2014

The influence of rearing environment on life history and morphological traits of sailfin molly fish (P. latipinna)

G. Davidson

C. Crawford

M. Voytko

K. Hogan

M. Ptacek

The Influence of Rearing Environment on Life History and Morphological Traits of Sailfin Molly Fish (*Poecilia latipinna*)

Grant Davidson, Caitlin Crawford, Michelle Voytko, Kelly Hogan, & Margaret Ptacek

Department of Biological Sciences, College of Agriculture, Forestry, & Life Sciences

Abstract

Life history traits such as time to, and size at, maturity are influenced by both genetic and environmental factors. One such environmental factor may be the social environment in which a juvenile is reared. This study examined the life history traits of sailfin mollies *(Poecilia latipinna)* that were reared in varying social environments: in isolation, in groups with an adult male present, and in groups without an adult male present. Since females prefer larger males, we anticipated that males reared in the presence of an adult male should delay maturation, and therefore mature at larger sizes in order to better compete for mates. We found that males reared with an adult male took three times longer to mature and were almost 30 percent larger than males reared without adult males or in isolation. Our results suggest that social environment has significant effects on the final size at maturity, and therefore fitness, of male sailfin mollies.

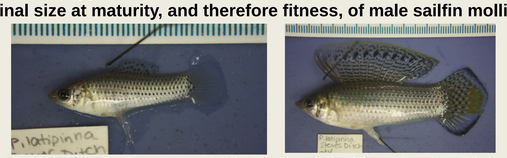


Figure 1. A sexually mature small (25mm in standard length) male sailfin molly (left) and large (50mm in standard length) male (right) from Steve's Ditch, Wakulla County, FL.

Introduction

In livebearing fishes in the family Poeciliidae, life history traits are influenced by both genetic and environmental factors. For example, male swordtail fishes with a mutant allele in the sex-linked *mc4r* gene show delayed maturation, and therefore, reach larger size at maturity (Lampert et al. 2010; Smith et al. 2014). Male size is fixed at maturity, thus, a small male will never grow to the size of a large male (Cummings 1943; Ptacek & Travis 1996). This is critical to male fitness, as larger males are preferred by females but smaller males have greater lifetime reproductive success due to earlier maturation (Reynolds & Gross 1992; Ryan & Keddy-Hector 1992; Ptacek & Travis 1997).

Environmental factors can also influence the time to, and size at, maturity, particularly the social environment in which a juvenile is reared. For example, in green swordtails (*Xiphophorus helleri*), a closely related species to mollies, males shifted time to maturation based on the perceived size of adult conspecifics (Walling et al. 2007).

This study examined the effects of raising sailfin mollies (*P. latipinna*) in varying social environments: (1) in isolation, (2) in groups with an adult male, and (3) in groups without an adult male.

Predictions

Determine if rearing environment influences life history traits of juvenile male mollies:

(1) Males will take longer to mature in the presence of an adult male
(2) Males will mature at larger size in the presence of an adult male
(3) Males will have larger ornaments (dorsal sailfin) in the presence of an adult male

Methods

Siblings from each family were divided into three treatments: (1) isolation (n=12), (2) groups without an adult male (n=8), and (3) groups with an adult male (n=8)

At maturation, fish were photographed and measured for the following morphological features using ImageJ software: (1) standard length (mm), (2) gonopodium length (mm), (3) dorsal fin area (mm^2)

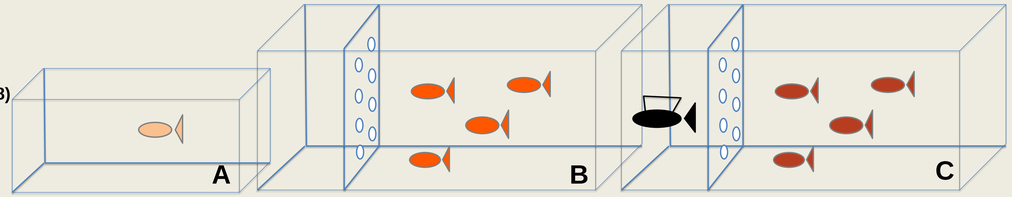


Figure 2. Aquaria for treatments (A) offspring raised in isolation, (B) offspring raised in groups without an adult male present, and (C) offspring raised in the presence of an adult male, in which the adult male (black) is separated from offspring (orange) by a transparent barrier that allows the transfer of chemical cues.

Results

(A) Time

Source	F	p-value
Rearing Environment	6.9037	0.0059 *

(B) Size

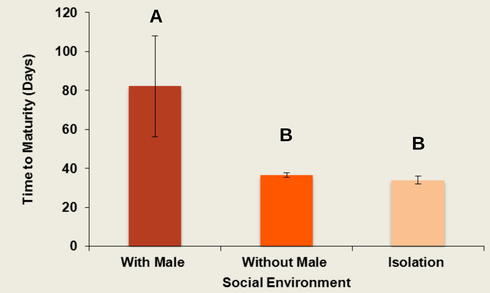
Source	F	p-value
Rearing Environment	24.75	<0.001 *

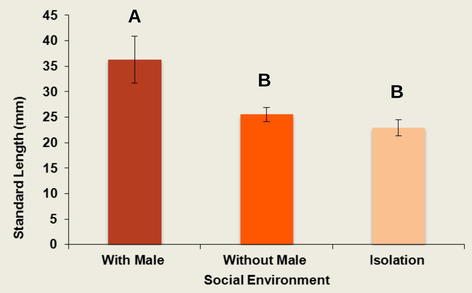
(C) Dorsal Fin

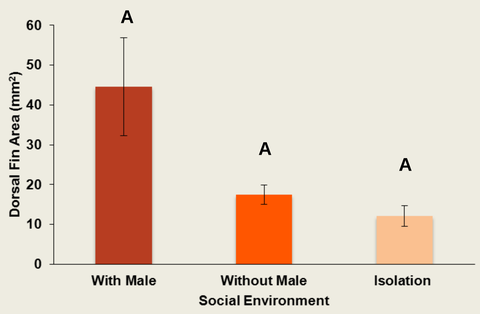
Source	F	p-value
Rearing Environment	3.2802	0.0608

(D) Gonopodium

Source	F	p-value
Rearing Environment	1.1607	0.3356







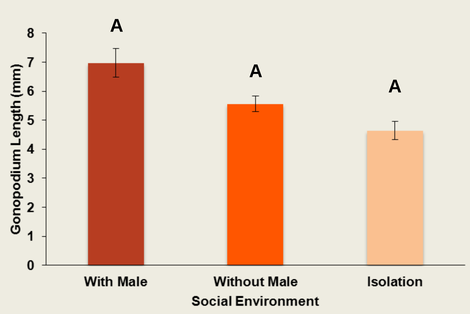


Figure 3. Time to (A) and size at (B) maturity, as well as size of the sexually selected dorsal fin (C) and non-sexually selected gonopodium (D) of male offspring reared in groups with an adult male, in groups without an adult male, and in isolation. The tables show the results of a one-way ANOVA testing for effects of rearing environment on each trait.

Conclusions

Males reared in groups with an adult male:

(1) Took 3x longer to mature
(2) Were 30% larger
(3) Had a larger dorsal sailfin

than males reared without adult males or in isolation.

These results suggest that exposure to adult males during ontogeny allows juvenile males to delay maturity, and thus, increase size at maturity. As a result, larger males enjoy greater fitness in competition for mates and lifetime reproductive success.

Future Directions

- Identify the mechanism that delays maturation in juvenile males, namely *chemical* versus *visual cues* from adults
- Identify how *sexually selected traits* (sailfin size) are influenced by the social environment

References

Cummings, J.B. (1943) *Journal of Morphology* 73: 1-17.

Lampert, K.P., et al. (2010) *Current Biology* 20: 1729-1734.

Ptacek, M.B., & Travis, J. (1996) *Animal Behaviour* 52: 59-71.

Ptacek, M.B., & Travis J. (1997) *Evolution*, 51: 1217-1231

Reynolds, J.D., & Gross, M.R. (1992) *Proceedings: Biological Sciences* 250: 57-62.

Ryan, M.J. & Keddy-Hector, A.C. (1992) *The American Naturalist* 139: S4-S35.

Smith, C.C., et al. (2014) *Environmental Biology of Fishes*

Walling, C.A., Royle, N.J., Metcalfe, N.B., & Lindstrom, J. (2007) *Biology Letters* 3: 144-146.

Acknowledgements

This project was partially funded by ACCIAC and Creative Inquiry. We thank Michael Childress for assistance with statistical analyses, as well as John Smink for assistance with fish care.