Game Theoretical Perspectives on Conflict and Biological Communication

Akademisk avhandling
som för avläggande av filosofie doktorsexamen vid Stockholms universitet
offentligen försvaras på Zoologiska institutionen Svante Arrhenius väg 14-16,
sal G, fredagen den 19 september 1997, kl. 10.00
av

Peter L. Hurd
B.Sc., M.Sc.

Zoologiska institutionen
106 91 Stockholm

Stockholm 1997
ISBN 91-87272-54-7

Abstract This thesis investigates communication between animals with conflicting interests. Particular attention is paid to conventional signalling, in which signals are not inherently costly and information is inferred by convention. This type of signalling is emphasised for two reasons: firstly it is communication in its purest sense, and secondly it seems to more accurately reflect the properties of many biological signals. The costs which maintain the evolutionary stability of communication are of great interest because of the apparent benefit to be gained through the use of misleading signals, such as bluffs. I argue that these stabilising costs emerge from the manner in which receivers respond to signals, rather than being inherent to the signals themselves.

The theoretical papers in this thesis begin with the most basic signalling game and proceed towards a more general understanding of conventional signalling. I begin by investigating the importance of signal cost in the simplest possible model of communication, the Action-Response game. I demonstrate that the signals used do not have to be costly to be reliable, even when the signaller and receiver are in a state of conflict. I then consider the effect of adding costs to signals in a game in which reliable conventional signalling already exists, and demonstrate that the costly signals will be used by the weaker, not stronger, signallers. This demonstrates a stabilising mechanism fundamentally different from that of the handicap hypothesis, with its stabilisation through signal cost. Finally, I identify the conditions other than cost which are necessary for conventional signalling to be evolutionarily stable. These conditions relate to the information which both signaller and receiver must gain over the course of an interaction. Most models used to investigate signalling cannot account for behaviour seen in more complicated biological interactions because they are too simple to produce results other than that of the handicap prediction.

The other work included in this thesis addresses issues raised by the models. I review the literature on threat display use by birds, and present evidence that these displays are conventional signals. The stability of conventional signalling rests upon the existence of some common interest within a larger conflict between signaller and receiver. I present a clear example of communication attributable to common interest between fighting opponents. Cichlids of the species *Nannacara anomala* use a distinct colour signal, the Medial Line display, to coordinate another agonistic behaviour, tail-beating. It appears that both individuals benefit from the clearer assessment of relative fighting ability that this coordination affords. These *N. anomala* colour displays are quite conspicuous. It has been assumed that when common interest exists, signals will be very subtle, whereas when signaller and receiver are in conflict, signals will be exaggerated and conspicuous. Using an evolving neural-network model, I demonstrate that selection for exaggerated signals may exist even when the signaller and receiver have complete common interests.