Rep. Lundy Field Soc. 45

SEXUAL SELECTION IN HOUSE SPARROWS

By

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For several years now there has been a plan to study the isolated population of House sparrows on Lundy. During this time preliminary work by Dr. Ian Owens has included the putting up of nest boxes and the ringing of as many of the population as could be managed in the time available. This summer will see the start of intensive work on the island by myself. I am based at the University of Leicester and have just begun a three year PhD studying the breeding behaviour of the house sparrow, *Passer domesticus*. I will spend most of the breeding season on the island during which time I will be collecting behavioural data and samples which will be analysed during the winter at Leicester. Lundy has a unique set of characteristics that make it an ideal site for this project; a sizeable population of house sparrows exist in virtual isolation from other populations; additionally the small area in which the sparrows live should make them all fairly accessible as will their habit of using nest boxes.

In the field of evolutionary ecology one of the most widely studied and productive areas has been the breeding behaviour of both male and female individuals in their attempt to optimise their own reproductive success. This work has focused on a wide variety of animals but with most success in various species of birds. One of the most unexpected discoveries, that has been recently made using the relatively new technique of DNA fingerprinting, is the extent to which apparently monogamous species seek extra-pair copulations. The House Sparrow, *Passer domesticus*, is one of the birds that has so far been revealed to have quite a high level of extra-pair copulations. In the House Sparrow the birds usually form a monogamous pairing for the whole breeding season, with both the male and female taking care of the offspring. Despite this, either member of the pair may also copulate with other individuals. What is currently of great interest is exactly why the members of a mated pair participate in these. There are many lines of thought as to why this behaviour occurs and the mechanisms involved.

A breeding female has to invest a lot of energy in producing a clutch of eggs and rearing the chicks to fledging and beyond. For this reason it has been argued that a female will try to optimise the return she gets in terms of genetically fit offspring. She could potentially increase this fitness in two obvious ways. Firstly, by producing a clutch which has been fathered by two different males she will increase the genetic variability of her offspring which in terms of natural selection could pay dividends. A more direct way of increasing the fitness of her offspring is by pairing with the "fittest" male possible. If such a system existed whereby males and females were capable of assessing each other's fitness we would expect that on average the fittest males would form monogamous pairings with the fittest females and the least fit with the least fit. A female that is paired with a poor quality mate may therefore solicit matings from a male of higher quality than she herself could pair with. In this way, at least part of her clutch will be genetically better than she could otherwise hope.

Male birds of course do not have to invest as heavily in the production of offspring as females as sperm are hundreds of times cheaper to produce than eggs. This suggests that a male could potentially father many more offspring and will therefore not be as concerned about the quality of females with which he has extra-pair copulations. The main evolutionary advantage to a male of extra-pair copulations will be the possibility of increasing the number of offspring he can father.

There is a potential price to be paid by individuals who are caught out participating in extra-pair copulations. If the male in a monogamous pair suspects that his partner has been cheating on him then there is a likelihood that he will abandon the clutch. This would be a high price to pay in terms of the female's production of offspring in that season. It is no surprise that many birds concentrate all their reproductive efforts in their own nest with their own partner, the risks of extra-pair copulation not being worth the

possible gains. The females paired to the fittest males would be expected to solicit extra-pair copulations least. Over the course of the next few years I will be hoping to unravel the mechanisms driving extra-pair copulations and some of the associated problems and behaviours.

One of the implications of adaptive explanations for the kind of mating behaviour found in the House Sparrow is that individuals can actually assess each other's "fitness". In the House Sparrow it has been suggested that the birds are using signals of fitness, notably the black bib of the male. The black bib is a secondary sexual character and may be comparable with the train of the peacock in that its function might primarily be for attracting a mate. So what exactly does such a secondary sexual character actually signal? There are two principal sets of hypothesis, the "honest signals" hypothesis and the "arbitrary signals" hypothesis. Both of these hypotheses have to satisfy two important observations. First, real fights between males are rare and contests over mates are often decided on the basis of ritualised displays or colouration. Second, individuals usually choose between potential sexual partners on the basis of elaborate ornamental traits. The honest signals hypothesis claims that the reason secondary sexual characters are used is because they accurately signal the bearer's condition, i.e. a big bibbed male sparrow is generally in better condition than a bird with a smaller bib because it is in some way expensive to maintain a big bib.

The arbitrary signals hypothesis suggests that the badge does not convey any information at all but simply indicates a convention. Costly fights are avoided by males if they all comply to a convention that individuals with a big bib are dominant over individuals with smaller bibs. This system would work only if there is no long term advantage to individuals in having a big bib. All individuals would gain an advantage because there would be less costly fights. However, having a small bib would not necessarily mean that you will be ridden over rough shod if you are actually fit. If females preferred to mate with individuals carrying an arbitrary trait, in effect this trait would then become "sexy" and males would be selected to bear the trait whether or not it was costly and conveyed any information about the individual.

Anders Müller at the University of Uppsala has shown that female sparrows appear to prefer males with large bibs. Whether this can be explained by the arbitrary or honest signals hypotheses is to be tested in the Lundy study. One of the ways in which the two theories can be tested is to assess the genetic heritability of "survival traits" versus "sexy traits" among males. Survival traits will include things such as surviving through the winter and dominance at food sites during times of greatest stress. Sexy traits include how early a male mates in the spring and whether he achieves extra-pair copulations or not. The honest-signals theory based on genetic components predicts that both survival- and sexy-traits will be heritable and that they will be positively correlated. The honest signals hypothesis, based on environmental components of condition, predicts that neither survival- or sexy-traits will be heritable. The arbitrary signals theory predicts that only sexy-traits will be heritable.

To assess the heritability of traits it will be necessary to compare offspring to their parents. This is often hard in natural populations because juveniles disperse away from their parents. The reason why this study is being conducted on Lundy is an attempt to avoid this problem. The population of sparrows on the island is very sedentary with very few birds willing to negotiate the 14 km from the island to the mainland, so it will be possible to compare the characteristics of offspring with those of their parents. The other benefit of the island is that the whole population of sparrows is very localised around the village at the south end of the island and will therefore be easy to monitor and study. Over the past four years the sparrows have gradually taken to breeding in nest boxes which were put up for the purpose of this study. This makes the birds more accessible which is an important element of the work which needs to be done as we will need to identify siblings against each other and their parents.

I will be starting my fieldwork in April/May 1995 and will spend several months on Lundy in an effort to follow as many of the individual birds as I can through the season. One of the most important things to do in a study such as this is to be able to recognise all of the birds individually and to this end I will be marking each bird's legs with a

unique combination of four colour rings. The adults will all be caught in mist nets before the beginning of the breeding season to minimise disturbing them during breeding. The chicks will be ringed just before they fledge. This is made easier to achieve when they nest in boxes. Using DNA finger printing techniques back at the University of Leicester after the field season I will be able to assign parentage to all the chicks in individual clutches and hence uncover the extent and consequences of extra-pair copulations. Over the period of the study I will then be able to follow individual birds and assess their individual success in terms of survival and reproduction and I will have the benefit of a complete history of that bird including data on condition, bib size, growth rate, fledging age and many other variables believed to be relevant to the success of individuals.

ACKNOWLEDGEMENTS.

I would like to thank the Landmark Trust for their continued interest and support for this study. This project is being generously funded bv the Natural Environment Research Council.

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