

# Extra-pair parentage: a new theory based on transactions in a cooperative game

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## ABSTRACT

**Question:** What is the adaptive significance of extra-pair parentage?

**Theoretical approach:** We view parentage as a ‘transaction currency’ for exchanges of ecological benefits. We develop a multi-player cooperative game, using the core and the Nash bargaining solution as solution concepts.

**Model assumptions:** Birds can negotiate about who pairs with whom. Parentage can be exchanged between individuals as a result of negotiations. Number of offspring fledged from a nest depends on the experience and situation of the social parents and not on their genes (i.e. only direct benefits, no genetic benefits).

**Predictions:** We predict extra-pair parentage to occur when individuals with higher breeding capability are paired to individuals with lower breeding capability. Social interactions between males are predicted to precede the occurrence of extra-pair paternity. We give an example experiment to test our model.

*Keywords:* cooperative games, direct benefits, extra-pair paternity, genetic benefits, negotiation, social selection.

## BACKGROUND

Most bird species are socially monogamous and cooperate in raising offspring (Cockburn, 2006). However, with the advent of molecular methods to assign parentage in the wild, the picture changed remarkably: in most species, some nests contain young that are sired by males other than their social parent [called extra-pair paternity (Griffith *et al.*, 2002)]. Less frequently encountered, but still fairly common, are nests that contain young whose genetic mother is not the female tending the nest [extra-pair maternity (Yom-Tov, 2001)].<sup>1</sup> These two phenomena together represent an interesting problem in evolutionary biology: breeders in such nests

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<sup>1</sup> We use the term ‘extra-pair maternity’ for all cases where the social mother is excluded as a genetic parent. The terms widely used in the literature are intraspecific brood parasitism and quasi-parasitism. In intraspecific brood parasitism, both the social mother and father are excluded as the genetic parent, corresponding to simultaneous extra-pair paternity and extra-pair maternity. On the other hand, quasi-parasitism is extra-pair maternity only. See ‘Discussion’ for more on the issue.

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