

**Vascularization of the Second Dorsal Fin of
Nuptial Male *Etheostoma squamiceps*
(Percidae: Teleostei)**

William J. Poly and James E. Wetzel

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- **John E. McCosker¹ and David G. Smith²**. ¹ *California Academy of Sciences, San Francisco, California 94118*; ² *National Museum of Natural History, Smithsonian Institution, Washington, D.C. 20560*.

VASCULARIZATION OF THE SECOND DORSAL FIN OF NUPTIAL MALE *ETHEOSTOMA SQUAMICEPS* (PERCIDAE: TELEOSTEI).—Nuptial male darters of the *Etheostoma squamiceps* species group possess modified second dorsal fins during the reproductive season. In May 2002 we discovered that nuptial male spottail darters from two streams in Illinois and Kentucky had extensive vascularization of the second dorsal fin, a feature hitherto unreported for the species. Accumulation of red blood cells in the fleshy knobs of the second dorsal fin produced a marked orange-red color in some of the male darters. Nuptial male *E. crossopterum* from a stream in Kentucky did not exhibit the vascularization in the second dorsal fin.

Darters of the subgenus *Catonotus* exhibit sexual dimorphism during the reproductive season; the males develop fleshy knobs on the first or second dorsal fins, enhanced color patterns, swollen heads, and/or fleshy ridges on some body scales (Mayden 1985; Braasch and Mayden 1985; Page et al. 1992). The second dorsal fin of male darters of the *Etheostoma squamiceps* species group become modified, resulting in fins with specific pigment patterns and shapes, especially at the tips of the fin rays. These modified fins are the most useful morphological features for distinguishing darters in the group (Page et al. 1992). Dorsal fin knobs and pectoral fin spots of darters from the three clades within *Catonotus* have been hypothesized to serve as egg mimics that increase the likelihood of females choosing to spawn with males (Page and Bart 1989; Porter et al. 2002). Although many studies have been done on members of the *E. squamiceps* species group (Braasch and Mayden 1985; Page et al. 1992; Bandoli 2002 and references therein), an additional difference in the second dorsal fin of *E. squamiceps* was noticed recently.

MATERIALS AND METHODS.—*Etheostoma squamiceps* were collected with a seine from Coefield Creek (near town of Franklin Mines, Crittenden Co., KY), and we kept 4 nuptial males that exhibited orange-red color in the tips of the second dorsal fin. *Etheostoma squamiceps* also were collected from Hogthief Creek (Co. Rd. 3 bridge near junction with Co. Rd. 12, 6 km N of Elizabethtown, Hardin Co., IL), and we kept 3 nuptial males for comparison with the Coefield Creek specimens. *Etheostoma crossopterum* were collected from Ferguson Creek (S.R. 70 bridge crossing, 4.5 km E of Smithland, Livingston Co., KY), and 5 nuptial males were kept for comparison. Darters from each of the three sites were captured on 4 May 2002, returned to the laboratory, and their fins were examined (while alive) with a dissecting microscope on the same day. Photomicrographs were taken of the second dorsal fin of a live male *E. squamiceps* from Coefield Creek on 6 May 2002 (deposited in California Academy of Sciences, CAS 216888, n = 2 males) and other specimens from the sites were frozen for genetic analyses as part of a separate project.

RESULTS.—Of the darters captured in Coefield Creek, four adult males exhibited bright orange-red coloration at the tips of the second dorsal fin rays in addition to the usual nuptial condition. Bright coloration was not evident in fins of male *E. squamiceps* from Hogthief Creek at the

time of capture. Extensive vascularization of the second dorsal fin was observed in all male *E. squamiceps* from both Coefield and Hogthief creeks using light microscopy but was more pronounced in some specimens from Coefield Creek due to greater amount of coloration, which first caught our attention in the field. The color appeared orange to the naked eye at the time of collection, but when observed with a light microscope, the color appeared red. Accumulation of red blood cells in the fleshy knobs produced the marked coloration (Fig. 1). The circulation of blood through the fin membranes and into the fin knobs was observed in live fishes with a microscope, revealing the accumulation of blood in the fin knobs; hence, the color of the knobs was not due to carotenoids. The second dorsal fin of *E. crossopterum* did not exhibit any obvious vascularization as seen in the fins of *E. squamiceps*, and thus serves as an additional difference between nuptial males of the two species.

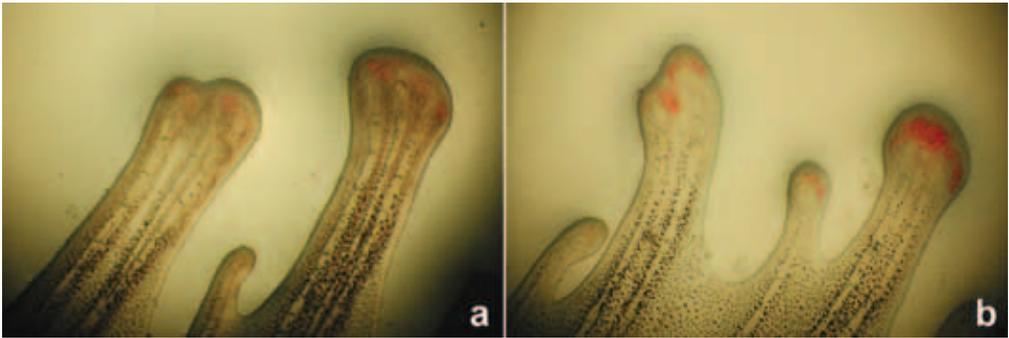


FIGURE 1. Fleshy knobs at tips of second dorsal fin rays of *Etheostoma squamiceps* (71.3 mm SL, nuptial male, CAS 216888), showing extensive vascularization of the fin (a and b are different portions of the same fin).

DISCUSSION.— Further study of the fins of live males of this group of darters might reveal that other species have highly vascularized second dorsal fins during the reproductive season, especially those species with fleshy knobs on the second dorsal fin (*E. chienense*, *E. oophylax*, *E. neopterum*, and *E. pseudovulatum*), and might provide a synapomorphy for some or all of the species of the fleshy-knob clade (Page et al. 1992). However, in the most recent phylogenetic study of the subgenus *Catonotus*, *E. squamiceps* did not cluster with three other fleshy-knob species (Porterfield et al. 1999); therefore, the vascularization may be an autapomorphic character in *E. squamiceps*.

The knobs on the second dorsal fin are believed to serve as egg mimics that attract females to the nest site (Page and Bart 1989; Page et al. 1992). The extensive vascularization of the second dorsal fin of *E. squamiceps* might provide coloration that makes the white knobs resemble the color of eggs and thus more effectively mimic eggs, especially because the knobs of this species are small in comparison to the other fleshy-knob species. Two of the other fleshy-knob species have yellow knobs that resemble eggs more closely due to the coloration (Page et al. 1992). Porter et al. (2002) did not consider *E. squamiceps* as a species possessing egg mimics. Female *E. squamiceps* spawn with larger males significantly more often than with smaller males as determined in laboratory trials (Bandoli 1999); however, fin knob development was not evaluated, and the role of the knobs as egg mimics has yet to be determined for this species. The fin vascularization noted in this paper provides another morphological difference between nuptial males of *E. squamiceps* and *E. crossopterum* and an opportunity to further evaluate the function of the vascularization with regard to spawning success and brood care.

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— William J. Poly¹ and James E. Wetzel². ¹*Department of Ichthyology, California Academy of Sciences, San Francisco, California 94118*; ²*Fisheries and Illinois Aquaculture Center, Southern Illinois University, Carbondale, Illinois 62901*.

THE ADVERTISEMENT CALL OF *BRACHYTARSOPHRYS FEAE* (BOULENGER 1887) (ANURA: MEGOPHRYIDAE).— Little is known about the natural history or calling behavior of the five species of frogs currently placed in the genus *Brachytarsophrys* (*B. feae*, *B. carinensis*, *B. intermedius*, *B. platyparietus*, and *B. chuannanensis*). Because of their rarity, these animals have received little attention in the historical literature. In March 2002, while conducting a survey in Kachin State in northern Myanmar, we encountered and recorded chorusing *Brachytarsophrys feae*. To the best of our knowledge, to date, this is the only analyzed recording of any frog belonging to this genus to be reported in the literature.

The males of *Brachytarsophrys feae* (Fig. 1) were found in evergreen montane forest at an elevation of 1,085 m. All individuals were found under rock overhangs which formed small caves in the middle of shallow slow flowing streams. In all instances, the opening to the cave faced downstream, and the substrate was gravel or cobble. Individuals were found in regions where the stream was densely covered by canopy. The stream width was about 1.5 meters, and the banks were heavily vegetated. Five males were heard calling at one locality near Ngar War Village, Hkakabo Razi National Park, Kachin State, Myanmar (27°50'03.5"N, 97°45'40.8"E). The call of one individual (SVL 116.2 mm) was recorded at 2145 hrs. during



FIGURE 1. *Brachytarsophrys feae*, Northern Myanmar. Photo by Hla Tun.