VISION AND OTHER SPECIAL SENSES

Sheep have panoramic vision of 330°–360° and binocular vision of 25°–50°. They are thought to have colour vision and are able to distinguish between a variety of colours: black, red, brown, green, yellow and white (Alexander and Shillito, 1978). They have no accommodation, so must lift the head to see distant objects. This also means that they are unable to judge depth.

Sheep eyes possess very low hyperopia with little astigmatism. Such physiological optics are likely to produce a well-focused retinal image of objects in the middle and long distance (Piggins, et al., 1996).

Sight is a vital part of communication and when sheep are grazing they maintain visual contact with each other (Crofton, 1958; Kilgour, 1977). Each sheep throws its head to check the position of the other sheep. This constant monitoring is probably what keeps the sheep in a mob as they move along grazing.

Psychological stress induced by isolation is reduced if sheep are provided with a mirror, indicating that the sight of other sheep has stress-reducing properties (Parrott, 1990).

Work has been done by Franklin and Hutson (1982a,b,c) to find what stimuli attract sheep to move along a laneway. They found that olfactory stimuli were of no use as attractants and that there was no practical advantage in using sheep calls to attract sheep to move along a race. The use of a decoy sheep was effective in attracting sheep to move out of a pen and along a race, and sheep moved out of a pen faster towards a mirror that reflected the countryside, or towards open-wire mesh than towards a covered race ending.

Deprivation of the senses of smell, sight and hearing on the mating behaviour of rams indicated that the absence of sight has the most inhibitory effect on behaviour and reduced the oestrus detection activity and dexterity of mating. The loss of hearing has no marked effect on mating behaviour (Smith, 1975).

Taste is the most important sense in establishing forage preferences, with sweet and sour plants being preferred and bitter plants being more commonly rejected. Touch and sight are also important in relation to specific plant characteristics, such as succulence and growth form (Krueger, et al., 1974).

SOCIAL ORGANISATION, DOMINANCE HIERARCHIES AND LEADERSHIP

Dominance. In a flock of grazing sheep there is little or no sign of dominance. In small domestic flocks, sheep will compete for small amounts of food by pushing and shoving rather than active bunting. Dominance–subordination relationships were assessed in Merinos and Border Leicesters by Squires and Daws (1975). They found an almost linear hierarchy in Merinos and a less rigid structure in Border Leicesters when a competitive feeding situation was created.

Social groups. Sheep form strong social groups that are stable and the social organisation of the flock influences grazing patterns. Animals are not randomly dispersed in any environment and free-ranging groups may exhibit extreme non-randomness in the use of resources, particularly vegetation. Young lambs form strong social bonds with each other or other objects (e.g., goats, humans, dogs, cattle). Sometimes a strong bond forms between two animals and they become mutually dependent.

The number of dominance fights within flocks is higher in single-sex, single-age groups than in mixed-sex groups of varying ages (Stolba, et al., 1990).

The social system of sheep appears to have been shaped by anti-predator and foraging strategies that rely upon learned traditions (Festa-Bianchet, 1991).

Age-effects studies on cohesive and aggressive behaviour in sheep indicate that older animals are more likely to be involved in fights (Stolba, et al., 1990).

Family groups are less likely to display fighting and attention-seeking behaviours, indicating that a socially stable flock may be less affected by environmental heterogeneity than groups that are not as well integrated socially (Stolba, et al., 1990).

Characteristics of flock structure. Research has shown that different breeds have different flock structures (Arnold et
al., 1981):

1. Merinos are a tightly knit flock and rarely form sub-groups. They graze close to each other and disperse into sub-groups only under extreme food shortage, when sex and age groups segregate out.
2. Southdowns usually form a few sub-groups and are closely associated when grazing, but not when camping.
3. Dorset Horns always form many sub-groups.

In cases where sub-groupings occur, the flock maintains a social entity because membership of sub-groups is constantly changing. The identification of a flock structure is important to understand when managing sheep. One important aspect is that, irrespective of breed, flocks of sheep drawn from different sources do not readily integrate into a socially homogeneous group (Winfield et al., 1981). This means that if the paddock is large enough, each group will use a different area, even if the food is better in one part. This can lead to some sheep being under-nourished.

In a gregarious breed, such as Merinos, the flock moves as a unit and is unsuited to grazing in pastures that are not uniformly abundant. The net effect of such behaviours, particularly on an extensive scale, is that to increase or decrease stocking rate will not necessarily lead to improved animal production of an area. This is because the non-random spread of animals in that grazing area makes some sectors virtually psychologically unavailable to some individuals.

Sheep have a strong bias for associating with others of their own breed both when grazing and camping (Arnold, et al., 1974).

Observations in undisturbed flocks shows that group identity develops when small flocks are estab-

lished. Breed identity perception also exists within flocks composed of groups of sheep of different breeds (Arnold, et al., 1974).

Leadership. Squires and Daws (1975) found that position in a moving flock was highly correlated with social dominance, but there is no definite study to show consistent voluntary leadership by an individual sheep.

Under mixed-stocking situations, sheep do not usually associate with cattle. However, sheep will stay close to and follow cattle when forced into close association with cattle at an early age, with wethers staying nearer to cattle than ewes (Anderson, et al., 1996).

Sheltering behaviour. If shade is available in summer, sheep use it, but if it is not available they stand about in groups, shading their heads under the flanks or between the hind legs of adjacent lambs rather than lying down (Schreffler and Hohenboken, 1980). A major problem in Australia is that about 20% of winter-born lambs die from lack of shelter. An important research project has looked at ways in which Merinos can be forced to take shelter before their lambs are born. Research has shown that it may be possible to train sheep to spend resting periods in sheltered areas by shearing during the cooler months; subsequently, a high proportion may lamb in shelter, thereby reducing lamb mortality (Lynch et al., 1980).

The use of-artificial wind-breaks—either a tall, relatively unpalatable hybrid phalaris or polythene shade cloth, provided protection from wind and reduced the death rate of single lambs from 35.5% without shelter to 8.8% with shelter, when the temperature was less than 5° during the 6 hours after birth (Alexander et al., 1980).

The selection of sites for shelters is important so the behaviour of the sheep must be considered and the shelters placed where the sheep naturally prefer. Sheep tend to graze into the wind on treeless plains, in hot weather, but on cold wet days they huddle in the downwind corner of the paddock, so shelters can be put there. They also tend to camp on hilltops in cold weather, so shelters could be placed on ridge tops. Least-used shelters are typically near roads, human activity and paddock ends (Pollard, et al., 1999).

Under most conditions, sheep tend to spend more of their time closer to trees than would be expected by chance. This effect is intensified in paddocks with trees planted at low density (Sibbald, et al., 1996).

Camping behaviour. Certain breeds of sheep have definite 'bedding habits', known as camping. Choice of campsite is important and often the sites chosen for day camps differ from night camps. Sheep have clearly defined tracks leading from the water points to day campsites (Squires, 1981). Merinos camp on high ground during cold weather and near water or under shade during hot weather. In adjacent small pastures, camping is along the common boundary or adjacent corners. Because sheep camp, a large proportion of faeces is dropped at the campsite and so plant nutrients are transferred from the pasture to the campsite. The distribution of plants is also influenced and there can be a build-up of internal parasite eggs at the campsite. In the management of pastures it may be necessary to fence off campsites at times and force the sheep to move to other areas.

Grazing. Grazing is a social behaviour like sheltering and camping. Sheep tend to have two primary grazing periods, during the early morning and again late in the afternoon. The period from mid-morning to mid-afternoon is the least active. Grazing time, which may range from about 5½–10 hours a day, is affected by many factors, including day length and other environmental factors, breed, availability of pasture and water, and topography.

The grazing patterns adopted by sheep in small experimental paddocks are likely to be affected by daylength, lack of grass, and rate of loss of liveweight (Lynch, et al., 1979).

The satiety mechanism is of much greater importance in sheep than the hunger mechanism in stimulating grazing (Forbes, 1978).

Sheep have a cleft upper lip that permits very close grazing, lower incisor teeth and upper dental pad. As the animal grazes, it jerks its head slightly forward and up to break stems, leaves and grass blades against the dental pad and lower incisors.

The intake of herbage by grazing sheep is influenced by the age, size, weight and physiological state of the animal, climatic conditions and the availability and quality of herbage on offer. Little is known, however, about the interactions between body condition, cold stress and pasture availablity on the intake of grazing sheep (Arnold, 1970).

Sheep grazing and efficiency is affected by paddock shape. Ewes grazing in retangular paddocks grazed for less time, had lower intake levels and used forage less efficiently than ewes in square paddocks (Sevi, et al., 2001).

SEXUAL BEHAVIOUR

In a pen environment it has been shown that no relationship exists between dominance and mating behaviour (Schreffler and Hohenboken, 1974). In open environments there are conflicting results and although the dominant ram can prevent others from mating, it did not necessarily have the highest scores for percentage of ewes mated, number of mounts per oestrous ewe, or total number of mounts. Also, competition of ewes for a ram may have an effect, although there is no evidence (Squires, 1981).

Exposure to recently mated rams increases the sexual performance of other rams. Odour cues associated with the ewe or mating ***per se*** is thought to enhance the sexual efficiency of unmated rams (Maina, et al., 1997).

The odour of the oestrous ewe stimulates the ram, although it is the ewe who seeks out the ram and stays close beside it. The male responds to urination of the oestrous female by sniffing, extending the neck and curling the lip. This is the flehmen response. The tongue goes in and out and the male may bite the female's wool, and raise and lower one front leg in a stiff-legged striking motion. If the female is receptive she will stand for copulation.

In sheep, the duration of sexual receptivity in the presence of the ram is reduced when the ram is contin-

uously present with the ewes (Romano, et al., 2001).

The continuous presence of a ram after the removal of progesterone sponges hastens oestrus onset and reduces the interval between sponge removal and ovulation, without modifying oestrus duration and time between oestrus onset and ovulation in ewes synchronised during the breeding season (Romano, et al., 2001).

Ewes in oestrus will often display ram-seeking behaviour, defined as a ewe being persistent in staying at the common fence with attention focused on the ram to the virtual exclusion of grazing (Ortman, 2000).

Mating efficiency may drop if food is short and ewes disperse into small sub-groups. In this situation the rams may not be able to find them at the usual ratio of 4 rams per 100 ewes. This is one reason that understanding flock behaviour under various environmental conditions is so important.

There are several advantages to using wethers, which include low cost and convenience of treatment compared to the cost of vasectomy of the ram, and the use of wethers to identify ewes for artificial insemination or in the post-mating period to detect non-pregnant ewes.

The use of wethers (castrated male sheep) treated with oestrogen or testosterone has been shown to be as good as vasectomised rams for inducing ewes to ovulate and for detection of ewes in oestrus (Fulkerson et al., 1981).

MATERNAL–OFFSPRING BEHAVIOUR

Some ewes remain with the flock during lambing and others seek isolation. Within seconds of birth the ewe faces the lamb and begins vigorous licking and eating of foetal membranes. The young must find the teat within 1–2 hours of birth, and it seems that visual cues are very important for successful teat location (Bareham, 1975). Strange lambs are accepted immediately after birth and some ewes adopt new-born lambs if they have lost one. Adoptions in sheep flocks are more common than is generally realised and has some consequences in genetic experiments where lambs are identified with their mothers many hours or even days after birth. From about 12 hours after birth, a strange lamb is actively rejected.

Add-on fostering is limited only by the inability to properly match odour-familiar cues on a ewe's own and alien lambs (Price, et al., 1998).

Lambs recognise their mothers' voices by individual differences (Shillito-Walser, 1980) and ewes recognise their lambs by a variety of cues. These cues may be vocal recognition (Shillito-Walser et al., 1981). Other workers (Morgan, et al., 1975) suggested that recognition depended mainly on smell, while other studies (Alexander and Stevens, 1981) showed that ewes could recognise their lambs from auditory and visual cues alone, but that the correct olfactory cues are required for suckling to be permitted. These cues may be of differing importance depending on the breed of sheep, size of groups, and the environment they are running in.

Litter size has a strong effect on the time spent grooming by the ewe. The birth of the second-born twin results in a dramatic reduction in grooming of the first-born twin (O'Connor, et al., 1989).

Analysis of lamb behaviour found that singles were more active, lying for less time and having a greater number of suckling attempts than twins (O'Connor, et al., 1989).

Offspring behaviour has no effect on the onset of bonding behaviours of the ewe, and neonatal lamb activity is largely independent of the behaviour of the dam (Dwyer, et al., 1999).

Suckling behaviour is modified by ewe behaviour and this affects the strength of the bond between ewe and lamb (Dwyer, et al., 1999).

The sheep is a follower species and in the first day of life the ewe remains within one metre of the lamb, so the placement of water, food and shelter is important. The distance between ewe and lamb when both are grazing increases rapidly over the next 10 days of life, reaching a plateau with an average distance of 20 metres. Accidental separation in the first few days causes great agitation of both lamb and ewe, and reunion is immediately followed by suckling.

In the first 24 hours after birth, lambs identify their mothers at close quarters only (less than 50 cm), and discrimination at a distance of several metres becomes established only when the lambs are between 2 and 3 days old (Nowack, 1991). This helps to account for the prevalence of cross-suckling and mismothering in the early days of life.

Suckling has strong rewarding properties in the establishment of a peferential relationship with the mother by the lamb but the maintenance of this preference does not rely strongly on suckling (Nowack, et al., 1997).

The strength of the ewe–lamb bond is determined mainly by milk yield with a threshold level below which weaning occurs (Arnold et al., 1979).

Lambs become familiar with and recognise individuals (twins and non-twins) as a result of direct association. They also discriminate between novel scents and artificial odorants associated with their familiar agemates, but such odors neither mask nor substitute effectively for lambs' individually recognisable phenotypes (Porter, et al., 200I).

The management of the maternal-offspring bond is important in the husbandry of lambing ewes. The main objectives are:

1. To produce lambs capable of finding teats and suckling successfully;
2. To produce ewes whose behaviour facilitates suckling.

Some circumstances delay suckling which will reduce the chances of successful suckling. These include:

1. mother remains lying after birth;
2. mother circles;
3. mother is absent—she may be attending to one twin at the expense of the other; and
4. the weather may be too hot or too cold.

The sheep producer can help to ensure that suckling is successful in several ways:

1. environmental control such as positioning of shade, shelter, food and water;

2. supervision of lambing; and
3. selection of suitable breeds who make good mothers.

ABNORMAL BEHAVIOUR

The most important abnormal behaviour is concerned with maternal behaviour. Sometimes a ewe may wander away from her lamb, butt the lamb or move away as the lamb approaches to suckle. These behaviours are more common in ewes with twins, who seem unable to recognise that they have more than one lamb.

Aggressive behaviours are preferentially directed towards members of the same flock (Ruiz-d-la-Torre, et al., 1999).

A small percentage of rams commonly will not mate with oestrous females and, if given a choice, will display courtship behaviour towards another ram in preference to a female. This partner-preference behaviour of rams may be traceable to foetal development and could represent a phenomenon of sexual differentiation (Resko, et al., 1998).

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