and variation in cichlid feeding behavior; Liem (1984) found eight possible feeding patterns, and that there are species (e.g., some algae scrapers) capable of all eight.

The developmental changes in Midas cichlids may confer an advantage by allowing juveniles and adults to exploit different food resources. However, such a simple hypothesis must be advanced with caution because of the complicated manner in which some cichlids vary their diet seasonally (Katunzi, 1983). Also to be considered, as mentioned above, is the ability of certain species to switch from their normal food acquisition methods to take advantage of surrounding resources.

Ontogenetic changes in morphology and feeding behavior are certainly not unique to the Midas cichlid. Other cichlids and many other fishes undergo dramatic changes in their osteology, body proportions and trophic interactions during growth. As just one example, another neotropical cichlid, *C. managuense*, apparently has a developmental history exactly the opposite of *C. citrinellum*, progressing from a biting juvenile to a suction-feeding adult (A. Meyer, pers. com.).

Barel's (1983) model relies on a rigid correlation between form and function. While the juvenile and adult ends of the developmental transition in the Midas cichlid do conform to the sucking and biting morphotypes, adults are partially piscivorous and therefore not limited to biting. In this species and others, there is not always an exact fit between form and function; cichlids are not restricted by their morphology to one way of feeding. It is this functional plasticity, along with a consideration of ontogeny, that should be emphasized in studying cichlid functional morphology.

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Literature Cited

Barel, C. D. N. 1983. Towards a constructional morphology of cichlid fishes (Teleostei, Perciformes). Neth. J. Zool. 33(4):357–424.

Barlow, G. 1976. The Midas cichlid in Nicaragua, p. 333–353. *In:* Investigations of the ichthyofauna of Nicaraguan lakes. T. B. Thorson (ed.). University of Nebraska, Lincoln, Nebraska.

Katunzi, E. F. B. 1983. Seasonal variation in the feeding of a molluscivorous cichlid: *Haplochromis sauvagei* Pfeffer 1896. Neth. J. Zool. 33(3):337–341.

Liem, K. F. 1979. Modulatory multiplicity in the feeding mechanism in cichlid fishes, as exemplified by the invertebrate pickers of Lake Tanganyika. J. Zool. Lond. 189:93–125.

———. 1980. Adaptive significance of intra- and interspecific differences in the feeding repertoires of cichlid fishes. Amer. Zool. 20:295–314.

———. 1984. Functional versatility, speciation, and niche overlap: are fishes different?, p. 269–305. *In:* Trophic interactions within aquatic ecosystems. D. G. Meyers and J. R. Strickler (eds.). American Association for the Advancement of Science Selected Symposium 85; held at Toronto, Ontario, Canada, Jan. 3–8, 1981.

McKaye, K. R., and A. Marsh. 1983. Food switching by two specialized algae-scraping cichlid fishes in Lake Malawi, Africa. Oecologia (Berlin) 56:245–248.

Ribbink, A. J., A. Marsh, A. C. Marsh, A. C. Ribbink and B. J. Sharp. 1983. A preliminary survey of the cichlid fishes of rocky habitats in Lake Malawi. Afr. J. Zool. 18:149–310.

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BRANCHIAL BROODING IN THE PIRATE PERCH, *APHREDODERUS SAYANUS* (GILLIAMS).—The pirate perch, *Aphredoderus sayanus* (Percopsiformes: Aphredoderidae), inhabits its coastal waters along the east coast of the United States and backwater areas of the Mississippi Valley (Lee, 1980). There is little published work on the reproductive biology or other life history aspects of *A. sayanus* (Pflieger, 1975), primarily due to difficulties in making in situ observations. The vent and urogenital tract

of larval *A. sayanus* are originally located just anterior to the anal fin and migrate forward until situated in the jugular position in adult fish (Mansueti, 1963). The position of the vent and urogenital pore in adults has led some investigators (Martin and Hubbs, 1973; Pflieger, 1975) to hypothesize that the female incubates eggs in her branchial cavities in much the same way as the closely related cavefishes (Amblyopsidae) do. Breder and Rosen (1966) reported that *Amblyopsis spelaea* DeKay females carry their eggs in gill cavities until hatching and then carry the young until the yolk sac has been absorbed, which is a period of 4–5 months (Eigenmann, 1909; Poulson, 1963). Although the occurrence of eggs in the gill cavities of wild-caught pirate perch has not been previously reported, Martin and Hubbs (1973) noted that when eggs were artificially stripped from pirate perch they moved along a groove into the branchial chamber. The purpose of this paper is to make the first report of eggs in the branchial cavity of a preserved adult female.

The examination of a series of pirate perch collected by B. B. Collette (Cornell University 30169) in the Cape Fear drainage (19.3 km southwest of Pender County line, 4.7 km northeast of the Cape Fear River on North Carolina Rt. 35, on March 26, 1956), Pender County, North Carolina, yielded one female (58 mm standard length) that contained three eggs in the left branchial cavity. The eggs in the gills were yellow, spherical and 1.4 mm in diameter. Martin and Hubbs (1973) reported that the eggs artificially stripped from pirate perch were 1.0 mm in diameter. Ten eggs dissected from the anterior portion of the ovary of the pirate perch which contained eggs in her left branchial cavity had a mean diameter of 1.14 mm (SD = 0.107, range = 1.0–1.3 mm). It should be noted that several other pirate perch examined contained encysted parasites in the branchial cavities. These parasites were white, not spherical and firmly attached to the gills. The eggs, while located within the branchial cavity, were not firmly attached to the gills. Size differences between unfertilized eggs and eggs located in the gills may have been due to fertilization and water hardening. The time of year that these individuals were collected is near the spawning time suggested by Murdy and Wortham (1980). To date no information is available on the retention time of eggs in the branchial chambers.

Literature Cited

Breder, C. M., and D. E. Rosen. 1966. Modes of reproduction in fishes. Natural History Press, Garden City, New York, New York.

Eigenmann, C. H. 1909. Cave vertebrates of America, a study in degenerative evolution. Carn. Inst. Wash. Publ. 104:1–241.

Lee, D. S. 1980. *Aphredoderus sayanus* (Gilliams), p. 484. *In:* Atlas of North American freshwater fishes. D. S. Lee, G. R. Gilbert, C. H. Hocutt, R. E. Jenkins, D. E. McAllister and J. R. Stauffer, Jr. (eds.). North Carolina Biological Survey. Publ. 1980–12.

Mansueti, A. J. 1963. Some changes in the morphology during ontogeny in the pirate perch, *Aphredoderus sayanus.* Copeia 1963(3):546–557.

Martin, F. D., and C. Hubbs. 1973. Observations on the development of the pirate perch, *Aphredoderus sayanus* (Pisces: Aphredoderidae) with comments on yolk circulation patterns as a possible taxonomic tool. *Ibid.* 1973(2):377–379.

Murdy, E. O., and J. W. E. Wortham, Jr. 1980. Contributions to the reproductive biology of the eastern pirate perch, *Aphredoderus sayanus.* Virginia J. Sci. 31(1–2):20–27.

Pflieger, W. E. 1975. The fishes of Missouri. Missouri Dept. of Conservation, Western Publ. Co., Jefferson City, Missouri.

Poulson, T. L. 1963. Cave adaptation in amblyopsid fishes. Am. Midl. Nat. 70(2):257–290.

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