

Grand Canyon Humpback Chub Population Stabilizing

The humpback chub (*Gila cypha*) (fig. 1) is a long-lived, freshwater fish found only in the Colorado River Basin. To survive in the famously turbulent Colorado River, the species developed some unusual adaptations, including a large adult body size, large predorsal hump, and small eyes. A number of factors have contributed to the decline of humpback chub and other native Colorado River fish. In 1967, the humpback chub was added to the federal list of endangered species and is today protected under the Endangered Species Act of 1973. Only six populations of humpback chub are currently known to exist, five in the Colorado River Basin above Lees Ferry, Arizona, and one in Grand Canyon, Arizona.

Monitoring and research of the Grand Canyon population of humpback chub is overseen by the U.S. Geological Survey's Grand Canyon Monitoring and Research Center (GCMRC) under the auspices of the Glen Canyon Dam Adaptive Management Program (GCDAMP). Recently collected data indicate that the number of adult (age-4+) humpback chub in Grand Canyon stabilized between 2001 and 2005 after more than a decade of decline.

Background

The majority of Grand Canyon humpback chub are found in the Little Colorado River (the largest tributary to the Colorado River in Grand Canyon) and the Colorado River near its confluence with the Little Colorado River. Small numbers of humpback chub are found elsewhere in Grand Canyon, but successful reproduction has only been documented for those fish found in or near the Little Colorado River.

Reproduction has been restricted to the Little Colorado River because of changes in the mainstem Colorado River after the completion of Glen Canyon Dam. For example, prior to the dam, the water temperature of the Colorado River fluctuated seasonally from 0°C to 29°C (30–80°F). Today, because the release structures of the dam are well below the surface of Lake Powell, the water that leaves the dam is cold, with an average temperature of 8°C (46°F). Water temperatures in the main channel of the Colorado River have been too cold for humpback chub to successfully reproduce except near the Little Colorado River.

Recent Findings

Since scientists began monitoring efforts in 1989, the population of adult humpback chub in Grand Canyon has declined



Figure 1. The humpback chub (*Gila cypha*) is an endangered freshwater fish found only in the Colorado River Basin. Recently collected data indicate that the number of adult fish (age-4+) in Grand Canyon stabilized between 2001 and 2005 after years of decline (photograph courtesy of George Andrejko, Arizona Game and Fish Department).

steadily until recently (fig. 2.). The death of 15% to 20% of adult fish each year and a low rate of juvenile fish surviving into adulthood contributed to the decline. Adult mortality rates and the failure of juvenile fish to reach adulthood have both been attributed to changes in Little Colorado River and Colorado River hydrology, the weakening of young fish by the nonnative Asian tapeworm (*Bothriocephalus acheilognathi*), and competition with and predation by nonnative fish species.

Between 2001 and 2005, however, conditions appear to have improved and the number of adult fish stabilized at an estimated 5,000 fish (fig. 2). Additionally, near the confluence of the Colorado and Little Colorado Rivers, catch-rate data from the monitoring program indicate an increased abundance of juvenile humpback chub between 2003 and 2005. Increases in juvenile fish during the same period were also apparent for other native species found near the confluence, including bluehead sucker (*Catostomus discobolus*), flannelmouth sucker (*Catostomus latipinnis*), and speckled dace (*Rhinichthys osculus*).

Elsewhere in Grand Canyon, catch rates for humpback chub produced in 2005 were higher than previous years in middle and lower Marble Canyon (U.S. Geological Survey, unpub. data, 2006). Higher than average catch rates at these locations were unexpected because they are up to 25 river miles above the confluence of the Colorado and Little Colorado Rivers where spawning usually occurs. These findings suggest that more favorable conditions for spawning and incubation existed in the Colorado River main channel during 2005.

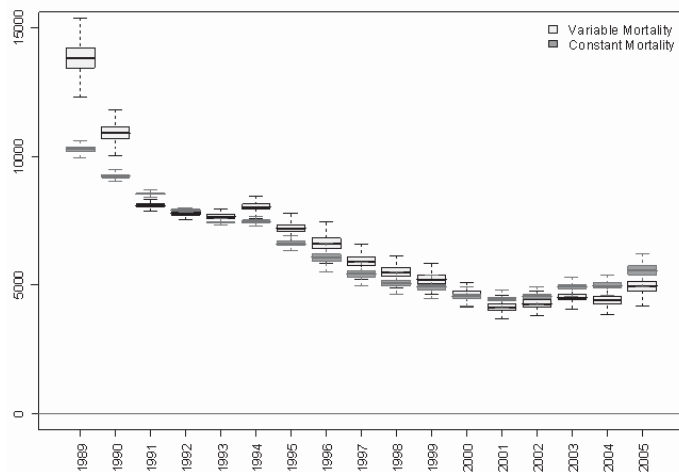


Figure 2. Adult (age-4+) humpback chub population estimates (1989–2005) for the Little Colorado River. Upper and lower bounds are 95% Bayesian credible intervals. When confidence intervals are considered, the model indicates that the population has stabilized.

Discussion

The exact causes of the stabilization of the adult population and increased numbers of young humpback chub cannot be specified at this time. However, humpback chub in Grand Canyon are thought to have benefited from several changes, including the experimental removal of nonnative fish, experimental water releases, and drought-induced warming.

Beginning in 2003, large numbers of rainbow trout (*Oncorhynchus mykiss*) and brown trout (*Salmo trutta*) were removed from the area near the confluence of the Colorado and Little Colorado Rivers. Rainbow and brown trout are thought to compete with humpback chub for food and prey on young fish. Since 2003, the rainbow trout population in the Colorado River near the Little Colorado River has been reduced by more than 60%. The removal effort will continue through 2006.

Humpback chub produced in 1999 may also have benefited from substantial in-stream warming as the result of the 2000 low summer steady flow experiment. The experiment held Glen Canyon Dam releases constant at 8,000 cubic feet per second from June through August 2000 and included two habitat maintenance flows (high, steady dam releases). As a result, in the summer of 2000, peak water temperatures in some parts of Grand Canyon exceeded 20°C (68.5°F), which represents a temperature increase when compared with typical peak temperatures of 15–18°C (59–64°F) in recent years. Humpback chub habitat may also have been improved as the result of experimental floods conducted in 1996, 1997, 2000, and 2004.

Since 2003, water temperatures below the dam have also increased as the result of drought conditions. As drought has reduced flows into Lake Powell, the level of the reservoir has dropped, allowing warmer water found closer to the surface of the reservoir to reach the release structures. In 2005, water temperatures in the mainstem Colorado River near the Little Colorado River exceeded 17°C (60.8°F), the warmest temperatures recorded since the reservoir filled in 1980 and approximately the minimum temperature needed by humpback chub to successfully reproduce. Native fish are thought to benefit

from warmer water releases; however, there is great concern that warmer water temperatures may also benefit nonnative warmwater fish like the channel catfish (*Ictalurus punctatus*), a voracious predator.

Scientists are not yet able to determine the relative importance of the various factors that may be contributing to recent improvements. More work will be required to understand how nonnative fish, temperature, and the operation of Glen Canyon Dam interact to affect the humpback chub population in Grand Canyon.

The Glen Canyon Dam Adaptive Management Program was established to monitor and analyze the effects of dam operations on downstream resources and to use these assessments to recommend to the Secretary of the Interior adjustments intended to improve the values for which the Glen Canyon National Recreation Area and Grand Canyon National Park were established. Fieldwork related to humpback chub research was conducted cooperatively by GCMRC and GCDAMP partners, including the Arizona Game and Fish Department and the U.S. Fish and Wildlife Service.

References

- Coggins, L.G., Pine, W.E., III, Walters, C.J., Van Haverbeke, D.R., Ward, D., Johnstone, H.C., 2006, Abundance trends and status of the Little Colorado River population of humpback chub: *North American Journal of Fisheries Management*, v. 26, p. 233–245.
- Gloss, S.P., and Coggins, L.G., 2005, *Fishes of Grand Canyon* in Gloss, S.P., Lovich, J.E., and Melis, T.S., eds., 2005, *The state of the Colorado River ecosystem in Grand Canyon*: U.S. Geological Survey Circular 1282, 220 p.
- Melis, T.S., Martell, S.J.D., Coggins, L.G., Pine, W.E., III, and Andersen, M.E., 2006, Adaptive management of the Colorado River ecosystem below Glen Canyon Dam, Arizona: using science and modeling to resolve uncertainty in river management, in *Specialty Summer Conference on Adaptive Management of Water Resources*, Missoula, Mont., 2006, CD-ROM Proceedings (ISBN 1-882132-71-8): Middleburg, Va., American Water Resources Association.
- Paukert, C.P., Coggins, L.G., and Flaccus, C.E., 2006, Distribution and movement of humpback chub in the Colorado River, Grand Canyon, based on recaptures: *Transactions of the American Fisheries Society*, v. 135, p. 539–544.

More Information

Matthew E. Andersen
 U.S. Geological Survey
 Southwest Biological Science Center
 Grand Canyon Monitoring and Research Center
 2255 N. Gemini Drive
 Flagstaff, Arizona, 86001
 Tel: 928-556-7094
 E-mail: mandersen@usgs.gov
 Website: www.gcmrc.gov