Lees Ferry Tailwater Fishery Research and Monitoring Activities, 1999

Fishery Fact Sheet
Research Branch
Arizona Game and Fish Department

Prepared in cooperation with **Grand Canyon Monitoring and Research Center**

INTRODUCTION

This report provides results of monitoring and research activities conducted during 1999 by Arizona Game and Fish Department for Grand Canyon Monitoring and Research Center under Cooperative Agreement 1425-97-FC-40-22690. More detailed information on our activities can be found in McKinney et al. 1999 and McKinney and Persons 1999. This report is intended to provide a summary of our activities and findings during 1999.

Activities during 1999 included:

- **ELECTROFISHING MONITORING**
- **CREEL SURVEY**
- **SNORKEL SURVEYS**
- **STOCK ASSESSMENT SPREADSHEET MODEL DEVELOPMENT**
- **FLOY TAG STUDY**
- **PIT TAG EVALUATION**
- **SEDIMENT MAPPING**

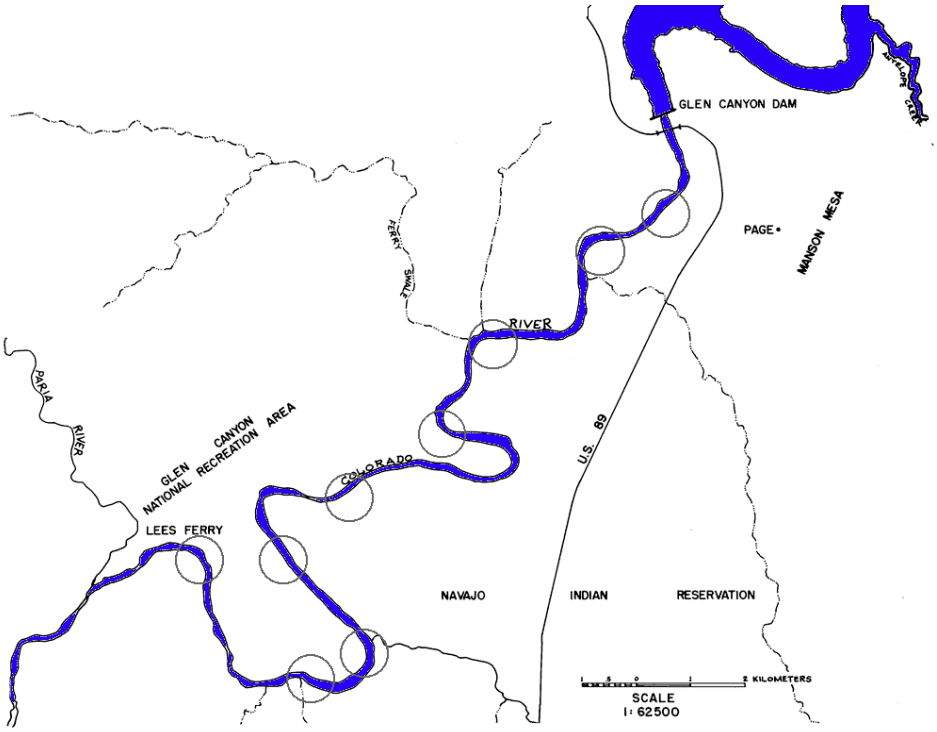


Figure 1. Study area with electrofishing monitoring locations.

MANAGEMENT OBJECTIVES

The Lees Ferry fishery is managed by the Arizona Game and Fish Department under the Blue Ribbon concept. The intent is to utilize the natural productivity of water to grow fish with the use of special regulations. Blue Ribbon management requires special regulations that encourage "catch-and-release". Specific management objectives for the Lees Ferry fishery in 1995 (Reger et al. 1995, Adaptive Management Work Group 1998) were:

- **POPULATION SIZE:** the estimated population of age 2 and older fish should be maintained at or above about 100,000, and
- **NATURAL RECRUITMENT:** Age 3 fish should be at least 50% wild spawned,
- **GROWTH RATES:** growth rates of trout should be maintained to produce age 3 fish that are 457 mm TL with relative weights (Anderson and Neumann 1996) of at least 0.80.

Our monitoring and research activities were designed to assess the status of the fishery in relation to these objectives.

ELECTROFISHING MONITORING

As part of our monitoring activities conducted since 1991 we captured rainbow trout at nine standardized transects (ca. 33 min/transect; McKinney et al. 1996, 1997) using a stratified-random design representative of cobble bars, pools and runs. We used a complex pattern of pulsed direct current, applying 215 volts and maintaining a 15-ampere average output to a 30 cm stainless steel anode system (Sharber et al. 1994). Fish were measured to the nearest mm total length (TL), weighed to the nearest gram (g) and released unless collected for analysis of food habits, health or growth. During 1999 we sampled three times (May, September and December) at 9 transects (Figure 1). We computed catch rates (catch per minute effort) and relative condition (Kn) as part of our assessment of management objectives. All fish were scanned for coded wire tags to determine if they were hatchery reared fish or wild spawned fish.

Catch Rates/Population density

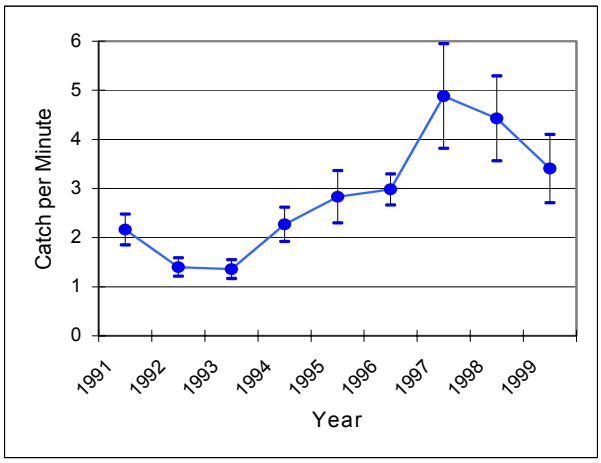


Figure 2. Mean and 95% confidence interval of rainbow trout catch per minute by electrofishing.

No significant change in mean catch per unit effort of all fish combined was detected from 1997 to 1999 (Figure 2). Increases in confidence intervals of catch rate estimators during 1997-1999 are due to a reduction in the number of sites sampled from 15 to 9. Based on the population size of 262,000 fish > 305 mm estimated during July 1998, and a similar catch rate in 1999, we are still meeting the management objective to maintain a population of age 2 and older fish at or above 100,000.

Size composition / natural recruitment

Small fish (<152 mm) made up approximately 29% of the catch indicating successful reproduction (Figure 3). Incidence of hatchery-reared fish in EF samples declined from approximately 6% (11/98) to 2% (12/99), and mature hatchery fish are now rare. PIT tagged RBT from the 1998 mark/recapture experiment continue to be recaptured in low numbers.

Hatchery-reared fish have been marked with coded wire tags as a method to assess growth since 1991 (Figure 4). With the discontinuation of stocking in 1999 and the disappearance of hatchery marked fish in the reach we began marking rainbow trout with Passive Integrated Transponder (PIT) tags to estimate growth of wild spawned fish. Inasmuch as stocking has been discontinued, the management objective that Age 3 fish should be 50% wild spawned is being met, and will continue to be met.

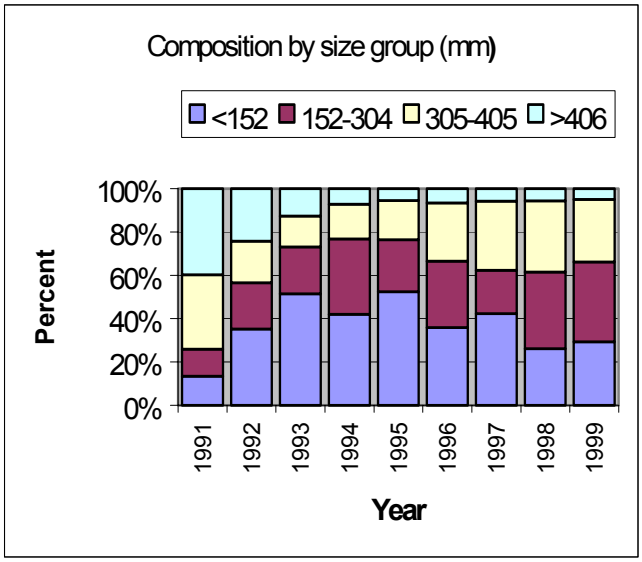


Figure 3. Percent of rainbow trout in electrofishing catch by size group.

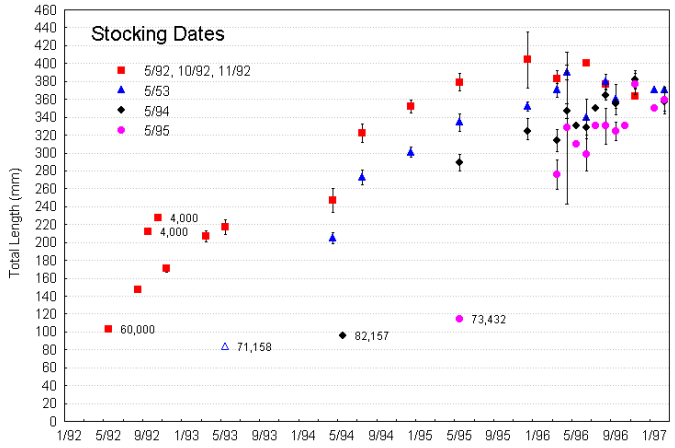


Figure 4. Mean lengths of coded-wire tagged rainbow trout (± 1 SE) in the Lees Ferry reach. Number of fish per stocking is indicated following initial mean length at stocking.

Growth

Growth rate estimates from coded wire tags were less than the management objective, with fish achieving only about 380 mm by Age 3 (Figure 4). With the discontinuation of stocking tagged fish we are evaluating other methods of assessing growth rates.

An age validation exercise using known-age trout from Lee's Ferry indicated that visual inspection of opercula, subopercula and possibly cleithra may be used to approximate age of fish from this ecosystem. Otoliths contained too many irregular rings to allow interpretation. More work is planned pending preparation of additional specimens.

Condition (W_R / K_N)

Seasonal variation in relative condition in 1999 was 'normal' (i.e., greatest in summer, lowest in winter), but annual mean (77.6) declined 3.4% from 1998 (80.5) (Figure 5). Relative weight or relative Condition is below the management objective of 0.90, probably because of the high density of fish in the reach.

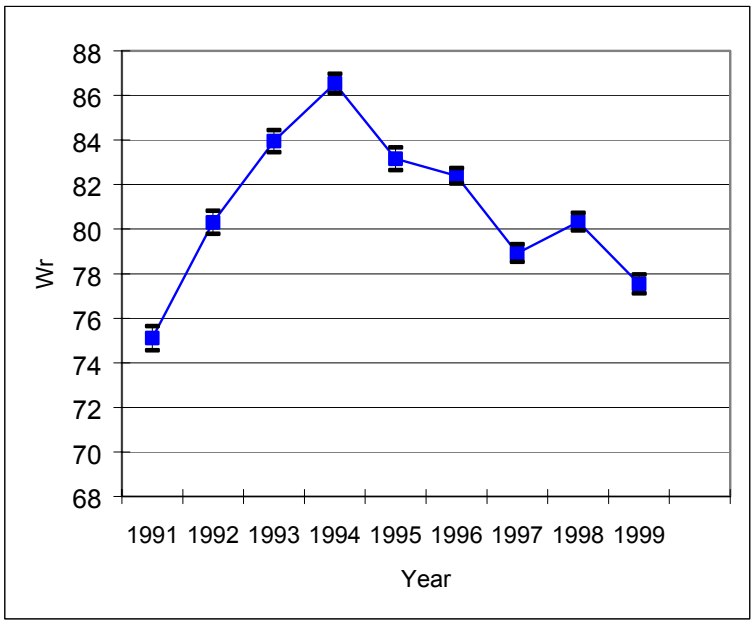


Figure 5. Yearly relative condition factor (± 95% confidence interval) of rainbow trout in the Lees Ferry reach.

CREEL SURVEY

The Flagstaff Regional office of Arizona Game & Fish Department conducted creel surveys during 1999. Glen Canyon National Recreation Area collected angler use data. Catch rate and use data provide the best long term data set for assessing angler use, and also appear to reflect population density measured from electrofishing surveys. Angler catch rates averaged greater than 1 fish per hour, with approximately 140,000 angler hours of use during 1999 (Figures 6, 7). Both use and catch rates appeared to stabilize during 1999, suggesting stability in the population.

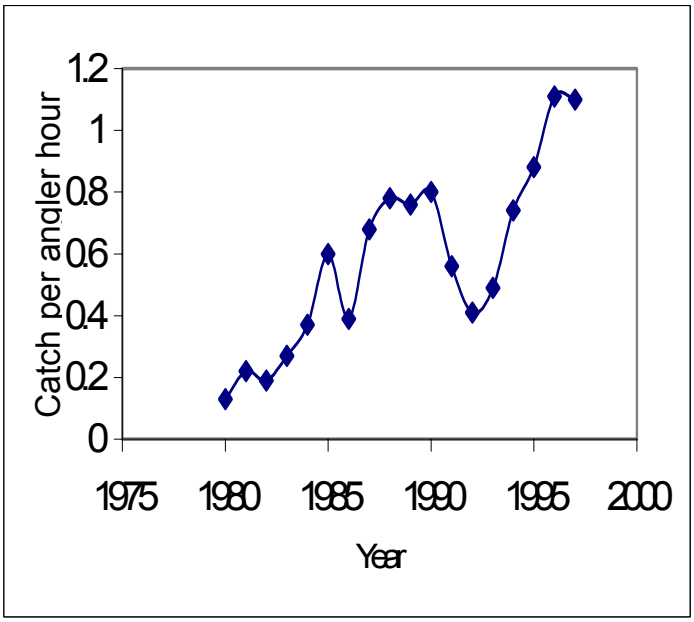


Figure 6. Mean catch of rainbow trout per angler hour, Lees Ferry 1980-1998.

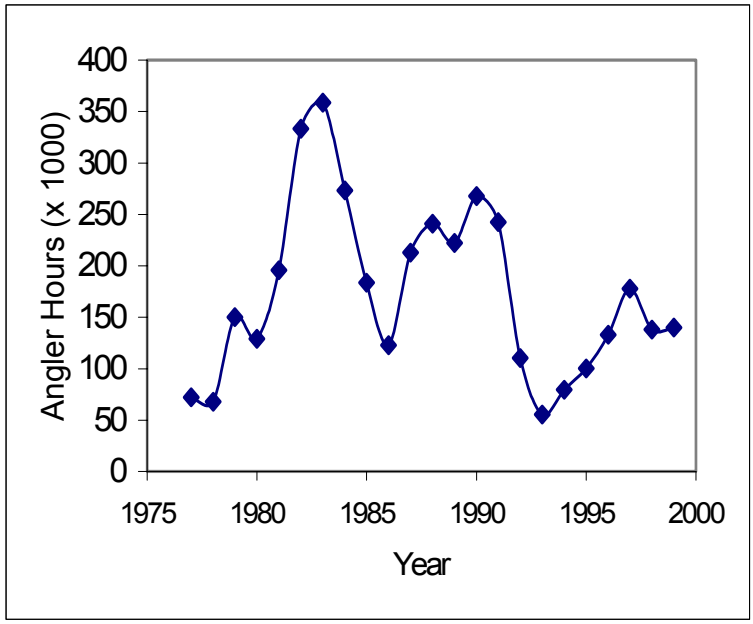


Figure 7. Annual use (angler hours), Lees Ferry 1977-1999.

SNORKEL SURVEYS

We continued our efforts to evaluate snorkel surveys as a method to assess relative abundance of trout in the Lees Ferry reach. We conducted one trip (9/1/99) at four standardized EF transects doing 2-3 dives per transect. Snorkel surveys are less intrusive and have the potential to be less expensive than electrofishing monitoring. Current difficulties with snorkel surveys include an inability to accurately determine size classes of fish counted, and an inability to count small fish. However, as an index of relative abundance of fish it may be a good substitute for electrofishing. We would like to continue to assess the use of snorkel surveys as a possible replacement for some electrofishing surveys. We would still need to conduct at least one electrofishing survey each year to determine size of fish.

Highlights of snorkel surveys included:

- Further collaboration with Lee's Ferry fishing guides
- Fish counts did not agree with electrofishing catch as they did in 1998, possibly because higher numbers of fish can be counted visually than can be captured by a single EF pass.
- Low between-replicate variation on pooled mean counts (7-19%) despite different light conditions/personnel in 1999 vs. 1998.
- Familiarity with transects allowed us to complete survey in 2/3 the time it took in 1998.
- Expansion/refinement of snorkel methods likely; shows great promise as monitoring tool, especially as a calibration method for electrofishing catch per unit effort.

STOCK ASSESSMENT SPREADSHEET MODEL DEVELOPMENT

A **spreadsheet stock assessment model** is being developed with the assistance of Dr. Carl Walters, University of British Columbia, to characterize the rainbow trout fishery. Initial data to drive the model were angler catch data from creel surveys conducted since 1967. Using a nonlinear least squares search routine a model was fitted to the observed data that explains much of the change in angler catch rates using standard fishery stock-recruitment model parameters and flow variables. Parameters included recruitment, survival, mortality, von Bertalanffy K, and daily flow fluctuations. The model should help assess the feasibility of attaining the listed management objectives, and allow examination of effects of different management options. The model is undergoing revision and should result in a peer-reviewed publication.

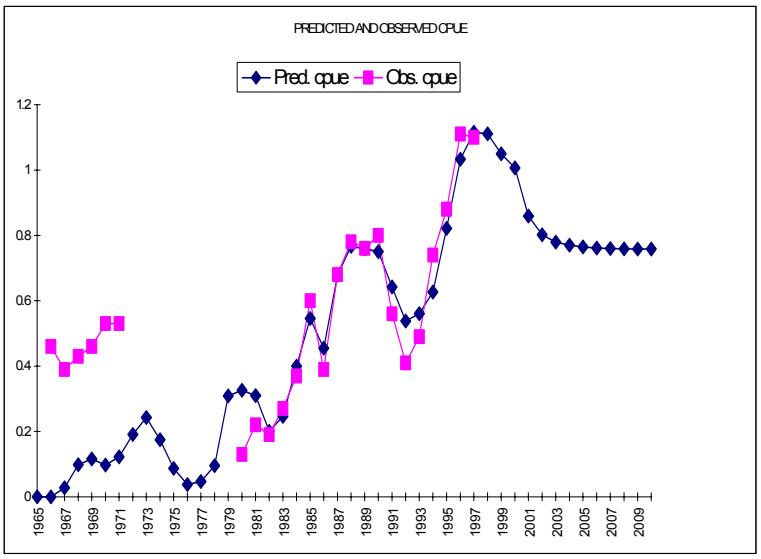
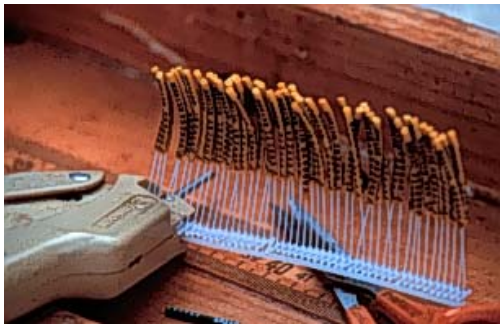


Figure 8. Predicted and observed angler catch per hour used in Stock Assessment Model.

Power analysis and evaluation of electrofishing protocol was begun during 3/99, analysis is ongoing. Preliminary results suggest that our current protocol is capable of detecting moderate variations in trout relative density and condition over both short (1-2 yr.) and long-term (5+ year) time scales. Results also indicate that detectable magnitudes of change vary considerably with fish size. Complete results will be presented during 2000.

OTHER ACTIVITIES:

FLOY TAG STUDY



One of the questions that arose as a result of developing the stock assessment model was the need to understand how many times an individual fish was caught by anglers to verify population density estimates based on creeled fish. Therefore, we designed a cooperative study to work with professional fishing guides to mark fish with Floy tags. Expert taggers provided training to a select group of guides, and the guides were provided tagging guns and tags.

Volunteer professional fishing guides tagged 726 sport-caught RBT, confirmed 55 recaptures over a period of 9 months at seven cobble bars in the upper half of the tailwater.

- Mark/recapture relationship was linear and tight; marked fish are recovered by angling in a predictable fashion.
- 5.8% of sample recaptured once, 0.7% recaptured twice, 0.1% recaptured 3 times during 9 months.
- Average RBT days at liberty: 45 (SE=6 days).
- Floy tagging by fishing guides can provide estimates of adult RBT vulnerability to fly tackle, mortality, and population size but several modifications are necessary.
  - ✓ Guides must record total numbers of marked and unmarked fish captured, estimate total angling effort. Accurate fish length measurements may be necessary depending on study objectives. Degree of participation by non-guided anglers in reporting recaptures must be assessed, enhanced through PR, or alternative modeling approaches need to be applied to the data.

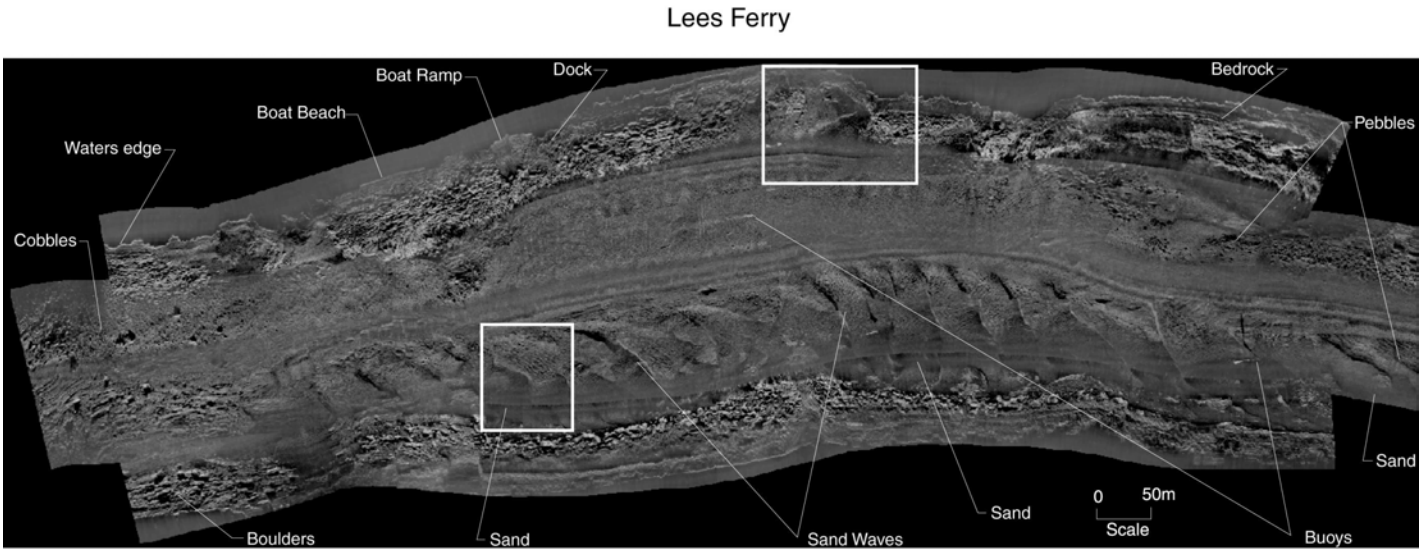
OUTREACH

Whirling disease has destroyed many western rainbow trout fisheries, and has recently been discovered in the San Juan arm of the Colorado River, upstream from Lees Ferry. In order to educate anglers about whirling disease and methods that may help prevent the spread of the disease, a Whirling Disease (WD) forum was held on 12/3/99.

- 12 guides, one angler and one AGFD wildlife manager from Region II attended.
- Information on WD biology, distribution and prevention very well received.
- Additional information/posters to be distributed locally in early 2000.
- Attendees expressed interest in collaborating with Whirling Disease Foundation to hold workshop on WD prevention and development of management contingency plans.
- A poster was developed and posted at the boat ramp and at guide shops advising anglers to wash and clean their equipment when moving from one body of water to another.

SEDIMENT MAPPING

During May 1999 Roberto J. Anima , US Geological Survey (USGS) on contract with GCMRC, demonstrated use of side-scan sonar to quantify spatial distribution of sediment types in the Lee's Ferry reach (Figure 8), of 240 miles of side-scanning sonar data collected by the Coastal and Marine Geology Team of the U.S. Geological Survey. The illustration consists of three side-scanning sonar tracklines that have been digitally stitched together to form a mosaic of the river bed. The mosaic shows the distribution of various features on the river bed. Side-scanning sonar is being used to map the distribution of sediment along the Colorado River to monitor changes on the river bed over time. The same data is being used to map potential fish habitats and spawning grounds. This type of survey, which can be linked to Lee's Ferry GIS databases, shows some promise in future monitoring of trout habitat and spawning substrate availability, particularly during experimental floods. It also provides a path for future integration of sediment resource monitoring and the Lees Ferry fishery monitoring.



RECOMMENDATIONS FOR FUTURE WORK

- ✓ Evaluate use of alternative methods such as video taping or counting fish in addition to netting them during electrofishing runs. Implications from recent snorkel surveys are that at high densities the electrofishing netters may be netting fish at saturation, and even if more fish are in the population the netters may not be able to net them. This could lead to underestimates of population densities based on catch-per-unit-effort indices.
- ✓ Continue to evaluate use of PIT tags for marking fish to assess growth and recruitment parameters.
- ✓ Continue to evaluate use of bony structures to assess growth rates.
- ✓ Evaluate creel program to determine if level of effort (12 interview days per month) is adequate, or if the effort can be reduced to save costs.

- **REPORTS SUBMITTED IN 1999**

McKinney, T., D.W. Speas, R.S. Rogers and W.R. Persons. 1999. Rainbow trout and lower trophic levels in the Lee's Ferry tailwater below Glen Canyon Dam, Arizona: A Review. Final Report to U.S. Bureau of Reclamation, Grand Canyon Monitoring and Research Center, Flagstaff, Arizona. Arizona Game and Fish Department, Phoenix, AZ. Cooperative Agreement No. 1425-98-FC-40-22690.

McKinney, T., D.W. Speas, R.S. Rogers and W.R. Persons. 1999. Rainbow trout in the Lee's Ferry recreational fishery below Glen Canyon Dam, Arizona, following establishment of minimum flow requirements. Final Report to U.S. Bureau of Reclamation, Grand Canyon Monitoring and Research Center, Flagstaff, Arizona. Arizona Game and Fish Department, Phoenix, AZ. Cooperative Agreement No. 1425-97-FC-40-22690.

- **PUBLICATIONS IN 1999**

McKinney, T., R. S. Rogers, and W. R. Persons. 1999. Effects of flow reductions on aquatic biota of the Colorado River below Glen Canyon Dam, Arizona. North American Journal of Fisheries Management. 19:984-991.

- **PUBLICATIONS SUBMITTED IN 1999**

McKinney, T., A.T. Robinson, D.W. Speas and R.S. Rogers. Health assessment and associated metrics for rainbow trout in the Colorado River below Glen Canyon Dam, Arizona. Submitted to North American Journal of Fisheries Management.

McKinney, T., D.W. Speas, R.S. Rogers, and W.R. Persons. Rainbow trout in a regulated river below Glen Canyon Dam, Arizona following increased minimum flows and reduced discharge variability. Submitted to North American Journal of Fisheries Management.

REFERENCES CITED

Maddux, H. R., D. M. Kubly, J. C. deVos, W. R. Persons, R. Staedicke and R. L. Wright. 1987. Effects of varied flow regimes on aquatic resources of Glen and Grand Canyons. Final Report to U. S. Department of Interior, Bureau of Reclamation. Arizona Game and Fish Department, Phoenix.

McKinney, T., R.S. Rogers, A. Ayers and W.R. Persons. 1996. Effects on algae, macrophytes, macroinvertebrates, rainbow trout and flannelmouth sucker in the Glen Canyon Dam tailwater. Pp.71-94 *in* The effects of an experimental flood on the aquatic biota and their habitats in the Colorado River, Grand Canyon, Arizona. Final Report to Grand Canyon Monitoring and Research Center, Flagstaff, AZ. Arizona Game and Fish Department, Phoenix.

McKinney, T., R.S. Rogers and W.R. Persons. 1997. Lee's Ferry reach: lower trophic levels and rainbow trout 1997 annual report. Report to Grand Canyon Monitoring and Research Center, Flagstaff, AZ. Arizona Game and Fish Department, Phoenix.

McKinney, T. and W. R. Persons. 1999. Lee's Ferry rainbow trout fishery--an ecological review. Final Report to Grand Canyon Monitoring and Research Center. Arizona Game and Fish Department, Phoenix.

McKinney, T., D.W. Speas, R.S. Rogers and W.R. Persons. 1999. Rainbow trout in the Lee's Ferry recreational fishery below Glen Canyon Dam, Arizona, following establishment of minimum flow requirements. Final Report to U.S. Bureau of Reclamation, Grand Canyon Monitoring and Research Center, Flagstaff, Arizona. Arizona Game and Fish Department, Phoenix, AZ. Cooperative Agreement No. 1425-97-FC-40-22690.

Persons, W.R., K. McCormack and T. McCall. 1985. Fishery investigation of the Colorado River from Glen Canyon Dam to the confluence of the Paria River: assessment of the impact of fluctuating flows on the Lee's Ferry fishery. Final Report, Federal Aid in Sport Fish Restoration, Dingell Johnson Project F-14-R-14. Arizona Game and Fish Department, Phoenix.

Reger, S., K. Tinning and L. Piest. 1989. Colorado River Lee's Ferry fish management report, 1985-1988. Arizona Game and Fish Department, Phoenix.

Sharber, N. G., S. W. Carothers, J. P. Sharber, J. C. deVos, Jr. and D. A. House. 1994. Reducing electrofishing-induced injury of rainbow trout. North American Journal of Fisheries Management 14:340-346.

Stone, J. L. 1964. Limnological study of Glen Canyon tailwater area of the Colorado River, July 1, 1963-June 30, 1964. Arizona Game and Fish Department, Phoenix.

Stone, J. L. and A. B. Queenan. 1967. Tailwater fisheries investigations: creel census and limnological study of the Colorado River below Glen Canyon Dam, July 1, 1966-June 30, 1967. Arizona Game and Fish Department, Phoenix.

Stone, J. L. and N. L. Rathbun. 1968. Tailwater fisheries investigations: creel census and limnological study of the Colrado River below Glen Canyon Dam, July 1, 1967-June 30, 1968. Arizona Game and Fish Department, Phoenix.

Stone, J. L. and N. L. Rathbun. 1969. Tailwater fisheries investigations: creel census and limnological study of the Colorado River below Glen Canyon Dam, July 1, 1968-June 30, 1969. Arizona Game and Fish Department, Phoenix.

For more information, please contact us at:

Bill Persons
Arizona Game and Fish Department
Research Branch
2221 West Greenway Road
Phoenix, AZ 85023
(602) 789-3375

bpersons@gf.state.az.us

Roberto J. Anima
Coastal and Marine Geology Program
U.S. Geological Survey MS-999
345 Middlefield Road
Menlo Park, CA 94025 USA
Office #: (650) 329-5212
Fax #: (650) 329-5190

ranima@octopus.wr.usgs.gov