CHAPTER
38

Management of Galliformes

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Fig 38.1 | In warm climates, game cocks are housed on "string walks". A leg leash, just long enough for the bird to reach a shelter but not to fight with other birds, allows group confinement. Fighting of cocks is considered inhumane and illegal in some countries; however, it is a part of the culture in others.

Members of the order Galliformes are found on every continent except Antarctica. The red junglefowl, common turkey and helmeted guinea fowl have been domesticated for centuries. Their descendants, through selective breeding, are of considerable economic importance today. Some varieties are very plentiful in the wild, while others like the Japanese quail (*Coturnix japonica*) and various pheasants are approaching a level of complete domestication.

Many Galliformes are commonly maintained as game and food (meat and/or eggs) birds. Some are stable in captivity under variable ambient conditions, easy to breed and inexpensive. Other species are from niches with specific environmental requirements and need specialized diets, humidity and temperature ranges to survive. Currently, commercial production of chickens and turkeys in the USA for food has surpassed that of the beef, pork and fish industries. In 1900, per capita consumption of chicken was 1 pound and had risen to 80 pounds by the year 2000!

In this chapter, "domestic fowl" means *Gallus gallus, forma domestica* (domestic form of the red junglefowl); "domestic turkey" is *Meleagris gallopavo, forma domestica* (domestic form of the common turkey) and "domestic guinea fowl" is *Numida meleagris, forma domestica* (domestic form of the helmeted guinea fowl) (Table 38.1).

Maintaining, breeding, treating or commercially dealing with gallinaceous birds may be regulated by laws that govern the protection of animals, property rights, exchange of goods, liability, epornitics, food for human consumption, hunting and (international) transport of animals. In the USA, voluntary federal and state programs such as the National Poultry Improvement Plan (NPIP) provide testing for specific diseases to facilitate interstate and international transport of fowl. Laws are

Table 38.1 | Families and Subfamilies of Gallinaceous Birds

Family (Subfamilies)	No. of Genera	No. of Species
Cracidae (cracids)	10	43
Megapodiidae (megapodes)	7	12
Phasianidae (phasianids)	70	203
Numidinae (guinea fowl)	4	6
Pavoninae (peafowl)	2	3
Meleagridinae (turkeys)	1	2
Argusianinae (peacock pheasants and argus pheasants)	3	8
Phasianinae (pheasants)	8	21
Lophophorinae (monals)	1	3
Pucrasiinae (koklass)	1	1
Ithagininae (blood pheasant)	1	1
Gallinae (junglefowl)	1	4
Tragopaninae (tragopans)	1	5
Galloperdicinae (spurfowl)	1	3
Ptilopachinae (stone partridge)	1	1
Perdicinae (partridges, snowcocks, francolins, Old World quail)	27	98
Odontophorinae (New World quail)	9	31
Tetraoninae (grouse)	9	16

presently in place and/or being considered in some states that would prevent the interstate or international transport of fowl for purposes of fighting (Fig 38.1).

Anatomy and Physiology

Considering the large number of birds in the order Galliformes, there are surprisingly minimal anatomic and physiologic differences as compared to other animal orders. Likely, the strict physical requirements for flight have limited variability. Several peculiarities should be discussed. In the circulatory system, for example, most gallinaceous birds have right and left internal carotid arteries; however, the megapodes have only the right internal carotid artery. The respiratory rates, heart rates and rectal temperatures of some gallinaceous birds are listed in Table 38.2 and are highly variable, depending on the metabolic rate and physiology of the specific bird.

INTEGUMENT

Many gallinaceous species develop a durable, vascularized thickening of the corium in the ventral thoracic region called a brooding spot. The feathers in this region are temporarily lost and body heat is transferred directly from the brooding bird to the eggs.

The preen gland in the domestic fowl consists of two bilaterally symmetric lobes, each with one secretory duct opening into the uropygial papillae. Some breeds of domestic fowl have two uropygial papillae. Tail-less breeds of the domestic fowl and the argus pheasants

Table 38.2 | Respiratory Rate, Heart Rate and Rectal Temperature of Selected Gallinaceous Birds

Bird Group	Respiratory Rate (per min)	Heart Rate (per min)	Temperature (°C)
Domestic fowl	12-37	220-360	41.2
Domestic turkey	28-49	93-163	40.7
Pheasant	12-37	—	—
Bobwhite quail	—	—	44.0
Common quail	40-85	249-494	42.2

(*Argusianus argus*) have no preen gland. A brush-like feather tuft that absorbs secretions from the gland is present on the uropygial papillae. This feather tuft is absent in the megapodes.

Some gallinaceous birds have unique skin appendages. Junglefowl possess marked unpaired carneous combs consisting of a wide intermediate layer, which is formed of a fibrillar network filled with mucus-like substances that impact elastic stability of the comb. The strongly vascularized corium and the epidermis cover the intermediate layer. Feathers are present on the comb bonnet in some domestic fowl breeds. The paired wattles of the throat are similar in structure to the comb (Fig 38.2). Like the comb, the size of the wattles is influenced by hormones, and both are better developed in cocks than in hens. Paired cheek or earlobes are located ventral to the auditory canal and are of varying colors. It has been suggested that the color of the earlobe is related to the color of the eggshell in *Gallus gallus*.

The structure of the skin appendages on the head and neck of turkeys varies from those described in junglefowl. These appendages have no elastic intermediate layer but do have superficial, muscular and vascular layers. The dewlaps of turkeys are smooth, increase and decrease in size and can change color. Turkeys have a single snood on the forehead that can readily increase or decrease in length. Numerous red caruncles are located on the poorly feathered blue skin of the head. A beard consisting of tough, dark bristles is present at the border between the neck and chest. Turkey hens have more poorly developed skin appendages than cocks, and a beard is found occasionally in older hens, probably as a result of hormonal changes.

In New World quail (Odontophoridae), the edge of the lower bill is serrated or slightly jagged. An osseous process, which can be large in some species or subspecies, exists near the junction of the upper bill and cranium of helmeted guinea fowl and some cracids (Cracidae). This helmet consists of a cone of spongy bone covered by the corium and a keratinized epidermis. The wattles of the helmeted guinea fowl (*Numida meleagris*) are white to light blue and, like the helmet, are larger in cocks than in hens. Some other phasianids,

Fig 38.2 | Developed comb and wattles in the rooster (foreground) and hen are shown. The comb of the male is typically more prominent and brightly colored; in this case, it is cyanotic due to feed impaction of the crop.

some megapodes (Megapodiidae) and some cracids also possess ornamental appendages of the head and neck. In some species, these appendages are visible only during mating displays. Some breeds of the domestic fowl, some megapodes, some francolins, (Peliperdixidae), some tragopans (Tragopanidae) and some pheasants (Phasianidae) have completely featherless heads and necks, or featherless areas of the head or neck. Unfeathered areas of skin frequently are colored. Many grouse species (*Bonasa* spp.) have red-colored supraocular combs. These unfeathered regions become swollen during mating season.

The cocks of many gallinaceous birds have spurs, which are osseous eminences originating from the tarsometatarsus and are covered by keratinized epidermis. If spurs occur in hens, they are poorly developed and often have no osseous component. The cocks' spurs are frequently sharp and can easily injure rivals, hens, clients or veterinarians. Cracids and grouse do not have spurs. In the common pheasant, annual rings are formed in the epidermis at the base of the spurs and can be used to determine the minimum age of the bird.

Adaptations to Low Temperatures

The feet and toes of grouse are feathered. In ptarmigans (*Lagopus* spp.), even the plantar surface of the foot is covered with fur-like feathers. Long nails and keratinous pins on both sides of the digits facilitate locomotion on snow. Dense plumage and a thick layer of subcutaneous fatty tissue help protect against the cold. Hair-like feathers cover the nostrils. In ptarmigans, shivering for the active production of body heat starts only below -12° C.

Plumage

The chicks of all gallinaceous birds are nidifugous (can ambulate and self feed) and hatch with a downy plumage. The deck feathers (tectrices), flight feathers (remiges) and tail feathers (rectrices) form the contour feathers of the plumage. The number of rectrices varies among different species: the domestic fowl has 7 pairs; the Bulwer's wattled pheasant has 12 to 16 pairs. Ornamental feathers can originate from different portions of the plumage, including tail coverts (peafowl), rectrices (many pheasants) and chin feathers (capercaillies). Birds that are indigenous to open terrain often have a patterned plumage that serves as camouflage. Some species like the golden pheasant show polychromatism of the plumage.

Dark periorbital feathers hide the eyes of many gallinaceous birds. Attempting to escape from predators by running or flying in open terrain is a poor defense; thus, most ground-dwelling gallinaceous birds remain immobile when predators approach, and flee only as a last-ditch effort to escape.

Gallinaceous birds generally have well-developed afterfeathers (hypopennae). In some cracids, the vanes of the first primaries are curved and narrow, which, when a bird flies, produce a unique sound that is used to mark its territory.

Most gallinaceous birds molt naturally once a year, generally after the breeding season. Gallinaceous birds retain their ability to fly during a molt. The secondaries are molted in a divergent pattern from an inner starting point. The rectrices are molted randomly. The willow ptarmigan lives in a subarctic-type habitat and molts three times a year in order to adapt to color changes in the environment, with the winter plumage being mainly white. Some grouse (capercaillies and ptarmigans) even molt the horny sheath (rhamphotheca) of the bill (in small pieces) after the breeding season. Ptarmigans also replace their nails. Molting of commercial chickens is often done on a scheduled basis to improve the level of egg production and quality of the eggshell.

Some birds (notably grouse [Tetraoninae], pigeons [Columbidae]) undergo a stress-induced physiologic response when attacked by predators, which results in release of the feathers (the shock or fright molt). The predator or handler is left with a collection of feathers and the bird escapes.

Gallinaceous birds normally fly at a low level, have a high-frequency wing flap and tire quite rapidly. Their flight is often limited to gliding for short distances. Some species lead a nomadic life. Birds that dwell in high mountainous regions in the summer usually move to lower altitudes in the winter. The only true migratory gallinaceous birds are the common quail (*Coturnix*

coturnix) and the Japanese quail. Some gallinaceous birds move by running, which is assisted by quick flapping of the wings. A normal cruising speed for the common pheasant would be 33 km/h (20.5 mph), while the common turkey cruises through the forest at 24 km/h (15 mph). The nidifugous chicks of the gallinaceous birds are able to fly shortly after hatching. The chicks of the phasianids first attempt to fly at the age of 10 to 16 days, and the cracid chicks start to fly 3 to 4 days after hatching. Megapode chicks, which are not tended by their parents, are able to fly short distances just after hatching.

LOCOMOTOR SYSTEM

The furcula (wishbone) of the domestic fowl is V-shaped and has a ventral process. In the crested and plumed guinea fowl (Numidinae), an indentation exists at the junction of the two clavicles. This indentation holds the U-shaped loop of the elongated trachea. The medial notch of the sternum extends far cranially, and fibrous membranes connect the lateral and medial notches. In this region, the sternum does not protect the liver, and injections, abdominocentesis or handling procedures must be carefully performed.

The ground-dwelling phasianids generally have a long femur, tibiotarsus and tarsometatarsus to facilitate ambulation, while the tree-dwelling cracids have shorter tarsometatarsi. The legs of all gallinaceous birds are well muscled. Cracids are active climbers, and other gallinaceous birds need strong feet and legs to scratch the ground in search of food. The toes of cracids and megapodes are on the same plane, whereas the first toe of the phasianids originates more proximally than the other digits. The first digit of the gallinaceous birds is oriented mediocaudally and the three other digits are directed cranially. Some breeds of the domestic fowl have five digits, with the additional digit being located medial to the first.

RESPIRATORY SYSTEM

Desert-dwelling gallinaceous birds such as sand partridges (*Ammoperdix heyi*) possess well-developed salt glands situated in an osseous indentation above the eyes. This extrarenal excretory organ for salt empties through a duct into the nasal cavity.

The cocks or both genders of some gallinaceous birds have elongated tracheas. The additional length produces a U-shaped or circular loop in the trachea that lies between the skin and the muscle layer in the ventral thoracic or cranial abdominal region. In helmeted curassows, the loop extends to the cloaca, and in some other cracids, it extends to the caudal end of the sternum. Crested and plumed guinea fowl and the common capercaillie also have elongated tracheas. Although the function of the loop is not fully understood, it may be involved in generating deep sounds.

The tracheobronchial syrinx of gallinaceous birds is a simple structure. The neopulmo, which is the phylogenetically younger portion of the lung, is well developed in Galliformes. A phylogenetic increase in the size of the neopulmo is accompanied by a decrease in the size of the caudal thoracic air sacs. The common turkey has a well-developed neopulmo and has no caudal thoracic air sacs. Four clavicular air sacs are recognized in gallinaceous embryos. In the common turkey, only two of the four clavicular air sacs merge with the unpaired cervical air sac, and two clavicular air sacs remain distinct. In other birds, all the embryonic clavicular air sacs merge into one. With these adaptations, the common turkey has only seven air sacs, while most gallinaceous birds have nine air sacs: the unpaired clavicular air sac, and the paired cervical, cranial thoracic, caudal thoracic and abdominal air sacs.

ALIMENTARY TRACT

Most gallinaceous birds have a pointed bill (rostrum) that is used to pick up food. In grouse, the bill is stronger and is used for cutting tough vegetable matter. In gallinaceous birds, the cere is usually limited to the base of the upper bill; however, in cracids, two-thirds of the bill is covered by the cere.

The tongue of gallinaceous birds is shaped like an acute triangle, is stabilized by a bone and has no intrinsic musculature. Most gallinaceous birds have a crop. This esophageal diverticulum is missing in small cracids and snowcocks, and in its place is a slight bulge in the diameter of the esophagus or only an increased stretchability of the esophagus. The sage grouse (*Centocercus minimus*) and some other North American grouse (*Artemisia* spp.) use a diverticulum in the middle part of the esophagus for territorial display and not for the storage of food. During display, the "inflatable esophageal air sacs" are inflated to expose featherless, brightly colored skin. The organ also may play a part in amplifying the voice.

The ventriculus and its associated musculature are well developed in most gallinaceous birds. Grouse and snowcocks (*Tetraogallus himalayensis*), which eat extremely rough food, possess the most heavily muscled ventriculi. The sage grouse, which feeds on soft food, has a thin-walled ventriculus.

The secretory ducts of the liver and the pancreas open into the duodenum. Gallinaceous birds have a gall bladder and two bile ducts. In the domestic fowl, the pancreas extends to the apex of the duodenal loop and

generally has three secretory ducts. The largest pancreas is found in gallinaceous birds that feed on grain.

All gallinaceous birds have well-developed ceca. Peristaltic movements of the small intestine and antiperistaltic movements of the rectum transport fluid and small food particles into the cecal lumen. The contents of the ceca are dark-colored and have a sticky consistency. The size of the ceca will increase or decrease, depending on the amount of crude fiber in the diet. In some species, bacterial digestion of cellulose occurs in the ceca. Species like grouse and snow cocks, which feed on foods with high amounts of crude fiber, have particularly well-developed ceca.

The cecal flora probably plays an important role in the synthesis of vitamins and the metabolism of nitrogen. Uric acid that enters the cloaca is transported into the ceca by antiperistaltic movements of the rectum and is used for the synthesis of amino acids produced by bacteria and available to the bird. The ceca are usually emptied once a day, typically in the morning.

URINARY AND REPRODUCTIVE SYSTEMS

The testicles are generally yellowish or white but can be pigmented in some species like the common capercaillie or in some breeds of the domestic fowl. The testicles enlarge during the breeding season. Fertile semen is not produced between breeding seasons. The ductus deferens and, in some species, an enlarged area of the caudal ductus deferens serve as reservoirs for the storage of semen. Gallinaceous cocks have a non-erectile phallus.

Husbandry

Most gallinaceous birds are best maintained in combination indoor and outdoor aviaries and can live to 6 to 20 years, depending on the species (Table 38.3). In general, the available space should be as large as possible. In some countries, law stipulates the minimum areas.

A pair of pheasants can be maintained and bred in an aviary with a floor space 4 x 6 m with an additional 4-m^2 shelter. A common pheasant cock with five to six hens needs 30 to 38 m^2. An aviary for peafowl should be at least 3 m wide x 3 m deep x 3 m high. These species are best maintained in open-air enclosures or big gardens. One pair of bobwhite (*Colinus virginianus ridgwagi*) or California quail (*Callipepla californica*) needs a minimum of 1.5 m x 1.5 m floor space. For grouse, small aviaries 4 m deep x 8 m wide are recommended, because these birds may injure themselves if they fly into netting at the high speeds attained in larger flights.

Table 38.3 | Longevity of Selected Gallinaceous Birds

Bird	Years
Peafowl	Approx. 20
Bobwhite quail	Approx. 6
Grouse	8-10
Common pheasant	10-18
Cracids	20+

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Fig 38.3 | A pheasant is provided with protection from the elements in an enclosure with a simple A-frame shelter at a popular zoological garden. Note the bent toes, a form of metabolic bone disease from malnutrition.

Many Galliformes prefer to roost in elevated positions, making the height of an aviary important. Shelters should be provided to protect birds from sun, wind and rain (Fig 38.3). Tropical or subtropical species maintained in cold climates require an indoor aviary or, if kept outdoors in winter, a heated shelter. The mesh size of netting should be small enough to prevent a bird from placing its head through the mesh, and preventing a predator from injuring or killing the bird. It also should prevent the smallest predators from entering the aviary. Some gallinaceous birds, especially the common pheasant and many quail,[23] fly straight up when panicked. For this species, the top netting in an enclosure should be loose to provide some give and reduce the chances of head[24] (scalping) and neck injuries. An opaque barrier can be placed at the back of the aviary, extending up to one-half of the height, to provide extra visual security for the birds.

Ground dwellers like some quail, partridges and francolins do not need elevated perches. Perches should be placed far enough from walls or wire netting to prevent the tail or wing feathers from contacting these surfaces. Peafowl, Reeve's pheasant (*Syrmaticus reevesii*), argus pheasants and Phoenix fowl (a strain of red junglefowl) require especially high perches placed 3 to 4 m above the ground to accommodate their long tail feathers.

Sharp corners should be avoided in designing the aviary. Curved corners or dense bushes planted in the corners reduce the possibility of trauma.

Shrubs also help to landscape an aviary and provide shelter for the birds; however, the aviary should not be over-planted. Too many plants will make an aviary difficult to clean. Natural turfs are attractive but are not recommended when keeping birds that are highly susceptible to infectious diseases. An aviary with a concrete floor that is covered with an exchangeable layer of sand meets the needs of sensitive species (like grouse or the cheer pheasant) and is better than natural soil. Plants may be grown in containers that are removed when the aviary needs cleaning.

Snowcocks need large rocks for perching and shaping their bills. Some species like monals, eared pheasants (*Crossoptilon crossoptilon*) and the cheer pheasant (*Catreus wallichi*) use their upper bill to search the soil for roots and insects. If these birds are maintained on artificial substrate, natural abrasion of the bill will not occur and manual trimming will be necessary. Gallinaceous birds do not bathe in water. Most gallinaceous birds like to take dust or sand baths. The placement of abrasive materials on the plumage may function to lightly abrade and polish the edges of the feathers and may help reduce the number of external parasites as long as the sand itself is not contaminated. Insect powders should be used only if they are known to be nontoxic for the species concerned and only if the birds do in fact have parasites. In the winter, willow ptarmigan bathe in the snow.

Various bird species should generally not be mixed in one aviary because of possible interspecific aggression and the potential transmission of infectious agents. If species are combined, it is best to mix birds that do not compete for the same food or biotope and have originated from the same geographic region.[25] Ground-dwelling gallinaceous birds can be combined with bush- or tree-living species like thrushes, babblers, starlings, bulbuls and doves (with the exception of the ground pigeon); however, mixing of species is not recommended. Predatory species, including birds that feed on eggs, should not be combined with gallinaceous birds.

Silver pheasant (*Lophura nycthemera*), eared pheasant (*Crossoptilon auritum*), golden pheasant (*Chrysolophus pictus*), Lady Amherst's pheasant (*Chrysolophus amherstiae*), Elliot's pheasant (*Syrmaticus ellioti*), and Indian peafowl can be maintained in open-air enclosures that are fenced but not covered. Birds in open-air enclosures must have sufficient hedges, bushes or trees for protection. Higher trees should be available for roosting. Fruit trees or oaks (some are poisonous) provide a food source as well as cover. Clipping the wings before introducing it to new surroundings should reduce the flight capacity of a bird.

Losses to predators can occur in open-topped facilities, particularly with respect to chicks. Rare species should not be maintained in an open-topped enclosure. A breeder who uses open-topped enclosures should expect that the loss of a bird to a predator is the responsibility of the breeder and not the fault of the predator. Some gallinaceous birds are noisy, especially the Indian peafowl and guinea fowl during the breeding season, and should be maintained in secluded areas to avoid complaints from neighbors.

Nutrition

Many diseases and problems in captive Galliformes are directly or indirectly related to malnutrition. Breeders of gallinaceous birds should be aware of the natural foods consumed by any species maintained in captivity. Conclusive data on the nutritional demands (with respect to maximal egg or meat production and not for longevity and appearance) is available only for the domestic fowl, domestic turkey and the Japanese quail. Some information is available for the domestic guinea fowl and less has been determined for the common pheasant. All nutritional guidelines for other gallinaceous birds are based on experience.[26] Special care must be exercised when feeding commercial turkey and/or chicken feeds. Levels of calcium, protein and energy vary considerably among the starter, grower, layer and finisher rations. As well, many commercial poultry feeds contain antibiotics and other drugs (anticoccidials) that may be harmful to some birds or other animals on the premises.

Generally, the protein requirement increases at the beginning of the mating season because of egg and semen production. After the breeding season, the amount of protein in the feed should be gradually reduced. With any change in the diet, the new food should be mixed slowly into the daily diet until the conversion is complete.

"EASY" BIRDS

Many gallinaceous birds are omnivorous. The nutritional requirements of common pheasant, golden pheasant, peafowl, guinea fowl, turkeys, partridges and New World quail are relatively easy to provide. Commercial diets for domestic fowl, domestic turkey, common pheasant and Japanese quail are available in many countries. Pellets designed for turkeys can be used in species without special requirements. Adding fresh green plants to the diet

provides the birds with nutritional diversity. Grass or corn silage also can be offered in small quantities. During the breeding season, the diet should contain 20 to 25% crude protein. Outside the breeding season, a maintenance diet containing less than 20% crude protein is best. Commercial diets for the domestic turkey are usually better suited for pheasants than diets developed for domestic fowl. Feeding is best accomplished by providing small portions of the diet several times a day in the non-breeding season and offering food ad libitum during the breeding season.

Most New World quail are primarily seed eaters and are easy to feed. Forest-adapted species may be largely insectivorous and have higher and more specific protein requirements in comparison to other gallinaceous birds. Cracids are mainly, but not exclusively, vegetarians. They can be sustained on pellets containing 21% crude protein supplemented with fruits but no grains. During the breeding season, they are fed soybean paste, chopped hard-cooked eggs, chopped meat or mealworms (larvae of the meal beetle) with calcium as a supplement. The primarily meat diet of these birds results in odiferous feces. Megapodes can be fed a commercial poultry diet.

Birds with a High Protein Requirement

Some gallinaceous birds like peacock pheasants (*Polyplectron bialcaratum*), argus pheasants and the roulroul (crested wood partridge) do best with high-protein diets. In addition to high-protein turkey or pheasant diets, adult peacock pheasants should be fed mealworms, chopped meat, fruits and a small quantity of grain. Green plants are rarely consumed by these species. The roulroul is fed a commercial soft feed for insectivorous birds, mixed with live insects, chopped hard-cooked eggs and chopped meat with calcium as a supplement.

"DIFFICULT" BIRDS

Some gallinaceous birds consume almost exclusively vegetable material. The koklass (*Pucrasia marolapha*), the blood pheasant (*Ithaginis cruentus*), snowcocks, tragopans and grouse are examples. Feeding these species with game bird pellets or, even worse, with commercial diets for domestic fowl and turkeys results in obesity, reduced fertility and imbalances in the intestinal microflora. These species should be maintained only where natural-type foods are available year-round. These gallinaceous birds should be fed large amounts of fresh vegetables. Pellets should be provided only in small quantities, if at all. Koklass naturally feed on ferns, grasses, leaves, mosses, buds and berries. In captivity they should be provided soft green plants, fruits and berries, and no grains. In the summer, grasses and lucerne (alfalfa) can be provided. Spinach, romaine lettuce and fresh, frozen vegetables can be substituted in the winter months. Free-ranging blood pheasants feed on mosses, lichen, ferns, grass tips and conifer needle-buds. They browse constantly in planted aviaries. Their chicks feed on these plants immediately after hatching.

Tragopans consume oak trees, bamboo sprouts, grasses, mosses, oak nuts, berries and a few insects. In captivity, tragopans can be fed lucerne, grasses, cucumbers, apples and different kinds of berries. In the spring, summer and autumn, grouse feed on a variety of plants. In the winter, most grouse species are restricted to consuming one or a few plant species. During the winter season, the spruce grouse, capercaillies and other grouse species feed almost exclusively on conifer needles, the black grouse on birch buds, and ptarmigans on buds from different deciduous trees (birch, alder, willow).

Captive grouse should receive natural foods or at least large amounts of leaves, grass and berries supplemented with a limited quantity of pellets and grain. Capercaillies and ptarmigans require a diet high in crude fiber. Even with strict attention to the diet, the bacterial fecal flora in capercaillies in captivity is similar to the fecal flora of the domestic fowl and differs substantially from the fecal flora of free-ranging capercaillies. The tannin and essential oil content of natural food plants may support the growth of autochthonous intestinal flora in free-ranging grouse. In the sage grouse, leaves and sprouts of the North American big sagebrush are the sole winter food and the main portion of food in the summer.

Some commercial poultry diets contain coccidiostatic agents. Halofuginone is toxic for the common pheasant, guinea fowl and the common partridge. Monensin is toxic for guineafowl. The presence of antimicrobial agents can be life-threatening in species that depend on a functional cecal flora and fauna (eg, grouse) for proper digestion. In general, the effects of coccidiostats and other medical feed supplements on gallinaceous birds have not been sufficiently studied. It is safer to provide food without these potentially toxic supplements.

All gallinaceous birds should have access to grit, when not fed strictly an artificial diet. The grit container should be emptied and refilled regularly because birds select only stones that are suitable for their body mass. Pellets or complete rations have an adequate supply of calcium and should not be supplemented with lime or crushed shell. Fresh, clean water must be available at all times for all species.

CHICKS

During their first few weeks of life, free-ranging gallinaceous chicks feed mainly on live invertebrates like insects,

larvae of insects, worms and snails in order to obtain the protein levels needed to sustain rapid growth. Starting at 5 to 6 weeks of age, the protein requirements begin to decrease and the intake of carbohydrates increases to meet energy requirements. By 6 months of age, most young gallinaceous birds have reached a mass equivalent to that of adults. The quantity of carbohydrates in the diet must then be reduced to prevent obesity.

Feed should be provided to newly hatched chicks on a large, flat plate on which they can move around and practice pecking. By 5 to 7 days of age, food can be offered in larger containers. The change from the plate to larger containers should occur by offering feed in both containers at the same time. Small chicks may drown in large water containers.[28] Reducing the drinker depth by placing stones or glass marbles in the container will reduce losses.

Chicks of unpretentious species (common pheasant, peafowl, guinea fowl) are initially fed a starter diet like turkey starter (28% crude protein) and are transferred to a lower protein diet like turkey grower (18-20% crude protein) from the eighth to eighteenth week of age.[29]

Chicks of the vegetarian species are difficult to feed. It is best to provide these birds with foods that are similar to those eaten by their free-ranging counterparts. A diet composed of turkey starter mixed with mealworms, ant cocoons, chopped hard-cooked eggs, diced romaine lettuce, spinach, dandelion and other green plants is a viable substitute. In several species (some grouse), chicks obtain food by pecking at the ground and by cutting off parts of plants with the bill. In these species, it is important that chicks be provided intact plants that are placed in the ground or tied in bundles to facilitate natural food-gathering behavior. Chicks that are to be released into the wild must be introduced to their natural foods to prevent starvation. Perhaps chicks are imprinted with food shapes and colors, or at the least they learn what foods to consume from the hen.

The chicks of some gallinaceous birds will not pick downward in the first days of life. This is because peacock pheasants, crested argus, great argus and some other gallinaceous hens feed their chicks for several days after hatching. Argus pheasant chicks can be enticed to peck by offering live food (mealworms). Monal chicks fed mealworms will pick at their siblings' toes.

Reproduction

Some gallinaceous birds breed easily in captivity, while others rarely reproduce. Breeding failures are an indication that the birds are not provided a suitable environment or there may be medical problems with the individual birds.[30] Some pheasant and quail species are approaching a level of domestication that is advantageous for both the captive animal and the breeder. Comparatively, "semi-domesticated" animals are of no value if offspring are to be released to the wild with the intent of reintroducing genetic diversity into dwindling populations. Genetic selection and breeding to achieve color variants increase the expression of genetic abnormalities, semi-lethal factors and susceptibility to disease. The clutch size and incubation times for commonly maintained gallinaceous birds are listed in Table 38.4. Parameters for artificial incubation are listed in Table 38.5.

GENERAL CONSIDERATIONS

Gallinaceous birds to be used for breeding purposes should be introduced to each other before the breeding season in surroundings that are novel to both the males and females. The female should be introduced to the enclosure a few hours prior to the male. In some species, it is possible to keep several males together if there are no females present. If females are present, only one male should be housed in an aviary or in one compartment. In monogamous species, only a single pair should be housed together.[28]

Males of some species are very aggressive. During the breeding season, they may attack other males, other bird species or even the keeper. Pursuit by the male and mock escape by the female is normal behavior in some species like eared pheasants and francolins. If there is insufficient space for the hen to escape, she may be injured or killed by the cock. Beak trimming or restricting the flight capabilities of the male can prevent injuries to the hen, but are inferior procedures to providing adequate space for a pair of birds to behave normally. Densely planted aviaries that provide a hen with areas to hide still may have inherent problems. Fiberglass panels leaned against the wall or concrete tubes provide similar protection and are easy to clean.

For species in which there are substantial differences in body size between the genders, aviaries can be designed to allow the hen to visit the cock when she wishes. Small holes just big enough for the hen are used to connect adjacent enclosures. This allows the hen to enter the cock's enclosure while preventing the cock from entering the hen's area. This is an effective method for breeding birds like the common capercaillie. In some species, the hen chooses the most attractive of several cocks and if only one cock is available, breeding may not occur if the hen does not like the cock. In some species, the visual or acoustic presence of other males is necessary to stimulate display and mating behavior.

Table 38.4 | Clutch Sizes and Incubation Times of Gallinaceous Birds

	Species	Clutch Sizes	Incubation Time (days)
Megapodiidae			
	Alectura lathami	25-30	46-54
Cracidae			
	Ortalis spp.	3	26-28
	Penelope spp.	2-3	27-29
	Aburria spp.	2-3	unknown
	Penelopina spp.	2	unknown
	Oreophasis spp.	2	unknown
	Nothocrax spp.	2	28
	Mitu spp.	2	29-30
	Pauxi spp.	2	30
	Crax spp.	2	29
Phasianidae			
Perdicinae	*Lerwa* spp.	5-7	unknown
	Tetraogallus spp.	5-8	26
	Tetraophasis spp.	4	unknown
	Arborophila spp.	3-5	20-21
	Perdix spp.	8-20	24-25
	Alectoris spp.	8-14	24-26
	Bambusicola spp.	4-6	18-20
	Francolinus spp.	4-8	19-21
	Pternistis spp.	3-9	18-20
	Scleroptila spp.	3-6	22
	Dendroperdix spp.	4-9	19
Numidinae	*Guttera* spp.	8-10	unknown
	Numida spp.	8-12	27
	Acryllium spp.	10-14	23-24
	Agelastes spp.	12	unknown
Pavoninae	*Afropavo* sp.	3-4	26-27
	Pavo spp.	3-5	28-30
Meleagridinae	*Meleagris* spp.	8-15	28
Argusianinae	*Polyplectron* spp.	2	18-23
	Rheinardia spp.	2	25
	Argus spp.	2	24-25
Phasianinae	*Chrysolophus* spp.	5-12	22-23
	Phasianus spp.	8-12	22-24
	Graphephasianus spp.	6-12	24
	Syrmaticus spp.	7-15	24-25
	Colophasis spp.	6-8	25-28
	Lophura spp.	5-15	22-25
	Crossoptilan spp.	4-14	24-28
	Catreus spp.	9-14	26

	Species	Clutch Sizes	Incubation Time (days)
Phasianidae (Continued)			
Lophophorinae	*Lophophorus* spp.	4-5	27
Pucrasiinae	*Pucrasia* spp.	5-7	20-21
Ithagininae	*Ithaginis* spp.	5-12	27
Gallinae	*Gallus* spp.	5-8	19-21
Tragopaninae	*Tragopan* spp.	4-10	28-31
Ptilopachinae	*Philopachus* spp.	4-6	unknown
	Peliperdix spp.	2-6	unknown
	Ortygornis spp.	4-8	18-19
	Perdicula spp.	4-8	22
	Cryptoplectron spp.	4-7	16-18
	Ammoperdix spp.	8-14	22-24
	Synoicus spp.	4-12	20-22
	Coturnix spp.	7-14	16-20
	Margaroperdix spp.	5	unknown
	Caloperdix spp.	8-10	18-20
	Melanoperdix spp.	5	unknown
	Rollulus spp.	4	18-20
	Haematortyx spp.	8-9	unknown
	Rhizothera spp.	5	unknown
Odontophorinae	*Colinus* spp.	7-28	22-23
	Callipepla spp.	9-17	22-23
	Oreotyx spp.	6-15	24-25
	Philortyx spp.	8-12	22-23
	Dendrortyx spp.	4-7	28-30
	Odontophorus spp.	4-5	26-27
	Dactylortyx spp.	5	unknown
	Cyrtonyx spp.	6-16	24-25
Tetraoninae	*Tympanuchus* spp.	5-17	24-25
	Bonasa spp.	11	24
	Tetrastes spp.	7-11	23-25
	Centrocercus spp.	7-13	25-27
	Dendragapus spp.	7-10	24-25
	Falcipennis spp.	4-10	21-22
	Lagopus spp.	6-9	20-23
	Lyrurus spp.	7-10	26-27
	Tetrao spp.	5-12	26

Most gallinaceous birds incubate eggs on the ground and should be provided with flat trays containing moss, foliage or hay for nesting material. Tragopans, the Congo peafowl (*Afropavo congosis*), the bronze-tailed peacock pheasant (*Pavo cristatus*), the crested argus pheasant, the mikado pheasant (*Syrmaticus mikado*), the Salvadori's pheasant (*Lophura inornata*) and the cracids nest in trees. A box placed approximately 150 cm from the ground and filled with hay and foliage can be used as an artificial nest. A slanted limb should be provided for easy access to the nest. Nests of ground- and tree-nesting birds should be inconspicuous to provide the pair with visual security, but should be placed such that the birds can easily look out.

Most gallinaceous birds are non-determinant layers and if the first clutch of eggs is removed, the hen will lay a second and sometimes a third clutch. Hatching is genetically determined and should not normally be assisted. Because gallinaceous chicks are nidifugous, the family can stay together only if all the chicks hatch at the same time. Synchronization of the hatch dates can occur by two mechanisms: 1) The hen does not incubate the

Table 38.5 | Parameters for Artificial Incubation of Some Gallinaceous Birds

Species	Incubation Chamber		Hatching Chamber	
	Temp. (°C)	Humidity (%)	Temp. (°C)	Humidity (%)
Common pheasant (*Phasianus colchicus*)	37.5	60	37	85
California quail (*Callipepla californica*)	38.5-39.0	50-60	—	80
Common capercaillie (*Tetrao urogallus*)	37.5	60-70	36.5-37.0	80-90
Black grouse (*Tetrao tetrix*)	37.4	55-60	—	85-90
Ruffed grouse (*Bonasa umbellus*)	37.5	60-65	—	70-75
Chukar partridge (*Alectoris chukar*)	37.5	65	37	85

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Fig 38.4 | The red junglefowl hen is commonly used by aviculturists to incubate the eggs of species that commonly abandon their eggs.

clutch until the last egg has been laid, allowing the eggs to cool (which slows the process of embryogenesis); or 2) The chicks in a clutch synchronize hatching through audible signals. This latter process occurs in species like the Japanese quail. When sounds are heard from other eggs, the chicks increase the speed of hatching. When no sounds are heard from other eggs, the most developed chicks reduce their speed of hatching. Most gallinaceous chicks are independent by 3 months of age. The exception is the megapode chick, which is independent immediately after hatching.

Foster Breeding

The hens of some gallinaceous birds are unreliable brooders in captivity. Cracid, common pheasant and nearly all species of New World quail hens are not reliable brooders in captivity. These hens can be encouraged to produce two or three clutches per year instead of one by using foster parents or an incubator for hatching eggs. Chinese silk fowl (*Bambusicola thoracica*) and bantams make excellent foster parents (Fig 38.4). Domestic turkey hens can be used to incubate the eggs of larger gallinaceous birds. Small and fragile eggs should be placed under golden pheasant hens, which are cautious brooders and excellent care providers. During the last week of incubation, the eggs of tropical birds being raised in dry climates should be moistened with a clean mister once a day. After hatching, the hens and chicks can be placed in a small enclosure that is moveable and can be placed on fresh grassy areas on a daily basis. Chicks are prone to chilling the first few days posthatch and must have supplemental body heat from the attending hen or a heat lamp where appropriate.

The disadvantages of foster parenting are as follows:

- Crushing of small, fragile eggs by heavy or clumsy adults
- Premature cessation of brooding if the natural incubation period of the foster hen is shorter than the fostered eggs
- Trauma or death of the chicks if the hen recognizes them to be strange (this is a particular problem when behavioral incompatibilities exist between the hen and chicks)
- Transmission of infectious agents between hen and chicks
- Inappropriate imprinting

Placing the eggs in an incubator for the last third of the incubation period can reduce infanticide and disease transmission (this method is often used for grouse). A hen of the same species should rear chicks that are to be released into the wild.

For many pheasants, the percentage of carbon dioxide in the incubator must be increased up to approximately 1% (verified with a gas detector) during the last 2 days of incubation. This is achieved by reducing the intake of fresh air and serves to stimulate the hatching process. Chicks should be taken out of the incubator immediately after hatching.

SPECIFIC REPRODUCTIVE CHARACTERISTICS

Megapodes

Megapode eggs differ from those of other gallinaceous birds, owing to their uncommon brooding biology. The eggs are not incubated by the parents but by solar heat, fermentation heat or geothermal energy. One egg can reach a size of up to 17% of the hen's body mass. The eggs are thin shelled and contain a large yolk that is rich in lipids. Cocks or both sexes begin constructing an induction mound out of foliage and earth when the air temperature and atmospheric humidity reach a certain level. The hens lay their eggs every 2 to 3 days in previously prepared holes, which are quickly covered after ovi-

position. Eggs are deposited in a mound, with the pointed pole downward, and they are not turned during incubation. They do not have a fixed air chamber or chalaza.

The birds may determine the temperature of the mound, and perhaps other parameters, with the bill or tongue. The mean temperature in the incubation mound is around 34° C. The incubation mound is cooled when needed by scratching holes. This allows carbon dioxide to escape and oxygen to enter. The incubation period varies from 45 to 90 days, depending on the temperature in the mound. Brush turkey chicks leave the mound 24 to 30 hours after hatching. Normally, megapode chicks do not come into contact with their parents, which function only to care for the incubation mound. The chicks join their siblings that have hatched at around the same time. Megapodes are sexually mature by 1 year of age.

The Australian brush turkey (*Alectura lathami*) is easy to maintain and breed in captivity, and is the most common captive representative of the megapodes. This species is monogamous. In one breeding season, an Australian brush turkey hen lays about 25 to 30 eggs.

Cracids

Cracids are Central and South American species that are considered monogamous. The breeding season lasts from March until July. Most nests are well hidden in a fork or branch of a tree, but some species are ground-nesters. Only the hen incubates the eggs. A clutch consists of two to three eggs, which are rough shelled with wide pores and a uniform white color. Newly hatched chicks are immediately able to climb trees. The family stays together until the next breeding season. Sexual maturity occurs by 2 years of age.

Turkeys

The common turkey is polygamous. Behavior of free-ranging birds is dramatically different from that of domesticated breeds. The brain volume of domesticated turkeys is 3% smaller (brain:body weight ratio) than that of their wild-type conspecifics. The nest is formed of a flat depression in the soil and may be padded with leaves, grass or twigs. The chicks are able to fly at 2 weeks of age. Several hens, together with their offspring, typically associate in a flock in the winter. The young birds leave their mother before the next breeding season. Young turkeys are sexually mature at 2 years of age.

New World Quail

New World quail are monogamous. Both parents participate in building the nest and brooding the chicks. Young birds are sexually mature by 1 year of age, in some species even earlier. Outside the breeding season, the gregarious New World quail live together in large family groups (coveys). At the beginning of the breeding season, the older cocks become very aggressive toward young cocks. Captive bobwhite quail have become polygamous and it is possible to keep one cock with two hens, indicating the effects of domestication.

Grouse

Some grouse species like ptarmigan, ruffed grouse, hazel hen (*Tetrastes bonasia*), spruce grouse (*Falcipennis canadensis*) and blue grouse (*Dendragapus obscurus*) are monogamous. In these species, cocks should not be allowed to see or hear other cocks. Hazel hen males may attack the female if a rival can be heard but not seen. Other grouse species are polygamous. In these species, the hen chooses one cock from a group of displaying males. One cock may be chosen to mate with several hens. Hens in captivity breed best when allowed to choose between two or more cocks. The cocks, which are housed in different compartments of an aviary, may see and hear each other if there are enough hiding places for the hens. In most grouse only the hen provides chick care. The chicks of different species can be distinguished by the varying color patterns on the head and back plumage. Most grouse are sexually mature at 1 year of age. Crossbreeding between different genera and species occurs in free-ranging birds. Similarities in the appearance and display behavior of hens seem to induce cocks to crossbreed. Hens will choose cocks of another species if a representative of their own species is not available.

Peafowl

The Congo peafowl is monogamous. The nest is always built in a tree. Both parents care for the chicks. The Indian (*Pavo cristatus*) and the green peafowl (*Pavo muticus*) are polygamous. In captivity, it is possible to keep one cock with four to five hens. The hens care for the clutch and the chicks, which mature slowly. Hens reach sexual maturity in the second year and cocks in the third year of life. The green peafowl is more aggressive than the Indian peafowl, but has a more pleasant call.

Pheasant

Most pheasant species are polygamous. One common pheasant cock can be kept with five to six hens (Fig 38.5). The hens make poor care providers in captivity. They tend to be indiscriminate in the placement of eggs and will not incubate the eggs. Young common pheasants are sexually mature at 1 year of age. Free-ranging golden pheasants are monogamous, but in captivity one cock can be kept with three to four hens. The hens are exceptional care providers and defend their chicks. Young golden pheasant hens are sexually mature within 1 year, cocks within 2 years. Lady Amherst's pheasant

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Fig 38.5 | A male Reeves pheasant has worn a path in its aviary in an attempt to find mates or compete with other males.

cocks and hens can be aggressive during the breeding season. Only a few of the birds found in captivity are purebred. Both male and female argus pheasants, peacock pheasants and the copper pheasant establish and defend their own territories. Males should be introduced to females for only a short time during the breeding season to prevent aggressive behavior and traumatic injuries to both genders.

Junglefowl and Domestic Fowl

Junglefowl can either be monogamous or polygamous. The hens can breed year-round, but the main breeding season is from February to May in the northern hemisphere. A red junglefowl cock can be maintained with three to four hens. The young birds are independent at an age of 4 months and sexually mature after the first year. Many domestic fowl breeds have lost much of their brooding behavior, and eggs must be artificially incubated.[32]

GENDER DETERMINATION

Many gallinaceous birds show a marked sexual dimorphism. The size (height and width), the body mass (weight), the color of the plumage, the shape of certain feathers, the presence of spurs, and the length and color of the tail feathers assist in gender determination between adults of some species (Table 38.6). In some breeds of domestic fowl, fertile cocks may have plumage that resembles that of hens.

Highly skilled individuals can determine gender by examining the cloaca in 1-day-old chicks or adults. The cloacal examination in newly hatched chicks of small bird species must be carefully done. Holding a chick too tightly can cause asphyxiation. Restraint of a chick for gender determination should start by gently pressing on the abdomen from both sides distal to the keel bone to stimulate defecation. The procedure is then similar to that described for Anseriformes (see Chapter 36, Management of Waterfowl).

Behavioral clues like dominance and certain mating rituals may suggest a gender but are not always indicative. Under certain conditions, the hens of some gallinaceous birds behave like and can have plumage like the males. DNA analysis or endoscopic examination of the gonads provides definitive determination of gender in species with similar morphologic characteristics.

Table 38.6 | Gender Determination of Selected Species of Gallinaceous Birds Without Marked Sexual Dimorphism[28]

Genus	Plumage Identical	Plumage Similar	Differences
Megapodiidae			
Alectura spp.	X		Cocks have neck appendages
Cracidae			
Ortalis spp.	X		Voice of cock is deeper
Penelope spp.	X		In some species, iris colors differ
Nothocrax spp.	X		In cocks, the tracheal loop is palpable
Pauxi spp.	X		In hens, plumage is sometimes a red phase
Phasianidae			
Numidinae			
All genera	X		Cock's call has 3 syllables; hen's call has 2 syllables
Argusianinae			
Polyplectron spp.		X	Hen's plumage is dull; cocks have spurs
Phasianinae			
Crossoptilon spp.	X		In general, cocks have spurs
Catreus spp.		X	Cocks have long, sharp spurs
Ptilopachinae			
Ptilopachus spp.		X	
Perdicinae			
Tetraogallus spp.		X*	In some species, cocks have short spurs
Arborophila spp.		X*	In some species, cocks have short spurs
Bambusicola spp.		X*	
Francolinus spp.	X		
Pternistis spp.	X		In some species, cocks have spurs
Scleroptila spp.	X		Cocks have spurs
Ortygornis spp.	X		Cocks have spurs
Coturnix spp.		X	
Odontophorinae			
Odontophorus spp.		X*	
Tetraoninae			
Tympanuchus spp.		X	
Bonasa spp.		X	
Tetrastes spp.		X	
Lagopus spp.	X		Only in winter

*Some species of the genus are very similar, but not identical

ARTIFICIAL INSEMINATION

Artificial insemination is of economic importance in the domestic turkey and domestic guinea fowl. Domestic turkey cocks, like domestic fowl cocks, are fertile year-round, except during periods of extreme heat or during the molt period. Domestic guinea fowl cocks are not fertile all year and artificial insemination is used to induce year-round production.

The semen is collected by massaging the caudal region of the back or the abdomen, followed by stimulation of the cloaca. Fecal contamination of the semen may occur. It is best to collect the semen directly from the spermatic duct with a syringe and a blunted hypodermic needle. The semen may be diluted with Ringer's or Tyrode's solution by up to a factor of three.

Avian semen has a short half-life and must be used as quickly as possible. The semen is introduced with a syringe and a blunted hypodermic needle into the hen's oviduct. It is best to inseminate the hen just after she has laid an egg. This ensures that the oviduct is open, providing the semen with unrestricted access to the infundibulum.

Restraint

Cocks with spurs can injure handlers, especially when they become increasingly aggressive during the mating season. The beak also can serve as a weapon. Although serious injuries are rare, the face and the eyes of handlers should always be protected from a bird's beak, even in small species. The legs of a gallinaceous bird should be the initial focus for restraint.

Catching gallinaceous birds in an aviary can be done gently with a long, hooked stick. The birds should never be restrained by the feathers alone. The whole body must be secured to prevent a shock molt. Shock molt is most common in tail feathers but other feathers can be involved. Birds can be nearly "bald" after several failed restraint attempts. In larger species, the base of the wing is fixed along side the body with one hand and the legs are controlled with the other hand. The abdomen should be supported from below. If assistance is not available, a large bird can be restrained against one's body. Birds can usually be calmed by placing a loose-fitting, lightweight cotton sock over the head to reduce vision.

Disease Considerations

Gallinaceous birds are susceptible to a wide variety of viral, bacterial, mycoplasmal, parasitic, chlamydial, rickettsial and fungal agents (Table 38.7). Information on these diseases may be found in other literature.

NUTRITIONAL DISEASES

Vitamin C deficiency does not occur in most birds; however, it has been reported in willow ptarmigan chicks and may occur in other grouse chicks. Though the chicks are able to produce endogenous vitamin C (as all gallinaceous birds probably can), the internal production is not sufficient in the first weeks of life, and has to be augmented by the intake of vitamin C from natural food plants (eg, blueberries). Clinical signs of vitamin C deficiency are abnormal behavior, enteritis, ruffled plumage, weakness of the wings and legs, bone fractures, retarded growth and death before the age of 4 weeks. Characteristic necropsy findings include weight loss, pale and edematous skeletal muscles, petechial hemorrhage in the muscles and mild subcutaneous edema. Fractures in the diaphysis of the humerus, radius, ulna, femur and tibiotarsus with massive callus formation and lateral twisting of the tibia also may occur. Feeding chicks natural foodstuffs high in vitamin C will prevent deficiency. Birds with poor quality diets often develop pododermatitis (Fig 38.6).

INTEGUMENT CONCERNS

Amputation of the comb or the wattles may be indicated following extensive injury, infection or frostbite. Adequate hemostasis is necessary to prevent fatal hemorrhage. Occasional trimming of the keratinous tip of the bill is necessary if the horny layer grows too fast, or if insufficient abrasive materials are available to facilitate

Fig 38.6 | Chickens on poor-quality diets often develop bumblefoot. The pain from the bumblefoot causes chickens to lay down frequently, which may lead to sternal ulcers.

Table 38.7 | Checklist of Infectious Diseases in Gallinaceous Birds

Viruses

Poxviridae
- Avian pox

Herpesviridae
- Infectious laryngotracheitis
- Marek's disease
- Quail Herpesvirus
- Turkey Herpesvirus

Adenoviridae
- Quail bronchitis
- Quail necrotizing hepatitis
- Inclusion body hepatitis
- Egg drop syndrome (infectious salpingitis)
- Marble spleen disease
- Hemorrhagic enteritis of turkeys
- Chicken splenomegaly
- Adenovirus infection of the blue grouse, Guinea Fowl

Parvoviridae
- Parvovirus infection of chickens
- Parvovirus-like infection of turkeys

Circoviridae
- Infectious anemia

Reoviridae
- Viral arthritis
- Other reovirus infections
- Rotavirus infections

Birnaviridae
- Infectious bursal disease

Togaviridae
- Eastern and St. Louis encephalitis
- Avian serositis
- Louping-ill
- Israel turkey meningoencephalitis

Coronaviridae
- Coronaviral enteritis of turkeys (bluecomb disease)
- Infectious bronchitis

Rhabdoviridae
- Rabies

Paramyxoviridae
- Newcastle disease
- PMV-2 infection
- PMV-3 infection
- Turkey rhinotracheitis
- Swollen head syndrome

Orthomyxoviridae
- Avian influenza, fowl plague

Retroviridae
- Leukosis
- Reticuloendotheliosis
- Lymphoproliferative disease of turkeys

Picornaviridae
- Avian encephalomyelitis
- Turkey viral hepatitis
- Infectious nephritis

Bacteria

Staphylococcus spp.
- Staphylococcosis

Streptococcus spp.
- Streptococcosis

Mycobacterium avium
- Tuberculosis

Eryspelothrix rhusiopathiae
- Erysipelas

Listeria monocytogenes
- Listeriosis

Clostridium spp.
- Ulcerative and necrotic enteritis (*Cl. colinum* and *Cl. perfringens*)
- Botulism (toxin of *Cl. botulinum*)

Escherichia coli
- Colibacillosis
- Coligranulomatosis

Salmonella spp.
- Salmonellosis

Klebsiella spp.
- *Klebsiella* infection

Yersinia pseudotuberculosis
- Pseudotuberculosis

Pseudomonas spp.
- *Pseudomonas* infection

Aeromonas hydrophila
- *Aeromonas* infection

Bordetella avium
- Bordetellosis (turkey coryza)

Campylobacter spp.
- Avian hepatitis

Borrelia anserina
- Spirochetosis

Treponema spp.
- Infectious typhlitis in chickens

Pasteurella spp.
- Fowl cholera

Actinobacillus salpingitidis
- Actinobacillosis

Haemophilus spp.
- *Haemophilus* infection

Francisella tularensis
Tularemia

Mycoplasma

Mycoplasma spp.
- *Ureaplasma* sp.

Chlamydia

Chlamydophila psittaci
Chlamydiosis

Rickettsia

Coxiella burnetii
- Query (Q) fever

Aegyptianella pullorum
- Aegyptianellosis

Mycoses

Aspergillus spp.
- Aspergillosis

Candida albicans
- Candidiasis

Dactylaria gallopavo
- Dactyloriosis

Trichophyton spp.
- Favus

Mycotoxicoses

Toxins of *Aspergillus* spp., *Penicillium* spp., *Fusarium* spp. and others

Parasites

Protozoal Parasites
- *Trypanosoma avium*
- *Spironucleus meleagridis*
- *Histomonas meleagridis* (Blackhead disease)
- *Trichomonas* spp.
- *Chilomastix gallinarum*
- *Entamoeba* spp.
- *Endolimas* spp.
- *Eimeria* spp.
- *Toxoplasma gondii*
- *Sarcocystis* spp.
- *Cryptosporidium* spp.
- *Haemoproteus* spp.
- *Leucocytozoon* spp.
- *Plasmodium* spp.

Metazoal Parasites

Trematodes
- *Prosthogonimus* spp.

Cestodes
- *Davainea proglottina*
- *Raillietina* spp.
- *Amoebotaenia cuneata*
- *Choanotaenia infundibulum*
- *Hymenolepis* spp.
- *Metroliasthes lucida*
- *Fimbriaria fasciolaris*

Nematodes (in digestive tract)
- *Capillaria* spp.
- *Trichostrongylus tenuis*
- *Heterakis* spp.
- *Ascaridia* spp.
- *Gongylonema ingluvicola*
- *Cheilospiruro* spp.
- *Dispharynx nasuta*
- *Tetrameres* spp.
- *Subulura* spp.

Nematodes (in respiratory tract)
- *Syngamus trachea*

Nematodes (in the eye)
- *Oxyspirura* spp.

Nematodes (in other locations)
- *Aproctella stoddardi*
- *Singhfilaria hayesi*

Acanthocephalans
- *Mediorhynchus papillosus*

Arthropods
- External parasites like lice, fleas, flies, mosquitoes, midges and ticks occur in most gallinaceous birds. Mites occur above all in intensively reared gallinaceous birds, predacious bugs in some gallinaceous birds.

normal wear. The excessive horn is pared off prudently with a sharp knife without cutting into the viable parts of the bill.

Cannibalism may occur in some Galliformes and is characterized by vent picking, feather pulling, toe picking, head picking and egg eating. Overcrowding, incorrect feeding, an inappropriate daylight cycle, high light intensity, poor housing conditions (eg, high proportion of toxic gases in the air), genetic predisposition and other factors may all promote cannibalism.

Beak trimming has been successful in commercial poultry production facilities, when performed by experienced personnel, to reduce the incidence of cannibalism and resulting injury. Removal of the comb and wattles is sometimes performed by commercial poultry breeders to reduce losses associated with aggressive behavior, especially associated with males. These procedures may not be suggested in gallinaceous birds raised for hobby. When performed improperly, these procedures may interfere with the bird's ability to eat, may result in infection and even affect the bird's social ranking in the flock. The bill is not only important for the uptake of food but also has sensory functions and is necessary for preening. Damage to the beak should be considered a substantial handicap. In most cases, cannibalism can successfully be prevented by correcting the deficiencies in the birds' environment; however, once feather picking is started, beak trimming or other management changes such as separating the birds or use of an anti-picking ointment[a] may be necessary to break the cycle (Fig 38.7).

Trimming of the flight feathers in one wing can be used to prevent birds from escaping from open aviaries or to reduce the mobility of an aggressive cock during the breeding period. Usually all but the outermost two primaries and the innermost three secondaries are transected, creating an effective and cosmetic wing trim. With one wing trimmed, the bird is unbalanced and cannot gain speed during flight. Because the feathers will be replaced during the next molt, trimming must be repeated annually in adults. Under certain circumstances, it may be necessary to trim both wings. Other methods like pinioning or cutting the short tendon of the *extensor carpi radialis* make birds permanently unable to fly. The client should be made aware of the consequences of these procedures. Birds unable to fly or ambulate normally would be more susceptible to attack by pets and wild animals such as raccoons. In many countries, such practices are outlawed for humane reasons.

VACCINATION CONSIDERATIONS

Vaccination programs used in the commercial broiler, turkey and layer industries may be very comprehensive and complex. These enterprises often have large numbers of birds, 1 million or more in many cases, on a single premises. Thus, disease prevention rather than treatment is the goal. Disease prevention is achieved through strict programs whereby disease organisms are prevented entry onto the premises by using biosecurity and by vaccination. Vaccination programs for each farm unit are designed specifically to provide maximum protection to the birds, while being economic and causing minimum stress to the flocks. Disease challenge risk in an area also must be considered in the program design.

Fig 38.7 | Anti-picking lotion may help reduce cannibalism.

In collections where gallinaceous birds are maintained, the goal likewise should be disease prevention by preventing entry of disease organisms onto the premises. Vaccination, as the second line of defense, is important in reducing losses in high-risk areas where disease challenge occurs. The primary obstacle in vaccinating collections of gallinaceous birds is availability of quality commercial vaccines. Vaccines for fowl are readily available for commercial use, but not for smaller collections. Due to market considerations, poultry vaccines are produced in vials containing 3000 or more doses per vial. Once vaccines are reconstituted, in the case of lyophilized products such as pox, infectious bronchitis, Newcastle, infectious bursal disease and infectious laryngotracheitis, they must be administered promptly (within 2 hours). As only small numbers of birds may be vaccinated at a time, vaccination may not be feasible. Other vaccines such as Marek's require storage in liquid nitrogen and must be administered to chicks promptly after hatching to be effective. These vaccines also must be used within 1 hour after careful thawing and mixing of the vaccine, as they are very fragile, cell-associated products. In the case of Marek's disease, birds will be exposed to this ubiquitous field virus soon after hatch in most instances, thus prompt vaccination is essential if it is to be efficacious (Fig 38.8).

Vaccination programs for gallinaceous birds in smaller collections are therefore limited to diseases that are more

Fig 38.8 | Vaccination of recently hatched chicks against Marek's disease.

virulent in nature and are high risk in a particular region. A disease such as infectious bronchitis, which causes only a mild and transitory respiratory condition in some gallinaceous birds and in which multiple serotypes are circulating, often is not considered for vaccination.

Diseases commonly considered for vaccination if endemic or if virulent strains are of concern in the area include Marek's disease, infectious laryngotracheitis, pox, Newcastle and infectious bursal disease (Figs 38.9a,b).

Although live-type vaccines are labile and must be stored under refrigerated conditions in the dark, have expiration dates, are sold in doses of 5000 or more per vial, and the contents of the vaccine must be used promptly following reconstitution, vaccination would often be indicated for valuable collections. Veterinarians, often working with clients from a number of collections, may divide the lyophilized vaccine pellet prior to reconstitution, using aseptic technique, to reduce vaccine waste and cost.

Vaccinations are often used in response to post mortem diagnosis. This is not always possible (Fig 38.10).

Product Mentioned in the Text

a. Anti-Pick Lotion, Vineland Laboratories, 1-800-846-3547, www.vinelandlabs.com

Figs 38.9a,b | A chicken is presented with respiratory disease. Note exudates around the eye and sinuses. Infectious bronchitis is mild and transitory and is not usually considered for vaccination.

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Fig 38.10 | Two coincidental findings in a dead rooster: an eye worm and a fly "strike". Fly eggs will hatch into maggots. The cause of death was not determined.

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