Age estimation of a large bighead carp from Grand Lake, Oklahoma

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On April 23, 2011, a 1356-mm total length (TL), 39.8 kg bighead carp (*Hypophthalmichthys nobilis*) was brought to the Oklahoma Department of Wildlife Conservation. This specimen is the largest bighead carp recorded from Oklahoma, and it is near the maximum size reported from the United States. This specimen was estimated to be nine years old based on estimates from three different structures (pectoral fin ray, branchiostegal ray, and otolith). The age, together with past Oklahoma records of the species, indicates that there has been multiple introductions or undocumented reproduction of bighead carp in the Grand Lake basin.

INTRODUCTION

Bighead carp (*Hypophthalmichthys nobilis*) were first found in Oklahoma in 1992 in Grand Lake (1). Adult specimens have been observed since (2), but reproduction has not been documented. Fishery managers have sought to determine if the species is self-sustaining in Oklahoma or the result of one (or several) instances of illegal introduction such as occurred in Kansas in 1988 (1). To help address this question, an analysis of the age of bighead carp specimens is needed to determine if specimens routinely (i.e., annually), but infrequently (i.e., ~2 per year), caught by anglers could be part of the initial stock of fish introduced into the system.

There is a paucity of data on age of bighead carp, especially for large (>1 m) individuals. The maximum age appears to be between 16 and 20 years (3, 4), but fish of this age in the United States have not been documented. The oldest potential bighead carp reported from the United States was a 10-year old, 937 mm (total length; TL) specimen from Lake Erie (5), but the specimen was only identified to genus and it could have been the closely related silver carp (*Hypophthalmichthys molitrix*). Studies of age and growth of bighead carp in the Mississippi and Missouri Rivers (6, 7, 8) have reported no specimens greater than 1 m long or older than 7 years (Figure 1).

If bighead carp live to 20 years, then a specimen near its maximum size of 40 kg (3) would probably be old and might be a survivor from the initial introduction like the one reported in 1992 from the Grand Lake system (1). Few bighead carp in the United States have been reported near the maximum size of 40 kg and none of the fish this size have been analyzed for age. Individuals as large as 40.8 kg and 47.6 kg have been reported from Texas (3,9) and Missouri (10), respectively. On April 23, 2011, a 39.8 kg specimen measuring 1356 mm TL was brought to the Oklahoma Department of Wildlife Conservation (ODWC). This fish, which was caught by a fisherman on Grand Lake, was kept frozen for further analysis. Estimating the age of this specimen, which is the objective of this study, would help

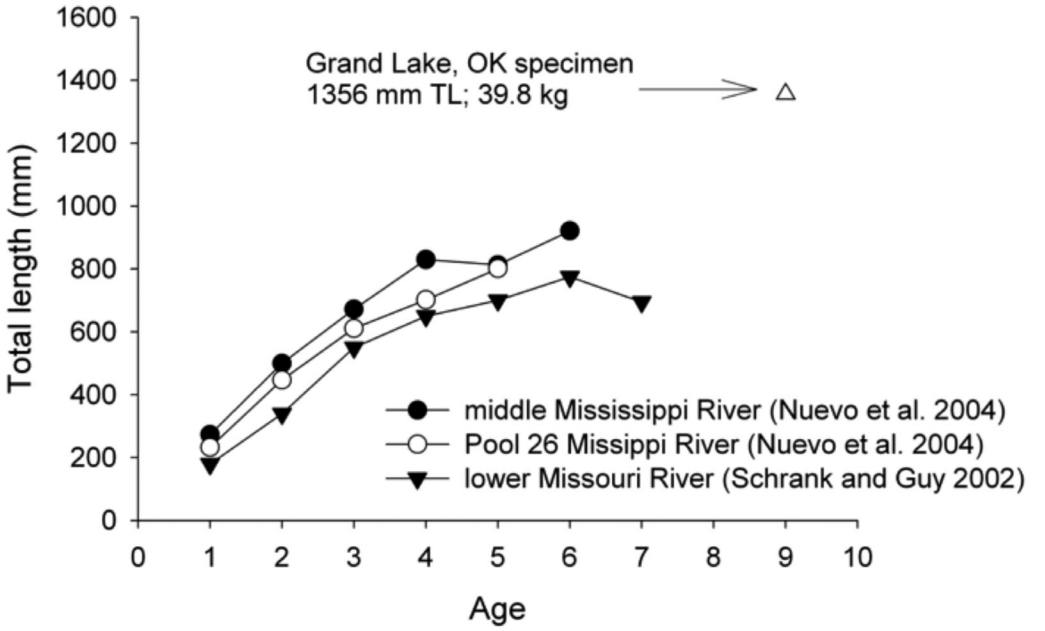

Figure 1. Mean back-calculated length-at-age for bighead carp estimated for three populations in the United States and the size and estimated age of the large specimen from Grand Lake, Oklahoma captured on April 23, 2011.

determine if bighead carp in the Grand Lake system represent one (or a few) past introduction events in the early 1990s. A substantially younger age might reflect undocumented natural spawning.

METHODS

Estimating age of bighead carp has met with difficulty (3, 7), and a suitable structure for age estimates has not been agreed upon (3, 5, 6, 7, 8). Therefore, we used three different structures: otolith (lapillus; mislabeled as sagittal otolith by [7]), branchiostegal ray, and pectoral fin ray. Each structure was sectioned (otolith in the middle; branchiostegal ray and pectoral fin ray at the thickest part above the base) to 0.635 mm thick with a Buehler Isomet low speed diamond saw. The section was mounted on a glass slide with thermoplastic cement and estimated for age by each of three readers using a compound microscope at 40X power with transmitted light.

RESULTS

At least two readers agreed on age for all three structures used and all readers agreed for ages estimated from the pectoral fin ray (Table 1). The largest difference in age estimates among readers was a two-year difference. The modal age estimate among readers for each structure was nine years (Figure 2). Based on its age and total length, this specimen represents one of the largest and fastest-growing bighead carp reported (Figure 1).

DISCUSSION

This is the largest bighead carp whose age has been estimated and reported in the primary literature. By utilizing three readers experienced with estimating ages of fish from hard parts and by using three hard parts to estimate age, we are confident in our age estimates. Moreover, our variation in age estimates among readers was low,

Table 1. Estimated age of a 1356-mm TL bighead carp from Grand Lake, April 23, 2011, according to three different readers and structures.

Structure	Reader 1	Reader 2	Reader 3	Mode	Max difference among readers
Otolith	11	9	9	9	2
Branchiostegal ray	9	8	9	9	1
Pectoral fin ray	9	9	9	9	0

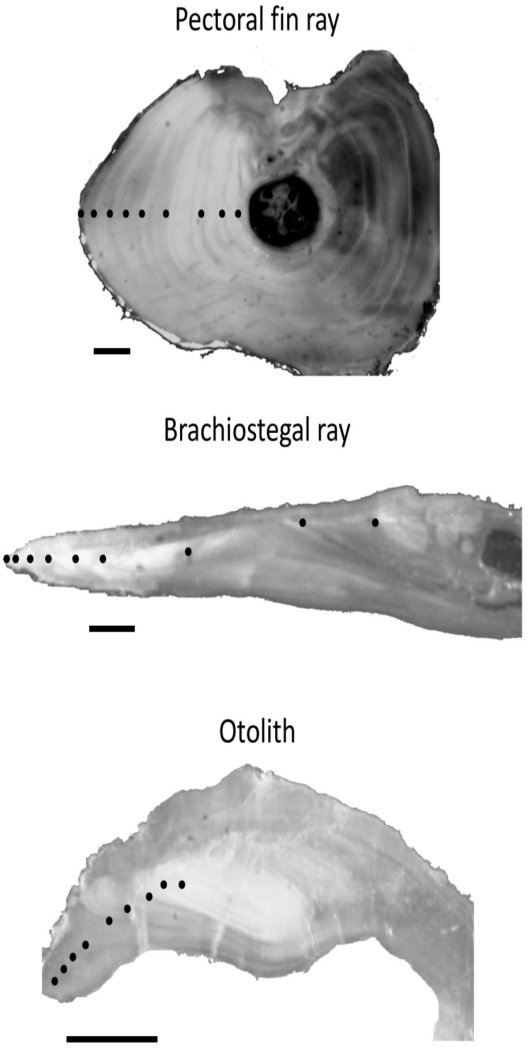

Figure 2. Cross section of pectoral fin ray, branchiostegal ray, and otolith from a 1356-mm TL bighead carp captured from Grand Lake, Oklahoma on April 23, 2011. The nine annuli are indicated with dark circles and the scale bar near each structure represents 1 mm.

lending additional credibility to our age estimates. As a result, the growth rate of this individual far exceeds previous estimates for bighead carp in the United States (3, 5, 6, 7, 8), although similar rates have been reported for populations in the Ukraine (11). Whether the growth of this specimen is typical for this introduced population is impossible to determine with one specimen, but it does demonstrate the potential for extremely fast growth in the United States.

The estimated age of this individual strongly suggests that it could not have come from fish introduced in Kansas in 1988 (1). We conclude that this relatively young specimen represents additional, unknown introductions or undocumented reproduction. Either explanation would have important implications for management of the fisheries in Grand Lake.

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