SEXUAL SELECTION IN CRAYFISH: A REVIEW

BY

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ABSTRACT

Crayfish are used as model organisms in many research fields but this potential is not fully expressed in behavioral studies. This review paper attempts to organize the results of the abundant literature on crayfish reproduction within the framework of the sexual selection theory. Our aim is to stimulate further research in this promising field of study.

INTRODUCTION

Crayfish are used as model organisms of study in a variety of research fields, from ecology to molecular evolution. However, at least in the field of behavior, this taxon appears to be an “almost perfect” model system (Hazlett, 2009). In fact, notwithstanding the about 640 species described so far (Crandall & Buhay, 2008), over 75% of studies have focused on 10 species only (Gherardi et al., 2010). As a consequence, important questions about the evolution of crayfish behavior are difficult to be addressed. This drawback is particularly evident when the aim is to understand the evolutionary mechanisms through which sexual selection operates.

Here, we attempt to organize the results of the abundant literature on the reproductive biology of crayfish within the framework of the sexual selection theory. Sexual selection is a term coined by Charles Darwin (1871) to indicate the process leading to the evolution of morphological and/or behavioral traits that increase the reproductive success of the individuals of each sex but that

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cannot be accounted for by natural selection. Females, who invest in few costly gametes, are highly choosy, whereas males, who produce large numbers of cheap sperm, are limited in their reproductive output only by the frequency of matings (Trivers, 1972). Because of this intersexual difference in investment, typically selection gives rise to ‘reluctant’ females on one hand and ‘ardent’ males with exaggerated morphological and/or behavioral traits on the other.

**INTRASEXUAL SELECTION**

Contest and scramble competition

Intrasexual competition occurs when two or more individuals are dependent on the same resource and when this resource is limited. There are two modes of competition: contest competition, in which one individual gains the exclusive access to a given resource by impeding its access to competitors, and scramble competition, in which each individual tries to maximize its share with that resource without directly interfering with the others (Barki, 2008). However, especially when the resource is a receptive female, these two modes of competition are extremes in a continuum and often may co-occur or occur in sequence during the mating season.

This is well illustrated in the case of *Orconectes rusticus* in southern Ontario (Berrill & Arsenault, 1982). The mating season of this species is short during spring and female receptivity is synchronous. During the first 10 days of mating activity when the operational sex ratio (OSR) is about 1:1, males and females wander and copulations is frequent. Aggressive interruptions of copulations by other males begin 8-9 days after, when OSR starts to rise due to the increased number of already mated females that sequester themselves in shelters to incubate the extruded eggs. When receptive females become extremely rare (after 1-2 additional weeks) feeding replace competition in males and copulations stop.

Intermale competition for the access of a female occurs in *Austropotamo-bius pallipes* (cf. Gherardi et al., 2006) and *Pacifastacus trowbridgii* (cf. Mason, 1970). It is particularly intense in laboratory groups of *A. pallipes* (cf. Gherardi et al., 2006), which results in a decreased number and duration of mating attempts if compared with a competition-free context. The ability to dominate over other males depends on a number of extrinsic (e.g., experience of wins/losses) and intrinsic factors (e.g., body size, weight, and chelar dimensions, neurochemical state) (Tricarico & Gherardi, 2007). An obvious determinant of dominance is size: in laboratory groups of *A. pallipes*, larger males even