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Perception of Asian carp as a possible food source among Missouri anglers

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ABSTRACT

Silver and bighead carps were imported from China to the United States in the 1970s as a biological control mechanism for improving water quality. After escaping captivity, both species spread into the Mississippi River Basin and now threaten to enter the Great Lakes. Human consumption is one solution, but many Americans believe that carp is unsavory. A random sample of 2,000 licensed anglers in Missouri was asked to complete a mail-back questionnaire about Asian carp, yielding a 27% response rate (n = 465). Results indicated that knowledge and perception about carp were poor, and food neophobia (fear of new foods) scores were above average. Less than 15% of respondents had eaten carp, but nearly 53% were willing to try. Marketing should focus on the benefits of consumption while downplaying any possible concerns. Although education programs are worthwhile, taste might be more influential to change public attitudes toward Asian carp.

KEYWORDS

Asian carp; consumption; food; perceptions

Introduction

Silver carp (*Hypophthalmicthys molitrix*) and Bighead carp (*Hypophthalmicthys nobilis*), collectively known as Asian carp, were imported from China into the United States during the 1970s as a biological control mechanism to improve water quality (Kelly, Engle, Armstrong, Freeze, & Mitchell, 2011). Subsequent flooding allowed both species to escape confinement, resulting in unusually large concentrations of Asian carp in the Mississippi River and its tributaries, especially in the Illinois River downstream from Chicago (Chick & Pegg, 2001). Other reasons for the widespread distribution of Asian carp include ample space and food supply, tolerance of temperature extremes and salinity, rapid sexual maturity, and high levels of fecundity (Anderson, Kaller, & Thomas, 2010). High densities of invasive carp can result in serious problems for aquatic ecosystems because they consume planktonic organisms, thereby compete with native species for food and other resources (Irons, Sass, McClelland, & Stafford, 2007). Asian carp can also prevent recreational enjoyment of affected waterways. Silver carp tend to leap from the water when startled, causing personal injury and property damage to boats (Stokstad, 2010).

Asian carp threaten to enter Lake Michigan via the Chicago Sanitary and Ship Canal (Jerde et al., 2013). If a carp infestation arises in the Great Lakes, it will likely disrupt a multibillion dollar commercial and recreational fishing industry (Tsehaye, Catalano, Sass, Glover, & Roth, 2013). To prevent this occurrence, the U.S. Army Corps of Engineers built three "invisible fences" from 2002 to 2010 to pulse electricity into the water at Lockport,

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Illinois (Chick & Pegg, 2001). However, Asian carp DNA has been found in Lake Michigan (Jerde, Mahon, Chadderton, & Lodge, 2011) and one live Bighead carp was caught beyond the electric barrier in June 2010 (Mahon, Jerde, Chadderton, & Lodge, 2011), calling into question the effectiveness of some prevention measures.

Electric current is one way to deter Asian carp movement (Hinterthuer, 2012), but this strategy does nothing to reduce existing populations. Angling is not a solution because Silver and Bighead carp are not caught using traditional methods. Commercial harvest is a viable option, but the supply of fish is currently larger than demand (Conover, Simmonds, & Whalen, 2007). Some uses include fertilizer, oils, and pet food (Charlebois, Parks, TePas, & Peterson, 2010).

Human consumption of Asian carp should be considered as a possible management strategy, but many Americans think these species are "unsavory," and changing this negative perception might be difficult (Varble & Secchi, 2013). The social and cultural stigma of carp has a long history in the United States. (Cole, 1905). One reason for disdain is the abundance of intramuscular bones found in carp. Asian carp are also thought to possess contaminants given they inhabit Midwestern Rivers that often contain pollutants (Varble & Secchi, 2013). Although some people worry about health risks posed by eating fish from contaminated waters (Sheaffer & O'Leary, 2005), there is impetus for consuming locally grown, harvested, and processed food (Adams & Salois, 2010). A number of people are also reluctant to consume invasive species (Nuñez, Kuebbing, Dimarco, & Simberloff, 2012) due to a fear of new foods (Pliner & Hobden, 1992).

Although controversial among some fisheries biologists, controlling an invasive species through human consumption can increase awareness of non-natives and boost local economies (Nuñez et al., 2012). Conservation through gastronomy is becoming more popular (Franke, 2007), especially with Asian carp. The Louisiana Department of Wildlife and Fisheries (LDWF), for example, launched a "Silverfin Promotion" encouraging people to eat carp (LDWF, 2010). The Illinois Department of Natural Resources featured Asian carp in "Target Hunger Now!" a program using natural resources to feed needy people (McCloud & Solano, 2011). Although human consumption can become a population control mechanism for Asian carp (Weis, 2011), people may be reluctant to eat invasive species if the primary reason to do so is based on reducing their numbers. Instead, Charlebois et al. (2010) suggested that marketing efforts should focus on the benefits of Asian carp as a "healthy, tasty, wild-caught river fish."

Phelps (2012) showed that people liked the taste of Asian carp over catfish. Through a market-based study, Varble and Secchi (2013) found their respondents were willing to try a free sample of Asian carp and purchase it from a grocery store or restaurant. The primary focus on human consumption of Asian carp is a high-volume/low-price export (mainly to China), rather than developing a high-quality/high-price product for the domestic market (Charlebois et al., 2010). According to Varble and Secchi (2013), increasing domestic consumption of Asian carp would reduce stress on U.S. waterways by providing a local and plentiful supply of fish. Can this goal be achieved, and if so, how? This study examined perceptions of Missouri anglers regarding Asian carp as a possible food source. At present, little information exists on public demand.

Methods

To determine these perceptions, a mail-back questionnaire was administered to a sample of 2,000 Missouri anglers selected randomly from the statewide population of fishing license

holders (~500,000) in 2014. Contact information was obtained from the Missouri Department of Conservation. A slightly modified version of the Tailored Design Method (Dillman, Smyth, & Christian, 2014) was used throughout the survey process, which included an initial contact and two follow-ups with those who did not return completed questionnaires. The rationale for selecting anglers was based on their interest in and likely consumption of fish.

The three-page questionnaire asked anglers a variety of questions about Asian carp and took respondents about 15 minutes to complete. The first section examined knowledge about Asian carp through a series of eight multiple-choice items, each of which included one correct answer, two distractors, and an "I don't know" option to discourage guessing. Each item was coded "right" or "wrong" and summed, yielding a total knowledge score from 0 to 8. "I don't know" responses were coded as incorrect. Perceptions about Asian carp were measured on a 10-point desirability scale (1 = *lowest* to 10 = *highest*). Seven other common fish in Missouri were listed as well, but each one was rated independently. Several items examined attitudes toward Asian carp using a 5-point scale (1 = *strongly disagree* to 5 = *strongly agree*).

Two measures were used for determining level of interest in eating Asian carp. The first one was a forced-choice, 4-option scale (as one of the first to consume to not willing to consume at all). A second evaluation measured food neophobia, the willingness to try unique and different foods (Pliner & Hobden, 1992). Food neophobia was measured using a 10-item scale, coded 1–7 (lowest to highest agreement) and summed after reverse coding five statements to obtain a total score (Pliner & Hobden, 1992). Acceptance of new food products is an important antecedent of a successful marketing campaign (Henriques, King, & Meiselman, 2009), along with maximizing possible benefits and minimizing any concerns associated with human consumption. Two open-ended questions, one measuring likely benefits and the other examining potential concerns of eating Asian carp, were hand-sorted and coded into themes using an inductive process.

Results

In total, 1,735 of the 2,000 questionnaires mailed to licensed anglers in Missouri were deliverable. After reminding twice, 465 individuals completed and returned their questionnaires (27% response rate). The majority of respondents were middle-aged (M = 46 years; SD = 13.5), Caucasian (95%), and male (73%). More than 23% were college graduates and almost 12% had postgraduate degrees. These Missouri anglers considered themselves to be environmentally friendly (M = 4.2, SD = 0.66) and preferred to buy locally harvested and processed foods (M = 4.1, SD = 0.93). Many respondents disagreed with the idea that eating fish from Missouri rivers was a serious health risk (M = 2.4, SD = 1.05).

Knowledge, perceptions, and attitudes

Overall respondent knowledge of Asian carp was low (M = 3.2, SD = 1.90), as these anglers selected incorrect answers about 60% of the time. For example, 73% of the anglers were not aware that Asian carp only consumed microscopic organisms, and 86% did not know that both fish species were mid-stream feeders. Less than 30% of respondents knew when Silver and Bighead carp were introduced to the United States. Most of these anglers (83%),

Table 1. Respondent knowledge about Asian carp.

Questions	Attribute	*n*	%
What is an invasive species?	Right	383	83
	Wrong	78	17
Which area in the United States has the greatest concentration of Asian carp?	Right	222	48
	Wrong	237	52
What was the primary reason for importing Asian carp?	Right	218	47
	Wrong	242	53
Which type of carp tends to jump out of the water when frightened?	Right	220	47
	Wrong	243	53
When were Asian carp first imported into the United States?	Right	136	29
	Wrong	326	71
How many species of carp are found in the United States?	Right	128	28
	Wrong	331	72
What is Asian carp's main food source?	Right	123	27
	Wrong	340	73
Which best describes Asian carp's feeding behavior?	Right	66	14
	Wrong	396	86
Total	Right		41
	Wrong		59

however, knew the definition of an invasive species. See Table 1 for information on knowledge about Asian carp.

The perception of Asian carp among these anglers was weak relative to other freshwater fish common in Missouri (M = 2.96, SD = 2.26). Having a low perception of Asian carp was consistent with some attitudes and beliefs, but not others. For example, respondents strongly disagreed with the statement, "Asian carp are a welcome addition to native fish populations" (M = 1.7, SD = 0.95) and strongly agreed with the statement, "Asian carp can harm the freshwater ecology of our waterways" (M = 4.1, SD = 1.16). These anglers disagreed with the idea that nothing can be done to eradicate Asian carp from our waterways (M = 2.4, SD = 1.07), yet they were neutral about consumption as a possible management strategy (M = 3.0, SD = 1.1).

Willingness to consume

Although 88% of these anglers had never eaten Asian carp, almost 53% expressed an interest in doing so. Willingness to consume Asian carp was measured by responses to a series of graduated questions: 14% said they would be one of the first to consume; 17% said they would consume after a few others had tried it; and 21% said they could consume after many other people had tried eating Asian carp. Nearly half of the sample (47%) said they were not willing to consume Asian carp, which is fairly consistent with their above-average food neophobia scores (M = 44.76, SD = 12.61; Table 2).

Benefits and concerns

Of the 302 benefits from consuming Asian carp as reported by these anglers in the open-ended questions, healthy eating (e.g., good source of protein, high in omega-3 fatty acids, low in cholesterol) outscored all other responses (n = 104, 34%). The value of population control and helping the environment was the second most frequently mentioned reason (n = 71, 24%). Price was third most common reason, given that Asian carp are viewed as an inexpensive food source (n = 30, 10%).

Table 2. Food neophobia among respondents.

Items	*n*	*M*	*SD*
At dinner parties, I will try a new food (R)	458	5.03	1.70
I like foods from different countries (R)	458	4.93	1.75
I am constantly sampling new and different foods (R)	461	4.80	1.65
Ethnic food looks too weird to eat	456	4.77	1.72
I am afraid to eat things I have never had before	460	4.75	1.81
I do not trust new foods	459	4.65	1.68
I like to try new ethnic restaurants (R)	446	4.37	1.78
I will eat almost anything (R)	457	4.00	1.95
I am very particular about the foods I will eat	458	3.98	1.92
If I do not know what is in a food, I would not try it	460	3.84	1.99
Total		44.76	12.61
Coded 1–7 (lowest to highest agreement)			
R = item reverse coded for analyses (1 = 7 to 7 = 1)			

A total of 344 concerns about consuming Asian carp were listed by respondents. The most frequently mentioned issue was health risks, including the fish (e.g., toxins, bacteria, and diseases) and water quality (e.g., pollution, heavy metals, and chemical compounds). The number and structure of bones found in Asian carp was second most commonly mentioned (n = 55, 16%); taste, flavor, and odor ranked third (n = 49, 14%); and low status or negative perception (e.g., nasty and trash fish) was the fourth most frequently mentioned concern (n = 31, 9%).

Discussion

Most of the anglers considered Asian carp as a threat to freshwater ecology and believed this issue deserves immediate attention. However, human consumption as a control strategy yielded mixed results. Perhaps this uncertainty was due to questionnaire wording given that the item did not specify who should perform this behavior (e.g., "you" or "someone else"). The primary reasons for eating Asian carp included health benefits and reducing their population. Despite the relatively high food neophobia scores, over half of the respondents were willing to eat something new. This result is meaningful, considering that nearly 9 out of 10 anglers had never eaten Asian carp. Varble and Secchi (2013) found similar results, as over 70% of their subjects were willing to try a free sample of Asian carp and 68% were willing to purchase it in grocery stores. Although low cost is a benefit, price can also have a downside. Given that Asian carp are numerous, the fish has a low market value. Some people may see inexpensive products as less desirable.

Commercial harvest is a possible management strategy, yet the supply chain for Asian carp is non-existent in Missouri, unlike Illinois (Garvey et al., 2012). These anglers placed a high value on local food sources and perceived themselves to be environmentally friendly. Although respondents did not think that fish consumption was a health risk statewide, they were somewhat apprehensive about toxicity and chemicals in Asian carp. According to recent studies, this concern appears to be unfounded, as Silver and Bighead carp have small amounts of heavy metals (Rogowski et al., 2009) and concentrations of arsenic, mercury, and selenium are well below thresholds set by the U.S. Food and Drug Administration (Levengood, Soucek, Sass, Dickinson, & Epifanio, 2014).

Public perceptions of carp are low relative to other common freshwater fish in Missouri. In fact, the only fish scoring lower than carp was gar. This finding appears to

be a reflection of American culture. Boniness was one reason for disdain. In all likelihood, anglers were referring to the bone structure, meaning the y-bones make carp difficult to fillet (yield of meat is only about 10–12%). In other words, the value of carp is not worth the effort to clean it, hence the moniker "trash fish." However, resource management agencies should not reinforce this stereotype. Carp was once considered the queen of rivers (Walton, 1993). Asian carp are eaten across Europe and the fish is considered a delicacy in Asian countries. Simply informing U.S. residents to eat around the bones is not likely to have the same effect as practiced elsewhere.

A lack of knowledge about carp may contribute to its poor image, a finding that suggests the potential effect of education is large. Information can be useful for addressing ignorance and correcting misperceptions about Asian carp. Only one-quarter of respondents knew there were five species of carp in the United States. Although many anglers are aware of Grass and Common carp, the internet sensation over Silver carp may have produced some confusion between the species. Evidence to support this claim comes from answers to questions regarding their diet and mid-stream feeding behavior. Common carp were imported from Germany in the 1800s as a food source for immigrants, resulting in widespread distribution across the United States (Cole, 1905). Common carp are often seen uprooting vegetation while spawning in ponds, lakes, and reservoirs. Such behavior has resulted in nicknames such as 'aquatic hog' or 'pig with fins,' only worsening the species' image in Missouri and perhaps elsewhere. Guilt by association is likely.

Better explanations of the diet and feeding habits of Asian carp could be useful for modifying its negative perceptions among anglers. Silver and Bighead carp are mid-stream feeders that consume phytoplankton and zooplankton, respectively. Food sources and feeding locations of Asian carp reduce the amount of earthy flavors and aromas that can affect taste (Papp, Kerepeczki, Pekar, & Gal, 2007). Although texture is important, the main reason people dislike eating fish is the "fishy" taste. Unlike bottom dwelling species, Asian carp have a mild flavor (Bardach, Ryther, & McLarney, 1974). One taste test supported the feeding location hypothesis, as Silver carp, a mid-stream feeder, tasted significantly better than catfish, a bottom-feeder (Elmore, 2013). Ironically, Silver carp tastes better than catfish, yet its overall perception is much lower.

Although providing information about Asian carp is worthwhile, knowledge acquisition of "undesirable" species may not be sufficient to improve public attitudes. For example, attitudes toward snakes held by elementary school students did not improve, even after doubling their knowledge scores (Morgan & Gramann, 1989). According to the Elaboration Likelihood Model (Petty & Cacioppo, 1981), persuasion through the central route (information processing) is more difficult to achieve than using peripheral routes (cues and non-issue-relevant concerns). In this context, social science theory suggests that taste (peripheral route) would be more effective than information (central route) when promoting consumption, despite the importance of both aspects.

Anecdotal evidence from public food events featuring invasive species suggests that taste allows individuals to be receptive of new information, thus lessening the tendency for counter-argumentation. The flesh of Asian carp absorbs spices and seasonings easily, virtually eliminating the "fishy" taste that might otherwise prevent a favorable impression. Future research should focus on relative effectiveness of taste and information to promote human consumption.

In conclusion, this sample of anglers considered Asian carp to be a threat to freshwater ecology in Missouri. However, respondents were not convinced about human

consumption as a possible management strategy. Knowledge and perceptions about carp are poor, yet information alone will not likely solve this environmental issue. Asian carp are an underutilized food source and a potential market exists if taste, water quality issues, fish health, and bones can be addressed. It is not a "trash fish." Persuasive messages should focus on nutrition, population control, and price. Public acceptance of carp is unlikely from each social class, so targeting those who have a history of eating river fish might be more successful than trying to create new market segments.

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