Discussion Paper
(April 4, 2002)

Lees Ferry Trout Fishery Status and Trends

Prepared jointly by GCMRC and AGFD

Introduction

There has been considerable interest and discussion regarding the current status and trends in the Lees Ferry trout population and particularly the sport fishery associated with the population. The Grand Canyon Monitoring and Research Center (GCMRC) stimulated much of this discussion by advancing the proposition that predatory and competitive interactions between rainbow trout and brown trout in the Colorado River ecosystem (CRE) near the confluence of the Colorado River and the Little Colorado River may be contributing to the observed decline of humpback chub. GCMRC has suggested that until the population of salmonids in the CRE below the Paria River is reduced in number, any effort to benefit the humpback chub through improving habitat conditions, may be overwhelmed by the potential predatory-prey and competitive interactions with non-native fish. In addition, in 2000, GCMRC raised questions about the size of the Lees Ferry rainbow trout population (256,000 age II^{+}) and suggested that those densities of fish could not be sustained in the Lees Ferry reach and provide the quality fishery called for by the Arizona Game and Fish Department and incorporated into the goals of the Glen Canyon Dam Adaptive Management Program.

In response to declining humpback chub population trends, GCMRC is recommending testing a period of fluctuating flows to disadvantage trout spawning and recruitment. The GCMRC is proposing testing fluctuating flows during a short period of the year (Jan-March). The experimental design calls for repeating this treatment for two consecutive years. The goals of the treatment differ in different parts of the CRE. In the CRE below the Paria River, the goal is to reduce the number of trout which may be acting as predators/competitors on the native humpback chub population. In the Lees Ferry reach, the goal is to reduce the density of trout in order to increase growth and average fish size and to improve the overall quality of the fishery.

The purpose of this document is to facilitate a discussion over the conflicting views regarding the effect the proposed treatment may have on the Lees Ferry trout fishery. To that end, Section 1 of this document provides data that depict some key characteristics of the trout population in recent years. Section 2 provides some plausible explanations for the trends shown in the different data sets. We anticipate additional explanations to be developed as we continue discussions with the Lees Ferry trout guides, the Arizona Game and Fish Department, the TWG, and outside scientists and the public. Section 3 presents a discussion of what we currently consider to be the most plausible explanations.

Section 1 – Data

Figure 1 depicts the catch rate, an index of abundance, of rainbow trout in the Lees Ferry reach using electrofishing methods spanning the time period 1991 – March 2002. The data displayed in this figure indicate that the catch rate increased significantly since the 1991-93 period. This increase appears to have started about 1993 and since 1997 the abundance of rainbow trout appears stable or slightly declining. While the samples collected in March 2002 with the Coffelt boat indicate a possible decline in catch rate since 2001, these data are inconclusive at this time (Figure 1A) and only represent a single month of sampling for 2002.

Figure 2 presents data that shows that since 1990 there has been a decreasing proportion of larger fish in the population (i.e. decrease in proportional stock density, PSD). Thus, of all fish in the population 12 inches and larger (305 mm), only 5% are 16 inches and larger (406 mm).

Figure 3 depicts the average relative condition factor (1991-2001), which is a measure of the plumpness of the fish based on the relationship between a fish's length and its weight.

Figure 4 presents data that shows the angling catch rate has essentially mirrored the electrofishing catch-rate increase beginning in 1991. However since 1998, the angling catch rate has exhibited a more precipitous decline than the electrofishing catch rate, which may be oscillating.

Figure 5 displays data that depicts the size distribution of rainbow trout captured using electrofishing methods during March and April 2000-2002. Notice that these sampling events illustrate that the population contains a very high proportion of fish in the smallest size classes.

We have one piece of observational data that needs to be considered. Beginning in early fall 2001, the Lees Ferry trout guides reported catch rates began to decline significantly, indicating to them a decrease in population abundance. This decline in catch-rate is further-supported by AGFD creel survey data (Figure 6).

Figure 7 shows the relationship between fish density as reflected by mean annual electrofishing catch per minute and the amount of available habitat as reflected by mean annual streamflow.

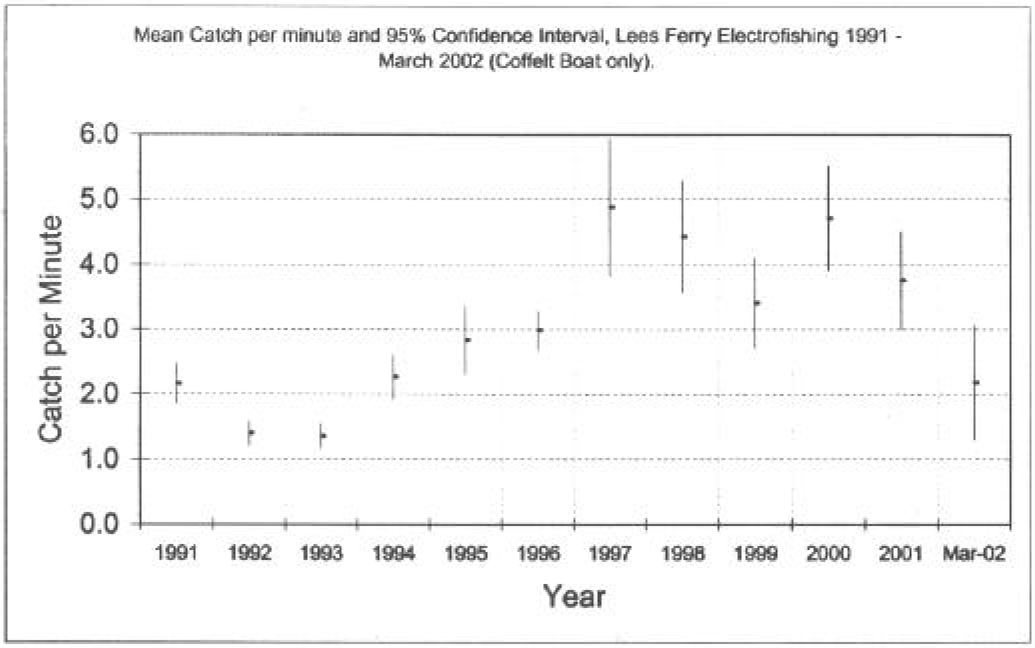

Figure 1. Mean catch per effort for RBT caught in Glen Canyon reach using electrofishing since 1991. Catch rates increased until 1997 and have been stable or slightly decreasing since then.

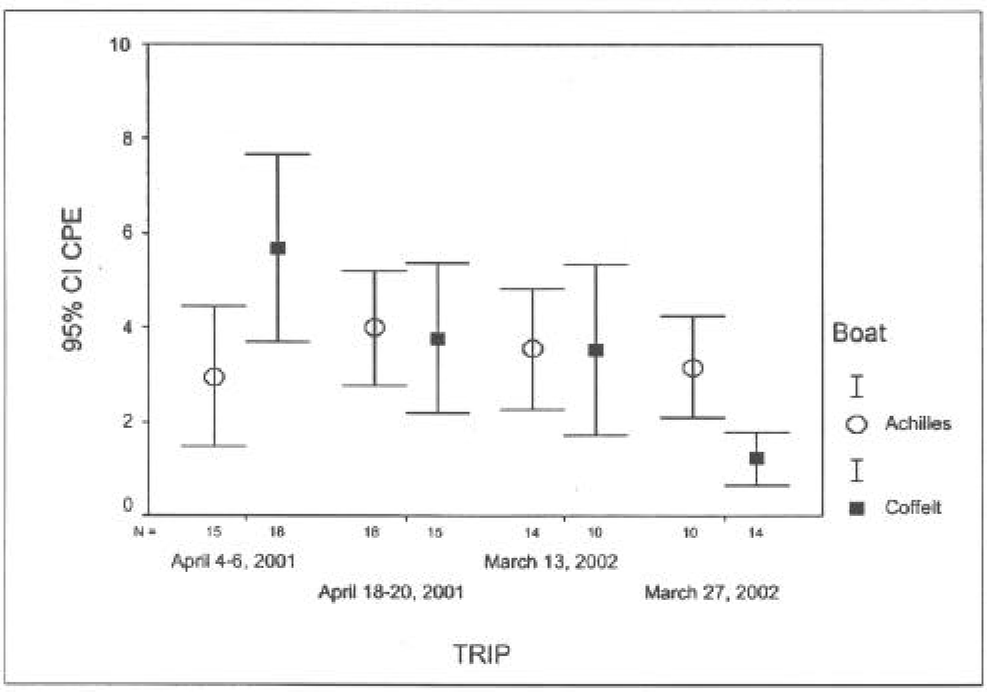

Figure 1A. Comparison of electrofishing catch rates for two types of electrofishing boats used at Lees Ferry. The Coffelt boat (C) is the boat used over the long term at Lees Ferry. The Achilles boat (A) is the boat used in downstream trout sampling and the proposed boat of choice for future Lees Ferry sampling following several years of paired comparisons to demonstrate that switching to this boat won't produce an anomaly in the time series data.

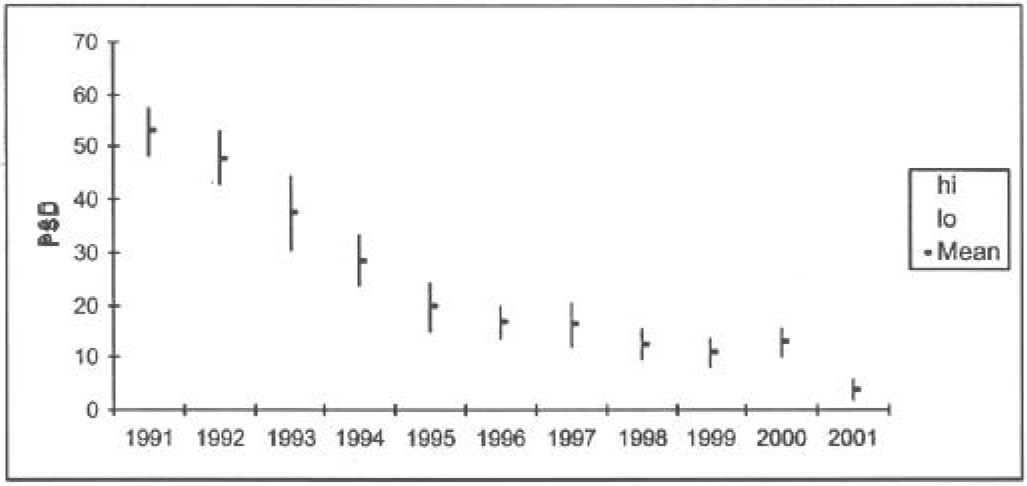

Figure 2. Proportional Stock Density (PSD), i.e. the proportion of fish 16 inches and larger contained within the population of fish 12 inches and larger, PSD = (abundance ≥ 16 inches)/(abundance ≥ 12 inches).

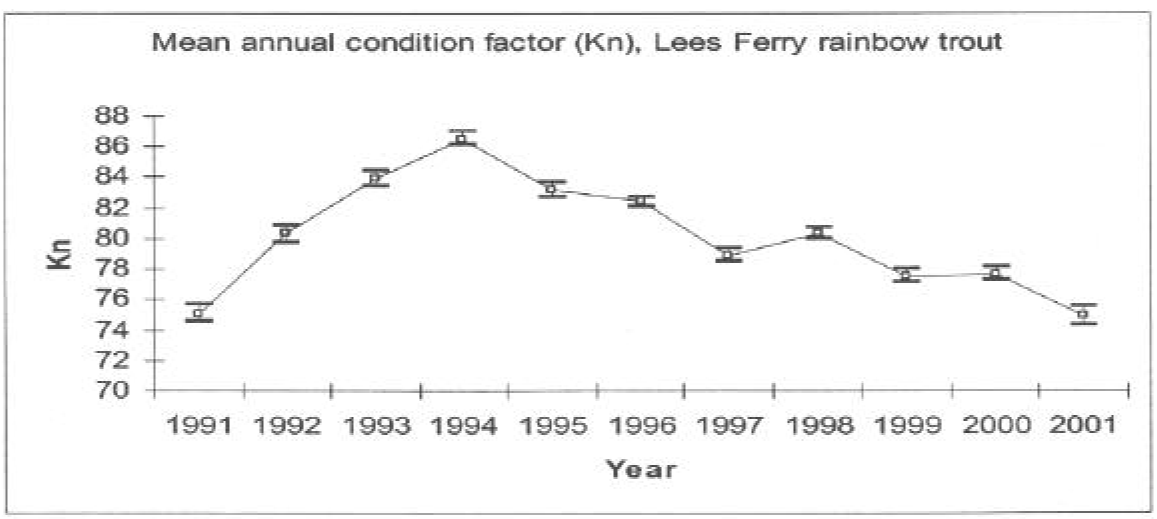

Figure 3. Condition factor by year for Lees Ferry trout (1991-2001).

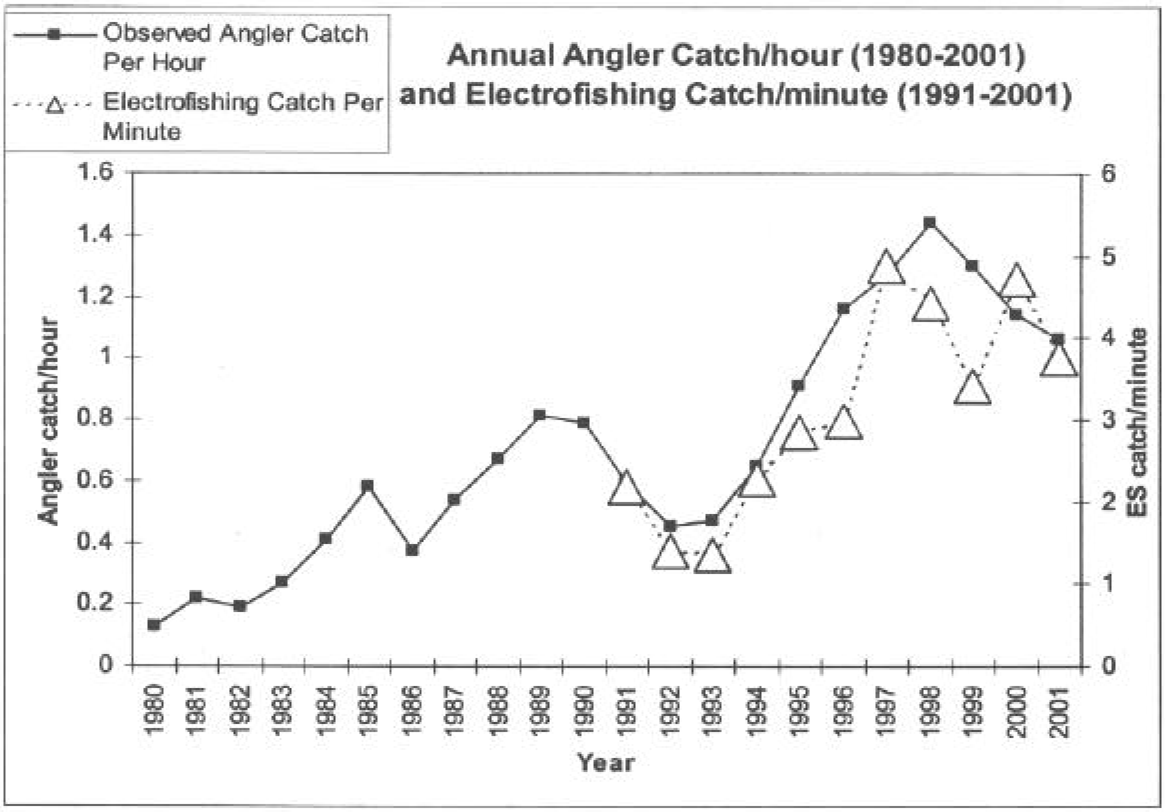

Figure 4. Mean annual electrofishing catch per minute (1991 – 2001; triangles) and mean annual angler catch per hour (1980 – 2001; squares).

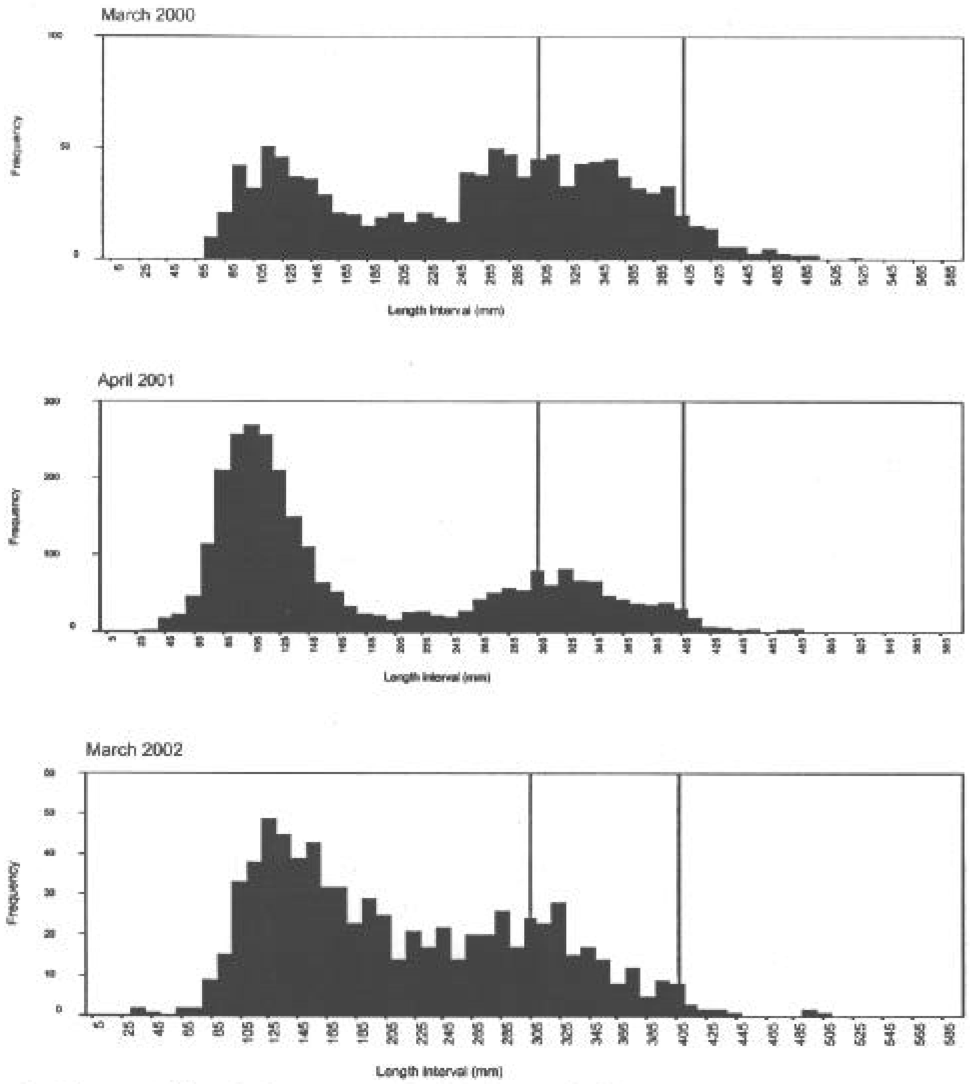

Figure 5. Observed length frequency distributions of rainbow trout captured using electrofishing methods in the Lees Ferry reach during March 2000- 2002. Vertical lines are at 305 mm (12 inch) and 406 mm (16 inch).

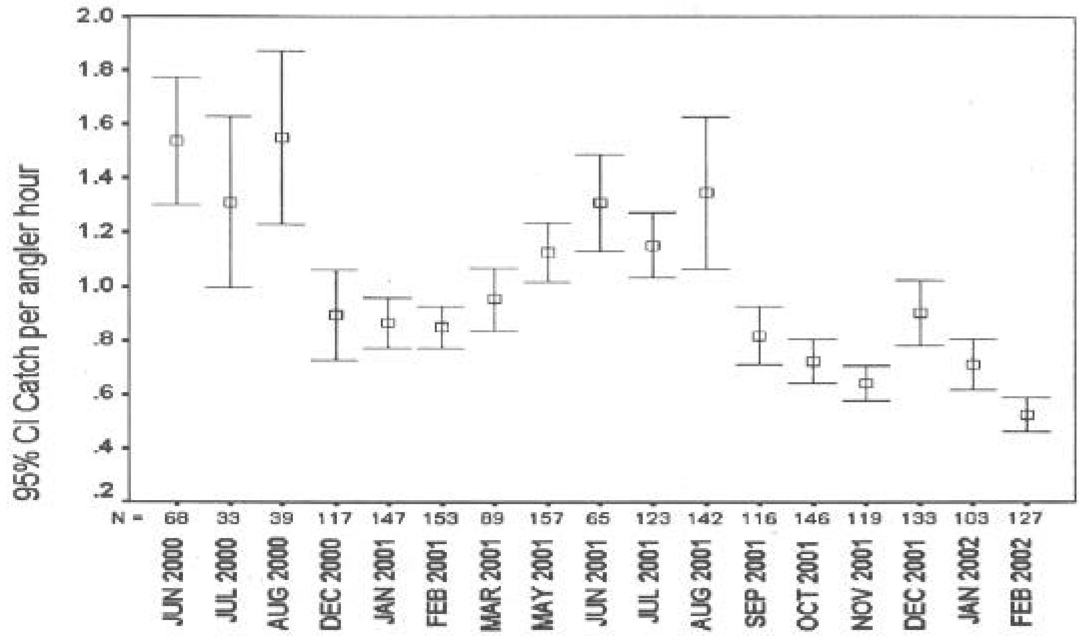

Figure 6. Mean and 95% confidence interval, catch of rainbow trout per angler hour, Lees Ferry June 2000-February 2002. Region II creel data provided by Jodi Niccum, 3/23/02.

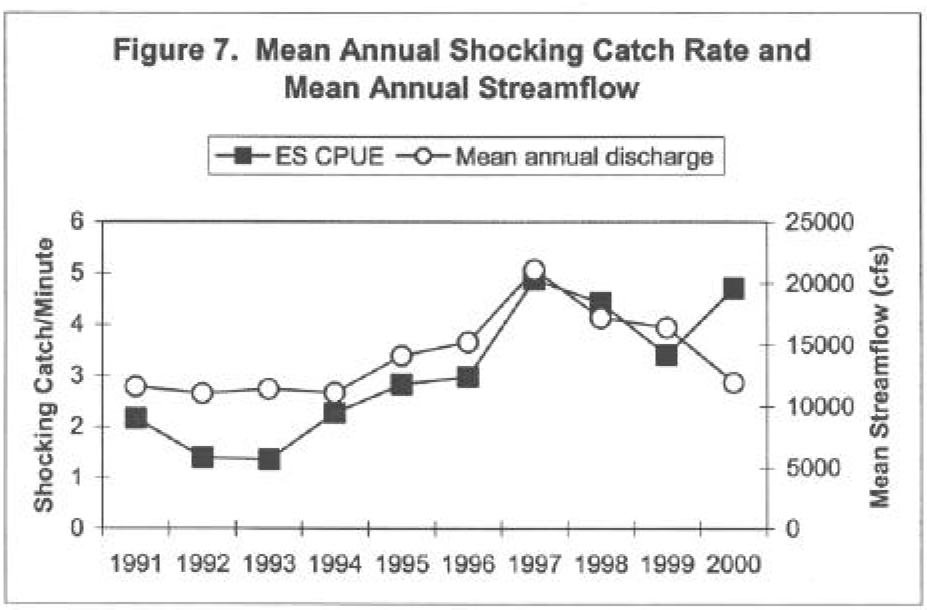

Figure 7. Fish density as reflected by mean annual electrofishing catch per minute and the amount of available habitat as reflected by mean annual streamflow.

Section 2 – Plausible explanations of the data

Are there plausible explanations for the divergence in creel catch rates and catch rates reported by the Lees Ferry trout guides and the data from electrofishing monitoring?

1) Long-term electrofishing data may not be sensitive to short-term changes.

Data from March 13, 2002, using both the Achilles and Coffelt boats, suggested no significant decline in electrofishing catch rates from 2001. However more recent data (March 27, 2002) from only the Coffelt boat (as was used from 1991 – 2001) shows a significant decline in the catch rate between 2001-2002, see Figure 1.

2) The electrofishing data may not be representative of the population due to poor sampling design.

In fisheries jargon this is known as hyperstability, that is the sampling always produces consistent catches because sampling is done where biologists know they will catch fish. The electrofishing effort is based on a random selection of sampling sites, which should eliminate this problem if it existed. Examinations of electrofishing and creel data suggest that hyperstability is not a problem. Electrofishing and creel data from 1991 – 1998 are well correlated, however beginning in 1999 angler catch rates and electrofishing catch rates have diverged. There is also a possibility that the time series is reflecting that some sort of asymptote (i.e., theoretical limit in fish density or carrying capacity) has been reached and the trend is in an oscillatory phase.)

3) The foodbase may have declined or been over-exploited causing fish behavioral changes making them less vulnerable to anglers.

There is some likelihood that the foodbase was reset in September 2001 to a level commensurate with the 5,000 cubic feet per second (cfs) flows, allowed under the Record of Decision for an 8.23 million acre feet (maf) year. This level may represent the "carrying capacity" at which this fishery should be managed. It has been suggested that minimum flows of 8,000 cfs should be established to protect the foodbase. Existing data suggest there is not much area difference between 5,000 and 8,000 cfs flows.

Additional factors related to the foodbase may be influencing both access to food by fish and access to fish by anglers. There has been a fairly major shift in the composition of the invertebrate community in the Lees Ferry reach wherein snails now heavily dominate the community and preferred aquatic invertebrates are less abundant than in the early 1990's. This shift may represent a well-known ecological pattern; lack of disturbance, or conversely stability in habitat, causes lower diversity in the kinds of organisms present and tends to result in dominance by a few forms. Moreover, when the foodbase is found mostly at <5,000 cfs levels, this probably causes fish to move into those areas which at least under fluctuating (higher) flows make them less accessible to anglers-particularly shore and wading anglers.

In the discussion of carrying capacity, one should recognize that as water flows have decreased, carrying capacity has also likely decreased. This may be reflected in Figure 7. If our goal is to manage for a stable quality fishery we should base our objectives on a stable foodbase reflected by probable minimum flows allowed under the current Record of Decision of 5,000 – 8,000 cfs.

4) The data are saying the same thing -- too many fish, therefore fish are smaller, in poorer condition and not feeding, therefore anglers don't catch them.

Recent catch rate data from anglers does show a significant decline in catch rates (Figure 6.). The trend depicted in Figures 1, 2, and 3 reflects a well-known response of rainbow trout populations termed conservation of biomass. Whether stocked or naturally reproduced, available food and habitat can only support so much biomass or total weight of fish. Therefore more fish equate to smaller average size.

Higher density of fish is expected to produce a higher catch rate for both angler caught and fisheries management sampling efforts (Figures 1 & 4). However as reflected in the overall structure of the population, while the rate of catch goes up, the size of fish caught goes down. The most recent size frequency distribution for the population (spring 2002) shows a very high proportion of fish in the sub-catchable size ranges (<200mm; Figure 5). Fish in the 200-300mm (8-12 in) size range are not considered desirable by many Lees Ferry anglers.

Section 3 – Most probable explanations

In the judgment of GCMRC, it is likely that the final two explanations are the most probable. Over the time period 1993 – 1997, rainbow trout abundance appears to have reached a level approaching or exceeding carrying capacity. Since then, continued strong recruitments have likely had the effect of depressing growth and fish condition further. Beginning in September of 2001, minimum flows from Glen Canyon Dam may have decreased carrying capacity even more contributing to additional stress that is possibly being manifested in behavioral changes causing angler catch rate to decrease. If the fluctuating flows are successful at reducing recruitment, we should see fish condition, growth rates, and PSD increase as fish density is reduced.

Conclusions

The data presented above support the perspective that the Lees Ferry trout population and fishery have been in a state of decline over the past several years. This is manifest in smaller size fish and now in apparent declines in catch rates by anglers. The prescribed management action of reducing recruitment by a combination of reducing spawning success and reducing survival of young trout is expected to reverse both of these trends and improve the overall quality and stability of the fishery. Concerns remain regarding the potential for stranding some adult fish during the fluctuating flows in Jan-March. We are hopeful that these concerns can be addressed by further refining the specific upramp and downramp characteristics of the flows, by monitoring for stranding, and implementing other mitigation measures as necessary. The detailed approaches to this and other issues remain to be worked out. GCMRC and AGFD remain committed to mitigating these and other concerns, if possible.