Visual adaptation and microhabitat choice in two closely related cichlid species from Lake Victoria

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Publication date:
2017

Citation for published version (APA):
Mameri, D., van Kammen, C., Groothuis, T., Seehausen, O., & Maan, M. (2017). Visual adaptation and microhabitat choice in two closely related cichlid species from Lake Victoria. Poster session presented at 2017 Congress of the European Society for Evolutionary Biology, Groningen, Netherlands.

Visual adaptation and microhabitat choice in two closely related cichlid species from Lake Victoria

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Introduction

When different genotypes choose different habitats to better match their phenotypes, adaptive differentiation and reproductive isolation may be promoted. In cichlid fish, visual adaptation to alternative visual environments is hypothesised to contribute to speciation. Here, we investigated whether variation in visual sensitivity causes variation in visual habitat preference, in the context of the sensory drive hypothesis (Endler 1992, Boughman 2002). We use two closely related cichlid species that occur at different water depths in Lake Victoria, experiencing different light conditions and showing genetic differences in visual perception (*Pundamilia pundamilia* – inhabiting shallow waters; and *Pundamilia nyererei* – found in deeper waters, Seehausen et al 2008; **Figure 1**). We also explore potential effects of visual plasticity, taking advantage of captive fish artificially reared in two different light conditions, mimicking either shallow-water or deep-water light environments.

Model species

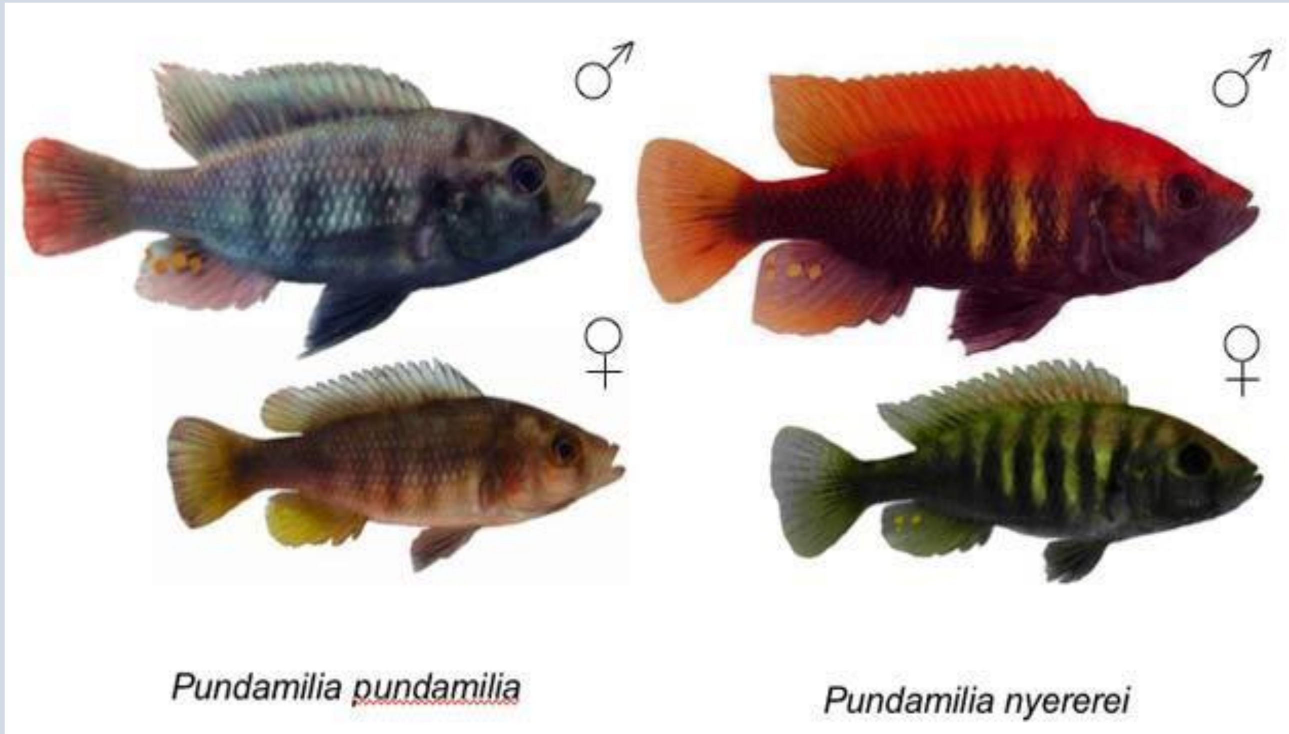

Fig.1. (A) *Pundamilia pundamilia* and *Pundamilia nyererei* (males and females) from Makobe Island, Tanzania.

Material and methods

- 120 fish tested in groups of 4 (fixed group composition across trials)
- 2 species: *P. pundamilia* (P) and *P. nyererei* (N); and hybrids (H)
- P and N were tested 3 times, and hybrids twice
- fish reared in either 'shallow' or 'deep' light conditions
- Food odour cues spread prior to trials, in both sides of the tank
- Time spent on each side recorded in 1-hour trials (at group level)

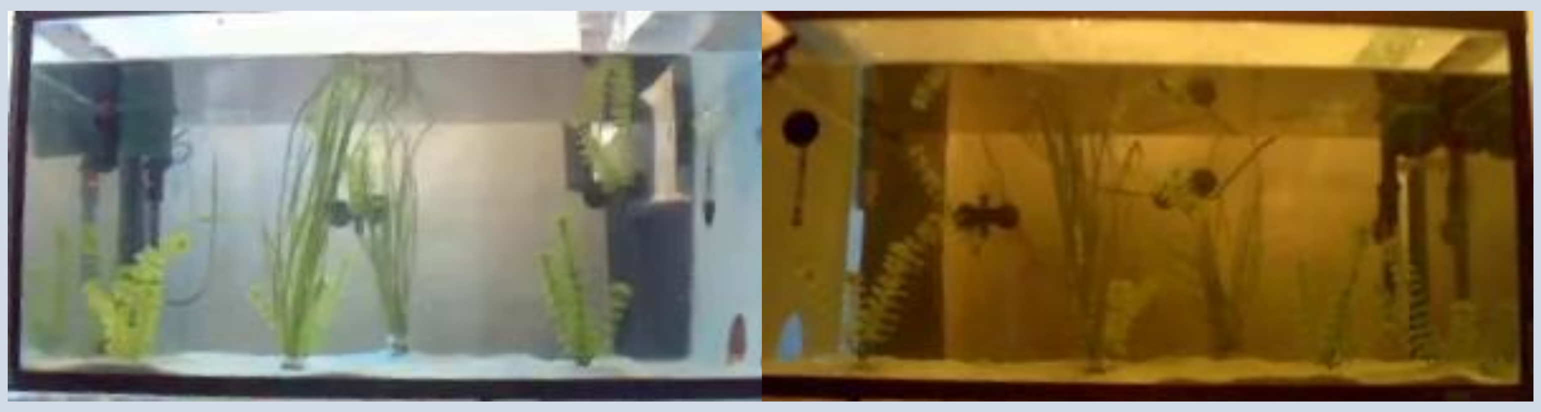

Figure 3. Experimental tank. A PVC sheet divided the tank into two equally-sized compartments. A hole in the divider allowed the fish to perceive the other light environment and cross from one side to the other. In the photograph, the left side was set up with the shallow light condition and the right side with the deep light condition.

Main results and discussion

NO DIFFERENCES BETWEEN SPECIES

There was no significant difference in light preference between species (P-N-H; T =1.21, d.f. = 76 , P = 0.23; GLMM model with species, light environment and trial number as predictors) – **Figure 3.**

EFFECTS OF THE REARING LIGHT ENVIRONMENT

Fish spent more time in the light environment they were reared in (T=2.49, df= 76, p=0.015), particularly in the first trial - **Figure 4**. The interaction effect of rearing environment and trial number was marginally significant (T=-1.98, df=38, p=0.051).

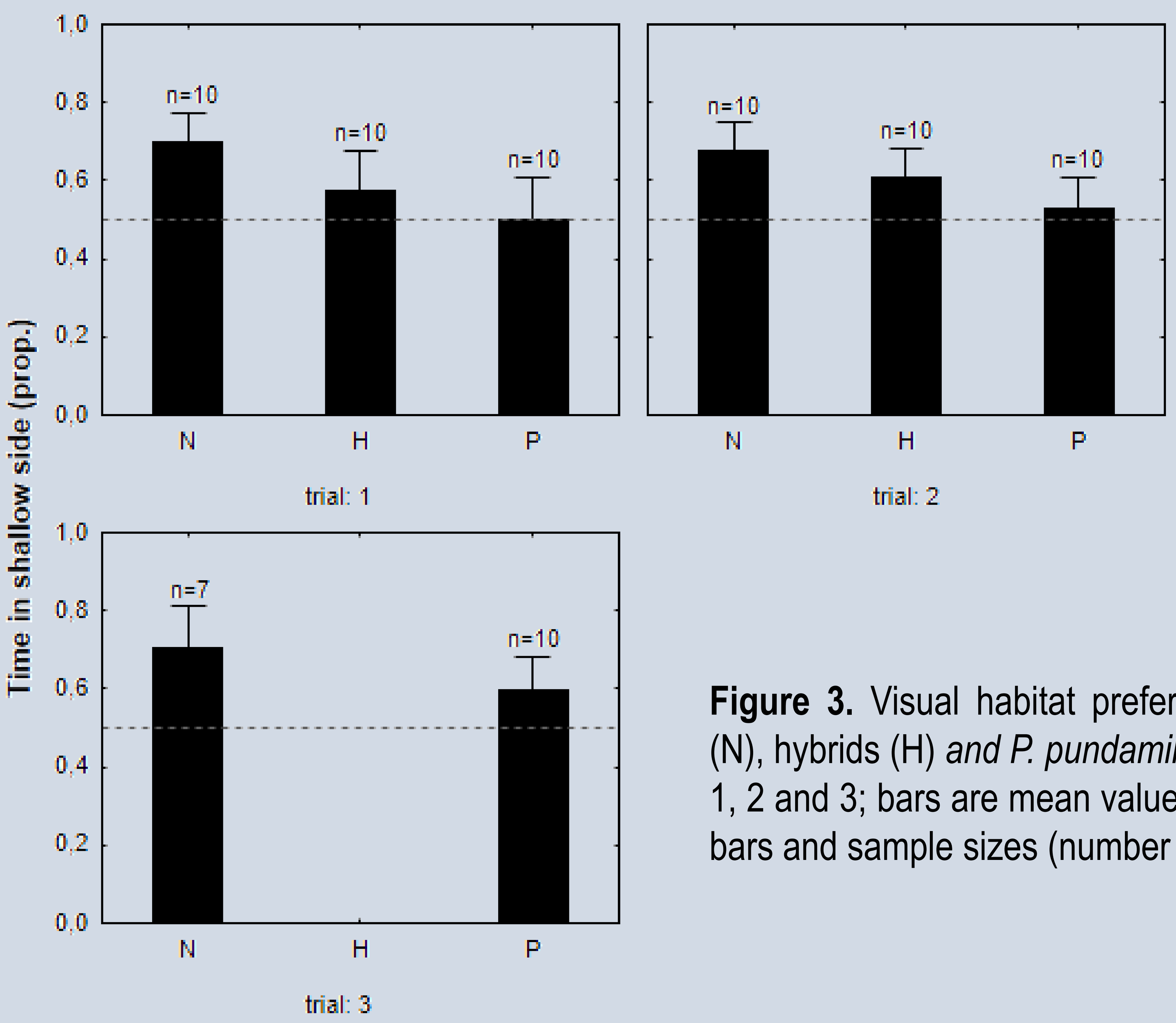

Figure 3. Visual habitat preference for *P. nyererei* (N), hybrids (H) *and P. pundamilia* (P) groups in trials 1, 2 and 3; bars are mean values with standard error bars and sample sizes (number of groups).

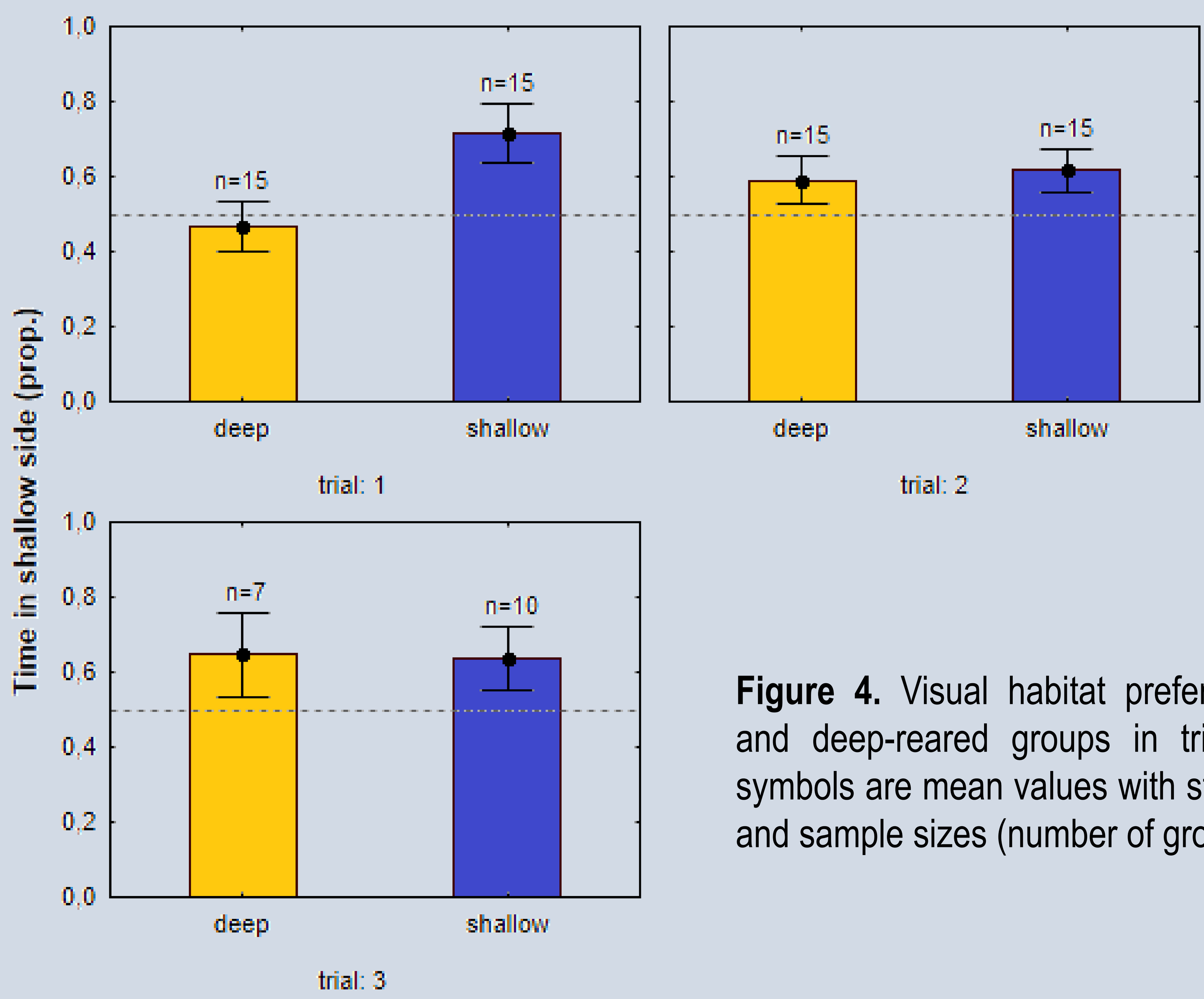

Figure 4. Visual habitat preference for shallow and deep-reared groups in trials 1, 2 and 3; symbols are mean values with standard error bars and sample sizes (number of groups).

- Contrary to predictions, *P. pundamilia* and *P. nyererei* did not differ in visual habitat preference
- The effect of rearing light environment that we observed is consistent with the result of Wright et al. (2017), who found that the same two light regimes affected female mate preference in *Pundamilia*
- While we provided food chemical cues to stimulate exploration, the testing paradigm did not provide an actual reward. This should be addressed in future experiments.

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