FEATURE

Introducing Copi as a Positive Path Toward Combatting Invasive Carps in North America

James E. Garvey | Center for Fisheries, Aquaculture, and Aquatic Sciences, School of Biological Sciences, Southern Illinois University, Carbondale, IL 62901.
E-mail: jgarvey@siu.edu

Kevin S. Irons | Illinois Department of Natural Resources, Springfield, IL

Gina Behnfeldt | Tetra Tech, Langhorne, PA

Karolina A. Kwasek | Center for Fisheries, Aquaculture, and Aquatic Sciences, School of Biological Sciences, Southern Illinois University, Carbondale, IL

A Copi po-boy sandwich prepared by Chef Brian Jupiter of Chicago. Photo Credit: Alex Garcia.

DOI: 10.1002/fsh.11088

A group of loosely related, large-bodied fishes collectively called carps have had a complex relationship with North Americans. Despite lessons learned about invasive Common Carp *Cyprinus carpio* in the early 1900s, Bighead Carp *Hypophthalmichthys nobilis*, Black Carp *Mylopharyngodon piceus*, Grass Carp *Ctenopharyngodon idella*, and Silver Carp *H. molitrix* were introduced to the United States more than 50 years ago and are expanding throughout the Mississippi River basin. Increased economic value in the North American seafood market could aid management. Complete eradication through harvest is unlikely, but controlling densities and containing dispersal may be possible. Improving perceptions of nutrition, palatability, and safety of wild-caught carps should increase consumer demand. A branding and marketing effort launched in June 2022 renamed the foodstuff produced from the four species as the trademarked brand Copi. The "Choose Copi: Eat Well. Do Good." campaign allows consumers to know that these fishes are an environmentally sound and responsible alternative to other seafood choices. The Copi brand has gained interest nationwide, with food processors and distributors engaged, although the contribution of Copi to harvest removal from rivers and resulting population dynamics is yet to be quantified. Developing a regional fishing industry for Copi, while also aiding fisheries and aquaculture for native species, remains an economic and logistical challenge within the vast river network.

INTRODUCTION

> Carp: (1) Verb. To complain about unimportant matters, perhaps from the old Nordic word *karp*, to boast; (2) Noun. Four species of cyprinid fishes from East Asia. From *karpfen* (German) and/or *karp* (Polish).

Emily Dickinson's poem, "Fame is a Fickle Food" could have been written for the loosely related group of fishes known collectively as carps (Cypriniformes). In much of the world, carps bask in fame, but in North America, where they are invasive, this group's name is now infamous. Perhaps counterintuitively, the potentially negative moniker "carp" may hinder attempts to curb the spread of these nonnative species. We briefly explore the ongoing love–hate relationship that many North Americans have with carps and suggest that a publicity makeover is needed to help combat this group of fish invaders in North American rivers and lakes.

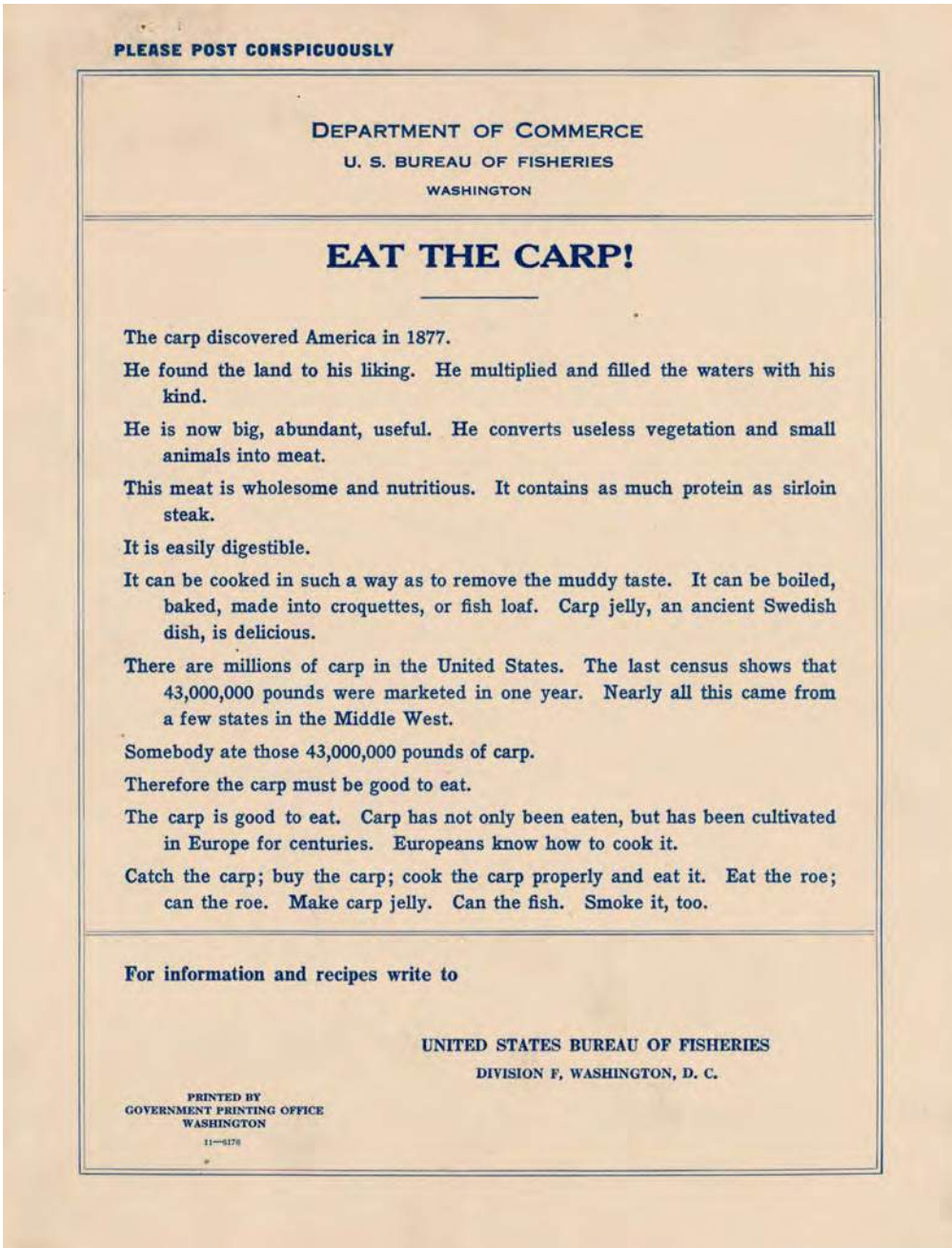
THE FIRST CARP WAVE

It all started with love. European and Asian carp-like species in the suborder Cyprinoidei were introduced into North America because of their popularity and perceived promise. Goldfish *Carassius auratus* and their cousin, the ornamental koi, a variant of Common Carp *Cyprinus carpio*, were established in the wild as escaped curiosities and pets as early as the 1600s (Courtenay and Stauffer 1990). And despite Goldfish and koi being invasive in the wild today, they are still considered lucrative pets and ornamentals as part of a global industry now worth billions of U.S. dollars (Biondo and Burki 2020). As the European human population grew in North America in the 18th and 19th centuries, an apparent bias toward food fish from the home continent over the wealth of native fishes within the new frontier led landowners and the government to choose nonornamental Common Carp as a "superior" food fish species. This species was brought to the United States from Europe, cultured domestically, and then widely spread throughout the USA by the government to seed waterways (Kolar et al. 2010; Figure 1). *The U.S. Fisheries Commission Bulletin* in the late 1800s was peppered with commentary such as this:

> The carp is the best fish I know of for workingmen and mechanics, who rarely lack an appetite, and who will always consider the fish good when they can get it. My personal opinion is that it is a very superior fish, and I will even go so far as to say that I prefer it to trout.
>
> (Edward Thompson 1883)

How many of these effusive remarks were handpicked to bolster support of federal Common Carp stocking policy is left to history.

Although the enthusiasm by many North Americans for ornamentals in garden ponds and home aquariums continues to this day, Common Carp's fame in North America declined by the middle 1900s, as they became a maligned poster child for the widespread decline of water quality and native fishes in the continent. By 1955, Common Carp were clearly lumped by fisheries managers with other "rough fishes" (i.e., fishes without apparent commercial or recreational value), and a lack of a market for them, despite their high abundance, was clearly a problem (Premetz 1956; Klein et al. 2018). Part of this was due to a global glut of marine seafood as ships overseas were reconfigured into fishing vessels after World War II. Also, tastes of American consumers were changing from whole fish caught locally to processed, heavily marketed foods, such as frozen fish sticks. Federal aid in sport fish funding, beginning in 1950, shifted the focus of many fisheries agencies from sustenance to recreation. Common Carp became firmly ensconced as an overabundant nuisance rather than a resource to be fished. Further damaging Common Carp's reputation was the observation that poor water quality often co-occurs with them, as they browse on benthic macroinvertebrates, uproot vegetation, increase turbidity, and elevate nutrients (Fischer et al. 2013; Simonson et al. 2023). Because the impact of Common Carp worsens when their densities are high (Chumchal et al. 2005), lack of density control by harvest likely exacerbated water quality to the dismay of managers trying to enhance sport fish populations. Another problem was the growing perception of poor flavor and texture of Common Carp. Declining water quality, high contaminants, and increased algal production throughout North America likely played a role. A common belief that has held since the 1800s is that polluted, unclear water produces poor quality Common Carp (Smiley 1883). Science supports this old observation. A primary factor affecting off-taste in Common Carp is geosmin, which is a compound that is produced by algae and soil microbes in nutrient-rich waters (Varble and Secchi 2013; Varga et al. 2015) and, incidentally, also responsible for the smell of fresh rain. Common Carp, like many popular recreational and commercial freshwater and marine fishes, often have high contaminant burdens and are included in many fish consumption advisories (Cleary et al. 2021), which may give consumers pause. Whether the poor sentiment about modern Common Carp relative to its 19th century predecessors and other popular species is truly deserved is unknown. It is interesting to note that Common Carp has remained a



PLEASE POST CONSPICUOUSLY

DEPARTMENT OF COMMERCE
U. S. BUREAU OF FISHERIES
WASHINGTON

EAT THE CARP!

The carp discovered America in 1877.

He found the land to his liking. He multiplied and filled the waters with his kind.

He is now big, abundant, useful. He converts useless vegetation and small animals into meat.

This meat is wholesome and nutritious. It contains as much protein as sirloin steak.

It is easily digestible.

It can be cooked in such a way as to remove the muddy taste. It can be boiled, baked, made into croquettes, or fish loaf. Carp jelly, an ancient Swedish dish, is delicious.

There are millions of carp in the United States. The last census shows that 43,000,000 pounds were marketed in one year. Nearly all this came from a few states in the Middle West.

Somebody ate those 43,000,000 pounds of carp.

Therefore the carp must be good to eat.

The carp is good to eat. Carp has not only been eaten, but has been cultivated in Europe for centuries. Europeans know how to cook it.

Catch the carp; buy the carp; cook the carp properly and eat it. Eat the roe; can the roe. Make carp jelly. Can the fish. Smoke it, too.

For information and recipes write to

UNITED STATES BUREAU OF FISHERIES
DIVISION F, WASHINGTON, D. C.

PRINTED BY
GOVERNMENT PRINTING OFFICE
WASHINGTON
11—6178

Figure 1. Announcement circulated by the U.S. Bureau of Fisheries in the late 1800s to promote the harvest of Common Carp.

valued wild-caught recreationally fished food source in Europe (Wedekind et al. 2001), despite similar water quality issues. And Common Carp comprise about 8–9% of all aquacultured fish globally (https://bit.ly/4acVLsh). Perhaps the concept of Common Carp as a resource may be more repugnant to North Americans than the reality.

THE SECOND CARP WAVE

Despite the harsh lessons learned about Common Carp in North America, four additional "carp-like" cyprinoid species, Grass Carp *Ctenopharyngodon idella*, Black Carp *Mylopharyngodon piceus*, Bighead Carp *Hypophthalmichthys nobilis*, and Silver Carp *H. molitrix*, were brought from aquaculture facilities overseas into the United States between 1960 and 1980. Although this may seem ill founded in hindsight, managers likely were not considering these fishes as synonymous with Common Carp and were apparently unconcerned about the negative connotations of the carp name when these new fishes were imported. In fact, whether these fishes should be called carps continues to be debatable and of cultural significance. The Chinese clearly differentiate these species from Common Carp in quality, esteem, and utility, calling them the "four famous cultivated fishes," with no reference to the name carp (Kocovsky et al. 2018). Rather than worrying over the common names, the managers of the 1970s were interested in using these potentially miraculous fishes to solve some pressing, pernicious problems of the day (Kelly et al. 2011).

Tapping the complementary trophic roles of these four famous fishes to sequester waste nutrients and produce cheap, healthy food in aquaculture appeared to be a winning combination with no downsides (Kelly et al. 2011). The idea of using these famous fishes for environmental and human benefit was by no means original or unfounded, because these four fishes had been used successfully in Chinese pond polyculture for centuries. Herbivorous Grass Carp effectively remove nuisance aquatic vegetation, and their sterile, polypoid kin are still widely used for management of nuisance weeds in many states (Schad and Dick 2018). As molluscivores, Black Carp were known to reduce snails that serve as hosts for farmed fish parasites (Kelly 2011). Two filter-feeding, planktivorous species, Bighead Carp and Silver Carp (collectively called bigheaded carp) were considered as nontoxic ways to reduce problematic algal blooms in burgeoning wastewater treatment plants following passage of sweeping clean water legislation in the 1970s. The need for such biological control was called out in *Silent Spring* by Rachel Carson, identifying the ecological tragedy caused by chemicals used to control pest organisms. Also, during this time, concerns about feeding a rapidly growing human population throughout the world was real and aquacultured carps were a solution. The fisheries managers were right. Outside of North America, the famous fishes currently are the most aquacultured inland fishes (https://bit.ly/3VeYaP7). Although we now know that the risks of successful introduction and spread were high, the field of invasion ecology was new, after being coined by Charles Elton only a decade earlier (Elton 1958). Recent, notable invasions of fishes like the Sea Lamprey *Petromyzon marinus* and Alewife *Alosa pseudoharengus* were the result of populations of wild fish moving into new areas due to the removal of geographical barriers via canals or from intentional, sustained, and widespread introductions, like Common Carp in the past. The thought of a few escaped fish taking hold and spreading without human action was apparently not a strong concern during this time of environmental crisis.

RISING CONCERN ABOUT CARPS

Despite the optimism about the use of these famous fishes in North America, things clearly went wrong. Diploid Grass Carp were spread widely for vegetation control and are now widely established in the lower United States (Figure 2). Although the other three species were not intentionally released into the wild, they escaped from aquaculture ponds into the Mississippi River drainage not long after their importation. Bigheaded carp definitively established reproduction by the early 1990s (Burr et al. 1996) and are now spreading widely in the first quarter of the 2000s (Figure 2). Black Carp populations are also now reproducing in the Mississippi River basin (Whitledge et al. 2022) and threatening native mussels, and Grass Carp are feared to be establishing in the Great Lakes (Embke et al. 2016).

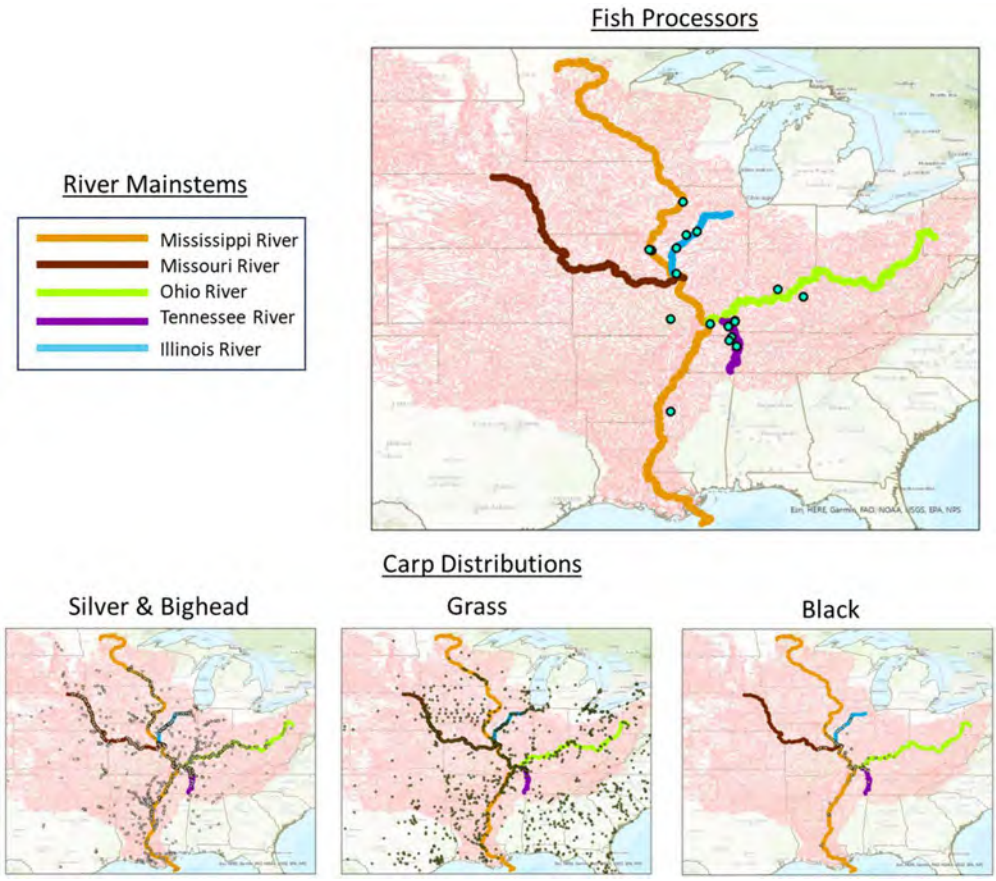


Figure 2. Distribution of fish processors (blue symbols) for Copi and invasive famous carps (source: U.S. Geological Survey, Nonindigenous Aquatic Species database [https://bit.ly/3wVXdkF] within the Mississippi River watershed. Most harvest is focused within the main-stem rivers, but these fishes are found throughout the watershed within its extensive, wide-ranging network of streams (pink lines).

The rise of these four famous fishes in the wild became particularly concerning by the early 2000s, when bigheaded carps lurched toward the Great Lakes via the Illinois River waterway, which is directly connected to Lake Michigan by the Chicago Area Waterway System (Chick and Pegg 2001). Their ability to negatively affect plankton was reminiscent of the Alewife invasion in Lake Michigan. The fact that Silver Carp were jumping out the water in spectacular displays and dying off in masses, sometimes at city waterfronts, also captured the attention of the public and policymakers, who did not want to see a repeat of the highly visible and unseemly Alewife die-offs in the Great Lakes that occurred decades before.

After the Illinois River invasion in the early 2000s, this group of four quasi-related famous fish species was categorized by scientists, managers, and the media as "Asian carps," with the name being codified within a comprehensive management plan published by the multiple-stakeholder Asian Carp Working Group in 2007 (Conover et al. 2007). As the report noted, the scope of this invasion was vast and expanding, with the current Mississippi River waterway comprising nearly two-thirds of the United States (Figure 2) and some of these carp populations reaching very high densities relative to native fishes. Silver Carp densities in the Illinois River are likely now the highest in the world (Sass et al. 2010). The further spread of these famous carp fishes into rivers of Canada, the eastern and western coastal rivers of the United States, and especially the Great Lakes, is a potent and sobering possibility (Cudmore and Mandrak 2011). Thanks to the media rightly reporting about the dangers of these aquatic nuisance species, Asian carps are now synonymous with other well-known, harmful, and apparently unpalatable invasive species like Sea Lamprey, Lionfish *Pterois* spp., and Common Carp. It is important to note that there are other nonnative and potentially nuisance species, such as Rainbow Trout *Oncorhynchus mykiss*, Lake Trout *Salvelinus namaycush*, Chinook Salmon *O. tshawytscha*, and Largemouth Bass *Micropterus nigricans* that also need to be controlled outside of their natural range, although their names are viewed positively by most consumers. Clearly, the relationships among naming, value, perceived threat by society, and control are complex and still not well understood, but likely play a role in the ability to fight current invasions and avoid future ones.

FIGHTING BACK AGAINST CARPS

Attempts to curb the invasion of famous fishes have grown substantially since the early 2000s with guidance from the 2007 U.S. National Plan (Conover et al. 2007). The passage of the Asian Carp Prevention and Control Act (ACPCA) in 2010 officially authorized the U.S. Fish and Wildlife Service to address the invasion (ACPCA 2010). Obviously, reducing the spread of these and other invasive species is best done through deterrence, such as prohibiting transport and applying selective fish barriers (Cupp et al. 2021), but when they are already present, they need to be controlled in other ways. Fish barriers are also costly, with a pending, long-term deterrent project for these fishes in the upper Illinois River estimated at greater than $US1 billion (Brandon Road Interbasin Project; https://bit.ly/4afDiLP). Piscicides work for some species. Lampricides effectively control larval Sea Lamprey isolated in tributary rivers of the Great Lakes (Sullivan et al. 2021). However, the only approved piscicide for carp control is rotenone, which is nonselective, must be broadly applied to adult populations, and viewed by the public with suspicion at best. Specialized entrapment gear deployed by fisheries agencies that is not approved for commercial harvest may be successful at reducing these fishes in local areas, although each famous fish species occupies specific habitats requiring a suite of techniques that are still being developed and evaluated (Collins et al. 2015; Butler et al. 2019). Also, the scope of the invasion is so broad that all resource agencies combined do not have the capacity to effectively remove enough carps to have an impact in the vast, dendritic Mississippi River network (Figure 2). To date, harvest by either contracted fishers or through incentive programs continues to be a widely applied method for controlling and perhaps reducing or more rarely eradicating populations of invasive fishes (Yick et al. 2021). For example, programs to physically remove Common Carp in the United States began in earnest by the mid-1900s and continue today with mixed success (Walsworth et al. 2020). Interestingly, early attempts to control Sea Lamprey in the 1950s included commercial harvest, given that lampreys are popular fare in other cultures. That did not gain traction (Bunch 2017), possibly due to similar perceptions that face carp harvest today. Even given the mixed record of success for other species, a similar harvesting approach as part of an integrated pest management plan was endorsed for the famous fishes by the national plan (Conover et al. 2007).

BEATING THEM BY EATING THEM

Harvesting the four famous fishes for control may result in complex outcomes. The best science available suggests that complete eradication in North America through harvest is unlikely due to the rapid growth rate, high fecundity, fast spread, and sheer geographic extent of the invasion in the complex river network of the Mississippi River basin (Tsehaye et al. 2013; Figure 2). Rather, the likely outcome of increased local harvest is some control through suppressed local densities and reduced impact to local native species. Individual bigheaded carps are in better condition at areas where intense fishing occurs (Coulter et al. 2018), which suggests compensation exists and may improve recruitment of survivors. Despite these mixed responses, the Spatially Explicit Invasive Carp Population (SEIcarP) model shows that fishing can contract established populations away from the edges of their range (Kallis et al. 2023), thus reducing the risk of spread into new ecosystems like the Great Lakes (Bouska et al. 2020). The SEIcarP model has been adopted to direct this containment harvest by commercial fishers on local carp populations that have the greatest impact on dispersal throughout the river network (Kallis et al. 2023). This management approach and others are being quantified at the scale of the entire Mississippi River basin using techniques, such as telemetry and hydroacoustics (Invasive Carp Coordinating Committee 2023). In the past decade, agency-funded removal of the bigheaded carp by fishers has occurred at the boundary between the Mississippi River basin and the Great Lakes in the upper Illinois River (Bouska et al. 2020), suppressing local populations and maintaining a successful defense of the Great Lakes (MacNamara et al. 2016). A recent incentive fishing program for famous fishes in the broader Mississippi River basin has helped remove more than 13,850 metric tons of these fishes since 2019. Such efforts are further being expanded across the Mississippi River basin, including in the Ohio River and its

tributaries, with the native fish community effects being evaluated by researchers (Figure 2). Bycatch of native fishes is a concern. However, this may not be a problem for the planktonic bigheaded carps that continue to be by far the densest of the four species. Bigheaded carps school in the open water of rivers where natives rarely occur. Also, the unique ways that these fishes are harvested using a combination of netting and sounds make bycatch a rarity (https://bit.ly/3vd7f08; Butler et al. 2019). Still, potential bycatch will require additional monitoring as fishing increases for these and the other two famous carp species.

Incentive removal programs are directed toward commercial fishers and processors. For harvest to grow and be a successful method of maintained and sustainable control and containment of the famous fishes, the public must want to consume them as food. To do this, North Americans must revisit the positive perceptions that brought these fishes to the continent in the first place. The most abundant species, bigheaded carps, are desirable because they are relatively low in contaminants, highly palatable, and feed on lower trophic levels (Garvey et al. 2012). These fish can accumulate contaminants (Levengood et al. 2013), but concentrations are insufficiently high to warrant concern by regulators. A consumption advisory that was in place in Tennessee due to concerns about contaminants in bigheaded carps was recently lifted after further analysis (TDEC 2023). Another perception issue among consumers is that bigheaded carps are difficult to eat because they contain large intramuscular bones. These bones can be removed in processing or navigated around when preparing and eating, with many instructional videos available for curious anglers (https://bit.ly/3PjvnoU). Unlike small pin bones in other fishes, these structures are large and likely no more a choking hazard than the bones in a bucket of fried chicken. Some concern also may arise among consumers, especially anglers, who are concerned about off tastes being akin to those perceived in Common Carp. This does not occur to the same extent for at least the bigheaded carps, because they consume plankton rather than benthic invertebrates (Varble and Secchi 2013). Regardless, domestic consumer demand remains low, suppressing value, with current prices at $0.09–0.30/pound. In comparison, whole, live, aquacultured Largemouth Bass in the region fetch up to $7.00/pound. Although there is interest in expanding exports of the famous fishes (especially the heads of Bighead Carp, which are highly valued in Chinese cuisine), there is insufficient volume of fish processed to offset costs of shipping and distribution overseas, especially because carps are already aquacultured widely and Asian consumers prefer live fish. There are many bright spots for the sale of these famous fishes in North America, with regional processors and local fish shops developing products, including minced fish and strips and a variety of value-added products, including cakes, sliders, tacos, burgers, nuggets, Bolognese sauce, empanadas, Rangoon, and a fajita mix. These, along with whole fish, take advantage of both domestic and export markets. There also continues to be a demand for live famous fishes in urban Asian markets in the United States and Canada. One drawback is that live transport of these species in North America is illegal via the ACPCA. That said, many processing production options exist for the market expanding from what has already been done at small scales. All components of the fish can be used as products leading to high economic value and low to zero waste, as is done for Icelandic Atlantic Cod *Gadus morhua* (Sigfusson 2020). Carps are sources of natural collagen, high-quality fish oil, protein, and other materials that can be developed into nutritional supplements and other consumables such as *surimi* (Yingchutrakul et al. 2022). The more value that is added to each fish will increase its profitability and provide incentives to enter the market.

Barriers to enhanced consumption and use of famous fish products in North America are many, including those that are real and those that are a matter of perception, which are perhaps tougher to surmount. One obstacle is the seemingly paradoxical approach of assigning value to a nuisance invasive species that is an environmental menace. Creating a financial incentive to remove the famous fishes also may create an economic dependence that protects them and facilitates their spread (Nunez et al. 2012; Pasko and Goldberg 2014). If harvest were to be successful at eradication, the United States has many native fishes that have supported large fisheries in the past, continue to support some tribal groups to this day, and can be sustainably harvested in carp's absence in the future (Garvey et al. 2010; Klein et al. 2018). Also, domestic aquaculture of native fishes is an untapped resource in much of the country (Engle and Van Senten 2022). Native freshwater production stands to grow with the huge strides that have been made in improving the water quality of inland waterways of the United States since the 1950s. Value-added industrial approaches developed by local processors for carps can be applied to native fishes, providing an economic reason to sustainably enhance native river populations, which is already done successfully for native sport fishes. No matter what economic benefit the invasive famous fishes create, federal and state laws prohibit their propagation and transport, so intentional stocking in the wild is unlikely (Kolar et al. 2010), especially if native fishes are protected. Fishers, processors, distributors, and consumers will need to be educated about the risks and penalties of moving famous fishes or interfering with monitoring and control efforts as enforced by the ACPCA and other legislation.

WHAT'S IN A NAME?

Perhaps the greatest impediment to developing an effective economic control machine in North America is the carp name itself. Confusion about what taxa are indeed invasive carps (e.g., all nonnative cyprinoids, large-bodied cyprinids, Common Carp, bigheaded carp, Asian carp, famous fishes) is clearly an issue for both consumers and fisheries professionals (Kocovsky et al. 2018). Even experts on taxonomy are debating about whether the famous fishes should be placed in a separate family (Xenocyprididae) than Common Carp (Cyprinidae). Surveys have shown that some consumers and anglers have few qualms about at least trying fishes called carp (Varble and Secchi 2013; Morgan and Ho 2018). It is important to consider whether the term carp is even part of the public consciousness. Concerns about the threat of Asian carp in the USA appear to be regional, with our analysis of Internet trends in Google Trends showing that searches for the term "Asian carp" most frequently occur in the Midwest, Kentucky, and Tennessee, presumably because this is the geographic epicenter of the invasion, and where the public is receiving a mixed message at best. Words used in the North American media to describe the carp invasion include infestation, overrun, aggressive, nuisance, invasive, voracious, and menace, which are not undeserved, but certainly not inviting the fishes to a dinner plate. Another perception problem is that the

collective descriptor, Asian carp, may be offensive to people of Asian descent (Kocovsky et al. 2018). This concern prompted the U.S. Asian Carp Regional Coordinating Committee to be renamed to the U.S. Invasive Carp Regional Coordinating Committee (https://invasivecarp.us). Asian consumers appear to view the apparent North American struggle with these fishes with some amusement and curiosity (Li et al. 2021). For North American consumers, a fresh start is necessary to revive the 19th century buzz about Common Carp that continues to exist overseas, with the important caveat that consuming the four famous fishes is an environmental solution and not an attempt to revive a nearly 500-year history of nonnative culture and stocking in North America.

Creating a positive campaign to spark consumption of the famous fishes in North America will require a comprehensive and consistent effort of economic development along with consumer education and acceptance (Tetra Tech 2018). This is particularly challenging in the United States, where overall seafood consumption lags far behind other countries and consumption of locally sourced freshwater fish is nearly zero. The average American consumes about 20 pounds of seafood (mostly shrimp and salmon) annually, as opposed to 200 pounds of chicken (National Marine Fisheries Service 2021). The 2007 National Plan outlining the ways to fight the carp invasion highlighted marketing. Following that, a business plan to develop a self-supporting market for carps was developed (Tetra Tech 2018). Branding through a comprehensive marketing campaigning is the most powerful way to create a product identity that sparks consumer interest and increases consumption. Some notable examples include, "The Incredible, Edible Egg," "Got Milk?" "Pork the Other White Meat," and "Beef, It's What's for Dinner." A similar approach may gain traction for the famous carps as a desirable food product. One of the early innovators in marketing famous carps as a valuable product is Chef Philippe Parola, who has expanded beyond promoting consuming famous carps in fine dining to preparing many invasive species (Parola 2023).

Attempts to popularize the four famous fishes by giving them a clear brand name have occurred for quite some time (Keevin and Garvey 2019). Chef Parola began popularizing the name "silverfin" in the early 2000s. Another name, "Kentucky tuna," was attempted in 2010 (National Fisheries Institute 2010). No brand identifier has gained traction, because of an apparent lack of professional and consumer support and an absence of a definable product that surpasses the fishes themselves, such as quality, taste, healthfulness, and environmental action. There also have been questions of legality. Several steps are necessary to make a true renaming effort successful and legal in the United States. Seafood products often look similar and, unfortunately, deceptive naming occurs. For example, Vietnamese catfish *Pangasius* spp. were sold domestically as North American catfish *Ictalurus* spp., prompting a "catfish war" between Vietnam and the United States. To mitigate this and other trade conflicts and to ensure food safety, the United States Department of Agriculture (USDA) and several sister agencies in the federal government work to ensure that naming on packaging is truthful, with the common name as recognized by the scientific community included. These names are maintained on the Food and Drug Administration's (FDA) Seafood List, and the process for renaming a fish species for commercial purposes is well described (USDA 1993). Renaming a fish to that of a popular species is clearly forbidden. However, fish renaming has been allowed by the USDA in the past. Slimehead *Hoplostethus atlanticus*, which gets its common name from the multiple mucus glands on its head, now has the approved trade name, Orange Roughy. The name is still descriptive of this brightly orange-colored fish and is unique, so that it does not create confusion with other species. Other such examples exist and have been promoted to use underutilized fishes by the National Marine Fisheries Service, sometimes to the point that these new fisheries need additional regulation—even protection—to prevent harm to the promoted or renamed species (Knecht 2007). Perhaps different from other fisheries examples is that the name carp already has a notorious connotation among consumers in the know. The converts to a renaming will likely be the consumers that do not know the backstory of carps or those who are willing to try the fishes, despite their inauspicious reputation, attaching a positive experience to a novel brand name.

INTRODUCING COPI

In June 2022, Copi was promoted as the new, trademarked, universal brand for Grass, Bighead, Silver, and Black carp as a food product through an initiative led by the Illinois Department of Natural Resources (https://bit.ly/3vof9DU). The intent was to start using the "Copi: Eat Well. Do Good" slogan for market development immediately, allowing a measured transition from the government incentive program that has led to large removals since 2019, to one that is self-supported by a market for Copi. The brand was developed through extensive market research and is a play on the word copious, which reflects the high abundance of these carps in the wild. In addition, a related logo with a unique color scheme, font, and fish design was created (Figure 3). The media event rolling out the Copi marketing campaign in June 2022 garnered national and international media attention and was accompanied by an extensive social media presence. It launched a carefully designed, appealing, and regularly curated website (https://choosecopi.com/) promoting the benefits of Copi, its history, where to buy it, recipes, and related news. The primary goal of this sustained campaign is to link the positive nutritional and culinary aspects of these fishes with the knowledge that consuming them helps solve a national environmental problem. Regional responses have been positive. Copi sandwiches and other culinary products have been introduced at the Illinois State Fair and other public venues, selling out quickly and receiving uniformly positive reviews (Alexander 2023). Copi is now officially a part of the English lexicon (https://bit.ly/3x4j2hL). Three months following launch, cumulative consumer responses measured as Google Trends searches for the Copi name were centered

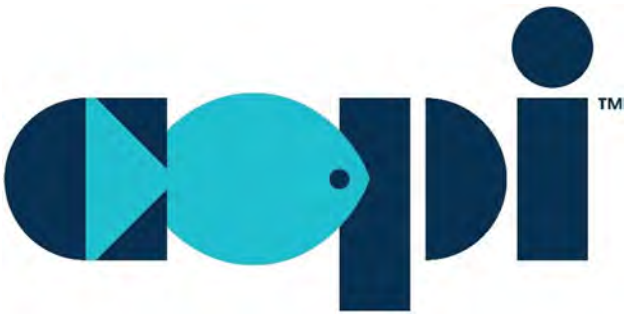


Figure 3. The Copi logo.

on Illinois, Missouri, and Tennessee. Other notable states with relatively high search scores were in the upper Midwest (Michigan), eastern USA (New York, Massachusetts), and western USA (California, Washington). During the 16 months since launch, searches for Copi continue to occur across these and other areas, suggesting that culinary interest in Copi is sustained. While Copi searches have broad geographic reach, our analysis revealed that searches for "Asian carp" continue to be centered in the central USA.

The Copi brand must be more than a name. As the Copi campaign moves forward, additional initiatives will allow the Copi brand to become more effective and long-lasting. Protecting the brand's integrity, quality, and intent will be accomplished by achieving trademark protections to the Copi name. Trademarking is a legal process by which the United States Patent and Trademark Office officially recognizes some specific use of a product name. Once approved, Copi will be given the permanent trademark of Copi® and will only refer to the use of the famous fish species as a consumed human foodstuff. Any by-products, such as meal, oil, fertilizer, pet food, and collagen that are derived from Copi processing will not be part of the Copi brand. The Illinois Department of Natural Resources will likely own and enforce the Copi trademark, although the goal is for this trademark to be transferred to an industry council or other stakeholder group as they organize around the new Copi products and desire to protect their value. In parallel, working with the FDA to have Copi be an accepted name for the famous fishes on the FDA Seafood List will allow the species to be processed and packaged under the Copi name only, without specifying the vague and potentially confusing word carp as the original source. Copi is a brand with a line of products and should not be considered as a biological unit for taxonomy and research. There will be no attempt to have the individual famous carp species common names changed by the American Fisheries Society and American Society of Ichthyologists and Herpetologists.

With sustained public–private support for transitioning from incentives to an independent market, the Copi branding and marketing campaign will arguably be one of the largest invasive species control and containment experiments in the world, similar in some ways in scale, extent, and interagency commitment to the multidecadal, multipronged control of Sea Lamprey in the Great Lakes, but with public-driven harvest of carp as a primary tool. Within the first 12 months of the Copi brand's infancy, it has garnered award-winning fame, being recognized by international marketing peers for mission-driven work that sparks global change, and being one of the best public relations campaigns of the year (https://bit.ly/3TDDPSf). However, the effort is going to take more than good publicity to be successful. The economic incentives that began in 2019 to encourage harvest of famous carps to boost their value past a break-even point were a start. But processing plants need to go beyond just converting bigheaded carp to fish meal or fertilizer by providing opportunities to develop high-value secondary Copi-branded products. More fishers and equipment also need to enter the fishery, which is a costly investment in a regional industry that has not grown in decades (Klein et al. 2018). The broad geographic extent of the invasion makes access to river reaches and processing plants logistically challenging for fishing operations trying to get fresh product to market (Bouska et al. 2020; Figure 2). These issues are not insurmountable, but will need consistent governmental and private support before the industry can move toward self-sufficiency. That said, the large areas within the complex stream network of the basin likely harbor a high density of Copi to be fished, allowing the industry to build to self-sufficiency. Private interest has grown with distributors for Copi, including AMT Global Strategies, Coast to Coast Seafood and Specialty Foods, Fortune Fish and Gourmet, Rushing Waters Fisheries, Seafood Merchants, Supreme Lobster, Sysco, and Third Generation Seafood at Fulton Fish Market. Harvest of carp species quantified by Tetra Tech since the Copi rollout in June 2022 through July 2023 was 4.5 and 1.7 million kilograms in the Illinois and Ohio river basins, respectively. Although the amount of these fishes distributed under the Copi name is currently unknown, stimulation of harvest through increased market demand can be compared to these benchmarks.

The Copi effort is not going to be the single measure that stems the invasive carp problem in North America. However, when integrated with management models, like the SEIcarP, effective deterrents, strong enforcement, public outreach, and sound science leadership, it has the capability to make control and containment more manageable and effective while serving an economic and public good. It can be argued that consuming these fish regionally also reduces the carbon footprint of utilizing imported seafood alternatives from around the globe due to freezing and transportation costs. Many of the most impoverished areas of the United States, such as the Mississippi Delta region up to southern Illinois, overlap with rivers and lakes where the invasion is prevalent (Figure 2). Food insecurity in these areas may be combatted by providing local Copi as an economically reasonable and nutritious product available locally, as well as supporting economies to harvest and process in these areas. Copi can also be used as an export product provided by the United States to battle hunger abroad. Importantly though, for this effort to work, the Copi campaign must be consistent, long lasting, and associated with a trusted, high-quality, and accessible product. The fishing industry must take ownership and continue to build the Copi brand as it weans itself from incentives. As public and private support for Copi grows, the hope is that diverse native fisheries will return to prominence and regional aquaculture of native fishes will grow, leading to a sustainable future for river-based economies in the United States.

ACKNOWLEDGMENTS

Thanks to two anonymous reviewers and the science editor for helpful comments that greatly improved this manuscript. There is no conflict of interest declared in this article.

REFERENCES

ACPCA (Asian Carp Prevention and Control Act). 2010. Public Law 1421, 111th Congress, 2nd session (December 2, 2010). Available: https://bit.ly/3wYp3gb. (March 2024).

Alexander, T. 2023. Copi in the spotlight at Illinois State Fair as fish's popularity as a food source increases. WCBU (August 22). Available: https://bit.ly/3IGCzYc (March 2024).

Biondo, M. V., and R. P. Burki. 2020. A systematic review of the ornamental fish trade with emphasis on coral reef fishes-an impossible task. Animals [online serial] 10:10112014.

Bouska, W., D. C. Glover, J. T. Trushenski, S. Secchi, J. E. Garvey, R. MacNamara, D. P. Coulter, A. A. Coulter, K. Irons, and A. Wieland. 2020. Geographic-scale harvest program to promote invasivorism of bigheaded carps. Fishes [online serial] 5:5030029.

Bunch, K. 2017. Sea Lamprey: the greatest invasive control success story. Great Lakes Connection (June 12). Available: https://bit.ly/3IEKhSU. (March 2024).

Burr, B. M., D. J. Eisenhouser, K. M. Cook, C. A. Taylor, G. L. Seegert, R. W. Sauer, and E. R. Atwood. 1996. Nonative fishes in Illinois waters: what do the records reveal? Transactions of the Illinois Academy of Science 89:73–91.

Butler, S. E., A. P. Porreca, S. F. Collins, J. A. Freedman, J. J. Parkos, M. J. Diana, and D. H. Wahl. 2019. Does fish herding enhance catch rates and detection of invasive bigheaded carp? Biological Invasions 21:775–785.

Chick, J. H., and M. A. Pegg. 2001. Invasive carp in the Mississippi River basin. Science 292:2250–2251.

Chumchal, M. M., W. H. Nowlin, and R. W. Drenner. 2005. Biomass-dependent effects of Common Carp on water quality in shallow ponds. Hydrobiologia 545:271–277.

Cleary, B. M., M. E. Romano, C. Y. Chen, W. Heiger-Bernays, and K. A. Crawford. 2021. Comparison of recreational fish consumption advisories across the USA. Current Environmental Health Reports 8:71–88.

Collins, S. F., S. E. Butler, M. J. Diana, and D. H. Wahl. 2015. Catch rates and cost effectiveness of entrapment gears for Asian carp: a comparison of pound nets, hoop nets, and fyke nets in backwater lakes of the Illinois River. North American Journal of Fisheries Management 35:1219–1225.

Conover, G., R. Simmonds, and M. Whalen. 2007. Management and control plan for bighead, black, grass, and Silver carps in the United States. Asian Carp Working Group, Aquatic Nuisance Species Task Force, Washington, D.C.

Coulter, D. P., R. MacNamara, D. C. Glover, and J. E. Garvey. 2018. Possible unintended effects of management at an invasion front: reduced prevalence corresponds with high condition of invasive bigheaded carps. Biological Conservation 221:118–126.

Courtenay, W. R. J., and J. R. J. Stauffer. 1990. The introduced fish problem and the aquarium fish industry. Journal of the World Aquaculture Society 21:145–159.

Cudmore, B., and N. E. Mandrak. 2011. Assessing the biological risk of Asian carps to Canada. Pages 15–30 *in* D. C. Chapman and M. H. Hoff, editors. Invasive Asian Carps in North America. American Fisheries Society, Symposium 74, Bethesda, Maryland.

Cupp, A. R., M. K. Brey, R. D. Calfee, D. C. Chapman, R. Erickson, J. Fischer, A. K. Fritts, A. E. George, P. R. Jackson, B. C. Knights, G. N. Saari, and P. M. Kočovský. 2021. Emerging control strategies for integrated pest management of invasive carps. Journal of Vertebrate Biology [online serial] 70:21057.1-21.

Elton, C. 1958. The ecology of invasions by animals and plants. Methuen and Company, London.

Embke, H. S., P. M. Kocovsky, C. A. Richter, J. J. Pritt, C. M. Mayer, and S. S. Qian. 2016. First direct confirmation of Grass Carp spawning in a Great Lakes tributary. Journal of Great Lakes Research 42:899–903.

Engle, C. R., and J. van Senten. 2022. Resilience of communities and sustainable aquaculture: governance and regulatory effects. Fishes [online serial] 7:7050268.

Fischer, J. R., R. M. Krogman, and M. C. Quist. 2013. Influences of native and non-native benthivorous fishes on aquatic ecosystem degradation. Hydrobiologia 711:187–199.

Garvey, J., B. Ickes, and S. Zigler. 2010. Challenges in merging fisheries research and management: the upper Mississippi River experience. Hydrobiologia 640:125–144.

Garvey, J. E., G. G. Sass, J. Trushenski, D. Glover, P. M. Charlebois, J. Levengood, B. Roth, G. Whitledge, B. C. Small, S. J. Tripp, and S. Secchi. 2012. Fishing down the Bighead and Silver Carps: reducing the risk of invasion to the Great Lakes. Technical report to Illinois Department of Natural Resources, Carbondale. Available: https://bit.ly/3IGkfyo. (March 2024).

Invasive Carp Regional Coordinating Committee. 2023. 2023 invasive carp action plan. Available: https://bit.ly/3VlcN3o. (March 2024).

Kallis, J., R. Erickson, D. Coulter, A. Coulter, M. Brey, M. Catalano, J. Dettmers, J. Garvey, K. Irons, E. Marschall, K. Rose, M. Wildhaber, and D. Glover. 2023. Incorporating metapopulation dynamics to inform invasive species management: evaluating Bighead and Silver Carp control strategies in the Illinois River. Journal of Applied Ecology 60:1841–1853.

Keevin, T., and J. Garvey. 2019. Using marketing to fish-down bigheaded carp (*Hypophthalmichthys* spp.) in the United States: eliminating the negative brand name, "carp". Journal of Applied Ichthyology 35:1141–1146.

Kelly, A. M. 2011. Alternative methods to use of Black Carp for snail control in aquaculture ponds. Pages 73–87 *in* D. C. Chapman and M. H. Hoff, editors. Invasive Asian Carps in North America. American Fisheries Society, Symposium 74, Bethesda, Maryland.

Kelly, A. M., C. R. Engle, M. L. Armstrong, M. Freeze, and A. J. A. J. Mitchell. 2011. History of Introductions and governmental involvement in promoting the use of Grass, Silver, and Bighead carps. Pages 163–174 *in* D. C. Chapman and M. H. Hoff, editors. Invasive Asian Carps in North America. American Fisheries Society, Symposium 74, Bethesda, Maryland.

Klein, Z. B., M. C. Quist, L. E. Miranda, M. M. Marron, M. J. Steuck, and K. A. Hansen. 2018. Commercial fisheries of the upper Mississippi River: a century of sustained harvest. Fisheries 43:563–574.

Knecht, G. B. 2007. Hooked: pirates, poaching, and the perfect fish. Rodale Books, Emmaus, Pennsylvania.

Kocovsky, P. M., D. C. Chapman, and S. Qian. 2018. "Asian carp" is societally and scientifically problematic. Let's replace it. Fisheries 43:311–316.

Kolar, C. S., J. Walter, W. R. Courtenay, Jr., and L. G. Nico. 2010. Managing undesired and invading species. Pages 213–259 *in* W. A. Hubert and M. C. Quist, editors. Inland fisheries management in North America, 3rd edition. American Fisheries Society, Bethesda, Maryland.

Levengood, J. M., D. J. Soucek, A. Dickinson, G. G. Sass, and J. M. Epifanio. 2013. Spatial and interspecific patterns in persistent contaminant loads in Bighead and Silver Carp from the Illinois River. Ecotoxicology 22:1174–1182.

Li, D. P., W. Prinyawiwatkul, Y. Q. Tan, Y. K. Luo, and H. Hong. 2021. Asian carp: a threat to American lakes, a feast on Chinese tables. Comprehensive Reviews in Food Science and Food Safety 20:2968–2990.

MacNamara, R., D. Glover, J. Garvey, W. Bouska, and K. Irons. 2016. Bigheaded carps (*Hypophthalmichthys* spp.) at the edge of their invaded range: using hydroacoustics to assess population parameters and the efficacy of harvest as a control strategy in a large North American river. Biological Invasions 18:3293–3307.

Morgan, M., and Y. Ho. 2018. Perception of Asian carp as a possible food source among Missouri anglers. Human Dimensions of Wildlife 23:491–498.

National Fisheries Institute. 2010. Kentucky tuna: a bad idea that's against the law. About Seafood (July 14). Available: https://bit.ly/492JbLb. (March 2024).

National Marine Fisheries Service. 2021. Fisheries of the United States. Available: https://bit.ly/3PM8Px9. (March 2024).

Nunez, M. A., S. Kuebbing, R. D. Dimarco, and D. Simberloff. 2012. Invasive species: to eat or not to eat, that is the question. Conservation Letters 5:334–341.

Parola, P. 2023. Can't beat 'em, eat 'em!: 40 invasive species with recipes. Can't Beat' Em Eat' Em, L.L.C, Baton Rouge, Louisiana.

Pasko, S., and J. Goldberg. 2014. Review of harvest incentives to control invasive species. Management of Biological Invasions 5:263–277.

Premetz, E. D. 1956. Development of markets for underutilized Lake Erie fish: progress report. Commercial Fisheries Review 18:1–7. Available: https://bit.ly/3TbLqWE. (March 2024).

Sass, G. G., T. R. Cook, K. S. Irons, M. A. McClelland, N. N. Michaels, T. M. O'Hara, and M. R. Stroub. 2010. A mark–recapture population estimate for invasive Silver Carp (*Hypophthalmichthys molitrix*) in the La Grange Reach, Illinois River. Biological Invasions 12:433–436.

Schad, A. N., and G. O. Dick. 2018. Aquatic vegetation community structure response to hydrilla management with triploid Grass Carp, herbicide, and native vegetation planting. Lake and Reservoir Management 34:417–425.

Sigfusson, T. 2020. The new fish wave: how to ignite the seafood industry. Leete's Island Books, Sedgwick, Maine.

Simonson, M. A., M. J. Weber, G. M. Wilkinson, and A. R. Annear. 2023. Annual changes in water quality and sportfish community structure following commercial harvest of Common Carp and Bigmouth Buffalo. Lake and Reservoir Management 39:174–189.

Smiley, C. 1883. The German carp and its introduction in the United States. Bulletin of the United States Fisheries Commission 3:333–336. Available: https://bit.ly/3x3AVNK. (March 2024).

Sullivan, W. P., D. P. Burkett, M. A. Boogaard, L. A. Criger, C. E. Freiburger, T. D. Hubert, K. G. Leistner, B. J. Morrison, S. M. Nowicki, S. N. P. Robertson, A. K. Rowlinson, B. J. Scotland, and T. B. Sullivan. 2021. Advances in the use of lampricides to control Sea Lampreys in the Laurentian Great Lakes, 2000–2019. Journal of Great Lakes Research 47:S216–S237.

TDEC (Tennessee Department of Environment and Conservation). 2023. TDEC lifts "Do not consume" advisory for Silver Carp, Bighead Carp

in Mississippi River in Memphis. TDEC Newsroom (September 7). Available: https://bit.ly/4cvZnYH. (March 2024).
Tetra Tech. 2018. Illinois Department of Natural Resources Asian carp business process, final report. Available: https://bit.ly/3lEMoWB. (March 2024).
Tsehaye, I., M. Catalano, G. Sass, D. Glover, and B. Roth. 2013. Prospects for fishery-induced collapse of invasive Asian carp in the Illinois River. Fisheries 38:445–454.
USDA (U.S. Department of Agriculture). 1993. FDA [Food and Drug Administration]'s guide to acceptable market names for seafood sold in interstate commerce. USDA, Center for Food Safety and Applied Nutrition, College Park, Maryland.
Varble, S., and S. Secchi. 2013. Human consumption as an invasive species management strategy. A preliminary assessment of the marketing potential of invasive Asian carp in the US. Appetite 65:58–67.
Varga, D., Z. Sándor, C. Hancz, I. Csengeri, Z. Jeney, and Z. Papp. 2015. Off-flavour compounds in Common Carp (*Cyprinus carpio*) flesh in context of type of fish pond. Acta Alimentaria 44:311–315.
Walsworth, T. E., K. Landom, and J. W. Gaeta. 2020. Compensatory recruitment, dynamic habitat, and selective gear present challenges to large-scale invasive species control. Ecosphere [online serial] 11:e03158.
Wedekind, H., V. Hilge, and W. Steffens. 2001. Present status, and social and economic significance of inland fisheries in Germany. Fisheries Management and Ecology 8:405–414.
Whitledge, G. W., P. T. Kroboth, D. C. Chapman, Q. E. Phelps, W. Sleeper, J. Bailey, and J. A. Jenkins. 2022. Establishment of invasive Black Carp (*Mylopharyngodon piceus*) in the Mississippi River basin: identifying sources and year classes contributing to recruitment. Biological Invasions 24:3885–3904.
Yick, J. L., C. Wisniewski, J. Diggle, and J. G. Patil. 2021. Eradication of the invasive Common Carp, *Cyprinus carpio* from a large lake: lessons and insights from the Tasmanian experience. Fishes [online serial] 6:6010006.
Yingchutrakul, M., N. Wasinnitiwong, S. Benjakul, A. Singh, Y. Y. Zheng, E. Mubango, Y. K. Luo, Y. Q. Tan, and H. Hong. 2022. Asian carp, an alternative material for surimi production: progress and future. Food [online serial] 11:1318. AFS