Irving, RA, Schofield, AJ and Webster, CJ. Island Studies (1997). Bideford: Lundy Field Society

Animal Psychology and Behaviour

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Psychology is the study of the mind and behaviour, with behaviour being manifest as actions which can be objectively measured or precisely defined. For example, providing there is a clear working definition of head shaking (ie. lateral movement of the head from side to side) any number of observers can use it to decide and agree on whether an individual is head shaking or not. Studying the mind, however, is not as straightforward as there is a tendency towards subjectivity. This is inevitable owing to those aspects of the mind which are usually studied: perception, sensation, memory and thought. One fact is true nonetheless: with animals we cannot simply ask them about themselves; instead we have to devise ways of finding out about them and how they function, and it is only through behaviour that we can obtain such information.

Animal behaviour is diverse and there are a number of scientific disciplines devoted to its study. Such studies can be undertaken virtually anywhere, but of all possible locations, small islands are perhaps among the best suited to research of this kind, with an isolated population and field conditions conducive to close examination of the animals; whether birds, wild mammals or the domestic stock, islands represent natural field laboratories. Over the last few years, the potential for such work on Lundy has been realised. Here a general framework describing aspects of animal psychology is presented, along with some examples of recent work conducted on Lundy.

Studying animal behaviour

Ethology has been defined as, "the study of animal behaviour in the natural environment, which uses evolutionary adaptation as its primary explanatory principle" (Gray 1991). Some regard animal behaviour as one of the most important aspects of biology, and the following section will examine briefly the history, emergence and subsequent development of ethology. This will include a summary of its growth and an examination of its subdisciplines.

Ethology and evolution

Early work on animal behaviour was set against an evolutionary background, as is evident from the definition of ethology. Evolution depends on *natural selection*, a process by which some individuals are preferred over others. Natural selection can be thought of as selective breeding by nature and parallels the artificial breeding programmes seen with domestic species, for example the selective breeding of Friesian cows for high milk yield when kept under intensive conditions. The immediate environment in which an individual lives is referred to as the ecological niche and this niche imposes selective pressures on the individual.

Natural selection is based on the fact that not all individuals in a population will survive and reproduce. The determination of who does and who does not depends partly on the individual's inherited characteristics. It follows then that any characteristics which increase the likelihood of survival are selected *for* in nature, whilst those characteristics which decrease the chances of survival are selected *against*. If this is the case, so long as there are heritable differences between individuals which have a direct bearing on their chances of survival, evolution will occur. If there are no changes in the environment then a species can become adapted to it, can cope with the pressures exerted on it and have no need to evolve further. However, environments change continually. Species living in them, therefore, must continue to evolve in order to remain adapted to their environment. (Fig.1 provides definitions of the terms used.)

The growth and diversification of ethology

Since its development in Europe in the 1930s ethology has grown considerably as a scientific discipline and although it invokes some evolutionary explanation, has expanded and diversified in many ways, for example into comparative, social and behavioural ethology. The two most famous ethologists largely responsible for establishing comparative ethology were Konrad Lorenz (1903-1989) and Niko Tinbergen (1907-1988), both of whom were originally zoologists interested in the biological aspects of behaviour. Comparative ethologists study individuals, relate differences in different animals' behaviour to the ecological pressures of the environments that they live in, maintain that the behaviour of animals could be studied in exactly the same way as other factors such as their morphology, and believe that the more closely related two species are, the more likely they are to share behaviours. Unlike comparative ethologists, social ethologists focus their attention on groups of individuals or societies. Their primary concern is to understand the society as a whole and then to consider the individual within it. A social ethologist would maintain that the most important selective pressures impinging on an animal would be those arising from its society.

So far we have examined disciplines in which behaviour is studied. However, other scientific disciplines are concerned with animals' ability to learn. There are two main approaches to the study of animal learning: behaviourism and cognitivism.

An early form of behaviourism stated that learning could be accounted for completely by simple Stimulus-Response (S-R) connections. However, by the 1960s a new kind of behaviourism, methodological behaviourism, arose. Here it was suggested that all that could be observed about an animal is its behaviour, which can then be used to infer thought. Methodological behaviourists infer internal mental (cognitive) processes, represented by an intervening 'O' in the S-O-R relationship, where 'O' represents organism variables. Organism variables might include the

individual's emotion, motivation, past experience and personality, amongst other things. In other words, between the Stimulus (S) and Response (R) something happens within the animal which has a determining role on the observed response (see Fig.2). Methodological behaviourism provided the foundations for a new approach to the study of animal learning: the study of cognition or knowledge: "the study of the ability to acquire, organise, store, access and use information" (Gray 1991,16).

Ethologists and behaviourists thus had much in common. Indeed, by the 1960s they began to co-operate. Behaviourists started to take into account biological constraints on learning and admitted that learning was subject to evolution according to imposed environmental constraints and pressures. Meanwhile, ethologists were discovering that the behaviour of mammals in particular was much more flexible than that of the birds which they had traditionally studied, and that prior experiences, including learning, played an important role in the determination of behaviour. This 'merging' to some extent culminated in cognitive ethology, otherwise referred to as the study of cognition in animals. Cognitive ethology has undergone rapid growth over the last fifteen years and a large amount of evidence has been gathered showing that animals possess awareness and consciousness and are able to employ their cognitive skills and strategies to solve problems (eg Randle 1995).

In order to study farm animals, and in particular their welfare, another branch of ethology arose, applied ethology. Applied ethology differs from the pure ethology practised by Lorenz and Tinbergen (mainly on birds) in two ways: first, the greater use of quantitative methods, and second, the integration of information from other disciplines. Whilst pure ethologists study behaviour for its own sake, describing what behaviours a species performs and how much of each behaviour there is, applied ethologists formulate and statistically test hypotheses, studying behaviour as a means of examining why behaviours and behavioural problems and abnormalities do or do not occur.

Applied ethologists employ both descriptive and manipulative methods. Much of the early work was devoted to comparisons of farmed animals' behavioural repertoires with their natural or *wild* counterparts. Another approach was to monitor the occurrence of abnormal behaviours, such as crate chewing by veal calves. The occurrence of vices such as weaving in stabled horses and stereotypes, such as pacing in caged animals, were also examined. Their causes were determined (often boredom owing to inadequate environmental stimulation) and measures put in place to rectify them. Disrupted patterning of behaviour was also studied; for example it was found that if overcrowded, dairy cows increased the amount of time they spent chasing and jostling one another (Wierenga 1980). The manipulative approach makes use of comparisons between 'control' and 'experimental' conditions, in which differences can be related to the conditions

Figure 1. **Definitions associated with the process of Evolution**

Term	**Definition**
Evolution	A process of gradual change.
Natural Selection	The selective breeding that results from the obstacles to reproduction that are imposed by the natural environment. The driving force of evolution.
Ecological Niche	The precise environment in which the individual lives and reproduces.
Selective Pressure	An aspect of the environment in general, or more specifically the Ecological Niche, which might render some individuals 'fitter' than others.
Adaptedness	An indication of how well suited an individual is to the environmental conditions in which he/she lives.
Fitness	The ability to leave behind descendents, where a 'fit' individual leaves more than a 'less fit' individual.

Note. These definitions are derived from Lea (1984, pp5-6) and Gray (1991)

being examined, for example of two different calf rearing conditions, where a number of calves were group reared whilst the same number of calves were reared in partial isolation (Broom and Leaver 1978).

It has been suggested that psychology is an important aspect of animal welfare research. This view is particularly salient given the current interest in the animal mind. Much of the applied ethology research published in the early 1980s was devoted to animal choice in which an attempt was made to assess animals' preferences by giving them the opportunity to make choices. Another focus of applied ethology, stemming from developmental psychology, is the relative role of genetics and the environment (physical and social) in determining an animal's behaviour.

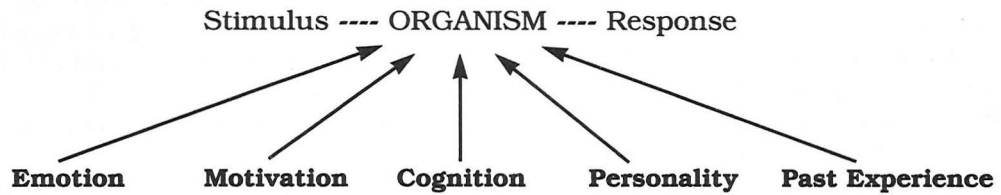
Much work has been undertaken and is underway within the branches of animal psychology described here. Some of that work has been undertaken on islands, with the control (even laboratory) conditions they provide giving the results particular significance. The majority of the research carried out on Lundy is documented in the Lundy Field Society's Annual Report. Inspection of the contents of the Report demonstrates that a large number of studies have been carried out on many species over the last fifty years. Some of these fall under the realm of pure ethology, some ecology and others, more recently, applied ethology. Almost all of Lundy's species have been studied to some extent. Some examples illustrate the range.

Island studies, Lundy studies

> *"Islands have been recognised as important 'field laboratories' for many years, the physical isolation making them ideal for research. Because of this, the results of research conducted on Lundy have an importance which extends beyond the island's immediate environs."*
>
> LFS introductory leaflet

Perhaps the single most important advantage of islands for the types of research described in this contribution, is the physical, geographical isolation they provide. Such isolation means that researchers are removed from the hurly-burly of mainland life and can commit themselves fully to the research in hand. For those, including students who are unfamiliar with the species under study, islands provide an ideal environment in which to gain familiarity and confidence. Two of the physical attributes of Lundy render it particularly suitable for carrying out research into animal behaviour. First, the small size means that, on the whole, it is relatively easy to locate the species under study. Second, and particularly for those interested in birds and marine life, there is a relatively large amount of coast per unit area. Habitats around Lundy are also varied, each coast having a different aspect and influenced by different winds. In 1925 Loyd referred to

Figure 2 **The Influence of 'Organism Variables' on Learning**



Lundy's climate as 'peculiar', with prevailing winds from the West and a sheltered East side. Lundy also boasts a range of species (see Linn, this volume). As well as the birds, there are wild mammals such as Soay sheep, goats and deer, rabbits and rats, and a number of domestic farm animal species including sheep, ponies, until recently cattle and at times different pig species. Over the years a number of species have been introduced to Lundy, with little success, including squirrels, red necked wallabies, barbary sheep, red deer, fallow deer (Bathe *et al* 1984), peafowl and swans (Langham and Langham 1984,44). Earlier, Loyd (1925, 77) attributed many of these failures to birds of prey. The only species successfully introduced to Lundy (by M. Coles Harman in the 1940s) were goats, Soay sheep and sika deer (Bathe *et al* 1984). All three species were suited to the Lundy environment and their populations expanded rapidly.

Whilst it can be argued that having populations of wild or feral animals contained on an island is an advantage, Bathe *et al* (1984) highlight a number of drawbacks associated mainly with culling policies. In 1955 there were 100 deer, 45 goats and 85 soays which were substantially reduced to 30 deer, 12 soays and 27 goats by a cull carried out in 1957 (Langham and Langham 1984, 44). Culls are generally haphazard and indiscriminate affairs and result in a population of individuals which does not have a natural population structure. However, Bathe *et al* (1984) conclude that culls can be carried out satisfactorily if proper planning and control is exercised (see Gulland 1992 for an example of good culling strategy used on the Soay sheep). As a consequence animal populations on islands can be intrinsically less stable than those on the mainland. Instability is further enhanced if the population is 'closed', that is, there are no incomers bringing new genes with them. But, so long as groups are managed appropriately, islands can provide an excellent opportunity for monitoring population changes.

One of the main problems with studying groups of wild animals is their wariness of humans. However, the presence of many visitors on Lundy renders the animals relatively used to human movement all over the island. As a result, they are fairly easy to study and with little disruption of their typical behaviour and daily patterns.

Since 1963 there have been a number of studies of the grey seal on Lundy. Hook (1963) noted how the number of individuals hauling out onto the shores of Lundy peaks in August, followed by a steep drop. Numbers then increase again sharply in November as individuals arrive from breeding groups elsewhere. Seals typically haul out on the side of the island with the least swell (Clarke 1977). A series of studies carried out by Clarke and Baillie (1973; 1974) suggest that individual seals show some loyalty to the island returning for at least two consecutive years, and furthermore that some individuals show preference for particular haul-out and pupping sites (Clarke

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1987). It has been possible to identify individuals, most frequently using small cuts and hair patterns (Clarke 1977), a project now being developed by John Heath. Clarke concluded that a core of individuals use Lundy and that there is little movement between Lundy and the mainland. Heath's work will no doubt shed more light on this.

A number of studies have been carried out to assess the behaviour and activity of the rats on Lundy. Many of these investigated whether or not rats have been responsible for the infamous decline of the puffin population (eg. Perrin and Gurnell 1971). Allen (1974) examined two aspects of the social behaviour of the feral goats on Lundy: communication and hierarchy. This work uncovered a complex of startle reactions, comprising different combinations of snorts and movements. Many aspects of the Lundy sika deer behaviour have also been studied (see Bathe and Scriven 1974), including vigilance (Boddington 1987), their ecological effect on Lundy (Boddington and Eaton 1987) and their perceptual processes (Eaton 1988).

Since 1990 a number of studies have been carried out on the farm animal species. These include an assessment of the social behaviour and personality of the North Devon cattle (Randle 1992) and the Lundy ponies (Randle 1994a) and an investigation into the ecological influences on lamb play behaviour (Randle 1993). Other unpublished work carried out on Lundy includes association and neighbour preferences in steers and Friesian heifers, suckling behaviour of single and twin lambs and a comparison of mother-young behaviour in the soay and domestic sheep. Further work might focus on how typical farming practices work on an island; practices peculiar to farming on an island (for example transporting livestock by boat) could also be examined.

Two further points should be made: First, Lundy's inhabitants have generally been supportive of such studies, as they are keen for the behaviour and ecology of 'their' species to be understood, and to integrate findings into their management. Of course, the support of organisations such as the Lundy Field Society is also invaluable. Another great attribute of Lundy is that it can accommodate field trips, and in doing so a good atmosphere is generated and individual's motivations for engaging in research increased. Second, the implications of work carried out on Lundy are not restricted to the island itself. Work carried out on Lundy often serves as pilot material leading to other research both on and off the island. For example, Stephen Lea started investigating the diving behaviour of the European shag on Lundy in 1990. This work then continued both on Cormorant on the Exe estuary and on Little and Pied shags on South Island, New Zealand (Lea *et al* in press). Another regular visitor to the island over many years is Denver Daniels, who has carried out a series of ethological studies of the Kittiwake on Lundy, which have been continued elsewhere in Europe (Daniels 1983, 1992; Daniels *et al* 1984). Research carried out on Lundy can also be used

to confirm findings of studies carried out elsewhere. For example I have used the cattle on Lundy to back up conclusions reached in research on the mainland (Randle 1994b).

Summary

The study of animal behaviour is not straightforward; rather it is multi-faceted and to be done properly must be multidisciplinary. This contribution has described the growth of ethology, the area of study devoted to animal behaviour. Applied and cognitive ethology were highlighted as currently fashionable areas of research which enable questions to be answered about animal welfare and the animal mind respectively. Examples of such work undertaken on Lundy were presented.

Lundy provides a wonderful opportunity for carrying out a wide range of research projects in a stimulating environment. This has been attributed to a number of factors, including its physical attributes, the range of wild and domestic species present, and the interest and support of the islanders, those who visit Lundy regularly, and the Lundy Field Society. However, in my view, the real attraction of Lundy is the atmosphere, whether attributable to geographical isolation or social, or a mixture of the two, which makes it a refreshing, stimulating place to engage in research of all kinds, at any level, whether plain discovery and wonderment at how a particular animal behaves, or in-depth research of international credibility.

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