Monterey Bay Aquarium
Seafood Watch

Environmental sustainability assessment of wild-caught invasive carp from the United States caught using combined gillnets–trammel nets, seine nets, and fyke nets

Species: Bighead carp (*Hypophthalmichthys nobilis*), Common carp (*Cyprinus carpio*), Grass carp (*Ctenopharyngodon idella*), Silver carp (*Hypophthalmichthys molitrix*)

Location: Illinois, Kentucky, Missouri, Tennessee

Gear: Combined gillnets–trammel nets, Seine nets (unspecified), Fyke nets

Type: Wild Caught

Author: Seafood Watch

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Assessed using Seafood Watch Fisheries Standard v4

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About Seafood Watch

Monterey Bay Aquarium's Seafood Watch program evaluates the environmental sustainability of wild-caught and farmed seafood commonly found in the United States marketplace. Seafood Watch defines sustainable seafood as originating from sources, whether wild-caught or farmed, which can maintain or increase production in the long-term without jeopardizing the structure or function of affected ecosystems. The program's goals are to raise awareness of important ocean conservation issues and empower seafood consumers and businesses to make choices for healthy oceans.

Seafood Watch's science-based ratings are available at www.SeafoodWatch.org. Each rating is supported by a Seafood Watch assessment, in which the fishery or aquaculture operation is evaluated using the Seafood Watch standard.

Seafood Watch standards are built on our guiding principles, which outline the necessary environmental sustainability elements for fisheries and aquaculture operations. The guiding principles differ across standards, reflecting the different impacts of fisheries and aquaculture.

- Seafood rated Best Choice comes from sources that operate in a manner that's consistent with our guiding principles. The seafood is caught or farmed in ways that cause little or no harm to other wildlife or the environment.

- Seafood rated Good Alternative comes from sources that align with most of our guiding principles. However, one issue needs substantial improvement, or there's significant uncertainty about the impacts on wildlife or the environment.

- Seafood rated Avoid comes from sources that don't align with our guiding principles. The seafood is caught or farmed in ways that have a high risk of causing harm to wildlife or the environment. There's a critical conservation concern or many issues need substantial improvement.

Each assessment follows an eight-step process, which prioritizes rigor, impartiality, transparency and accessibility. They are conducted by Seafood Watch scientists, in collaboration with scientific, government, industry and conservation experts and are open for public comment prior to publication. Conditions in wild capture fisheries and aquaculture operations can change over time; as such assessments and ratings are updated regularly to reflect current practice.

More information on Seafood Watch guiding principles, standards, assessments and ratings are available at www.SeafoodWatch.org.

Guiding Principles

Seafood Watch defines sustainable seafood as originating from sources, whether fished[1] or farmed, that can maintain or increase production in the long term without jeopardizing the structure or function of affected ecosystems.

The following guiding principles illustrate the qualities that fisheries must possess to be considered sustainable by the Seafood Watch program (these are explained further in the Seafood Watch Standard for Fisheries):

- Follow the principles of ecosystem-based fisheries management.
- Ensure all affected stocks are healthy and abundant.
- Fish all affected stocks at sustainable levels.
- Minimize bycatch.
- Have no more than a negligible impact on any threatened, endangered, or protected species.
- Managed to sustain the long-term productivity of all affected species.
- Avoid negative impacts on the structure, function, or associated biota of aquatic habitats where fishing occurs.
- Maintain the trophic role of all aquatic life.
- Do not result in harmful ecological changes such as reduction of dependent predator populations, trophic cascades, or phase shifts.
- Ensure that any enhancement activities and fishing activities on enhanced stocks do not negatively affect the diversity, abundance, productivity, or genetic integrity of wild stocks.

These guiding principles are operationalized in the four criteria in this standard.Each criterion includes:

- Factors to evaluate and score
- Guidelines for integrating these factors to produce a numerical score and rating

Once a rating has been assigned to each criterion, Seafood Watch develops an overall recommendation. Criteria ratings and the overall recommendation are color coded to correspond to the categories on the Seafood Watch pocket guides and online guide:

Best Choice/Green: Buy first; they're well managed and caught or farmed responsibly.

Good Alternative/Yellow: Buy, but be aware there are concerns with how they're caught, farmed or managed.

Avoid/Red: Take a pass on these for now; they're caught or farmed in ways that harm other marine life or the environment.

[1] "Fish" is used throughout this document to refer to finfish, shellfish and other invertebrates

Summary

This report reviews U.S. domestic state-sponsored commercial fisheries targeting three invasive carp species using combined gillnets (which includes set gillnets, trammel nets, and fyke nets) and seine nets. Although the term 'invasive carp' is typically used to describe silver carp (*Hypophthalmichthys molitrix*), bighead carp (*H. nobilis*), and grass carp (*Ctenopharyngodon idella*), we have included common carp (*Cyprinus carpio*)—a long-established non-native species—under this umbrella term for the purposes of this report. While the fisheries in this report are not targeting common carp, we have included ratings for common carp that is caught while fishing for the silver carp, bighead carp, and grass carp. We have not included black carp (*Mylopharyngodon piceus*) because this invasive carp species is not currently caught in substantial quantities. Only states with contracted commercial fishing programs for invasive carp are included in this report. Those fisheries include the following four states and bodies of water: Illinois (Illinois River), Kentucky (Barkley Lake and Kentucky Lake), Tennessee (Barkley Lake, Kentucky Lake, and Pickwick Lake), and Missouri (Mississippi River). Invasive carp caught by gillnets and seine nets in Illinois and by seine nets in Missouri is rated green. Invasive carp caught in Kentucky, Tennessee, and Missouri gillnets is rated yellow. The difference in these ratings is driven by Criterion 2: there are no red-scoring species in the former fisheries, while Criterion 2 is scored red in the latter fisheries due to potential impacts to highly vulnerable sturgeon and/or paddlefish.

The continued range expansion of invasive carps threatens regional waterway sustainability via competition and predation on native species and by disrupting aquatic plant ecology. Due to the invasive nature of bighead carp, silver carp, grass carp, and common carp, all species reviewed received "very low concern" and "low concern" scores for abundance/stock status and fishing mortality, respectively. The management goal for these commercial fisheries is to maximize harvest and minimize the spread of nuisance carp species.

The Illinois fisheries regularly catch and retain native fish species during sets for invasive carp. These species are also caught in other commercial fisheries, but there is limited information on the total level of fishing mortality. There are some concerns with bycatch within the gillnet fisheries in Tennessee, Kentucky, and Missouri, primarily due to the potential impact to "Endangered" or "Threatened" sturgeons and/or paddlefish. Although bycatch rates of pallid sturgeon and lake sturgeon are reportedly low in these fisheries, these species were included due to their high vulnerability and an unknown relative impact from the fisheries under assessment; the impacts are unknown because there are uncertainties in the self-reported bycatch data in Kentucky and a complete lack of bycatch data in Missouri and Tennessee. The Missouri seine fishery targets large schools of silver carp and the gear is unlikely to impact sturgeons and/or paddlefish. Bycatch is expected to be low in the seine fishery, but data are lacking for such a determination, so finfish are included as a species group.

There are numerous state, regional, and national programs in place to monitor and mitigate the impact of invasive carp species on native species and habitats. The establishment of Invasive Carp Harvest Incentive Programs has regionally bolstered carp industry infrastructure, improved record-keeping/catch accounting requirements, and resulted in significant increased harvest of invasive carps in recent years. However, management effectiveness varied by state, and higher scores were largely driven by state policies prohibiting the stocking of invasive carp, and whether the fishery regularly retains native species. Due to data-deficiencies, we are unable to fully assess the effectiveness of management measures for native retained species, but the general regulations and policies in place are expected to be effective. In the Illinois

fisheries, management of invasive carp is thorough, but appropriate management targets (e.g. reference points) have not been defined for native species that are retained in the invasive carp fisheries. Because there are no native retained main species in the Kentucky and Tennessee fisheries, only the management of invasive carp impacts the score for factor 3.1; both states have comprehensive programs in place to reduce abundance of invasive carp and prevent further spread, resulting in a "highly effective" score. Missouri also has numerous management measures that are likely effective at mitigating the impact from invasive carps, but the state permits the stocking of grass carp in private ponds, which precludes a score of "highly effective" for factor 3.1. All fisheries have bycatch measures in place such as gear-tending requirements, minimum mesh sizes, soak time limits, and prohibitions on retaining species of concern, but the Missouri and Tennessee fisheries do not have bycatch data that allows a full assessment of the effectiveness of these mitigation measures.

Invasive carp are typically targeted over mud, sand, or gravel substrates (some mussel beds occur regionally), and all gear types do occasionally come into contact with the bottom; however, these impacts are minor. The establishment of invasive carps in U.S. waterways has resulted in community and trophic changes, and commercial harvest of invasive carps is expected to provide benefits to native species and habitats. The collective efforts to monitor and limit range expansion of invasive carps, reduce abundance through intensive targeted harvest, and monitor fish community response to these measures, results in a "low concern" for ecosystem-based fisheries management for those fisheries which do not regularly retain native species. The uncertainty on the impact of these commercial fisheries on populations of retained native species in the Illinois and Missouri fisheries results in a "moderate concern" score for ecosystem-based fisheries management.

Final Seafood Recommendations

SPECIES | FISHERY	C 1 TARGET SPECIES	C 2 OTHER SPECIES	C 3 MANAGEMENT	C 4 HABITAT	OVERALL	VOLUME (MT) YEAR
Bighead carp | Mississippi River | America, North - Inland Waters | United States | Illinois | Combined gillnets - trammel nets	5.000	2.644	3.000	3.000	**Best Choice (3.303)**	17 (MT) 2021
Bighead carp | Mississippi River | America, North - Inland Waters | United States | Missouri | Combined gillnets - trammel nets	5.000	1.732	3.000	3.000	**Good Alternative (2.971)**	2 (MT) 2021
Bighead carp | Mississippi River | America, North - Inland Waters | United States | Illinois | Seine nets	5.000	2.644	3.000	3.000	**Best Choice (3.303)**	12 (MT) 2021
Bighead carp | Kentucky Lake, Lake Barkley | America, North - Inland Waters | United States | Set gillnets | Encircling gillnets	5.000	1.732	4.000	3.464	**Good Alternative (3.310)**	11 (MT) 2021
Bighead carp | Kentucky Lake, Lake Barkley, Pickwick Lake | America, North - Inland Waters | United States | Tennessee | Set gillnets | Encircling gillnets	5.000	1.732	4.000	3.464	**Good Alternative (3.310)**	4 (MT) 2021
Common carp | Mississippi River | America, North - Inland Waters | United States | Illinois | Combined gillnets - trammel nets	5.000	2.644	3.000	3.000	**Best Choice (3.303)**	3 (MT) 2021
Common carp | Mississippi River | America, North - Inland Waters | United States | Missouri | Combined gillnets - trammel nets	5.000	1.732	3.000	3.000	**Good Alternative (2.971)**	12 (MT) 2021
Common carp | Kentucky Lake, Lake Barkley | America, North - Inland Waters | United States | Set gillnets | Encircling gillnets	5.000	1.732	4.000	3.464	**Good Alternative (3.310)**	Unknown
Common carp | Kentucky Lake, Lake Barkley, Pickwick Lake | America, North - Inland Waters | United States | Tennessee | Set gillnets | Encircling gillnets	5.000	1.732	4.000	3.464	**Good Alternative (3.310)**	Unknown
Grass carp | Mississippi River | America, North - Inland Waters | United States | Illinois | Combined gillnets - trammel nets	5.000	2.644	3.000	3.000	**Best Choice (3.303)**	5 (MT) 2021
Grass carp | Mississippi River | America, North - Inland Waters | United States | Missouri | Combined gillnets - trammel nets	5.000	1.732	3.000	3.000	**Good Alternative (2.971)**	39 (MT) 2021
Grass carp | Mississippi River | America, North - Inland Waters | United States | Illinois | Seine nets	5.000	2.644	3.000	3.000	**Best Choice (3.303)**	12 (MT) 2021

Grass carp | Kentucky Lake, Lake Barkley | America, North - Inland Waters | United States | Set gillnets | Encircling gillnets	5.000	1.732	4.000	3.464	**Good Alternative (3.310)**	34 (MT) 2021
Grass carp | Kentucky Lake, Lake Barkley, Pickwick Lake | America, North - Inland Waters | United States | Tennessee | Set gillnets | Encircling gillnets	5.000	1.732	4.000	3.464	**Good Alternative (3.310)**	39 (MT) 2021
Silver carp | Mississippi River | America, North - Inland Waters | United States | Illinois | Combined gillnets - trammel nets	5.000	2.644	3.000	3.000	**Best Choice (3.303)**	515 (MT) 2021
Silver carp | Mississippi River | America, North - Inland Waters | United States | Missouri | Combined gillnets - trammel nets	5.000	1.732	3.000	3.000	**Good Alternative (2.971)**	305 (MT) 2021
Silver carp | Mississippi River | America, North - Inland Waters | United States | Missouri | Seine nets	5.000	2.644	3.000	3.000	**Best Choice (3.303)**	305 (MT) 2021
Silver carp | Mississippi River | America, North - Inland Waters | United States | Illinois | Seine nets	5.000	2.644	3.000	3.000	**Best Choice (3.303)**	276 (MT) 2021
Silver carp | Kentucky Lake, Lake Barkley | America, North - Inland Waters | United States | Set gillnets | Encircling gillnets	5.000	1.732	4.000	3.464	**Good Alternative (3.310)**	3,696 (MT) 2021
Silver carp | Kentucky Lake, Lake Barkley, Pickwick Lake | America, North - Inland Waters | United States | Tennessee | Set gillnets | Encircling gillnets	5.000	1.732	4.000	3.464	**Good Alternative (3.310)**	610 (MT) 2021

Missouri's contracted commercial fishing program for invasive carp began in October 2023. Production volume from Missouri is based on data from October 2023 to July 2024. Because these data were not separated by gear type, the volume for silver carp is apportioned evenly between the two gears.

Production volume for the Illinois contracted commercial fishery is from the 2020 season for the gillnet fishery and from the 2019 season for the seine fishery {ACRACC 2020}. There was no seine net fishery in 2020 in the Upper Illinois Waterway, so all production in the contracted commercial fishery is from the gillnet fishery. To get a rough estimate of production from the seine fishery in 2019, we subtracted the 2020 gillnet production from the total production. Catch of common carp in the contracted seine net fishery is rare {ACRACC 2020}, so this species is not included in the fishery.

Kentucky production volume is from the 2021 fishing season and includes catch from Barkley Lake and Kentucky Lake because the majority of production under the Invasive Carp Harvest Program is from the two lakes {KDWFR 2022b}. Tennessee production volume is from 2023–24. Common carp production within the invasive carp fisheries in Kentucky and Tennessee was not available as of the writing of this report, but production is expected to be minor relative to silver carp.

Summary

All the assessed fisheries are scored green in Criterion 1 because the four assessed species are all nonnative. All assessed fisheries score yellow or better in Criterion 3 and green in Criterion 4 because of the robust management strategies in place to mitigate the impact of invasive carp species on native fish and ecosystems. The differences in overall ratings are driven by Criterion 2.

All invasive carps caught with gillnets and seines in Illinois are rated green. There are no species of concern caught in these fisheries, stocking invasive carp is prohibited in Illinois, and the state has highly effective management measures in place to reduce populations of these invasive species, with no evidence of negative impacts to native species.

Silver carp caught in Missouri with seines receives a green rating because, although bycatch is unknown, it is unlikely that the gear catches sturgeon/paddlefish, and management measures are expected to reduce silver carp abundance without significant impact to native species.

Silver, bighead, grass, and common carps caught in Missouri and Tennessee with gillnets receive a yellow rating, because the insufficient bycatch data mean that we cannot fully assess the potential effects of the fishery on sturgeon or paddlefish species.

Silver, bighead, grass, and common carps caught in Kentucky with gillnets receive a yellow rating. Although there are catch composition data and an observer program is in place, there is evidence that bycatch is underreported, resulting in uncertainty on the impact of the fishery on lake sturgeon and paddlefish.

Scoring Guide

Scores range from zero to five where zero indicates very poor performance and five indicates the fishing operations have no significant impact.

Final Score = geometric mean of the four Scores (Criterion 1, Criterion 2, Criterion 3, Criterion 4).

Best Choice/Green = Final Score >3.2, and no Red Criteria, and no Critical scores

Good Alternative/Yellow = Final score >2.2-3.2, and neither Harvest Strategy (Factor 3.1) nor Bycatch Management Strategy (Factor 3.2) are Very High Concern2, and no more than one Red Criterion, and no Critical scores

Avoid/Red = Final Score ≤2.2, or either Harvest Strategy (Factor 3.1) or Bycatch Management Strategy (Factor 3.2) is Very High Concern or two or more Red Criteria, or one or more Critical scores.

[2] Because effective management is an essential component of sustainable fisheries, Seafood Watch issues an Avoid recommendation for any fishery scored as a Very High Concern for either factor under Management (Criterion 3).

Introduction

Scope of the analysis and ensuing recommendation

This report reviews U.S. domestic, state-sponsored, commercial fisheries targeting three invasive carp species: bighead carp, silver carp, and grass carp. Common carp is included in the ratings because it is sometimes caught on trips targeting the three invasive carp species. We use the term “invasive carp” in place of “Asian carp” as used by the Invasive Carp Regional Coordinating Committee (ICRCC). Silver carp and bighead carp are sometimes lumped together as “bighead carp.” An additional species of invasive carp, black carp, is not reviewed here because there are no developed commercial fisheries targeting black carp to date in the U.S. (despite recent range expansion). Common carp has been established in the U.S. since the 1800s and is often excluded from descriptions of “invasive carp” by the ICRCC and others; for brevity, we include it under the general term “invasive carp” throughout this report. More recently introduced to the U.S., silver carp and bighead carp pose a significant conservation threat to the Mississippi River basin and the connected Great Lakes (Figures 2–4). The life history and foraging ecology of these two carp species threaten regional waterway sustainability via competition and predation on native species and by disrupting aquatic plant ecology (ACRCC 2019)(ACRCC Action Plan 2019).

Four states with state-sponsored, contracted, commercial fisheries for invasive carps along the Mississippi River basin are included within this assessment: Illinois, Kentucky, Tennessee, and Missouri. Although gear types vary by waterway and state, the gear types used to target invasive carp fall into three primary categories: 1) gill/trammel nets, 2) fyke nets (generally hoop nets or buffalo nets), and 3) seine nets (see the following section for more detail on gears). Several other states have commercial fisheries targeting carp species (often alongside native species), but *only* those states with contracted fisheries are included here. The contracted fisheries in these states are almost exclusively targeting silver carp and bighead carp, but grass carp and common carp are often caught in these fishing events. For this reason, we include ratings for all four species.

Species Overview

The four invasive carp species (Figure 1) have a varied distribution and history in the United States. Silver, grass, and bighead carp are distributed across the Mississippi River basin. Common carp is distributed throughout most of the U.S., except Alaska and Puerto Rico. Invasive and common carp commercial fisheries are state managed; however, regional partnerships and committees have been established to support efforts to control the spread of invasive carp in the Mississippi River basin and Great Lakes areas. Major players in these efforts are represented by the four natural resource agencies in the states of Illinois, Kentucky, Missouri, and Tennessee, along with the ICRCC, the United States Geological Service (USGS), the U.S. Fish and Wildlife Service (USFWS), and the U.S. Army Corps of Engineers.

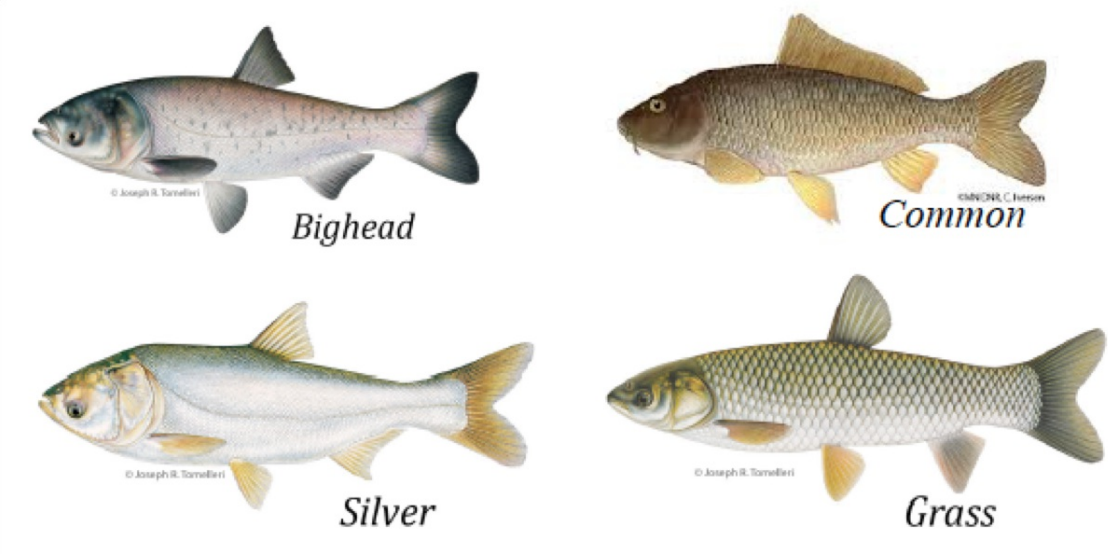


Figure 1: Invasive and common carp species reviewed.

Common carp (*Cyprinus carpio*): Common carp has a more longstanding history in the U.S. and was originally introduced in the early 1800s to support aquaculture and to feed increasing immigrant populations (Nico et al. 2023a). High reproductive rates, coupled with a wide thermal tolerance, facilitated the stocking and spread of common carp throughout much of the U.S. (Figure 2) (Fishbio 2016). Common carp has large scales, a long dorsal fin base, and two pairs of long barbels in its upper jaw. Common carp is omnivorous; it eats an herbivorous diet of aquatic plants but prefers to scavenge the bottom for insects, crustaceans (including zooplankton), crawfish, and benthic worms (Nico et al. 2023a). The size and weight of common carp increase with age, and wild individuals typically live for 20 years (Nico et al. 2023a). Common carp is one of the most damaging aquatic invasive species due to its wide distribution and severe impacts in shallow lakes and wetlands (DNR Minn 2019).

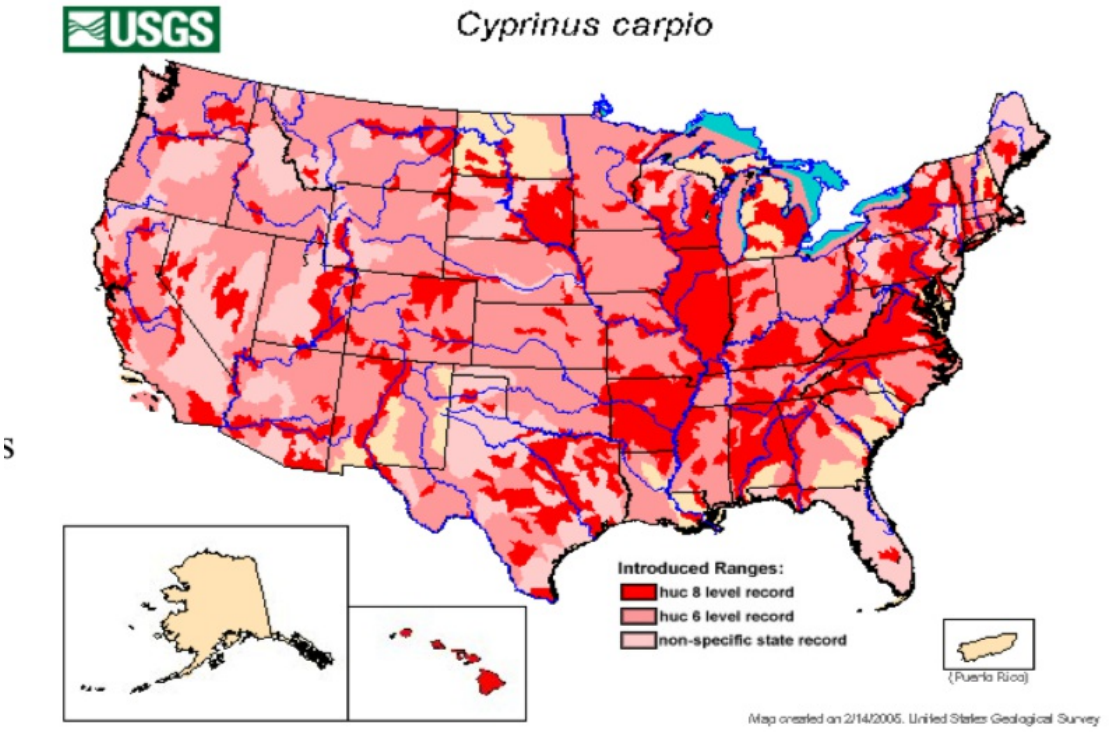


Figure 2: Common carp distribution in the United States (Nico et al. 2023a).

Bighead carp (*Hypophthalmichthys nobilis*): Bighead and silver carp were imported from eastern China and Asia to Arkansas in the 1970s to improve water quality in aquaculture ponds and sewage treatment lagoons and as a potential addition to fish production ponds (Nico et al. 2023c). Bighead carp has spread through the Mississippi River basin and has been collected as far north as Lake Pepin in Minnesota (Nico et al. 2023c). Bighead carp is a deep-bodied, or wide, fish with a large toothless mouth and very large head. Bighead carp has been known to hybridize (cross-breed) with silver carp and produce viable, reproductive offspring (ICRCC 2024a). Bighead carp is an R-selected species and can mature in 2 to 3 years, commonly weighing up to 40 lb (Nico et al. 2023c). But under the right conditions, it can grow to more than 80 lb (ACRCC 2019). Bighead carp is extremely hardy and can adapt to many temperate freshwater environments. Bighead carp is a voracious eater and consumes a wide range of zooplankton, detritus, and small invertebrates, outcompeting native species for food (Nico et al. 2023c). The bighead carp lacks a true stomach, so it must feed almost continuously {ACCRC 2019}.

Silver carp (*Hypophthalmichthys molitrix*): Silver carp is now established throughout much of the Mississippi River basin and is expanding into the Ohio River and other basins (Figure 3) (ACRCC Action Plan 2019). Silver carp is deep-bodied, or wide, with a moderately large and broad head encompassing just under one-third of its body size. Silver carp feeds primarily on phytoplankton and can outcompete many native fish juveniles (Nico et al. 2023d). Like the bighead carp, silver carp lacks a true stomach, so it must feed almost continuously (ICRCC 2024b). Silver carp matures in 2 to 4 years and commonly weighs 20 lb; when older, it can reach a maximum size of more than 80 lb (ibid).

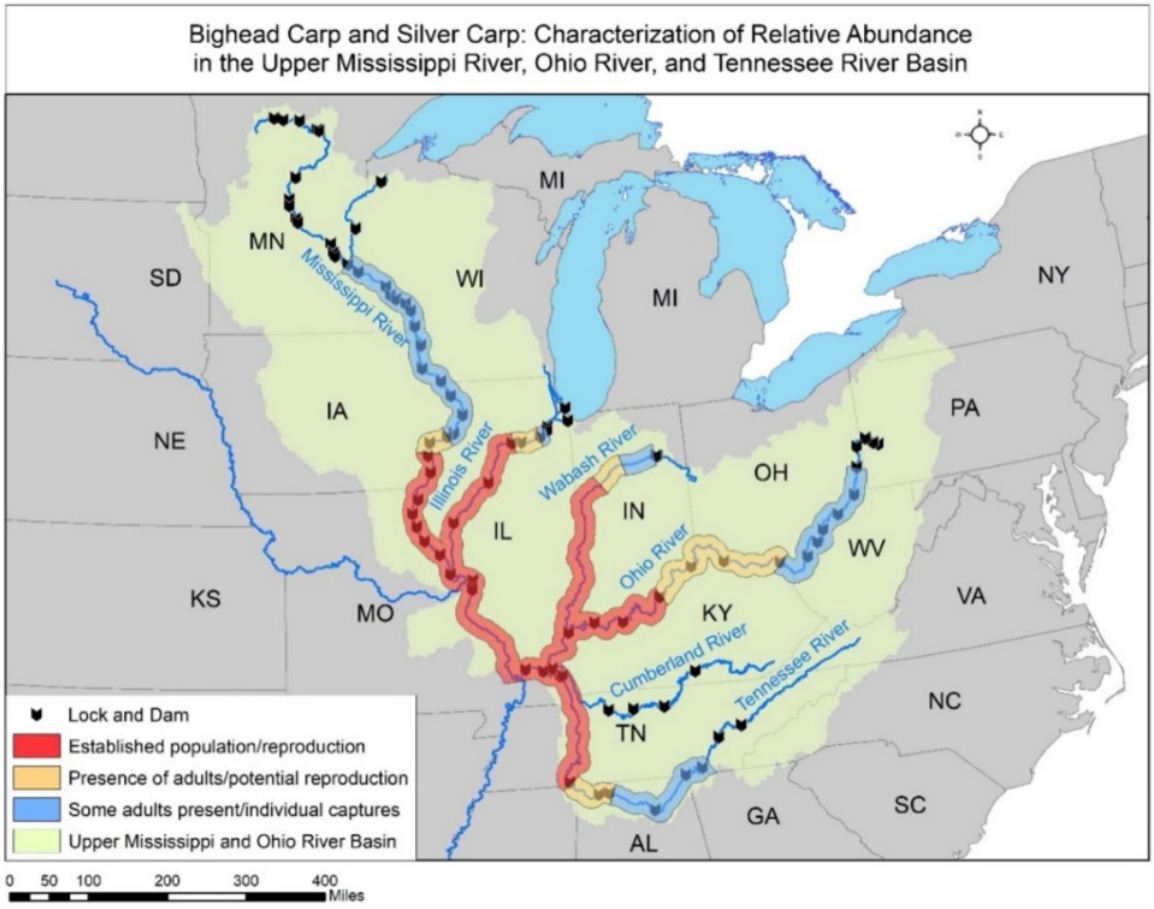


Figure 3: Characterization of current (2017) relative abundance of bighead carp and silver carp in the Upper Mississippi River basin, Ohio River basin, and Illinois Waterway/Chicago Area Waterway System {ACCRCC Action Plan 2019}.

Grass carp (*Ctenopharyngodon idella*): Grass carp was historically used by resource managers as a means of combating nuisance aquatic vegetation in ponds and lakes in the U.S. (Nico et al. 2023b). Records indicate that, by the mid-1970s, grass carp had been stocked in at least 45 states (ibid). Although not considered widely established outside the Mississippi River basin, grass carp is now the most widespread species of invasive carp in North America (Figure 4) (ACRCC Action Plan 2019). Grass carp prefers large, slow-flowing waterbodies and spawns in large rivers with moderate currents; however, adult grass carp can tolerate water temperatures ranging from 32 to 100 °F (ICRCC 2024c). Grass carp feeds on aquatic plants, but can also consume detritus, insects, small fish, earthworms, and other invertebrates, in the absence of aquatic vegetation (ibid). Grass carp can consume up to 40 percent of its body weight per day (ibid). Grass carp matures between 3 and 6 years, but it can take more than a decade to grow to a maximum size of 80 lb (ibid).

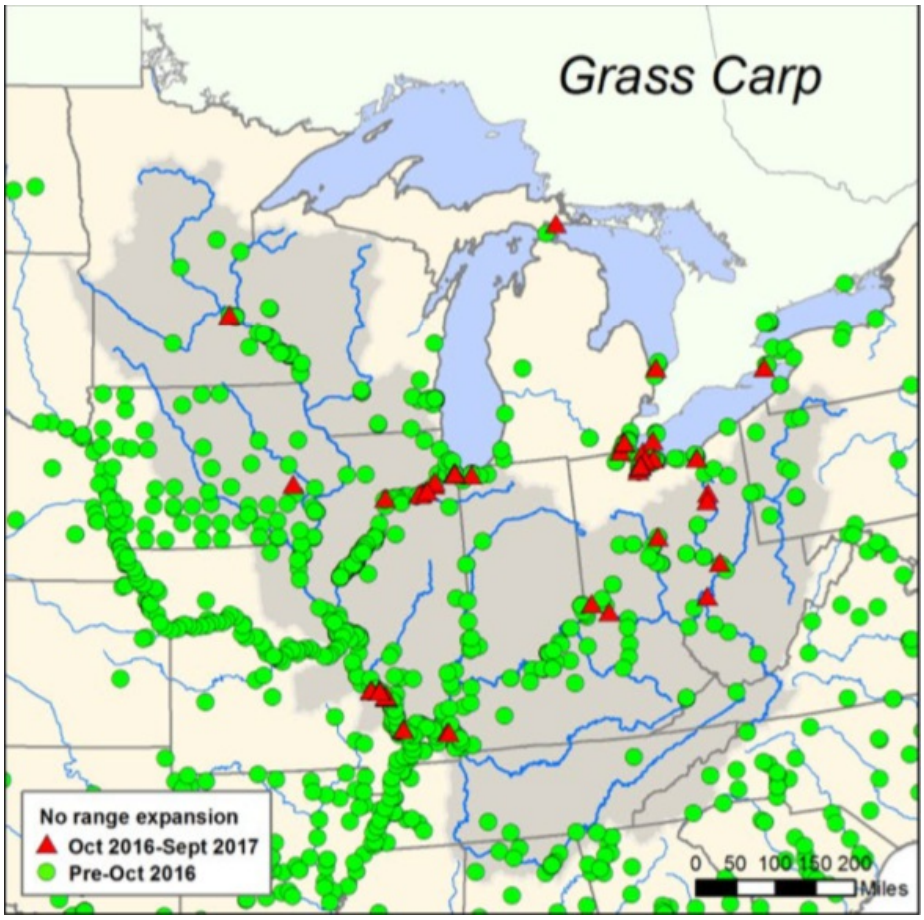


Figure 4: Range expansion maps of all grass carp: green circles represent the data points of occurrences before the reporting period (before October 2016); red triangles identify the new data points collected from October 2016 to September 2017; yellow triangles indicate occurrences that expanded the range of that species. Source: USGS NAS Database {ACCRCC Action Plan 2019}.

Gear types: There are three primary gear types used to capture invasive and common carp: 1) entanglement gear (gill/trammel nets), 2) traps (fyke nets, hoop nets, pound nets), and 3) active gear (seine nets). Gear types vary by inland and river waterway and state. Gillnets/trammel nets predominate in the Mississippi River basin; however, fyke nets are used frequently, and seine nets are gaining traction in some areas with larger commercial fisheries, such as Illinois. Fyke nets (Figure 5) and gillnets/trammel nets (Figure 6) are examples of passive capture techniques that involve the capture of fishes or other aquatic animals by entanglement, entrapment, or angling devices that are not actively moved by humans or machines while the organisms are being captured {Hubert et al., 2012}. It is important to note that, although gillnets are often fished passively, some fishers in the region are fishing them more actively by driving the carp into the gillnets with loud noises or other disturbances in the water (Tompkins 2024, pers. comm.). Seine nets (Figure 7) are an example of an active form of capture.

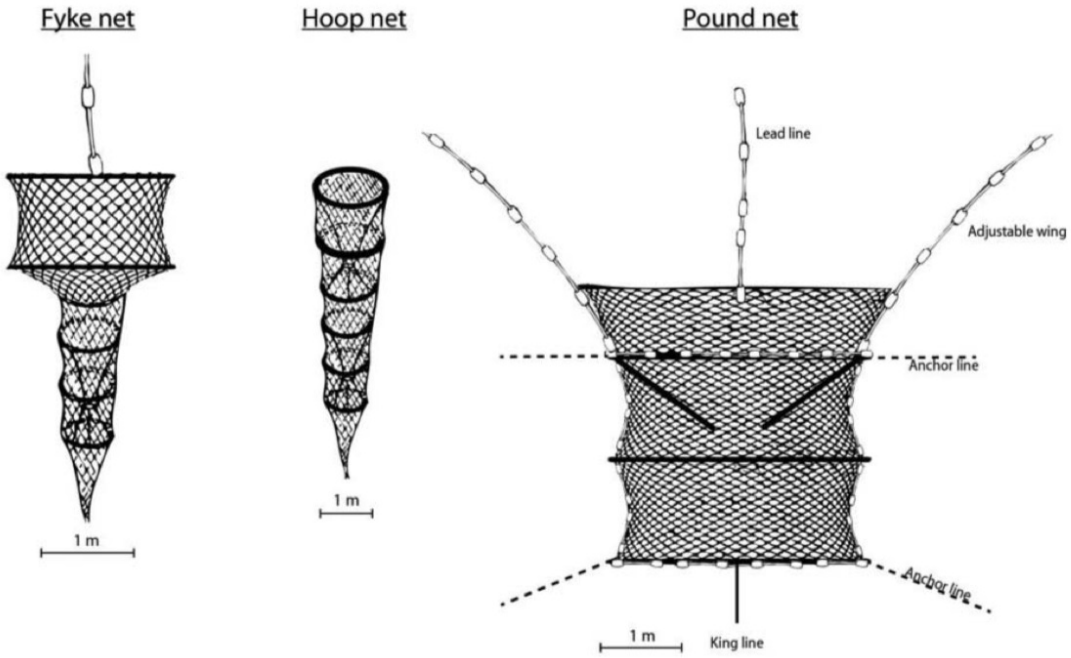


Figure 5: Fyke net schematic examples (Collins et al. 2015).

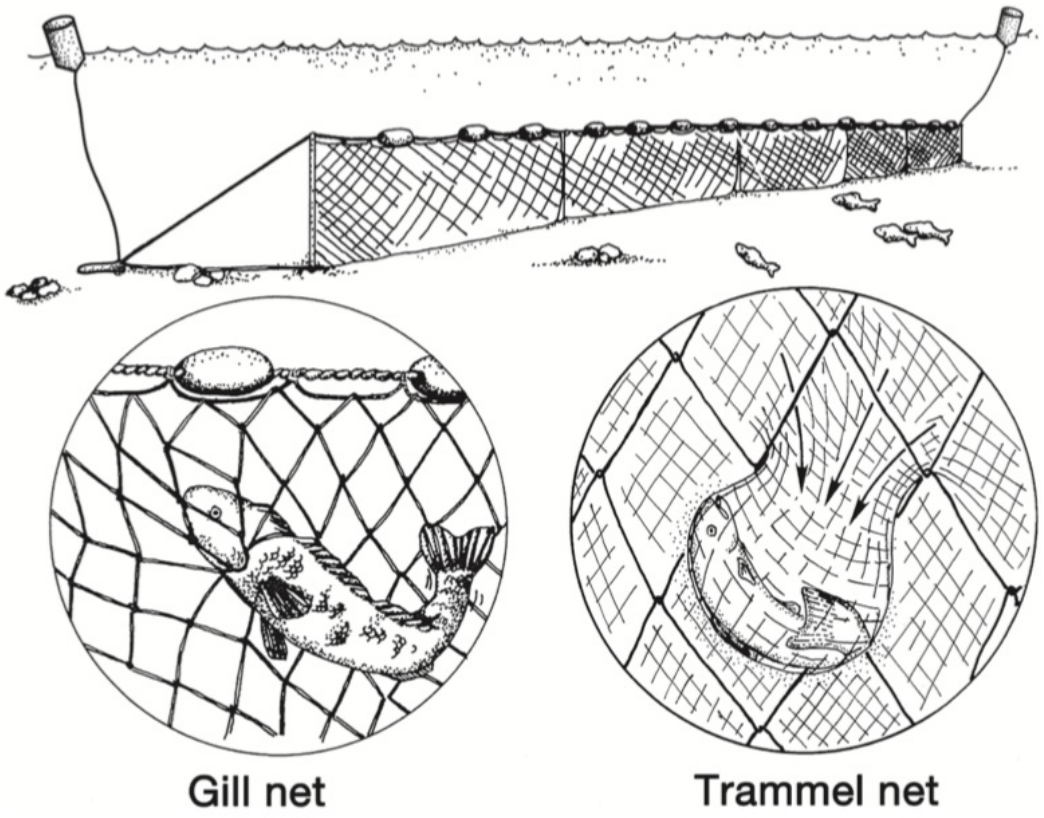


Figure 6: Schematic of gillnet and trammel net gear (Hubert et al. 2012).

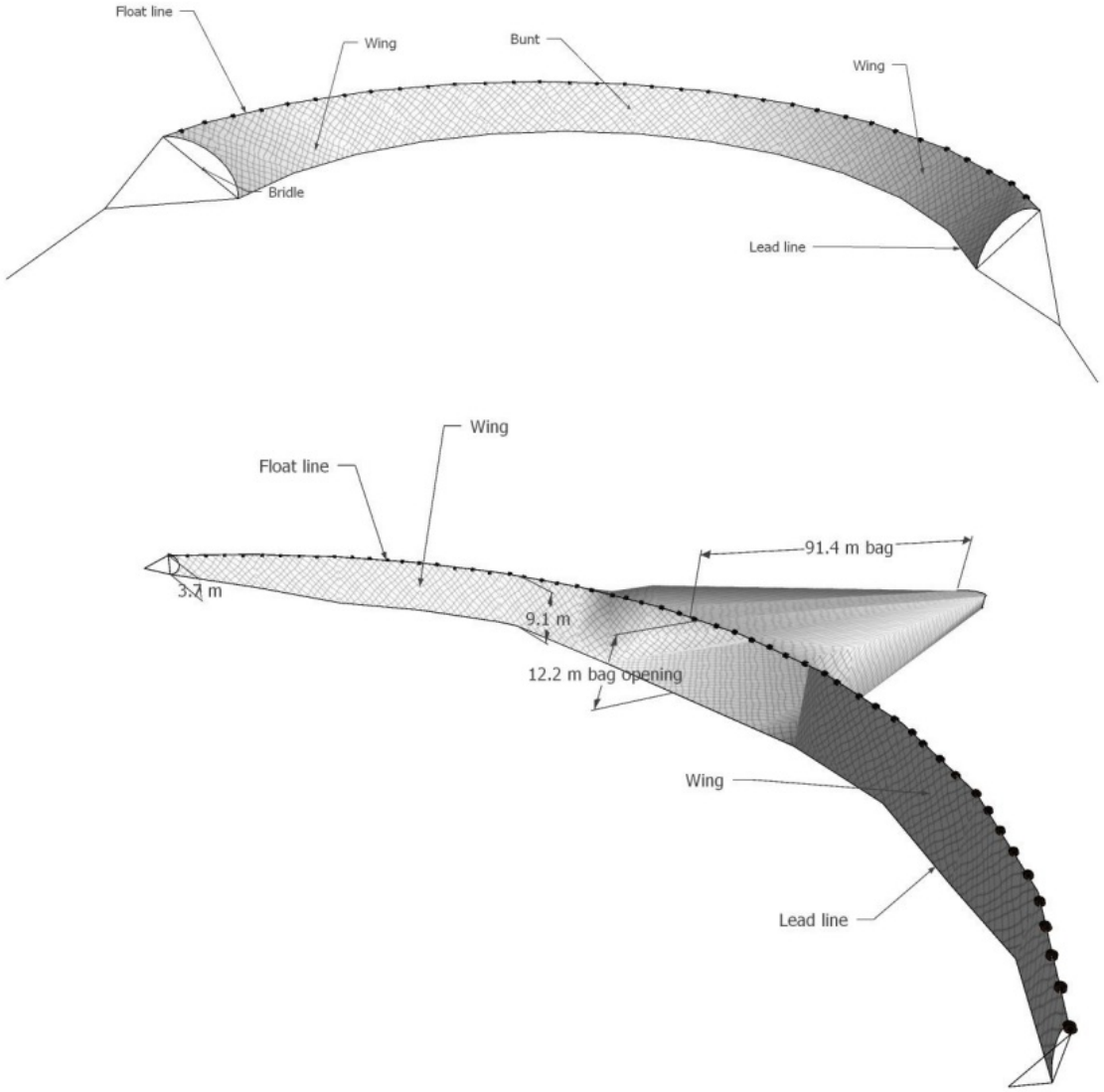


Figure 7: Generalized schematic of a commercial seine without a bag (top) and with a bag (bottom) (ICRCC 2023).

Production Statistics

Harvests of invasive and common carp vary by state. Illinois, Kentucky, and Tennessee harvest the highest levels of invasive carp in the basin. Low market demand and production capacity of invasive carp have limited the development of large-scale markets for these species. States like Kentucky, Tennessee, and Illinois support harvest incentive programs to foster the retention and utilization of carp species, and Missouri initiated a similar program in 2023. Substantial harvests of invasive carp in Kentucky support three processors in the western part of the state that process invasive carp for human consumption. Conversely, some states with less infrastructure have struggled to find processing facilities willing to pay competitive market-value prices for invasive carp. The price of invasive carp varies by state and is also influenced by its intended use (human consumption or fishmeal/fertilizer). Illinois, Missouri, and Kentucky pay harvesters

$0.10/lb for invasive carp (McMullen 2024, pers. comm.)(Tompkins 2024, pers. comm.) and the market price ranges from $0.09/lb to $0.30/lb (Garvey et al. 2024).

Common carp commercial fisheries have a longstanding history in the domestic U.S., with landings data dating to the early 1900s. By 1908, approximately 15 million pounds of common carp were caught in the Illinois River alone (Illinois State Museum 2024). In the second half of the 20th century, common carp landings in the Upper Mississippi River basin peaked in the early 1970s at nearly 7 million lb but declined significantly since (UMRCC 2020). Landings of silver and bighead carp in the Mississippi River basin have increased dramatically since 2001. Grass carp landings have been steady since 2009, averaging roughly 390,000 lb from 2009 to 2017 {UMRCC 2019}. As states along the Mississippi and Ohio River basins continue to work to develop markets and harvest incentive programs, it is expected that commercial landings of invasive carp will continue to increase (ACRCC Action Plan 2019). Data on production and market value are limited by state. The bulk of the catch in the Illinois fisheries is silver carp (Figure 8). From 2010 to 2022, contracted commercial fishers in Illinois have removed an estimated 5,805 t of invasive carp from the Illinois Waterway (IWW), below the electric dispersal barrier (ICRCC 2022). This total includes 1.3 million silver carp, 104,349 bighead carp, and 11,473 grass carp (ibid). Approximately 512.6 t of invasive carp were removed in the IWW in 2022 (ICRCC 2023). Commercial fishers harvested roughly 3,696 t of silver carp, 11 t of bighead carp, and 34 t of grass carp in 2021 under Kentucky's Asian Carp Harvest Program, primarily in Kentucky Lake and Lake Barkley (ORB/TNCR Invasive Carp Partnership 2022). The catch of bighead carp increased substantially over the course of the program (Figure 9). Tennessee's Carp Harvest Incentive Program (TCHIP) reported annual processing of 3,557 t of invasive carp (primarily silver carp) from 2022 to 2024 (Ganus 2024, pers. comm.). The Incentivized Carp Harvest Program in Missouri began in the autumn of 2023 on the Mississippi River. Harvest data are not yet available from the program, but commercial fishers landed a total of 300,609 lb of silver carp, 4,956 lb of bighead carp, 4,337 lb of common carp, and 4,644 ls of grass carp in the Mississippi River in 2021 (MDC 2023b).

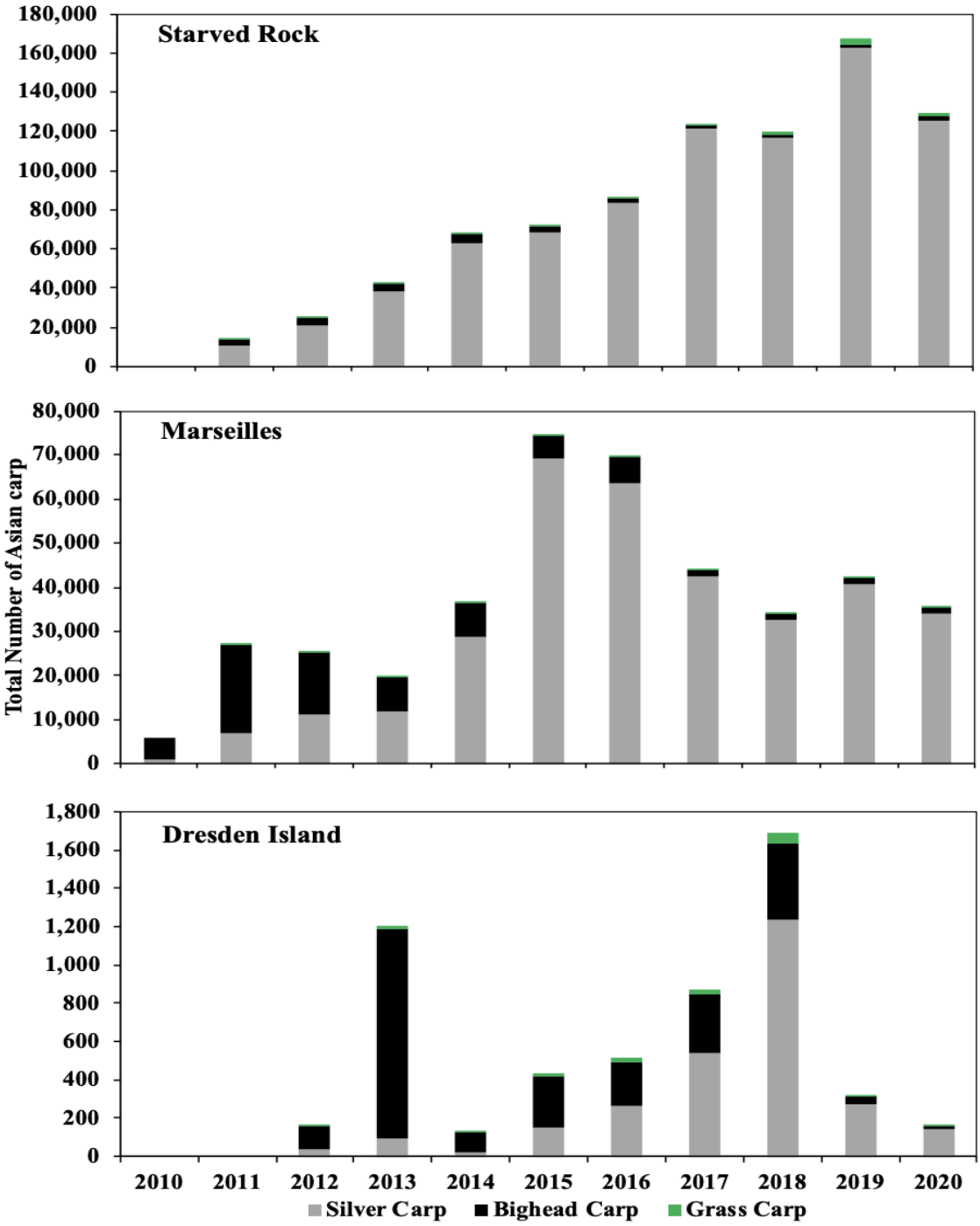
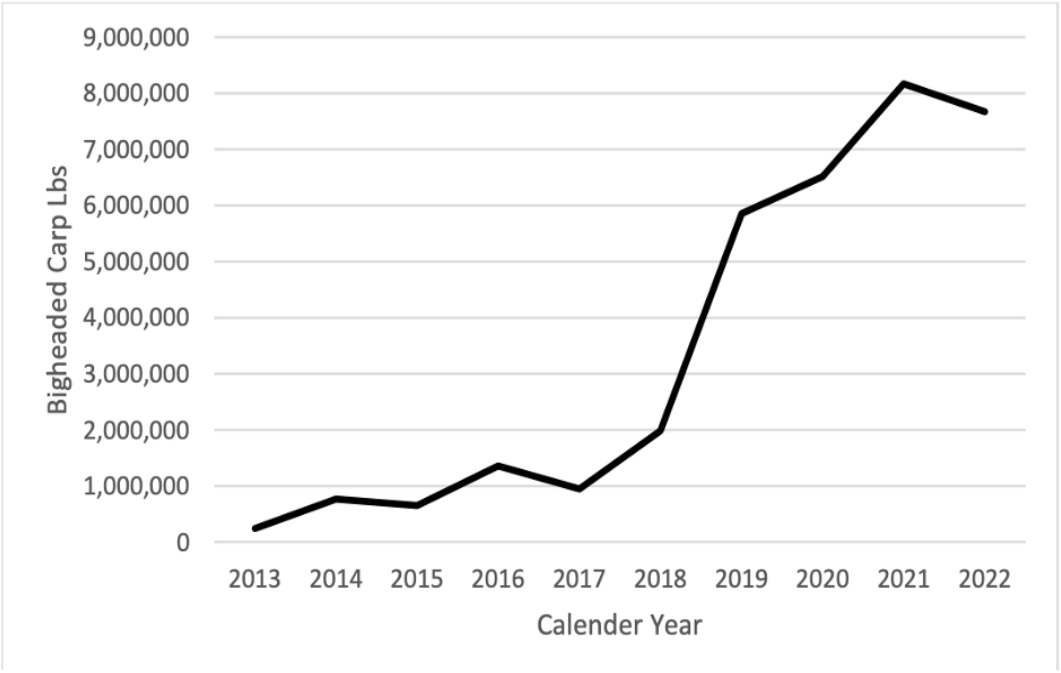


Figure 8: Annual catch of silver carp, bighead carp, and grass carp in Starved Rock (2011–20), Marseilles (2010–20), and Dresden Island (2011–20) pools (ACRCC 2020).



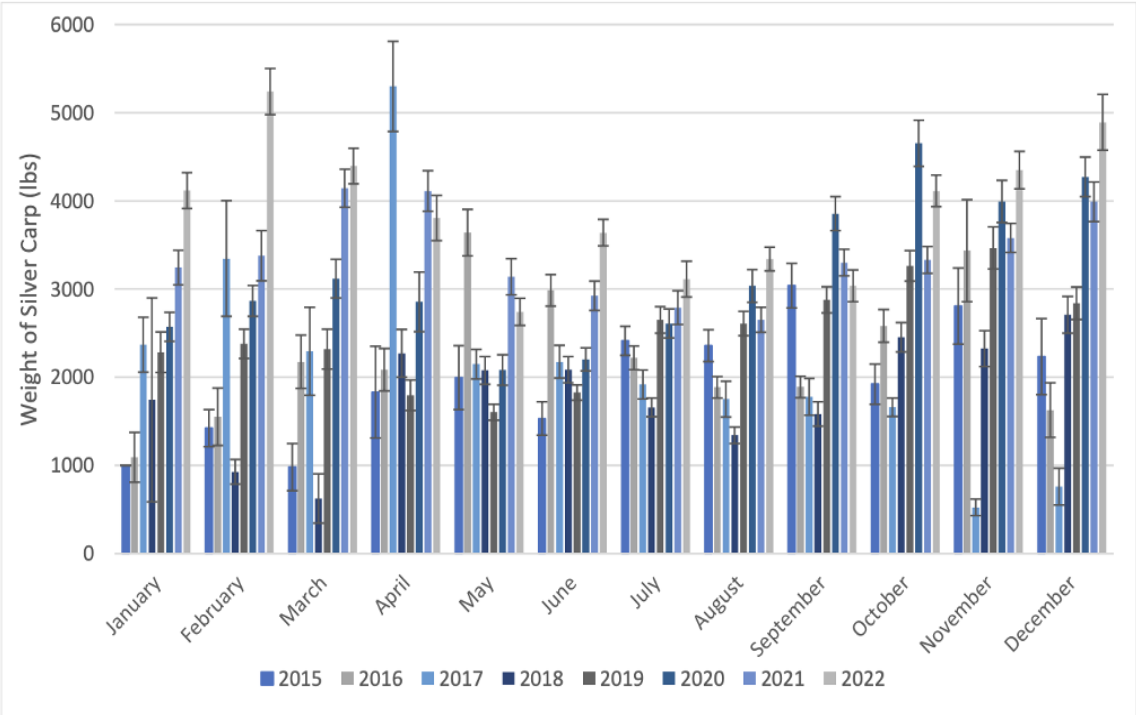


Figure 9: Pounds of bigheaded carp harvested in Kentucky through the Invasive Carp Harvest Program (ICHP) by calendar year (top) and monthly average total weight (lbs) of silver carp harvested per trip by commercial fishers fishing under the ICHP from January 2015 to December 2022 (bottom). Note: 2020 was the first year that grass carp harvest was tracked through the ICHP and accounted for an additional 111,190 lb in 2020, 74,430 lb in 2021, and 55,805 lb in 2022 {KDFWR 2023}.

Importance to the US/North American market.

Domestically, the market for food grade carp has decreased in the U.S. since 2020, but there has been an increase in demand for use of carp in fishmeal, fertilizer, and lobster bait (ORB/TNCR Invasive Carp Partnership 2022). Illinois spearheaded a marketing effort in 2022 to enhance a market for invasive carp (ICRCC 2022), and carp products have been rebranded as “Copi” (IDNR 2022). Other markets in development include pet food and leather production (Tompkins 2024, pers. comm.).

Invasive carp species are not standard imports to the U.S. due to limited domestic demand. Beginning in 2012, small amounts of carp species products were imported from Asia (primarily China, Vietnam, and South Korea), ranging from 2,722 t to 4,536 t, with values ranging from $3 million to $20 million, from 2012 to 2022 (NOAA 2023). Imports in 2022 totaled 3,404 t, valued at $17 million (NOAA 2023). The National Oceanic and Atmospheric Association (NOAA) tracks these imports; however, it is important to note that “carp” is lumped in with other more commonly traded species like catfish and tilapia. Therefore, carp likely represents a small proportion of these imports.

Similarly, carp exports are not tracked by species, and they are reportedly lumped in with other more common species. Exports ranged from 544 t to 998 t from 2010 to 2022, with estimated values ranging from $1.9 million to $3.6 million (NOAA 2023). Exports in 2022 totaled 517 t in 2022, with an estimated value of $2.4 million (NOAA 2023). Primary countries exported to include Canada, Mexico, and China.

Common and market names.

According to the the U.S. Food & Drug Administration, there are 20 species with “carp” as an acceptable market name (FDA 2024). “Copi” is a relatively new market name used to refer to silver carp, bighead carp, and grass carp (IDNR 2022). Other market and vernacular names are provided in Table 1.

Table 1

Common name	Market name	Vernacular name	Reference(s)
Common carp	Carp	European Carp, German carp, mirror carp, carfu	(Nico et al. 2023a)
Bighead carp	Bighead carp, silverfin, Copi		(IDNR 2022)
Silver carp	Silver carp, silverfin, Copi	Amur carp, Asiatic Carp, Israel Carp	(IDNR 2022)
Grass carp	Carp, silverfin	White amur, silver orf	(Nico et al. 2023b)

Primary product forms

Products include a variety of fillets, fish cakes, burgers, smoked fish, fish paste, and fish powder; pet foods; fishmeal; fertilizer; medical applications; nutritional supplements; and others (ACRCC 2019).

Assessment

This section assesses the sustainability of the fishery(s) relative to the Seafood Watch Standard for Fisheries, available at www.seafoodwatch.org. The specific standard used is referenced on the title page of all Seafood Watch assessments.

Criterion 1: Impacts on the species under assessment

This criterion evaluates the impact of fishing mortality on the species, given its current abundance. When abundance is unknown, abundance is scored based on the species' inherent vulnerability, which is calculated using a Productivity-Susceptibility Analysis. The final Criterion 1 score is determined by taking the geometric mean of the abundance and fishing mortality scores. The Criterion 1 rating is determined as follows:

- ***Score >3.2=Green or Low Concern***
- ***Score >2.2 and ≤3.2=Yellow or Moderate Concern***
- ***Score ≤2.2 = Red or High Concern***

Rating is Critical if Factor 1.3 (Fishing Mortality) is Critical.

Guiding principles

- *Ensure all affected stocks are healthy and abundant.*
- *Fish all affected stocks at sustainable level*

Criterion 1 Summary

BIGHEAD CARP			
REGION / METHOD	**ABUNDANCE**	**FISHING MORTALITY**	**SCORE**
Mississippi River | America, North - Inland Waters | United States | Illinois | Combined gillnets - trammel nets	5.000: Very Low Concern	5.000: Low Concern	Green (5.000)
Mississippi River | America, North - Inland Waters | United States | Missouri | Combined gillnets - trammel nets	5.000: Very Low Concern	5.000: Low Concern	Green (5.000)
Mississippi River | America, North - Inland Waters | United States | Illinois | Seine nets	5.000: Very Low Concern	5.000: Low Concern	Green (5.000)
Kentucky Lake, Lake Barkley | America, North - Inland Waters | United States | Set gillnets | Encircling gillnets	5.000: Very Low Concern	5.000: Low Concern	Green (5.000)
Kentucky Lake, Lake Barkley, Pickwick Lake | America, North - Inland Waters | United States | Tennessee | Set gillnets | Encircling gillnets	5.000: Very Low Concern	5.000: Low Concern	Green (5.000)

COMMON CARP			
REGION / METHOD	ABUNDANCE	FISHING MORTALITY	SCORE
Mississippi River | America, North - Inland Waters | United States | Illinois | Combined gillnets - trammel nets	5.000: Very Low Concern	5.000: Low Concern	Green (5.000)
Mississippi River | America, North - Inland Waters | United States | Missouri | Combined gillnets - trammel nets	5.000: Very Low Concern	5.000: Low Concern	Green (5.000)
Kentucky Lake, Lake Barkley | America, North - Inland Waters | United States | Set gillnets | Encircling gillnets	5.000: Very Low Concern	5.000: Low Concern	Green (5.000)
Kentucky Lake, Lake Barkley, Pickwick Lake | America, North - Inland Waters | United States | Tennessee | Set gillnets | Encircling gillnets	5.000: Very Low Concern	5.000: Low Concern	Green (5.000)

GRASS CARP			
REGION / METHOD	ABUNDANCE	FISHING MORTALITY	SCORE
Mississippi River | America, North - Inland Waters | United States | Illinois | Combined gillnets - trammel nets	5.000: Very Low Concern	5.000: Low Concern	Green (5.000)
Mississippi River | America, North - Inland Waters | United States | Missouri | Combined gillnets - trammel nets	5.000: Very Low Concern	5.000: Low Concern	Green (5.000)
Mississippi River | America, North - Inland Waters | United States | Illinois | Seine nets	5.000: Very Low Concern	5.000: Low Concern	Green (5.000)
Kentucky Lake, Lake Barkley | America, North - Inland Waters | United States | Set gillnets | Encircling gillnets	5.000: Very Low Concern	5.000: Low Concern	Green (5.000)
Kentucky Lake, Lake Barkley, Pickwick Lake | America, North - Inland Waters | United States | Tennessee | Set gillnets | Encircling gillnets	5.000: Very Low Concern	5.000: Low Concern	Green (5.000)

SILVER CARP			
REGION / METHOD	ABUNDANCE	FISHING MORTALITY	SCORE
Mississippi River | America, North - Inland Waters | United States | Illinois | Combined gillnets - trammel nets	5.000: Very Low Concern	5.000: Low Concern	Green (5.000)
Mississippi River | America, North - Inland Waters | United States | Missouri | Combined gillnets - trammel nets	5.000: Very Low Concern	5.000: Low Concern	Green (5.000)
Mississippi River | America, North - Inland Waters | United States | Missouri | Seine nets	5.000: Very Low Concern	5.000: Low Concern	Green (5.000)
Mississippi River | America, North - Inland Waters | United States | Illinois | Seine nets	5.000: Very Low Concern	5.000: Low Concern	Green (5.000)
Kentucky Lake, Lake Barkley | America, North - Inland Waters | United States | Set gillnets | Encircling gillnets	5.000: Very Low Concern	5.000: Low Concern	Green (5.000)
Kentucky Lake, Lake Barkley, Pickwick Lake | America, North - Inland Waters | United States | Tennessee | Set gillnets | Encircling gillnets	5.000: Very Low Concern	5.000: Low Concern	Green (5.000)

Criterion 1 Assessments

SCORING GUIDELINES

Factor 1.1 - Abundance
Goal: Stock abundance and size structure of native species is maintained at a level that does not impair recruitment or productivity.

- *5 (Very Low Concern) — Strong evidence exists that the population is above an appropriate target abundance level (given the species' ecological role), or near virgin biomass.*
- *3.67 (Low Concern) — Population may be below target abundance level, but is at least 75% of the target level, OR data-limited assessments suggest population is healthy and species is not highly vulnerable.*
- *2.33 (Moderate Concern) — Population is not overfished but may be below 75% of the target abundance level, OR abundance is unknown and the species is not highly vulnerable.*
- *1 (High Concern) — Population is considered overfished/depleted, a species of concern, threatened or endangered, OR abundance is unknown and species is highly vulnerable.*

Factor 1.2 - Fishing Mortality
Goal: Fishing mortality is appropriate for current state of the stock.

- *5 (Low Concern) — Probable (>50%) that fishing mortality from all sources is at or below a sustainable level, given the species ecological role, OR fishery does not target species and fishing mortality is low enough to not adversely affect its population.*
- *3 (Moderate Concern) — Fishing mortality is fluctuating around sustainable levels, OR fishing mortality relative to a sustainable level is uncertain.*
- *1 (High Concern) — Probable that fishing mortality from all source is above a sustainable level.*

Bighead carp (Hypophthalmichthys nobilisS)

Factor 1.1 - Abundance

Mississippi River | America, North - Inland Waters | United States | Illinois | Combined gillnets - trammel nets
Mississippi River | America, North - Inland Waters | United States | Missouri | Combined gillnets - trammel nets
Mississippi River | America, North - Inland Waters | United States | Illinois | Seine nets
Kentucky Lake, Lake Barkley | America, North - Inland Waters | United States | Set gillnets | Encircling gillnets
Kentucky Lake, Lake Barkley, Pickwick Lake | America, North - Inland Waters | United States | Tennessee | Set gillnets | Encircling gillnets

Very Low Concern

All four carp species assessed in this report are nonnative; therefore, abundance is considered a "very low concern" based on Seafood Watch Criteria.

Factor 1.2 - Fishing Mortality

Mississippi River | America, North - Inland Waters | United States | Illinois | Combined gillnets - trammel nets
Mississippi River | America, North - Inland Waters | United States | Missouri | Combined gillnets - trammel nets
Mississippi River | America, North - Inland Waters | United States | Illinois | Seine nets
Kentucky Lake, Lake Barkley | America, North - Inland Waters | United States | Set gillnets | Encircling gillnets
Kentucky Lake, Lake Barkley, Pickwick Lake | America, North - Inland Waters | United States | Tennessee | Set gillnets | Encircling gillnets

Low Concern

Silver carp, bighead carp, grass carp, and common carp are nonnative and fishing mortality is considered a "low concern" in all states. State-specific, nonnative carp harvest information follows.

Justification:

Illinois

Illinois' carp harvest programs are designed to maximize harvests (ICRCC 2022). Total catches of invasive carp and common carp are relatively high in Illinois, averaging over 6 million lb total from 2013 to 2017 (Maher 2017). Because of identification challenges and similar morphology between species, bighead carp and silver carp landings are reported together in Illinois and averaged approximately 5 million lb from 2013 to 2017; both grass carp and common carp averaged roughly 775,000 lb during that same period and peaked at over 1 million lb in 2017 (ibid). There are three primary gear types used in Illinois: gillnets/trammel nets captured roughly 80% of carp catches in 2017, with hoop nets and seine nets at about 10% each (Maher 2017). In 2020, over 2.8 million lb of invasive carp were removed by contract fishers in the Peoria Pool of the Illinois Waterway and

106,373 lb from the Lockport, Brandon Road, and Dresden Island pools (ICRCC 2022).

Kentucky

Kentucky currently manages a comprehensive invasive carp tracking and harvest incentive program; a formal Asian Carp Control Strategy Framework and an Asian Carp Harvest Program were established in 2014 (KDFWR 2019). The Harvest Incentive Program supports invasive carp harvests in a number of ways, including: opening access to more waters during longer seasons for commercial fishers, subsidizing fishers' revenue per pound of invasive carp landed, and providing free ice to carp fishers (ibid). Catches of invasive carp have increased steadily since the inception of the programs in 2013 and 2014. Under the programs, commercial fishers harvested over 7 million lb of invasive carp in 2021 (KDFWR 2022b). Also, fishers landed 238,351 lb during testing of experimental gears in Kentucky waters in 2021 (ibid).

Tennessee

Data on carp harvests in Tennessee before 2016 are unavailable due to limited reporting requirements in Tennessee in previous years. In 2018, approximately 105,852 lb of common carp, 990,000 lb of silver carp, 25,000 lb of bighead carp, and 38,320 lb of grass carp were harvested {Ganus 2019, pers. comm.}. Fishery managers believe that these values reflect the catch levels from the past 5 years (ibid). Because of the nature of Tennessee's waterways, gillnets are the primary gear used to target invasive carp species.

Missouri

The Incentivized Carp Harvest Program in Missouri began in the autumn of 2023 on the Mississippi River (MDC 2023b). Harvest data are not yet available from this program, but commercial fishers landed a total of 300,609 lb of silver carp, 4,956 lb of bighead carp, 4,337 lb of common carp, and 4,644 lb of grass carp in the Mississippi River in 2021 (ibid).

Common carp (Cyprinus carpioS)

Factor 1.1 - Abundance

Mississippi River | America, North - Inland Waters | United States | Illinois | Combined gillnets - trammel nets
Mississippi River | America, North - Inland Waters | United States | Missouri | Combined gillnets - trammel nets
Kentucky Lake, Lake Barkley | America, North - Inland Waters | United States | Set gillnets | Encircling gillnets
Kentucky Lake, Lake Barkley, Pickwick Lake | America, North - Inland Waters | United States | Tennessee | Set gillnets | Encircling gillnets

Very Low Concern

All four carp species assessed in this report are nonnative; therefore, abundance is considered a "very low concern" based on Seafood Watch Criteria.

Factor 1.2 - Fishing Mortality

Mississippi River | America, North - Inland Waters | United States | Illinois | Combined gillnets - trammel nets
Mississippi River | America, North - Inland Waters | United States | Missouri | Combined gillnets - trammel nets
Kentucky Lake, Lake Barkley | America, North - Inland Waters | United States | Set gillnets | Encircling gillnets
Kentucky Lake, Lake Barkley, Pickwick Lake | America, North - Inland Waters | United States | Tennessee | Set gillnets | Encircling gillnets

Low Concern
Silver carp, bighead carp, grass carp, and common carp are nonnative and fishing mortality is considered a "low concern" in all states. State-specific, nonnative carp harvest information follows.

Justification:

Illinois

Illinois' carp harvest programs are designed to maximize harvests (ICRCC 2022). Total catches of invasive carp and common carp are relatively high in Illinois, averaging over 6 million lb total from 2013 to 2017 (Maher 2017). Because of identification challenges and similar morphology between species, bighead carp and silver carp landings are reported together in Illinois and averaged approximately 5 million lb from 2013 to 2017; both grass carp and common carp averaged roughly 775,000 lb during that same period and peaked at over 1 million lb in 2017 (ibid). There are three primary gear types used in Illinois: gillnets/trammel nets captured roughly 80% of carp catches in 2017, with hoop nets and seine nets at about 10% each (Maher 2017). In 2020, over 2.8 million lb of invasive carp were removed by contract fishers in the Peoria Pool of the Illinois Waterway and 106,373 lb from the Lockport, Brandon Road, and Dresden Island pools (ICRCC 2022).

Kentucky

Kentucky currently manages a comprehensive invasive carp tracking and harvest incentive program; a formal Asian Carp Control Strategy Framework and an Asian Carp Harvest Program were established in 2014 (KDFWR 2019). The Harvest Incentive Program supports invasive carp harvests in a number of ways, including: opening access to more waters during longer seasons for commercial fishers, subsidizing fishers' revenue per pound of invasive carp landed, and providing free ice to carp fishers (ibid). Catches of invasive carp have increased steadily since the inception of the programs in 2013 and 2014. Under the programs, commercial fishers harvested over 7 million lb of invasive carp in 2021 (KDFWR 2022b). Also, fishers landed 238,351 lb during testing of experimental gears in Kentucky waters in 2021 (ibid).

Tennessee

Data on carp harvests in Tennessee before 2016 are unavailable due to limited reporting requirements in Tennessee in previous years. In 2018, approximately 105,852 lb of common carp, 990,000 lb of silver carp, 25,000 lb of bighead carp, and 38,320 lb of grass carp were harvested {Ganus 2019, pers. comm.}. Fishery managers believe that these values reflect the catch levels from the past 5 years (ibid). Because of the nature of Tennessee's waterways, gillnets are the primary

gear used to target invasive carp species.

Missouri

The Incentivized Carp Harvest Program in Missouri began in the autumn of 2023 on the Mississippi River (MDC 2023b). Harvest data are not yet available from this program, but commercial fishers landed a total of 300,609 lb of silver carp, 4,956 lb of bighead carp, 4,337 lb of common carp, and 4,644 lb of grass carp in the Mississippi River in 2021 (ibid).

Grass carp (Ctenopharyngodon idellaS)

Factor 1.1 - Abundance

Mississippi River | America, North - Inland Waters | United States | Illinois | Combined gillnets - trammel nets
Mississippi River | America, North - Inland Waters | United States | Missouri | Combined gillnets - trammel nets
Mississippi River | America, North - Inland Waters | United States | Illinois | Seine nets
Kentucky Lake, Lake Barkley | America, North - Inland Waters | United States | Set gillnets | Encircling gillnets
Kentucky Lake, Lake Barkley, Pickwick Lake | America, North - Inland Waters | United States | Tennessee | Set gillnets | Encircling gillnets

Very Low Concern

All four carp species assessed in this report are nonnative; therefore, abundance is considered a “very low concern” based on Seafood Watch Criteria.

Factor 1.2 - Fishing Mortality

Mississippi River | America, North - Inland Waters | United States | Illinois | Combined gillnets - trammel nets
Mississippi River | America, North - Inland Waters | United States | Missouri | Combined gillnets - trammel nets
Mississippi River | America, North - Inland Waters | United States | Illinois | Seine nets
Kentucky Lake, Lake Barkley | America, North - Inland Waters | United States | Set gillnets | Encircling gillnets
Kentucky Lake, Lake Barkley, Pickwick Lake | America, North - Inland Waters | United States | Tennessee | Set gillnets | Encircling gillnets

Low Concern

Silver carp, bighead carp, grass carp, and common carp are nonnative and fishing mortality is considered a "low concern" in all states. State-specific, nonnative carp harvest information follows.

Justification:

Illinois

Illinois’ carp harvest programs are designed to maximize harvests (ICRCC 2022). Total catches of

invasive carp and common carp are relatively high in Illinois, averaging over 6 million lb total from 2013 to 2017 (Maher 2017). Because of identification challenges and similar morphology between species, bighead carp and silver carp landings are reported together in Illinois and averaged approximately 5 million lb from 2013 to 2017; both grass carp and common carp averaged roughly 775,000 lb during that same period and peaked at over 1 million lb in 2017 (ibid). There are three primary gear types used in Illinois: gillnets/trammel nets captured roughly 80% of carp catches in 2017, with hoop nets and seine nets at about 10% each (Maher 2017). In 2020, over 2.8 million lb of invasive carp were removed by contract fishers in the Peoria Pool of the Illinois Waterway and 106,373 lb from the Lockport, Brandon Road, and Dresden Island pools (ICRCC 2022).

Kentucky

Kentucky currently manages a comprehensive invasive carp tracking and harvest incentive program; a formal Asian Carp Control Strategy Framework and an Asian Carp Harvest Program were established in 2014 (KDFWR 2019). The Harvest Incentive Program supports invasive carp harvests in a number of ways, including: opening access to more waters during longer seasons for commercial fishers, subsidizing fishers' revenue per pound of invasive carp landed, and providing free ice to carp fishers (ibid). Catches of invasive carp have increased steadily since the inception of the programs in 2013 and 2014. Under the programs, commercial fishers harvested over 7 million lb of invasive carp in 2021 (KDFWR 2022b). Also, fishers landed 238,351 lb during testing of experimental gears in Kentucky waters in 2021 (ibid).

Tennessee

Data on carp harvests in Tennessee before 2016 are unavailable due to limited reporting requirements in Tennessee in previous years. In 2018, approximately 105,852 lb of common carp, 990,000 lb of silver carp, 25,000 lb of bighead carp, and 38,320 lb of grass carp were harvested {Ganus 2019, pers. comm.}. Fishery managers believe that these values reflect the catch levels from the past 5 years (ibid). Because of the nature of Tennessee's waterways, gillnets are the primary gear used to target invasive carp species.

Missouri

The Incentivized Carp Harvest Program in Missouri began in the autumn of 2023 on the Mississippi River (MDC 2023b). Harvest data are not yet available from this program, but commercial fishers landed a total of 300,609 lb of silver carp, 4,956 lb of bighead carp, 4,337 lb of common carp, and 4,644 lb of grass carp in the Mississippi River in 2021 (ibid).

Silver carp (Hypophthalmichthys molitrixS)

Factor 1.1 - Abundance

Mississippi River | America, North - Inland Waters | United States | Illinois | Combined gillnets - trammel nets
Mississippi River | America, North - Inland Waters | United States | Missouri | Combined gillnets - trammel nets
Mississippi River | America, North - Inland Waters | United States | Missouri | Seine nets

Mississippi River | America, North - Inland Waters | United States | Illinois | Seine nets
Kentucky Lake, Lake Barkley | America, North - Inland Waters | United States | Set gillnets | Encircling gillnets
Kentucky Lake, Lake Barkley, Pickwick Lake | America, North - Inland Waters | United States | Tennessee | Set gillnets | Encircling gillnets

Very Low Concern

All four carp species assessed in this report are nonnative; therefore, abundance is considered a "very low concern" based on Seafood Watch Criteria.

Factor 1.2 - Fishing Mortality

Mississippi River | America, North - Inland Waters | United States | Illinois | Combined gillnets - trammel nets
Mississippi River | America, North - Inland Waters | United States | Missouri | Combined gillnets - trammel nets
Mississippi River | America, North - Inland Waters | United States | Missouri | Seine nets
Mississippi River | America, North - Inland Waters | United States | Illinois | Seine nets
Kentucky Lake, Lake Barkley | America, North - Inland Waters | United States | Set gillnets | Encircling gillnets
Kentucky Lake, Lake Barkley, Pickwick Lake | America, North - Inland Waters | United States | Tennessee | Set gillnets | Encircling gillnets

Low Concern

Silver carp, bighead carp, grass carp, and common carp are nonnative and fishing mortality is considered a "low concern" in all states. State-specific, nonnative carp harvest information follows.

Justification:

Illinois

Illinois' carp harvest programs are designed to maximize harvests (ICRCC 2022). Total catches of invasive carp and common carp are relatively high in Illinois, averaging over 6 million lb total from 2013 to 2017 (Maher 2017). Because of identification challenges and similar morphology between species, bighead carp and silver carp landings are reported together in Illinois and averaged approximately 5 million lb from 2013 to 2017; both grass carp and common carp averaged roughly 775,000 lb during that same period and peaked at over 1 million lb in 2017 (ibid). There are three primary gear types used in Illinois: gillnets/trammel nets captured roughly 80% of carp catches in 2017, with hoop nets and seine nets at about 10% each (Maher 2017). In 2020, over 2.8 million lb of invasive carp were removed by contract fishers in the Peoria Pool of the Illinois Waterway and 106,373 lb from the Lockport, Brandon Road, and Dresden Island pools (ICRCC 2022).

Kentucky

Kentucky currently manages a comprehensive invasive carp tracking and harvest incentive program; a formal Asian Carp Control Strategy Framework and an Asian Carp Harvest Program were established in 2014 (KDFWR 2019). The Harvest Incentive Program supports invasive carp harvests in a number of ways, including: opening access to more waters during longer seasons for commercial fishers, subsidizing fishers' revenue per pound of invasive carp landed, and providing

free ice to carp fishers (ibid). Catches of invasive carp have increased steadily since the inception of the programs in 2013 and 2014. Under the programs, commercial fishers harvested over 7 million lb of invasive carp in 2021 (KDFWR 2022b). Also, fishers landed 238,351 lb during testing of experimental gears in Kentucky waters in 2021 (ibid).

Tennessee

Data on carp harvests in Tennessee before 2016 are unavailable due to limited reporting requirements in Tennessee in previous years. In 2018, approximately 105,852 lb of common carp, 990,000 lb of silver carp, 25,000 lb of bighead carp, and 38,320 lb of grass carp were harvested {Ganus 2019, pers. comm.}. Fishery managers believe that these values reflect the catch levels from the past 5 years (ibid). Because of the nature of Tennessee's waterways, gillnets are the primary gear used to target invasive carp species.

Missouri

The Incentivized Carp Harvest Program in Missouri began in the autumn of 2023 on the Mississippi River (MDC 2023b). Harvest data are not yet available from this program, but commercial fishers landed a total of 300,609 lb of silver carp, 4,956 lb of bighead carp, 4,337 lb of common carp, and 4,644 lb of grass carp in the Mississippi River in 2021 (ibid).

Criterion 2: Impacts on Other Species

All main retained and bycatch species in the fishery are evaluated under Criterion 2. Seafood Watch defines bycatch as all fisheries-related mortality or injury to species other than the retained catch. Examples include discards, endangered or threatened species catch, and ghost fishing. Species are evaluated using the same guidelines as in Criterion 1. When information on other species caught in the fishery is unavailable, the fishery's potential impacts on other species is scored according to the Unknown Bycatch Matrices, which are based on a synthesis of peer-reviewed literature and expert opinion on the bycatch impacts of each gear type. The fishery is also scored for the amount of non-retained catch (discards) and bait use relative to the retained catch. To determine the final Criterion 2 score, the score for the lowest scoring retained/bycatch species is multiplied by the discard/bait score. The Criterion 2 rating is determined as follows:

- ***Score >3.2=Green or Low Concern***
- ***Score >2.2 and ≤3.2=Yellow or Moderate Concern***
- ***Score ≤2.2 = Red or High Concern***

Rating is Critical if Factor 2.3 (Fishing Mortality) is Crtitical

Guiding principles

- *Ensure all affected stocks are healthy and abundant.*
- *Fish all affected stocks at sustainable level.*
- *Minimize bycatch.*

Criterion 2 Summary

Criterion 2 score(s) overview

This table(s) provides an overview of the Criterion 2 subscore, discards+bait modifier, and final Criterion 2 score for each fishery. A separate table is provided for each species/stock that we want an overall rating for.

BIGHEAD CARP			
REGION / METHOD	SUB SCORE	DISCARD RATE/LANDINGS	SCORE
Mississippi River | America, North - Inland Waters | United States | Illinois | Combined gillnets - trammel nets	2.644	1.000: < 100%	Yellow (2.644)
Mississippi River | America, North - Inland Waters | United States | Missouri | Combined gillnets - trammel nets	1.732	1.000: < 100%	Red (1.732)
Mississippi River | America, North - Inland Waters | United States | Illinois | Seine nets	2.644	1.000: < 100%	Yellow (2.644)
Kentucky Lake, Lake Barkley | America, North - Inland Waters | United States | Set gillnets | Encircling gillnets	1.732	1.000: < 100%	Red (1.732)
Kentucky Lake, Lake Barkley, Pickwick Lake | America, North - Inland Waters | United States | Tennessee | Set gillnets | Encircling gillnets	1.732	1.000: < 100%	Red (1.732)

COMMON CARP			
REGION / METHOD	SUB SCORE	DISCARD RATE/LANDINGS	SCORE
Mississippi River | America, North - Inland Waters | United States | Illinois | Combined gillnets - trammel nets	2.644	1.000: < 100%	Yellow (2.644)
Mississippi River | America, North - Inland Waters | United States | Missouri | Combined gillnets - trammel nets	1.732	1.000: < 100%	Red (1.732)
Kentucky Lake, Lake Barkley | America, North - Inland Waters | United States | Set gillnets | Encircling gillnets	1.732	1.000: < 100%	Red (1.732)
Kentucky Lake, Lake Barkley, Pickwick Lake | America, North - Inland Waters | United States | Tennessee | Set gillnets | Encircling gillnets	1.732	1.000: < 100%	Red (1.732)

GRASS CARP			
REGION / METHOD	SUB SCORE	DISCARD RATE/LANDINGS	SCORE
Mississippi River | America, North - Inland Waters | United States | Illinois | Combined gillnets - trammel nets	2.644	1.000: < 100%	Yellow (2.644)
Mississippi River | America, North - Inland Waters | United States | Missouri | Combined gillnets - trammel nets	1.732	1.000: < 100%	Red (1.732)
Mississippi River | America, North - Inland Waters | United States | Illinois | Seine nets	2.644	1.000: < 100%	Yellow (2.644)
Kentucky Lake, Lake Barkley | America, North - Inland Waters | United States | Set gillnets | Encircling gillnets	1.732	1.000: < 100%	Red (1.732)
Kentucky Lake, Lake Barkley, Pickwick Lake | America, North - Inland Waters | United States | Tennessee | Set gillnets | Encircling gillnets	1.732	1.000: < 100%	Red (1.732)

SILVER CARP			
REGION / METHOD	SUB SCORE	DISCARD RATE/LANDINGS	SCORE
Mississippi River | America, North - Inland Waters | United States | Illinois | Combined gillnets - trammel nets	2.644	1.000: < 100%	Yellow (2.644)
Mississippi River | America, North - Inland Waters | United States | Missouri | Combined gillnets - trammel nets	1.732	1.000: < 100%	Red (1.732)
Mississippi River | America, North - Inland Waters | United States | Missouri | Seine nets	2.644	1.000: < 100%	Yellow (2.644)
Mississippi River | America, North - Inland Waters | United States | Illinois | Seine nets	2.644	1.000: < 100%	Yellow (2.644)
Kentucky Lake, Lake Barkley | America, North - Inland Waters | United States | Set gillnets | Encircling gillnets	1.732	1.000: < 100%	Red (1.732)
Kentucky Lake, Lake Barkley, Pickwick Lake | America, North - Inland Waters | United States | Tennessee | Set gillnets | Encircling gillnets	1.732	1.000: < 100%	Red (1.732)

Criterion 2 main assessed species/stocks table(s)

This table(s) provides a list of all species/stocks included in this assessment for each 'fishery' (as defined by a region/method combination). The text following this table(s) provides an explanation of the reasons the listed species were selected for inclusion in the assessment.

KENTUCKY LAKE, LAKE BARKLEY | AMERICA, NORTH - INLAND WATERS | UNITED STATES | SET GILLNETS | ENCIRCLING GILLNETS			
SUB SCORE: 1.732	DISCARD RATE: 1.000	SCORE: 1.732	
SPECIES	ABUNDANCE	FISHING MORTALITY	SCORE
Lake sturgeon	1.000: High Concern	3.000: Moderate Concern	Red (1.732)
Paddlefish	1.000: High Concern	3.000: Moderate Concern	Red (1.732)
Bighead carp	5.000: Very Low Concern	5.000: Low Concern	Green (5.000)
Common carp	5.000: Very Low Concern	5.000: Low Concern	Green (5.000)
Grass carp	5.000: Very Low Concern	5.000: Low Concern	Green (5.000)
Silver carp	5.000: Very Low Concern	5.000: Low Concern	Green (5.000)

KENTUCKY LAKE, LAKE BARKLEY, PICKWICK LAKE | AMERICA, NORTH - INLAND WATERS | UNITED STATES | TENNESSEE | SET GILLNETS | ENCIRCLING GILLNETS

SUB SCORE: 1.732 | DISCARD RATE: 1.000 | **SCORE: 1.732**

SPECIES	ABUNDANCE	FISHING MORTALITY	SCORE
Lake sturgeon	1.000: High Concern	3.000: Moderate Concern	Red (1.732)
Paddlefish	1.000: High Concern	3.000: Moderate Concern	Red (1.732)
Bighead carp	5.000: Very Low Concern	5.000: Low Concern	Green (5.000)
Common carp	5.000: Very Low Concern	5.000: Low Concern	Green (5.000)
Grass carp	5.000: Very Low Concern	5.000: Low Concern	Green (5.000)
Silver carp	5.000: Very Low Concern	5.000: Low Concern	Green (5.000)

MISSISSIPPI RIVER | AMERICA, NORTH - INLAND WATERS | UNITED STATES | ILLINOIS | COMBINED GILLNETS - TRAMMEL NETS

SUB SCORE: 2.644 | DISCARD RATE: 1.000 | **SCORE: 2.644**

SPECIES	ABUNDANCE	FISHING MORTALITY	SCORE
Smallmouth Buffalo	2.330: Moderate Concern	3.000: Moderate Concern	Yellow (2.644)
Bighead carp	5.000: Very Low Concern	5.000: Low Concern	Green (5.000)
Common carp	5.000: Very Low Concern	5.000: Low Concern	Green (5.000)
Grass carp	5.000: Very Low Concern	5.000: Low Concern	Green (5.000)
Silver carp	5.000: Very Low Concern	5.000: Low Concern	Green (5.000)

MISSISSIPPI RIVER | AMERICA, NORTH - INLAND WATERS | UNITED STATES | ILLINOIS | SEINE NETS

SUB SCORE: 2.644 | DISCARD RATE: 1.000 | **SCORE: 2.644**

SPECIES	ABUNDANCE	FISHING MORTALITY	SCORE
Gizzard shad	2.330: Moderate Concern	3.000: Moderate Concern	Yellow (2.644)
Smallmouth Buffalo	2.330: Moderate Concern	3.000: Moderate Concern	Yellow (2.644)
Freshwater drum	2.330: Moderate Concern	5.000: Low Concern	Green (3.413)
Bighead carp	5.000: Very Low Concern	5.000: Low Concern	Green (5.000)
Grass carp	5.000: Very Low Concern	5.000: Low Concern	Green (5.000)
Silver carp	5.000: Very Low Concern	5.000: Low Concern	Green (5.000)

MISSISSIPPI RIVER | AMERICA, NORTH - INLAND WATERS | UNITED STATES | MISSOURI | COMBINED GILLNETS - TRAMMEL NETS

SUB SCORE: 1.732 | DISCARD RATE: 1.000 | **SCORE: 1.732**

SPECIES	ABUNDANCE	FISHING MORTALITY	SCORE
Sturgeons (unspecified)	1.000: High Concern	3.000: Moderate Concern	Red (1.732)
Finfish	2.330: Moderate Concern	3.000: Moderate Concern	Yellow (2.644)
Bighead carp	5.000: Very Low Concern	5.000: Low Concern	Green (5.000)
Common carp	5.000: Very Low Concern	5.000: Low Concern	Green (5.000)
Grass carp	5.000: Very Low Concern	5.000: Low Concern	Green (5.000)
Silver carp	5.000: Very Low Concern	5.000: Low Concern	Green (5.000)

MISSISSIPPI RIVER | AMERICA, NORTH - INLAND WATERS | UNITED STATES | MISSOURI | SEINE NETS

SUB SCORE: 2.644 | DISCARD RATE: 1.000 | **SCORE: 2.644**

SPECIES	ABUNDANCE	FISHING MORTALITY	SCORE
Finfish	2.330: Moderate Concern	3.000: Moderate Concern	Yellow (2.644)
Silver carp	5.000: Very Low Concern	5.000: Low Concern	Green (5.000)

Main species for invasive carp target fisheries were determined based on data from the Kentucky Asian Carp Harvest Program (ACHP) observed trips ("KDFWR ride-alongs") and the Illinois contracted commercial harvest program (Table 2). The ACHP was renamed the Invasive Carp Harvest Program (ICHP) in 2023 {Tompkins 2024, pers. comm}. Main species were identified for relevant gear types if they composed > 5% of the catch by weight and/or number or are species of concern that are regularly caught. A large portion of invasive carp landings in Tennessee occur in Lake Barkley and Kentucky Lake on the Tennessee–Kentucky border (ORB/TNCR Invasive Carp Partnership 2022). Therefore, we used catch composition data from the KDFWR ride-along program to determine main species in the Tennessee fishery. Missouri lacks catch composition data; therefore, we referred to the Unknown Bycatch Matrix (UBM) tool for the gillnet fishery, and "finfish" and "sturgeon (spp.)" were identified through the UBM to be included as main species. While catch composition data are also lacking in the Missouri seine fishery, the gear is likely to behave similarly as in other regions. Catch data from Illinois and Kentucky indicate that gillnets are more likely to encounter paddlefish and sturgeon species than seines (Table 2), and silver carp accounts for > 95% of the statewide seine harvest in Missouri (MDC 2023b), which suggests that few native species are caught and landed in the invasive carp seine fishery. For these reasons, we applied the UBM to the Missouri seine fishery, and finfish are included as a main species, but not paddlefish/sturgeon.

Lake sturgeon was not reported in surveys in the Ohio River (KDFWR 2019c), which is unsurprising given that the Ohio River population is considered extirpated (Haxton and Bruch 2022b). There was one lake sturgeon caught during observed fishing trips in Kentucky from 2018 to 2020 (Table 2, a). But KDFWR notes that between 50 and 75% of bycatch is not likely reported from unobserved trips (KDFWR 2019c)(KDFWR 2022b). Because the Mississippi River watershed subpopulation of lake sturgeon is assessed as "Critically Endangered" by the International Union for the Conservation of Nature (IUCN) (Haxton and Bruch 2022b) and bycatch is underreported, we included lake sturgeon as a main species in the Kentucky and Tennessee fisheries. Similarly, paddlefish is also included as a main species because it is assessed by the IUCN as "Vulnerable" (Moore and Rider 2022) and actual levels of bycatch are uncertain.

In the Illinois gillnet fishery, the only other main species is smallmouth buffalo because it accounts for > 5% of the catch (Table 2, b) (ACRCC 2020). Main species in the Illinois seine fishery include smallmouth buffalo, freshwater drum, and gizzard shad because each of these species accounts for > 5% of the catch (Table 2, c) (ACRCC 2020). Paddlefish is not included as a main species in Illinois fisheries because bycatch of paddlefish is sporadic (≈31 fish per year in gillnets and < 1 fish per year in seines) (ACRCC 2020) and we found no evidence of bycatch underreporting.

Although bycatch rates of endangered pallid sturgeon and threatened lake sturgeon are reportedly low in targeted invasive carp fisheries, these species were included due to their conservation status and uncertain bycatch data. Sturgeons (spp.) and paddlefish limited the Criterion 2 score for all fisheries except the Illinois gillnet, Illinois seine, and Missouri seine fisheries.

Table 2

Information on catch composition in invasive carp fisheries. Percentage of catch is based on the total number of fish caught in observed trips.

Data Source	Invasive carp	Paddlefish	Smallmouth buffalo	Freshwater drum	Lake sturgeon	Gizzard shad
a) KDFWR ride-alongs with commercial fishers in 2018–20 (KDFWR 2022b)*	96%	0.3%	0.8%	0.4%	1 fish in 2018	0%
b) Gillnet and trammel net catch data from contracted fishers on the upper Illinois River in 2010–20 (ACRCC 2020).	81%	345 fish	13.0%	2.0%	none reported	< 1%
c) Commercial seine catch from the upper Illinois River in 2010–19 (ACRCC 2020).	63%	5 fish	7.0%	9.0%	none reported	6%

* The proportion of the catch in KDFWR ride-along trips was calculated from the total number of silver carp, bighead carp, and grass carp caught in observed fishing trips across all mesh sizes (Table 6 in KDFWR 2022b) and the total number of native species caught in observed trips (Table 13 in KDFWR 2022b). Of the observed catch, 1.1% consisted of common carp; this value is included in the invasive carp total.

Criterion 2 Assessment

SCORING GUIDELINES

Factor 2.1 - Abundance
(same as Factor 1.1 above)

Factor 2.2 - Fishing Mortality
(same as Factor 1.2 above)

Factor 2.3 - Modifying Factor: Discards and Bait Use
Goal: Fishery optimizes the utilization of marine and freshwater resources by minimizing post-harvest loss. For fisheries that use bait, bait is used efficiently.

Scoring Guidelines: The discard rate is the sum of all dead discards (i.e. non-retained catch) plus bait use divided by the total retained catch.

Ratio of bait + discards/landings	Factor 2.3 score
<100%	1
>=100	0.75

Finfish (Finfish S)

Factor 2.1 - Abundance

Mississippi River | America, North - Inland Waters | United States | Missouri | Combined gillnets - trammel nets
Mississippi River | America, North - Inland Waters | United States | Missouri | Seine nets

Moderate Concern
Bycatch data are limited in Missouri. Based on expert input, the following list of finfish species represents a proxy list for species most likely to be caught as bycatch in targeted invasive gillnet and seine fisheries in the Mississippi River: smallmouth buffalo, bigmouth buffalo, black buffalo, blue catfish, channel catfish, flathead catfish, freshwater drum, longnose gar, shortnose gar, and river carpsucker (McMullen 2024, pers. comm.). Abundance is considered a “moderate concern” for teleost fish that are not from highly vulnerable taxa.

Factor 2.2 - Fishing Mortality

Mississippi River | America, North - Inland Waters | United States | Missouri | Combined gillnets - trammel nets
Mississippi River | America, North - Inland Waters | United States | Missouri | Seine nets

Moderate Concern
Because of data deficiencies for the Missouri invasive fisheries, the relative contribution to fishing mortality from the fisheries under assessment is uncertain. The UBM considers finfish fishing mortality a “high concern” for gillnet and bottom seine fisheries, but this can be overridden if there is evidence that species being caught are not of high concern; there is evidence that this is the case in Missouri (see Justification). Therefore, this factor is considered a “moderate concern.”

Justification:
The following information was provided by Missouri Department of Conservation staff (McMullen 2024, pers. comm.).

- Target fisheries for native species such as buffalofish and catfish are likely the main source of fishing mortality for these native taxa. In addition, anecdotal information indicates that a number of fishing regulations and/or fishing behavioral choices may reduce fishing mortality of unwanted finfish bycatch species.
- Target fisheries for invasive carp are often focused during cooler seasons, which may reduce temperature-dependent fishing mortality rates for a number of species.
- The large mesh size used to target invasive carp species is likely to release smaller and juvenile finfish.

Freshwater drum (Aplodinotus grunniensS)

Factor 2.1 - Abundance

Mississippi River | America, North - Inland Waters | United States | Illinois | Seine nets

Moderate Concern

Freshwater drum is targeted by recreational and commercial fishers throughout its range, but it is relatively understudied (Whitten et al. 2022). The IUCN has assessed freshwater drum as a species of “Least Concern” because the species is abundant across a broad range with no major threats (NatureServe 2019a). Based on the IUCN assessment, abundance is considered a “moderate concern.”

Factor 2.2 - Fishing Mortality

Mississippi River | America, North - Inland Waters | United States | Illinois | Seine nets

Low Concern

Freshwater drum is a common bycatch species reported in the contracted commercial seine fishery for invasive carp in Illinois {ACRACC 2020}. In 2019, 834 freshwater drum (26% of the catch) were reportedly caught in the seine fishery in Marseilles Pool in the Upper Illinois River (ibid). A recent study estimated freshwater drum total annual mortality rates of 7.6 to 29.4% in the Illinois River and three other major Midwestern rivers, despite a lack of harvest regulations (Whitten et al. 2022). From 2001 to 2005, the total annual commercial harvest of freshwater drum averaged 1.29 million lb in the Upper Mississippi River and its tributaries, and the species is popular with recreational fishers (ibid).

Although total fishing mortality is unknown and freshwater drum is a regular component of the catch in the Illinois invasive carp fishery, the fishery is not a substantial contributor to fishing mortality. Therefore, fishing mortality is considered a “low concern.”

Gizzard shad (Dorosoma cepedianumS)

Factor 2.1 - Abundance

Mississippi River | America, North - Inland Waters | United States | Illinois | Seine nets

Moderate Concern

There is limited information on the health of specific gizzard shad populations. The IUCN has assessed gizzard shad as a species of “Least Concern” because there are a large number of subpopulations across the U.S., the adult population is unknown but inferred to be large and stable, and there are no major threats (NatureServe & Daniels 2019). Based on the IUCN assessment, abundance is considered a “moderate concern.”

Factor 2.2 - Fishing Mortality

Mississippi River | America, North - Inland Waters | United States | Illinois | Seine nets

Moderate Concern

Gizzard shad is common bycatch species reported in the contracted commercial seine fishery for

invasive carp in Illinois. From 2010 to 2019, a total of 6,042 gizzard shad were caught in the commercial seine fishery in the Upper Illinois River, accounting for ≈6% of the catch over that time period {ACRACC 2020}. Gizzard shad is retained in other Illinois commercial fisheries, but there was zero landings in the 2018–20 seasons because of viral hemorrhagic septicemia virus regulations {Tripp 2024, pers. comm.}. Because we are unable to assess the cumulative impact of the invasive carp seine fishery throughout Illinois, and gizzard shad fishing mortality is unknown, this factor is considered a "moderate concern."

Lake sturgeon (Acipenser fulvescensS)

Factor 2.1 - Abundance

Kentucky Lake, Lake Barkley | America, North - Inland Waters | United States | Set gillnets | Encircling gillnets
Kentucky Lake, Lake Barkley, Pickwick Lake | America, North - Inland Waters | United States | Tennessee | Set gillnets | Encircling gillnets

High Concern
Lake sturgeon is widely distributed in North America and found in three major drainages: the Mississippi River, the Great Lakes, and Hudson Bay. Although lake sturgeon occurs in the greatest abundance in the large lakes and rivers of the Great Lakes region of the United States and Canada, most of its natural range in the U.S. is in the Mississippi River Basin, from the upper Mississippi River and its major tributaries to the southern border of Arkansas (Haxton and Bruch 2022a). Formerly abundant throughout much of the Mississippi River basin, lake sturgeon is now rare in the Upper Mississippi River basin and nearly extirpated from the Ohio River and most its tributaries (Center for Biological Diversity 2018). The Center for Biological Diversity submitted a petition to list lake sturgeon as a "Threatened" species in 2018, but the U..S Fish and Wildlife Service determined that a listing was not warranted (89 FR 30311). The IUCN has assessed the global lake sturgeon population as "Endangered" (Haxton and Bruch 2022a) and the Mississippi River subpopulation as "Critically Endangered" (Haxton and Bruch 2022b). Based on the IUCN statuses, abundance is considered a "high concern."

Justification:
Given the conflicting assessments between the IUCN and the USFWS, Seafood Watch evaluated the available information on lake sturgeon to determine whether lake sturgeon meets the main species criteria. The IUCN "Critically Endangered" status for the Mississippi River subpopulation is based on an "inferred reduction in population size of > 90% within the last three generations (266 years)" (Haxton and Bruch 2022b), and the global status of "Endangered" is based on a > 75% reduction in population size over the past three generations (Haxton and Bruch 2022a). The USFWS decision to not list the species under the Endangered Species Act (ESA) is based on the conclusion that "lake sturgeon are not in danger of extinction or likely to become in danger of extinction within the foreseeable future throughout all of its range or in any significant portion of its range" (89 FR 30311). The USFWS also notes that, as a result of stocking programs and restoration work, ongoing management measures have resulted in positive trends and increased resiliency compared to previous decades (ibid).

While there are positive signs for lake sturgeon, the depleted population status still results in inclusion based on Seafood Watch criteria that main species include those which are overfished, endangered, threatened, undergoing overfishing, or otherwise a species of concern.

Factor 2.2 - Fishing Mortality

Kentucky Lake, Lake Barkley | America, North - Inland Waters | United States | Set gillnets | Encircling gillnets
Kentucky Lake, Lake Barkley, Pickwick Lake | America, North - Inland Waters | United States | Tennessee | Set gillnets | Encircling gillnets

Moderate Concern

There was one lake sturgeon caught during observed fishing trips in Kentucky from 2016 to 2018 (KDFWR 2019c). But KDFWR notes that between 50% and 75% of bycatch is not likely reported from unobserved trips (ibid). Although habitat degradation is considered the primary threat to lake sturgeon populations across the Mississippi River basin (Haxton and Bruch 2022b), the impact of incidental bycatch is considered unknown in Kentucky and Tennessee. Therefore, because there are no available reference points to determine whether F is at an appropriate level, fishing mortality is considered a “moderate concern.”

Paddlefish (Polyodon spathulaS)

Factor 2.1 - Abundance

Kentucky Lake, Lake Barkley | America, North - Inland Waters | United States | Set gillnets | Encircling gillnets
Kentucky Lake, Lake Barkley, Pickwick Lake | America, North - Inland Waters | United States | Tennessee | Set gillnets | Encircling gillnets

High Concern

American paddlefish moves long distances through the Mississippi basin and historically through 26 state jurisdictions. State-specific surveys have been conducted to track trends, and the understanding of paddlefish migratory behavior has improved over time (Pracheil et al. 2012). State agency biologists completed questionnaires in 1983, 1994, and 2006 (Bettoli et al. 2009). In each survey, the population status was qualitatively documented as extirpated, stable, increasing, decreasing, or unknown (ibid). In the most recent survey (2006), 16 biologists reported the status of the population in their states as stable, stable/increasing, or increasing, while 3 states reported the status as stable/decreasing or decreasing (Bettoli et al. 2009). More recently, the IUCN has assessed the global population of American paddlefish as “Vulnerable” (population trend unknown) (Moore and Rider 2022) and the Mississippi–Ohio–Missouri River subpopulation as “Vulnerable” (population trend stable) (Moore and Paukert 2022b). Because the fishery overlaps with the “Vulnerable” Mississippi–Ohio–Missouri River subpopulation, paddlefish abundance is considered a “high concern.”

Justification:

Abundance of paddlefish in the Mississippi River basin is not tracked consistently against a biomass

target or limit reference point. It is known that paddlefish stocks in general and recruitment have greatly decreased due to habitat changes such as sedimentation and backwater (little or no river current) (Scarnecchia et al. 2019). Recently, a 5-year tagging study (Devine et al. 2020) provided a baseline estimate of annual abundance for paddlefish moving through the sampling area on an average year between 2015 and 2019 to be 60,004 (SE = 24,098; 95% CI: 28,152–128,062).

Factor 2.2 - Fishing Mortality

Kentucky Lake, Lake Barkley | America, North - Inland Waters | United States | Set gillnets | Encircling gillnets
Kentucky Lake, Lake Barkley, Pickwick Lake | America, North - Inland Waters | United States | Tennessee | Set gillnets | Encircling gillnets

Moderate Concern

Paddlefish is regularly caught as bycatch in the invasive carp fishery in Kentucky, but there is also a targeted commercial fishery and recreational fishery for paddlefish (KDFWR 2019c). The annual number of paddlefish reported as bycatch in the invasive carp fishery ranged from 93 to 889 fish from 2011 to 2017 (KDFWR 2019c). Although a high percentage of paddlefish is reported to be released alive, KDFWR reported survival rates of 48% in 2016 and 2017, but just 32% in 2018 (ibid). The number of paddlefish caught per trip is consistently lower in self-reported data than on trips observed by KDFWR (Figure 10) (ibid).

Although potentially biased because of the survey design, a total of 940 paddlefish were harvested in the Kentucky bowfish fishery in the 2017–18 season (ibid). The statewide commercial harvest of paddlefish in 2017 was 8,977 fish, while 376 fish were reported as bycatch in the invasive carp fishery that year (ibid). Using the lowest survival rate observed in Kentucky (32%), reported bycatch in the invasive carp fishery in 2017 would account for 2.5% of the total reported fishing mortality from the three available data sources (i.e., the sum of recreational harvest in the bowfish fishery, targeted commercial harvest, and mortality in the invasive carp fishery).

On the Ohio River, 7,377 paddlefish were harvested annually in recent years in the targeted fishery pursued by Illinois, Indiana, and Kentucky fishers (MICRA 2023b). See the following Justification for information on paddlefish fishing mortality estimates. Because paddlefish fishing mortality in the invasive carp fishery is expected to be a small contributor to total fishing mortality, but the self-reported bycatch data are uncertain, and there are no available reference points to determine whether F is at an appropriate level, fishing mortality is considered a “moderate concern.”

Justification:

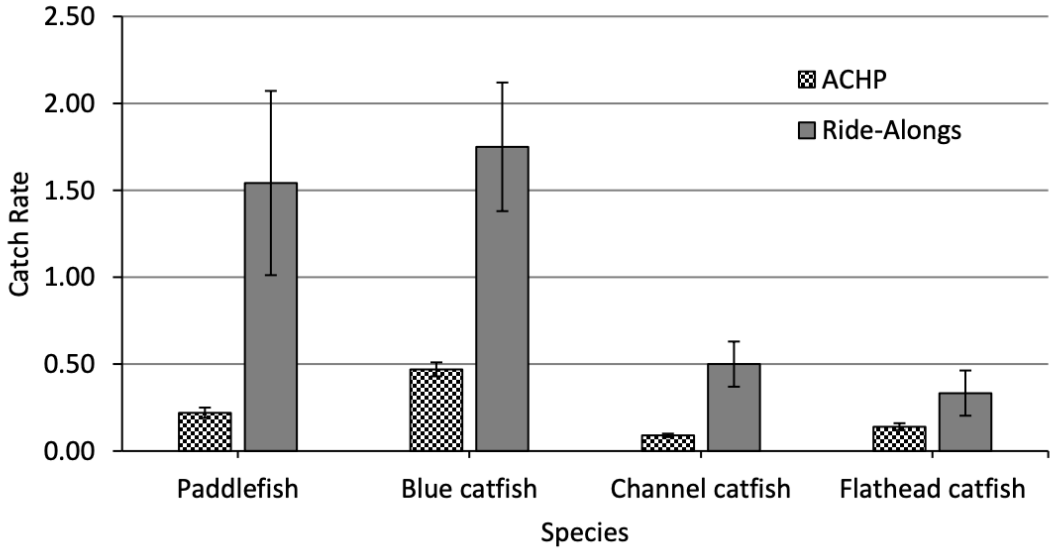


Figure 10: Comparison of catch rates for common bycatch species as reported by commercial fishers utilizing the Asian Carp Harvest Program (ACHP) and through KDFWR ride-alongs with commercial fishers. Error bars represent standard error values (KDFWR 2019c).

A 5-year (2015–19) tagging study was completed to estimate exploitation rates for paddlefish in the Mississippi River basin (Devine et al. 2020), where mark–recapture techniques were used in combination with telemetry to evaluate annual survival and the contribution of both natural and fishing mortality factors. An average annual exploitation rate was estimated at 2.5% (SE = 0.6) for the study area, and an instantaneous fishing mortality estimate of 0.03 (SE = 0.12) (Devine et al. 2020). Although the exploitation rate is much lower than what has been reported in previous years, there are still concerns regarding a lack of data in other regions of the Mississippi River basin, including studies on population dynamics and movement data.

Paddlefish is susceptible to overharvest, and consistent overharvest runs a risk of complete extirpation (Hupfield et al. 2016). A 2016 study found annual mortality rates in different portions of the Mississippi Basin to range from 26% to 34%, with exploitation rates of 15% to 20% {Hupfeld et al.2016}. Concerns have been voiced that these exploitation rates are resulting in growth and recruitment overfishing: particularly, Sharov et al. opined that fishing mortality rates exceeding $F_{40\%}$ in most systems point to the possibility of overfishing throughout the Mississippi River basin (Sharov et al. 2014). In the past, some have questioned the existing minimum length limits and whether or not they prevent recruitment overfishing (Scholten & Bettoli 2005).

Previous studies showed a lack of information indicating that fishers throughout the Mississippi River basin are voluntarily complying with length limits that ensure females spawn at least once before capture {Hupfeld et al. 2016}(Sharov et al. 2014), suggesting that paddlefish fishing mortality could be above sustainable levels. Regulations on minimum length remain a concern that affects fishing mortality estimates (Devine et al. 2020). Since the 2017–18 season, for every harvest zone in the

Mississippi River zone, the minimum length limit was set at 37 in (940 mm) with the intention of protecting around 30% of paddlefish spawning stock from being harvested (Rider et al. 2019).

Smallmouth Buffalo (Ictiobus bubalusS)

Factor 2.1 - Abundance

Mississippi River | America, North - Inland Waters | United States | Illinois | Combined gillnets - trammel nets
Mississippi River | America, North - Inland Waters | United States | Illinois | Seine nets

Moderate Concern

The IUCN has assessed smallmouth buffalo as a species of "Least Concern" because there are a large number of subpopulations across a vast range and there are no major threats (NatureServe & Soto Galera 2019). A recent study of fishery-independent data in the Upper Mississippi River System (UMRS) and Illinois River found a stable population trend (as measured by catch per unit effort [CPUE]) in the Upper Illinois River and a steady increase in the Lower Illinois River from 1959 to 2015; this contrasted with declining trends in four of the five sampled pools within the UMRS (Maxson et al. 2024). But the trends depend on the method used, and by restricting the data to 1993 to 2015, the trend in the Lower Illinois River becomes nonsignificant and the trend in the Upper Illinois River becomes a significant decline (ibid). Because of these conflicting indicators, abundance is considered a "moderate concern" based on the IUCN assessment.

Factor 2.2 - Fishing Mortality

Mississippi River | America, North - Inland Waters | United States | Illinois | Combined gillnets - trammel nets
Mississippi River | America, North - Inland Waters | United States | Illinois | Seine nets

Moderate Concern

Smallmouth buffalo is a common bycatch species reported in the contracted commercial seine and gillnet fishery for invasive carp in Illinois {ACRACC 2020}. From 2010 to 2019, an annual average of 686 smallmouth buffalo were caught in the commercial seine fishery in the Upper Illinois River; bycatch in the gillnet fishery from 2010 to 2020 averaged 18,025 smallmouth buffalo per year (ibid). By comparison, an annual average of 588,545 buffalofish species (bigmouth buffalo, smallmouth buffalo, and black buffalo) were landed in other fisheries from areas that overlap with the contracted commercial fishery from 2018 to 2020 (LDFW 2023) (IDNR 2024). But because buffalo landings are not reported by species, total fishing mortality for smallmouth buffalo in the IWW is unknown. Therefore, fishing mortality is considered a "moderate concern."

Sturgeons (unspecified) (Acipenser spp.S)

Factor 2.1 - Abundance

Mississippi River | America, North - Inland Waters | United States | Missouri | Combined gillnets - trammel nets

High Concern

The three sturgeon species that may interact with targeted invasive carp fisheries include pallid, lake, and shovelnose sturgeon. American paddlefish also has the potential to be caught in carp fisheries regionally. Pallid sturgeon is listed as “Endangered” under the federal Endangered Species Act (ESA) (USFWS 2021), lake sturgeon is listed as “Endangered” by the IUCN (Haxton and Bruch 2022a)(Haxton and Bruch 2022b)(Haxton and Bruch 2022c), and paddlefish and shovelnose sturgeon are both listed as “Vulnerable” by the IUCN (Phelps and Webb 2022)(Moore and Rider 2022), although subpopulation listings vary. Because of the status of a number of species in this group, abundance for sturgeons (spp.) is considered a “high concern.”

Justification:

American paddlefish moves long distances through the Mississippi River basin and historically through 26 state jurisdictions. A range-wide, coordinated management effort is not in place, but state-specific surveys have been conducted to track trends, and understanding of paddlefish migratory behavior has improved over time (Pracheil et al. 2012). State agency biologists completed questionnaires in 1983, 1994, and 2006 (Bettoli et al. 2009). In each survey, the population status was qualitatively documented as extirpated, stable, increasing, decreasing, or unknown. In the most recent survey (2006), 16 biologists reported the status of the population in their states as stable, stable/increasing, or increasing, while 3 states reported the status as stable/decreasing or decreasing (Bettoli et al. 2009). The IUCN has assessed the global population of American paddlefish as “Vulnerable” (population trend unknown) (Moore and Rider 2022), the Pearl and Pascagoula Rivers subpopulation as “Critically Endangered” (population trend unknown) (Moore and Paukert 2022a), the Texas Gulf subpopulation as “Endangered” (population trend decreasing) (Moore and Paukert 2022c), and the Mississippi–Ohio–Missouri River subpopulation as “Vulnerable” (population trend stable) (Moore and Paukert 2022b).

The shovelnose sturgeon is unique among sturgeons in that it seems to be relatively stable within its historic habitat range, despite facing the same threats that have severely depleted other sturgeon species. The smaller size and earlier maturation of shovelnose may account for its greater resilience to habitat and fishing impacts (Phelps et al. 2016). Shovelnose sturgeon migrates throughout the Mississippi River and its tributaries, crossing multiple state jurisdictions. As with paddlefish, assessments of the population status in each of the 26 states where shovelnose sturgeon were historically distributed were conducted using questionnaires in 1983, 1994, and 2006. Of those states, nine reported that the population was stable; in two states the population had increased, and in one it had decreased. Research by Phelps et al. (2016) suggests a stable stock status in the upper Missouri and upper Mississippi Rivers. Concerns about how habitat fragmentation affects stock status in the middle and lower Missouri River and the middle and lower Mississippi River, and the absence of data in some areas of the Ohio River (Indiana, Ohio, and Kentucky) are also listed (Phelps et al. 2016). The IUCN has assessed shovelnose sturgeon as “Vulnerable” because of a substantial decline in population size over the past 100 years and ongoing threats (Phelps and Webb 2022).

Pallid sturgeon populations have declined dramatically over the last century (Jordan and Nelson-

Stastny 2022). Pallid sturgeon in the Lower Missouri River and Middle Mississippi River also are in decline for a number of reasons. Lack of reproduction and recruitment are associated with a highly altered hydrogragh and are resulting in reduced spawning cues, habitat fragmentation and loss, and reduction in prey productivity (USFWS 2003). A mark-recapture study (with no recaptures and very high uncertainty) found roughly 2.6 to 15 fish per river kilometer, with major variations between river segments (Friedenberg et al. 2018). According to the latest 5-year status review, pallid sturgeon numbers remain low and the species remains classified as “Endangered” (USFWS 2021).

Lake sturgeon is widely distributed in North America and is found in three major drainages: the Mississippi River, the Great Lakes, and Hudson Bay (Haxton and Bruch 2022a). Formerly abundant throughout much of this southern area, lake sturgeon has been drastically reduced or eliminated throughout most of its southern range (ibid). Culling throughout the late 1800s followed by overharvesting in the early 1900s caused this slow-growing, long-lived species to decline in abundance (USFWS 2001). The Center for Biological Diversity submitted a petition to list lake sturgeon as a “Threatened” species in 2018, but the U.S. Fish and Wildlife Service determined that a listing was not warranted (89 FR 30311). The IUCN has assessed the global lake sturgeon population as “Endangered” (Haxton and Bruch 2022a), the Mississippi River subpopulation as “Critically Endangered” (Haxton and Bruch 2022b), and the Great Lakes–St. Lawrence watershed subpopulation as “Endangered” (Haxton and Bruch 2022c).

Factor 2.2 - Fishing Mortality

Mississippi River | America, North - Inland Waters | United States | Missouri | Combined gillnets - trammel nets

Moderate Concern

Bycatch data in Missouri invasive carp fisheries are limited. Targeted fisheries do exist in Missouri for paddlefish and shovelnose sturgeon, but harvest of “Endangered” pallid sturgeon and lake sturgeon (listed by Missouri as “Endangered”) is prohibited (MDC 2023). Total fishing mortality relative to potential reference points for paddlefish and shovelnose sturgeon is unknown and the extent of mortality of lake and pallid sturgeon is uncertain. Therefore, fishing mortality for sturgeons (spp.) is considered a “moderate concern.”

Justification:

Although carp fisheries are not targeting sturgeon, it is possible that both pallid and shovelnose sturgeon can interact with the gear types, but true rates of bycatch are unknown. There are limited target reference points for shovelnose fishing mortality. Previous research suggested that shovelnose mortality was increasing and recruitment declining in the Mississippi River, where harvests were occurring (Tripp et al. 2009)(Phelps et al. 2016). Shovelnose and pallid sturgeons can be mistaken for one another, so shovelnose sturgeon fisheries in the Mississippi River basin have been closed where there is overlap in their distributions. Now shovelnose can only be harvested in the Ohio River, Wabash River, and Upper Mississippi River upstream of Lock and Dam 26 (USFWS 2014)(Thornton 2018). There is no commercial fishery for lake sturgeon, but the species is still susceptible to bycatch in commercial fisheries targeting other species (UMRCC 2020).

Although data are limited, paddlefish distribution is likely to overlap with invasive carp fishery

operations in some regions. Paddlefish is susceptible to overharvest, and consistent overharvest runs a risk of complete extirpation {Hupfeld et al. 2016}. A 2016 study found annual mortality rates in different portions of the Mississippi Basin to range from 26% to 34%, with exploitation rates of 15% to 20% {Hupfeld et al. 2016}. Concerns have been voiced that these exploitation rates are resulting in growth and recruitment overfishing: particularly, Sharov et al. (2014) opined that fishing mortality rates exceeding $F_{40\%}$ in most systems point to the possibility of overfishing throughout the Mississippi Basin (Sharov et al. 2014). In the past, some have questioned the existing minimum length limits and whether or not they prevent recruitment overfishing (Scholten & Bettoli 2005).

Factor 2.3 - Discard Rate/Landings

Mississippi River | America, North - Inland Waters | United States | Illinois | Combined gillnets - trammel nets
Mississippi River | America, North - Inland Waters | United States | Missouri | Combined gillnets - trammel nets
Mississippi River | America, North - Inland Waters | United States | Illinois | Seine nets
Kentucky Lake, Lake Barkley | America, North - Inland Waters | United States | Set gillnets | Encircling gillnets
Kentucky Lake, Lake Barkley, Pickwick Lake | America, North - Inland Waters | United States | Tennessee | Set gillnets | Encircling gillnets
Mississippi River | America, North - Inland Waters | United States | Missouri | Seine nets

< 100%

There is generally a paucity of information on bycatch rates and discard mortality in most inland fisheries along the Mississippi River basin (Raby et al. 2011). But recent data from invasive carp fisheries in Illinois and Kentucky show that the target species typically account for the majority (> 60%) of the catch {ACRACC 2020}(KDFWR 2022b). Although the proportion of discards to total landings is unknown in all states, a number of factors yield a < 100% score, including: (1) invasive carp (especially silver carp) tend to school and fishers target these large schools using fish finders, (2) a few studies suggest varying levels of discard mortality rates among common bycatch species such as catfish and paddlefish, and (3) there is no bait used in invasive carp fisheries.

Justification:

Fishery managers report that fishing methods for invasive carp species tend to rely on the use of fish finders to locate large schools. This method yields low bycatch relative to overall landings. Most states have gear tending requirements to limit bycatch mortality associated with long soak times. There are limited studies on discard mortality rates of common bycatch species; however, one study found relatively low discard mortality rates of blue catfish caught by hooks, suggesting a resilient physiology for the species group {Schmitt and Shoup 2013}. Another tagging study estimated low discard mortality rates of sublegal paddlefish (4% post-release mortality rate) in gillnets, suggesting some degree of physiological resilience in this species. Survival of bycatch is often temperature-dependent in the Mississippi River basin, where cooler water is linked to lower discard mortality rates (Bettoli et al. 2009){Schmitt and Shoup 2013}.

Criterion 3: Management Effectiveness

Five factors are evaluated in Criterion 3: Management Strategy and Implementation, Bycatch Strategy, Scientific Research/Monitoring, Enforcement of Regulations, and Inclusion of Stakeholders. Each is scored as either 'highly effective', 'moderately effective', 'ineffective,' or 'critical'. The final Criterion 3 score is determined as follows:

- *5 (Very Low Concern) — Meets the standards of 'highly effective' for all five factors considered.*
- *4 (Low Concern) — Meets the standards of 'highly effective' for 'management strategy and implementation' and at least 'moderately effective' for all other factors.*
- *3 (Moderate Concern) — Meets the standards for at least 'moderately effective' for all five factors.*
- *2 (High Concern) — At a minimum, meets standards for 'moderately effective' for Management Strategy and Implementation and Bycatch Strategy, but at least one other factor is rated 'ineffective.'*
- *1 (Very High Concern) — Management Strategy and Implementation and/or Bycatch Management are 'ineffective.'*
- *0 (Critical) — Management Strategy and Implementation is 'critical'.*

The Criterion 3 rating is determined as follows:

- ***Score >3.2=Green or Low Concern***
- ***Score >2.2 and ≤3.2=Yellow or Moderate Concern***
- ***Score ≤2.2 = Red or High Concern***

Rating is Critical if Management Strategy and Implementation is Critical.

Guiding principle

- The fishery is managed to sustain the long-term productivity of all impacted species.

Five factors are evaluated in Criterion 3: Management Strategy and Implementation, Bycatch Strategy, Scientific Research/Monitoring, Enforcement of Regulations, and Inclusion of Stakeholders. Each is scored as either 'highly effective', 'moderately effective', 'ineffective,' or 'critical'. The final Criterion 3 score is determined as follows:

Criterion 3 Summary

FISHERY	MANAGEMENT STRATEGY	BYCATCH STRATEGY	DATA COLLECTION AND ANALYSIS	ENFORCEMENT	INCLUSION	SCORE
Kentucky Lake, Lake Barkley | America, North - Inland Waters | United States | Set gillnets | Encircling gillnets	Highly effective	Highly effective	Moderately Effective	Highly effective	Highly effective	**Green (4.000)**

Kentucky Lake, Lake Barkley, Pickwick Lake | America, North - Inland Waters | United States | Tennessee | Set gillnets | Encircling gillnets	Highly effective	Moderately Effective	Moderately Effective	Highly effective	Highly effective	Green (4.000)
Mississippi River | America, North - Inland Waters | United States | Illinois | Combined gillnets - trammel nets	Moderately Effective	Highly effective	Highly effective	Highly effective	Highly effective	Yellow (3.000)
Mississippi River | America, North - Inland Waters | United States | Illinois | Seine nets	Moderately Effective	Highly effective	Highly effective	Highly effective	Highly effective	Yellow (3.000)
Mississippi River | America, North - Inland Waters | United States | Missouri | Combined gillnets - trammel nets	Moderately Effective	Moderately Effective	Moderately Effective	Highly effective	Highly effective	Yellow (3.000)
Mississippi River | America, North - Inland Waters | United States | Missouri | Seine nets	Moderately Effective	Moderately Effective	Moderately Effective	Highly effective	Highly effective	Yellow (3.000)

Commercial fishery management measures vary by state, but general regulations and monitoring programs are in place (e.g., gear, seasonal, and area restrictions, license and reporting requirements, and fishery-independent surveys). Control and management of invasive carps occurs at the state, regional, and federal levels. The first national management plan for invasive carp was implemented in 2007. The Mississippi Interstate Cooperative Resource Association (MICRA) is a partnership between federal, tribal, and state agencies that coordinates and communicates interjurisdictional management issues within six Mississippi River sub-basins. MICRA identifies priorities and recommends state-led projects to address carp in these sub-basins and helped develop Invasive Carp Control Strategy Frameworks (now called Invasive Carp Action Plans) for regional implementation within the sub-basin partnerships (Figure 12) (Aldridge et al. 2022). This framework covers the Ohio River Basin (ORB), the Upper Mississippi River Sub-Basin (UMRB), Lower Mississippi River Sub-Basin (LMRB), and Missouri River Sub-Basin (MORB). The primary management strategy to control populations of invasive carps is commercial harvest (Cupp et al. 2021), but diligent management is critical to prevent negative impacts to native species, and states should require observers with contract fishers (Jackson and Runstrom 2018). Kentucky and Illinois require observers in the contracted fisheries, but other states do not have such requirements in place, which is reflected in the scoring of Criterion 3. The Illinois fisheries regularly retain incidentally caught native species, and management of those species is considered in Factor 3.1. The Kentucky and Tennessee gillnet fisheries and Missouri seine net fishery are only scored against management strategies for nonnative carps, because retained native bycatch in those fisheries does not exceed 5%.

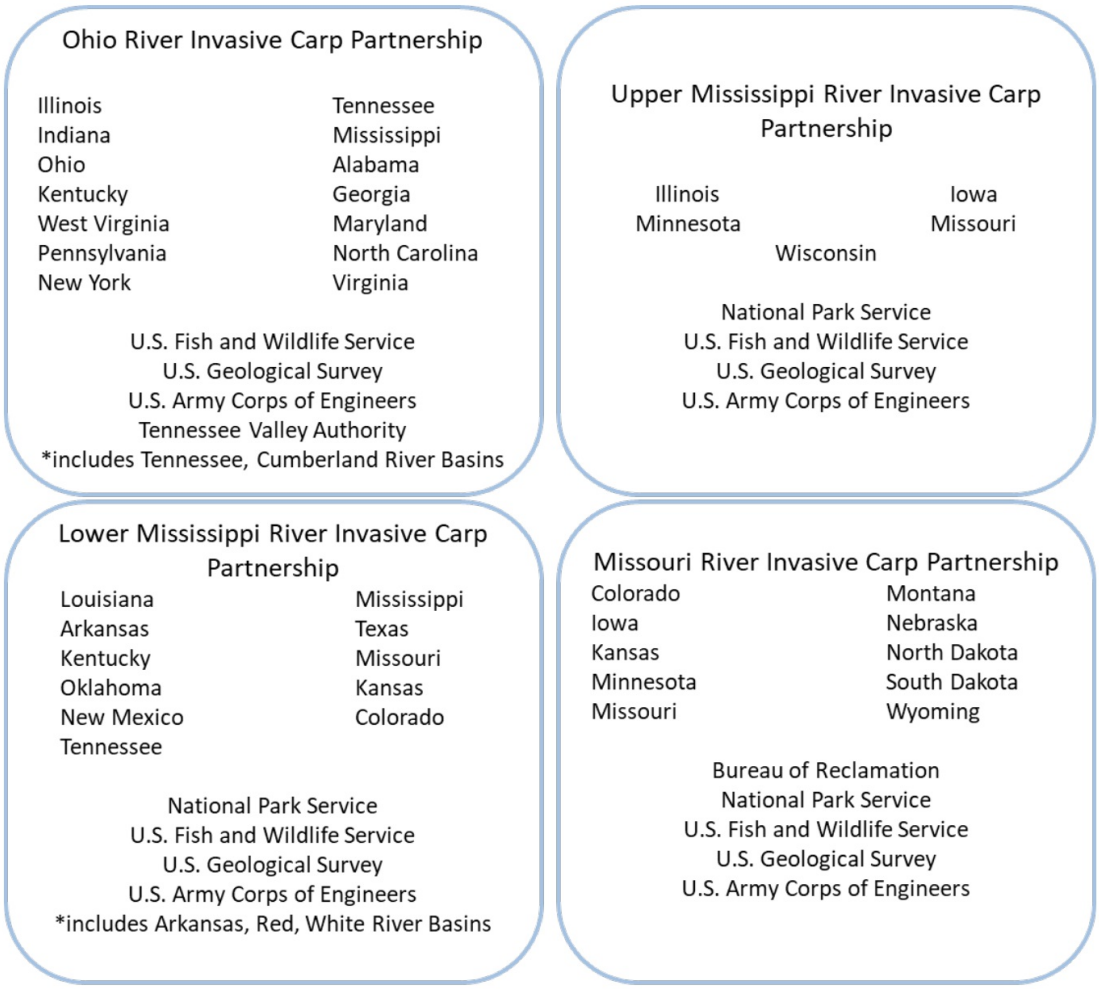


Figure 12: Structure for interagency coordination and implementation of Asian Carp Control Strategy Frameworks in the Mississippi River basin. Basin-wide coordination occurs through the MICRA Invasive Carp Advisory Committee, and regional coordination occurs through four sub-basin invasive carp partnerships: Ohio River (inclusive of the Tennessee–Cumberland Sub-Basin), Lower Mississippi River (inclusive of the Arkansas–Red–White Sub-Basin), Missouri River, and the Upper Mississippi River. Figure from (Aldridge et al. 2022).

Criterion 3 Assessment

SCORING GUIDELINES

Factor 3.1 - Management Strategy and Implementation

Considerations: What type of management measures are in place? Are there appropriate management goals, and is there evidence that management goals are being met? Do manages followscientific advice? To achieve a highly effective rating, there must be appropriately defined management goals, precautionary policies that are based on scientific advice, and evidence that the measures in place have been successful at maintaining/rebuilding species.

Factor 3.2 - Bycatch Strategy

Considerations: What type of management strategy/measures are in place to reduce the impacts of the fishery on bycatch species and when applicable, to minimize ghost fishing? How successful are these management measures? To achieve a Highly Effective rating, the fishery must have no or low bycatch, or if there are bycatch or ghost fishing concerns, there must be effective measures in place to minimize impacts.

Factor 3.3 - Scientific Research and Monitoring

Considerations: How much and what types of data are collected to evaluate the fishery's impact on the species? Is there adequate monitoring of bycatch? To achieve a Highly Effective rating, regular, robust population assessments must be conducted for target or retained species, and an adequate bycatch data collection program must be in place to ensure bycatch management goals are met.

Factor 3.4 - Enforcement of Management Regulations

Considerations: Do fishermen comply with regulations, and how is this monitored? To achieve a Highly Effective rating, there must be regular enforcement of regulations and verification of compliance.

Factor 3.5 - Stakeholder Inclusion

Considerations: Are stakeholders involved/included in the decision-making process? Stakeholders are individuals/groups/organizations that have an interest in the fishery or that may be affected by the management of the fishery (e.g., fishermen, conservation groups, etc.). A Highly Effective rating is given if the management process is transparent, if high participation by all stakeholders is encouraged, and if there a mechanism to effectively address user conflicts.

Factor 3.1 - Management Strategy And Implementation

Kentucky Lake, Lake Barkley | America, North - Inland Waters | United States | Set gillnets | Encircling gillnets
Kentucky Lake, Lake Barkley, Pickwick Lake | America, North - Inland Waters | United States | Tennessee | Set gillnets | Encircling gillnets

Highly effective

Management of invasive carps in Kentucky and Tennessee is coordinated under the LMRB and ORB Frameworks (the Tennessee and Cumberland Rivers [TNCR] Partnership falls under the ORB Framework). The main management strategy for invasive carps is to prevent further spread and reduce biomass through commercial harvest under state-sponsored harvest programs (KDFWR 2019c). Because there are no other main retained species, only management of nonnative carps is scored here. Kentucky and Tennessee have strategies in place to prevent further spread and reduce biomass of invasive carp species, mechanisms to allow for recovery of native species affected by invasive carps, and rules against stocking of invasive carp. Therefore, management strategy and implementation is considered “highly effective” for both states.

Justification:

Kentucky

Fishers participating in the ICHP must return native sport fish and roe-bearing species to the water, but may retain native roughfish species; however, those participating in the License Fee Waiver portion of the ICHP are only permitted to retain invasive carps (Kentucky General Assembly 2021). Kentucky has regulations in place to minimize the impacts of commercial gillnets on native species, including a limit on harvest of rough fish caught in gillnets targeting invasive carp, a minimum mesh size, and net tending requirements (Kentucky General Assembly 2021). In addition, KDFWR has tested different mesh sizes to monitor the effects on bycatch and catch rates of invasive carps (KDFWR 2019c).

Kentucky has banned stocking of all invasive carp species, except for triploid grass carp (which cannot reproduce). It is also illegal to transport invasive carp alive in order to prevent accidental release into other waterways (Kentucky General Assembly 2022). The primary management strategy to control invasive carp is commercial harvest. Kentucky supports a large-scale harvest program (ICHP), which involves linking directly with processors and commercial fishers in Kentucky. “The goal is to bring in 5 million pounds of invasive carp this year, 8 million pounds in 2020, 10 million pounds in 2021, 15 million pounds in 2022, and 20 million pounds each in 2023 and 2024” (Yu 2019).

KDFWR is currently partnering with the USFWS and several other entities to test an invasive carp deterrent system, called a Bio-Acoustic Fish Fence, at Lake Barkley Lock (KDFWR 2022). This system will be tested for 3 years, and if effective at deterring invasive carp from moving through the lock chamber, this technology may be implemented at additional locks in Kentucky’s river systems (ibid). KDFWR has also coordinated with neighboring states and other agencies to create a strategic plan for deployment of invasive carp barrier systems in the Tennessee, Cumberland, and Ohio Rivers

once funding is available (Tompkins 2024, pers. comm.). Kentucky began testing a “modified unified” harvest method (a seining technique used to herd carp into bays) to harvest invasive carps from entire bays and to determine if the method could be used to estimate relative abundance (KDFWR 2022). KDFWR is also in the process of assessing the impacts of invasive carp on native fish communities and their fisheries, and has contracted with private entities to test experimental gears for capturing invasive carp (TNCR 2021).

KDFWR regularly monitors trends in fish condition (e.g., relative weights), length frequency, and catch per unit effort (CPUE) of native species (including smallmouth buffalo) through fishery-independent sampling (KDFWR 2019c). Through its community sampling program, KDFWR also collects information to determine the impact of invasive carps on native fish assemblages and to assess the effectiveness of removal efforts (ibid). In its latest annual report, KDFWR notes that “gillnetting efforts in 2018 have produced little strain on native populations and the most common by-catch species removed from net sets are smallmouth buffalo and paddlefish” (KDFWR 2019c).

Kentucky supports a recovery program for threatened lake sturgeon. In 2007, KDFWR initiated a long-term project to restore a self-sustaining population of lake sturgeon to the upper Cumberland River drainage, where the species once occurred. Also, the KDFWR enacted a regulation (301 KAR 1:201) that makes it illegal to keep (possess) any lake sturgeon caught while fishing (KDFWR 2019).

Tennessee

Under the LMRB and ORB Framework partnerships, the Tennessee Wildlife Resources Agency (TWRA) monitors invasive carp abundance and distribution and provides incentives for commercial harvest. A Harvest Incentive Program (ACHIP) is in place in Tennessee, funded by state government subsidies, which allows wholesale fish dealers to buy carp at higher values per pound (TWRA 2023). The TWRA awards grants to wholesale fish dealers to increase the capacity to store and move invasive carps (TNCR 2021). The 2021 harvest under the ACHIP totaled 7.47 million lb of invasive carp from Kentucky and Barkley Lakes (ibid). The LMRB Partnership is testing technologies to prevent carp from invading new locations, implementing carp removal programs, and utilizing commercial fishing (LMR Invasive Carp Partnership 2021). A number of strategies are in place to prevent the spread of invasive carps in Tennessee. Transporting live fish is prohibited for invasive carp, and stocking invasive carp is prohibited (except sterile/triploid grass carp; TN Rule 1660-1-26). Stocking and transport of common carp by licensed dealers is not prohibited at this time. TWRA conducts sampling in Reelfoot Lake and is pursuing contract/commercial fishing, but no commercial removals have occurred to date (ibid). Tennessee supports an ongoing research project in conjunction with the The Nashville District of the U.S. Army Corps of Engineers, USGS, University of Minnesota, Fish Guidance Systems, and the Kentucky Department of Fish and Wildlife Resources to construct and test an acoustic bubbler system or Bio-Acoustic Fish Fence (BAFF) below the Barkley dam, beginning in the fall of 2018 (The Lake News 2018).

Tennessee also works to rebuild species that could be negatively affected by invasive carp invasions, such as the threatened lake sturgeon. A recovery plan is in place to conserve habitat and restock lake sturgeon in the Tennessee River area (USFWS 2019b).

- trammel nets
Mississippi River | America, North - Inland Waters | United States | Illinois | Seine nets

Moderately Effective
Illinois has a robust management strategy to prevent further spread of invasive carp and to reduce biomass. But there are also native species in these fisheries that are retained and that regularly account for at least 5% of the catch. In the seine fishery, these species include freshwater drum, gizzard shad, and smallmouth buffalo; smallmouth buffalo is the only native retained species that regularly accounts for > 5% of the catch in the gillnet fishery {ACRACC 2020}. IDNR monitors bycatch levels and size selectivity for various gillnet mesh sizes, to improve bigheaded carp capture efficiency and reduce harm to native species (MICRA 2020), and there is a long-term, fishery-independent monitoring program within the UMRS and Illinois River (USGS 2024). Illinois has regulations in place to minimize the impacts of commercial gillnets on native species, including minimum mesh sizes and net tending requirements (IDNR 2021). But there are no reference points defined for native retained species in the Illinois invasive carp fisheries.

The effectiveness of the management strategies for all retained species is unknown, but it is unlikely that the invasive carp fishery is having serious negative impacts. Although management of invasive carp alone is thorough, significant uncertainty is introduced by the inability to analyze the management strategies of native retained species that are regularly caught in Illinois gillnets and seine nets. Therefore, management strategy and implementation is considered “moderately effective” for both the Illinois fisheries.

Justification:
Invasive Carp

A number of strategies are in place to prevent the spread of invasive carps in Illinois. Bighead and silver carp are listed as injurious in Illinois, and possession of them alive is prohibited. It is also illegal to stock any invasive species in the state (Maher 2019, pers. comm). Additional measures are aimed at reducing carp biomass, including a targeted fishing project in the upper Illinois River (2018 catches exceed 1.3 million lb) and the Middle Mississippi River (≈180,000 lb) to reduce population levels.

Illinois also supports a number of harvest incentive programs, and a processing support program was established in 2017. As part of the invasive carp Market Value Program (MVP), the Illinois Department of Natural Resources offers grant funding for current invasive carp processors and product makers, to support development of new markets and sales opportunities for invasive carp products (IDNR 2018). IDNR, Southern Illinois University, and the Invasive Carp Steering Committee recently collaborated to rebrand invasive carp species as “copi” in a marketing campaign to increase human consumption of these invasive species (IDNR 2022). Illinois also contracts directly with commercial fishers to support invasive carp harvests. Since the inception of the contracted commercial fishing program in 2010, the leading edge of the invasive carp population in the Upper Illinois Waterway has made no appreciable progress toward Lake Michigan, showing that management measures have been successful in preventing further spread of invasive carps (ACRACC 2022).

Native Species

Fishery-independent sampling on the Illinois River is used to detect changes in native fish communities, to inform management decisions {ACRACC 2020}; bycatch data of native species are regularly collected {ACRACC 2020}; and there are general harvest regulations that are used to sustain fisheries in the state (IDNR 2017). There is currently no minimum size limit for freshwater drum, gizzard shad, or buffalo species, but there are some spatial management measures in place that are expected to benefit these species (e.g., closures to commercial fishing in National Wildlife Refuges, Waterfowl Management Areas, and state Wildlife Areas within portions of the Illinois and Mississippi Rivers) (IDNR 2023).

Smallmouth buffalo have long been commercially important in the UMRS, but there are conflicting data on population trends within the UMRS, and, according to Maxson et al., the long lifespan of this species warrants consideration in management actions (Maxson et al. 2024).

Mississippi River | America, North - Inland Waters | United States | Missouri | Combined gillnets - trammel nets
Mississippi River | America, North - Inland Waters | United States | Missouri | Seine nets

Moderately Effective

The Missouri Department of Conservation (MDC) initially contracted with groups to remove invasive carp in MDC-designed target areas, but catch of carp under this program fell short of harvest goals (LMR Invasive Carp Partnership 2021). MDC initiated a contracted commercial fishery in October 2023 to increase the harvest of invasive carp in the Mississippi River (McMullen 2024, pers. comm.) Under this new program, the state pays fishers 10 cents/lb harvested and sold to a buyer for at least 7 cents/lb (ibid). In addition, there are no catch or minimum size limits for invasive carp species, and Missouri prohibits the transport of live catch of these species (MDC 2023). MDC conducts sampling in the Missouri River and its tributaries to monitor invasive carp, and collects data on bycatch species for relative abundance estimates (Aldridge et al. 2022). But MDC does permit the stocking of grass carp in private ponds (MDC 2024).

Missouri has regulation and permit requirements for all commercial fisheries in the state, including gear restrictions, minimum mesh sizes, gear tagging and tending requirements, minimum size limits (applies to catfish species, paddlefish, and shovelnose sturgeon), monthly catch reports, and spatial restrictions (e.g., no commercial fishing gear may be used within 300 yards of the mouth of any tributary stream or underneath the ice) (MDC 2023). But there are no reference points defined for native retained species in the Missouri invasive carp gillnet fishery, which is a requirement for a “highly effective” score.

It is unlikely that the invasive carp fishery is having serious negative impacts and, although Missouri permits stocking of grass and common carp, these species have long been established in the region. While management of invasive carps alone is thorough, significant uncertainty is introduced by the inability to analyze the management strategies of native retained species that are regularly caught in Missouri gillnets. Although there are no other main species in the seine net fishery, a highly effective score requires that stocking of invasive species be prohibited. Therefore, management stragety and implementation is considered “moderately effective” for both the Missouri fisheries.

Factor 3.2 - Bycatch Strategy

Kentucky Lake, Lake Barkley | America, North - Inland Waters | United States | Set gillnets | Encircling gillnets

Highly effective

Kentucky has regulations in place to minimize the impacts of commercial gillnets on native species, including a limit on the harvest of rough fish caught in gillnets targeting invasive carp, a minimum mesh size, and net tending requirements (Kentucky General Assembly 2021). Gear must always be tended when set less than 3 ft below the surface of the water, and gear cannot be left unattended for more than 6 hours when set in waters deeper than 3 ft from April 1 to September 30 and for more than 8 hours when set from October 1 to March 31 (ibid). There is evidence that mitigation measures are effective for vulnerable species (e.g., observed and self-reported paddlefish bycatch has declined each year since 2015, even as effort has increased) (KDWFR 2023). Reduced bycatch is attributed to changes in fishing methods (e.g., from passive setting to active setting of gillnets) (ibid). To limit the bycatch of most sport fish species, the minimum mesh size in the commercial gillnet fishery is 3-in bar mesh (KDFWR 2019c), and KDFWR has tested different mesh sizes to monitor the effects on bycatch and catch rates of invasive carps. Bycatch is monitored, sport fish and roe-bearing species must be immediately released, it is illegal to possess lake sturgeon (KDFWR 2019c)(KDFWR 2019), and gear-tending requirements reduce the likelihood of ghost fishing. Therefore, Kentucky's bycatch strategy is considered "highly effective."

Kentucky Lake, Lake Barkley, Pickwick Lake | America, North - Inland Waters | United States | Tennessee | Set gillnets | Encircling gillnets

Moderately Effective

Tennessee primarily takes invasive carp with gillnet gear, which is generally not highly selective. We used bycatch data from the Kentucky fishery as a proxy for species likely encountered in Tennessee, because the main area of commercial harvest of nonnative carps occurs in lakes that form part of the border between the two states. While this information was used to determine main species in Criterion 2, it is not considered in scoring Tennessee's bycatch strategy. Tennessee state statute requires that nontarget species be returned to the water, and the number of permits issued to sensitive target species (such as paddlefish) is restricted, to limit effort (TN Rule 1660-01-30) (TWRA 2017). Commercial fishing gear must be marked and gillnets must have a minimum mesh size of 3 in or greater (TFWC 2018). But the efficacy of these bycatch reduction techniques is unknown due to limited state-specific data; therefore, bycatch strategy is considered "moderately effective" for Tennessee.

Justification:

Fishery managers report that bycatch rates are likely low due to the nature of the fishery (gillnets set higher in the water column to avoid more benthic species like sturgeon and catfish, and gear is set on schools of silver carp as identified with fish finders (Ganus 2024, pers. comm.). Tennessee commercial fishers must check gillnets every 24 hours, but are allowed to leave their gillnets unattended overnight (TFWC 2018). The impacts of ghost fishing are unknown in Tennessee, and there are no gear reporting requirements. Managers report that it is unlikely that lost gillnets in the

Tennessee waterways would continue to fish effectively as ghost gear due to water movement (Ganus 2024, pers. comm.).

Mississippi River | America, North - Inland Waters | United States | Illinois | Combined gillnets - trammel nets
Mississippi River | America, North - Inland Waters | United States | Illinois | Seine nets

Highly effective

Bycatch in Illinois is intensely monitored in the contracted commercial fishery in the upper Illinois River, where the targeted invasive carp harvest occurs (ACRCC 2020). Although bycatch data collection is limited in other parts of the state, and species composition may vary by waterbody, catch in the Illinois River likely characterizes the fishery in general, and bycatch is likely similar across big rivers in Illinois (Irons 2023, pers. comm.). The main bycatch species include commercial species open to harvest—buffalo spp., freshwater drum, and gizzard shad—all of which are caught in relatively low volumes and may be retained for human consumption or use as bait/other (Irons 2023, pers. comm.). Management measures for these retained native species are considered in Factor 3.1. Paddlefish is occasionally caught in the gillnet fishery {ACRACC 2020}, but a commercial roe harvest permit is required for fishers taking roe-bearing species (IDNR 2023), and paddlefish may only be harvested from October 1 to May 31 (IDNR 2021). Pallid and lake sturgeon are prohibited from harvest by both commercial and recreational fishers, and they must be released immediately if caught.

Commercial fishers are required to be in attendance of their entanglement gear (IDNR 2021), which may reduce the mortality of bycatch and the likelihood of ghost fishing. Minimum mesh size limits are in place, and gillnets are restricted to certain areas of the state (IDNR 2021). Because there are precautionary strategies in place designed to minimize the impacts of the fishery on bycatch species, and gear-tending requirements mitigate the impacts of derelict gear, this factor is considered “highly effective.”

Mississippi River | America, North - Inland Waters | United States | Missouri | Combined gillnets - trammel nets
Mississippi River | America, North - Inland Waters | United States | Missouri | Seine nets

Moderately Effective

Gillnets used to target invasive carps in Missouri are generally not highly selective, but bycatch data are unavailable. Likewise, bycatch data are unavailable for the Missouri seine fishery. Fishery managers report that bycatch rates are likely low due to the nature of the fishery (i.e., gear is set on schools of silver carp as identified with fish finders) (McMullen 2024, pers. comm.). To mitigate gear loss and bycatch mortality, the Wildlife Code of Missouri requires that gillnets be attended at all times, mesh size must exceed 2 in, and labeling of all commercial gear is required (MDC 2023); gear tending requirements reduce the likelihood of ghost fishing. Alligator gar, pallid sturgeon, and lake sturgeon are prohibited from harvest by both commercial and recreational fishers, and they must be released immediately if caught (MDC 2023). Missouri has precautionary bycatch strategies in place, but we are unable to assess the effectiveness of these measures in the absence of catch composition data in the invasive carp gillnet fishery. Given this uncertainty, bycatch strategy is considered “moderately effective” rather than “highly effective.”

Factor 3.3 - Scientific Data Collection and Analysis

Mississippi River | America, North - Inland Waters | United States | Illinois | Combined gillnets - trammel nets
Mississippi River | America, North - Inland Waters | United States | Illinois | Seine nets

Highly effective

The abundance and range of invasive carp species are closely monitored by federal and state authorities through coordinated efforts supported by MICRA and ICRCC (Aldridge et al. 2022). State and federal partners are continuing to evaluate the response of carp removal on native fish communities and the effectiveness of monitoring and control efforts (e.g., (TNCR 2021)). Some data related to invasive carps stock abundance are collected in Illinois, and management in Illinois relies on an appropriate strategy for carp species. In addition, researchers collect data on native species caught during carp removal efforts, to monitor relative weight through time (UMR Invasive Carp Partnership 2020). A mark-recapture study was conducted in the La Grange Reach of the Illinois River, and data indicated an exponential increase in silver carp catches since 1998, with an intrinsic rate of increase approaching 84%, suggesting that this area may have some of the highest densities of wild silver carp in the world (Sass et al. 2010). Additional monitoring of invasive carps is conducted via reported fishery landings data, and the Illinois Natural History Survey program regularly conducts fish community sampling and monitors large river fishes throughout the state (UMR Invasive Carp Partnership 2021). Bycatch is monitored in the contracted commercial fishery by agency biologists, and, in waters closed to all other commercial fishing, contracted fishers are required to have observers onboard {ACRACC 2020}. Because Illinois has programs in place to seek knowledge related to the stock status of nonnative carps, and bycatch is appropriately monitored in the state-sponsored fisheries, this factor is considered “highly effective.”

Mississippi River | America, North - Inland Waters | United States | Missouri | Combined gillnets - trammel nets
Kentucky Lake, Lake Barkley | America, North - Inland Waters | United States | Set gillnets | Encircling gillnets
Kentucky Lake, Lake Barkley, Pickwick Lake | America, North - Inland Waters | United States | Tennessee | Set gillnets | Encircling gillnets
Mississippi River | America, North - Inland Waters | United States | Missouri | Seine nets

Moderately Effective

The abundance and range of invasive carp species is closely monitored by federal and state authorities through coordinated efforts supported by MICRA and ICRCC (Aldridge et al. 2022). Regional abundance estimates of nonnative carp have not been conducted in Tennessee, and commercial landings data before 2016 are uncertain (Ganus 2024, pers. comm.). TWRA has recently conducted invasive carp sampling with gillnets and electrified dozer trawls in reservoirs in the TNCR Basin, to monitor abundance (TNCR 2021). There is also a long-term monitoring program for native fish communities in the Tennessee Valley, and researchers are monitoring invasive carp population expansion and relative densities (ORB/TNCR Invasive Carp Partnership 2021). State and federal

partners are continuing to evaluate the response of carp removal on native fish communities and the effectiveness of monitoring and control efforts (e.g., (TNCR 2021)).

In Missouri, data are not collected on invasive carp abundance regionally; however, the state relies on commercial landings as one data-limited assessment method (McMullen 2024, pers. comm.). MDC is currently monitoring the movement of invasive carp between river basins, actively working on improving control and removal methods, and conducting outreach to Mississippi River stakeholders (Aldridge et al. 2022). MDC plans to observe a subsample of removal efforts to identify and quantify bycatch (ibid).

Kentucky conducts a number of research and monitoring projects for invasive carps in western and central Kentucky management areas. Example projects include monitoring sport fish bycatch in the Asian Carp Harvest Program through review of commercial fishing harvest reports and ride-alongs with commercial fishers, regional silver carp demographic and movement studies, and new gear development studies (KDFWR 2018). Although lost fishing gear information is tracked in Kentucky, there are limited data on ghost fishing related to target and nontarget species. Commercial fishers targeting invasive carp species for harvest are required to submit daily harvest reports that are compiled into an annual ICHP project report—these reports include bycatch species and condition upon release (alive or moribund), and KDFWR monitors bycatch via a “ride-along” program (KDFWR 2022b).

There are efforts to monitor the range and abundance of invasive carp, but there are limited bycatch data in Tennessee and Missouri because observer programs are not in place. Kentucky has a bycatch monitoring program in place, but observer coverage only occurs on a small percentage of trips, and bycatch is underreported by as much as 50 to 75% {KDFWR 2023}. For these reasons, scientific data collection and analysis is considered “moderately effective” for Tennessee, Missouri, and Kentucky.

Factor 3.4 - Enforcement of and Compliance with Management Regulations

Kentucky Lake, Lake Barkley | America, North - Inland Waters | United States | Set gillnets | Encircling gillnets

Highly effective

Permits are required to commercially fish in the state of Kentucky, and KDFWR requires commercial fishers who are fishing on the ICHP to call in to the area KDFWR biologist to request a fishing location and time (KDFWR 2019c). Fishers are also required to record their daily catch and bycatch and condition of bycatch upon release, and KDFWR staff conduct ride-alongs with commercial fishers on a regular basis to record additional information (ibid). All daily harvest logs must be submitted at the end of each month. If reports are not submitted, then the fishers could face a suspended or revoked license (Tompkins 2024, pers. comm.). Appropriate permitting and reporting requirements, accompanied by the capacity to ensure compliance, result in the enforcement of management regulations to be considered “highly effective” for Kentucky.

Kentucky Lake, Lake Barkley, Pickwick Lake | America, North - Inland Waters | United States | Tennessee | Set gillnets | Encircling gillnets

Highly effective

Tennessee commercial fishers are required to report their catch monthly (and roe removals daily) as determined by the Tennessee statute governing commercial fishing. Wholesale fish dealers are also required to submit reports monthly to ensure appropriate processing (TN Rule 1660-1-30) (TWRA 2017). Site visits are conducted by state fishery managers as part of the Tennessee Asian Carp Harvest Program. County officers also monitor waterways as needed (Ganus 2024, pers. comm.). Appropriate permitting and reporting requirements, accompanied by the capacity to ensure compliance, result in the enforcement of management regulations to be considered “highly effective” in Tennessee.

Mississippi River | America, North - Inland Waters | United States | Illinois | Combined gillnets - trammel nets
Mississippi River | America, North - Inland Waters | United States | Illinois | Seine nets

Highly effective

Permits are required to commercially fish in the state of Illinois, and commercial harvesters are required to report their catch annually as determined by the Illinois statute governing commercial fishing (IDNR 2021). Illinois fishery managers will not issue a license for the current year until a report from the previous year has been submitted (ibid). Also, the state has the authority to audit the records of wholesale aquatic life dealers to verify the accuracy of reports submitted by commercial fishers (Maher 2019, pers. comm.). Recently, a specialized law enforcement unit within IDNR increased inspections of industries linked to the invasive carp trade; as a result of increased inspections, there has been an improvement in compliance (ACRACC 2022). Appropriate permitting and reporting requirements, accompanied by the capacity to ensure compliance, allow the enforcement of management regulations to be considered “highly effective” in Illinois.

Mississippi River | America, North - Inland Waters | United States | Missouri | Combined gillnets - trammel nets
Mississippi River | America, North - Inland Waters | United States | Missouri | Seine nets

Highly effective

The Wildlife Code of Missouri requires that commercial fishers keep a dated receipt that includes the weight and species of fish and the weight of extracted fish eggs (raw or processed) of each species landed for 3 years, for inspection purposes, and that commercial fishers submit a monthly harvest report (MDC 2023). Monthly reports must be received by the department within 30 days of the end of each month, and failure to do so is sufficient cause to have the commercial fishing permit revoked for the current year and denied renewal of the following year (ibid). In addition, MDC Protection Division staff conduct annual inspections with all commercial permittees (McMullen 2024, pers. comm.). Appropriate permitting and reporting requirements are in place, and capacity is sufficient to ensure the compliance of the fishery. Therefore, enforcement and compliance is considered “highly effective” in Missouri.

Factor 3.5 - Stakeholder Inclusion

Mississippi River | America, North - Inland Waters | United States | Illinois | Combined gillnets - trammel nets
Mississippi River | America, North - Inland Waters | United States | Missouri | Combined gillnets - trammel nets
Mississippi River | America, North - Inland Waters | United States | Illinois | Seine nets
Kentucky Lake, Lake Barkley | America, North - Inland Waters | United States | Set gillnets | Encircling gillnets
Kentucky Lake, Lake Barkley, Pickwick Lake | America, North - Inland Waters | United States | Tennessee | Set gillnets | Encircling gillnets
Mississippi River | America, North - Inland Waters | United States | Missouri | Seine nets

Highly effective

Management of invasive carp is coordinated through 28 state natural resources management agencies through MICARA; also, the Invasive Carp Action Plan is a result of collaboration between state, provincial, and federal agencies and other stakeholders (Aldridge et al. 2022). Under these initiatives, ICRCC partners have supported improved methods for commercial harvest of invasive carps (ibid).

At the individual state level, natural resource agencies provide various avenues for stakeholder involvement in fishery and natural resource issues, and fishery commisions provide recommendations to natural resource managers (see Justification). Stakeholder inclusion is considered “highly effective” in Illinois, Kentucky, Tennessee, and Missouri for involving major user groups in management discussions, providing transparent mechanisms for addressing user conflicts, and encouraging participation in the commercial carp fishery, a program designed to reduce biomass of the invasive species.

Justification:

Illinois

Public meetings are utilized to solicit input before any substantive changes in common and invasive carp fisheries, and the formulation of an Illinois commercial fishing association further bolsters communication between fishers and managers in the region (Maher 2019, pers. comm.). Managers suggest that the harvest incentive programs for invasive carps also provide important avenues for communication between stakeholders (Irons 2023, pers. comm.).

Kentucky

Under statute, the Kentucky Fish and Wildlife Commission “shall at all times keep a watchful eye upon the Department of Fish and Wildlife Resources, and advise the Commissioner to take such action as may be beneficial to the department and in the interest of wildlife and conservation of natural resources” (KDFWR 2024). Commission meetings occur quarterly and are open to public input (ibid). Also, KDFWR has literature and educational programs for the public regarding identification and prevention measures for invasive carp (KDFWR 2022)(Tompkins 2024, pers.

comm.).

Tennessee

The Tennessee Commercial Fishing Advising Committee and Tennessee Fishing Commission meet annually as part of the state's fishery regulation cycle (TWRA 2024)(State of Tennessee 2024). Commission meetings are open to the public, and public comment periods provide the opportunity for various stakeholders to comment on management changes and legislation (Ganus 2024, pers. comm.).

Missouri

Monthly commercial landings reports include a comments/questions box, and permittees are regularly invited to comment or submit questions via the Commercial Fisheries newsletter (MDC 2020). Missouri fish and wildlife regulations are reviewed and updated by the MDC Regulations Committee; public input is reviewed by this committee, and recommendations are sent to the MDC director and Conservation Commission (MDC 2024b). Potential regulation changes are posted online, with the opportunity for public comment (ibid). Public meetings throughout the state are utilized to solicit input before any substantive changes in the invasive carp fisheries (McMullen 2024, pers. comm.). Missouri requests public input on proposed regulatory changes, as demonstrated by changes to catfish management in 2021 (Karnes 2021).

Criterion 4: Impacts on the Habitat and Ecosystem

This Criterion assesses the impact of the fishery on seafloor habitats, and increases that base score if there are measures in place to mitigate any impacts. The fishery's overall impact on the ecosystem and food web and the use of ecosystem-based fisheries management (EBFM) principles is also evaluated. Ecosystem Based Fisheries Management aims to consider the interconnections among species and all natural and human stressors on the environment. The final score is the geometric mean of the impact of fishing gear on habitat score (factor 4.1 + factor 4.2) and the Ecosystem Based Fishery Management score. The Criterion 4 rating is determined as follows:

- ***Score >3.2=Green or Low Concern***
- ***Score >2.2 and ≤3.2=Yellow or Moderate Concern***
- ***Score ≤2.2 = Red or High Concern***

Guiding principles

- Avoid negative impacts on the structure, function or associated biota of marine habitats where fishing occurs.
- Maintain the trophic role of all aquatic life.
- Do not result in harmful ecological changes such as reduction of dependent predator populations, trophic cascades, or phase shifts.
- Ensure that any enhancement activities and fishing activities on enhanced stocks do not negatively affect the diversity, abundance, productivity, or genetic integrity of wild stocks.
- Follow the principles of ecosystem-based fisheries management.

Rating cannot be Critical for Criterion 4.

Criterion 4 Summary

FISHERY	FISHING GEAR ON THE SUBSTRATE	MITIGATION OF GEAR IMPACTS	ECOSYSTEM-BASED FISHERIES MGMT	FORAGE SPECIES?	SCORE
Kentucky Lake, Lake Barkley | America, North - Inland Waters | United States | Set gillnets | Encircling gillnets	Score: 3	Score: 0	Low Concern		Green (3.464)
Kentucky Lake, Lake Barkley, Pickwick Lake | America, North - Inland Waters | United States | Tennessee | Set gillnets | Encircling gillnets	Score: 3	Score: 0	Low Concern		Green (3.464)
Mississippi River | America, North - Inland Waters | United States | Illinois | Combined gillnets - trammel nets	Score: 3	Score: 0	Moderate Concern		Yellow (3.000)
Mississippi River | America, North - Inland Waters | United States | Illinois | Seine nets	Score: 3	Score: 0	Moderate Concern		Yellow (3.000)
Mississippi River | America, North - Inland Waters | United States | Missouri | Combined gillnets - trammel nets	Score: 3	Score: 0	Moderate Concern		Yellow (3.000)
Mississippi River | America, North - Inland Waters | United States | Missouri | Seine nets	Score: 3	Score: 0	Moderate Concern		Yellow (3.000)

The arrival of nonnative carp to freshwater systems in North America has had major impacts, and in response to the socioeconomic and ecological risks of bighead and silver carp establishment in the Great Lakes, managers have invested heavily in deterrent methods and intensive commercial harvest as means of controlling invasive carp populations and limiting further spread. Harvest of invasive carps is expected to provide benefits to native species, but it is difficult to compare those expected benefits to the effect of harvesting native species caught in invasive carp fisheries. For these reasons, Factor 4.3 is scored differently for those fisheries that regularly retain native species.

Criterion 4 Assessment

SCORING GUIDELINES

Factor 4.1 - Physical Impact of Fishing Gear on the Habitat/Substrate
Goal: The fishery does not adversely impact the physical structure of the ocean habitat, seafloor or associated biological communities.

- *5 - Fishing gear does not contact the bottom*
- *4 - Vertical line gear*
- *3 - Gears that contacts the bottom, but is not dragged along the bottom (e.g. gillnet, bottom longline, trap) and is not fished on sensitive habitats. Or bottom seine on resilient mud/sand habitats. Or midwater trawl that is known to contact bottom occasionally. Or purse seine known to commonly contact the bottom.*
- *2 - Bottom dragging gears (dredge, trawl) fished on resilient mud/sand habitats. Or gillnet, trap, or bottom longline fished on sensitive boulder or coral reef habitat. Or bottom seine except on mud/sand. Or there is known trampling of coral reef habitat.*
- *1 - Hydraulic clam dredge. Or dredge or trawl gear fished on moderately sensitive habitats (e.g., cobble or boulder)*
- *0 - Dredge or trawl fished on biogenic habitat, (e.g., deep-sea corals, eelgrass and maerl)*
  Note: When multiple habitat types are commonly encountered, and/or the habitat classification is uncertain, the score will be based on the most sensitive, plausible habitat type.

Factor 4.2 - Modifying Factor: Mitigation of Gear Impacts
Goal: Damage to the seafloor is mitigated through protection of sensitive or vulnerable seafloor habitats, and limits on the spatial footprint of fishing on fishing effort.

- *+1 —>50% of the habitat is protected from fishing with the gear type. Or fishing intensity is very low/limited and for trawled fisheries, expansion of fishery's footprint is prohibited. Or gear is specifically modified to reduce damage to seafloor and modifications have been shown to be effective at reducing damage. Or there is an effective combination of 'moderate' mitigation measures.*
- *+0.5 —At least 20% of all representative habitats are protected from fishing with the gear type and for trawl fisheries, expansion of the fishery's footprint is prohibited. Or gear modification measures or other measures are in place to limit fishing effort, fishing intensity, and spatial footprint of damage caused from fishing that are expected to be effective.*
- *0 —No effective measures are in place to limit gear impacts on habitats or not applicable because gear used is benign and received a score of 5 in factor 4.1*

Factor 4.3 - Ecosystem-Based Fisheries Management

Goal: All stocks are maintained at levels that allow them to fulfill their ecological role and to maintain a functioning ecosystem and food web. Fishing activities should not seriously reduce ecosystem services provided by any retained species or result in harmful changes such as trophic cascades, phase shifts or reduction of genetic diversity. Even non-native species should be considered with respect to ecosystem impacts. If a fishery is managed in order to eradicate a non-native, the potential impacts of that strategy on native species in the ecosystem should be considered and rated below.

- *5 — Policies that have been shown to be effective are in place to protect species' ecological roles and ecosystem functioning (e.g. catch limits that ensure species' abundance is maintained at sufficient levels to provide food to predators) and effective spatial management is used to protect spawning and foraging areas, and prevent localized depletion. Or it has been scientifically demonstrated that fishing practices do not have negative ecological effects.*
- *4 — Policies are in place to protect species' ecological roles and ecosystem functioning but have not proven to be effective and at least some spatial management is used.*
- *3 — Policies are not in place to protect species' ecological roles and ecosystem functioning but detrimental food web impacts are not likely or policies in place may not be sufficient to protect species' ecological roles and ecosystem functioning.*
- *2 — Policies are not in place to protect species' ecological roles and ecosystem functioning and the likelihood of detrimental food impacts are likely (e.g. trophic cascades, alternate stable states, etc.), but conclusive scientific evidence is not available for this fishery.*
- *1 — Scientifically demonstrated trophic cascades, alternate stable states or other detrimental food web impact are resulting from this fishery.*

Factor 4.1 - Physical Impact of Fishing Gear on the Habitat/Substrate

Mississippi River | America, North - Inland Waters | United States | Illinois | Combined gillnets - trammel nets
Mississippi River | America, North - Inland Waters | United States | Missouri | Combined gillnets - trammel nets
Mississippi River | America, North - Inland Waters | United States | Illinois | Seine nets
Kentucky Lake, Lake Barkley | America, North - Inland Waters | United States | Set gillnets | Encircling gillnets
Kentucky Lake, Lake Barkley, Pickwick Lake | America, North - Inland Waters | United States | Tennessee | Set gillnets | Encircling gillnets
Mississippi River | America, North - Inland Waters | United States | Missouri | Seine nets

Score: 3

Invasive carps are typically targeted over mud, sand, or gravel substrates (some mussel beds occur regionally). Gill/trammel nets, fyke nets, and seine nets are typically set at the mid-water column to target carp, but do occasionally come into contact with the bottom (Ganus 2024, pers. comm.)(Hubert et al. 2012), so they receive a score of “3” based on Seafood Watch Criteria.

Factor 4.2 - Modifying Factor: Mitigation of Gear Impacts

Mississippi River | America, North - Inland Waters | United States | Illinois | Combined gillnets - trammel nets
Mississippi River | America, North - Inland Waters | United States | Missouri | Combined gillnets - trammel nets
Mississippi River | America, North - Inland Waters | United States | Illinois | Seine nets
Kentucky Lake, Lake Barkley | America, North - Inland Waters | United States | Set gillnets | Encircling gillnets
Kentucky Lake, Lake Barkley, Pickwick Lake | America, North - Inland Waters | United States | Tennessee | Set gillnets | Encircling gillnets
Mississippi River | America, North - Inland Waters | United States | Missouri | Seine nets

Score: 0

Gillnets, seine nets, and fyke nets come into contact with the river bed; however, depending on the waterway flow and target species, the actual amount of contact the gear has with the floor will vary. All states reviewed do not allow dredging or bottom trawling, to protect the river floor and/or mussel beds from negative impacts (IDNR 2023)(Kentucky General Assembly 2023)(MDC 2023)(TWRA 2017). The ban on trawling and dredging commercial fishing gear reduces the negative impacts of commercial fishing gear on a portion of river floor; however, gillnets, seine nets, and fyke nets do contact the bottom occasionally, and the invasive carp target fisheries receive a “0” based on Seafood Watch standards for gear mitigation.

Factor 4.3 - Ecosystem-based Fisheries Management

Kentucky Lake, Lake Barkley | America, North - Inland Waters | United States | Set gillnets | Encircling gillnets
Kentucky Lake, Lake Barkley, Pickwick Lake | America, North - Inland Waters | United States | Tennessee | Set gillnets | Encircling gillnets

Low Concern

The potential invasion of silver and bighead carps into the Great Lakes is considered the greatest invasion threat to those ecosystems (Ivan et al. 2020). As synthesized by Altenritter et al. (2022), silver carp and bighead carp have been shown to reduce macro-zooplankton density, biomass, and species richness; reduce abundance of other native planktivores such as bigmouth buffalo and gizzard shad; and drive shifts in community fish composition. A food web modeling assessment in the Mississippi River found that carp invasion into new areas could cause declines of 10–30% in the initial biomass of native species; following invasive carp removal, select native species groups may increase from 2% to 166% (Figure 11), and the largest increases in biomass occur for species that compete with carp for resources (blue sucker, shovelnose sturgeon, and American eel) (Kramer et al. 2019). While there is ample evidence of fish community and trophic structure changes following carp invasion (e.g., (Pendleton et al. 2017)(DeBoer et al. 2018)), there is still uncertainty about how native fish assemblages respond to the harvest of bighead and silver carp, and community-scale responses to the harvest of these two carp species are not yet fully understood (Altenritter et al. 2022). Common and grass carp are also documented as having negative impacts to ecosystems in which the two species have been introduced. Common carp increases water turbidity by destroying aquatic vegetation, which negatively affects species requiring vegetation and clean water {Nico et al. 2022a}. Grass carp has negative impacts to macrophytes, alters water quality, and may carry diseases that are transmissible to native fish species (Nico et al. 2023b).

There are no other regularly retained native species in the Kentucky and Tennessee gillnet fisheries. A score of “very low concern” requires that an ecosystem study demonstrates that the fishery has no unacceptable ecological and/or genetic impacts. While there is broad-scale evidence of the ecosystem impacts of the carp invasion and subsequent removal, we found no studies specific to Lake Barkley or Kentucky Lake. This factor is considered a “low concern” because the commercial harvest of invasive carp is used to reduce harm to native fish populations, community structure, and trophic function, and the Kentucky gillnet and Tennessee gillnet fisheries do not regularly retain native species.

Justification:

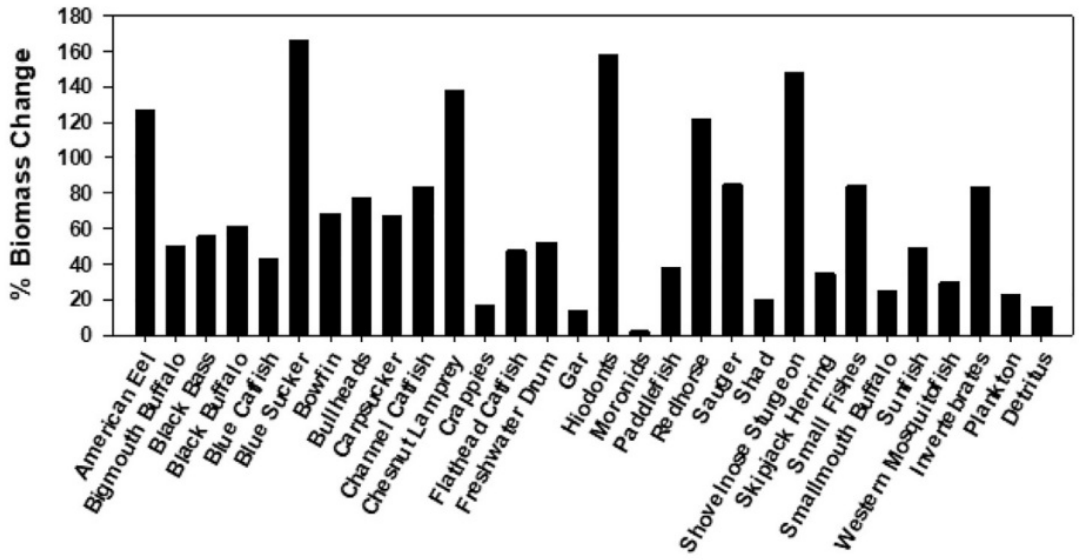


Figure 11: Relative change in biomass of model groups following the simulated removal of common, grass, silver and bighead carp in the Middle Mississippi River (Kramer et al. 2019).

The most recent ICRCC Action Plan (March 2022) describes priority projects aimed at carp detection, prevention, and control (ICRCC 2022). The ICRCC partnership represents a collaboration of 27 U.S. states and Canadian federal, state, provincial, and local agencies and organizations, with the primary goal of preventing the introduction and establishment of invasive carp in the Great Lakes, and controlling them where they already occur. One main component of the ICCRC strategy is the Electrical Dispersal Barrier System (EDBS) in the Chicago Area Waterway System. The EDBS is intended to stop the movement of juvenile and adult invasive carp toward the Great Lakes. Other prevention measures include Bio-Acoustic Fish Fences and Acoustic Deterrent Systems (LMR Invasive Carp Partnership 2021); in addition, the use of CO_2 as a non-lethal deterrent for invasive carp is currently being tested (ICRCC 2022).

Other ICRCC projects focus on increased monitoring of the distribution and abundance of invasive carp across the Mississippi River Basin, contract fishing, agency removal, gear testing, and market development. USGS also supports a number of projects throughout the Mississippi River basin. USGS has focused partly on conducting risk assessments and life-history research, to enhance the ability of agencies to manage invasive carps and minimize their influence and spread. For example, “FluEgg” is a numerical model that can be used to assess invasive carp reproduction risk in rivers. In addition to larger regional partnerships, state fishery management agencies support efforts more locally to minimize the spread of invasive carp and to restore native species ecology. Kentucky, Tennessee, and Illinois manage harvest incentive programs to support sustainable commercial fisheries and enhance the profitability of invasive carp production. The following examples briefly describe different control measures and relevant information on native species.

- **Agency removal**
    - MDC and a private company began testing the electrified dozer trawl in 2021 and

tested different electrical current levels to determine the most effective catch methods (LMR Invasive Carp Partnership 2021). A benefit of this gear is that it can be used in locations and at times that are not typically fished by commercial fishers (ibid). The relatively few nontarget species that were caught were generally released unharmed, and nonnative carp were transferred to farm field for use as fertilizer (ibid).

- **Commercial harvest**
    - KDFWR contracts commercial fishers to target invasive carp in the Ohio River. Preliminary results suggest that a suspension of fishing efforts in the summer may reduce impacts to bycatch and increase carp harvest (ORB Partnership 2022). Mortality rates for bycatch appear low due to the nature of the fishing technique; i.e., rapid net setting and pulling of nets is used because it is more effective when targeting invasive carps (ibid).
    - Under the ICHP, agency observers report low catch rates (< 1% of all bycatch) and high survival rates (98%) of sport fish encountered in commercial gillnets (ORB/TNCR Invasive Carp Partnership 2022). Although more data are necessary, KDFWR reports that, since the onset of carp invasion and harvest in Kentucky Lake, sport fish condition has not fluctuated outside historical variations (ibid).
    - There is limited information on bycatch in Tennessee and Missouri, but management measures are in place to reduce impacts to native species (see Factors 3.1 and 3.2).
- **Gear testing**
    - Kentucky recently awarded contracts to two private entities to test invasive carp experimental gears in Kentucky waters to increase removal efficiency (ORB/TNCR Invasive Carp Partnership 2022). All gear testing must be accompanied by KDFWR observers to monitor impacts to native species (ibid).
    - MDC is testing different gillnet gear configurations and herding with electrofishing (MOR Sub-basin Invasive Carp Partnership 2021).

Mississippi River | America, North - Inland Waters | United States | Illinois | Combined gillnets - trammel nets
Mississippi River | America, North - Inland Waters | United States | Missouri | Combined gillnets - trammel nets
Mississippi River | America, North - Inland Waters | United States | Illinois | Seine nets
Mississippi River | America, North - Inland Waters | United States | Missouri | Seine nets

Moderate Concern

The potential invasion of silver and bighead carps into the Great Lakes is considered the greatest invasion threat to those ecosystems (Ivan et al. 2020). As synthesized by Altenritter et al. (2022), silver carp and bighead carp have been shown to reduce macro-zooplankton density, biomass, and species richness; reduce abundance of other native planktivores such as bigmouth buffalo and gizzard shad; and drive shifts in community fish composition. A food web modeling assessment in the Mississippi River found that carp invasion into new areas could cause declines of 10–30% in the initial biomass of native species; following invasive carp removal, select native species groups may increase from 2% to 166% (see Figure 11), and the largest increases in biomass occur for species that compete with carp for resources (blue sucker, shovelnose sturgeon, and American eel) (Kramer

et al. 2019). While there is ample evidence of fish community and trophic structure changes following carp invasion (e.g., (Pendleton et al. 2017)(DeBoer et al. 2018)), there is still uncertainty about how native fish assemblages respond to the harvest of bighead and silver carp, and community-scale responses to the harvest of these two carp species are not yet fully understood (Altenritter et al. 2022). Common and grass carp are also documented as having negative impacts to ecosystems in which the two species have been introduced. Common carp increases water turbidity by destroying aquatic vegetation, which negatively affects species requiring vegetation and clean water {Nico et al. 2022a}. Grass carp has negative impacts to macrophytes, alters water quality, and may carry diseases that are transmissible to native fish species (Nico et al. 2023b).

We are unable to fully evaluate ecosystem-based management for retained native species, which precludes a “low concern” score. Harvest of invasive carps is expected to provide benefits to native species, but it is difficult to compare those expected benefits to the effect of harvesting native species caught in invasive carp fisheries. In the Illinois seine fishery, those species include freshwater drum, gizzard shad, and smallmouth buffalo. Smallmouth buffalo is the only regularly retained species in the Illinois gillnet fishery, and it is unknown what species of native finfish are regularly retained in the Missouri gillnet and seine fisheries. This factor is considered a “moderate concern” because the commercial harvest of invasive carp is used to reduce harm to native fish populations, community structure, and trophic function, but the ecosystem impacts of retaining native species caught in invasive carp fisheries remain unknown.

Justification:
The most recent ICRCC Action Plan (March 2022) describes priority projects aimed at carp detection, prevention, and control (ICRCC 2022). The ICRCC partnership represents a collaboration of 27 U.S. states and Canadian federal, state, provincial, and local agencies and organizations, with the primary goal of preventing the introduction and establishment of invasive carp in the Great Lakes, and controlling them where they already occur. One main component of the ICCRC strategy is the Electrical Dispersal Barrier System (EDBS) in the Chicago Area Waterway System. The EDBS is intended to stop the movement of juvenile and adult invasive carp toward the Great Lakes. Other prevention measures include Bio-Acoustic Fish Fences and Acoustic Deterrent Systems (LMR Invasive Carp Partnership 2021); in addition, the use of CO_2 as a nonlethal deterrent for invasive carp is currently being tested (ICRCC 2022).

Other ICRCC projects focus on increased monitoring of the distribution and abundance of invasive carp across the Mississippi River basin, contract fishing, agency removal, gear testing, and market development. USGS also supports a number of projects throughout the Mississippi River basin. USGS has focused partly on conducting risk assessments and life-history research, to enhance the ability of agencies to manage invasive carps and minimize their influence and spread. For example, “FluEgg” is a numerical model that can be used to assess invasive carp reproduction risk in rivers. In addition to larger regional partnerships, state fishery management agencies support efforts more locally to minimize the spread of invasive carp and restore native species ecology. Kentucky, Tennessee, and Illinois manage harvest incentive programs to support sustainable commercial fisheries and to enhance the profitability of invasive carp production. The following examples briefly describe different control measures and relevant information on native species.

- **Agency removal**
    - IDNR conducts electrofishing (often in conjunction with gillnets) on the Ohio River and its tributaries. All bycatch species are released, and invasive carp are euthanized (ORB Partnership 2022). Mortality of native species is rare because nets are set for less than 2 hours at a time (ibid).
    - Illinois DNR is testing a mobile fish ladder that is capable of scanning and sorting fish, to selectively remove invasive carp and allow native fish passage (ICRCC 2022).
    - MDC and a private company began testing the electrified dozer trawl in 2021 and tested different electrical current levels to determine the most effective catch methods (LMR Invasive Carp Partnership 2021). A benefit of this gear is that it can be used in locations and at times that are not typically fished by commercial fishers (ibid). The relatively few nontarget species that were caught were generally released unharmed, and nonnative carp were transferred to farm field for use as fertilizer (ibid).
- **Commercial harvest**
    - Bycatch is monitored in the contracted commercial fishing program in Illinois, and IDNR is working to collect data on gillnet size selectivity, to improve the catch efficiency of invasive carp and avoid harm to native species (MICRA 2020).
    - There is limited information on bycatch in Tennessee and Missouri, but management measures are in place to reduce the impacts to native species (see Factors 3.1 and 3.2).
- **Gear testing**
    - MDC is testing different gillnet gear configurations and herding with electrofishing (MOR Sub-basin Invasive Carp Partnership 2021).

Ecological Role of Native Species

Freshwater drum serves as a host for freshwater mussels via the deposition of fertilized eggs by female mussels into the gills of freshwater drum (Chong and Roe 2018). There are at least five species of freshwater mussel—*Leptodea leptodon*, *L. fragilis*, *Ellipsaria lineolata*, *Potamilus alatus*, and *Truncilla truncata*—that require freshwater drum as their hosts (ibid). *L. leptodon* is federally endangered, due to habitat degradation, and is only consistently found in three Missouri streams (USFW 2010). It has been absent for more than 50 years from the Upper Mississippi River basin (ibid). Because the fishery under assessment is a nonsubstantial contributor to freshwater drum fishing mortality, the species is excluded from the scoring criteria for ecosystem-based fishery management.

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Scientific reviewdoes not constitute an endorsement of the Seafood Watch® program, or its seafood recommendations, on the part of the reviewing scientists. Seafood Watch® is solely responsible for the conclusions reached in this report.

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Appendix A: Updates to the U.S. Invasive Carp Report

Updates to the September 4, 2019 U.S. Invasive Carp report were made on October 15, 2024:

The report was reassessed from v3 to v4 of the Seafood Watch Standard for Fisheries. During this reassessment, the scoping of the report was reduced to include only state-sponsored contract fisheries. Therefore, Arkansas, Indiana, Iowa, and Louisiana fisheries were removed from the report. Invasive carp species caught by seine nets and gillnets in Illinois upgraded from yellow to green. Invasive carps caught by gillnets in Missouri, Tennessee, and Kentucky remained unchanged, but the Missouri seine net fishery for silver carp upgraded from yellow to green.

Seafood Watch made the following specific updates:

- **Criterion 1**
    - Illinois (seine only): removed common carp as a Criterion 1 species because there are minimal numbers of this species caught in the contracted seine fishery.
    - Missouri (gillnet only): removed grass, bighead, and common carp as Criterion 1 species because > 95% of the landings in this fishery consist of silver carp.
- **Criterion 2**
    - Missouri (gillnet only): Added information updates (e.g., new IUCN assessments) to Factor 2.1 for sturgeon species.
    - Missouri (seine net only): Removed the sturgeon species group.
    - Kentucky gillnet: Removed the sturgeon species group and added the following individual species: lake sturgeon, paddlefish, and smallmouth buffalo.
    - Illinois gillnet: Removed the sturgeon species group and added paddlefish and smallmouth buffalo.
    - Illinois seine net: Removed the sturgeon species group and added smallmouth buffalo, freshwater drum, and gizzard shad.
- **Criterion 3**
    - *Factor 3.1*
        - Illinois gillnet and seine fisheries changed from “highly effective” to “moderately effective” because the effectiveness of the management strategies for all retained native species is unknown.
    - *Factor 3.2*
        - Kentucky gillnet, Illinois gillnet, and Illinois seine fisheries changed from “moderately effective” to “highly effective” because bycatch strategies minimize the impacts of the fishery, the fisheries have observer programs in place, and gear-tending requirements mitigate the impacts of derelict gear.
    - *Factor 3.3*
        - Illinois gillnet and Illinois seine fisheries changed from “moderately effective” to “highly effective” because there are programs in place to seek knowledge related to stock status, and bycatch is appropriately monitored.
- **Criterion 4**
    - *Factor 4.3*
        - Illinois gillnet, Illinois seine, Missouri gillnet, and Missouri seine fisheries changed from “very low concern” to “moderate concern” because of the unknown effects on

native species retained in the invasive carp fisheries.

- Kentucky gillnet and Tennessee gillnet fisheries changed from “very low concern” to “low concern” because there is no ecosystem study demonstrating that the fishery has no unacceptable ecological impacts in the Mississippi River (Missouri) or Kentucky and Barkley reservoirs (Kentucky and Tennessee).