

# When Fish Grow Like Weeds: Options and Strategies for Managing Impacts of Invasive Asian Carp in Tennessee

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# When Fish Grow Like Weeds: Options and Strategies for Managing Impacts of Invasive Asian Carp in Tennessee

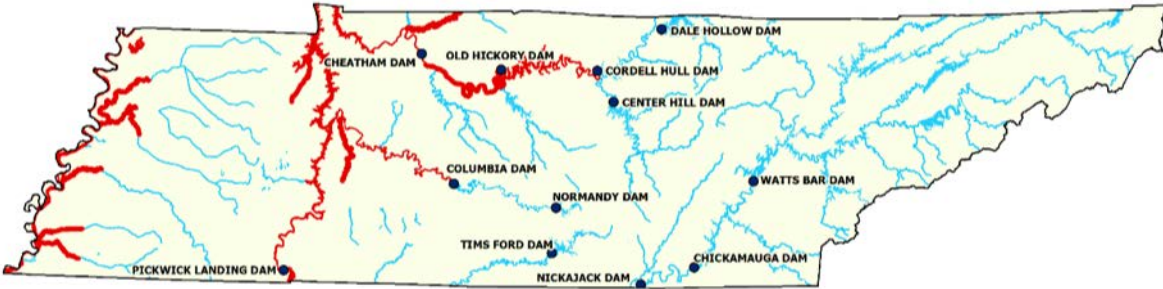
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Ever since they escaped Arkansas aquatic farms in the 1970's, Asian carp have created headaches for policymakers and boaters alike. Several species of fish are collectively known in the United States as Asian carp. Common carp resemble bloated goldfish and range from a couple of pounds to 40lbs. These bottom-feeders are what most Americans recognize as "carp". Common carp were introduced in the early 1800s as a food-fish but are now rarely eaten in the United States. Grass carp, bighead carp, and silver carp were originally introduced to the United States in the 1960s and 1970s to control invasive vegetation and algae in agricultural ponds and municipal wastewater treatment facilities. Thanks to an explosive growth rate and voracious appetites, these fish can disrupt native fisheries, ecosystems, and local economies dependent on fisheries. In this policy brief, we focus on the introduction, dispersal, and management of Asian carp with a special focus on the economic strategies currently being attempted in the United States.

## Background:

While states have been on-guard for the impending invasion of the Great Lakes (and thus disrupting the lucrative salmon fishery) for some time, Asian carp have only recently been found in Tennessee. These fish migrated into Tennessee waters from the Mississippi River via locks at Kentucky and Barkley dams. Currently, Asian carp reside in those Tennessee rivers directly emptying into the Mississippi as well as the Tennessee and Cumberland rivers (Tennessee Wildlife Resources Association, s. d.). A map of the current known distribution of Asian carp in Tennessee is presented in Figure 1. While adult bighead and silver carp have been reported near Niackajack Dam, Chickamauga Dam, and Watts Barr Dam, there is no evidence of reproduction in these areas.



**Figure 1. Known distribution of Asian carp in Tennessee.** *Source: Tennessee Wildlife Resources Agency*

When nonnative carp invade local waterways, two major impacts are noticed -ecosystem disruption and physical interaction. Carp disrupt the ecosystem they invade by devouring food that feed other fish and animals. Two species of Asian carp (bighead and silver) feed specifically on phytoplankton which ecologists frame as the foundation of an aquatic ecosystem, supporting all other forms of animal life. Since they can outcompete other plankton feeders (baitfish, paddlefish, others). This can send ripples up the food chain and detrimentally impact predators of these species. By robbing part of the base of the food chain, carp will likely impact popular and lucrative fisheries within Tennessee. Species such as catfish prey on species of shad that feed on plankton. Sportfish such as largemouth and smallmouth bass forage on plankton-dependent species as well. As many local lakes/rivers have thriving economies built on sportfishing, an advancing carp invasion will impact fishing-tourism.

However, impacts from Asian carp will extend beyond sportfishing. One species in particular, silver carp, have a unique impact on boaters. When startled by a boat engine or propeller, silver carp leap over 8 feet into the air (Tennessee Wildlife Resources Association, s. d.). Since an average silver carp weighs 20lbs (a maximum of 60lbs), this unique characteristic of silver carp creates a dangerous situation for those recreating on the state’s rivers, lakes and reservoirs. There are numerous reports of serious injuries stemming from leaping carp striking boaters and jet-skiers in the head or neck. In fact, the United State Geological Survey (USGS) terms waterskiing in the Missouri River “exceedingly dangerous” due to carp populations (United States Geological Survey, s. d.).

## What can be done?

A well-designed strategy in response to the Asian carp invasion in Tennessee is like a three-legged stool. The first leg of the stool is prevention - preventing carp populations from establishing in new areas of Tennessee. Tennessee has followed other states’ by banning the transport of baitfishes across lakes and rivers to prevent accidental introductions (Tennessee Wildlife Resources Association, s. d.). However, this approach is stymied by the fact that carp look very similar to native fish (gizzard shad and others) when they are young. This year, the USGS has also attempted to limit the spread of carp from Kentucky to Tennessee via Barkley Dam by using experimental auditory technology to create auditory barriers to prevent carp from migrating through locks and channels. Illinois has also used “bubble” barriers and electric barriers to prevent silver and bighead carp from spreading into the Great Lakes. While lab research on the efficacy of these barriers has

yielded promising results, the true efficacy of underwater sound barriers for deterring carp remains to be seen.

The second leg of the stool is control – limit or stop the spread or growth of Asian carp in areas of Tennessee where they have already established. There is an ongoing debate among researchers and resource managers about how much effort should be devoted to prevention and control (Finnoff et al. 2007). Devoting efforts to prevention does increase the *likelihood* that certain bodies of water will remain free of carp. But the benefits of carp prevention efforts are unknown - there is the possibility that scarce resources could be devoted to preventing the establishment of carp only to have them establish anyway. On the other hand, decision makers know what they will get with control efforts but control does not achieve carp-free water bodies. Also, silver carp already poppulate mos the Mississippi River drainage. Thus, the preferred strategy for combatig Asian carp in Tennessee will involve a mix of prevention and control efforts.

The third leg of the stool is surveillance – investments to learn where carp currently are and where they are not. Knowing where carp are established in the state is critical for ensuring that scarce resources devoted to managing the Asian carp are not wasted (Sims et Finnoff 2016). Preventing invasion in a reservoir where carp have already established is a waste of resources. Likewise, investing in the control activities outlined above in areas where carp have not yet established is wasteful at best and could lead to intentional introductions of carp as individuals attempt to take advantage of the economic incentives.

There are various strategies to prevent and control the spread of Asian carp that may be viable options for the state of Tennessee. As mentioned previously, auditory or “bubble” barriers can be introduced to create a pseudo-fence to prevent the further encroachment of carp to other waterways. However, physical barriers are not a silver bullet strategy for carp management. The efficacy of physical barriers is still being tested. The efficacy of these physical barriers can also be undermined by unintentional introductions beyond the barrier through bait buckets. Physical barriers are also very costly and are not practical in every water body in the state. As for actual removal: the most simplistic is using nets to remove carp. In Utah Lake near Provo Utah, large scale carp netting programs have been implemented but the fish often end up in local landfills. This is economically problematic since the local government is paying \$700,000 annually for fishing with no consumptive use (Nuñez 2015).

Additionally, carp populations can be combatted along the biological dimension- specifically via reproduction, predators, and sickness. To alter the reproductive dynamics of carp, most strategies boil down to thwarting typical genetics. For instance, to control sea lamprey populations and some insects, biologists introduce sterile male individuals to lower the reproductive success of those populations (Roberts et al. 1997). The same strategy for carp might be too onerous to accomplish, yet might open other opportunities. For example, by duplicating a sterile carp’s genetic chromosomes, future generations of carp can be rendered sterile (Conover, Simmonds et Whalen 2007). This is essentially “stunting” the population, rather than the individual. Furthermore, promising advances in “gene drive” technology could be used to create genes that render a 2<sup>nd</sup> or 3<sup>rd</sup> generations sterile (Conover, Simmonds et Whalen 2007). Altering reproductive processes in carp populations are a promising strategy but are not without scope and risk concerns. Permanently

altering the genetic pool may yield unanticipated and irreversible effects on Tennessee's aquatic ecosystems including sport fisheries.

Policymakers could also leverage the biological interaction of predators to carp. More aggressive species, such as alligator gar, could be introduced as a form of biocontrol to exert downward pressure on carp populations. However, introducing species as a form of biocontrol has a history of backfiring. Hawaiian mongoose was introduced to control invasive snakes but preferred native birds. In fact, Asian carp were originally introduced to control algae in farm ponds.

Additionally, known carp viruses and diseases could be leveraged for biological control. These could be imported from endemic populations and genetically manipulated before introduction to increase efficacy (Conover, Simmonds et Whalen 2007). Again, while the logic behind this proposition is strong, the uncertain consequences such as disease transmission to other species, disease resistance from carp, or the possibility of re-transmission to populations of native carp, make this strategy risky.

## **A Carp-to-Table Movement: Getting Control of a Tasty Pest**

Asian carp differs from most invasive species in one important way – people can eat them. Grass carp, bighead carp, and silver carp are surface feeding vegetarians with mixed table quality unlike the bottom-feeding common carp. In particular, silver carp is a prized food fish in its native range, with a white clean meat. Interestingly, these fish are actually becoming *rarer* in their native range, while they are becoming a growing nuisance in their invaded ranges (*Courier Journal* 2015).

Unlike most invasive species that have no marketable value (for example kudzu), market forces create an incentive for individuals to catch carp leading to a market-based form of Asian carp control. Policymakers have turned to creative economic solutions to managing carp populations ranging from attempts to internationally exporting carp products to areas where demand is high, to attempting to stoke local consumptive demand for a fish that has a negative table reputation in the United States. The basic idea - covered in more detail below - is to use smaller governmental inputs to create a sustainable system that will self-manage carp populations by bringing it from a pest to a harvestable commodity.

The current price for carp in the United States is too low to expect market forces to create an adequate incentive to control the Asian carp invasion on their own. However, enhancing the existing market for Asian carp is currently the most practical method to reduce Asian carp in Tennessee. Tennessee Wildlife Resources Agency (TWRA) is currently developing plans to provide incentives to commercial fishers and wholesale fish dealers. In May of 2018, the Tennessee Fish and Wildlife Commission approved a \$500,000 budget request to provide incentives for the commercial harvest of Asian carp in Kentucky Lake (Tennessee Wildlife Resources Association, s. d.). To encourage commercial harvest of Asian carp, economic incentives can be created to increase the supply or demand for Asian carp for consumption.

One way to increase the supply of Asian carp is a bounty program whereby individuals are paid to catch carp. Unlike other existing bounty programs for invasive species like the Burmese python, silver carp's market value means individuals only need to be paid a relatively small amount to push fishermen to harvest carp. Currently, Kentucky has implemented a 15-cent per pound

incentive for carp harvests (*Courier Journal* 2015). It remains to be seen if this bounty is high enough to raise harvest levels and temper current carp populations and growth.

Another strategy to increase supply currently being tested is the subsidization of silver carp processing facilities. Since carp are a bonier fish than other domestic species, the processing requirements are higher (Garvey 2015). By subsidizing the plants that convert carp into fillets, the local and state governments can achieve a varied set of policy goals. Lowering processing costs can equip the manufacturer of carp fillets or carp sections to engage the original market for carp - China. For instance, Two Rivers Fisheries is a small carp exporter that exported 264,000 tons of Missouri and Kentucky carp products *back* to China in 2015 (*Courier Journal* 2015). This strategy could be a model for managing current carp populations by creating the apparatus to consistently harvest and export carp back to China.

Some policies have taken aim at increasing the demand for Asian carp among consumers. Termed here as “rebranding,” the idea is to convince domestic consumers that the invasive species tastes good, *or* that eating the invasive species is a good thing for the environment. This stokes demand so that consumers actively seek out these nuisance fish when they make seafood purchases. The first rebranding strategy takes the unpalatable verbal connotation of “carp” (read as a bottom-feeding fish not suitable for eating) and changes the moniker to a more consumer-friendly name. This is not out of context for fisheries marketing. For instance, the fish that routinely fetches one of the highest prices on the global market, “Chilean Seabass” is not a seabass at all. Instead, marketers recognized the fish’s harsh name from ichthyology- Patagonian Toothfish - was unpalatable to consumers, and thus renamed it to a trustable and appealing “seabass” for the common market. Currently, this strategy is being attempted in local markets to encourage consumers to try the fish. For instance, silver carp in Kentucky has been renamed “Kentucky Blue snapper,” again appealing to consumers’ perception that snapper means a fine eating fish. Alternatively, policymakers can attempt to appeal to consumers’ altruistic tendencies by packaging fish products with statements that affirm the consumption of carp as an ecosystem-friendly choice. This can be magnified to a larger level, as public campaigns to encourage consumption as an altruistic act is being tried in Gulf states and Caribbean countries for a similar invasive fish (“Save the reef, eat a lionfish”).

The upside of market-based approaches to controlling Asian carp are the additional jobs and incomes created around the new carp fishery. However, market-based approaches are not without cause for concern. At some point, fishermen might introduce *more* carp to ensure consistent harvests in the future. Fundamentally, market-based approaches would not be an eradication plan (pushing carp populations to extinction) since creating an industry, infrastructure, and employment around a resource in hope that the resource might be exterminated seems imprudent.

## **Conclusion:**

Currently, local and state governments are reacting to the invasion of Asian carp into local waterways. In addition to disrupting local fisheries and ecosystems, carp present a unique danger to recreational users as they become airborne when startled, striking and injuring boaters. For the populations established in a river/lake system, policy makers across the country are attempting several economic policies to attempt to eradicate or control carp populations. First, fishermen can be paid a per-pound bounty to harvest more carp. A bounty that is too low will not create the proper incentives for harvesting and bounty that is too high might incentivize re-introduction. Secondly, governments have subsidized the processing facilities necessary for carp to re-enter the export

market. The goal is to boost shipments to areas where demand is highest (China, where the species is currently near-threatened) by reducing the cost to get the carp from lake to plate. Again, this strategy might work for managing the population, but it seems unlikely to create conditions where eradication is likely, especially after governments have invested in creating new industries around this resource. Lastly, governments can attempt to change consumers mind about eating carp by either making the idea more palatable or by making it a semi-altruistic act (akin to eco-friendly labeling). The right choice depends on the goals of decision makers, the biology and population dynamics of Asian carp, and markets for Asian carp.

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