Role of male spatial distribution and condition-dependent colouration on female spawning behaviour and reproductive success in bluegills

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Summary
Female choice for male ornamental colouration has been demonstrated in a number of different taxa. Among fishes, most studies have been conducted in a laboratory setting and show that females prefer more colourful male ornaments. In this study, we observed female bluegills (Lepomis macrochirus) spawning in their natural environment and compared spawning behaviours to male traits and position within a colony. We observed spawning activities of 76 parental males in Lake Opinicon, Ontario. We captured each male and used reflectance spectrometry to objectively quantify the colour of six body regions and measured morphological characteristics. Our results show that female spawning behaviours did not significantly differ between central and peripheral males, although egg scores were higher in central nests. During spawning, females appeared to enter the nests of parental males haphazardly. However, our results suggest that male cheek colouration influenced the number of females spawning, the number of eggs they released, and the amount of time they spent in the nest. Moreover, male breast colouration significantly predicted reproductive success as quantified through egg scores. Together, our findings suggest that females may use male cheek and breast colouration, condition-dependent sexual ornaments, as key traits on which to base their mate choice decisions.

Keywords: bluegill, female preference, spawning behaviours, male ornamental colour, nest location/

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Introduction

Female choice for elaborate male traits can evolve through several mechanisms (reviewed in Andersson & Simmons, 2006). In general, females exhibit preferences for particular traits if they stand to gain direct or indirect benefits by evaluating these traits in mate choice (Andersson, 1994a). Females may benefit directly from their choice of mates if male ornaments reflect their ability to provide resources such as high quality territories, food, parental care, or protection. Alternatively, female choice for elaborate male traits may yield indirect (genetic) benefits. For example, the sexy son hypothesis proposes that females benefit from choosing attractive males because their male offspring will also bear these attractive traits (Weatherhead & Robertson, 1979). Moreover, because their daughters will also inherit preferences for these same traits, male traits and female preferences can spread rapidly through the runaway process in subsequent generations (Fisher, 1930). Female choice for male ornaments may also yield indirect genetic benefits if these traits honestly reveal heritable aspects of male quality, such as heritable parasite resistance (Hamilton & Zuk, 1982). Finally, models of mate choice based on genetic compatibility suggest that females obtain reproductive benefits by choosing males that are genetically dissimilar from themselves (Brown, 1997; Mays & Hill, 2004; Neff & Pitcher, 2005; Andersson & Simmons, 2006). Male traits that reveal the possibility of direct benefits, indirect benefits, and compatible genes are not mutually exclusive, and all may play a role in female assessment of male traits (Kokko et al., 2002; Andersson & Simmons, 2006).

The vibrant ornamental colouration displayed by males of many species provides a striking example of traits involved in female mate choice. Classic examples include female preferences for redder plumage in house finches (*Carpodacus mexicanus*) (Hill, 1990), and female preferences for orange spots in Trinidadian guppies (*Poecilia reticulata*) (Endler, 1980, 1983). In fishes, ornamental colouration has been studied on a comparatively small number of species, most notably guppies (e.g., Endler, 1980, 1983; Kodric-Brown, 1985; Houde, 1987) and the threespine stickleback (*Gasterosteus aculeatus*; e.g., Rowland, 1989; Milinski & Bakker, 1990). Many of these studies have convincingly demonstrated a role of colour in female mate choice in a laboratory environment (Nicoletto, 1995; Brooks & Endler, 2001; Karino & Urano, 2008); however, lab experiments do not always correspond to mate