

Background choice as an anti-predator strategy

- preference between visually complex and matching backgrounds in the least killifish



It is a general idea that prey can decrease their risk of being detected by a predator by choosing backgrounds that match their body colouration [1]. However, recent studies also suggests that visual complexity of the background impedes prey detection and might therefore also play an important role in escaping predation [2,4]. Here we tested preference for matching and preference for complex backgrounds, by studying the least killifish (*Heterandria formosa*) under simulated predation threat. More specifically, we tested their preference between matching and mismatching background patterns, and between matching and complex background patterns. Our results showed that the fish preferred matching background before non-matching. Interestingly, females showed preference for complex background before matching whereas males consistently showed preference for matching backgrounds. We discuss the possibility that visual complexity may serve as a straightforward and reliable cue of a safe habitat.

Introduction

Background-matching prey colouration effectively decreases the risk of detection by predators. It has traditionally been assumed that prey have been selected for preference for those parts of habitats that visually match their colour patterns [1,3]. Considering the popularity of this idea, however, very little empirical support exists for this. Moreover, recently this traditional idea has been challenged by an alternative hypothesis. It has namely been shown that not only the visual resemblance between the prey and its background, but also the visual complexity of the background makes prey detection more difficult [2,4]. This suggest that prey could decrease their risk of detection by preferring visually complex backgrounds.

During a series of behavioural aquarium experiments we therefore tested the background preference of the least killifish (*Heterandria formosa*) both with and without simulated predation threat (hereafter predation threat) to further investigate whether the response observed indeed was an anti-predator response or not. We aimed to test how they chose between backgrounds with (a) respect to the visual similarity between the fish and the background and (b) with respect to the level of visual complexity of the background.

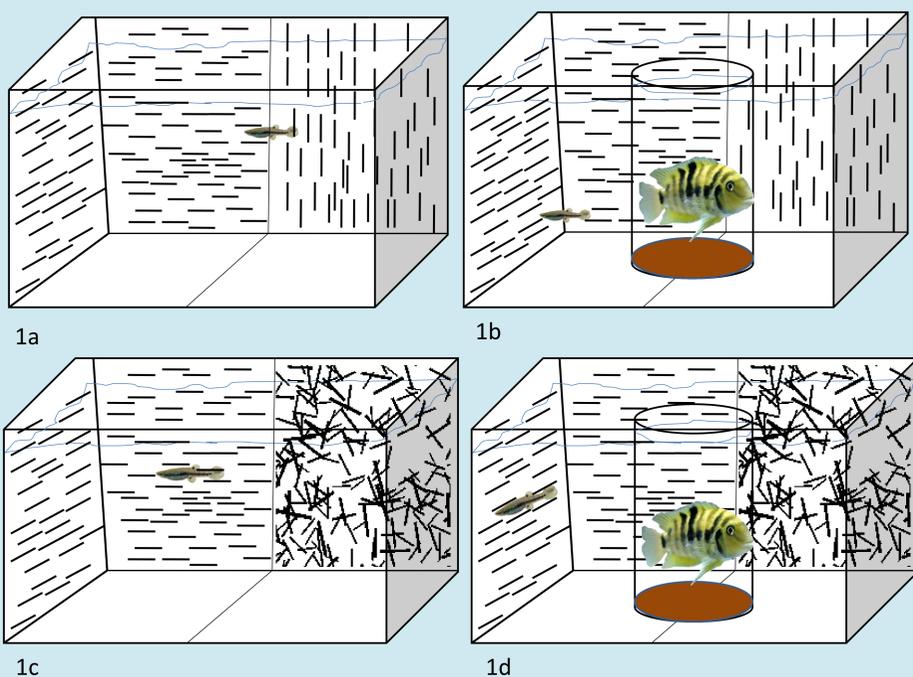


Fig 1 a-d: Experimental setup with matching background vs mismatching (a and b) , and matching vs complex (c and d). Without predation threat (a and c) and with predation threat (b and d).

Methods

Killifishes derived from a wild population in Otter Creek, Florida , were individually observed when choosing between two different backgrounds within one experimental aquarium either with, or without a simulated predation threat added (Fig. 1). From the killifishes' body pattern (the black stripe, fig.1) we created artificial backgrounds in MatLab that were matching and mismatching (same amount of elements, but matching or mismatching orientation, fig 1a, b) but also matching and complex (same elements but with random orientation allowing overlap, fig.1c, d). As simulated predation threat we used live convict cichlids (*Cichlasoma nigrofasciatum*) which were individually placed in an transparent container located in the middle of an experiment aquarium (fig. 1b and d). During a 15 min observation we scored location of the fish giving total time spend on each side.

References: [1] Endler, J. A. (1984) Biological Journal of the Linnean Society 22: 187-231. [2] Merilaita, S. (2003) Evolution 57: 1248-1254. [3] Ruxton, G. D., Sherrat ,T. N., Speed, M. P. (2004). Oxford University Press, New York. [4] Dimitrova, M., Merilaita, S. (2010) Behavioral Ecology 21: 176-181.

Results

Both males and females showed preference for matching background before mismatching when under predation threat (fig. 2). Unlike males however, females showed preference for complex background before matching when under predation threat (fig.3).

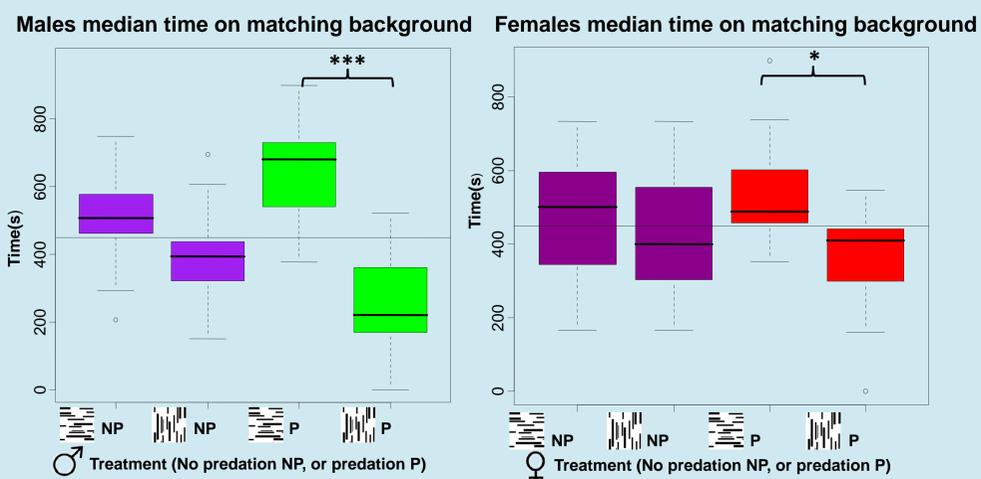


Fig 2. Median time males (left graph) and females (right graph) spend on matching vs mismatching backgrounds with and without predation threat.

*** Wilcoxon Signed rank test; N= 15, V= 116, p=0.0004272

* Wilcoxon Signed rank test; N= 15, V= 98, p=0.03015

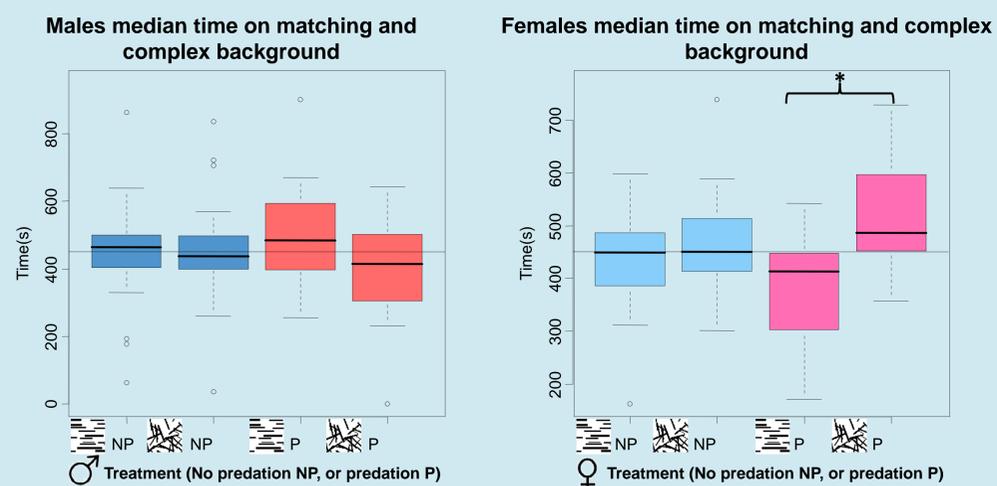


Fig 3. Median time males (left graph) and females (right graph) spend on matching vs complex backgrounds with and without predation threat.

* Wilcoxon Signed rank test; N= 20, V= 32, p=0.00486

Discussion

Our results show that both males and females of the least killifish prefers matching background before mismatching when under predation threat. In contrast to males however, females showed preference for the more complex background before matching when under predation threat. This finding lends support for the idea that the level of visual complexity could also act as an important cue of habitat safety. Being larger than males, females might spend more time on foraging activities and thus be more exposed to predation threat than males. While background matching might be a more reliable cue when resting and being still, visual complexity might be a more straightforward cue when moving around and may then serve as a more reliable cue of a safe habitat.

