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Variations in the birth sex ratio and neonatal mortality in a natural herd of horses

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Abstract Variations in birth sex ratios and sex differences in juvenile mortality occur in a number of mammalian species, and in many cases have been linked to resource availability. Most of these biases in offspring sex ratios concern polygynous species with pronounced sexual dimorphism, and where females only are philopatric. Data on species with unusual life-history strategies, such as slight sexual dimorphism or dispersal by both sexes, are of particular interest. In this study of a natural herd of horses (*Equus caballus*) which experienced an eruptive cycle, and therefore a period of nutritional stress, male offspring had higher neonatal mortality rates in nutritionally poor years than in good ones, whereas "year quality" had no effect on the mortality of female offspring; year quality could therefore be used by mares as predictor of sex-specific offspring survival. We show that the environmental conditions that predicted lower survival of males were negatively related to their production: the birth sex ratio the following year was female-biased; and mares were less likely to produce a son when they had produced a son the preceding year. There was no significant effect of mother's parity, age or rank, or the timing of conception or birth on offspring sex ratios. The mechanism leading to biases in the birth sex ratio could have been the loss of male embryos by mares that did not foal. As there was no evidence for selective abortion of male foetuses in females that did foal the next year, it is not necessary to invoke maternal adjustment, though this remains a possibility. Finally, there was a suggestion that male offspring were more costly to raise than females, since mothers that reared a son in poor years tended to experience an increase in the interbirth interval between their two subsequent offspring.

Key words Birth sex ratio · Neonatal mortality · Resource availability · Horses

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Introduction

Adaptive biases in offspring sex ratios have been predicted by a number of theoretical studies (e.g. Trivers and Willard 1973; Clark 1978; Maynard Smith 1980; Silk 1983). Biased birth sex ratios and differential juvenile mortality have indeed been documented in a variety of animals: among these, mammals are of particular interest since there is now considerable observational and experimental evidence that variations in this class are related to resource availability (see Clutton-Brock et al. 1985; Clutton-Brock and Iason 1986; Clutton-Brock 1991).

The data available show that the directions of biases in birth sex ratios are often inconsistent, both within and across species. It therefore appears that many factors may affect birth sex ratios, directly or indirectly. It is likely that more than one mechanism is involved, and it has rarely been possible to distinguish between variations in offspring sex ratios which are due to maternal adjustment and those which are due to the consequences of sexual selection (see Clutton-Brock 1991 for a full treatment of these issues).

In addition to manipulating the birth sex ratio, parents could also vary the sex ratio of their offspring by manipulating juvenile survival. There is at the moment no evidence that this, energetically wasteful, mechanism is used (Clutton-Brock 1991). Nonetheless, variations in juvenile survival are commonly important components of variance in the reproductive success of mammals