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# 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.

**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).

## 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 0ºC to 29ºC (30–80ºF). 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 8ºC (46ºF). 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 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.

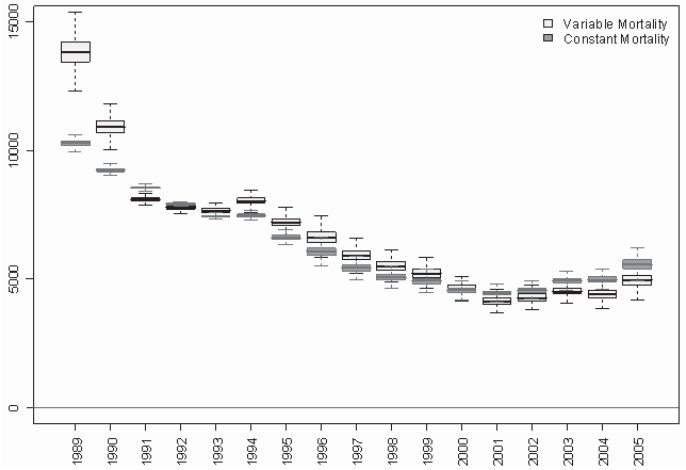


**Figure 2.** Adult (age-4+) humpback chub population estimates (1989–2005) for the Little Colorado River. Upper and lower bounds are 95% Bayesian credible intervals. When confidence intervals are considered, the model indicates that the population has stabilized.

## 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 20ºC (68.5ºF), which represents a temperature increase when compared with typical peak temperatures of 15–18ºC (59–64ºF) 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 17ºC (60.8ºF), 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.

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## 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

# Grand Canyon Monitoring and Research Center

## Information on Humpback Chub, August 2006

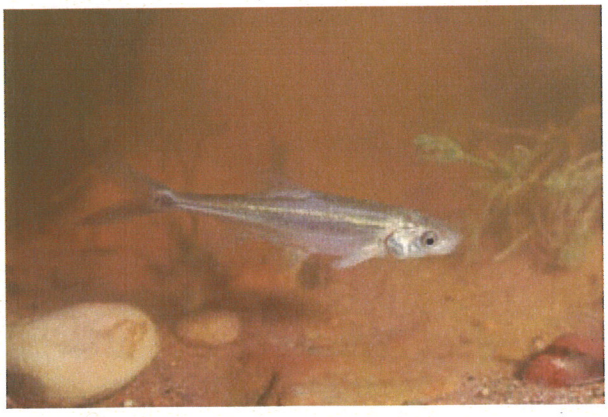
### News Release

Humpback Chub
Photograph by George Andrejko
Arizona Game and Fish Department

#### Endangered Humpback Chub Population in Grand Canyon Stabilizing

Recently collected data for endangered humpback chub (*Gila cypha*) in Grand Canyon suggest that the population of adult fish (age 4+) may be stabilizing after more than a decade of decline, according to biologists wi the U.S. Geological Survey's (USGS) Southwest Biological Science Cent Between 2001 and 2005, the number of adult fish appears to have stabili at an estimated 5,000 fish. In 2005, scientists also detected more juvenile fish (age 1 to 4) and young-of-year fish, or fish hatched in 2005, than previous years.

"The possible stabilization of adult fish numbers is exciting news for the recovery effort because it means that conditions exist in Grand Canyon that allow young fish to reach reproductive age," says Matthew Andersen, USGS Southwest Biological Science Center Supervisory Biologist. "Until recently, the Grand Canyon populati was steadily declining because adult fish were dying at a rate of 15% to 20% annually and young fish were not surviving in sufficie numbers to replace adult mortality."



Juvenile Humpback Chub
Photograph by Randy Babb,
Arizona Game and Fish Department

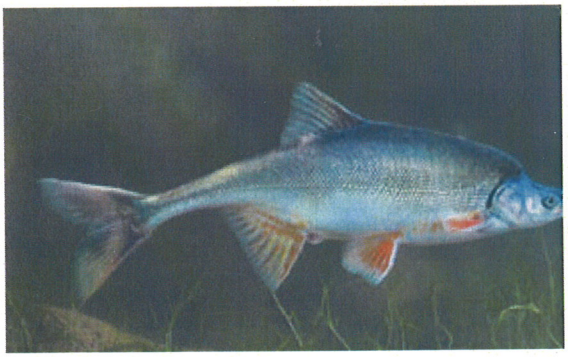
Catch-rate data also indicate an increased abundance of juvenile humpb chub between 2003 and 2005 near the confluence of the Colorado and L Colorado Rivers, where spawning is known to occur. Increases in juvenil fish during the same period were also apparent for other native species found near the confluence, including bluehead sucker (*Catostomus discobolus*), flannelmouth sucker (*Catostomus latipinnis*), and speckled dace (*Rhinichthys osculus*).

Catch rates for young-of-year humpback chub were higher in 2005 than previous years in middle and lower Marble Canyon. Higher than average catch rates at these locations were unexpected because they are up to 2 river miles above the confluence of the Colorado and Little Colorado Riv where spawning was thought to be confined. These findings suggest that more favorable conditions for spawning and incubation existed in the Colorado River main channel during 2005.

The primary factors thought to be contributing to the findings are as follows:

- Humpback chub may have benefited from the experimental removal of large numbers of rainbow trout (*Oncorhynchus mykiss*) and brown trout (*Salmo trutta*) from the area near the confluence of the Colorado and Little Colorado Rivers. Raint and brown trout are thought to compete with humpback chub for food and prey on young fish. Since 2003, the rainbow trou population in the Colorado River near the Little Colorado River has been reduced by more than 60%. The removal effort wi continue through 2006.
- Native fishes, including humpback chub, are thought to have benefited from drought-induced warming beginning in 2003 a continuing through 2005. Until recently, water temperatures in the main channel of the Colorado River have been too cold f humpback chub to successfully reproduce except near the Little Colorado River. As the level of the Lake Powell has dropp warmer water found closer to the surface of the reservoir has reached the release structures. In 2005, water temperatures the mainstem Colorado River near the Little Colorado River exceeded 17°C (60.8°F), the warmest temperatures recorded i this section of the river since the reservoir filled in 1980 and approximately the minimum temperature needed by humpbac chub to successfully reproduce.
- Humpback chub hatched in 1999 may 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, peak water temperatures in lower sections of Grand Canyon exceeded 20°C (68.5°F) in the summer of 2000, compared with typ peak temperatures of 15-18°C (59-64°F).

The humpback chub was federally listed as endangered on March 11, 1967. The likely factors contributing to the decline of the species in Grand Canyon include changes in flow and reduced water temperature resulting from the regulation of the Colorado River by Glen Canyon Dam, the weakening of young fish by the nonnative Asian tapeworm (*Bothriocephalus acheilognathi*), and competition with and predation by nonnative fish species.



Humpback Chub
Photograph by George Andrejko
Arizona Game and Fish Department

Specific recovery goals for humpback chub in Grand Canyon are currently being established by the U.S. Fish and Wildlife Service, which has jurisdiction over the humpback chub as a federally endangered species.

The USGS Southwest Biological Science Center's Grand Canyon Monitoring and Research Center (GCMRC) is responsible for the synthesis and analysis of fish data collected by a number of cooperating entities, including U.S. Fish and Wildlife Service and Arizona Game and Fish Department. These activities are undertaken as part of the Glen Canyon Dam Adaptive Management Program, which is administered by the U.S. Department of the Interior.

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For more information, download the USGS fact sheet *Grand Canyon Humpback Chub Population Stabilizing* and images of humpback chub at www.gcmrc.gov/research/humpback_chub/20060802.htm.

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