D-J Report: The Upper Clark Fork River Fishery

Introduction

Environment

The environment of the Upper Clark Fork River has undergone dramatic physical change during the interval of European occupation. Prior to the arrival of Europeans, the river system evolved for many years with only minor perturbations from climatic variation. In that period, the river was inhabited by a limited fish fauna including bull and westslope cutthroat trout, mountain whitefish, longnose and coarsescale suckers, redside shiners, longnose dace, northern pike minnows and sculpins.

The impact of European settlement began with the removal of beavers by fur trappers, the gold mining boom, followed closely by the development of the livestock industry. All of these had negative consequences for native salmonids, which were adapted to a relatively stable environmental regime and a limited array of competing species. Beaver trapping reduced the number and distribution of that species with concomitant alteration of fish habitats associated with them. Livestock use was intense in wintering areas along the Upper Clark Fork River valley where snow accumulations were normally small. Large numbers of livestock occupying the riparian zone seem likely to have had significant impacts on woody riparian vegetation, bank stability, and thus sedimentation. Early gold operations included a variety of methods, many of which resulted in major increases in sediment production and channel degradation. Milling operations commonly used mercury in the gold extraction process and large volumes of mercury were released into the environment in the process. Much of that mercury persists in the tributaries of the Clark Fork at this writing.

The onset of copper mining, milling and smelting operations in Butte and Anaconda just before the turn of the century set the stage for the Clark Fork's decline. Enormous volumes of fine materials, mostly mill tailings and the associated metals, were released into the drainage and ultimately carried downstream throughout the river system. There, those fine materials and metals were deposited both within the channel of the stream and in overbank deposits within the floodplain. The resultant toxicity reduced aquatic life to a few resistant species. The river from the early part of the 20^{th} century to mid-century was largely uninhabitable for trout. After mid-century, small efforts to retain at least some portion of the toxic metals in the Warm Springs Treatment Pond System allowed water quality to recover to a degree and trout began to recolonize the lower sections of the river above Missoula. This process continued and brown trout appeared in the section of the river near Warm Springs in the 1970s.

Brown trout, brook trout, and rainbow trout were introduced into the watershed even before mid-century. These species of exotic trout established naturally self-sustaining populations in suitable tributary habitats. In the tributaries, rainbow trout hybridized with westslope cutthroat and brook trout hybridized with bull trout. Both native species suffered loss of genetic integrity and in some cases were ultimately extirpated as pure species. Brook trout proved to be effective competitors with the native westslope cutthroat and reduction in numbers and distribution of the cutthroat resulted.

Brown trout were the species that would re-establish trout fishing over the majority of the length of the Upper Clark Fork. Due to their resistance to degraded environmental quality, and in particular their greater tolerance for toxic metals, they became the dominant mainstem trout species. Without brown trout, the upper river would not, even now, support a viable trout fishery.

Superfund

The Clark Fork River from its headwaters at the confluence of Mill, Willow, and Warm Springs Creeks to Milltown Dam was designated a Superfund Priority site in 1986. Since that time, this river segment has been the object of a great deal of study and controversy. The US Environmental Protection Agency has been primarily responsible for directing studies and decision making regarding the need for remedial cleanup and the form that any cleanup option selected might take. In addition, the State of Montana under a provision of the Superfund statute filed a natural resources damage claim against the Atlantic-Richfield Company seeking to recover lost public natural resource values resulting from contamination of the river and its watershed. Both processes continue at this writing. Those with interests in the quality of the river environment and its fisheries have been both participants and observers of the ongoing process. The final decision on cleanup method and extent has been long awaited. That decision will determine the future of the Clark Fork fishery. Funds that may be secured from the natural resources damage lawsuit may be used to supplement the Superfund cleanup efforts. These are pivotal issues for the river, its trout, and the anglers who wish to pursue them.

Methods

The trout populations of the Upper Clark Fork have been monitored using electrofishing population estimates for 30 years. The oldest established sections are called the pH Shack and Williams-Tavenner sections. The pH Shack section was named for a structure where pH measurements were made that assessed the effects of lime addition in the Warm Springs treatment ponds. That structure, and the river section on which it was located, no longer exists. The pH Shack and Williams-Tavenner sections have been monitored for 30 and 21 years and are 1.35 and 1.22 miles in length, respectively. The Galen section was adopted as an additional long term monitoring site beginning in 1999. It is 1.1 miles long. The addition of this section was intended to provide a pre-cleanup data collection site in an area where Superfund action might be expected to have significant effects on the trout population. Collection of several estimates over a period of years will allow the establishment of a reasonably reliable baseline data set against which post-cleanup population responses can be compared. The pH Shack section begins at approximately river mile 483.5, the Galen section at river mile 479.8, and the Williams-Tavenner Section at river mile 454.4.

Habitat conditions within the trout population monitoring sections have changed over the period of data collection. The Williams-Tavenner section has been least modified. Land use changes there have been negligible. Water quality data are lacking. The Galen section was bermed after the 1989 fishkill. Those berms, intended as a temporary measure to reduce the inputs of metals to the river during high intensity rainfall events, have been breached in a number of places within the Galen section. The pH Shack section has been most significantly altered during the period of record. The original upstream end of the section no longer exists. Extensive modification of the Warm Springs Treatment Ponds and the channels of the Mill-Willow Bypass have resulted in major change to the habitat within the pH Shack section. Berming took place along the section proper. Upstream, removal of metals rich sediment along the course of the Mill-Willow Bypass and the reconfiguration of the stream channels both within and below the Bypass have influenced the pH Shack section. The removal of the Bypass metals deposits resulted in a reduction in the availability of metals, which had been shown to be responsible for repeated fish kills in the Warm Springs area of the Clark Fork. Changes in the configuration of the Warm Springs Treatment Ponds seem to have effects on the delivery of pond invertebrates to the stream system possibly reducing the total nutrient resource available to support trout. Rebuilding efforts on the channel of the Mill-Willow Bypass have resulted in significant generation of fine sediments, which have entered the pH Shack section where their deposition has damaged stream habitat for both invertebrates and fish. Despite these insults, the pH Shack section is almost textbook brown trout habitat in a physical sense. Banks have been free of significant livestock use for many years and the riparian willow assemblage is mature and provides excellent brown trout cover as well as bank stability. Absent metals, this would be brown trout heaven.

Marking and recapture of trout have been achieved by the use of boat mounted electrofishing gear. Early estimates were done primarily with mobile electrode gear using pulsed DC current and a 3 person crew. The method changed in the late 1980s with the adoption of a fixed boom boat and a crew of 2. The use of pulsed DC electrofishing gear was discontinued and straight DC mode adopted. Both collection methods used downstream drift techniques. Most estimates have utilized a single marking and single recapture run. In a few instances where the experience of the crew indicated that insufficient numbers of fish were marked in a single pass, a second marking run was made after an interval of a couple of weeks. Time elapsed between marking and recapture runs was generally about 2 weeks.

Early estimates were made in both spring and fall. These were curtailed to a spring estimate only in the early 1980s since the vast majority of trout in the system were brown trout and estimates of this species during late summer and fall were felt to be inaccurate due to the mobility of brown trout prior to spawning. Population estimates were made annually on each section until the late 1980s and early 1990s. During the latter period, the river trout populations were subjected to intense scrutiny and greatly increased levels of electrofishing as a facet of Superfund and Natural Resources Damage investigations. In response, the sampling regime was modified to an alternate year schedule to reduce impacts to the trout populations of the sample sections. Section lengths for the Williams-Tavenner and Galen sections have remained the same over the period of sampling. The pH Shack section was originally somewhat longer but was shortened to reflect changes in the river system and new access points for boat launching and recovery. All sections include sufficient variation in channel condition and configuration to be reasonably representative of the river segments in which they are located.

Estimates have been made by the use of the MFWP version of the Peterson Estimator, a mark and recapture method. There are a variety of variables in both the use of the electrofishing gear and the conditions in which it is used. Among these variables are river flow volume, water temperature, season of the year, type and output selection of the electrofishing unit, work crew experience, and more. These variables may have significant influences on the estimates generated. Interpretation of the resultant data must be done with the limitations of the methodology constantly in mind. Presentation of data has been modified to reflect the estimated number of brown trout over 6 inches in total length per mile of stream. Estimates are presented with 95% confidence intervals included. These data are of most utility and accuracy when they are compared to other estimates from the same section. With additional distance or time interval, more, different and often unknown variables become operable and render comparison and interpretation increasingly tenuous.

Results

Sections

The data collected are summarized in the following figures displaying the information for each of the three sections. The pH Shack section estimates of brown trout numbers are presented in Figure 1. Estimates from the Galen section are displayed in Figure 2. The Williams-Tavenner section records are shown in Figure 3. Interpretation of the information presented should be tempered with the cautions specified in the previous section firmly in mind.

pH Shack Section

The estimates displayed in Figure 1 are for the period 1973 to 2002. It seems reasonable to assume that brown trout had colonized the upper section of the river for sometime before the first estimates were made. Estimated numbers of brown trout increased from the first levels of about 1000 per mile to a density of around 2000 per mile in the period from 1973 to 1988. Since 1988 there seems to have been an overall decline in brown trout numbers to a level of approximately 1000 per mile. There have certainly been multiple factors at play in determining the population density of brown trout in the interval. Among those factors have been: drought; periodic metals incidents in which water quality has been so low as to cause direct fish mortalities; changes in water quality and the distribution and abundance of fine sediments associated with reconfiguration of the stream channel and banks above the section; and changes in the configuration of the ponds, which have altered the flow of invertebrates into the river section.

The pH Shack section is the area of the Upper Clark Fork supporting the greatest trout density. That density is most striking since it is also the river reach with the lowest flow volumes so that apparent density is accentuated. Due to the abundance of trout and the access to the stream provided by the FWP Warm Springs Wildlife Management Area, the vast majority of angler use of the Clark Fork above the mouth of Rock Creek takes place in the vicinity of the pH Shack section. The Warm Springs Treatment Ponds receive the flow of Silver Bow Creek and improve the quality of the water. While the pond environment is far from hospitable to aquatic life, those forms able to tolerate the water quality are presented with a significant nutrient resource relatively free of competing species. Densities of Daphnia, amphipod and isopod crustaceans can be very high. A portion of this invertebrate production is carried into the outflow of the ponds and significantly enhances the food resources available to trout for a relatively short distance downstream from the outflow. The result is a modified tailwater effect. The circumstance is not typical of tailwaters since the pond volumes and depths do not offer the temperature influences to downstream waters that are typical of the large lakes or impoundments normally associated with tailwaters.

Another significant influence of the Warm Springs Treatment Ponds on the pH Shack section is in direct contribution of salmonids to the stream. The ponds have been inhabited by brown trout for many years. Those fish were wild fish that made their way downstream from tributaries higher up the drainage. After the discovery of the presence of large brown trout in the ponds, a stocking program was initiated using hatchery rainbow trout. On occasion some river brown trout were relocated to the ponds as well, to supplement the brown trout population. Large sized individuals of both species on occasion moved downstream out of the ponds and into the river. During the reconfiguration of the ponds in the early 1990s, the outflow structures were redesigned and rebuilt. The new structures seem to be much more conducive to downstream fish movement and the numbers of downstream migrants increased rather dramatically. The numbers of pond fish moving out of the ponds and into the stream seems to be positively correlated with high pond water outflows. In years of high flows, many large fish leave the ponds. In low flow years, few fish move downstream. In either event, the fish are prevented from moving back to the pond system due to the configuration of the outflow system. It appears that both habitat characteristics of the stream below the ponds as well as the available food resources are inappropriate for the large pond fish. While their life expectancy is likely short once they leave the ponds and enter the stream, the large average size attracts a great deal of angler attention. And results in false impressions of the productive potential of the river segment and unrealistic expectations of the size of fish likely to be encountered.

It appears that not only numbers but size distribution of brown trout in the section has changed through time. It is impossible to determine the factors responsible for the changes. Within the 20 year span of the author's experience in the area, it seems that numbers of trout have, in fact declined, and that both average and maximum fish sizes are somewhat reduced. An associated change has been observed, qualitatively, in the population of mountain whitefish in the section. In the early 1990s and before, the pH Shack section whitefish population seemed to be rather small. Whitefish were present in relatively low densities compared to river areas farther downstream. The individual whitefish occupying the section were somewhat noteworthy for their large size. Most whitefish observed were adults and might have averaged more than 2 pounds in weight. Subsequently, whitefish in the pH Shack section seem to have become much more abundant and the population represents a broader distribution of age classes as well as an overall sharp decline in average size. The factors responsible for the change in the whitefish population and the relationship between whitefish and trout population densities are unknown.

Galen Section

Trout population estimates for the Galen section are presented in Figure 2. Four estimates have been made in this newly adopted monitoring section. The 1987 estimate suggests the number of brown trout greater than 6 inches in total length was larger at that time than those calculated for estimates made in 1999, 2001, and 2003. Habitat conditions within the section seem to be appropriate for a significantly higher trout population than is currently present. Metals contamination is likely responsible for the depressed population of trout in this section. No qualitative changes in fish population are apparent. It is important that this section be continued in the monitoring program so that the consequences of Superfund cleanup on brown trout populations may be assessed.

The habitat in the Galen section is good. Since 1996, the Galen section riparian area has been fenced and livestock grazing impacts eliminated. Regrowth of woody riparian vegetation has been substantial.

Williams-Tavenner Section

The Williams-Tavenner section has not changed dramatically in terms of habitat quality within the last 20 years. Woody riparian vegetation is at very low densities and appears to be the result of past livestock grazing practices. Cattle pasturing in the section seems to have been reduced in recent years but there is no indication of significant regeneration of riparian vegetation.

Trout population estimates in the 21 year span of the monitoring have ranged from 100 to 400 fish per mile with a long term average in the vicinity of 200 fish per mile. Despite somewhat degraded habitat, the physical appearance of the aquatic environment in the section suggests that trout populations should be considerably higher than those observed. Estimates in 1998, 2000, and 2002 are suggestive of a downward trend in trout population density. Beyond the impacts of metals toxicity, it may be that this trend is the result of drought.

For a stream of this size, the population of trout of about 200 fish per mile seems to be at the cusp of a fishery. Certainly the availability of alternative waters with higher populations of trout enters the equation. But, little or no recreational angling pressure is directed at this section of river and others having similar trout populations. They could be classified as marginally fishable as a result of low trout populations.

Fishes

The river above the mouth of Rock Creek has a natural fish fauna comprised of relatively few species. A number of introduced species now are self-sustaining in the drainage. The fish species are briefly discussed below.

Native Species

Coarsescale Sucker. This sucker is common in the Upper Clark Fork.

Longnose Sucker. Present in the Clark Fork but less common, generally, than the previous species.

Northern Pike Minnow. The Clark Fork distribution of this species is primarily downstream of Drummond. They become increasingly common in the lower reaches of the river.

Redside Shiner. This minnow is widely distributed in the drainage but seems to be limited to areas of very low current velocity. Most frequently seen in association with submerged aquatic vegetation.

Longnose Dace. This species has been observed over much of the upper river but is nowhere common. Most frequently seen in the lower section of the river.

Westslope Cutthroat Trout. This species is broadly distributed within the basin but pure populations exist primarily in the upper reaches of tributary streams. Most of these are at some risk owing to hybridization with introduced rainbow trout or hatchery cutthroats and competition with exotic brook trout. Above the mouth of Rock Creek, Clark Fork River examples of this species, whether hybridized or pure, seem to be confined to stray individuals moving downstream from the tributaries and entering the river proper. They comprise only a fraction of 1% of the total trout population of the river. Below the mouth of Rock Creek, cutthroats become rather common and it is believed that these are fish originating in Rock Creek that move downstream into the Clark Fork. Whether these fish return to Rock Creek for spawning or other purposes is unknown.

Bull Trout. Bull trout are a rarity in the Clark Fork. In the tributaries, bull trout populations are significantly reduced in range and number. Populations exist in the Warm Springs Creek drainage, the Flint Creek drainage, and Rock Creek. Only in Rock Creek and its tributaries do they seem reasonably secure. Bull trout have been recorded in the mainstem Clark Fork on only a few occasions. They, like the cutthroats, appear to be fish that have migrated downstream into the river. Twenty years of records show only a handful of bull trout.

Mountain Whitefish. Whitefish are common throughout the length of the Clark Fork above Milltown Reservoir. They receive small attention from anglers.

Slimy Sculpin. Relatively uncommon in comparison to sculpin densities observed in other streams. Much of what appears to be suitable sculpin habitat is sparsely occupied or vacant. Populations of slimy sculpin seem to have varied in density rather markedly in the uppermost sections of the river.

Introduced Species

Northern Pike. Not observed above Milltown Reservoir.

Rainbow Trout. This trout is not believed to have been native to the Clark Fork. It has been widely introduced within the drainage. Self-sustaining populations are uncommon. Most common in Rock Creek where it may exist only as a hybrid with the native westslope cutthroat. Largely absent from the river above Drummond. Individuals seen in the river near Warm Springs appear to be of hatchery origin and seem likely to be down-migrants from pond stocking. Observed spawning in Warm Springs Creek where a few young rainbows have been collected. These may have been the result of natural reproduction. There is no evidence of the development of a self-sustaining population of rainbows above the mouth of Rock Creek. Rainbows are present in small numbers above Drummond but only become common at or below the mouth of Rock Creek.

Brown Trout. Brown trout make up 98% or more of the trout population upstream from Drummond. Brown trout are the backbone of the fishery in the upstream reaches of the river. It appears that they are more tolerant of a variety of environmental degradation than are the other trout species present. They seem to be substantially more resistant to metals toxicity. It appears that this self-sustaining species utilizes tributary streams as the primary reproductive sites.

Brook Trout. Brook trout populations are common in the tributary streams but only the occasional individual has been observed in the mainstem. Most brook trout seen in the river have been observed in the immediate vicinity of tributary streams with brook trout populations.

Pumpkinseed. A few individuals of this species have been seen in the river in areas adjacent to ponds where pumpkinseeds are self-sustaining. They are poorly adapted to flowing water environments. There are, within the basin, several pond populations that have persisted for many years.

Largemouth Bass. A couple of individuals have been observed in the same areas where the previous species was seen. Largemouth bass have been successfully introduced into some oxbow lakes and artificial ponds along the river corridor downstream of Drummond. They are not known to be inhabitants of the river proper.

If a Superfund cleanup were to be done that actually had a significant effect on the river environment, there would likely be corresponding shifts in fish species distribution and faunal composition. At present, it appears that all trout species in the basin, with the exception of brown trout, are unable to tolerate the concentrations of metals in the mainstem and are confined to the tributaries.

DISCUSSION

The geomorphology of the Upper Clark Fork basin combines factors with enormous potential to produce trout. Much of the drainage is on limestone formations, which result in alkaline waters conducive to aquatic ecosystem productivity. The segment of river upstream from Garrison has a relatively gentle gradient, a serpentine course of alternating pools and riffles, and a substrate composed of gravel and cobble. An early European account mentions the inability of the expedition's members to catch trout smaller than 4 pounds. Absent the insults of the last century, the river would be world famous.

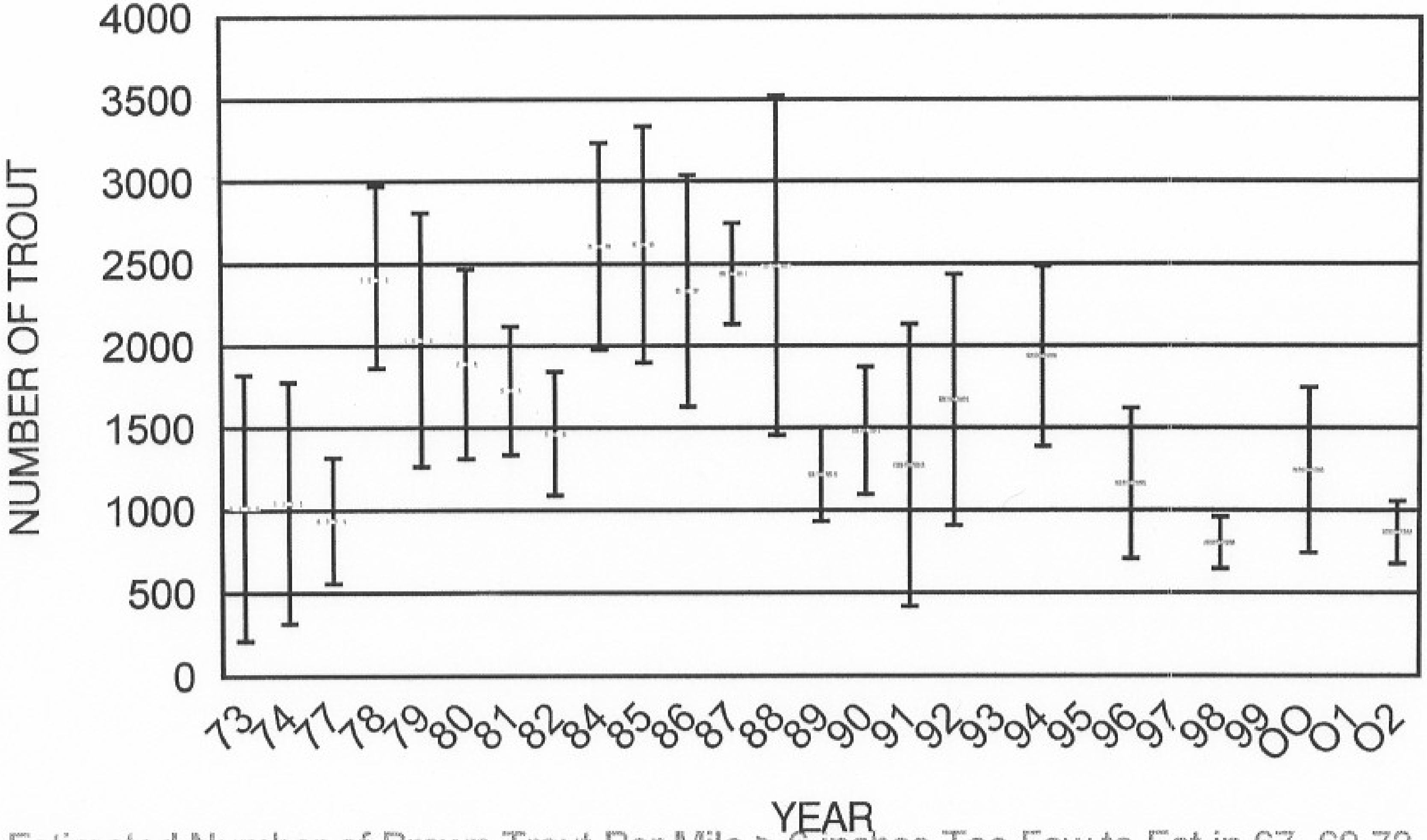
The inability of the system to produce trout in numbers approximating those that might be expected given the factors mentioned above is clearly the result of changes in the environment during the past century. A multiplicity of negative influences have damaged the river's trout producing capacity. Among these are loss of woody riparian vegetation, sedimentation, channel modification, de-watering, and reduced water quality. All of these play a role in crippling the river fisheries. But beyond all other impinging factors, the role of toxic metals seems most important. If the impact of metals on the food chain and the trout were somehow removed, the trout population density would increase several fold. Metals are the single most important factor in depressing the river's trout numbers.

If a cleanup under Superfund is designed in such a fashion that availability of metals to the river's biota is significantly reduced, we can look forward to a resurgence of the fishery. Should some half-measure of cleanup be implemented that leaves metals available to the river ecosystem, then the river will continue at only a fraction of its potential.

Wayne Hadley
22 May 2003

pH SHACK SECTION

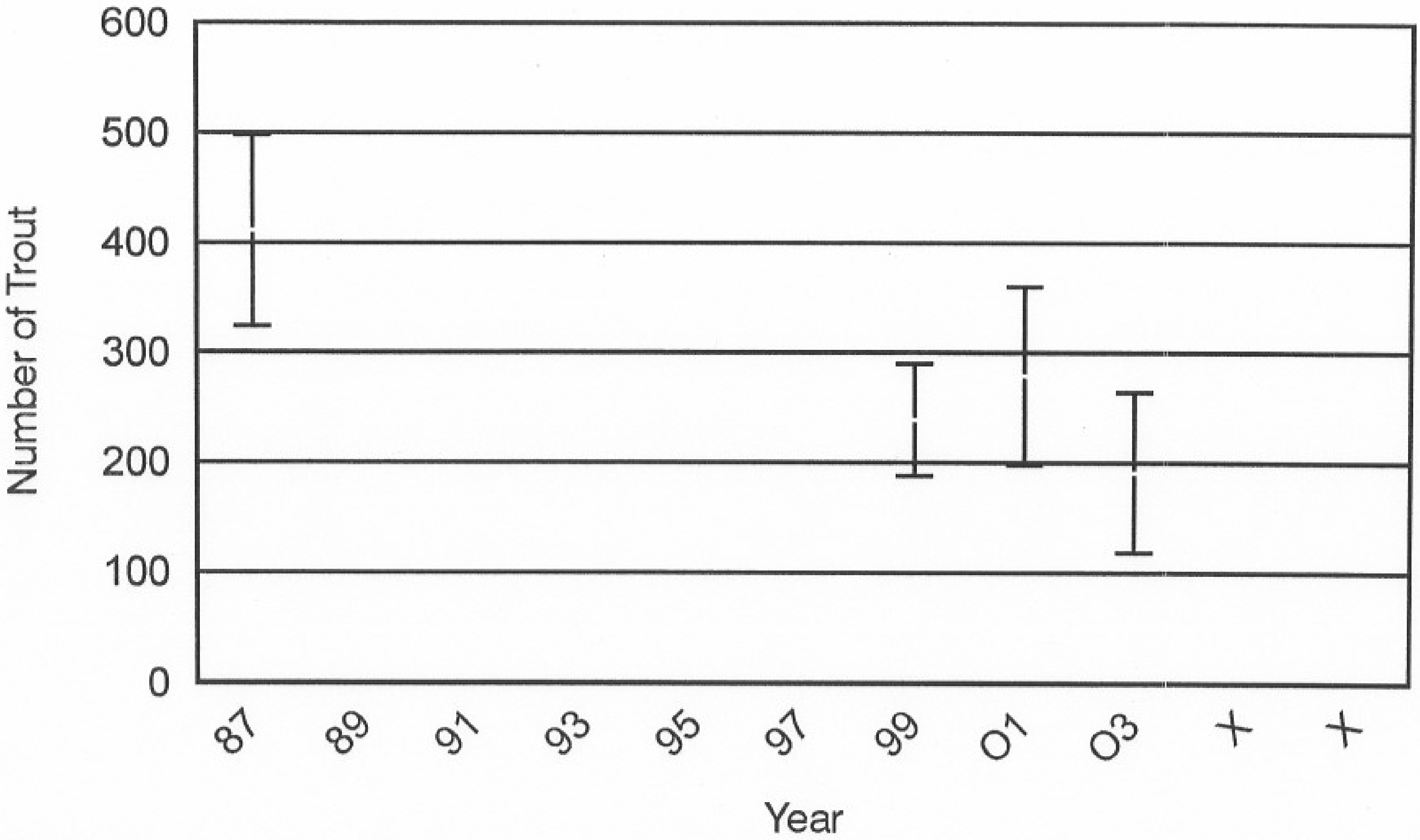
Clark Fork River



Estimated Number of Brown Trout Per Mile > 6 inches Too Few to Est in 67, 69,72
Figure 1

GALEN SECTION

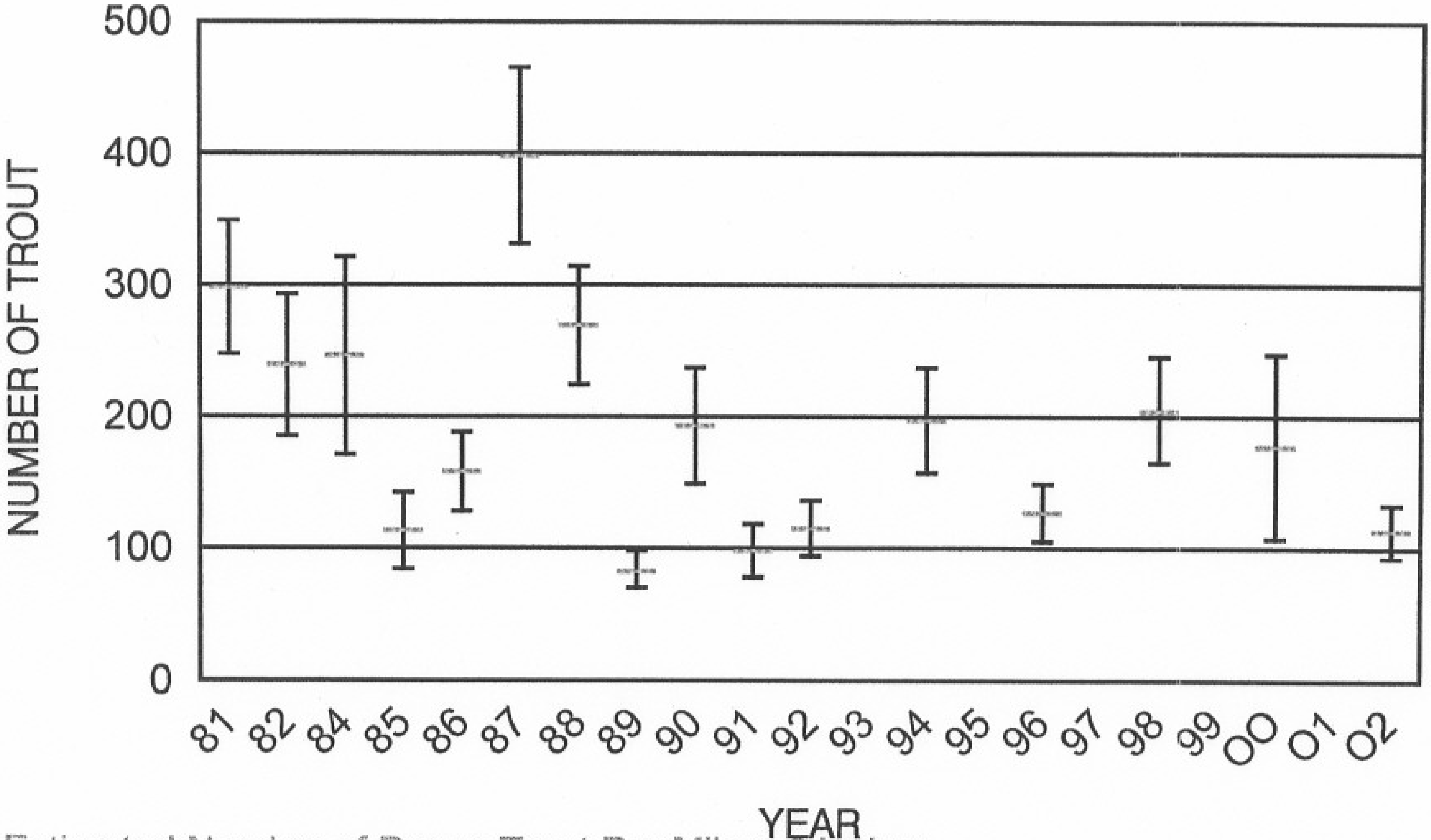
Clark Fork River



Estimated Number of Brown Trout Per Mile > 6 inches
Figure 2

WILLIAMS-TAVENNER SECTION

Clark Fork River



Estimated Number of Brown Trout Per Mile > 6 inches
Figure 3