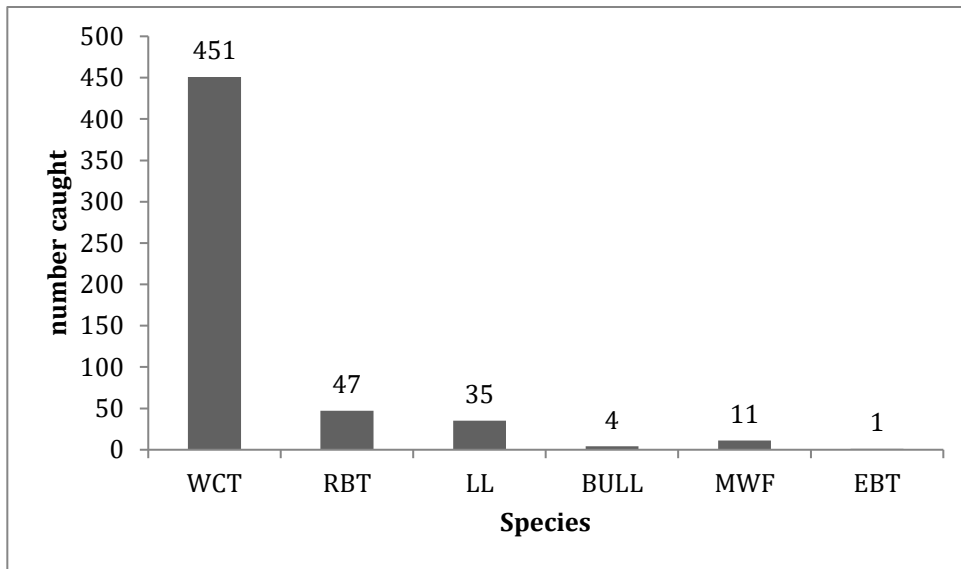


Figure 4. Number of reported fish caught by fishermen, by species, during survey period of 5/22/2015 to 7/1/2015 on the West Fork of the Bitterroot River. WCT=Westslope Cutthroat Trout, RBT=Rainbow Trout, LL=Brown Trout, DV=Bull Trout, MWF=Mountain Whitefish, EBT= Eastern Brook Trout

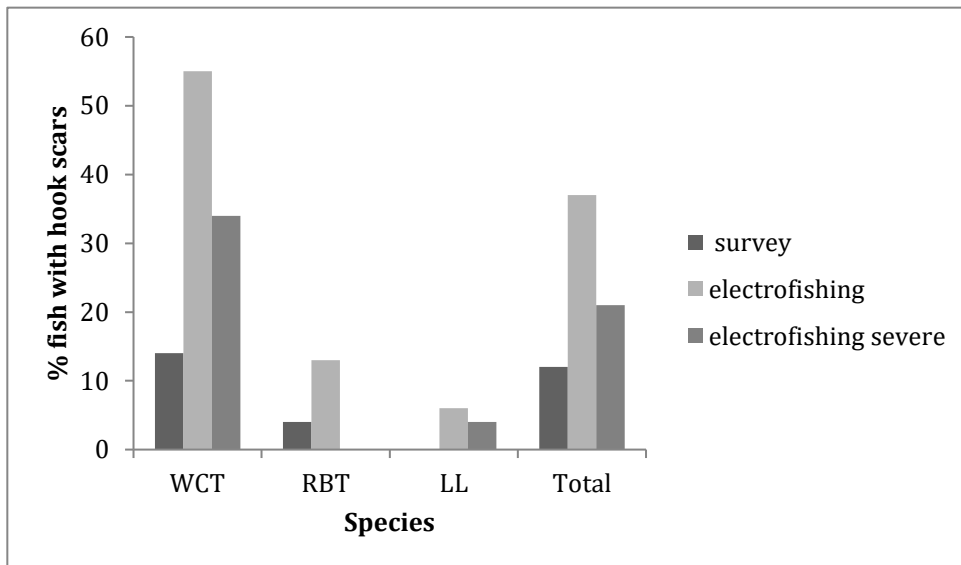


Figure 5. Hook scarring rates reported by recreational anglers 5/22 – 7/1, 2015 compared to hook scarring from West Fork Electrofishing survey, September 15, 2014. WCT=Westslope Cutthroat, RBT=Rainbow Trout, LL=Brown Trout Consult Appendix A for difference between hook scarring and severe hook scarring.

Angler Perceptions and Attitudes

Despite the low amount of hook scarring observed by anglers, the majority of anglers surveyed (59%) thought hook scarring was an issue, a proxy for if they believed hook-scarring was occurring and observable in the fishery. Professionally guided anglers thought that hook scarring was an issue at a higher rate (73%) than self-guided anglers (40%). Interestingly, there was no correlation between angler satisfaction with their catch and the level of hook scarring observed (Pearson .0998) (Figure 6). However, anglers gave an average score of 1.8 (acceptable to very acceptable) when they were asked if the level of hook scarring they observed was acceptable.

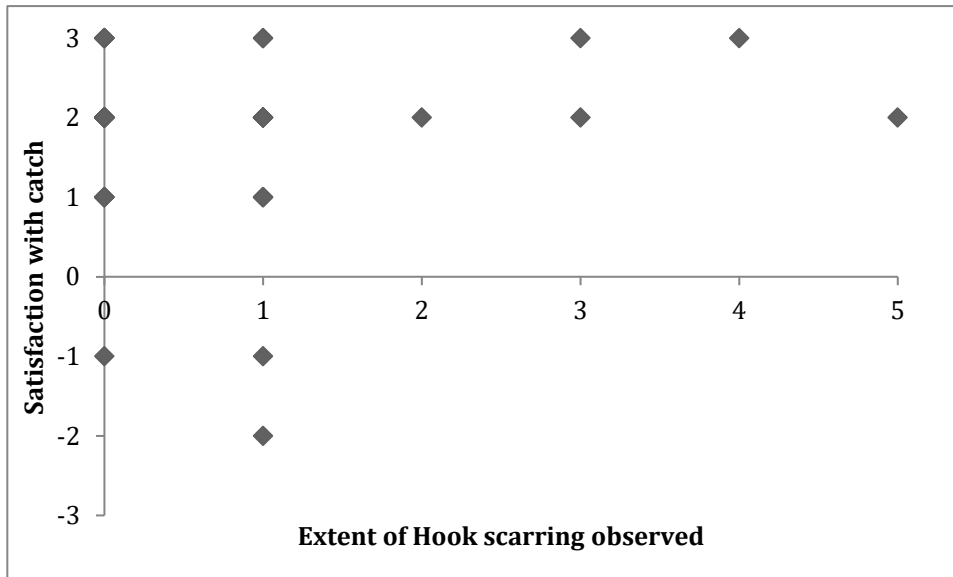


Figure 6. Satisfaction with daily catch compared to observed level of hook scarring from 2015 angler surveys, West Fork Bitterroot. n=46. (0,3) n=4, (0,2) n=17, (0,1) n=6, (0,-1) n=1, (1,3) n=2, (1,2) n=5, (1,1) n=3, (1,-1) n=1, (1,-2) n=1, (2,2) n=1, (3,3) n=1, (3,2) n=1, (4,3) n=1, (5,2) n=1.

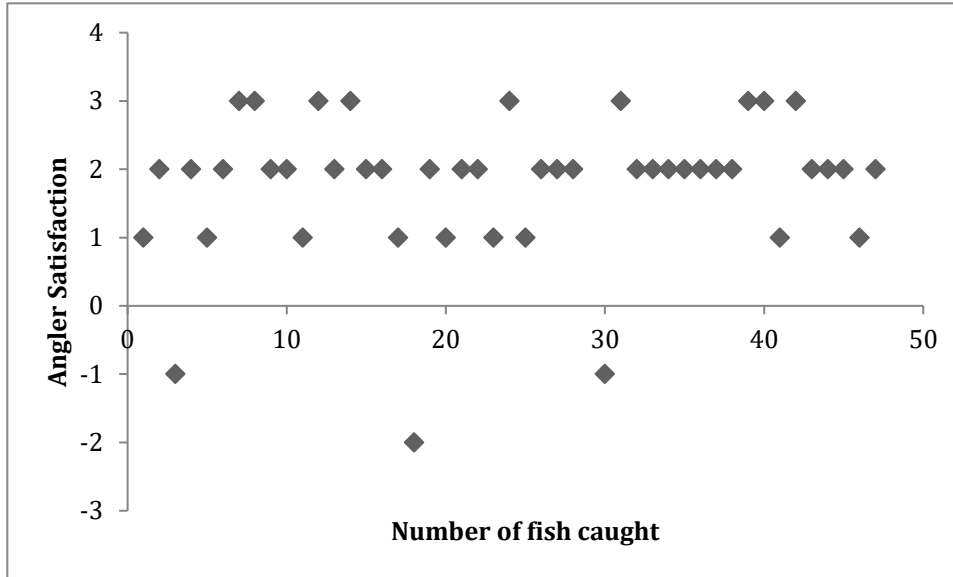


Figure 7. Angler satisfaction compared to the number of fish caught from 2015 Angler Survey, West Fork Bitterroot.

Discussion:

I was able to take away several interesting trends from my data. First, anglers were voluntarily using barbless hooks at a very high rate. Second, anglers observed and reported hook scarring at a lower rate than previous biological estimates in the same stream reach. Third, the majority of anglers believed hook scarring was an issue. Finally, angler satisfaction was not affected by hook scarring, or the number of other anglers observed while fishing.

Angler Gear Type and Hook Data

Even though most of the anglers reported using barbless hooks, this reporting could potentially suffer from a social desirability bias, a serious concern in face to face surveys such as mine. Social desirability bias is the “extent to which a question elicits answers that are socially unacceptable or socially undesirable” (Tourangeau et al. 2000, Tourangeau and Yan, 2007). In Schill and Kline’s (1995) paper analyzing non-compliance for Idaho fishing regulations 29% of anglers were using barbed hooks in an area where it was prohibited by regulations. Of these, 20% were unaware of the regulation or were using barbed hooks by accident (forgot to flatten barb or buy barbless hooks). The rate of barbless hook use observed in the West Fork exceeded the rate observed in Idaho (Schill and Kline 1995), despite barbed hooks being legal. This suggests that the fisheries in these two areas differ, barbless hook use has increased since 1995, or social desirability bias substantially influenced my data. Even so, guided anglers in the West Fork may be more likely to use barbless hook more often to minimize population impacts and injury (Appendix F). First, guides have a vested interest in trying to minimize handling time to reduce mortality and hopefully ensure future catches of the same fish by their clients (job security). Second, guides with novice or somewhat

experienced clients use barbless hooks largely to ensure their own safety and ease the challenge of hook removal from bodies when novice fly casters make a poor cast.

Hook size used by anglers decreased throughout the survey period. The decreasing trend in hook size can be largely explained by decreasing insect size after the peak of the salmon fly hatch. While surveying I noticed increasing numbers of golden sallys, spotted sedge, and pale morning duns after the salmon fly hatch that are all better replicated by smaller flies than the large (size 6) usually favored to imitate salmon flies. The use of smaller flies through the latter part of the summer could possibly decrease hook scarring rates and severity by reducing the size of wounds from catch and release.

Catch Data

The difference in hook scarring rates between electrofishing samples in the fall of 2014, and my survey in May and June of 2015 is probably due to several factors. First, the time of the year that my survey occurred was during the peak fishing season, but was still two months earlier than the electroshocking survey. In those additional two months it is possible that a higher proportion of fish were captured, or recaptured, and released causing hook scarring to occur at a higher rate at the end of the season.

Additionally, hook scarring is a standard observation on MFWP survey forms that biologists and technicians are trained to look for and identify. Recreational fishermen and guides lack this training and probably have varying degrees of ability to identify hook scars. Most catch and release anglers also seek to minimize handling time of fish that limits the angler or guides ability to notice hook scarring.

The percentage of hook scarring by species from the angler survey is proportional to the electroshocking survey and reflects the species composition and abundance in the West Fork of Westslope Cutthroat, Rainbow Trout, and Brown Trout.

Angler Perceptions and Attitudes

My data did not strongly suggest that anglers were bothered by crowding on the river despite relatively high floating traffic except for 6/12 when angler use peaked (Appendix D). This could be caused by several factors. For one, recreational floaters and outfitters are generally good at dispersing on the river so they are not constantly within sight of each other. Second, take-outs and put-ins were rarely crowded, which reduced stress and the perception of crowding. These measures however are not representative of all anglers on the West Fork of the Bitterroot because my survey did not include bank or shore anglers. Previous studies on the Madison River, MT have shown shore anglers are more affected by crowding caused by floating anglers (Schoolmaster, 1986).

My data suggest little if any correlation between hook scarring and angler satisfaction. There are slight positive associations of catch rate and angler satisfaction, regardless of hook scarring (Figures 6 and 7). Other factors that could be elevating angler satisfaction regardless of catch and hook scarring are if anglers caught big fish or caught a specific species they were targeting, the age of anglers and their need to catch fish to be satisfied, and the distance traveled to reach the

river and amount of time spent fishing (Beardmore et al. 2015, McCormick and Porter 2014).

Many respondents answered that they thought hook scarring was an issue even though there was no relationship between angler satisfaction and hook scarring. This may stem from people thinking hook scarring is an issue if asked. This bias could be magnified with guided clients, if the guide educates them about hook scarring during the fishing day or during the survey. From comments received, hook scarring seemed to be more of a slight annoyance to people than an issue.

Future Directions

Hook scarring, and catch and release fisheries in general are under studied, leaving many questions that have yet to be answered. By broadening this study to cover a larger time scale and other sites where hook scarring is high we could better quantify if hook scarring negatively affects angler satisfaction. We also need research to determine if hook scarring decreases with regulations requiring mandatory use of barbless hooks in catch and release fisheries. Hatchery experiments to determine the effects of hook size on scarring rates and clarify the effect of barbs also have potential to increase our understanding of the physiological affects of repeat capture by anglers with different sizes and types of hooks.

Another useful research question would be if angler education about hook scars increases the ability of anglers to identify hook scarring and if this affects their attitude about hook scarring and satisfaction with catching scarred fish. This question could be examined using an experiment with two angler groups, a control (uneducated about hook scarring) and treatment (educated about hook scarring) and having both groups take the same float trip. After the trip you could survey both groups about attitudes on hook scarring, as well as the rate of hook scarring they noticed, and analyze any differences.

Acknowledgements: I would like to thank Lisa Eby and Chrissy Oschell who guided me through the process of designing and conducting this research as well as Mike Patterson, Mike Mitchell, Chris Clancy, Pat Saffel and Jennifer Corbin for their help and critiques.

Appendix A:

No hook scar



Hook scar



Severe Hook scar

Figure 8. Degree of hook scarring on Westslope Cutthroat Trout (Photo Credit: Chris Clancy)

Appendix B: West Fork Bitterroot Access Map



Figure 9. Map of West Fork of the Bitterroot with surveyed access sites marked.

Benjamin Rich

Appendix C: Angler satisfaction and hook scarring survey

Table 1. Introductory and demographic questions for angler survey

Survey Date:
 Put in:
 Take out:
 Number of boats in party:
 Fishing time (hours):
 Number of other anglers observed:
 Was the number of other anglers observed acceptable?
 -3 -2 -1 0 1 2 3
 extremely very somewhat neutral somewhat very extremely
 unacceptable unacceptable unacceptable acceptable acceptable acceptable
 Was this a guided trip? Yes No
 Do you have a current Montana Fishing License? Yes No
 Do you have a current copy of the Montana Fishing Regulations? Yes No
 How do you rate yourself as a trout angler?
 Beginner__ Somewhat Experienced__ Experienced__ Expert__

Table 2. Fish ID

Brown Trout: Correct Incorrect
 Bull Trout: Correct Incorrect
 Rainbow Trout: Correct Incorrect
 Brook Trout: Correct Incorrect
 Westslope Cutthroat: Correct Incorrect

Table 3. Gear Questions

Gear Type? Spinning Fly
 Hook Type? Treble J-Hook Circle
 Primary Hook Size? 2 4 6 8 10 12 14 16 18 20 ____
 Barbed? Yes No

Table 4. Angler Satisfaction Questions

Were you satisfied with your catch today?
 -3 -2 -1 0 1 2 3
 extremely very somewhat neutral somewhat very extremely
 dissatisfied dissatisfied dissatisfied satisfied satisfied satisfied
 To what extent did you observe hook scarring?
 0 1 2 3 4 5
 none few some many most all
 Do you think hook scarring is an issue?
 0 1 2 3 4 5
 Is the level of hook scarring you observed acceptable

-3 -2 -1 0 1 2 3
 extremely very somewhat neutral somewhat very extremely
 unacceptable unacceptable unacceptable acceptable acceptable acceptable

Table 5. Catch Questions

Species Targeted: WCT RB EB BULL LL MWF Other
 Species # caught # scarred
 Westslope Cutt
 Rainbow Trout
 Brown Trout
 Bull Trout
 Whitefish
 Other

Appendix D: Acceptability of number of other anglers observed

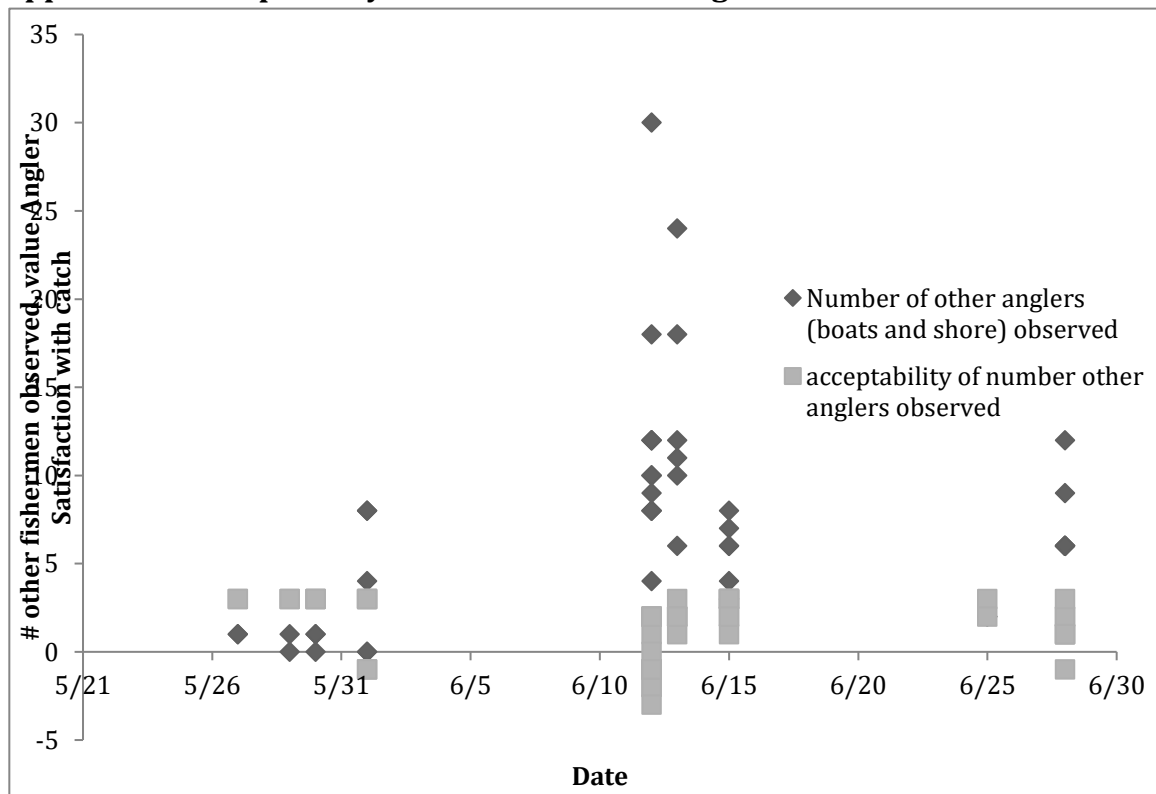


Figure 10. Number of other boats and shore anglers observed paired with acceptability of other anglers observed by date.

Appendix E: Distribution of surveys

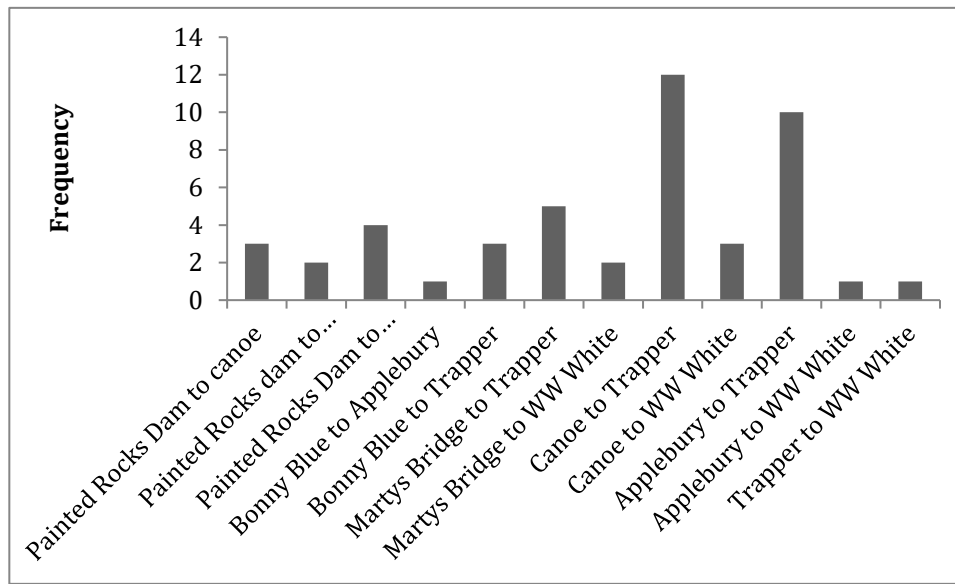


Figure 11. Frequency of floats by section (put-in to take-out) on the West Fork of the Bitterroot during the survey period 5/22-7/1, 2015.

Appendix F: Comments from anglers and guides

One guide I talked to insists on using barbs for paying clients so they lose less fish although he personally angles with barbless.

Some guides (~10%) specifically believe that there is not enough boat traffic and the river is under utilized and can support more use to get more people outdoors and into fishing.

One guide suggested that he is not seeing enough hook scarring. He supported this position by saying he thinks hook scars are positive because they show that other fishermen are releasing fish well enough that they can survive and be recaptured.

One local Bitterrooter floating and using spinning gear insisted on regulations like the Beaverhead and Bitterroot to limit guide pressure.

One guide suggested changing regulations to allow anglers to keep rainbow trout on the West Fork to allow the public to help with reducing hybridization and keeping fish to get a complete experience.

One party of two guided boats reported children on shore throwing sticks and small rocks at their boats and anglers as they rowed past.

Appendix G: Additional Results

The majority of anglers were able to correctly identify salmonid species with 80% accuracy for Westslope Cutthroat, 86% accuracy for Rainbow Trout and 73% percent accuracy for Brown Trout. I believe that these numbers overestimate the ability of the public to identify fish because guides and fishing partners often offered hints or provided answers during this the part of the survey, and the testing material showed only pictures of adult fish with bright, archetypical markings.

Works Cited

- Beardmore, B., L. M. Hunt, W. Haider, M. Dorow, and R. Arlinghaus. 2014. Effectively managing angler satisfaction in recreational fisheries requires understanding the fish species and the anglers. *Canadian Journal of Fisheries and Aquatic Sciences* (ja).
- Bloom, R. K. 2013. Capture efficiency of barbed versus barbless artificial flies for trout. *North American Journal of Fisheries Management* 33(3):493-498.
- Cooke, S. J., and C. D. Suski. 2005. Do we need species-specific guidelines for catch-and-release recreational angling to effectively conserve diverse fishery resources? *Biodiversity & Conservation* 14(5):1195-1209.
- Dotson, T. 1982. Mortalities in trout caused by gear type and angler-induced stress. *North American Journal of Fisheries Management* 2(1):60-65.
- DuBois, R. B., and R. R. Dubielzig. 2004. Effect of hook type on mortality, trauma, and capture efficiency of wild stream trout caught by angling with spinners. *North American Journal of Fisheries Management* 24(2):609-616.
- Hunsaker, D., L. F. Marnell, and F. P. Sharpe. 1970. Hooking mortality of yellowstone cutthroat trout. *The Progressive Fish-Culturist* 32(4):231-235.
- Kagervall, A., T. A. Heberlein, G. Hellström, and G. Ericsson. 2014. Conceptualization and measurement of catch-and-release norms. *Human Dimensions of Wildlife* 19(2):139-153.
- Klein, W. 1965. Mortality of rainbow trout caught on single and treble hooks and released. *The Progressive Fish-Culturist* 27(3):171-172.
- Marnell, L. F., and D. Hunsaker. 1970. Hooking mortality of lure-caught cutthroat trout (*salmo clarki*) in relation to water temperature, fatigue, and reproductive maturity of released fish. *Transactions of the American Fisheries Society* 99(4):684-688.
- McCormick, J. L., and T. K. Porter. 2014. Effect of fishing success on angler satisfaction on a central Oregon rainbow trout fishery: Implications for establishing management objectives. *North American Journal of Fisheries Management* 34(5):938-944.
- McMichael, G. A. 1998. Upper Yakima River angler survey June 21 to August 13, 1995. *Yakima River Species Interactions Studies* :120.
- Meka, J. M. 2004. The influence of hook type, angler experience, and fish size on injury rates and the duration of capture in an Alaskan catch-and-release rainbow trout fishery. *North American Journal of Fisheries Management* 24(4):1309-1321.

- Meka, J. M., and S. D. McCormick. 2005. Physiological response of wild rainbow trout to angling: Impact of angling duration, fish size, body condition, and temperature. *Fisheries Research* 72(2):311-322.
- Muoneke, M. I., and W. M. Childress. 1994. Hooking mortality: A review for recreational fisheries. *Reviews in Fisheries Science* 2(2):123-156.
- Schill, D. J., J. Griffith, and R. E. Gresswell. 1986. Hooking mortality of cutthroat trout in a catch-and-release segment of the Yellowstone River, Yellowstone National Park. *North American Journal of Fisheries Management* 6(2):226-232.
- Schill, D., and P. A. Kline. 1995. Use of random response to estimate angler noncompliance with fishing regulations. *North American Journal of Fisheries Management* 15(4):721-731.
- Schill, D., and R. Scarpella. 1997. Barbed hook restrictions in catch-and-release trout fisheries: A social issue. *North American Journal of Fisheries Management* 17(4):873-881.
- Schoolmaster, F. A. 1986. Bank-and float-angler perceptions of use levels on the Madison River, Montana. *North American Journal of Fisheries Management* 6(3):430-438.
- Taylor, M. J., and K. R. White. 1992. A meta-analysis of hooking mortality of nonanadromous trout. *North American Journal of Fisheries Management* 12(4):760-767.
- Tourangeau, R., L. J. Rips, and K. Rasinski. 2000. *The psychology of survey response*. Cambridge University Press, .
- Tourangeau, R., and T. Yan. 2007. Sensitive questions in surveys. *Psychological Bulletin* 133(5):859.