4/7/2010

To: Dolores River Dialogue Steering Committee

From: Chester Anderson, Watershed llc, dba B.U.G.S. Consulting (**B**ioassessment **U**nderwater, **G**IS and **S**tats)

Through: Dolores River Dialogue Science Committee

Subject: Factors affecting populations of flannelmouth suckers on the Dolores River between McPhee Dam and the San Miguel River.

Purpose: The purpose of this memo is to provide a cursory overview of the status of and potential stressors on flannelmouth suckers in the Dolores River from McPhee Dam to the confluence with the San Miguel and to offer recommendations for addressing key data gaps. The information was gathered from a cursory review of the literature and conversations with fisheries biologists. This review stemmed from the statements that:

1. native fish populations were stable during pre-dam, intermittent flows that occurred on the Dolores August through November,
2. native fish populations are declining under current, post-dam perennial flows, and
3. higher, perennial base flows are required to protect populations of native fish on the Dolores River.

Leading to the questions:

1. despite an apparent increase in baseflow, why are flannelmouth populations in the Dolores between McPhee Dam and the confluence with the San Miguel River considered to be in a precarious state? and
2. why would greater perennial base flows be effective at conserving flannelmouth populations on the Dolores River between McPhee Dam and the confluence with the San Miguel River?

Flannelmouth Suckers in the Dolores

Important to the range-wide conservation of flannelmouth suckers and one of the most unique aspects of the Dolores River is that there are no non-native white suckers in the river to hybridize with the flannelmouths. Therefore, the native flannelmouth suckers in the Dolores are of a pure genetic strain and the river offers a refuge from hybridizing with white suckers that not many other streams provide.[1]

In July 1971, Holden and Stalnaker surveyed Dolores River fish populations from near Cahone, CO downstream to the confluence with the Colorado River.[2] Near Cahone they categorized flannelmouths as abundant. Near Slickrock no flannelmouths were found. Near Paradox flannelmouth populations were considered low and at the San Miguel River flannelmouths were abundant. Abundant was defined as having relatively high biomass with several age classes present.

[1] Dolores River Dialogue Correlation Report 2006; White 2009
[2] Holden and Stalnaker 1975

Since 1987, the Colorado Division of Wildlife (CDOW) has annually surveyed fish populations in the Dolores River Dialogue (DRD) Reach 1. Within this Reach and up to 1989, the CDOW found a few large (~18 in) flannelmouths each year. According to the DRD Correlation Report, "flannelmouth suckers showed strong populations from the dam downstream in initial surveys in the early 1990s, but they are now rarely found in sampling efforts between McPhee dam and the Dove Creek pump site in Reach 3."[3] In Ponderosa Canyon DRD Reach 2, flannelmouths were found in 1993 but not in the 2005 or 2007 surveys. At Dove Creek pumps (DRD Reach 3) flannelmouths have not been found in annual surveys since 2004 and have never been abundant in the annual surveys that CDOW has conducted at this station since 1989. Rick Anderson's surveys at the Big Gypsum study site (DRD Reach 4) showed highly variable numbers, ranging from a high of 28 percent of species composition in 2005 (>45 fish per mile) to 3.3 percent of the species sampled in 2004 (9 fish per mile).[4] The higher numbers in 2005 were thought to have washed downstream by spill water from more favorable upstream sites rather than recruited locally.[5] A survey completed in 2007 in the Big Gypsum study site found less than 5 flannelmouths per mile (a total of 10 flannelmouths between 8 and 10 inches) at the Big Gypsum site.[6] In Slickrock Canyon (DRD Reach 5) in 2007 an average of 2.5 flannelmouths per mile were found.

In 2008, CDOW stated that the catch per unit effort for flannelmouth suckers was 2-4 times lower than in the 1990's and that native species are in danger of being extirpated from the river[7] and "today native suckers are almost absent from 53 miles of previously occupied habitat above Disappointment Creek" and "large (>400 mm) adult flannelmouth suckers were common in the late 80's to early 90's up to Bradfield bridge...."[8]

Adult flannelmouths are shaped such that they can move about easily on the bottom of fast water habitats where they consume algae, detritus and benthic macroinvertebrates. Adults are more commonly found in fast water runs and riffle habitats than in slower moving pools and backwaters.[9] They disperse large numbers of eggs over gravel/cobble substrate during the springtime. The eggs adhere to benthic rocks and/or settle into interstitial spaces where they develop rapidly. It may be necessary for egg habitat to be mostly clean of mud and silt deposits.[10] After hatching, the young fish drift to suitable slower waters (*i.e.* eddies and shoreline habitats) where they mature.[11] Flannelmouths are not restricted to warm water habitats. In the San Juan Basin they have been found at elevations near 9,000ft.[12]

---

[3] Dolores River Dialogue Correlation Report 2006
[4] Stewart and Anderson 2007
[5] Dolores River Dialogue Correlation Report 2006
[6] Colorado Division of Wildlife data
[7] White *et. al.* 2008
[8] Kowalski *et. al.* 2010
[9] Stewart and Anderson 2007
[10] Eric Best personnel communication 2010; Anderson 2005.
[11] Bezzerides and Bestgen 2002; Rees *et. al.* 2005
[12] Colorado Division of Wildlife 2005

Young flannelmouth suckers require a refuge from visual predators such as smallmouth bass, green sunfish, and trout. The refuge may be murky water or fast water that the predators either avoid or are less effective in. Larger flannelmouths are not as susceptible to predation as are young flannelmouths.[13]

Non-native Predators

Predation by non-native fish species likely plays a significant role in reducing the survival of young flannelmouths and their recruitment to spawning age.[14] Since 1987, populations of non-native predators including rainbow trout, brown trout, smallmouth bass, and green sunfish have increased in Reaches 1 through 4.[15] Since 1987, the CDOW has stocked DRD Reach 1 with thousands of fingerlings of trout on a near annual basis.[16] The diet of adult trout may include fish eggs, fish larvae, and small fish. Trout fingerlings may consume fish eggs, and fish larvae. Trout populations peaked in 1993 in DRD Reach 1 when large numbers were spilled over the McPhee Dam spillway from the reservoir along with Kokanee Salmon and small mouth bass.[17] During the 2006 CDOW survey between the Pyramid and Disappointment Creek, over 80 smallmouth bass were found. Smallmouth bass feed heavily on small fish. Green sunfish have been present in the Dolores since prior to McPhee Dam and are occasionally caught in the slower waters of DRD Reach 1 and 2.[18] At the Dove Creek site green sunfish were 21% of the catch in 2004.[19] Green sunfish feed on small fish, fish eggs and fish larvae.

Base Flows

The higher the base flows, the lower the density of predators, and the more refuge habitat is available to young flannelmouths.[20] Diversions out of the Dolores basin began in the late 1800s when the majority of the river was diverted during late summer months.[21] A USGS gauge at the old town site of McPhee, CO shows that flows were most likely intermittent (surface water limited to pools and no surface flows connecting the pools) during late summer months (Figure 1 and Figure 2) in DRD Reaches 1 through 5.[22] Since construction of McPhee Dam, base flows have been perennial (Figure 2 and Figure 3) although there has been a reduction of approximately 50% in the peak flows and an order of magnitude decrease in flows during the month of June. These reductions in peak flows equates to a large difference in annual stream power, leading to significant changes in in-stream habitat such as more fine sediment deposition and accumulation, less scouring effect, shallower pools and channel encroachment by vegetation onto new sediment deposits during drought periods.[23]

---

[13] Bezzerides and Bestgen 2002; Mueller and Wydoski 2004; Eric Best personal communication 2010
[14] Rees *et. al.* 2005; Bezzerides and Bestgen 2002.
[15] Colorado Division of Wildlife data
[16] Nehring 1991; Dolores River Dialogue Correlation report 2006
[17] Mike Japhet personal communication
[18] Colorado Division of Wildlife data
[19] Dolores River Dialogue Core Science Report 2005
[20] Bezzerides and Bestgen 2002; Stewart and Anderson 2007
[21] Dolores River Dialogue Hydrology Report 2005
[22] Gauge site located above the McPhee Dam site and below the Montezuma Valley Irrigation Company's diversion tunnels. Data from 1939 and 1952, Holden and Stalnaker 1975 mention intermittent flows in the middle section of the Dolores near Slickrock, CO
[23] David Graf personal communication April 2010

Stewart and Anderson (2007) conducted a habitat modeling investigation for the CDOW to develop recommendations of minimum base flows to support native fish populations on the Dolores, Yampa and Gunnison Rivers. They concluded that a base flow of 300 cfs in the Dolores would be necessary in order to maintain a biomass of flannelmouth suckers in the Big Gypsum Reach of the Dolores River comparable to reaches modeled on the Yampa, Gunnison and Colorado Rivers. They also concluded that the minimum base flow to support a modest population of flannelmouths was 50 - 60 cfs during spill years and should be 80 cfs during non-spill years. They also acknowledged that their results might be different for reaches above Disappointment Creek.[24]

When there is no shared shortage in water allocations, base flows below McPhee Dam range from 30 cfs during the winter months to 78 cfs during summer months (Figure 3). In the summer of 2002 releases from McPhee Dam were as low as 15 cfs due to drought and shared shortage among project allocations including those for release downstream. Releases from the dam were less than 20 cfs from 4/27/02 to 5/4/2003. Peak flow in 2003 was 41 cfs and hovered around 40 cfs for a few weeks and then below 20 cfs until May 4th, when slight improvements in base-flow occurred. Peak flows in 2004 were 92 cfs for 1 day.

Other River Systems With Populations of Flannelmouths

There are a number of examples throughout the Colorado River Basin where relatively healthy populations of flannelmouths exist. Data and observations of flannelmouth populations within these systems, as well as the systems themselves, suggest factors that may help support flannelmouth populations in the Dolores River. The examples include populations of flannelmouths that are found in hydrologically modified systems, below dams, at altitudes up to 9,000 ft, in relatively channelized, fast moving rivers and coexisting with non-native predators as well as in streams with reaches of intermittent flows and deep pools.[25] Site comparisons are useful in identifying limiting factors but unique aspects, such as the McPhee Project being an out of basin diversion without return flows to the river, are important to keep in mind. I briefly discuss 3 other systems below.

There is a 32 mile stretch of the Strawberry River, Utah with a hydrograph that is significantly different from natural, is confined on both ends by reservoirs and contains a healthy population of flannelmouths. Peak flows are less than 200 cfs and minimum flows are 31 cfs in January and 41 cfs in August. There are 4 main tributaries in this reach that the flannelmouths may utilize for spawning. The only non-native predator present is brown trout, found in the upper reaches, and it is thought that they may inhibit use of the upstream habitats by the flannelmouths.[26]

The Upper Muddy Creek in Wyoming has reaches that are intermittent during the late summer months due to a number of diversions for irrigation water but there are no on-channel dams that dampen peak flows. Non-natives include white suckers and creek

[24] Stewart and Anderson 2007
[25] Mueller and Wydoski 2004; Bower and Hubert 2008; Carter and Hubert 1995; Best 2007; CDOW 2005
[26] Breen and Hedrick 2009

chubs.[27] The flannelmouth population has been stable until recently and it is hypothesized that competition and interbreeding with white suckers is the reason for the recent decline.

There is a reach below Davis Dam on the Colorado River that has a reintroduced, reproducing population of flannelmouths. The reach is a channelized, armored section of river with non-native predators including smallmouth bass, striped bass and bluegills.[28] Researchers hypothesize that the flannelmouths find refuge from the predators in the fast flowing water, and have enough spawning success to maintain the population, but acknowledge that the mechanisms are still unknown.[29] Minimum flows are around 2,000 cfs, with maximums of over 20,000 cfs and daily fluctuations of several thousand cfs for hydropower generation. Breeding congregations of flannelmouths have been observed approximately 1.5 km below Davis Dam.[30]

There are three key questions regarding the native fishery and base flows on the Dolores River between McPhee Dam and the San Miguel River:

1. Why are native fish populations not protected by current base flows?
2. What base flows are necessary to support native fish populations? and
3. In addition to base flows, what other conditions are necessary to support native fish populations?

Conclusions

In order to have a stable population of flannelmouths in the Dolores River, spring habitat conditions that result in a successful spawn followed by at least 2+ subsequent years of adequate refuge for the young flannelmouths from predatory fish appear to be important.[31] A successful spawn is not required every single year for flannelmouths since they are long lived and very fecund.[32]

In the Dolores River upstream of the confluence with the San Miguel River, the best spawning habitat (i.e. run habitat that is free of mud and silt) is found in DRD Reaches 1 through 3 and within the upper portions of Reach 4, upstream of Disappointment Creek.[33&34] Because of McPhee Dam flannelmouths do not have access to upstream tributaries for spawning and between McPhee Dam and Disappointment Creek there are no perennial tributaries.

CDOW surveys show that non-native predators are present in each of these potentially suitable spawning areas. In Reach 1 there are occasional green sunfish in the slow waters

[27] Bower and Hubert 2008; Dr. Wayne Hubert personal communication 2010
[28] Mueller 2003; Eric Best Fisheries Biologist U.S. Bureau of Reclamation personal communication
[29] Mueller and Wydoski 2004
[30] Eric Best Fisheries Biologist U.S. Bureau of Reclamation personal communication; Best 2007.
[31] Rees *et. al.* 2005
[32] Mueller and Wydoski 2004
[33] Anderson 2005
[34] It was in this Reach on 4/25/06 that staff of the CDOW observed large groups of adult flannelmouths in spawning aggregations. The female flannelmouth that was sampled was ripe and the males exhibited tubercles

as well as adult rainbow and brown trout and hundreds of rainbow trout fingerlings stocked each fall. In Reaches 2 and 3 there are brown and rainbow trout. In the middle and lower reaches of Reach 3 and upper portions of Reach 4 (upstream of Disappointment Creek) there are small-mouth bass. Where Disappointment Creek enters the Dolores it creates silted benthic conditions that may not be conducive to successful flannelmouth spawning, although the murky water may offer refuge to young flannelmouths from non-native predators. In this reach there are non-native competitors such as carp and more non-native predators/competitors such as channel catfish and black bullhead catfish.[35]

Survival of young flannelmouths to spawning age appears to depend on at least two factors: the density of predators and the volume and availability of habitat that provides refuge from predators. This relationship suggests that there are at least three ways to support increased survival of young flannelmouths: decrease the number (or density) of predators, increase the amount of refuge habitat, or both. Methods for adjusting these variables include increasing base flows (to increase the amount of refuge habitat and decrease the density of predators) ensuring spill releases that have enough stream power to maintain or increase habitat availability, and/or decreasing predator populations. The amount of base flow necessary to support adequate survival and recruitment of young flannelmouths depends, at least in part, on the density of non-native predators in the system.

Methods of removing non-native predators have been developed and implemented throughout the Colorado River Basin for a number of years and the effectiveness of these methods is now being assessed. An April 2009 news release from The Upper Colorado Endangered Fish Recovery Program stated: "management of smallmouth bass populations remains problematic as researchers noted strong reproduction in 2006 and 2007 in sections of the Green and Yampa rivers. In 2008, the entire Upper Colorado River Basin experienced a return to higher and cooler flows and smallmouth bass reproduction was greatly diminished in all rivers. Efforts to remove smallmouth bass in 2007 and 2008 in the Yampa and Green rivers showed limited success. However, smallmouth bass populations on the Colorado River continued to decline for the third consecutive year."[36] For effective control of smallmouth bass (and for monitoring native fish populations), it is and will be critical to allocate water for sampling and non-native fish abatement.

While much attention has been given to low base flows on the Dolores River as a stressor on the native fish populations, there are examples, as discussed above, from around the Colorado Basin of rivers with altered peaks and/or base flows that still support healthy populations of native suckers. Water availability below McPhee Reservoir remains highly restricted, so additional water to meet existing minimum baseflow recommendations for native fish continues to be elusive. Therefore, it is worth taking a closer look at some of the other challenges facing native fish populations on the Dolores River. These include altered spring flows (i.e. reducing spawning success and overall

[35] Dolores River Core Science Report 2005
[36] Upper Colorado Endangered Fish Recovery Program April 21rst 2009 News Release

habitat quality and quantity), the relationship between temperatures and spawning cues, loss of access to upstream habitat and tributaries due to McPhee Dam, as well as the significant numbers of non-native predators below the Dam, including the impact that brown trout and large numbers of introduced rainbow trout fingerlings may have on flannelmouth eggs and young.[37]

Recommendations

There is a significant amount of research being conducted throughout the Colorado River Basin related to the conservation of flannelmouths and other native fish. I recommend that the DRD complete a more thorough review of the literature, participate in meetings concerning native fisheries, visit with the investigators that are conducting this research and continue to cooperate with CDOW fishery biologists to better understand the unique challenges, biological needs and the potential that the Dolores has for conserving native fish.

Further, to better understand what river flows are most crucial for maintaining populations of native fish on the Dolores River, it is essential to understand the:

- current status of native fish populations throughout the Dolores River,
- impacts of non-native fish including trout on native fish populations,
- methods of non-native fish removal and their effectiveness,
- conditions that lead to successful spawning and survival for native fish (e.g. temperatures and spawning cues, spawning habitat, refuge habitat, etc.), and
- the potential to use the Selective Level Outlet Works at McPhee Dam to expand native fish habitat upstream recognizing the risk of expanding non-native predator habitat and/or allow escapement of additional non-native species into the Lower Dolores.

[37] Sweetser *et. al.* 2002; Metcalf *et. al.* 1997; Rees *et. al.* 2005; Breen and Hedrick 2009

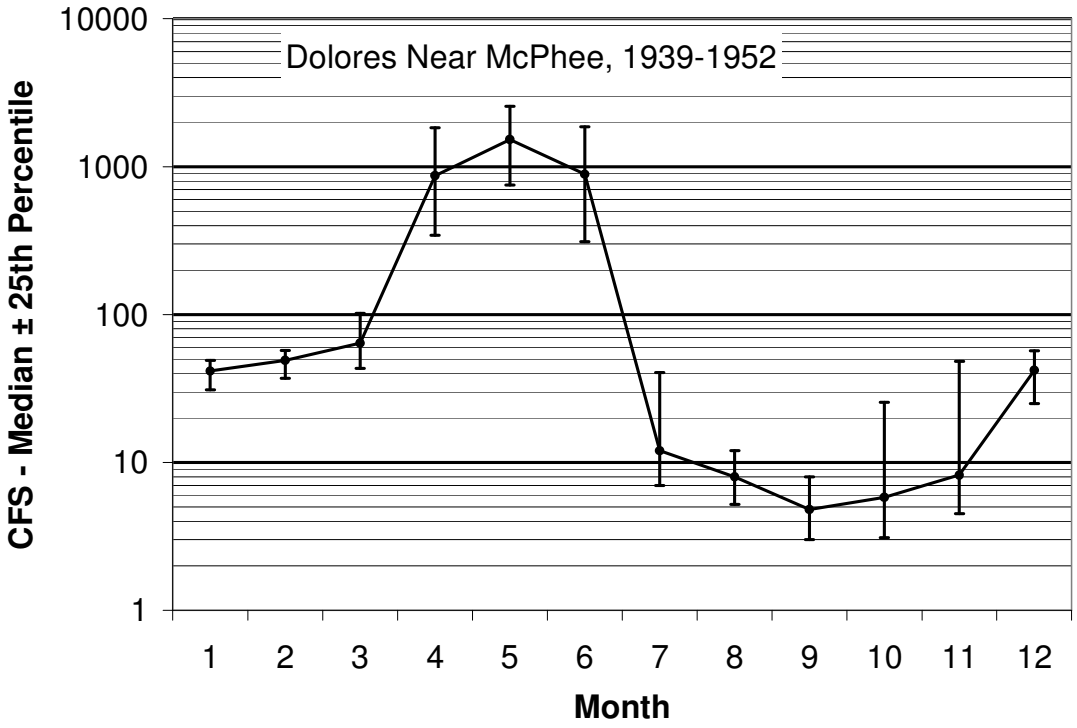

Figure 1. Median (±25th percentiles) flows at the old town site of McPhee, CO, below the MVIC diversion and dates prior to the construction of McPhee Dam. During the months of August through November, flows were less than 10 cfs 50% of the time.

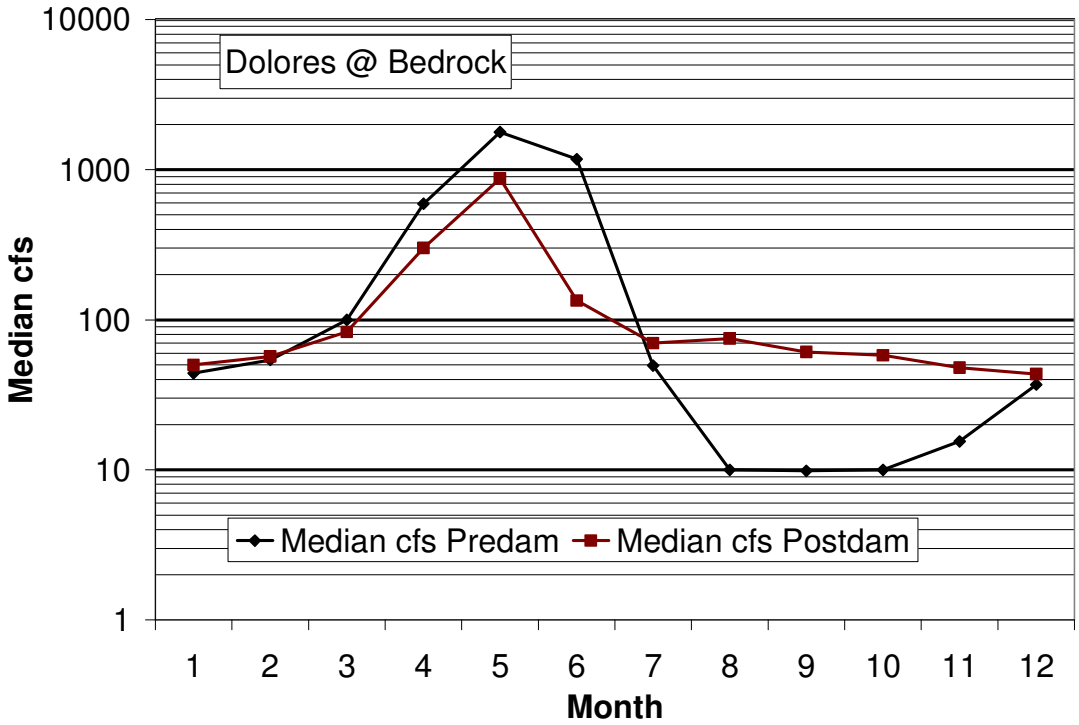

Figure 2. Discharge at the USGS Bedrock Gauge. Median flows prior to the construction of McPhee Dam were less than after the construction of McPhee Dam July through November.

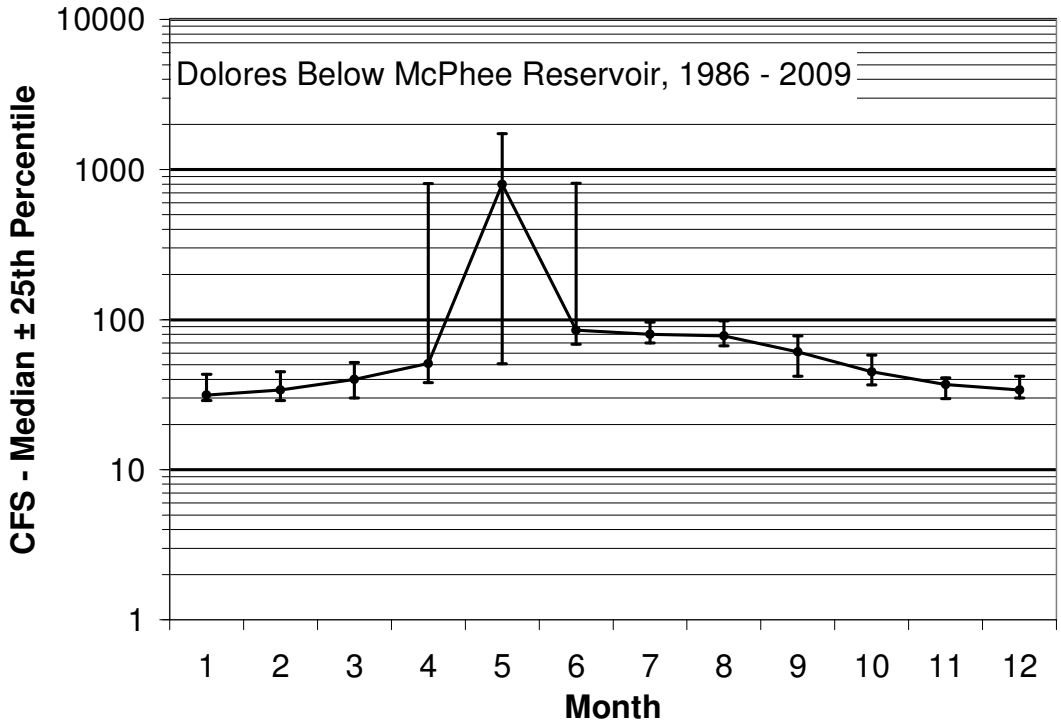

Figure 3. Median discharge (±25th percentiles) from McPhee Dam. Median flows were 30 cfs or greater for each month of the year.

References

Anderson, Richard. 2005. Riverine fish flow investigations, Colorado Division of Wildlife, Federal Aid Project F-288-R8.

Best, Eric. 2007. Investigations of flannelmouth sucker habitat use, preference and recruitment downstream of Davis Dam in the Lower Colorado River (LCRMSCP Work Task C-15). Lower Colorado River Multi-Species Conservation Program Office, Bureau of Reclamation, Lower Colorado Region, Boulder City, Nevada.

Bezzerides, Nick and Kevin Bestgen. 2002. final report status review of roundtail chub (gila robusta), flannelmouth sucker (*Catostomus latipinnis*), and bluehead sucker (*Catostomus discobolus)* in the Colorado River Basin. Larval Fish Lab Contribution 118.

Breen, J. Matthew and Tina N. Hedrick. 2009. Status of bluehead sucker, flannelmouth sucker and roundtail chub populations in three drainages of northeastern Utah. State of Utah Department of Natural Resources, Division of Wildlife Resources – Native Aquatic species

Bower, Michael R., Wayne A. Hubert, Frank J. Rahel. 2008. habitat features affect bluehead sucker, flannelmouth sucker, and roundtail chub across a headwater tributary system in the Colorado River Basin. Journal of Freshwater Ecology, Vol. 23, no. 3, Sept. 2008.

Colorado Division of Wildlife, Aquatic and Species Conservation Sections. 2005. Draft State of Colorado conservation and management plan for the roundtail chub (*Gila robusta*), bluehead sucker (Catastomus discobolus), and flannelmouth sucker (*Catostomaus latipinnis*).

Dolores River Dialogue. 2005. Core Science Report.

Dolores River Dialogue. 2006. Correlation report; summary of hydrologic and scientific findings and resulting matrix templates 9-5-06.

Holden, P. B. and C. B. Stalnaker. 1975. Distribution and abundance of fishes of the upper Colorado River Basin. Transactions American Fisheries Society. 104(2):217-231.

Kowalski, Dan, Jim White, Rick Anderson and Barry Nehring. 2010. Native fish of the Dolores River; status, trends and recommendations. Presentation to the Dolores River Dialogue March 23rd 2010.

Metcalf, Christopher, Frank Pezold and Betty G. Crump. 1997. food habits of introduced rainbow trout (Oncorhynchus mykiss) in the Upper Little Missouri River Drainage of Arkansas. *The Southwestern Naturalist*, Vol. 42, No. 2 (Jun., 1997), pp. 148-154

Mueller, G.A., and R. Wydoski. 2004. Reintroduction of the flannelmouth sucker in the lower Colorado River. North American Journal of Fisheries Management 24(1): 41-46.

Mueller, Gordon. 2002. The role of stocking in the reestablishment and augmentation of native fish in the Lower Colorado River Mainstream (1998-2002) U.S. Geological Survey, Fort Collins Science Center, Open-File Report 03-288.

Nehring, R. Barry. 1991. Aquatic winter habitat monitoring study and assessment of the interactions between stream discharge aquatic habitat and the trout population of the Dolores River below McPhee dam.

Rees, D. E., J. A. Ptacek, R. J. Carr, and W. J. Miller. 2005. Flannelmouth sucker (*Catostomus latipinnis*): a technical conservation assessment. USDA Forest Service, Rocky Mountain Region

Stewart, Gregory and Richard M. Anderson. 2007. Section II. Impacts of stream flow alterations on the native fish assemblage and their habitat availability as determined by 2D modeling and the use of fish population data to support instream flow recommendations for the sections of the Yampa, Colorado, Gunnison and Dolores rivers in Colorado Special report -- no. 80, Special report Colorado. Division of Wildlife.

Sweetser, Michael G., Scott D. Bryan, and Anthony T. Robinson. 2002. Movement, distribution, and predation: *Lepidomeda vittata* and nonnative salmonids in eastern Arizona. Western North American Naturalist 62(2), pp. 197–205.

Upper Colorado Endangered Fish Recovery Program News Release. April 21rst, 2009. Biologists resume research studies in Colorado and Utah in effort to recover endangered fish.

White, Jim, Dan Kowalski, Barry Nehring and Chris Kloster. 2007. Dolores River 2007 fish status report. Presented to the Dolores River Dialogue February 27th 2008 by David Graf.

White, Jim. 2009. Lower Dolores River fishery status. Presentation to the Lower Dolores Plan Working Group, February 17th, 2009.