

***Heterandria formosa* Girard, 1859, a weirdness of the Pisces group**

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Abstract. The present paper aims to make a description of the species *Heterandria formosa*, based on the scientific literature and experience of the authors. *H. formosa* is a weirdness of the Pisces group, is a good human model due to its reproduction, a good model for ecotoxicology and for evolutionary biology. A great advantage of using this species in research is the ease of breeding and reproduction in aquaria.

Key Words: human model, least killifish, tiny fish, aquarium.

Introduction. *Heterandria formosa*, known as the least killifish (Levell & Travis 2018), was long considered to be the smallest vertebrate in the world, approximately 2.1 cm in total length (TL), but was later dethroned by the Indonesian fish *Paedocypris progenetica* Kottelat, Britz, Tan & Witte, 2006 (8.8 mm) and then by the tiny amphibian from New Guinea *Paedophryne amauensis* (7.7 mm) (Rittmeyer et al 2012).

Taxonomy. The species *H. formosa* is a member of Class Actinopterygii (ray-finned fishes), Order Cyprinodontiformes (Rivulines, killifishes and live bearers), Family Poeciliidae (Poeciliids), Subfamily Poeciliinae, Genus *Heterandria* (Page & Burr 1991; Petrescu-Mag 2007a, b, 2008).

Distribution and Environment. The geographical area of the species is restricted to North America. It occurs only in the United States from Cape Fear River drainage in North Carolina to southern Louisiana (Froese & Pauly 2019). The fish lives in freshwater or brackish water. It is benthopelagic, non-migratory, and water has a pH range of 7.0-8.0 and a dH range from 9 to 19. Climate is tropical, water having a temperature of 20- 26°C (Riehl & Baensch 1991).

Morphology and Morphometrics. The fish become adult somewhere between 1 and 1.4 cm TL. Maximum length is 3.6 cm TL male/unsexed (Page & Burr 1991), while common length is around 2.1 cm TL male/unsexed (Hugg 1996) (see Figure 1). Females are larger than males (3.5 cm), having enlarged abdomen (see Figure 2).

Biology and Reproduction. Adults inhabit standing to slow-flowing water, which is plenty of vegetation. They feed on worms, crustaceans and plant matter (Mills & Vevers 1989).

H. formosa is a truly viviparous fish, embryo derives nearly all of its nourishment from the mother (Scrimshaw 1945). The female gives birth to live fry. The reproductive system of this species is very interesting. The female gives birth to 1-2 fry each day for about 10 days. The fry needs abundant vegetation to hide and grow during the first days

of life. Males are much smaller than females and possess an enormous gonopodium (Figure 1).



Figure 1. *Heterandria formosa* male (photo by Ott G.; Froese & Pauly 2019).



Figure 2. *Heterandria formosa* female (photo by Appleby C.; Froese & Pauly 2019).

Maintenance in Aquaria. A pair of least killifish can be kept in a tank as small as 30 cm x 20 cm x 20 cm, of about 12 L. They are omnivorous and will accept most types of food administered, but they prefer small live or frozen varieties of crustaceans such as *Artemia* or *Daphnia*, and the diet should contain a good proportion of these components. The fish will also consume small algae, so that the hobbyists or the researcher should ensure that animals receive some vegetable matter in the diet. In the absence of algae, crushed *Spirulina* flakes are a good choice.

Reproduction in Aquaria. Reproduction in tanks is very easy. It is impossible to prevent its reproduction if both sexes are present in an aquarium. Water parameters are less important, provided they are within the ranges stated above. The tank should be planted with abundant vegetation. The reproduction can be made with a pair of animals (one male, one female), but best results are obtained when they are reproduced in a small group with several individuals of each sex present in the same tank.

The gestation period takes about four weeks. The species has a slightly different method of fry production to most other members of the family, involving a process known as "superfoetation". Superfoetation is defined as development of a second foetus when one is already present in the uterus (Seriously Fish 2009). Fry at different stages of development can therefore be present in the uterus of the female at any given moment. Additionally, the egg yolks of the species are nutritionally poor, and the developing fry derive much of their nourishment via organs that function in a similar way to mammalian placenta (Seriously Fish 2009). As a result of this process, fry are dropped continually rather than in defined broods. Fry appear every day (in a number that depends on number of females in the tank), they are quite large at birth and can accept powdered dry foods and *Artemia* nauplii straight away (Seriously Fish 2009). In general, adults will not prey on their own offspring, except when food resources are limited.

Evolution. In the case of this species (*H. formosa*), Landy & Travis (2018) investigated maternal and environmental effects on the body morphology and found a remarkable plasticity of the species. Such observations are not new for the poeciliid fish, the group being in a full process of adaptative radiation and speciation (Alexander & Breden 2004; Schories et al 2009; Păsărin & Petrescu-Mag 2011; Oroian 2015; Petrescu-Mag 2018a, b; Oroian et al 2019).

Conclusions. *H. formosa* is a weirdness of the Pisces group, is a good human model due to its reproduction, a good model for ecotoxicology and for evolutionary biology. A great advantage of using this species in research is the ease of breeding and reproduction in aquariums.

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