

Kleine Mitteilung

**Effects of sex and maturity on preferred temperatures:
A proximate factor for increased survival of young
Poecilia latipinna?**

By J. R. STAUFFER, Jr., C. H. HOCUTT and W. F. GOODFELLOW

From the Center for Environmental and Estuarine Studies, Frostburg, Maryland

With 2 tables in the text

Abstract

Pregnant females and their newly born fry have significantly higher ($P \leq .05$) preferred temperature than do males. It is suggested that the higher preferred temperature of juveniles may direct them to areas where the threat of inter- and intraspecific predation is reduced or where higher temperatures would cause increased metabolism which could result in higher growth rates.

Introduction

Numerous authors have suggested that juvenile fishes tend to prefer warmer waters than do adults of the same species (BARANS & TUBB 1973; McCAULEY & READ 1973; OTTO et al. 1976; McCAULEY & HIGGINS 1979; REYNOLDS & CASTERLIN 1978). Moreover, they linked the differences in preferred temperature to testosterone levels. It is hypothesized that the elevated preferred temperature of juvenile fishes is a proximate factor which guides these organisms to shallow warmer water, where survival could be enhanced. The purpose of this paper was to 1) use *Poecilia latipinna* to test the hypothesis that brooding females and juveniles have a higher preferred temperature than males and 2) to speculate on the ecological consequences of such a behavioral phenomenon.

P. latipinna is a native inhabitant of the fresh and brackish waters of the Atlantic and Gulf coasts from North Carolina south to the Yucatan peninsula, Mexico and introduced populations occur in Canada and southwest United States (BURGESS 1980).

Methods and materials

Fish were obtained from a local aquarium shop and all test organisms bred in 75 l aquaria at the Appalachian Environmental Laboratory. Three groups (2-4 week old fry, pregnant females, and males) were acclimated to one of the following temperatures at a rate which did not exceed 1 °C/day: 20, 25, 30, and 35 °C. Fish were held at their re-

spective acclimation temperature ($\pm 1^\circ\text{C}$) for five days prior to testing. A 12:12 L:D photoperiod was maintained and constant aeration maintained oxygen levels between 90 and 100% saturation.

Temperature preference trials were conducted in a horizontal trough ($3.6 \times 0.2 \times 0.25$ m) which was patterned after the design of MELDRIM & GIFT (1971). Cool water was introduced into one end of the trough and a battery of heat lamps positioned under the trough established a 20°C temperature gradient which ranged above and below the respective acclimation temperature. Five fish from each group and each acclimation temperature were tested individually. Fish were placed in the trough and allowed to orient to the test condition for 40 minutes. Following the 40-minute orientation period, the water temperature at the organisms position was recorded every minute for 20 minutes. The mean of the 20 observations was deemed the acute preferred temperature for that particular animal (STAUFFER 1981). A two-way factorial ANOVA in conjunction with Duncan's multiple range test was used to determine the effect of acclimation temperature and group designation (i. e., male, female, juvenile) on preferred temperatures.

Results and discussion

Table 1 summarizes the selected temperatures for each group and acclimation temperature. The ANOVA indicated that there was a significant ($P \leq .05$) effect of acclimation temperature, group, and the interaction term on preferred temperature (Table 2). Duncan's multiple range test showed that the selected temperatures for organisms acclimated to 20°C were significantly ($P \leq .05$) lower than those selected at the other acclimation temperatures. Furthermore, the mean preferred temperature of males (27.5°C) was significantly ($P \leq .05$) lower than both the preferred temperature of juveniles (30.6°C) and pregnant females (30.8°C), which were not significantly ($P \geq .05$) different from each other. The significant interaction term is most likely caused by the low selected temperatures of the juveniles which were acclimated to 20°C . This response may be due to low thermal responsiveness (LTR) which has been reported for other juvenile species acclimated to low temperatures (STAUFFER 1980). Although 20°C is higher than temperatures usually associated with LTR, it does approach the lower lethal limit of these fishes. Repeated attempts to acclimate *P. latipinna* to 15°C resulted in 100% mortality.

It is interesting to note that preferred temperature did not consistently increase with increased acclimation temperatures. Data from acute tests have shown that for many eurythermal species, the preferred temperature is dependent upon the acclimation temperature (e. g., COUTANT 1977; STAUFFER 1980). For these eurythermal species, the preferred temperature is greater than the acclimation temperature until the final preferred temperature is reached. At acclimated temperatures above the final preferred temperature, fish prefer a temperature lower than the acclimated temperature. However, acute tests conducted with certain salmonid species (i. e., cold stenothermal species) have shown that in some instances preferred temperature appears to be independent

Table 1. Preferred temperatures of *Poecilia latipinna* males, females, and juveniles at varying acclimation temperatures.

Acclimation Temperature (C)	Replicates	Preferred Temperatures of <i>Poecilia latipinna</i>		
		males	females	juveniles
20	1	27.2	30.7	26.8
	2	25.4	28.5	26.8
	3	27.9	31.9	31.4
	4	26.4	32.6	24.3
	5	24.3	30.4	25.5
25	1	26.5	29.8	34.4
	2	25.2	30.3	33.0
	3	25.8	30.5	33.6
	4	26.8	22.7	34.0
	5	26.1	28.6	35.0
30	1	28.4	32.4	25.3
	2	28.0	34.1	31.8
	3	31.7	32.1	31.8
	4	28.8	32.2	32.3
	5	26.9	31.7	31.7
35	1	28.9	30.2	31.1
	2	29.7	32.6	30.7
	3	29.9	32.2	31.1
	4	25.1	31.6	30.7
	5	32.1	31.4	31.4

Table 2. Two-way factorial analysis of variance of the effect of acclimation temperature and test group (i. e., males, females, juveniles) on preferred temperature.

Source of variation	Sum of Squares	DF	Mean Square	F	Significance
Main Effects					
Group	134.8	2	67.4	18.5	*
Acclimation Temperature	67.7	3	22.6	6.2	*
Interaction					
Group × Temperature	143.3	6	23.9	6.6	*
Error	174.5	48	3.6		

* Significant $P \leq .05$.

of acclimation temperature (BRETT 1952; McCauley et al. 1977). Data presented herein and for other tropical species tested at the Appalachian Environmental Laboratory (e. g., *Oreochromis aurea*, *Oreochromis mossambicus*) suggest that this same phenomenon is true for warm stenothermal species such as *P. latipinna*.

The fact that both pregnant females and their newly hatched fry selected higher temperatures than males supports the hypothesis that preferred temperature may be the proximate factor which directs fry and pregnant females to warmer waters. These areas would be in the littoral zone of lakes and ponds which are characterized by dense vegetation and shallow water. Such areas would provide larvae with readily available food sources and provide areas in which the risk of both inter- and intraspecific predation would be decreased. Furthermore, the increased temperature may lead to increased growth rates which would further enhance survival.

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The mailing address:

JAY R. STAUFFER, JR., The Pennsylvania State University, School of Forest Resources, Ferguson Building, University Park, PA 16802/USA.