

## **RESEARCH IN ANIMAL BEHAVIOUR: WHAT AND WHY**

- Behaviour is a pervasive and fundamental property of living organisms, ranging from the simple responses of bacteria to the intricate social interactions of humans. Elucidating the mechanisms underlying behaviour and understanding its evolution represent major intellectual challenges in modern biology.
- Research on animal behaviour has an inherently integrative nature. It gathers together questions and methodologies across levels of analysis, across levels of explanation and across diverse taxa. This nature of behavioural studies challenges established boundaries in science, such as psychology, neuroscience, physiology, immunology, anthropology and sociology, evolutionary biology and ecology. In doing so, it promotes and sustains the development of new conceptual approaches in biology overall.
- Training in the field of animal behaviour meets an identified need for scientists with the ability to integrate various types of information. It provides young scientists with experience of analysing and modelling biological phenomena at the systems level as well as at the more reductionist levels of cellular and molecular mechanisms.
- The results of behavioural research play a key role in stimulating an interest in biological science among children and in educating the wider public. The questions asked by researchers of animal behaviour and the organisms studied are of inherent interest to a wide audience. They provide a mirror, enabling a better view and understand our own behaviour. The success of major natural history television series, based on the results of academic research, reflects the interest in and enthusiasm for animal behaviour studies.
- Research on animal behaviour also underpins progress towards objectives of importance in enhancing the quality of life in our society today and in the future:
  - understanding the links between genes, brain, behaviour and behavioural disorders
  - elucidating the role of behaviour in susceptibility to disease and stress
  - designing strategies for conservation and management of endangered species and biodiversity
  - forming policies on the welfare of wild and domestic animals
  - reducing the impact of agricultural and urban pests
  - understanding human behaviour and the origins of conflict and co-operation

### **Current issues: Examples**

Behavioural biologists work on a wide range of problems and species with an underlying theme of explaining the mechanisms and function of behaviour and the evolution of biological diversity. A comparative approach pervades all aspects of research in animal behaviour.

### ***Brain and behaviour***

- Behaviour is the obligatory gateway for scientists to examine the functioning of the brain. Understanding how the brain works is not only one of the great challenges in biology, but is also of significance in understanding diseases of the nervous system such as Alzheimer's. Cognitive neuroscience, a discipline aimed at understanding the functioning of the brain, encompasses approaches ranging from behaviour to molecular. The quality of research in this area rests squarely on the quality of knowledge about behaviour.

- Behavioural research contributes to analyses of established model systems of brain function, such as those on monkeys and rats. However, it also plays an important role in developing new models for understanding relationships between brain and behaviour. For example work on learning, memory and perceptual processes involved in bird song learning and imprinting are revealing new insights into neural plasticity and developmental influences on the brain.
- Novel in vivo imaging techniques, such as fMRI scanning, provide the potential for linking dynamic changes in the brain with specific behavioural events. Using transgenic techniques to study localised gene expression in the developing brain will boost the understanding of the relation between brain and behaviour even further.

### ***Animal cognition and welfare***

- Exploration of the cognitive capacities of animals reveals the ways in which different species navigate in space and perceive time, the extent to which they have mental images of future events, their capacity to recognise other individuals and their ability to solve abstract reasoning problems.
- Understanding animal cognition is vital to considerations of animal welfare. The key research issue for the development of future policy is the objective measurement of welfare. Although a variety of indices exist, behavioural evidence provides the ultimate arbiter of welfare and this, in turn, depends on understanding animal cognition, perception and motivation.
- A fruitful new integration is occurring between research on animal cognition and bioinformatics. Animal behaviour studies inspire computational models and ‘neural networks’ that are able to learn from their actions. Engineers are inspired by animal behaviour to design ‘animal robots’, which find increasing industrial applications.

### ***Reproduction and social behaviour***

- Males and females of many species differ conspicuously in their size, appearance and mating behaviour. Theoretical and empirical studies of mating strategies of animals have begun to explain the evolutionary origin and maintenance of this variety.
- Many animal species, from arthropods to primates, live in complex, well-organised societies. The combination of behavioural research and techniques like DNA-fingerprinting has revealed that understanding the reproductive success associated with different behavioural strategies is crucial to understanding conflict and collaboration in animal societies.
- These principles have proven very helpful in understanding phenomena ranging from why the majority of female bees are sterile and help the queen to breed, to why male lions and primates sometimes commit infanticide when they join family groups. Whether the principles underlying animal social behaviour help to understand human social behaviour is controversial. Careful comparisons will help to resolve the controversy.

### ***Resources, populations and the environment***

- The abundance and distribution of resources determine the reproductive behaviour of individuals, their social interactions and their dispersal. This affects the dynamics of populations. Behavioural models of population dynamics are being used to predict effects of habitat loss on natural populations and to develop conservation strategies for threatened habitats.

- Behaviour is a major evolutionary force shaping the interaction between species. The evolution of insect responses to plants, for example, is a crucial factor for both pollination and herbivory, and has an important impact on the efficiency of agriculture. Behavioural responses of pollinators to flowers determine whether or not pollination occurs, and the detection and choice of egg-laying sites by female insects is a key element in determining the impact of pests on their host plants.
- The interactions between animals and their food supply is also important in agricultural systems. For example, the sustainable management of grassland systems requires understanding of the impact of grazing livestock on the vegetation. Behavioural models based on modern theory provide this predictive understanding.

### ***Conservation and biodiversity***

- Knowledge of behaviour obtained in field studies and with captive animals is important in designing captive breeding programmes for endangered species and in helping to conserve endangered wild populations. Carrying out conservation programmes without such knowledge may result in wasting resources, time and money to no effect.
- Behavioural mechanisms play a key role in reproductive isolation in many species. Behavioural changes may even be at the basis of species formation. Analysing these processes is important in effective management of endangered species in the wild, in maintaining viable gene pools and in understanding the mechanisms underlying biodiversity.

### ***Communication***

- Communication provides a key to understanding how animals respond to and exploit their social environment. Studies of communication are shedding light on the complexities involved in animal decision making. They reveal the subtle signal information transmitted by a wide variety of sensory modalities. It is through the effects on behaviour that some of the extraordinary sensory capabilities of animals have been discovered.
- Research into communication holds considerable promise for manipulating behaviour. Odour cues commonly used by mammals and insects, for example, not only prime their social behaviour towards conspecifics, but also control individual reproductive status and development. The integration of chemical analysis of these signals with studies of their effects on individual and population behaviour will be essential for the successful development of novel methods of pest control.

### ***Behavioural genetics and development***

- Genome mapping and genetic analyses now allow the identification of genes underlying behaviour to a level previously unimagined. There are examples of genes being cloned and swapped between species to understand their role in behaviour. This will help to understand the genetic control of a wide range of behaviours and behaviour abnormalities.
- Behaviour is a product of both genetic and environmental factors. Increasing knowledge about the genomic structure of animals combined with studies of the influence of environmental factors, like intra-uterine effects, the social environment, feeding conditions and rearing habitat will help to understand the origin of individual variation in behaviour.
- Behavioural development in animals and humans is characterised by sensitive phases. Study of the mechanisms underlying the control of sensitivity is vital to understanding the origin and treatment of behavioural disorders in animals and humans.

## ***Behaviour and immunology***

- Integrative research has revealed an intricate interplay between behaviour, hormonal changes and immunosuppression. This is leading to a clearer understanding of the role of behaviour in generating individual differences in susceptibility to disease and stress.

## **A European dimension**

- Europe has an outstanding research record in animal behaviour, including the Nobel prize winning founders of the field (Niko Tinbergen, Konrad Lorenz and Karl von Frisch) and many of the current world leaders. Several international top-journals on animal behaviour have European editors and publishers.
- European countries have national and international societies for studying animal behaviour. All grow and expand their activities, indicating their viability. They initiate European collaboration, for instance by organising joint conferences and strategy meetings. All have members, experts in various areas, who are willing to provide information and who are important resources for policy making.