9.1 Origins

Many avian species have been domesticated for use by humans (Appleby et al., 2004), including ground-dwelling fowl (chickens, turkeys, guinea fowl, quail and pheasants), waterfowl (ducks and geese), the flightless ratites (ostrich, emu and rhea) and pigeons. Chickens (*Gallus gallus domesticus*), ducks (and especially Pekin ducks, *Anas platyrhynchos*) and turkeys (*Meleagris gallopavo*) are the most commonly used species worldwide, with an estimated 56 billion chickens, 2.7 billion ducks and 650 million turkeys raised commercially for meat or eggs annually.

Chickens were derived from the red junglefowl, *Gallus gallus*, modern forms of which are found in India, Burma (Myanmar), Malaysia, Thailand and Cambodia. Junglefowl were domesticated over 8000 years ago in South-east Asia, and were then taken by humans north into China, and from there to Europe. Domestic fowl were established in many European countries by 100 BCE (before the Common, i.e., Christian, Era, or BC), and were brought to the Americas around 1500 CE (Common Era, or AD). During the initial stages of domestication the fowl was probably valued mainly as a sacrificial or religious bird, or for cockfighting. However, the Romans created specialized breeds, including highly productive egg layers, and formed a complex poultry industry. This industry collapsed with the fall of the Roman Empire, and did not resume on a large scale until the 19th century, when there was an emphasis on breeding fowl for both ornamental and production traits.

Modern breeds are derived mainly from the two types of fowl developed during this period, Asiatic and Mediterranean. These were then hybridized in the 20th century for commercial use to create egg-laying and meat strains, referred to as laying hens and broiler chickens, respectively. Laying strains have been intensely selected for traits such as early onset of egg laying, a high rate of egg production, egg quality characteristics (shell strength, egg size) and food conversion efficiency. Broiler chickens have similarly been selected for food conversion efficiency but, in addition, intense selection pressure has been applied for rapid growth, a high ratio of white to dark meat (larger breast size) and meat yield, resulting in a chicken that reaches full adult body size in only 6 weeks, as compared with 17 weeks for an egg-laying chicken.

Turkeys are native to the Americas, and wild populations are still widespread throughout North and Central America. They were domesticated about 2000 years ago in Mexico. The early Spanish explorers brought turkeys back to Spain, and they were quickly distributed throughout Europe. The domesticated form of the turkey was then taken to North America by the European settlers in the 17th century. Breeding originally focused on plumage characteristics for show purposes. By the 20th century, however, selection programmes had begun to focus on meat production and, as a consequence, turkeys have been selected for many of the same traits as broiler chickens. In addition, there was selection against the dark plumage of the wild
turkey in order to remove the hormone melanin from the feather follicles, which improved the appearance of the carcass.

The Pekin duck was derived from the mallard, a species widely distributed throughout North America and Eurasia. Mallards were probably domesticated in Asia about 4000 years ago, and were farmed by the Romans for meat. The mallard has given rise to a large number of domesticated breeds of ducks, including breeds that have a high rate of egg laying. However, the most common breed is the Pekin from China, which is used for meat and feather (down) production. Like broilers and turkeys, commercial Pekin ducks have been selected for rapid growth and good feed conversion.

Other, less common, avian species domesticated for food production include the Muscovy duck (*Cairina moschata*), geese (*Anser anser*), guinea fowl (*Numida meleagris*), pigeons (*Columba livia*) and pheasants (*Phasianus colchicus*). The Muscovy is a forest duck native to South and Central America; its date of domestication is uncertain, although it was certainly domesticated by the 15th century. Muscovy are used for meat, and are also hybridized with Pekin to produce moulard ducks, which are used for the production of foie gras (fat livers). Geese have probably been domesticated several times, but most domestic forms are derived from the greylag goose, found in China and South-east Asia. They are produced for meat, feathers and foie gras. Guinea fowl were domesticated about 5000 years ago in Africa and are produced commercially there for meat and eggs. Pheasants are native to Central Asia, and were probably distributed across Europe as semi-domesticated birds by the Romans. They have only recently begun to be kept in close confinement and bred for meat production.

The most recently domesticated species are the Japanese and bobwhite quail (*Colinus sp.*), from Japan and North America, respectively, and the ratti species (ostrich, emu and rhea) from Africa and Australia. The ostrich (*Struthio camelus*) is the most widely used of the rattis. These are all multi-purpose species, used for both meat and eggs and sometimes for feathers. All have undergone domestication during the last hundred years.

Around the world, many of these species are raised on a limited scale for local consumption. Under these conditions they would often be kept outdoors in small flocks, sometimes with indoor shelter provided for inclement weather. For large-scale commercial production, however, all except the largest or less domesticated species (like rattiis and pheasants) are typically housed indoors to provide better environmental control, to allow automation of feeding, watering, egg collection and manure disposal, and for the purpose of disease prevention.

There are two basic types of commercial housing: floor systems and cages (see Fig. 9.1). Cages are the primary type of commercial housing used worldwide for mature egg-laying hens and quail. Meat-type birds (broilers, turkeys, ducks) and breeding flocks are typically housed in floor systems, with the birds being housed on flooring made of wire, slats, litter (e.g. wood shavings) or some combination of these. Because of concerns about the restriction of natural behaviour in some developed countries, however, an increasing number of caged egg-laying hens are being housed in so-called furnished cages, which contain perches, nest boxes and dust baths, in floor systems or even outdoors in free-range systems. A more detailed review of the different kinds of housing systems in commercial use for poultry can be found in Appleby et al. (2004).

![Fig. 9.1. The conventional (battery) cage is the most common system worldwide for housing hens (a), although newer designs of cages (furnished cages) containing nest boxes, perches and dust baths, are becoming increasingly common in some European countries, as are free-range (b) production systems. Meat-type birds like ducks (c), turkeys and broiler chickens are usually housed in floor systems containing thousands of tens of thousands of birds; some laying hens are also kept in such systems (image of ducks courtesy of Mike Turk).](image)

This chapter will focus mainly on the behaviour of chickens, turkeys and ducks, not only because they are the most commonly used species, but because their behaviour has been best studied. However, as discussed in Chapter 2, many domesticated species share behavioural traits that rendered them suitable for domestication, so many of the topics covered in this chapter will apply also to other domesticated birds.

9.2 Social Behaviour

All poultry species are highly social, although their wild ancestors show different forms of social organization (Mench and Keeling, 2001). Some live in small relatively stable groups. Junglefowl, for example, typically live in groups comprising one male and several females, with other males being solitary or living in small, all-male groups. Turkeys may also live in mixed-sex groups during the breeding season, but the rest of the year most commonly stay in all-male or all-female groups. Outranches also live in stable groups comprised of family members of different ages and sexes, except during the breeding season when they form breeding pairs or trios with two females and one male. The social groups of quail, ducks and geese are less stable in that group composition changes after the breeding season, or after migration to breeding and feeding grounds.

Behaviour of Fowl and Other Domesticated Birds
As in all social species, there is extensive communication among group members. Poultry species have excellent colour vision and acute hearing, and communication occurs via visual and vocal signals. Postures and displays are used to signal threats and social submission, and particularly elaborate displays are given during courtship (see below). Features of the head and neck are particularly important in some species for social recognition and communication. In chickens, comb size and colour are affected by sex hormone levels and are indicators of social status. Turkeys have a pale featherless neck area that changes colour to red and blue during social interactions, and the fleshy, pendant snood of male turkeys becomes engorged and enlarged during aggression and courtship.

Most poultry species also have an extensive vocal repertoire — the exceptions are ostriches and Muscovy ducks, which rarely vocalize. Calls can serve a variety of functions, including warning about approaching predators, decreasing the distance between flock-mates (contact calls), signalling threat or submission, or attracting offspring or other flock members to food. The most striking vocalizations are the ones that males make during territorial defence — the 'crows' of roosters and Japanese quail, the 'booms' of ostriches and the 'whistle' of bobwhites. These calls carry long distances and thus are an effective way for a male to defend a territory without having directly to confront the males on neighbouring territories.

Calls can also be used to signal social dominance. The crow of roosters is individually distinctive, and roosters use the quality and rate of crowing to assess the dominance status of other roosters. Social dominance hierarchies (peck orders) are a common feature of social organization in poultry. As the name implies, these orders are formed and maintained by aggressive pecking directed towards the head region of more subordinate birds, which, in turn, show submissive behaviour (see Fig. 9.2). In mixed-sex flocks, males and females generally develop separate dominance hierarchies and rarely show aggression towards one another. In established flocks, aggressive and submissive behaviours are usually subtle and difficult to observe, although sometimes there can be chasing, pecking and even fighting, particularly among males.

Despite periodic aggressive interactions, even when poultry are kept in large areas where they could avoid one another they tend to cluster together. The tendency to form groups rather than live independently evolved primarily for protection against predators. Even in the absence of predators, however, poultry often move together as a flock. They also tend to synchronize their behaviours, either because of circadian effects (see below) or due to social facilitation, with birds 'copying' one another's behaviour. Observing and copying other birds may allow a bird to exploit new resources (e.g. new food types or sources) or learn new behaviours — for example, chickens that have an opportunity to observe a trained hen peck a key to obtain food learn this task much more quickly than chickens that do not have this experience (Johnson et al., 1986).

In commercial conditions poultry may be kept in extremely large flocks containing thousands or even tens of thousands of birds (see Fig. 9.1), or in small groups but under crowded conditions where the birds cannot easily avoid one another (like cages). Except for breeding flocks, birds are also typically kept commercially in single-age, single-sex flocks instead of in the mixed-age and -sex flocks that would be the norm in the wild. As true of many domesticated animals, poultry are relatively tolerant of these variations in social groupings. However, social behaviour problems can arise in commercial settings (Mench and Keeling, 2001). Turkeys, for example, can be particularly aggressive towards one another in commercial flocks, sometimes pecking each other so severely that the head wounds result in death (Sherwin and Kelland, 1998). They are therefore usually kept in dim lighting to reduce pecking behaviour.

Social problems are sometimes seen also in female flocks. Subordinate laying hens may be pecked continuously by other birds — they have heads and combs scarred from pecking, poor body condition and spend much of their time trying to avoid other birds. This problem is particularly noticeable in moderate-sized groups, since in small groups the hens know one another and have a stable dominance hierarchy, whereas in large groups they seem to develop non-aggressive social strategies for establishing dominance. Even in the small groups typical of cages, however, more dominant hens may sometimes prevent subordinate hens from accessing the feeder to such an extent that the subordinate hens lose body condition and stop producing eggs (Cunningham and van Tienhoven, 1983). In cage systems, housing roosters with the hens can help to decrease problems with bullying of subordinates (Odén et al., 2000), since roosters suppress aggression amongst hens.

The most problematic social behaviours seen in commercial flocks are feather-pecking and cannibalism (Appleby et al., 2004). These are abnormal behaviours, and are more common in large than small flocks. Feather-pecking is the pecking and pulling of feathers from another hen. Unlike aggressive pecks, which are directed towards the head, feather pecks are directed towards body regions like the areas near the vent and preen gland, and the wings, back and tail. The pecking movements involved resemble feeding pecks rather than aggressive pecks, and there is evidence that feather-pecking is redirected foraging behaviour and can be reduced by providing foraging materials. For the recipient, having feathers pulled out is painful, and birds with large areas of exposed skin have more difficulty regulating their body temperature.

Cannibalism, which involves the pecking and tearing of the skin and underlying tissues of another bird, is an even more serious problem and one that can result in extremely high mortality in flocks. Cannibalism sometimes follows from feather-pecking, but can also arise independently. One situation in which it starts is when a hen has just laid an egg and her cloaca is still partly everted. Other hens are attracted to peck at this area, especially if the skin becomes broken and bleeds, leading to further pecking and consumption of the flesh.

Despite a great deal of research, the exact causes of feather-pecking and cannibalism are still not completely understood. The extent of these problems can vary enormously from one flock to another even when the management of the flock is very similar, and flocks do not necessarily experience both problems at the same time. Factors affecting the incidence of both types of behaviours include stocking density,
9.3 Foraging, Feeding and Drinking

Under natural conditions, poultry and their wild ancestors have a varied diet. All species feed on plants and, depending upon the species, may consume grasses, shrubs, roots, leaves and berries. They may also eat invertebrates and some species even eat small vertebrates like lizards and mice.

Foraging for food is a very important part of the natural behaviour of poultry – for example, under semi-natural conditions fowl devote a large proportion of their day to foraging activities. Components of foraging behaviour include ground pecking, ground scratching and grazing. Ducks also filter edible items out of the water by dabbling, using their bills.

Under commercial conditions, concentrated feed is provided in troughs and is usually readily available throughout the day. However, poultry still spend considerable time foraging if an appropriate foraging substrate, like loose litter, is provided. This indicates that they are motivated to forage even in the absence of a need to do so.

In housing environments without a foraging substrate, such as conventional cages, birds do not have access to such material and may instead spend a substantial portion of time manipulating the food in the feed trough by flicking it back and forth using movements of the beak. This can lead to the food being tossed out of the trough and wasted, which is an economic issue for egg producers. Methods used for reducing feed wastage include beak trimming (discussed above), which removes the hook from the beak and thus prevents food from being caught under the hook and flicked, and altering the feeder to prevent the birds from performing foraging movements – whether this results in frustration, however, is unknown.

There has been a considerable amount of research on food selection by chickens (Appleby et al., 2004). Chickens have a well-developed sense of taste, and reject potential food items that are acidic, bitter or extremely salty. Visual and tactile cues are also important – both chicks and adults preferentially peck at items of particular colours and have a preference for pecking at and ingesting small, rounded particles.

These preferences are, however, affected by their experience with particular food types, and may also vary depending upon the birds’ nutritional status. Under natural conditions, wild birds are faced with an array of food items that differ in nutritional quality, from which they must select a diet to meet their nutritional needs. Domestic birds show a similar ability to select a nutritionally adequate diet when given a choice of different feedstuffs, and will adjust their intake of protein, energy, minerals and vitamins (Hughes, 1984). Poultry do, however, develop a preference for the food to which they are accustomed, and become reluctant to consume new foods that differ in colour, taste or texture from their typical food (fixed neophobia). A major change in diet can thus cause them to reduce their feed intake, and consequently result in a reduction in growth or egg production.

Social factors have an important influence on feeding behaviour. Poultry show a propensity to feed as a group – that is, to feed synchronously – and feeding behaviour can be triggered by the sight or sound of other birds feeding. Individually caged hens will even synchronize their feeding behaviour with that of the hens in the neighbouring cages. If insufficient feeder space is provided for all birds to feed simultaneously, they may need to desynchronize their behaviour in order for all birds to consume enough feed.

Boats of feeding are alternated with brief boats of drinking. Chicks are attracted to pecking at shiny items, which in a natural setting would probably result in them finding, pecking at and ingesting water. Poultry drink by scooping up water in their beaks or bills, and then raising their heads so that the water runs down the oesophagus (see Fig. 9.3). In commercial settings poultry may be offered water in trough or bell-type drinkers or cups, which allows them to perform this natural drinking motion. However, to prevent water spillage, which can lead to the litter and manure becoming wet, it is now more common for birds to be given nipple drinkers instead of troughs or cups. Nipple drinkers require the birds to drink in an unnatural way.
although they can learn to do so and in fact develop various strategies for activating the nipple and consuming water. Poultry do become accustomed to using particular drinker types and may have difficulty drinking if they are moved to a house where there is a novel type of drinker – in this case, they may have to be shown where the drinkers are located, or be taught to activate them.

9.4 Body Maintenance

It is important for birds to keep their feathers clean and in good condition. The feathers provide a covering and insulating layer that helps to maintain body temperature and prevent injury to the skin. Birds perform two primary behaviours to maintain plumage condition: preening and dust or water bathing. During a preening bout, the bird uses its beak and face to distribute oil from a gland at the base of the tail, the uropygial gland, through its feathers (see Fig. 9.4a). The beak is also used at this time to align the barbs of the feathers, and to dislodge external parasites like mites and ticks.

Water bathing by ducks, and dust bathing by other poultry species, serves to remove dirt and excess oil from the feathers and improves feather structure. Dust bathing has been studied more than water bathing. A dust bathing bout begins with the bird lying down and pulling loose substrate close to its body (see Fig. 9.4b). The bird then rolls itself on the substrate and shakes its wings and body to toss the material on to its back and work it through the feathers. The dust bath ends with the bird standing up and shaking its body to remove the excess loose material and to realign its feathers. Fine materials such as sand or peat are preferred for dust bathing, probably because they are superior at penetrating the feathers to reach the downy portions.

To fully perform dust or water bathing birds must be provided with either loose material or water that is deep enough for them to immerse themselves. However, waterfowl raised commercially are rarely given bathing water due to cleanliness and disease problems, and poultry housed in cages are generally not provided with loose material. This is a welfare concern and has led to a great deal of research on the motivational aspects of dust bathing behaviour. Laying hens housed in cages without litter material will carry out dust bathing movements on the wire floor of their cages.

Fig. 9.4. Ground-dwelling poultry maintain their feathers in good condition by preening to distribute oil through their feathers (a), and by dust bathing to work loose material through their feathers, which removes any excess oil (b) (image of preening courtesy of Cleide Falcone, and of dust bathing, Anna Lundberg).

so-called 'sham' dust bathing, although it is unclear whether this behaviour actually satisfies their motivation to dust bathe.

9.5 Diurnal Rhythm

Most behaviours in poultry do not occur at random, but instead show distinct daily rhythms. All poultry species are diurnal, and hence sleep at night and are active during the daylight hours. The behaviours that show the strongest rhythms are those related to feeding, egg laying, mating, grooming and sleeping. Feeding behaviour occurs in bouts, or meals, with most bouts occurring in the first few hours after the lights go on (or dawn, when there is natural lighting), and then again late in the day before the lights go off (or dusk, when there is natural lighting). Because poultry do not typically feed at night, the morning feeding peak allows them to refill their food storage organ (the crop), which has become depleted overnight. The crop is then filled again for the night during the feeding peak late in the day. In laying hens, this late afternoon feeding peak also correlates roughly with the start of eggshell calcification, at which time there is an increase in the hen's calcium requirements.

Egg laying in many poultry species occurs at about the time the lights go on. This is approximately 24 h after ovulation, and reflects the period of time required for the egg to form as it moves through the oviduct. This means that the pre-laying behaviours associated with selecting a nest site and building a nest also show a strong diurnal rhythm, since they occur shortly before the egg is laid. The daily cycle of mating in breeding birds is also related to the egg-laying cycle, because the hen's fertility is lower around the time of oviposition. Mating is therefore most frequent in fowl in the afternoon because their eggs are laid in the morning, and most frequent in quail in the morning and evening because they lay their eggs in the afternoon.

Like feeding, preening behaviour occurs primarily in the morning and late afternoon. However, dust bathing behaviour takes place early in the afternoon. On average, fowl dust bathe for about 30 min every 2–3 days (Vestergaard, 1982). The strongly diurnal rhythm of this behaviour can be used to commercial advantage – to prevent hens from laying their eggs in the dust bath, which makes the eggs difficult to collect, dust bathing material can be provided only in the afternoons, after the peak of egg laying.

Although periods of rest may occur throughout the day, most resting and sleeping occurs at night. During periods of deep sleep poultry rack their heads under their wings, although they may also doze with their heads upright on the ground and their eyes closed or partially open. The smaller poultry species are very vulnerable to ground and aerial predators when asleep, so they prefer to roost in areas that offer some protection, for example on the water (waterfowl), in dense cover (quail) or on elevated roosting areas (chickens and turkeys). Roosting is a highly motivated behaviour – hens will push through a weighted door to gain access to a perch at night (Olsson and Keeling, 2002), and 100% of hens in commercial houses will perch on elevated perches at night if they are given the opportunity to do so.

A number of factors can affect the diurnal rhythm of behaviour (Appleye et al., 2004). For example, feeding rhythms are affected by the form and density of the diet, because these influence how long it takes the bird to consume an adequate meal. They are also affected by genetics, with birds selected for a high rate of feed intake and
weight gain, like broilers and turkeys, more likely to eat throughout the day and even at night. Egg-laying can be delayed by factors such as human disturbance or social interference from other birds (for example, a dominant hen preventing a subordinate hen from entering a nest box) – in this case, laying may not be accompanied by prelaying behaviour and the egg may just be laid while the hen is performing other activities during the day.

The most important factor affecting all diurnal rhythms, however, is the light cycle. Poultry have photoreceptors not only in their eyes but also in the pineal gland in their brain, and thus are very sensitive to light stimulation. Light acts as a ‘timekeeper’ (a zeitgeber), controlling the circadian rhythms of behaviour. The commercial poultry industry raises birds under many different kinds of light cycles. Some of these provide only very brief periods of either light or darkness, or levels of illumination that are so low that there is no distinct light/dark cycle. Broiler chickens and turkeys, for example, are often kept in very dim lighting to decrease activity and hence promote more rapid growth. This can lead to a marked change in their diurnal rhythms of behaviour. Figure 9.5 shows the patterns of foraging and preening behaviour in broiler chickens given 16 h of light and 8 h of darkness per day, but kept in either dim (5 lux) or brighter (50 lux) lighting during the light period. The broilers kept in dim lighting show a much less distinct rhythm of behaviour, and tend to distribute their foraging and preening behaviour more evenly throughout the day and night.

9.6 Sexual Behaviour

The ancestors of poultry species show a variety of different types of mating systems, ranging from promiscuity (polyandry, polygyny or both) to monogamous pair bonds that last for one or more seasons (Mench and Koelling, 2001). Individual males may set up territories to which females are attracted during the breeding season, or instead may associate with a harem of females year-round. Alternatively, males and females may congregate during the breeding season at special breeding grounds, called leks, where the females select the males with which they will mate.

Fowl have a harem polygynous mating system, with a dominant male maintaining a territory and mating with the females that live in his territory. Turkeys may also form harems under some circumstances, but usually mate in leks. Related male turkeys occupy a breeding site on the lek and attract females to their group by displaying the dominant male turkey at a particular site usually secures most of the matings during the height of the breeding season. Bobwhite quail form mating pairs during the spring and are usually monogamous during a particular breeding season. Ducks and Japanese quail are more variable in their behaviour; they sometimes form monogamous pair bonds, but also may mate promiscuously. Wild geese form long-term pair bonds in the wild, but the domesticated forms often mate promiscuously. The mating behaviour of raptors is particularly complex – they show both polygyny and polyandry during the breeding season, but also form short-term pair bonds.

Even in apparently promiscuous mating systems, birds (and particularly female birds) do not mate randomly but are selective about their choice of mates. Mate selection has been best studied in jumblefowl. Female jumblefowl use a variety of physical characteristics to assess the suitability of an unfamiliar mate – including comb colour, eye colour, spur length and comb size. Comb size is one of the most important cues and, since males that are less healthy have smaller combs, this may be one method females have for assessing the male’s fitness (Zuk et al., 1990). If the hen is familiar with the male, his dominance status and courtship behaviour are more important selection factors than his physical features.

Once potential mates are selected, courtship consists of a chain of stimulus-response patterns between the male and the female (see Fig. 9.6). The male usually is the obvious initiator of the sequence, but females do encourage courtship by approaching males or, in the case of female ostriches, engaging in displays. Male courtship displays are often very elaborate, involving noises, vocalizations, conspicuous
In commercial systems, mating patterns may change because of the ways in which the birds are managed (Appleby et al., 2004). Poultry are typically allowed to mate naturally, but are often kept in large groups. Under these circumstances, factors such as social dominance are much less likely to affect mate selection, since the birds probably cannot easily recognize one another. The ratio of males to females in commercial settings is designed to encourage promiscuous mating to ensure the maximum fertilization of eggs. In such settings both males and females may mate a number of times during the day even though such frequent mating is not necessary to produce fertilized eggs, since hens can store viable sperm in a specialized gland for days to weeks.

The exception to natural mating under commercial conditions is in turkeys, which have been selected for such large breast size that the males can no longer get close enough to the females to copulate. For this reason, turkey hens are artificially inseminated with semen collected from the toms in the flock.

9.7 Egg Laying, Incubation and Behaviour at Hatching

The behaviour associated with egg laying is expressed relatively inflexibly, probably because it is under genetic and physiological control. In fowl, pre-laying behaviour is triggered by the release of oestrogen and progesterone from the follicle after it is ovulated. Once it is triggered, the hen is very strongly motivated to find an appropriate nest site in which to lay her egg. A hen examines different potential sites, selects one and then commences to make a rudimentary nest by using her feet and rotating her body to create a hollow. During this time the egg has continued to develop as it moves down the oviduct, and it is laid after nesting behaviour is complete. The entire sequence, from nest searching to oviposition, takes about 1–2 h. The searching phase of the sequence may be extended when hens do not have access to a suitable nesting site, as in conventional cages.

Eggs laid outside the nest can be a significant problem in commercial production, since such eggs are difficult to collect and can become cracked and dirty, affecting their hatchability and economic value. So-called floor laying is variable both within and between systems, but there is increasing understanding of the factors that affect this problem (Appleby et al., 2004). Nest box design is important to hens. They tend to prefer dark, secluded areas as they would in the wild, as these areas are better protected from predators, although their preference is affected by early experience.

However, nest box design probably plays more of a role in determining which box a hen selects to lay her eggs in, rather than whether she lays them in a nest box or on the floor. What may be more important to the latter is how accessible the nest boxes are – most nest boxes in commercial houses are above ground level, and hens reared with no experience of perching may not be able to reach them easily and hence, instead, lay their eggs on the floor (Appleby et al., 1986).

Under natural circumstances, once a clutch of eggs is laid the parents sit on the eggs nearly continuously to keep them warm until they hatch. In chickens and turkeys the female alone incubates the eggs, but in other species (pigeons, ostriches and bob-white quail) both parents participate in incubation, while in some species (e.g. rheas) only the male incubates the eggs. Incubation behaviour in females is triggered by release of the hormone prolactin, which also causes the cessation of egg laying. However, genetically selecting commercial hens to produce a large number of eggs

Fig. 9.6. Mating behaviour involves an often elaborated sequence of behaviours between the mate and female. When males, like this tom (left), display by posturing, spreading their tail and showing neck and colour changes, the female (right) may avoid the male or crouch to indicate that she is receptive. If she crouches, the turkeys then engage in a copulatory sequence that ends with the tom inseminating the hen (from Hale et al., 1989).

Postures and spreading the feathers or wings to make the body look larger. Males sometimes also show colour changes or enlargement of certain body parts, such as the snood of male turkeys. The female signals her receptiveness to mating by crouching and everting her cloaca, which allows the male to mount her and mate.

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has also inadvertently resulted in selection against incubation behaviour. Therefore, most commercial strains of hens simply leave the nest after oviposition, and the pre-laying and laying cycle then begins again the next time an egg is to be laid.

Social interactions between parents and offspring occur in birds even before hatching (Rogers, 1995). Calls made by the developing embryos stimulate the incubating parent to turn the eggs or to return to the nest to resume incubation. Embryos also respond to the calls and behaviour of the parent with calls that further influence the parent's behaviour. Since the incubation of eggs is automated in commercial poultry production, these parent-offspring interactions are absent. However, the embryos also vocalize to one another, which causes the development of the less advanced embryos to accelerate and thus ensures that all of the eggs hatch at around the same time.

All domestic poultry except pigeons are precocial when they hatch, which means that their eyes are open, they are covered with down, they are mobile and they require little parental care. Under natural conditions, however, chicks and ducklings would stay close to one or both of their parents for several weeks after hatching. This closeness is maintained through a process called imprinting. Imprinting is a special form of learning that occurs during a sensitive period shortly after hatching, where the newly hatched bird instinctively follows the first moving objects it sees and thus learns the characteristics of its parent. In the absence of a parent or other adult bird, as is the case in commercial poultry production where typically only birds of the same age are housed together, chicks can imprint on other chicks, humans or even objects.

### 9.8 Care of Offspring

During the first few weeks after hatching chicks, ducklings and pouls are not able to maintain their body temperature well. The hen (or in the case of ratites both the female and the male) therefore 'broods' them to keep them warm by covering them with her body and wings. Although precocial young otherwise require little parental care, the parents do play a role in protecting young chicks from danger and teaching them about various aspects of the environment. The mother hen helps chicks to learn how to go up to roost on branches at night. Domestic fowl chicks and turkey pouls are attracted to edible foods (and steered away from inedible or toxic foods) by the pecking and vocalizations of the hen. In commercial flocks young birds are kept in single-age groups and thus there are no parental influences on their behaviour. While fowl chicks readily explore and find food and water themselves, or by copying the behaviour of other chicks that have already found food and water, turkey pouls sometimes 'stare out', meaning that they fail to start eating, presumably because of the lack of maternal stimulation. Placing conspicuous and attractive stimuli near the feeder, such as flashing coloured lights, can help to attract the pouls to the feeder (Lewis and Hurnik, 1979).

### 9.9 Offspring Development

Poultry become fully independent of their parents a few weeks or months after they hatch. During this time, their behaviours are developing into the forms seen in adult birds. As they explore and learn about foods, pecking at inedible items like sand decreases and pecking at edible items increases. They learn to recognize suitable dust bathing substrates, and the different elements that make up a dust bathing box begin to appear in their behavioural repertoire, with full dust baths finally being performed when they are several weeks of age.

Social behaviour is also developing at this time. Young chicks frolic and spar with one another, play behaviour that resembles adult chasing and fighting. Chicks begin to peck others aggressively when they are as young as 2 weeks of age, although submissive behaviours are not shown until a few weeks later. Aggression is not apparent in turkeys until they are much older, about 3 months of age. In either case, these interactions lead to the formation of male and female dominance hierarchies in the flock, although these may not become stable until the birds reach sexual maturity.

In addition, developing birds learn the characteristics of appropriate mates for normal sexual activity through a process called sexual imprinting, which occurs during a sensitive period prior to sexual maturity. If males and females are reared separately, as sometimes occurs in commercial production, a lack of ability to undergo sexual imprinting can cause problems with mating later on in breeding flocks, since the birds may form strong homosexual pair bonds or show reduced mating behaviour (Appleby et al., 2004). However, unlike some other bird species, in poultry it is not necessary for males to be present in order for the females to become sexually mature – the reason that hens can be kept in all-female groups for egg production.

### References


