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Aging Precision using Sectioned Pectoral Fin Rays from Silver Carp Hypophthalmichthys molitrix

Timothy Spier
tspier@murraystate.edu

Jessica Morris
Kentucky Department of Fish and Wildlife Resources, Jessica.morris@ky.gov

Josh Tompkins
Kentucky Department of Fish and Wildlife Resources, joshua.Tompkins@ky.gov

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Timothy Spier[1], Jessica Morris[2], and Josh Tompkins[3]

1- Murray State University, tspier@murraystate.edu, 2 – Kentucky Department of Fish and Wildlife Resources (KDFWR), Jessica.morris@ky.gov, 3 – KDFWR, Joshua.Tompkins@ky.gov

BACKGROUND

Many structures are used to age Silver Carp *Hypophthalmichthys molitrix*, but no consensus exists concerning which structure is best. Previous studies have used sections from the pectoral ray, but some of those studies have used transmitted light to illuminate the annuli of the sectioned pectoral ray. We used reflected light to enhance the contrast of annuli in sectioned pectoral rays and compared the aging precision obtained from this method among 6 readers who varied in their aging experience. We also investigated the possibility of using digital images of these sections to age the fish; such images might be useful for practice and training, too.

PRECISION

All Silver Carp used in this study were captured in Kentucky Lake or Lake Barkley. Pectoral ray sections (≈ 800 μm, N = 98) were submerged under water in a dark container and then observed at ≈ 10x with reflected light (Figure 1). Age was determined independently by 3 experienced readers and 3 novice readers; a consensus age was determined following any disagreements. Precision was estimated from percent agreement and average CV of estimated age across all fish (Table 1).

Table 1. Summary of precision estimates for different structures used to age Silver Carp. "Experienced" and "Novice" readers were individuals from this study, and their precision is compared to each other and to other studies.

STRUCTURE	GROUP	N	EXACT AGREEMENT (%)	± 1 YEAR (%)	AVERAGE CV (SE)
Pectoral ray (reflected light)	Experienced	3	74.5	95.9	4.21[a] (0.78)
	Novice	3	73.5	95.9	4.51[a] (0.81)
Pectoral ray (reflected light)	Williamson and Garvey (2005)	2	60	100	13
Pectoral ray (transmitted light)	Seibert and Phelps (2013)	2	57	93	10.22 (1.56)
Otolith	Seibert and Phelps (2013)	2	76	98	4.22 (0.83)

[a] Average CV was not significantly different between the experienced and novice readers (paired t-test, $t_{97} = 0.38$, p = 0.71).

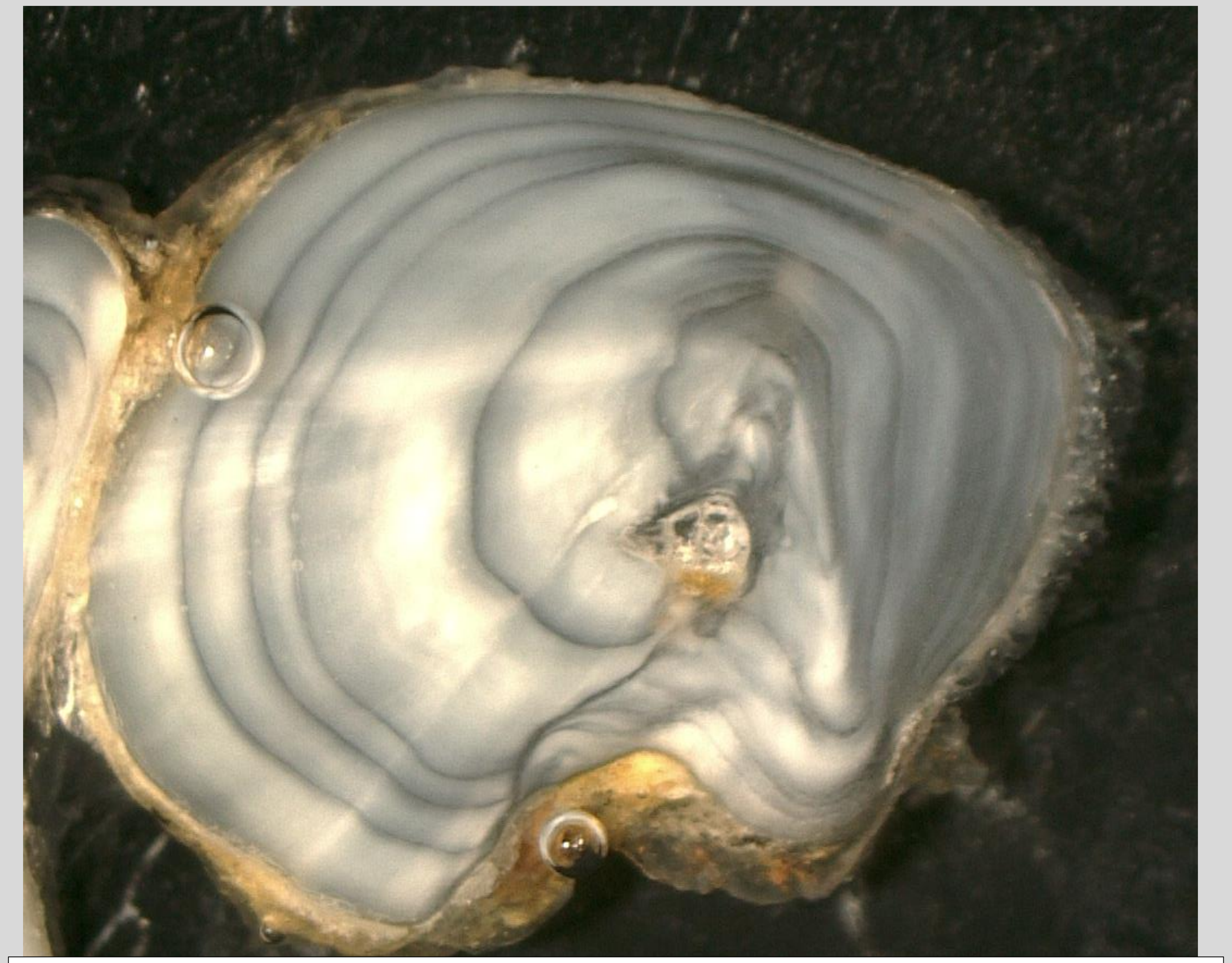

Figure 1. Example of a sectioned pectoral fin ray from a 5-year-old Silver Carp.

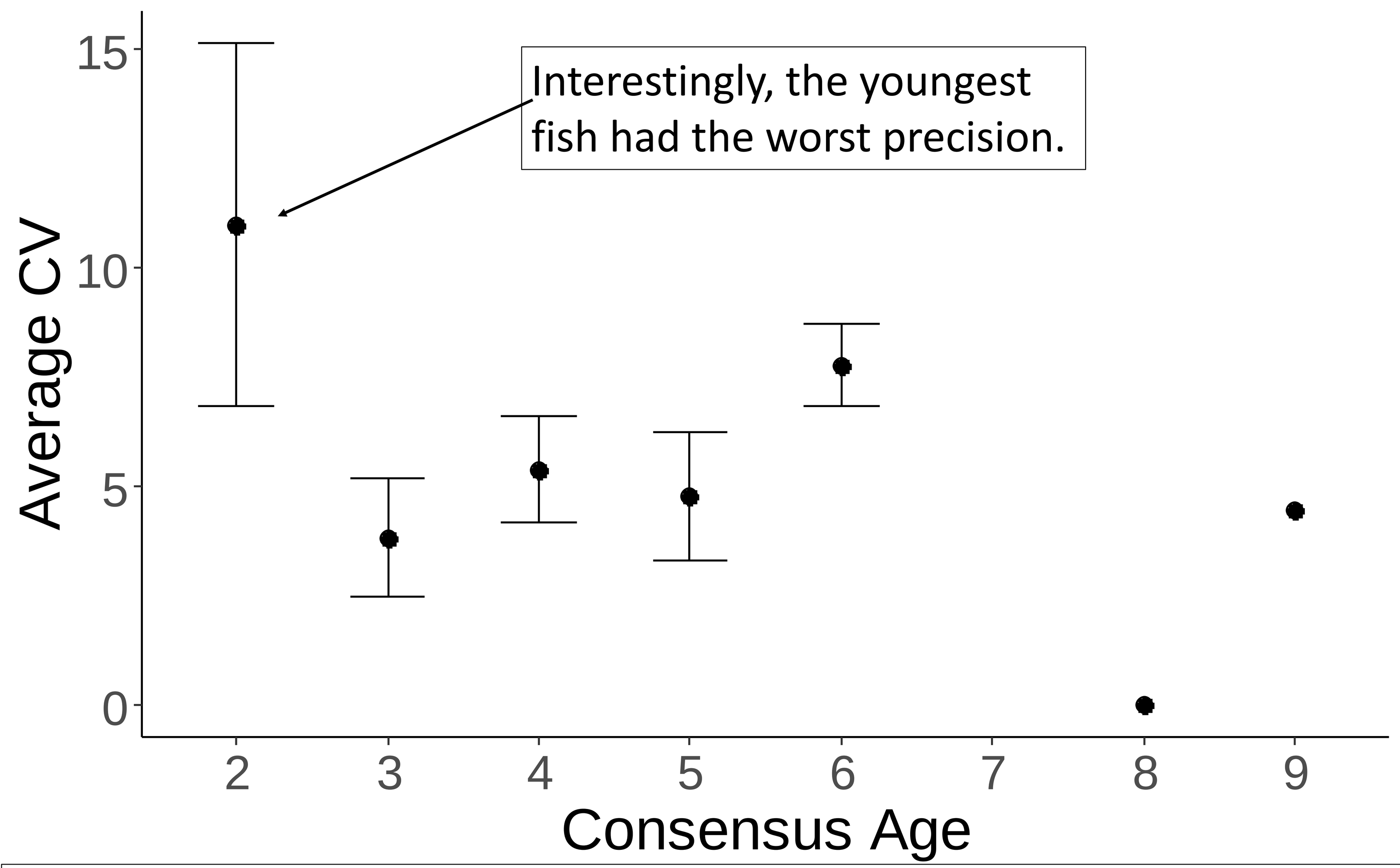

Figure 2. Average CV (SE) of estimated age compared to consensus age.

ONLINE IMAGES

Pectoral fin ray sections were first aged at a dissecting scope, and then digital images of the sections (N = 50) were provided in a random order in a series of 2 online quizzes given to 4 different readers. Percent agreement was 88.8% within 1 year for scope-aged fish and 98.0% for online images ($X^2 = 6.68$, df = 2, p = 0.04). Precision as measured by CV for the quizzes was comparable to observations directly from the dissecting scope (Figure 3).

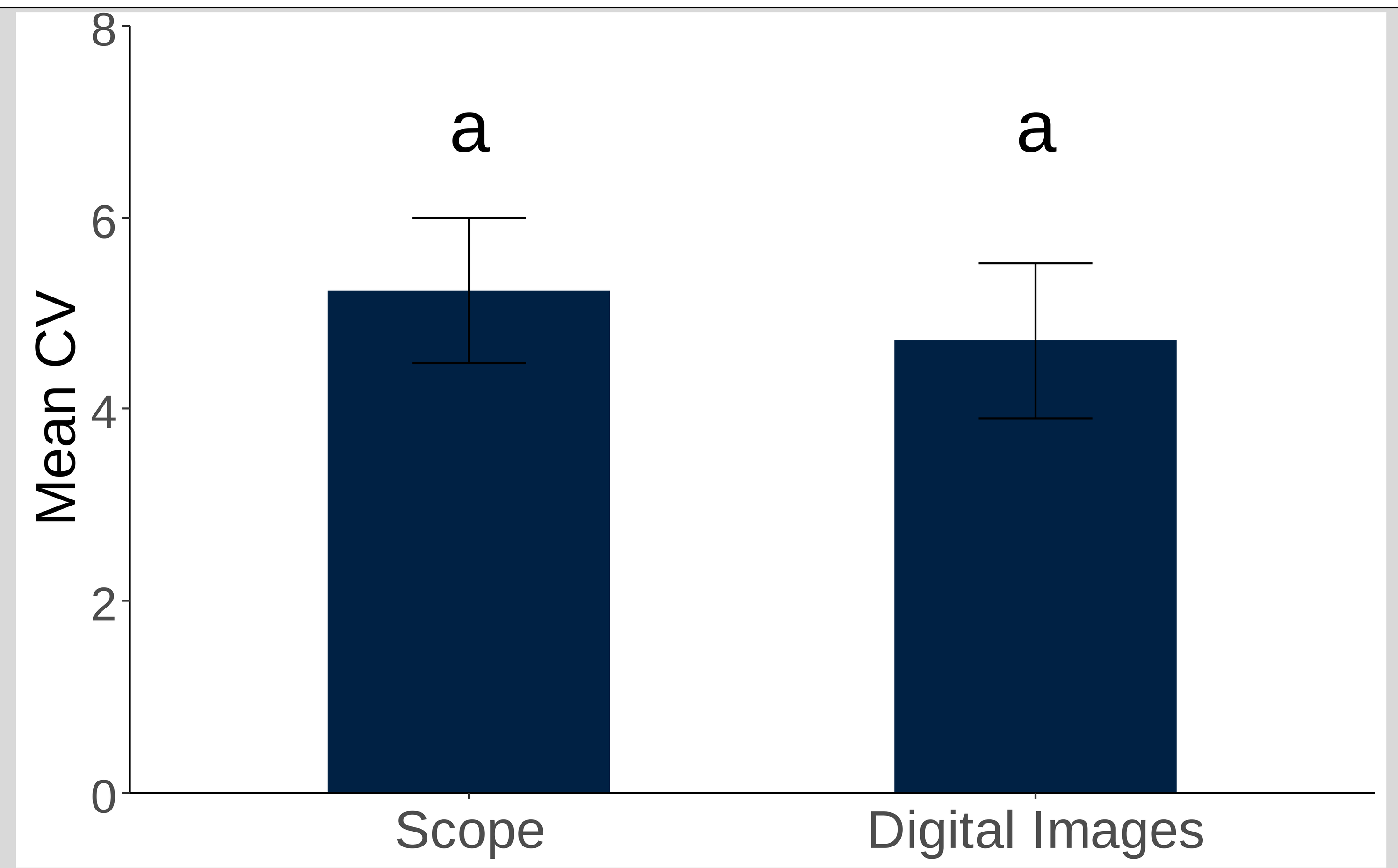

Figure 3. Mean CV (with SE) for fish aged at the dissecting scope was not significantly different from mean CV of digital images (paired t-test, $t_{97} = 0.68$, p = 0.50).

CONCLUSIONS

Pectoral ray sections illuminated with reflected light have comparable aging precision to other structures such as otoliths. Digital images of the pectoral ray sections can be aged directly while also being used for training and practice. We feel that viewing pectoral ray sections with reflected light under a dissecting microscope combined with viewing online digital images provides an appropriate aging protocol for Silver Carp.

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