Aphyosemion litoriseboris Radda 1976

In the November issue of the Journal of the American Killifish Association appeared a new technical paper contributed by Dr. A.C. Radda in which he describes a new species. Here lies a difficulty which may be experienced by some hobbyists in that the new species is none other than our old friend of many name changes, Aphyosemion walkeri Boulenger 1911 which now becomes Aphyosemion litoriseboris Radda 1976. The new Aphyosemion walkeri Boulenger 1911 is the fish which has been coded in the past as "GH 2/74" or simply as 'GH2' within the BKA. The true Aphyosemion walkeri was collected
on a collecting trip to Ghana in July/August 1974 by Mr. G. Schrieber and was found in the SE Accra Plains.

A spec. 'Spoorenberg' becomes Aphyosemion spoorenbergi Berkenkamp 1976.


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Occurrence of a Facultative Annual Cyprinodont in North America with Comments On Annualism

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Annualism or delayed egg development is uncommon among freshwater fishes. To date only two subfamilies of Cyprinodonts have been shown to include annuals (Scheel, J. J. 1968; Berkenkamp, H. O. 1973; Harrington, R. W., Jr. 1959). One species of Cyprinodontinae, Fundulus confluentus Goode & Bean, 1879, is known to have delayed egg hatching. The remaining annuals are of the subfamily Rivulinae.

Fundulus confluentus is set apart from all known Cyprinodont annuals by its northern distribution. The Susquehanna River near Havre de Grace, Hartford County, Maryland (39°30' N. latitude) is the species' northern limit (Schwartz, F. J. 1967). The northern limit of New and Old World Rivulins is about 10° N latitude (see figure 2). F. confluentus also occurs along the Atlantic coast to Key West, Florida (24° 30' N. latitude), and along the Gulf of Mexico to 28 km S.W. of New Orleans, St. Charles Parish, Louisiana (29° 40' N. latitude) (Radda, A.C. 1974; Fowler, H.W. 1945; Douglas, N.H. 1974). Although typically an euryhaline species, it is also to be found in artesian wells in Georgia (Dahlberg, M.D. & D.C. Scott 1971).

Both New and Old World Rivulins exhibiting delayed egg development correspond in their general latitude distributions. Since climate is directly related to latitude it can be assumed that development of such forms is an adaptation to some common climatic condition. Regardless of whether the evolution of such forms was convergent or from a single ancestral stock, it seems likely that an Old World counterpart of Fundulus confluentus could exist. To date no Old World Cyprinodont, in the same general latitude as F. confluentus, has been found.

1 The author concurs with R. R. Miller 1956 in placing Fundulinae and Aphaninae in the subfamily Cyprinodontinae.
reported as an annual, although habitats conducive to delayed egg development exist in the Mediterranean region. If such a form exists or existed it is probable that it would be a facultative annual (this term will be discussed later). As little or no data on life histories can be obtained from fossil material, it is possible that such a form perhaps *Pachylebias*, developed but was unable to survive to the present. Little published data is available on living forms of the Mediterranean region. Observations on *Valencia hispanica* by Labhart (1973) show no evidence of delayed egg development. Aksiray (1952) made no mention of delayed egg development in his study of *Kossiwigichthys*, *Anatolichthys* and *Aphanius*. My observations on *Aphanius* also show no annual characteristics. Thus, it would seem that an annual Cyprinodont counterpart of *Fundulus confluentus* either does not exist at present or else has not been studied in an environment conducive to delayed egg development.

The terminology relating to delayed egg development is often misused and misunderstood. The term annual Cyprinodont should be used only for those forms living in temporary pools (Scheel, 1968). These fish complete their life cycles in a single year. This does not mean that captive specimens will only live a single year, but rather that in their native environments the pools dry within a season and their eggs remain viable in the sediments of the pool until the rains come again. Although not annuals by this definition, many soil breeders of the New and Old Worlds lay eggs which will cease development for long periods of time when exposed to drought conditions. This latter group differs from the true annuals in that their native environments do not seasonally dry. They differ from the non-annual killifish in that under normal wet conditions their eggs may take months to hatch, whereas non-annual killifish normally develop and hatch in a period of a week or so. Pseudo-annual would seem a fitting term for this group of soil breeders. A second annual-like group of which *Fundulus confluentus* is an example, appears to be intermediate between the pseudo-annuals and the non-annuals. Like those of the pseudo-annuals, the eggs of this form will remain viable for months when exposed to drought conditions. Like those of the non-annuals, the eggs will normally develop in water in a week or so. I propose the term facultative annual for this group.

In general, there are two forms of *Fundulus confluentus*: one marine, and the other brackish to freshwater. The precise differences between these two forms is often difficult to ascertain. Following the differences stated by Hubbs (1931), the form which demonstrates delayed egg development belongs to the brackish to freshwater ecological form. In general, this form is smaller and demonstrates less sexual dimorphism. The males often retain the juvenile coloration (Figure 1). Although no records are available on the marine form, it is likely that it too demonstrates facultative annualism.

During the period 1973 to 1976 I repeatedly spawned the brackish to freshwater form of *Fundulus confluentus* (*F. ocellaris*) in aquaria. Unlike all other known annual Cyprinodonts *F. confluentus* does not bury its eggs in bottom sediments. In captivity the eggs are deposited throughout the aquaria on gravel, plant roots and floating plants. Harrington (1959) reports eggs from dried sod, bottom litter and algae mats in the wild. Foster (1967) gives the preferred spawning site as algae mats in the wild.
In the aquarium studies eggs were gathered from floating synthetic spawning mops and placed in petri dishes. The eggs, with an average diameter of 1.6 mm, are slightly adhesive. When exposed to water of low carbon dioxide level the time for development and hatching is about 13 days at 20°C. Development is faster at higher temperatures. When the eggs are placed in water of high carbon dioxide levels the time for development is delayed. This delay may be up to four weeks. Eggs placed on moist nylon sheets and kept in the dark require two to three months for full development. This period of dryness can be extended for up to four months. On one occasion I was able to hatch three fry from a series of 45 eggs which had been dry for 128 days after spawning. This period of 128 days is over one month longer than that previously reported by Foster (1967) and about equal to the time postulated by Harrington (1959).

Eggs stored on moist nylon sheets hatch within 20 to 40 minutes after they are immersed in aged water. Upon hatching the larvae show little unabsorbed yolk sac. As in the true annuals the yolk must have been absorbed during the resting stage (or stages, as reported by Klee, 1975). Larval fish begin feeding shortly after hatching. Growth is rapid compared with other Fundulus species, with sexual maturity being reached by the end of the third month. Although Foster (1967) states the majority of this species will only live a single season I have found the life span to be much longer. Tank-raised specimens live over two years when given ample room, proper feedings, and cool water.

Figure 1. Freshwater strain of Fundulus confluentis occurring in Southern Alabama, female above.
Figure 2. Schematic map showing distribution of known Cyprinodonts exhibiting delayed egg hatching.

**Literature**


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*species Aphyosemion amieti* Radda.

by Fred Wright.

Photo by the Author.

This extremely beautiful form of *Aphyosemion* which came into the BKA in late 1975, hails from South Western Cameroon where it inhabits brooks in the Sanaga System.