PC# 360

To: John Therriault, Clerk, Illinois Pollution Control Board
From: David L. Thomas, PhD (1)
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Potential impacts of Asian carp on fish populations in The Upper Dresden Island Pool and Implications to Water Quality Standards

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Introduction

A lot of literature is being generated about Asian carp, particularly the bighead and silver carp which have become established in the Missouri, Mississippi, Illinois and many other rivers in the central US. Greg Seegert (2010), in recent testimony before the Illinois Pollution Control Board (R08-9 Subdocket C), has argued that these carp will become abundant in the Upper Dresden Island Pool (UDIP) of the Illinois River, will consume a significant portion of the plankton population, and that this will lead to reduced condition of fish, poor spawning and recruitment, and a degradation of native fish populations. As pointed out below, Seegert's arguments are based on worse-case scenarios and are heavy on speculation, including the inclusion of a number of erroneous conclusions. While it is true that Asian carp may become established in this pool, there is really no reason to conclude that therefore this stretch of river will not be able to meet Clean Water Act Standards. In fact, the presence of the carp may make it even more important that all steps practical be taken to improve water quality in this stretch of the river to enhance native fish populations and allow them to better compete with invasive species such as the carp.

Spawning of Asian carp

Both bighead and silver carp spawn in late spring and early summer, and spawning seems to be initiated by rising water levels. Spawning grounds of bighead carp are characterized by rapidly flowing (current velocity 0.6 to 2.3 m/s) turbid water (Kolar et al. 2005). These authors point out that large lakes connected to rivers often serve as nursery areas for silver carp. In the Illinois and Mississippi rivers, floodplain lakes do seem to be nursery areas for Asian carp. Both species lay semi-buoyant eggs, and so spawning usually occurs where the water current is sufficient to keep the eggs from sinking to the bottom and dying. According to Irons et al. (2009), fry of both species hatch in approximately one day and float with the larval drift, where after 7 days they migrate toward shore. It is because of this aspect of their early life history that they may need a fairly long stretch of river to survive as larvae.

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Also, based on their biology in the Yangtze River in China, it appears that only select spawning sites are used each year. In the Yangtze River 36 sites for spawning bighead and silver carp were found in 1700 km of river (Kolar et al. 2005). This would indicate to me that there were large stretches of river where spawning did not occur. These sections could have included water that was moving too slow or was impounded precluding spawning or leading to eggs sinking and dying. Whether conditions are right within the UDIP for successful Asian carp spawning is still an open question and remains somewhat doubtful based on the literature. Without significant local spawning the population of Asian carp within the pool may be composed mostly of transient individuals, and it seems unlikely that they would reach a population density that would negatively affect local fish populations.

Asian carp food habits

In the first full paragraph on page 11 of Seegert's prefiled testimony (Exhibit 428) he discusses the potential impacts of Asian carp on plankton. He states that they will "indiscriminately ingest a wide variety of food resources including phytoplankton, zooplankton, fish eggs, and fish larvae, making these items less available for a wide variety of higher organisms...." Sampson, Chick and Pegg (2009) reported that bighead carp have an average gill raker width of 20-60 micro meters and can filter food particles as small as 17 micro meters. Silver carp have specialized fused gill rakers with an average pore size of 20-25 micro meters and are capable of consuming food particles as small as 8 micro meters. Sampson, Chick and Pegg (2009) compared the food habits of bighead and silver carp, to native plankton feeders bighead buffalo, gizzard shad, and paddlefish. They found diet composition (% number) of bighead and silver carp were similar to gizzard shad, showed less overlap with bigmouth buffalo and were dissimilar to paddlefish. They stated that silver carp selected primarily smaller prey (e.g. rotifers), whereas bigmouth buffalo and paddlefish preferred large prey (e.g., crustacean zooplankton). They did not report any fish eggs or larvae in the fish stomachs they analyzed. Size of gill rakers and manner and location of feeding all influence what prey items are consumed. They are not "indiscriminate" feeders.

Williamson and Garvey (2005) looked at the food habits of silver carp in the Mississippi River between Lock and Dam 26 at Alton and Cairo, Illinois. They found that "zooplankton taxa (wet weight across all individuals and dates) in silver carp diets were composed of 27% cladocerans and 69% rotifers at Grand Tower and 62% cladocerans and 37% rotifers at Chester." Phytoplankton, as measured by chlorophyll *a* concentrations, predominated in the diet of these carp. While the potential for competition for food with native fishes was a possibility for young fish, they concluded that direct overlap of food between adult silver carp and other fishes for phytoplankton behind Mississippi River structures was probably low, given that few other native river species appear to have similar filter feeding, herbivorous behavior.

Pongruktham et al. (2010) reported that silver carp feed predominately on phytoplankton and rotifer zooplankton. They stated that "very high algal abundances and chlorophyll concentrations in silver carp guts indicate the capability of the silver carp to remove a high proportion of phytoplankton from the water-column and in this way be successful competitors with native fishes for this resource."

Seegert speculates that Asian carp will lead to a reduction in plankton populations which will adversely affect native fishes. Sampson, Chick and Pegg (2009) concluded from their study that although they found little evidence that bighead and silver carp were reducing zooplankton abundance, their results

did not rule out the possibility that Asian carp could limit food resources for native fishes as their populations continued to increase in the Illinois and Mississippi rivers. These authors stated that backwater lakes with the greatest abundance of bighead and silver carp had low densities of cladocerans, nauplii and adult copepods. Cladoceran density was negatively related to both bighead and silver carp catch per unit effort. Rotifer density, however, was not significantly related to abundance of either bighead or silver carp.

Potential competition of Asian carp with native fish species

Scientists at the Illinois Natural History Survey have documented some reduction in condition of gizzard shad and bigmouth buffalo in the Illinois River (this means that their body weight at a given length was somewhat less after Asian carp invaded than before), but it is not clear at this point if this will have a significant impact on their populations. Irons et al. (2007) found that in the LaGrange Reach of the Illinois River there were significant declines in body condition of gizzard shad (-7%) and bigmouth buffalo (-5%) following the Asian carps invasion from 2000 to 2006. Bigmouth buffalo condition declined significantly in each year following the Asian carp's invasion but condition of gizzard shad increased in recent years. The catch per unit effort of gizzard shad did not change over time but the catch of bigmouth buffalo significantly decreased over time.

Kolar et. al (2005) stated in their paper that there is growing evidence of declines in native species, particularly fishes that are planktivorous as adults, after the introduction of Asian carp into the wild. In some of the examples they cite, potential confounding factors may have contributed to the reported declines. Pongruktham et al. (2010) found that the effects of silver carp on food web structure may be most direct and pronounced in seasonally isolated backwaters "where native fishes and silver carp migrate during early life stages and directly compete for a limited food resource".

In Seegert's testimony (Exhibit 428, bottom of page 11) he concludes that "because of reduced food supplies caused by the presence of Asian carp, condition factors of fish in the UDIP and Brandon Pool will decline." This statement assumes that 1) Asian carp will become abundant in these two pools, 2) that they will significantly reduce plankton populations, and 3) that this reduction will then lead to reduced condition factors in resident fish. All of these assumptions are based on speculation assuming a worse-case scenario (that is, a large reproducing population of Asian carp that is significantly reducing plankton populations). In the third paragraph of the page (12) of his testimony he speculates that poor fish condition will then lead to reduced fish eggs being produced. There is a big difference between a reduction in fish condition and a fish condition that is poor enough to adversely impact reproduction. However, Irons et al. (2007) did report that a 5% decline in gizzard shad condition has been shown to reduce fecundity 1 to 5% according to Kilambi and Baglin (1969).

Kolar et al. (2005) stated that "*for competition to occur there must first be a limiting resource. At this time it is not known whether plankton resources are limiting for fishes in the large rivers of the United States or whether the introduction of Hypophthalmichthys (Asian carp) could cause resources to become limited. Further research in this area is needed.*" As mentioned above, Sampson, Chick and Pegg (2009)

found little evidence that bighead and silver carp were reducing zooplankton abundance in the Mississippi and Illinois rivers at the time of their study.

While there is some evidence that native planktivorous fishes could be negatively affected by Asian carp, some predators may benefit. INHS field biologists on the middle Illinois River have found that largemouth bass, crappie, gar and white bass do congregate and are feeding on juvenile Asian carp when they are abundant and vulnerable (Gregg Sass, personal communication). And while catches of largemouth bass in the La Grange and Peoria reaches of the Illinois River have increased over the last couple of years, this may be due in large part to some higher water years which favor successful reproduction and recruitment, as opposed to more abundant food supply from young Asian carp (ibid). What it does illustrate, however, is that even in the presence of a significant Asian carp population, largemouth bass were able to successfully reproduce and increase in abundance.

One unknown with Asian carp in this new environment is that there have been some changes in aspects of their life history. Williamson and Garvey (2005) state that silver carp in their native range mature by age 3 and live for about 8 years, whereas individuals in the Mississippi River below Alton, Illinois appear to be reproducing 1 year earlier and only reaching about 5 years of age. As populations of these carp move north there may be other changes in their life history, and it will be some time before we are able to document what these changes will be.

Asian carp and water quality standards

In Seegert's testimony (Exhibit 428, bottom of page 2) he states the conclusion of his testimony that "attainment of the Clean Water Act aquatic life standards clearly will no longer be achievable once Asian carp have become established in the UDIP". First this assumes that Asian carp will become established in the pool and that this will result in further degradation of the fish and plankton population. His whole testimony bases itself on speculation, with the underlying assumption that Asian carp will become abundant in the pool, that they will reduce the plankton population and that all of these effects will negatively affect native fish populations. One could just as easily argue, if these assumptions were accepted, that if Asian carp are going to stress native fish populations then this would be even more reason to improve water quality, including reducing thermal pollution, to help native fishes have a more competitive advantage against invasive species. Having thermal discharges during higher spring flows could well induce the Asian carp to spawn earlier in the UDIP, assuming that they can successfully spawn in this stretch of river.

Seegert concludes his testimony by stating that the fish community is limited presently by "dams, poor habitat, toxic sediments, water level fluctuations, and barge traffic " but somehow the Asian carp population will thrive in this environment and further degrade the native fish community. As with much of this testimony, speculation is rampant and intermixed with some facts from the literature. Some of the reported "facts" are just misleading. For example, he reported that Shank et al. (2003) demonstrated reduced numbers or condition of paddlefish in the presence of Asian carp whereas what Shank et al. demonstrated was that when zooplankton were limited, age 0 bighead carp had a

competitive advantage over age 0 Paddlefish. Sampson, Chick and Pegg (2009) showed that there was very little overlap in diet between adult paddlefish and Asian carp in the Mississippi River.

A large percentage of our water bodies in the United States now have invasive species and many water bodies have multiple invasive species. There has been an estimate made that in the Great Lakes at least one new invasive species a year gets established in the lakes. If the presence of invasive species means that a water body would no longer meet the Clean Water Act goals, then we will have few water bodies that can achieve these goals. Rather what may be required is that we work to further improve water quality in our water bodies to give native species every chance to compete against invasive species.

I find little to support Seegert's contention that achievement of Clean Water Act aquatic life standards cannot be achieved if Asian carp become established in the UDIP.

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