

Facts About Invasive Bighead and Silver Carps

The U.S. Geological Survey (USGS) scientists at the Columbia Environmental Research Center (CERC), Columbia, Missouri, carry out basic and applied research on the ecology of invasive fishes in the Missouri and Mississippi river basins. Emphasis is placed on improving understanding of the life cycles of bighead and silver carp to provide information needed to manage these aggressively invasive species. USGS scientists collaborate with Federal and State management agencies and universities, nationally and internationally, to fill critical science information gaps.

Background and Problem

- Bighead and silver carp, together the “bigheaded carps”, are native to China. In North America, the term “Asian carps” is used to refer to the bigheaded carps together with the also-invasive grass carp and black carp, or sometimes to the bigheaded carps alone.
- Bigheaded carps were imported in the 1970s for aquaculture and use in sewage treatment. They escaped from captivity, and by the late 1990s had become extremely abundant in parts of the Mississippi River drainage. In the United States, they are an undesirable pest species, and there is evidence of competition with native fishes.
- Bigheaded carps can approach 100 pounds, but such sizes are rare. Silver carp commonly weigh up to 20 pounds, and bighead carp commonly weigh up to 40 pounds (fig. 1).
- Bigheaded carps eat plankton and have been shown to have dramatic effects on the amount and kinds of plankton. Most native fishes eat animal plankton during part of their life cycle, and some rely directly on plankton throughout their life.
- Bigheaded carp populations have increased exponentially in the Mississippi River Basin and pose a threat to native species because of their efficient plankton feeding ability and high fecundity. Their range in the United States now extends from Louisiana to Minnesota on the Mississippi River, to South



Figure 1. A U.S. Geological Survey biologist holds a bighead carp caught in the Missouri River.

Dakota on the Missouri River, to Ohio on the Ohio River, and throughout the Illinois River Basin.

- Silver carp jump from the water when frightened. Because moving boats frighten the carp (fig. 2), silver carp often jump into boats, sometimes injuring boaters or damaging equipment. Sometimes schools of silver carp will jump simultaneously. Unlike the silver carp, the bighead carp does not jump in response to boat traffic.



Figure 2. Silver carp jump behind a U.S. Geological Survey research boat. Note the protective nets on the boat.

- Bigheaded carps are poised to invade the Great Lakes, and there is great concern about their effects on the Great Lakes’ ecology and economy. It remains unknown if they will achieve large populations or have substantial undesirable effects there, but because of the value of the Great Lakes’ fisheries, the carp are thought to pose a substantial risk.
- In 2007, a stakeholder group led by the U.S. Fish and Wildlife Service completed the Management and Control Plan for Bighead, Black, Grass, and Silver Carps in the United States. The Plan outlines strategies for controlling these species, including basic life history research. In 2010, in response to the threat of Asian carp invasion of the Great Lakes, an Asian Carp Workgroup was formed and a “Framework” for preventing establishment of bighead and silver carp in the Great Lakes was assembled. USGS research supports specific goals of the Plan and the Framework.

Findings of U.S. Geological Survey Research on Bighead and Silver Carp

Behavior

- Adult bigheaded carps in the Missouri River and its tributaries select habitats with low water velocity and depths more than 2 meters.
- Bigheaded carps are active in cold water; activity increased and feeding began when the water temperature rose above 2–4 °C (36–39 °F).

- Both species were observed making long upstream migrations during river rises, known spawning cues for bigheaded carps.
- In China, bigheaded carps spawn in late June and early July, and spawn all their eggs over a short period. In the Missouri River, both species spawned throughout the warm months, often spawning only a part of their eggs at a time.

Spawning Locations and Egg and Larvae Development

- Bigheaded carps spawned heavily in many locations on the Lower Missouri River (fig. 3). In their native range, bigheaded carps spawned in only a few locations.
- Bigheaded carps did not spawn in the six Missouri River tributaries examined.

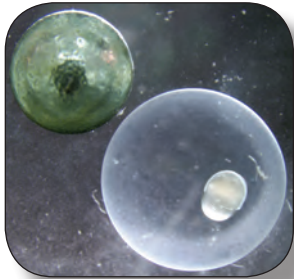


Figure 3. Mid-gastrula stage bighead carp egg, with a 4.35-millimeter BB for comparison. The embryo within the egg is very small compared to the size of the egg because of water absorbed after spawning. Taking on water increases egg size and decreases overall density, which aids the egg in remaining adrift.

- Bigheaded carps lay their eggs in flowing water, and their eggs and larvae drift in the current. A river long and fast enough to carry the young until they begin swimming is considered a requisite for reproduction. USGS research determined that bigheaded carps began to move to low velocity tributaries as soon as they began swimming. Development to this stage takes more than 100 hours. This information can be used to evaluate the adequacy of a river as spawning habitat.

Genetics

- Bighead and silver carp have shown limited but detectable genetic change since their introduction to North America.
- Bighead and silver carp often hybridize in the wild; the hybrids are fertile and often backcross.

Diet and Effects on Food Resources

- Bigheaded carps are considered plankton feeders, but gut analysis revealed that bigheaded carps in the Missouri River primarily ate detritus, which may indicate an ability to survive in a variety of environments.
- Bighead carp show selective feeding preference for blue-green algae when abundant.
- Bighead carp have been shown to outcompete native paddlefish in experimental pond studies possibly because of dietary overlap.

Pheromone Attractants and Repellents

- Bigheaded carps avoid alarm pheromones that are released when the skin of a similar species is injured, as during a predatory attack. Skin extracts may be useful as a repellent to protect habitats of other species at critical periods in their lifecycle.

- Bigheaded carps exhibit strong schooling behaviors. Chemical cues released into the water may serve as an attractant drawing individuals to the school. In laboratory studies, bighead carp show substantial preference for the chemical cues of the school. Such a stimulus may be useful as a lure to capture bigheaded carps in the wild.

Upcoming Research at Columbia Environmental Research Center will Examine:

- Innovative control methods such as pheromone attractants and natural repellents.
- Predation by bighead carp on the larvae of native fishes.
- Relations between bigheaded carps and toxin-producing cyanobacteria (blue-green algae).
- Adequacy of Great Lakes tributaries for spawning habitat of bigheaded carps.
- Use of non-planktonic food sources of the Great Lakes (such as attached algae and zebra mussel pseudofeces) as food sources by bigheaded carps.

Selected References

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