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Eugene H. Buck

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Harold F. Upton

Congressional Research Service

Charles V. Stern

Congressional Research Service

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Asian Carp and the Great Lakes Region

Eugene H. Buck

Specialist in Natural Resources Policy

Harold F. Upton

Analyst in Natural Resources Policy

Charles V. Stern

Analyst in Natural Resources Policy

James E. Nichols

Law Clerk

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Summary

Four species of non-indigenous Asian carp are expanding their range in U.S. waterways, resulting in a variety of concerns and problems. Three species—bighead, silver, and black carp—are of particular note, based on the perceived degree of environmental concern. Current controversy relates to what measures might be necessary and sufficient to prevent movement of Asian carp from the Mississippi River drainage into the Great Lakes through the Chicago Area Waterway System. Bills have been introduced in the 111th Congress to direct actions to avoid the possibility of carp becoming established in the Great Lakes.

According to the Great Lakes Fishery Commission, Asian carp pose a significant threat to commercial and recreational fisheries of the Great Lakes. Asian carp populations could expand rapidly and change the composition of Great Lakes ecosystems. Native species could be harmed because Asian carp are likely to compete with them for food and modify their habitat. It has been widely reported that Great Lakes fisheries generate economic activity of approximately \$7 billion annually. Although Asian carp introduction is likely to modify Great Lakes ecosystems and cause harm to fisheries, studies forecasting the extent of potential harm are not available. Therefore, it is not possible to provide estimates of potential changes in the regional economy or economic value (social welfare) by lake, species, or fishery.

The locks and waterways of the Chicago Area Waterway System (CAWS) have been a focal point for those debating how to prevent Asian carp encroachment on the Great Lakes. The CAWS is the only navigable link between the Great Lakes and the Mississippi River, and many note the potential of these waterways to facilitate invasive species transfers from one basin to the other. The U.S. Army Corps of Engineers has constructed and is currently operating electrical barriers to prevent fish passage. However, in light of recent indications that Asian carp may be present upstream of the barriers and in Lake Michigan, increased federal funding to prevent fish encroachment has been announced by the Obama Administration, and calls to permanently separate the two basins have grown. The potential closure of existing navigation structures in the CAWS and the permanent separation of the basins are currently the most contentious issues related to Asian carp control in the region, and a long-term solution has yet to be decided.

On January 19, 2010, the Supreme Court refused to order emergency measures sought by the state of Michigan to stop the migration of invasive Asian carp toward Lake Michigan from the Mississippi River basin via the CAWS. Michigan's renewed motion for a preliminary injunction was also denied by the Supreme Court on March 22, 2010. In response to the Supreme Court's denial, Michigan (along with Wisconsin, Minnesota, Ohio, and Pennsylvania) filed a complaint in the U.S. District Court, Northern District of Illinois against the U.S. Army Corps of Engineers and the Metropolitan Water Reclamation District of Greater Chicago on July 19, 2010.

In the 111th Congress, Section 126 in Title I of P.L. 111-85 directed the U.S. Army Corps of Engineers to implement additional measures to prevent invasive species from bypassing the Chicago Sanitary and Ship Canal Dispersal Barrier Project and dispersing into the Great Lakes. Other bills have been introduced to list additional Asian carp species as injurious under the Lacey Act (H.R. 48, H.R. 3173, S. 237, S. 1421), and to direct various federal agencies to take specific actions to increase control over and restrict the spread of Asian carp (H.R. 51, H.R. 4472, S. 237, S. 2946).

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Background

Four species of non-indigenous Asian carp are expanding their range in U.S. waterways, resulting in a variety of concerns and problems. Three species—bighead, silver, and black carp—are of particular note, based on the perceived degree of environmental concern. Current controversy relates to what measures might be necessary and sufficient to prevent movement of Asian carp from the Mississippi River drainage into the Great Lakes through the Chicago Area Waterway System. Movement of Asian carp into the Great Lakes is ultimately of concern because increased numbers of carp in the Great Lakes increases the risk that Asian carp will establish reproducing populations in these waters. Bills have been introduced in the 111th Congress to direct actions to avoid the possibility of carp becoming established in the Great Lakes.

Grass Carp¹

The grass carp or white amur, *Ctenopharyngodon idella*, was first imported to the United States in 1963 by the U.S. Fish and Wildlife Service for biological control of vegetation in aquatic environments. Grass carp are stocked to biologically control invasive aquatic plants, such as *Hydrilla* and Eurasian water milfoil. Shallow, quiet waters are their typical habitat, and this species easily tolerates waters near freezing. Grass carp initially escaped from the U.S. Fish and Wildlife Service Fish Farming Experimental Station in Stuttgart, AR. By 1970, grass carp had been stocked in lakes and reservoirs throughout the southeast United States and in Arizona, including some that were open to stream systems.² It has since spread widely across the country (**Figure 1**), including to four of the Great Lakes. Most grass carp now are stocked as sterile triploids,³ and grass carp have not established breeding populations in the Great Lakes basin.

Black Carp⁴

The black carp, *Mylopharyngodon piceus*, arrived in the United States in 1973 with silver and bighead carp. Subsequently, this species was imported as a food fish, as the only cost-effective biological control agent to control non-native snails in catfish aquaculture ponds in Arkansas and Mississippi, and as a potential sterile biological control agent for zebra mussels. Of the four species of carp in U.S. waterways, black carp has the most limited known distribution (**Figure 2**).

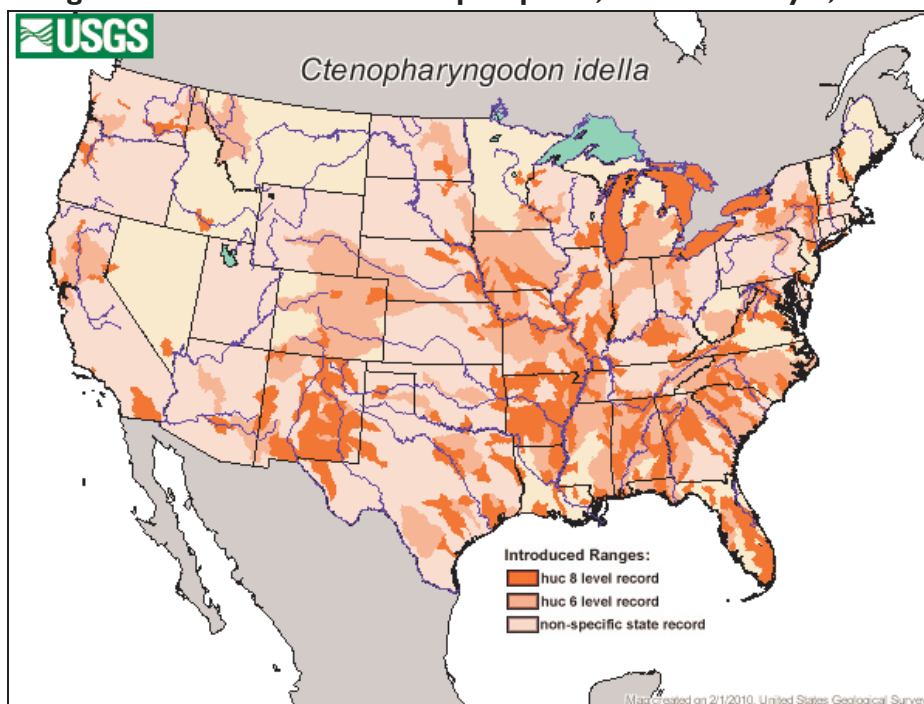
The preferred habitat of black carp is along the bottom in deep water of large rivers. Owing to this habitat preference for deeper waters, sampling to determine black carp distribution is considered incomplete, since sampling is more difficult in deeper waters. Black carp feed primarily on mussels and snails, and there are concerns that black carp may harm native mollusks, many of which are listed as threatened or endangered under the Endangered Species Act.

¹ Information from U.S. Geological Survey Fact Sheet, at <http://nas.er.usgs.gov/queries/FactSheet.asp?speciesID=514>; and A.J. Mitchell and A.M. Kelly, "The Public Sector Role in the Establishment of Grass Carp in the United States," *Fisheries*, Vol. 31, no. 3 (March 2006):113-121.

² F.J. Guscio and E.O. Gangstad, *Research and Planning Conference on the Biological Control of Aquatic Weeds with the White Amur*, prepared for the interagency Research Advisory Committee, Aquatic Plant Control Program, Office of the Chief of Engineers, Department of Army, 1970.

³ The U.S. Fish and Wildlife Service established a Triploid Grass Carp Inspection Program in 1985 to certify that only genetically triploid (i.e., sterile) grass carp are shipped among 32 states restricting the import of any non-sterile grass carp. For more information on this program, see http://www.fws.gov/policy/aquatichandbook/Volume_9/Volume9.htm.

⁴ Information from U.S. Geological Survey Fact Sheet, at <http://nas.er.usgs.gov/queries/FactSheet.asp?speciesID=573>.

Figure 1. Records of Grass Carp Capture, as of February 1, 2010

Source: U.S. Geological Survey, Nonindigenous Aquatic Species Fact Sheet on grass carp.

Notes: HUC (Hydrologic Unit Code) indicates to how much of a drainage basin the data apply. HUC 6 = one or more grass carp captured in the drainage basin. HUC 8 = one or more grass carp captured in the drainage subbasin. Records should not be interpreted as indicating the current presence of grass carp in all these areas.

Figure 2. Records of Black Carp Capture, as of February 2, 2010

Source: U.S. Geological Survey, Nonindigenous Aquatic Species Fact Sheet on black carp.

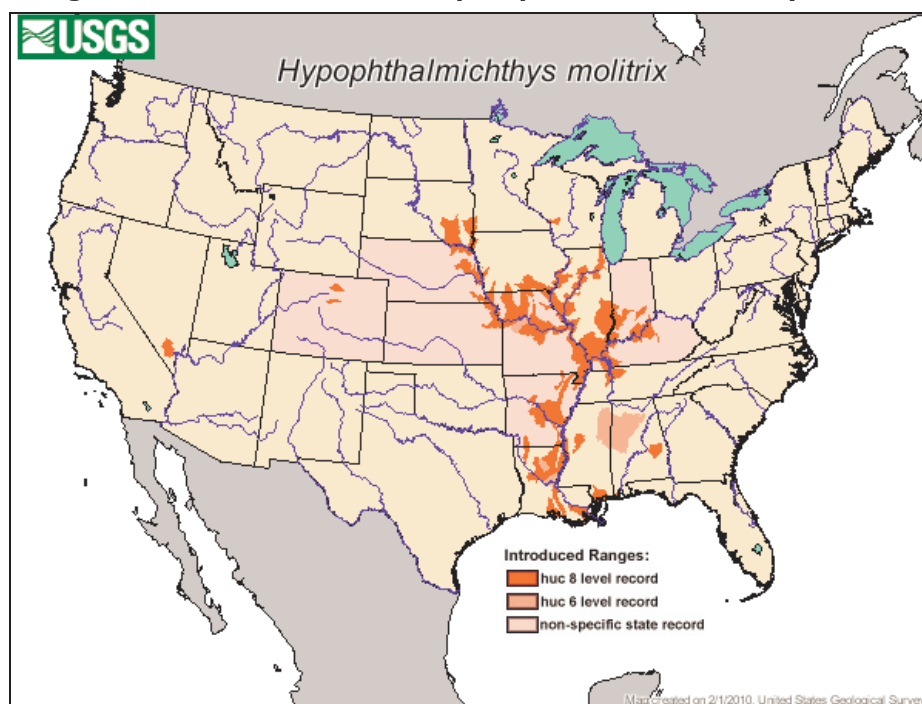
Notes: HUC 8 = one or more black carp captured in the drainage subbasin. Records should not be interpreted as indicating the current presence of black carp in all these areas.

Silver Carp⁵

Silver carp, *Hypophthalmichthys molitrix*, were brought into the United States in 1973 under an agreement of maintenance between a private fish farmer and the Arkansas Game and Fish Commission.⁶ This species has been used to control phytoplankton (microscopic drifting algae) in nutrient-rich water bodies and is also a food fish. Escapes from a state fish hatchery and from research projects involving use of these fish in municipal sewage systems,⁷ as well as possible inclusion of silver carp among other fish shipments, contributed to the spread of this species. Silver carp proved unsuitable for U.S. aquaculture, and were never widely used. The U.S. distribution of silver carp is confined primarily to the Mississippi River drainage, with no record of capture in the Great Lakes (**Figure 3**).

The silver carp is a filter-feeder, capable of consuming large amounts of phytoplankton, zooplankton (small drifting and/or swimming invertebrates), and detritus. Silver carp are easily startled by outboard motors, causing them to jump several feet out of the water.

Figure 3. Records of Silver Carp Capture, as of February 1, 2010



Source: U.S. Geological Survey, Nonindigenous Aquatic Species Fact Sheet on silver carp.

Notes: HUC (Hydrologic Unit Code) indicates to how much of a drainage basin the data apply. HUC 6 = one or more silver carp captured in the drainage basin. HUC 8 = one or more silver carp captured in the drainage subbasin. Records should not be interpreted as indicating the current presence of silver carp in all these areas.

⁵ Information from U.S. Geological Survey Fact Sheet, at <http://nas.er.usgs.gov/queries/FactSheet.asp?speciesID=549>.

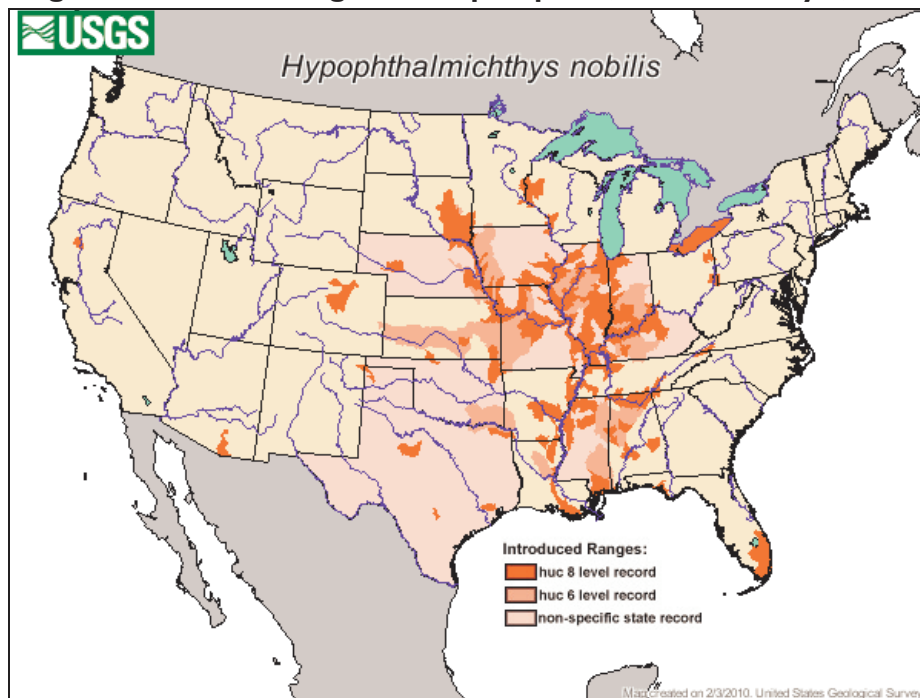
⁶ W.L. Shelton and R. O. Smitherman, "Exotic Fishes in Warm-Water Aquaculture," *Distribution, Biology, and Management of Exotic Fishes*, W.R. Courtenay, Jr. and J.R. Stauffer, eds., Baltimore, MD: The Johns Hopkins University Press, 1984, p. 262-301.

⁷ Scott Henderson, *An Evaluation of Filter Feeding Fishes for Removing Excessive Nutrients and Algae from Wastewater*, U.S. Environmental Protection Agency, Project Summary, EPA-600/S2-83-019, May 1983.

Bighead Carp⁸

Bighead carp, *Hypophthalmichthys nobilis*, were brought into the United States in 1973 under an agreement of maintenance between the Arkansas Game and Fish Commission and a private fish farmer.⁹ They proved suitable for U.S. aquaculture¹⁰ and continue to be economically important in Arkansas, Mississippi, and Alabama.¹¹ This species was discovered in open waters of the Ohio and Mississippi Rivers in the 1980s, probably after escaping from fish hatcheries and/or research projects involving use of these fish in municipal sewage systems.¹² In the United States, bighead carp are found primarily in the Mississippi River drainage. However, a limited number of bighead carp were captured by commercial fishermen in Lake Erie between 1995 and 2003 (Figure 4).

Figure 4. Records of Bighead Carp Capture, as of February 3, 2010



Source: U.S. Geological Survey, Nonindigenous Aquatic Species Fact Sheet on bighead carp.

Notes: HUC (Hydrologic Unit Code) indicates to how much of a drainage basin the data apply. HUC 6 = one or more bighead carp captured in the drainage basin. HUC 8 = one or more bighead carp captured in the drainage subbasin. Records should not be interpreted as indicating the current presence of bighead carp in all these areas.

⁸ Information from U.S. Geological Survey Fact Sheet, at <http://nas.er.usgs.gov/queries/FactSheet.asp?speciesID=551>.

⁹ W.L. Shelton and R. O. Smitherman, "Exotic Fishes in Warm-Water Aquaculture," *Distribution, Biology, and Management of Exotic Fishes*, W.R. Courtenay, Jr. and J.R. Stauffer, eds., Baltimore, MD: The Johns Hopkins University Press, 1984, p. 262-301.

¹⁰ At one time, the market for this species produced by aquaculture was primarily the ethnic live-fish trade in large cities. However, live sale of this species is now prohibited in many cities. For California markets, these fish were killed before entering the state to keep them as fresh as possible. An exception is New York City, where it is still legal to sell live bighead carp, but they must be killed before they leave the store.

¹¹ This species also was raised previously by aquaculture operations in Kansas and Illinois.

¹² Scott Henderson, *An Evaluation of Filter Feeding Fishes for Removing Excessive Nutrients and Algae from Wastewater*, U.S. Environmental Protection Agency, Project Summary, EPA-600/S2-83-019, May 1983.

Like silver carp, bighead carp typically require large rivers for spawning, but inhabit lakes, backwaters, reservoirs, and other low-current areas during most of their life cycle. They are filter-feeders, consuming primarily phytoplankton and zooplankton.

Managing Non-Native Species

Non-native species that do become established commonly exist at low populations for several generations, after which some begin a period of rapid population growth and range expansion. Although initial captures of wild silver carp were reported in the early 1970s, silver carp only rarely were captured in U.S. rivers until about 1999, after which their population began to grow at an exponential rate. Some suggest that floods in the early 1990s may have provided excellent spawning and recruitment opportunities for silver carp, and stimulated their later exponential growth phase.¹³ Field experience in the United States has shown that silver carp generally follow a few years after bighead carp in colonizing new habitat.¹⁴

Many factors may contribute to the introduction and spread of non-native species. For example, juvenile silver and bighead carp are easily mistaken for native baitfish. Thus, the dumping of unused bait by sport fishermen may contribute to the introduction and spread of these species. In addition, bighead carp (as well as a number of other potentially invasive non-native fish species) have been reared, transported, and traded in large numbers as live fish for human food, especially in large metropolitan areas. Such commerce in bighead carp occurred with relatively limited state and local regulation until recently.

Eradication of non-native species in aquatic environments is difficult and rare, having only occasionally been successful when efforts were focused on small-scale and closed systems like reservoirs, ponds, small locks, and marinas. Since eradication of a non-native species, once it has become established, is unlikely, difficult, and therefore expensive, management more often focuses on preventing troublesome species for entering new habitats, through regulating imports of certain nuisance species, preventing or slowing the spread of already introduced species, and monitoring to detect new invaders when their populations may be localized and at low densities such that eradication might still be possible.¹⁵ While efforts to prevent introduction may be costly, it almost always will be less expensive than continued attempts to eradicate or control non-native species that become established.

¹³ Duane Chapman, research fisheries biologist, U.S. Geological Survey, Columbia Environmental Research Center, Columbia MO, personal communication, February 26, 2010.

¹⁴ Greg Conover, "The Asian Carp Working Group Update," *ANS Task Force Spring Meeting Minutes*, May 26-27, 2004, p. 35-37; Available at http://www.anstaskforce.gov/Minutes/Spring04_Minutes.pdf.

¹⁵ For more background on prevention and control methods, see CRS Report RL30123, *Invasive Non-Native Species: Background and Issues for Congress*, by M. Lynne Corn et al.

Potential Impacts

Ecological Concerns

According to the Great Lakes Fishery Commission,¹⁶ Asian carp pose a significant threat to fisheries of the Great Lakes.¹⁷ Asian carp populations could expand rapidly and change the composition of Great Lakes ecosystems. Direct ecological effects are likely to result from their various diets: silver carp eat phytoplankton, bighead carp eat zooplankton, black carp eat invertebrates such as snails and mussels, and grass carp eat aquatic plants. Resident Great Lakes fish species could be harmed, because Asian carp are likely to compete with them for food and modify their habitat. Species at greatest risk include native mussels, other aquatic invertebrates, and fishes.¹⁸ As bighead and silver carp have dispersed and migrated within the Mississippi River drainage,¹⁹ these species have out-competed native fish to become the most abundant fish in certain areas.

On the other hand, others have predicted that black carp are not likely to become established in the Great Lakes if introduced, while silver carp are predicted neither to spread quickly nor to be perceived as a nuisance in the Great Lakes.²⁰ Bighead carp were not considered in this analysis.

Furthermore, the Great Lakes today are hardly pristine habitat, with the intentional human introduction of non-native species (e.g., brown and rainbow trout, coho and Chinook salmon) characterizing fishery management of the waters for many years. The intentional and accidental introduction of non-native species has changed this historic ecosystem in many ways, including depletion of previously dominant lake trout and whitefish species. In addition, the ecological changes wrought by non-native species arriving in ship ballast water (e.g., zebra mussels, round goby) and by other means (e.g., lamprey and alewife) have been substantial.

Economic Concerns

Recreational and commercial fisheries of the Great Lakes depend on fish populations that could be affected by Asian carp. The primary economic impacts of Asian carp are likely to be related to these fisheries, although concerns have also been raised about potential effects on recreational boating and hunting.²¹ Although the net effects are likely to be negative, it is also possible that the introduction of Asian carp to the Great Lakes may provide some utility such as the development of new commercial and recreational fisheries.²²

¹⁶ Established in 1954 under the bilateral U.S./Canada Convention on Great Lakes Fisheries.

¹⁷ See <http://www.glfc.org/fishmgmt/carp.php>.

¹⁸ See <http://www.asiancarp.org/rapidresponse/documents/AsianCarp.pdf>.

¹⁹ See <http://www.glfc.org/fishmgmt/carp.php>.

²⁰ Cynthia S. Kolar and David M. Lodge, "Ecological Predictions and Risk Assessment for Alien Fishes in North America," *Science*, vol. 298 (November 8, 2002), pp. 1233-1236.

²¹ According to the U.S. Fish and Wildlife Service, Asian carp degrade waterfowl habitat and put waterfowl production areas at risk. Reductions of waterfowl populations could decrease hunting opportunities and associated economic impacts from hunting expenditures.

²² Dan Brannan, "Business Hopes to Sell Invasive Carp to Asians," *The Telegraph*, March 14, 2010.

It has been widely reported that Great Lakes fisheries generate U.S. economic activity of approximately \$7 billion annually.²³ One should exercise caution in using this figure for assessing public policy alternatives or to make comparisons with the value of other economic sectors. The Great Lakes is composed of many fisheries, each specific to different water bodies, species, and groups of users. Asian carp are likely to affect each lake and areas within lakes to varying degrees because of different biological, chemical, and physical conditions. Anglers will be affected to different degrees depending on local ecological interactions and substitute angling opportunities.

Measures of economic activity such as the \$7 billion of economic impacts are only one dimension of economic analysis. The economic input-output studies of the recreational and boating sectors provided below cannot be used to estimate changes in social welfare,²⁴ to assess trade-offs among public policy alternatives, or to conduct benefit-cost analysis. To more fully understand how society would be affected, valuation studies would be required to estimate the potential changes in social welfare resulting from Asian carp introduction.

Although Asian carp introduction is likely to harm many Great Lakes fisheries, potential changes to ecosystems and the associated economy are not well understood. It is questionable whether accurate predictions of changes by lake, species, and associated fishery are possible. Potential changes resulting from species invasions are difficult to assess because of the underlying complexity of ecological and economic systems. Data and models required to make these assessments are not available and complete assessments would be costly and likely require years of research. The lack of definitive predictions does not mean that the effects of Asian carp introduction would not be significant or that managers should wait to assess the actual effects as Asian carp become established in the Great Lakes. Existing information related to Asian carp movement and population increases in the Mississippi Basin and the magnitude of recreational activities in the Great Lakes indicate that a major threat exists and the effects are likely to be significant.

The economic contributions of recreational and commercial activities on state and regional economies of the Great Lakes region are significant. The economic input-output data cited below measure financial activities associated with the money people spend to buy goods and services on their fishing trips. Expenditures at businesses that provide goods and services have direct, indirect, and induced effects on business revenues, jobs, and personal income in the local area and at the state level. This approach to assessing recreational fishing is the expenditure and economic impact approach. The following descriptions provide recent economic information, but do not consider the effects of Asian carp introduction.

The Great Lakes' recreational fisheries target perch, black bass, walleye, lake trout, salmon, pike, steelhead, and others. In 2006, approximately 1.5 million anglers fished 17.9 million recreational days on the Great Lakes.²⁵ These anglers spent an estimated \$1.2 billion during Great Lakes fishing trips and \$1.3 billion on equipment for activities related to Great Lakes fishing.²⁶

²³ This discussion only considers the U.S. economy; Canadian fisheries and recreation might also be affected. See the later section "Canadian Concern."

²⁴ Social welfare is a measure of the well-being of society or of a community. Estimates of changes in social welfare determine whether society loses or gains from a given action.

²⁵ U.S. Department of the Interior, Fish and Wildlife Service, and U.S. Department of Commerce, Census Bureau, 2006 *National Survey of Fishing, Hunting, and Wildlife-Associated Recreation*, Washington, DC, 2007.

²⁶ Southwick Associates, *Sportfishing in America: An Economic Engine and Conservation Powerhouse*, American Sportfishing Association, Multistate Conservation Grant Program, 2007. Hereinafter cited as "Southwick Associates (continued...)"

Economic impacts resulting from these expenditures included more than 58,000 jobs, salaries of \$2.1 billion, and total impacts²⁷ throughout the U.S. economy of slightly more than \$7 billion.²⁸ Great Lakes fisheries also support charter boat fishing businesses that provide recreational fishing services to anglers. In 2002, an estimated 1,746 charter firms made more than 93,000 charter trips in the Great Lakes region.²⁹ **Table 1** provides a breakdown of angling activity and economic impacts of recreational fishing by state.

Table 1. Great Lakes Recreational Fishing Activity and Economic Impacts in 2006

States	Anglers	Days Fished	Retail Sales (000s)	Salaries (000s)	Jobs	Total Impact (000s)
Illinois	56,000	728,000	\$93,589	\$55,158	1,511	\$175,074
Indiana	46,000	759,000	\$224,588	\$117,321	4,170	\$394,866
Michigan	461,000	6,981,000	\$562,654	\$312,197	8,283	\$1,001,641
Minnesota	48,000	272,000	NR	NR	NR	NR
New York	247,000	2,060,000	\$213,174	\$122,147	3,288	\$369,194
Ohio	328,000	2,807,000	\$480,482	\$248,301	9,915	\$801,817
Pennsylvania	85,000	598,000	\$399,342	\$213,921	5,200	\$725,705
Wisconsin	235,000	3,705,000	\$315,336	\$159,420	6,153	\$528,274
Totals (Great Lakes States)	1,506,000	17,910,000	\$2,289,165	\$1,228,465	38,520	\$3,996,571
Totals (United States)			\$2,524,266	\$2,189,490	58,291	\$7,089,230

Sources: U.S. Department of the Interior, Fish and Wildlife Service, and U.S. Department of Commerce, Census Bureau, *2006 National Survey of Fishing, Hunting, and Wildlife-Associated Recreation*, Washington, DC, 2007. Southwick Associates, *Sportfishing in America: An Economic Engine and Conservation Powerhouse*, American Sportfishing Association, Multistate Conservation Grant Program, 2007.

Notes: Great Lakes fishing includes lakes Superior, Michigan, Huron, Ontario, Erie, and St. Clair, connecting waters, and fishing in tributaries for smelt, steelhead, and salmon. Minnesota economic impacts were not reported (NR) because of small sample size. Illinois (<10), Indiana, and Pennsylvania estimates should also be used with caution because of small sample sizes (10 to 30). Retail sales include trip and equipment expenditures. Equipment expenditures were prorated according to how and where equipment such as boats were used. United States totals include economic impacts outside Great Lakes states that resulted from trip and equipment expenditures for Great Lakes fishing.

In 2008, Great Lakes commercial fishing produced 18.3 million pounds of fish with a landed value³⁰ of nearly \$17 million (**Table 2**).³¹ Commercial fisheries are important to many coastal communities, and except for Lake Erie, each lake supports tribal fisheries. Top species are lake

(...continued)

2007.”

²⁷ Total impacts include direct, indirect, and induced impacts as money is cycled through the economy, in this case as a result of expenditures on recreational fishing equipment and trips.

²⁸ Southwick Associates 2007.

²⁹ See <http://www.glerl.noaa.gov/seagrant/FEE/05-504-Economics.pdf>.

³⁰ In this case, landed value is the amount paid to fishermen at the dock.

³¹ U.S. Department of Commerce, National Marine Fisheries Service, *Fisheries of the United States 2008*, Silver Spring, MD, July 2009.

whitefish, yellow perch, walleye, chubs, and smelt. For certain species, specific lakes contribute the bulk of commercial landings—including Lake Huron (60% of whitefish), Lake Erie (84% of yellow perch, and 94% of smelt), and Lake Michigan (80% of chubs).³² Record harvests occurred in 1899, when 120 million pounds were landed in the United States.³³ Landings were dominated by lake herring and chubs (64 million pounds), lake trout (10 million pounds), and yellow perch (10 million pounds).³⁴ Landings and value of commercial fisheries in the Great Lakes have declined dramatically because of factors such as invasive species, pollution, habitat degradation, overfishing, competition with imports, personal tastes and preferences, and regulatory changes.

Table 2. Great Lakes Commercial Fishing Landings and Revenue in 2008

State	Landings (pounds)	Revenue
Michigan	9,998,000	\$7,448,000
Minnesota	318,000	\$158,000
New York	44,000	\$65,000
Ohio	4,493,000	\$5,315,000
Pennsylvania	50,000	\$140,000
Wisconsin	3,376,000	\$3,641,000
Total	18,279,000	\$16,767,000

Source: U.S. Department of Commerce, National Marine Fisheries Service, *Fisheries of the United States 2008*, Silver Spring, MD, July 2009, p.6.

There are 4.3 million boats registered in the Great Lakes states, and it has been estimated that 911,000 operate on the Great Lakes.³⁵ When disturbed by a boat motor, silver carp may jump as high as 10 feet out of the water. In parts of the Mississippi River drainage, silver carp have caused injuries and damaged equipment when large fish have jumped into moving boats. Silver carp also could injure boaters and water-skiers and detract from boating in the Great Lakes. As in the case of fisheries, predictions of the potential magnitude of economic effects on Great Lakes boating are not available.

In 2004, the U.S. Army Corps of Engineers in partnership with the Great Lakes Commission undertook a study of recreational boating in the Great Lakes states. Recreational boaters spent approximately \$9.8 billion during trips and \$5.7 billion on craft in Great Lakes states.³⁶ Economic results from these expenditures included more than 246,000 jobs and salaries of \$6.5 billion.

Table 3 provides economic measures of boating on Great Lakes states. The study found that a significant share of boating expenditures took place at Great Lakes marinas. It is also likely that a significant portion of boating expenditures are related to fishing activity.

³² Ronald E. Kinnunen, *Great Lakes Commercial Fisheries*, Michigan Sea Grant Extension, Marquette, MI, August 2003.

³³ Norman S. Baldwin, Robert W. Saafeld, and Margaret A. Ross, et al., *Commercial Fish Production in the Great Lakes 1867-1977*, Great Lakes Fishery Commission, Technical Report No. 3, Ann Arbor, MI, September 1979. Hereinafter cited as Great Lakes Fishery Commission 1979.

³⁴ Great Lakes Fishery Commission 1979.

³⁵ Great Lakes Commission, *Great Lakes Recreational Boating's Economic Punch*, Ann Arbor, MI, 2004. Hereinafter cited as "Great Lakes Commission 2004."

³⁶ Great Lakes Commission 2004.

Table 3. Annual Economic Impact of Boating on Great Lakes States in 2003
(includes all registered boats and boating in Great Lakes states)

State	Boats (000s)	Sales (000s)	Jobs	Salaries (000s)
Illinois	360,252	\$1,958,000	22,407	\$678,000
Indiana	216,145	\$2,203,000	30,437	\$710,000
Michigan	953,554	\$3,905,000	51,329	\$1,342,000
Minnesota	845,094	\$3,709,000	49,060	\$1,247,000
New York	528,094	\$2,749,000	28,901	\$987,000
Ohio	413,048	\$1,959,000	26,148	\$656,000
Pennsylvania	355,235	\$71,000	1,195	\$24,000
Wisconsin	610,800	\$2,493,000	36,640	\$825,000
Total	4,282,222	\$19,047,000	246,117	\$6,479,000

Source: Great Lakes Commission, *Great Lakes Recreational Boating's Economic Punch*, Ann Arbor, MI, 2004.

Social Concerns

The introduction of Asian carp to the Great Lakes, potentially changing lake ecosystems from “salmon and trout dominated” to “carp dominated,” has the potential to damage the public image of these lakes and to lower the feeling of “well being” and pride of area residents.³⁷ As such, the introduction of these species could reduce the social value of lake-related activities.

The Chicago Area Waterway System (CAWS)

The Chicago Area Waterway System (CAWS) is a segment of the Illinois Waterway in northeastern Illinois and northwestern Indiana. The Illinois Waterway is a 327-mile channel running from Chicago to St. Louis. It is maintained at a minimum depth of 9 feet by the U.S. Army Corps of Engineers (hereinafter referred to as the Corps).³⁸ It is the only navigable link between two of the largest freshwater drainage basins in the world, the Great Lakes and the Mississippi River. The CAWS portion of the Illinois Waterway includes modified rivers, locks, canals and other structures that control the flow of water through the Chicago metropolitan area. It has recently received attention for its potential to provide a pathway for Asian carp to migrate from the Mississippi River and its tributaries into the Great Lakes. The system of projects comprising the CAWS is shown in **Figure 5**.

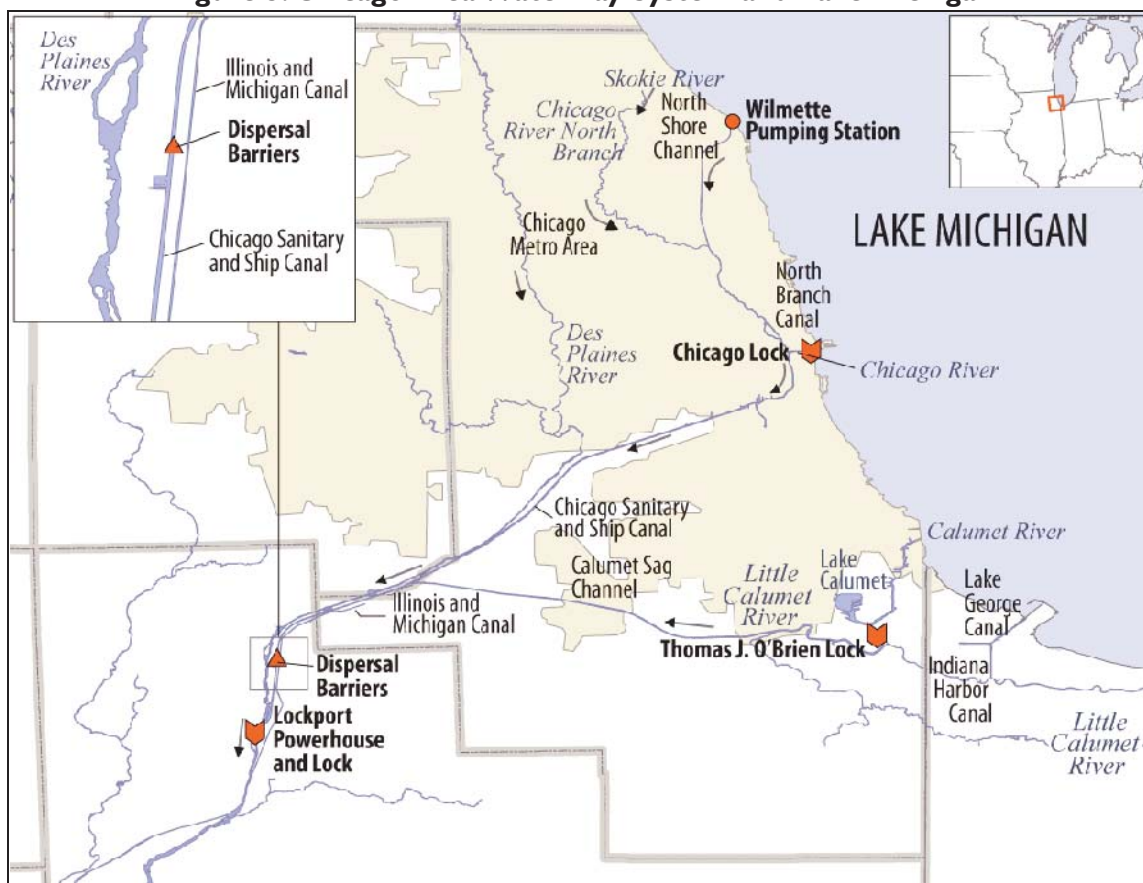
Historically, an important geologic feature in the Chicago area's watershed was the Chicago Portage. The Chicago Portage separated the drainage basins of the Mississippi River and the Great Lakes prior to modification of these waterways. These bodies of water were first artificially connected for navigation in 1848 through a privately-constructed 97-mile canal connecting the

³⁷ For example, see John Schneider, “Asian Carp's Threat Goes Far Beyond Economics,” *Lansing State Journal*, June 3, 2010; available at <http://www.lansingstatejournal.com/article/20100603/COLUMNISTS09/6030341>.

³⁸ Although the Corps has the primary authority to maintain the CAWS for navigation, multiple federal, state, and local entities also possess authorities that must be considered in the context of management actions in the CAWS. Some of these entities include the state of Illinois, the Metropolitan Water and Reclamation District of Greater Chicago, the City of Chicago, the Fish and Wildlife Service, the Environmental Protection Agency, and the U.S. Coast Guard.

Chicago River to the Illinois River. This canal, known as the Illinois and Michigan (I&M) Canal, was maintained for commercial use from 1848 to 1933. It was eventually replaced by the network of canals and locks that comprises the CAWS.³⁹ Canals within the CAWS today include the Chicago Sanitary and Ship Canal (or CSSC, completed in 1900), the North Shore Channel (completed in 1910) and the Cal-Sag Channel (completed in 1922). During construction of these canals, the flows of the Chicago River and the Calumet River were also permanently reversed away from Lake Michigan and toward the Mississippi River drainage basin through structural modifications and pumping.⁴⁰ The altered flow of the rivers prevented sewage discharge into the canals from contaminating Chicago's drinking water supply intakes on Lake Michigan.

Figure 5. Chicago Area Waterway System and Lake Michigan



Source: Adapted by the Congressional Research Service, February 2010.

In recent years, the locks of the CAWS have become a focal point for those debating how to prevent invasive species (and specifically, Asian carp) encroachment between the Great Lakes and the Mississippi River. The Corps operates multiple lock sites that connect the CAWS to the Great Lakes, including the O'Brien Lock (on the Cal-Sag Channel) and the Chicago Lock (on the Chicago River; see **Figure 5**). Both of these locks include sluice gates operated by the

³⁹ Today the I&M Canal remains open as a state park site. The I&M Canal's potential to move Asian carp into other CAWS canals has been an additional item of discussion in recent invasive species debates.

⁴⁰ The canal was designed to run southwest from Lake Michigan toward the Mississippi at a small gradient.

Metropolitan Water Reclamation District of Greater Chicago (MWRD) that can provide flood control in severe rainstorms.⁴¹ The MWRD independently owns and operates a third site (the Wilmette pumping station) on the North Shore Channel that directly connects the CAWS to the Great Lakes. The Corps also owns and operates the lock at Lockport Powerhouse and Lock, which is southwest of Chicago on the CSSC. (See **Figure 5**.) Due to its distance from the Great Lakes and the fact that the Corp's electric fish barriers operate upstream on the CSSC, this third lock has not been as prominent in recent invasive species debates.

The CAWS plays a significant role in the region's commercial and recreational navigation, although estimates of the full economic value of the locks within the CAWS (in particular, O'Brien Lock) vary widely. The Chicago Lock, one of the country's busiest locks for traffic, handled 36,256 vessels and conducted 11,599 lockages in 2008.⁴² The O'Brien Lock handled 17,532 vessels and conducted 6,310 lockages in 2008.⁴³ While most of the traffic on the Chicago Lock is recreational, the transit of commodity-laden commercial barges is higher at O'Brien Lock, which allows for shippers to offload onto deepwater vessels.⁴⁴ Statistics from the Corps indicate that approximately 7 million tons worth of commodities move through O'Brien lock annually, including bulk quantities of sand and gravel, coal, and steel.⁴⁵

Additional analysis, including a comparison of alternative means of freight transit, is necessary to fully understand the value of the locks to the region. In response to an initial estimate by the Corps that shippers saved approximately \$192 million by using the O'Brien and Chicago locks in 2008 (or an addition of approximately \$27 per ton of freight shipped), the state of Michigan commissioned a study which concluded that lock closure would lead to considerably lesser impacts than estimated by the Corps. The Michigan study estimated that a shift from barge to overland shipping would result in additional costs of approximately \$64 million-\$69 million annually, or approximately \$10 per ton.⁴⁶ This study has since been criticized by the Illinois Chamber of Commerce, which has published several academic critiques of the Michigan study, as well as a separate study estimating a much higher cost associated with lock closure.⁴⁷ In contrast to the Michigan Study, the Illinois Chamber of Commerce study estimated a total cost of \$530 million-\$580 million annually over the next eight years for lock closure, and a net cost to

⁴¹ The Corps and the MWRD coordinate during severe rainstorms, and may open both the locks themselves and the sluice gates to allow for discharge of floodwaters into Lake Michigan to prevent flooding of downtown Chicago. This last occurred in 2008.

⁴² For additional information, see http://www.ndc.iwr.usace.army.mil/lpms/pdf/lpmsstat_v3.pdf.

⁴³ U.S. Army Corps of Engineers, *Waterborne Commerce Statistics Center*, 2008. <http://www.ndc.iwr.usace.army.mil/lpms/lock2008web.htm>.

⁴⁴ Ibid. According to Corps statistics, approximately 6.8 million tons in bulk commodities transported through the O'Brien Lock in 2008, while 105,000 tons of commodities were transported through the Chicago Lock in 2008. For additional analysis of vessel movement and lockages based on Corps data, see Joel Brammeier, Irwin Polls, and Scudder Mackey, *Preliminary Feasibility of Ecological Separation of the Mississippi River and the Great Lakes to Prevent the Transfer of Aquatic Invasive Species*, Alliance for the Great Lakes, 2008 Project Completion Report, Chicago, IL, November 2008, pp. 50-55.

⁴⁵ See U.S. Army Corps of Engineers, *Waterborne Commerce of the United States, Calendar Year 2008, Part 3—Waterways and Harbors, Great Lakes*, IWR-WCUS-08-03, Alexandria, VA, 2008. Available at <http://www.iwr.usace.army.mil/ndc/wcsc/pdf/wcusgl08.pdf>.

⁴⁶ The study was included as an Appendix to Michigan's recent Supreme Court filing, and is available at http://www.michigan.gov/documents/ag/1-Appendix-Renewed_Motion_310133_7.pdf. For more information on this litigation, see page 16 of this report.

⁴⁷ See <http://www.ilchamber.org/lockclosingstudy.html>.

the Chicago economy of \$4.7 billion over a 20-year horizon.⁴⁸ The two studies differ considerably in their treatment of several important assumptions, including those related to both direct and indirect costs for the transition to overland shipping in the areas around the locks.

Federal Response to Asian Carp

Federal responses to the introduction of Asian carp in U.S. waters can generally be divided into two categories. First, Congress has directed the Corps and other agencies to undertake a limited number of actions that relate to the need to block inter-basin passage of aquatic nuisance species in the CAWS (both upstream and downstream). Since 2001, Asian carp prevention has been the most high-profile of these efforts, and has been conducted by the Corps with planning coordination and funding from other agencies. Second, the federal government is engaged in long-term, nationwide planning and management of Asian carp under authorities codified in the Nonindigenous Aquatic Nuisance Prevention and Control Act of 1990 (P.L. 101-646, as amended) and other statutes.⁴⁹ These actions have usually been conducted by the Aquatic Nuisance Species Task Force (ANS Task Force), chaired by the Fish and Wildlife Service (FWS) and the National Oceanic and Atmospheric Administration (NOAA), with support provided by various other agencies, including the U.S. Environmental Protection Agency (EPA), the U.S. Geological Survey (USGS), and the Corps.

Short-Term Prevention Efforts in the CAWS

Electric Dispersal Barriers

In the National Invasive Species Act of 1996 (P.L. 104-332), Congress directed the Corps and the ANS Task Force to investigate environmentally sound methods to prevent the dispersal of aquatic nuisance species from the Great Lakes into the Mississippi River drainage.⁵⁰ In response, an advisory panel of federal, state, local, and international representatives (known as the Dispersal Barrier Panel) recommended an electronic dispersal barrier demonstration project at the southwestern end of the CSSC north of Lockport Powerhouse and Lock (see **Figure 5**) as the preferred short-term method to stop the movement of invasive species through the CAWS.⁵¹ This type of barrier uses steel cables secured to the bottom of the canal to create a pulsating field of electricity that discourages fish from passing. It was selected based on projected cost, likelihood

⁴⁸ Joseph P. Schwieterman, *An Analysis of the Economic Effects of Terminating Operations at the Chicago River Controlling Works and the O'Brien Locks On the Chicago Area Waterway System*, DePaul University, Chicago, IL, April 7, 2010, at <http://www.ilchamber.org/documents/lockstudy/DePaul%20University%20Study%20on%20Terminating%20Lock%20Operations.pdf>.

⁴⁹ 16 U.S.C. § 4701.

⁵⁰ The waters of the CAWS were widely noted to be polluted and oxygen-deprived through the early 1980s. These conditions likely prevented the spread of aquatic species through the area over the earlier history of the CAWS. Recent efforts to clean up the waterway have also made possible the survival of many species in the area, including invasive species.

⁵¹ 16 U.S.C. § 4722(i)(3). Although the barrier was authorized and designed to repel multiple aquatic invasive species, the primary goal of the original barrier was to impede the downstream movement of round goby from the Great Lakes to the Mississippi River basin. Because of funding and construction delays, the demonstration barrier was not operational in time to prevent this movement, and round goby were found downstream of the barrier site in 1999.

of success, environmental impacts, commercial availability, permit requirements, and effect on existing canal uses. The barrier was completed in 2001 and became operational in 2002.⁵²

Around the same time the dispersal barrier became operational, rapid upstream encroachment of Asian carp toward Lake Michigan was becoming a management concern for the Fish and Wildlife Service. As a result, the demonstration barrier became the default method to prevent short-term encroachment for Asian carp. Based on subsequent experience and testing, the Dispersal Barrier Panel determined that the demonstration barrier should be upgraded into a stronger, more permanent barrier (Barrier I), and that construction of a second large barrier (Barrier II) would provide additional protection through redundancy in the barrier system.⁵³ Preliminary repairs to Barrier I were completed in October 2008, and the Corps plans to make Barrier I permanent and enhance its operating parameters after Barrier II is complete. Barrier II is located approximately 800 feet downstream from Barrier I, and has two sets of electrical arrays (known as Barriers IIA and IIB). Construction of Barrier IIA began in 2004, and this part of the barrier became permanently operational in April 2009 at a total cost of approximately \$10 million. Barrier IIB is scheduled to be operating no later than October 2010, at an expected cost of approximately \$13 million.⁵⁴ To date, the Corps has not estimated the long-term cost for barrier operations. However, the Corps requests \$7.25 million for barrier operations in the President's FY2011 Budget.⁵⁵

Federal agencies have coordinated rapid response activities to supplement the barrier protection system through the Asian Carp Regional Coordinating Committee. This committee, led by EPA's Great Lakes Program, includes representatives from federal agencies, as well as some state, local, nongovernmental, and Canadian government organizations. To date, the most visible action by the committee have been chemical treatments on the CSSC (December 1-7, 2009) and the Little Calumet River (May 20-27, 2010). For the CSSC action, more than 450 individuals were involved in the mass rotenone treatment of a 5.7-mile stretch of the CSSC while Barrier IIA was taken down for scheduled maintenance. This effort located a single Bighead carp, 500 feet above the Lockport Powerhouse and Lock and downstream from the electric barriers.⁵⁶

⁵² A full history of the demonstration barrier, including the rationale for the preferred barrier technology, is available at <http://www.seagrant.wisc.edu/ais/default.aspx?tabid=1543>.

⁵³ The demonstration barrier was originally authorized in the National Invasive Species Act of 1996 (P.L. 104-332) and its funding level was increased in Emergency Supplemental Appropriations Act for Defense, the Global War on Terror, and Hurricane Recovery, 2006 (P.L. 109-234). Funding for Barrier II was first provided as an environmental restoration project under WRDA 1986 (P.L. 99-662, §1135) in 2002 and required a local cost sharing partner. The project was subsequently authorized at a level of \$9 million in the District of Columbia Appropriations Act, 2005 (P.L. 108-335, §345). In WRDA 2007 (P.L. 110-114), Congress consolidated the multiple authorizations for barrier construction and authorized the Corps to permanently operate both barriers at a 100% federal cost.

⁵⁴ Personal Communication with Charles Shea, Dispersal Barrier Project Director, Army Corps of Engineers, Chicago District, February 24, 2010.

⁵⁵ Office of the Assistant Secretary of the Army, *FY 2011 Civil Works Budget for the U.S. Army Corps of Engineers.*, Washington, DC, February 2010, p. LRD-132.

⁵⁶ Illinois Department of Natural Resources, *Bighead Asian Carp Found in Chicago Sanitary and Ship Canal*, December 3, 2009. Available at <http://dnr.state.il.us/pubaffairs/2009/December/asianCarp3Dec2009.htm>. At the time, this finding was significant for its confirmation of Asian carp presence in the CSSC. In June, a fish was discovered upstream of the barriers in Lake Calumet. For more information, see "Monitoring" section.

Dispersal Barrier Bypass Research

In the Water Resources Development Act of 2007 (WRDA 2007, P.L. 110-114), Congress directed the Corps to study other means to prevent the spread of Asian carp through the CAWS, including the range of options for technologies to prevent passage beyond the electrical dispersal barriers.⁵⁷ In response to this directive, the Corps initiated a number of studies. First, in January 2010, the Corps produced a study (known as the Interim I study) that recommended a network of concrete and chain link barricades to deter fish passage over the Des Plaines River during flooding or through culverts connecting the CSSC to the I&M canal.⁵⁸ This project is expected to be built with approximately \$13.2 million in funding from the EPA's Great Lakes Restoration Initiative (GLRI), and is scheduled for completion by late October 2010. The Corps is also conducting a separate study (Interim II study) on optimal operating parameters for the electrical barriers. This final Interim II study is expected in late September 2010.

The Corps conducted a third study (Interim III study) exploring how its existing locks and other structures could be operated to minimize the likelihood of Asian carp infestation, and has convened meetings with navigation interests on potential operational changes for these structures. The Interim III study, released on June 2, 2010, concluded that partial changes in operating parameters would not be beneficial in slowing Asian carp migration; however, the Corps plans to install fish screens on certain sluice gates and modify operations to provide lock closure during chemical and other control efforts.⁵⁹ An additional study (Interim IIIa study) focused on other deterrent measures that could be quickly employed to prevent Asian carp migration into the Great Lakes.⁶⁰ This study, completed in April 2010, concluded that a deterrent combining acoustic air bubble barrier technology and strobe lights (ABS deterrent) would be the best available measure to reduce Asian carp migration risk, and noted eight candidate sites at which the ABS deterrent could be utilized.

Monitoring

The Corps and other agencies, including the FWS, EPA, and USGS, are also contributing resources toward monitoring efforts to evaluate the presence and movements of Asian carp in the CAWS. In addition to conventional sampling methods such as electrofishing and netting, the Corps is working with the University of Notre Dame to conduct an experimental fish sampling method known as environmental DNA (eDNA) testing. This method filters water samples, then extracts fragments of shed DNA to search for genetic markers unique to Asian carp. The method has yet to complete independent peer review, but an audit of the methodology by EPA in February

⁵⁷ See 121 Stat. 1121. The Corps is studying four areas in this regard: optimal operating parameters for the barriers, ANS barrier bypass, ANS human transfer, and ANS abundance reduction.

⁵⁸ U.S. Army Corps of Engineers—Chicago District, *Interim I Dispersal Barrier Bypass Risk Reduction Study & Integrated Environmental Assessment*, Final Report, Chicago, IL, January 2010. Available at http://www.lrc.usace.army.mil/pao/ANS_DispersalBarrierEfficacyStudy_Interim_I_FINAL.pdf.

⁵⁹ U.S. Army Corps of Engineers—Chicago District, *Interim III Dispersal Barrier Efficacy Study: Modified Structures and Operations, Illinois and Chicago Area Waterways, Risk Reduction Study and Integrated Environmental Assessment*, Final Report, Chicago, IL, June 2, 2010. p iii. Available at http://www.lrc.usace.army.mil/pao/02June2010_InterimIII.pdf. Notably, the Corps did not consider extended lock closure (i.e., more than two months) under this study.

⁶⁰ U.S. Army Corps of Engineers—Chicago District, *Interim IIIA Dispersal Barrier Efficacy Study: Modified Fish Dispersal Deterrents, Illinois and Chicago Waterways Risk Reduction Study and Integrated Environmental Assessment*, Chicago, IL, April 2010. Available at http://www.lrc.usace.army.mil/pao/02June2010_InterimIIIA.pdf.

2010 concluded that the technique is sufficiently reliable and robust in reporting a pattern of detection that should be considered actionable in a management context.⁶¹ While few Asian carp have been located upstream of the barriers using conventional sampling methods, positive eDNA test results for Asian carp found in multiple locations upstream suggest that they are very likely present at multiple locations on the lake side of the barriers.

On June 23, 2010, the Asian Carp Regional Coordinating Committee announced the catch of a live Bighead carp at Lake Calumet (upstream of the electric barriers, between O'Brien Lock and Lake Michigan) by a fisherman under contract with the Illinois Department of Natural Resources.⁶² The finding was significant as it represented the first live Asian carp located upstream of the barriers. It is currently unknown how the finding will affect previous management decisions, such as Corps decisions related to lock operations.

Nationwide Asian Carp Management and Long-Term Actions

Separate from efforts focusing on short-term prevention and other actions in the CAWS, the ANS task force has studied and initiated a number of nationwide management actions through its Asian Carp Working Group. Beginning around 2001, the working group requested and co-funded USGS risk assessments of multiple Asian carp species that found a high potential for black, silver, and bighead carp to become established in the United States.⁶³ In response to these findings, FWS listed black and silver carp as injurious under the Lacey Act in 2007.⁶⁴

Also in 2007, FWS authored a study, *Management and Control Plan for Bighead, Black, Grass, and Silver Carps in the United States*, produced in collaboration with federal and non-federal stakeholders. The final plan outlines seven broad goals (divided into 133 short- and long-term recommendations) that would contribute to a goal of extermination of wild Asian carp. Recommendations in that report include a wide array of methods, including those intended to stop Asian carp encroachment (such as electric barriers, bubble curtains, and sonic barriers to control carp movement) as well as those that would eliminate wild Asian carp populations outright (including concentrated fishing operations, genetic manipulation, and pheromone baiting).⁶⁵

⁶¹ U.S. Congress, House Committee on Transportation and Infrastructure, Subcommittee on Water Resources and Environment, *Statement of Professor David Lodge, Director, Center for Aquatic Conservation*, hearing on Asian Carp and the Great Lakes, 111th Cong., 2nd sess., February 8, 2010. Appendix: Laboratory Audit Report, Lodge Laboratory, Department of Biological Sciences, University of Notre Dame.

⁶² See <http://asiancarp.org/Wordpress/news/bighead-asian-carp-found-in-chicago-area-waterway-system/>.

⁶³ See Leo G. Nico and J. D. Williams, *Black Carp: A Biological Synopsis and Updated Risk Assessment*, U.S. Geological Survey, Final Report to the Risk Assessment and Management Committee of the ANSTF., Gainesville, FL, 2001, available at <http://www.fisheries.org/html/publications/catbooks/x51032C.shtml>; and C. S. Kolar, D. C. Chapman, and W. R. Courtenay et al., *Asian Carps of the Genus Hypophthalmichthys (Pisces, Cyprinidae): A Biological Synopsis and Environmental Risk Assessment*, U.S. Geological Survey, Report to the Fish and Wildlife Service, LaCrosse, WI, 2005, available at <http://www.fws.gov/contaminants/OtherDocuments/ACBSRAFinalReport2005.pdf>.

⁶⁴ The Lacey Act, 16 U.S.C. §§ 3371-3378, makes it unlawful to import, export, sell, acquire, or purchase fish, wildlife or plants taken, possessed, transported, or sold (1) in violation of U.S. or Indian law or (2) in interstate or foreign commerce involving any fish, wildlife, or plants taken, possessed or sold in violation of state or foreign law. Under this law, designated injurious species are identified at 50 C.F.R. § 16. See also http://www.anstaskforce.gov/Documents/Injurious_Wildlife_Fact_Sheet_2007.pdf.

⁶⁵ Greg Conover, Rob Simmonds, and Michelle Whalen, *Management and Control Plan for Bighead, Black, Grass, and Silver Carps in the United States*, Aquatic Nuisance Species Task Force, Asian Carp Working Group, Washington, DC, November 2007.

Through its Midwest regional office, FWS is in the process of implementing some of these recommendations, although full implementation of the plan would require additional resources; FWS estimated that full implementation of all of the measures would cost at least \$286 million over 20 years.⁶⁶ As outlined in the plan, other federal agencies, including the Corps, USGS, EPA, and the U.S. Coast Guard, would also contribute resources under their respective authorities.

The Corps is also studying the broader application of methods to permanently prevent interbasin transfer of aquatic nuisance species in this region. In WRDA 2007, Congress authorized a long-term study on the feasibility of approaches to permanently eliminate the risk of interbasin transfer of ANS, including permanent ecological separation of the basins.⁶⁷ This study, known as the Interbasin Transfer Feasibility Study, is expected to focus on the conveyance of Asian carp as well as other invasive species throughout the Great Lakes region (in addition to the CAWS). According to the Corps' FY2011 budget justifications for Civil Works, it has a remaining cost of \$8.5 million. In 2008, the Alliance for the Great Lakes conducted its own preliminary study on ecological separation that highlighted major issues and pointed out specific research needs in this area.⁶⁸ Permanent ecological separation of the basins (especially in the Chicago area) would likely involve significant changes to existing navigation structures and operations in the CAWS, and is perhaps the most contentious issue related to the Asian carp debate. To date, no long-term solution has yet been decided. For more information on efforts to mandate permanent ecological separation, see the "Litigation" and "Congressional Interest" sections of this report.

Asian Carp Control Strategy Framework

Recent positive eDNA test results in the Great Lakes and the finding of a fish during the December 2009 rapid response chemical treatment of the CSSC have raised the profile of efforts to control Asian carp. On February 8, 2010, the White House convened a Summit for Great Lakes governors on the threat of Asian carp to the Great Lakes. This meeting focused on defining strategies to combat the spread of Asian carp and improving coordination and effective response across all levels of government. At this summit, the Obama Administration unveiled a draft framework that was subsequently finalized. This framework, known as the Asian Carp Control Strategy Framework, was last updated on May 5, 2010.⁶⁹ It outlines future actions and funding sources to eliminate the threat of Asian carp in the Great Lakes, and builds on the existing Corps barrier and monitoring as well as the 2007 FWS national management plan. The draft plan identifies 25 short- and long-term actions and \$78.5 million in new funding (\$58 million from the President's GLRI, funded by EPA) to implement these recommendations.⁷⁰ (See **Table 4**.)

Short-term recommendations in the framework were projected to be implemented by May 15, 2010. They include (1) ensuring proper supplies for future rapid response operations, including rotenone, netting, and personnel; (2) intensifying fish collection and other monitoring efforts (including eDNA); (3) modifying structural operations for locks, dams, sluice gates, and pumping

⁶⁶ Asian Carp Workgroup, *Asian Carp Control Strategy Framework*, Washington, DC, May 5, 2010, p. vi. Available at <http://www.asiancarp.org/Documents/AsianCarpControlStrategyFrameworkMay2010.pdf>.

⁶⁷ P.L. 110-114, § 345.

⁶⁸ Brammeier et al., p. 99. The study recommended that the Corps take a more comprehensive look at the available engineering options for ecological separation.

⁶⁹ See <http://www.asiancarp.org/Documents/AsianCarpControlStrategyFrameworkMay2010.pdf>.

⁷⁰ For a complete summary of each recommendation, including funding sources, see *Asian Carp Control Strategy Framework*, *ibid.*, pages 13-33, or Table 1 in that report.

stations; (4) expediting construction of the 13-mile barrier and sustained operations of Barrier IIA; and (5) researching applications of targeted biological controls (such as pheromone attractants). Long-term actions that are to be undertaken between now and 2020 include (1) feasibility studies of additional structural enhancements (electric and other barriers); (2) future rotenone applications; (3) implementation of biological controls; (4) sustained operations of barriers and continued exploration of monitoring techniques; and (5) various other items, including controlled lock operations and development of a market for Asian carp.

Table 4. Asian Carp Control Strategy Matrix
(summary of items with funding identified)

Action Item	Agency	Funding	Source	Start Date
Ongoing Barrier Operation	Corps	\$3,750,000	Corps	FY2010
Increase eDNA, Other Monitoring Capacity	Corps, IL DNR, FWS	\$3,540,000	GLRI, Corps, FWS, ILDNR	Ongoing
Barrier IIB Construction	Corps	\$13,000,000	Corps	2009
Implement Interim Study I/ Construct Other Barriers	Corps	\$13,200,000	GLRI	FY2010 Q-2
Final Report on Additional Barriers	Corps	\$1,100,000	Corps	2009
Inter-Basin Transfer Feasibility Study, Lock Closure impacts	Corps	\$1,000,000	Corps, GLRI	FY2010
Commercial Market Enhancement	IL DNR	\$3,000,000	GLRI	FY2010
Additional Rotenone Actions	IL DNR, FWS, USCG	\$5,000,000	Not currently funded	FY2010 Q-4
Interbasin Transfer Assessment	USGS	\$500,000	GLRI	FY2010 Q-2
Targeted Removal	RR Team	\$2,000,000	GLRI	FY2010 Q-2
Commercial Fishing Removal	IL DNR, USCG	\$300,000	GLRI	FY2010
Lacey Act Enforcement	FWS	\$400,000	GLRI	FY2010
Integrated Pest Management	FWS	\$4,223,000	GLRI	FY2010
State Aquatic Nuisance Management Plans	FWS	\$11,000,000	GLRI	FY2010
Activities to Support ANS Priorities	FWS	\$8,500,000	GLRI & FWS	FY2010
Competitive Funding for Additional Support	EPA/FWS	\$8,800,000	GLRI	FY2010
Research & Other Science ^a	USGS, multiple agencies	\$4,203,000	Multiple Sources	Multiple start dates

Source: Asian Carp Workgroup, Asian Carp Control Strategy Matrix. (Adapted by CRS.)

Notes: This summary table combines multiple items in the Administration's framework. It also omits certain actions which do not require funding but were included in the framework.

a. Consists of 10 discrete items identified in the matrix to be undertaken by USGS and other agencies.

A review of the framework's recommendations indicates sustained or increased funding for most of the major ongoing federal efforts mentioned earlier in this report. Significantly, revisions to the framework since its original release have emphasized funding for the Interbasin Feasibility Study

and note 2012 as the targeted release date for the interim version of the study, which will focus on ecological separation of the CAWS. A more comprehensive study focusing on all Great Lakes waterways is to be completed subsequently.

Litigation

As mentioned above, Asian carp reproduce prolifically, eat almost continually, and, with respect to silver carp, can injure persons and property by leaping out of the water if startled by the sound of an outboard motor. The general reproductive and behavioral characteristics of the Asian carp could alter the ecology of the Great Lakes, and make recreational activities such as fishing and boating in the Great Lakes less desirable. The CAWS provides a hydrologic link between the Mississippi River basin and Lake Michigan. The apparent ecological and economic threat posed by the migration of Asian carp into the Great Lakes via the CAWS has prompted litigation in the U.S. Supreme Court, and, more recently, in U.S. district court.

United States Supreme Court Proceedings

In an attempt to mitigate the movement of Asian carp into the Great Lakes, the state of Michigan filed suit in the Supreme Court against the state of Illinois, the Army Corps of Engineers, and the Metropolitan Water Reclamation District of Greater Chicago on December 21, 2009.⁷¹ Michigan filed a motion for preliminary injunctive relief and a motion to reopen docket numbers 1, 2, and 3, Original, based on pre-existing litigation between Illinois and the Great Lakes states.⁷² In its motion for preliminary injunctive relief, Michigan sought an order from the Court that would direct Illinois, the U.S. Army Corps of Engineers, and the Metropolitan Water Reclamation District of Greater Chicago to immediately close the shipping locks near Chicago and implement temporary emergency measures to prevent Asian carp from invading the Great Lakes.⁷³ Several other states bordering the Great Lakes supported Michigan's request for preliminary injunctive relief.⁷⁴ The Solicitor General, on behalf of the United States, filed a memorandum opposing Michigan's request for a preliminary injunction.⁷⁵

⁷¹ The United States Supreme Court has "original and exclusive jurisdiction of all controversies between two or more States." 28 U.S.C. § 1251(a).

⁷² When the Supreme Court exercises its original jurisdiction, disputes between states are assigned a number and filed under "Original" dockets. The state of Michigan argued that the Court had original jurisdiction over this dispute based on a decree issued in 1967, which resolved a dispute between the several Great Lakes states and Illinois over the amount of water Illinois could withdraw from Lake Michigan for sanitary and navigational purposes. See *Wisconsin v. Illinois*, 388 U.S. 426 (1967). The Court retained original jurisdiction over the dispute. *Id.* Accordingly, docket nos. 1, 2, and 3, Original, remain "open" for the purpose of resolving additional disputes between Great Lakes states and Illinois, provided that such disputes relate to the operation of the Chicago Area Waterway System, which links the Mississippi River to Lake Michigan. Michigan's motion to reopen docket nos. 1, 2, and 3, Original, is available at <http://www.supremecourt.gov/SpecMastRpt/Orig%201,%202%20&%203%20Motion%20to%20Reopen.pdf>.

⁷³ Michigan named the state of Illinois a party to this dispute because, according to Michigan, Illinois was ultimately responsible for the operation of the CAWS, which is jointly operated by the Army Corps of Engineers and Metropolitan Water Reclamation District of Greater Chicago. *Mich. Mot. for Prelim. Injunction*. In response, the state of Illinois and the United States argued that Illinois is not a proper party to this dispute because the state does not exercise day-to-day control over the operation of the CAWS. *Ill. Response*; *U.S. Response*. The parties' filings are publicly available at http://www.supremecourt.gov/SpecMastRpt/RecentFilingsinOriginalNos_1_2_3.aspx (links to PDF versions of filings).

⁷⁴ Minnesota, New York, Ohio, Wisconsin, and the Canadian Province of Ontario filed amicus briefs in support of (continued...)

Without comment, the Supreme Court issued an order on January 19, 2010, which summarily denied Michigan's request to close the shipping locks near Chicago.⁷⁶

On February 4, 2010, Michigan's attorney general filed a renewed motion, asking the Supreme Court to reconsider issuing a preliminary injunction for the closure of Chicago-area locks based on new evidence that Asian carp are present in Lake Michigan.⁷⁷ Michigan's renewed motion for a preliminary injunction was denied – again without comment – by the Supreme Court on March 22, 2010.⁷⁸

In addition to Michigan's request for preliminary injunctive relief, Michigan requested that the Supreme Court reopen docket numbers 1, 2, and 3, Original, which relate to prior litigation between several Great Lakes states and Illinois regarding the operation of the CAWS.⁷⁹ In its motion to reopen, Michigan requested a supplemental decree from the Court declaring that the CAWS, as presently maintained and operated, constitutes a "public nuisance."⁸⁰ Additionally, Michigan requested that the Supreme Court grant a permanent injunction requiring Illinois, the Army Corps, and the Metropolitan Water Reclamation District of Greater Chicago "to expeditiously develop and implement plans to permanently and physically separate the carp-infested waters in the Illinois River basin" from Lake Michigan to prevent the spread of Asian carp into the lake.⁸¹

Michigan's motion to reopen docket numbers 1, 2, and 3, Original, however, was denied by the Supreme Court on April 26, 2010.⁸² The Supreme Court also denied Michigan's request to file a separate complaint in connection with the issues raised in Michigan's motion to reopen.⁸³

United States District Court Proceedings

As mentioned above, the state of Michigan—joined by Wisconsin, Minnesota, Ohio, and Pennsylvania—filed a complaint against the U.S. Army Corps of Engineers and the Metropolitan

(...continued)

Michigan's request for a preliminary injunction.

⁷⁵ Neither Illinois nor the United States denied the threat posed to the Great Lakes by the spread of Asian carp in their respective responses to Michigan's request for a preliminary injunction, but rather argued that the requested relief was unnecessary in light of current efforts to prevent the spread of Asian carp into the Great Lakes through the CAWS.

⁷⁶ The Supreme Court declined to address the merits of Michigan's arguments and simply denied Michigan's motion for a preliminary injunction in a one-sentence order. See <http://www.supremecourt.us/orders/courtorders/011910zor.pdf> (order denying Michigan's request for a preliminary injunction at page 3).

⁷⁷ See <http://www.supremecourt.gov/SpecMastRpt/1-Renewed%20Motion%20for%20PI.pdf> (Michigan's renewed motion for preliminary injunction).

⁷⁸ See <http://www.supremecourt.gov/orders/courtorders/032210zor.pdf> (order denying Michigan's renewed request for a preliminary injunction at page 2).

⁷⁹ See *Wisconsin v. Illinois*, 388 U.S. 426 (1967).

⁸⁰ *Mich. Mot. to Reopen* at 29 (available at <http://www.supremecourt.gov/SpecMastRpt/Orig%201,%202%20&%203%20Motion%20to%20Reopen.pdf>).

⁸¹ *Id.* at 29-30.

⁸² See <http://www.supremecourt.gov/orders/courtorders/042610zor.pdf> (order denying Michigan's motion to reopen docket numbers 1, 2, and 3, Original at pages 1-2).

⁸³ *Id.*

Water Reclamation District of Greater Chicago in the U.S. District Court, Northern District of Illinois on July 19, 2010.⁸⁴

The plaintiff states are requesting that the court: declare the CAWS (as presently maintained and operated) a public nuisance; issue an order directing the Army Corps to expedite the completion of a study to determine the feasibility of permanently separating the CAWS from Lake Michigan; and issue an order directing the Army Corps to immediately implement various measures “to prevent the migration of bighead and silver carp through the CAWS into Lake Michigan.”⁸⁵

Although it is difficult to predict the outcome of this dispute, it should be noted that after the U.S. Supreme Court denied Michigan’s request for declaratory and injunctive relief in April 2010, at least one Asian carp has managed to swim beyond the electrical Dispersal Barrier System operated by the Army Corps at various points in the CAWS. On June 22, 2010, a bighead Asian carp was captured alive in Lake Calumet, a small lake connected to the CAWS, approximately six miles downstream from Lake Michigan.⁸⁶ Prior to the capture of a live Asian carp in Lake Calumet, Michigan relied on eDNA⁸⁷ samples recovered from the CAWS to establish the possible presence of Asian carp in Lake Michigan.⁸⁸ The capture of a live Asian carp in the CAWS could bolster the persuasiveness of Michigan’s argument that the CAWS provides an avenue for Asian carp to migrate from the Mississippi River basin into the Great Lakes in spite of the Army Corps’ aforementioned efforts to prevent such migration.

Canadian Concern

For many decades, the United States and Canada have conducted a major cooperative program to deal with the consequences arising from the introduction of the non-native sea lamprey, *Petromyzon marinus*, to the Great Lakes. Through the Great Lakes Fishery Commission, the governments of the United States and Canada, together with neighboring states and provinces, spend millions of dollars annually to control this invasive parasite and limit its damage to sport and commercial fisheries.

Canada has assessed the risks posed by the introduction of Asian carp,⁸⁹ concluding that the risk of impact would be high in some parts of Canada, including the southern Great Lakes basin, by the four species of Asian carp. Canada is currently addressing these concerns through its participation in the bilateral Great Lakes Fishery Commission.

⁸⁴ Unlike in the proceedings before the U.S. Supreme Court, the state of Illinois is not named as a party to Michigan’s suit. An electronic version of Michigan’s complaint is available at <http://207.41.16.133/rfcViewFile/10cv4457.pdf> (last visited August 2, 2010).

⁸⁵ *Mich. Complaint* at 31-34.

⁸⁶ See Chris McCloud and Katie Steiger-Meister, “Bighead Asian Carp Found in Chicago Area Waterway System,” *Asian Carp Regional Coordinating Committee*, June 22, 2010, available at <http://asiancarp.org/Wordpress/news/bighead-asian-carp-found-in-chicago-area-waterway-system/>.

⁸⁷ For a brief discussion of eDNA, see accompanying text under “Monitoring” at 15-16.

⁸⁸ See <http://www.supremecourt.gov/SpecMastRpt/1-Renewed%20Motion%20for%20PI.pdf> (Michigan’s renewed motion for preliminary injunction). See also Illinois Department of Natural Resources, *Bighead Asian Carp Found in Chicago Sanitary and Ship Canal*, December 3, 2009, available at <http://dnr.state.il.us/pubaffairs/2009/December/asianCarp3Dec2009.htm>.

⁸⁹ Available at http://www.dfo-mpo.gc.ca/csas/Csas/DocREC/2004/RES2004_103_E.pdf.

Congressional Interest

Section 126, Title I, of P.L. 111-85 directed the Corps to implement additional measures to prevent aquatic nuisance species from bypassing the Chicago Sanitary and Ship Canal Dispersal Barrier Project and to prevent aquatic nuisance species from dispersing into the Great Lakes. On February 9, 2010, the House Transportation and Infrastructure Subcommittee on Water Resources and Environment held a hearing on Asian carp in the Great Lakes. On February 25, 2010, the Senate Energy and Natural Resources Subcommittee on Water and Power held a hearing to examine the science and policy behind efforts to prevent the introduction of Asian carp into the Great Lakes. In addition, several bills have been introduced in the 111th Congress to address multiple concerns about Asian carp.

- Several bills propose to amend the Lacey Act to add bighead carp (S. 1421/H.R. 3173, H.R. 48, and Section 171 of S. 237) to the list of injurious species that are prohibited from being imported or shipped interstate.⁹⁰ The Senate Environment and Public Works Subcommittee on Water and Wildlife held a hearing on S. 1421 on December 3, 2009, and the full committee reported this bill on May 5, 2010 (S.Rept. 111-181).
- H.R. 51 would direct the U.S. Fish and Wildlife Service to study the feasibility of various approaches to eradicating Asian carp from the Great Lakes watershed.
- H.R. 4472 and S. 2946 would direct the Secretary of the Army to take action with respect to the Chicago waterway system to prevent the migration of bighead and silver carp into Lake Michigan, including closing O'Brien and Chicago Locks.
- H.R. 4604 would direct the Secretary of the Army to prevent the spread of Asian carp in the Great Lakes and their tributaries.
- Section 172 of S. 237 would direct the Secretary of the Interior to establish an interbasin and intrabasin monitoring program to monitor the movement of aquatic invasive species in interbasin waterways, assess the efficacy of dispersal barriers and other options for preventing the spread of invasive species, and identify potential sites for dispersal barrier demonstration projects.

⁹⁰ FWS has considered listing bighead carp as an injurious species under the Lacey Act, but decided not to take this action because of the negative economic impact such a listing might have had upon the U.S. aquaculture industry. See 68 *Federal Register* 54409, September 17, 2003.

Author Contact Information

Eugene H. Buck
Specialist in Natural Resources Policy
gbuck@crs.loc.gov, 7-7262

Harold F. Upton
Analyst in Natural Resources Policy
hupton@crs.loc.gov, 7-2264

Charles V. Stern
Analyst in Natural Resources Policy
cstern@crs.loc.gov, 7-7786

James E. Nichols
Law Clerk
jnichols@crs.loc.gov, 7-5812