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Introduction

The order Galliformes (fowl-like birds), in line with the most up-to-date taxonomic information derived from DNA and other biochemical techniques (Sibley & Ahlquist 1990), is now divided into three families:

1. Phasianidae
2. Numididae
3. Odontophoridae.

These families, showing various representative species and the general characteristics, are listed in Table 13.1.

Until comparatively recently, taxonomists included within the order Galliformes two other avian families, the Cracidae (i.e. guans, chachalacas and curassows) and the Megapodiidae (megapodes, scrub fowl and brush turkeys). However, the latest taxonomic information now places these families in a separate order, the Craciformes. Both Galliformes and Craciformes are now included in the super order Gallomorphae (or Gallomorphs). Within this super order there are some 283 species, the original representatives of which were found in all the world's continents except Antarctica, and on many islands except those of Polynesia and New Zealand.

Although the Galliformes range in size from the relatively small Chinese painted quail (body length 13 cm) to the much larger turkeys and peafowl (approximately 117 cm), most are medium-sized birds similar in size, body form and behavioural characteristics to domestic chickens. The Galliformes are considered to be rather primitive, unspecialized birds that probably evolved early in the evolutionary cycle. They all have relatively large stout legs and feet, with three forward-pointing digits and a smaller hind digit. Many of these birds are mostly terrestrial, and are incapable of prolonged sustained flight. In most species within the order the mode of flight is a short but rapid take-off, and then gliding or flapping for short distances. The majority of these birds are non-migratory. However, both grouse and guinea fowl can fly quite strongly, and the Old World quail and some species living in high altitudes do undergo a partial migration to better feeding grounds in winter.

Veterinary anatomy and physiology

The skeleton

This is similar in all Galliformes to that of the domestic chicken, with well-developed muscular legs consistent with the relatively stout legs needed for a terrestrial lifestyle and scratching the ground in search of food. Some species (e.g. turkeys) have ossified leg tendons. All Galliformes have an anisodactyl foot with three cranially directed digits and a fourth, the hallux, situated somewhat higher up the tarsometatarsus and directed caudomedially. In some families or subfamilies (e.g. jungle fowl, turkeys, pheasants) the cock birds have an extra osseous sharp-pointed spur situated above the hallux and directed medially, which is used for fighting and territorial dominance. In the common pheasant (Phasianus colchicus), annual rings are formed at the base of the spur and can be used for ageing the bird. Care must be taken when handling such birds, since they can injure the handler. The green peacock will make a positive attack on humans and other animals using the spurs, and turkey cocks will fight to the death.

Some breeds of domestic chicken (e.g. Chinese silks, Dorkings and Houdans) have five digits, with the extra digit situated medial to the hallux.

The skull of the sand grouse (Pteroclididae spp.) has a well-developed fossa that contains the large salt gland, which acts as a supplementary excretory organ in these species. The helmeted guinea fowl (Numida meleagris) carries a spongy bone extension situated at the junction of the nasal and frontal bone, which is covered by pigmented skin. This structure, together with the wattles, is better developed in male birds.

In Galliformes, there are two deeply and cranially directed non-ossified incisions covered in fibrous sheets on each side of the sternal plate. It should be noted that these leave the underlying liver exposed and vulnerable to deep intramuscular injection if due care is not exercised. The furcula (i.e. the ‘wishbone’) in the crested and plumed guinea fowl (Numida meleagris) carries a spongy bone extension situated at the junction of the nasal and frontal bone, which is covered by pigmented skin. This structure, together with the wattles, is better developed in male birds.

The integument

The most obvious characteristic of the Galliformes is the presence of well-developed eye combs, wattles and ‘beard’ (in the common turkey), all of which are highly coloured (usually red) and inflatable. Some grouse also have inflatable coloured cervical air sacs. In some species (jungle fowl, pheasants, turkeys and some grouse) the tail feathers are well developed for display purposes, but the tail of the peacock is not formed of true rectrices but of elongated coverts. Most Galliformes moult
### Table 13.1a–c  Families, genera and representative species within the order Galliformes. The following are most likely to be encountered by the veterinarian, as they are often kept in captive collections

#### a.  Family: Phasianidae

#### i.  Subfamily Phasianinae (pheasants), 8 genera containing 21 species

In most species the male bird has highly coloured plumage whilst the female is more dowdy. Most cock pheasants have exceptionally long tails which are vaulted, i.e. in cross-section they are like an inverted V. The tail is used by the cock bird for display purposes when courting. The fourth digit (the hallux) is located more proximally on the metatarsus than the three forward-directed digits. In many species there is a pointed spur placed proximal to this fourth digit on the metatarsus. This appendage is used by the male birds for fighting to gain territory. Some species of pheasant have coloured facial skin on the head. Most pheasants make a whirring wing noise during territorial display and are also quite vocal.

| Genus      | Species | Characteristic                                                                 | Size          | Global distribution and normal habit                                                                 |
|------------|---------|-------------------------------------------------------------------------------|---------------|-------------------------------------------------------------------------------------------------------|
| Gallus     | G. gallus | The red jungle fowl: like the domestic chicken. From this species all the numerous breeds of domestic fowl have originated. The red jungle fowl will hybridize with domestic chickens. The species was probably first domesticated during the Bronze Age, and was originally kept for cock fighting. Unlike other pheasants, it has a more longitudinally arched tail and the cock has well-developed comb and wattles. | 66 cm (body) 28-30 cm (tail) | SE Asia (Kashmir, central India, Burma, Thailand, Malaysia, Sumatra and Java). Inhabits tropical rain forest, secondary growth scrub and rice stubble |
|            | G. sonneratii | The grey jungle fowl; Sonneray's jungle fowl: a somewhat larger; more dowdy bird than the red jungle fowl. Will hybridize with above species | 76 cm (body) 41 cm (tail) | Western and southern India. Habitat: forest scrub, bamboo                                           |
| Lophura    | L. nycthenera | The silver pheasant: male bird, marked comb and red facial skin, silver grey wings and tail, black under parts. Will hybridize with above species | 122 cm (body) 61-66 cm (tail) | South China, Burma, Thailand, Laos, Vietnam. Habitat: forest                                        |
| L. swinhoei | Swinhoe's pheasant; Formosan pheasant: marked comb and wattles, white neck, brown and dark blue/green plumage, dorsal tail white | 150 cm | Taiwan. Habitat: mountainous up to 2800 m                                                          |
| L. diandi  | Siamese fire-back pheasant: male has crest, grey mantle, golden back patch, black tail | 81-86 cm (body) | Burma, Thailand, Indo-China                                                                        |
| Phasianus  | P. colchicus | Common pheasant: two varieties; the white ring-necked form and the dark-necked form | 60-90 cm (body) 52 cm (tail) | Eurasia, China, Taiwan. Introduced to North America, Hawaii, New Zealand, UK. Habitat: grass scrub, temperate woodland |
| Syrmaticus | S. reevesi | Reeves's pheasant, bar-tailed pheasant; body plumage golden with feathers edged with black. Tail long, silver banded with dark brown | 86 cm (body) 101-152 cm (tail) | North and central China. Habitat: open woodland with pine, cypress and oak, tall grass and bushes      |
| Chrysolophus | C. pictus | Golden pheasant: red under neck and breast, head and back golden, wings green, red, blue and brown, tail brown | 39 cm (body) 76-79 cm (tail) | Central China, introduced locally in UK. Habitat: bushy slopes, bamboo, terraced fields             |
|            | C. armerstiae | Lady Amherst's pheasant: body plumage shows patches of green and white. silver; golden. Very long silver and brown tail | 55 cm (body) 76-117 cm (tail) | SE Tibet, SW China, Burma. Habitat: wooded slopes, bracken hillsides, bamboo thickets                 |
| Crossoptilon | C. crossoptilon | The white eared pheasant, Tibetan eared pheasant | 91 cm (body) | SE Tibet to NE Yunan and central Szechwan. Habitat: coniferous and mixed forest, rhododendron scrub, grassy slopes |

The eared pheasants – all have exceptionally long, rather bushy tails.
Table 13.1 (continued)

| Genus      | Species                          | Characteristic                                                                 | Size (body) | Global distribution and normal habit                                           |
|------------|----------------------------------|-------------------------------------------------------------------------------|-------------|-------------------------------------------------------------------------------|
| C. manchurian | The brown eared pheasant, Manchurian eared pheasant: Body brown, red facial skin with white collar and ear tufts | 99 cm (body) | NE China. Habitat: stunted conifer or birch, rocky open shrub, coarse grass |
| C. uratum | The blue eared pheasant, Mongolian eared pheasant | 97 cm (body) | W China. Habitat: conifer and mixed forest, bushy alpine meadow |

### ii. Subfamily Tragopinae; 5 species

- **Tragopan**
  - **T. satyra**
    - Satyr tragopan or crimson horned pheasant: white-specked orange and crimson plumage. Back and tail base olive brown. Scapulars crimson but wing otherwise brown. Head, crest and throat black, tail reddish brown barred black and rather truncated.
    - 69 cm body which looks plumpish
    - Eastern Palaearctic, central and eastern Himalayas. Habitat: high forests. Migrates downhill in winter

### iii. Subfamily Lophophorinae; 3 species

- The monal pheasants: heavy-bodied birds with a shorter, more square-shaped tail rather like a turkey. The cock birds have an iridescent plumage.
  - **Lophophorus**
    - **L. impeyanus**
      - The Himalayan monal or Impeyan: male has an upright crest, white lower back and lower rump. Upper tail coverts dark glossy blue-green, tail reddish-brown. Body and wings dark metallic green to purple, underparts black.
      - 71 cm (body)
      - Afghanistan Himalayas, SE Tibet. Habitat: open forest up to 3000 m

### iv. Subfamily Argusianinae; 3 genera, 8 species

- **Argusianus**
  - **A. argus**
    - The great argus pheasant: male bird rusty brown plumage with black circled eye spots and mottling. Long tail with two central tail feathers broad and very long. Head bare, blue skin.
    - 72 cm (body and tail)
    - Indochina, Sumatra, Borneo. Habitat: primary tropical rain forest up to 1500 m

- **Polyplectron**
  - **P. bicataratum**
    - The grey peacock pheasant, Burmese peacock pheasant: male greyish brown, light-coloured throat and underparts. Large violet ocelli on back and tail. Crest, yellowish facial skin.
    - 30 cm (body)
    - Central and southern Burma, Thailand, Laos, North Vietnam. Habitat: humid forest, lowlands and mountains up to 1800 m

- **P. empharum**
  - Palawan peacock pheasant, Napoleon peacock pheasant: male darkish brown with iridescent blue-green pointed crest. Tail has large blue-green eye spots. Facial skin reddish, white cheek patch.
    - 26 cm (body)
    - 25 cm (tail)
    - The island of Palawan in the Philippines, north of Borneo. Habitat: humid forest, lower elevation tropical rain forest

### v. Subfamily Parvoninae; 2 genera, 3 species

- Peafowl: all have well-developed spurs.
  - **Pavo**
    - **P. cristatus**
      - Common peafowl, Indian peafowl, blue peafowl. It is only the cock bird, the peacock, which develops the spectacular train and this does not develop until the third year. The long ornamental feathers of the tail are not true rectrices but elongated covert feathers.
      - 198–229 cm
      - India, Sri Lanka. Habitat: moist dry deciduous lowland forest up to 1500 m

- **P. muticus**
  - Green peafowl, Javanese green peafowl. Large bird, long train, brilliant green plumage, blue and yellow facial skin.
    - 213–244 cm
    - SW China, Assam, Burma, Thailand, Vietnam, Laos, Malaysia, Java. Habitat: open forest, riverbanks, forest edge, sometimes found up to 1000 m.
### Table 13.1  (continued)

| Genus       | Species   | Characteristic                                                                                                                                                                                                                                                                                                                                                     | Size       | Global distribution and normal habit                                                                 |
|-------------|-----------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------|------------------------------------------------------------------------------------------------------|
| Afropavo    | A. congesis | The African peafowl: male dark glossy green and bronze on back rump. Underside dark green, violet iridescent back of neck and sternum. Crown white and black spots. Facial skin blue                                                                                                                                  | 60-68 cm   | Zaire (Congo Basin). Habitat: dense lowland tropical rain forest                                      |
|             |           | vi. Subfamily Tetraonidae; 6 genera; 17 species \nThe grouse: birds in this subfamily have feathered external nares as well as feathered tarsi and sometimes feathered digits, particularly the ptarmigan, which inhabits colder regions. Grouse do not have tarsal spurs. During the breeding season some species (e.g. the prairie chicken, black, sharp-tailed and sage grouse) gather at traditional display arenas or lecks, where the males carry out an intricate repetitive dance to hold territory and attract females. All grouse are powerful fliers. |
| Lagopus     | L. lagopus | Willow grouse, Willow ptarmigan in North America: a stout, short-winged bird, reddish brown in colour with white wings. Wedge-shaped tail with darker outer feathers. Moults three times yearly. White in winter except tail. Male has inflatable red skin combs above eyes. Will burrow under snow for food and shelter | 38 cm      | Northern Palaeartic, temperate and subarctic. Introduced to Belgium. Habitat: tundra and taiga, heather moorland, willow, birch and juniper scrub, peat bog. Migrates to lower ground in winter |
| Lagopus     | L. lagopus subspecies scoticus | Red grouse: the same species as above but moults completely to red brown in summer without retaining the white wings                                                                                                                                                                                                 |           | Scotland. West Norwegian population is intermediate between red and willow grouse                     |
| Lagopus     | L. mertus  | Ptarmigan, rock ptarmigan in North America: a similar species to willow grouse, retains white wings, belly and legs throughout year. In breeding season plumage blackish brown mottled. In winter completely white except outer tail feathers. Red eye combs. Smaller than above species | 33 cm      | Holarctic as for willow grouse. Habitat: tundra but higher altitudes than L. lagopus and more barren rocky slopes |
| Lyrus       | L. tetrix  | Black grouse: black cock and grey hen, male plumage blue/black. Unusual lyre-shaped tail in male also white wing bar and pronounced red eye combs                                                                                                                                                               | Male 50 cm, female 38 cm | Palaeartic, UK. Eurasia. NE Siberia and eastern China. Habitat: peat bog with rushes and scrub with some trees. Rocky heather moorland up to 2000 m |
| Dendragapus | D. canadensis | Spruce grouse. Franklin grouse, fool-hen: male has dark head and neck, flecked white on breast otherwise brownish. Pronounced red eye combs. when erected with fan-shaped tail looks like small turkey cock                                                                                                                            | 41 cm      | Canada. Habitat: coniferous forest with dense undergrowth                                              |
| Dendragapus | D. obscurus | Blue grouse: not unlike spruce grouse but cock bird greyer and larger. Male displays yellowish or red skin covered inflatable oesophagus                                                                                                                                                                                               | 57 cm      | Western North America to California. Habitat: open mixed woodland and conifer. Lowland and mountain slopes, dry sage brush. Will roost under snow                              |
| Centracercus| C. uraphasianus | Sage grouse: male a very large bird (female smaller) mainly brownish in colour with white ruff on breast. Inflatable oesophagus, yellow eye combs. Pointed tail feathers                                                                                                                                                         | 71 cm      | Western North America. Habitat: sage brush, foothills and plains                                     |
| Genus   | Species           | Characteristics                                                                 | Size  | Distribution and Habitat                                      |
|---------|-------------------|---------------------------------------------------------------------------------|-------|---------------------------------------------------------------|
| Bomasa  | B. umbellus       | Ruffed grouse: plumage reddish brown to grey. Dark edge to fan-shaped tail. Dark ruff around neck. No eye combs. | 43 cm | Canada, Alaska and North America. Habitat: deciduous and mixed woodland |
| Tymanuchus | T. cupido       | Greater prairie chicken – similar species; Lesser and Attwater’s prairie chicken. Plumage buff-coloured markedly barred with dark brown. Male has large yellow eye combs and inflatable yellow skin covered oesophagus. Small rounded tail. Male shows prominent forwardly directed ruff of upper neck feathers which could be mistaken for a head crest. | 43 cm | Mid-West to southern USA. Habitat: tall grass prairie, open and scrubby grassland. Will burrow in snow to roost. |
| Tetroa  | T. urogallus      | Capercaillie: a huge grouse. Male slate grey, wings brown, head and throat dark. Small red eye combs. Black tail flecked white, also on abdomen. Hens may hybridize with blackcock. | 79-84 cm | Palaeartic and temperate western Europe to USSR. Habitat: coniferous and mixed forest. Taiga |
| vii.  | **Subfamily Meleagridinae; 2 genera, 2 species** | Turkeys: large powerful grouse-like birds in which the male bird carries on the head and neck coloured erectile caruncles (wattles) over bill. Used during courtship. The cock turkeys have tarsal spurs and will fight to the death. There is a square-ended fan-shaped tail. Rattle wing quills during courtship. | | |
| Meleagris | M. gallopavo    | Wild turkey: slightly smaller than the domesticated varieties. First domesticated by the Mexican Indians in the sixteenth century. | 94 cm | North America to Mexico. Habitat: woodland and open forest thickets |
| Agriachans | A. ocellata | Ocellated turkey: has eye spots on the tail. No expandable crest wattles as in common turkeys. Skin of head more blue than red of common turkey. | 86 cm | Yucatan in Guatemala. Habitat: subtropical lowland |
| viii. | **Subfamily Perdicinae; 20 genera, 106 species** | The Old World quails, francolins, partridge and snowcocks: all tend to be rather small, rotund birds with much shorter tails than pheasants. The Old World quails are all small birds with almost non-existent tails. The genus Coturnix contains the only migratory Galliformes. | | |
| Coturnix | C. japonica     | Japanese quail: dull grey/brown with light coloured streaks and eye stripes. Domesticated by the Japanese. | 15 cm | SE Asia, Burma, Thailand, Laos to Hong Kong and Japan. Taiwan. Introduced to North America. Habitat: grassland and cultivated areas |
| | C. delegorguei | Harlequin quail, Delegorgue’s quail. | 15 cm | Senegal to Ethiopia and South Africa. Habitat: savannah and grassland |
| | C. coromandelica | Rain quail, black-breasted quail. | 15 cm | India, S. N. Lanka, Burma |
| | C. coturnix | Eurasian quail: Rather like Japanese quail with black throat and rufous upper breast. Migrated in huge numbers in biblical times and collected by the Children of Israel in the Sinai. | 16 cm | Southern UK, Europe. Migrate across Mediterranean to North Africa. Habitat: rough grassland, cropland with grass tussocks |
| Excalfactoria | E. chinensis | Chinese painted quail, King quail, blue breasted quail: female, like other female quail, brownish, but male brilliant blue eye stripe, neck and flank. Black neck and white collar. | 13 cm | SE Asia and Australia. Habitat: grass and scrub |

(continued)
| Genus      | Species       | Characteristic                                                                 | Size  | Global distribution and normal habit                                                                 |
|------------|---------------|--------------------------------------------------------------------------------|-------|------------------------------------------------------------------------------------------------------|
| Rollulus   | R. rollulus   | The Roul Roul, crested green wood partridge, crowned wood partridge, green partridge: upper parts of body bright green. Only male has pronounced chestnut crest with iridescent black/blue breast and wing coverts. Female mostly green with brown wings | 28 cm | Malaysia, Sumatra and Borneo. Habitat: dense tropical forest but prefers drier more open clearings. Up to 1500 m elevation |
| Perdrix    | P. perdix     | Common or grey partridge: upper parts brown streaked black and white, brownish wing coverts. Face and throat orange/brown. Male has brown inverted horseshoe markings on breast | 28 cm | UK, most of Europe except southern Spain, Sicily and Sardinia, across to central Asia. Introduced to North America. Habitat: pastures, moorland, cultivated land, wasteland, sand dunes, semi-desert, shingle |
| Alectoris  | A. rufa subspecies A. graeca | Red-legged partridge: distinguished from above species by white eye stripe, white throat, mottled black bib. Red bill and red legs | 34 cm | SW Europe, southern UK, introduced to UK. Azores, Madeira. Canary Isles and North America as a game bird. Habitat: lowland scrub, drier land and heath. Dry cultivated land |
|           | A. chukar     | Chukar partridge: upper parts grey brown, flanks noticeably barred black and white | 36 cm | Asia and Asia Minor. Introduced to North America as a game bird. Habitat: similar to A. rufa |
| Francolinus | F. francolinus | Black francolin: a brownish bird, the male has black underparts markedly white flecked, also white cheeks | 36 cm | Cyprus, Syria, Iran to Pakistan, India and Assam. Introduced to Louisiana and southern Florida. Habitat: grass and cropland |
| Tetraogallus | T. himalayensis | Himalayan snowcock: all snowcocks (5 species and many subspecies) are very large partridge-like birds | 71 cm | Himalayas up to 6000 m, Afghanistan, India, western China. Introduced to mountainous areas of North America. Habitat: steep stone-covered slopes with sparse vegetation, alpine meadow |
| Lerwa      | L. lerwa      | Snow partridge: body form like other partridge but slightly longer. Tail plumage grey brown faintly barred white. Breast deep chestnut streaked white | 35 cm | Himalayas up to 5000 m, Pakistan, India, Tibet, western China. Habitat: alpine meadow, rocky slopes above tree line |
### Table 13.1 (continued)

| Genus   | Species          | Characteristics                                                                 | Size | Distribution and Normal Habitat                                                                 |
|---------|------------------|---------------------------------------------------------------------------------|------|--------------------------------------------------------------------------------------------------|
| b. Family: Odontophoridae (9 genera, 31 species) |                 |                                                                                 |      |                                                                                                  |
| Lophortyx | *L. californicus* | Californian quail, valley quail, crested quail: small pigeon-sized bird. Brownish grey upper breast, under parts flecked white, black throat, white collar; prominent teardrop-shaped plume | 25 cm | Western North America. West of the Rockies to southern California. Introduced New Zealand, Chile, Hawaii, Canada. Habitat: low tree shrub, open ground with low cover; city parks, sage brush |
| Callipepla | *C. squamata* | Scaled quail, blue quail: greyish brown. Tinge of blue from scaled breast and neck. Crest not typical quail type, more triangular and white tipped | 24 cm | SW North America and Mexico. Introduced to Washington State and Nevada. Habitat: barren semi-desert and scrubby grassland |
| Collinus | *C. virginianus* | Bobwhite quail: brownish with distinct white flecking and scaling on breast and flanks, white throat, white eye stripe, crest not well developed | 23–27 cm | SE Canada to Mid West and eastern North America to Mexico and Central America. Introduced to Britain and New Zealand. Habitat: scrub, open farmland, cities, road sides, derelict land |
| c. Family: Numididae (4 genera, 7 species) |                 |                                                                                 |      |                                                                                                  |
| Acryllium | *A. vulturinum* | Vulturine guinea fowl, so-called because it looks rather like a vulture with an almost vulturine bill. Black spotted white, underparts cobalt blue. Marked cape around neck of streaked black and white feathers | 58 cm | Southern Somalia, eastern Uganda, Kenya, NE Tanzania. Habitat: desert, thorn scrub, occasional forest |
| Numida | *N. meleagris* subspecies | Tufted guinea fowl, helmeted or hooded guinea fowl. 20 subspecies occur regionally. Very noisy birds which often have been used as good watchkeepers. Domesticated by the Romans circa fourth century BC | 56 cm | Most of Africa from Cameroon to Central Africa, Chad, Sudan, Ethiopia, Kenya, Tanzania, Zaire, Angola, South Africa. Habitat: dry thorn, bush, grassland and cultivation |
annually after the breeding season, but ptarmigan moult three times yearly in line with the changes in colour of their sub-Arctic habitat (Jones 1998). They also moult the claws. The capercaillie and ptarmigan also fractionally moult the horn of the beak. When handled, grouse tend to shed some feathers as a normal defence reaction against attack. Most Galliformes have a bilobed preen gland with an associated wick of feathers, but its presence in grouse and turkeys is variable. Sand grouse have modified breast feathers during the breeding season for carrying water to the chicks left in desert nest sites.

The respiratory system
In some species the trachea is elongated into loops, particularly in the male bird. This occurs in crested and plumed guinea fowl and in the capercaillie. The extended section of the trachea lies subcutaneously over the thorax and abdomen. The presence of an extended trachea may be important for the anaesthetist, because if respiration becomes depressed these birds may require assisted positive pressure ventilation in a much shorter time span than where a similar situation occurs in other species.

Normal respiratory rates in the common turkey (28–49 per minute) are approximately twice the rate in the domestic fowl (12–37 per minute); also, the common turkey has no caudal thoracic air sac.

Heart rates in the domestic turkey (93–163 per minute), in contrast to respiratory rates, are much lower than in the domestic fowl (220–360 per minute). Respiratory and cardiac rates are not documented for other species.

The alimentary canal
In the grouse, the beak is more robust than in most other Galliformes, being adapted to dealing with coarse vegetation. The New World quail have a ‘toothed’ lower beak. All Galliformes except snowcocks have a well-developed crop, which is, of course, an expansion of the oesophagus; in snowcocks its absence is compensated for by a dilatable oesophagus. Some male North American grouse (sage grouse, Centrocercus urophasianus; blue grouse, Drenragapus obscurus; prairie chickens, Tympanuchus cupido) have an inflatable diverticulum of the oesophagus covered with featherless, brightly coloured skin (red or yellow), and this is used during courtship and territorial displays.

The ventriculus (gizzard) is well developed muscually in all Galliformes except for the sage grouse, which consumes softer food. Muscular development of the ventriculus is particularly pronounced in most other grouse because of their coarse vegetable diet. Also, certainly in the red grouse (Lagopus lagopus scoticus), the length of the intestine changes seasonally in line with the seasonal change in diet and its digestibility, a physiological adaptation also recorded in species other than Galliformes.

A gall bladder and well-developed caeca are present in all Galliformes, and the latter organs are commonly involved in infectious processes, especially coccidiosis.

Reproductive system
Although usually white or buff in colour, the testes of some Galliformes such as the capercaillie and some breeds of poultry are pigmented a darker colour. The cock birds in all Galliformes have a non-intromittent phallus formed by two lateral folds (the lymphatic phallic bodies) situated on the ventral lip of the vent. During ejaculation, which is very rapid, the lymphatic bodies are momentarily engorged with lymph and the protruding vent is quickly applied to the protruding oviduct of the female. Semen is channeled between the two dilated lateral lymphatic phallic bodies.

Young wild turkeys are sexually mature at 2 years of age. New World quail are sexually mature at 1 year, although amongst the Old World quail (and certainly the Japanese quail, Coturnix japonica), some are developed and able to breed at 6 weeks! Grouse mature at 1 year. The male pea fowl is not sexually active until 3 years, whilst the hen is mature at 2 years. The common pheasant (Phasianus colchicus) is sexually mature at 1 year; in the golden pheasant (Chrysolophus pictus) the male bird is not mature until 2 years whilst the hen breeds at 1 year. Differential sexual maturity between the sexes may be an adaption to limit breeding between siblings and so disperse the gene pool.

Hybridization occurs between some species. The grey jungle fowl (Gallus sonneratii) hybridizes with the red jungle fowl (G. gallus), and of course the latter will breed with domestic chickens. The grey hen (Lyrurus tetrix) will hybridize with the male capercaillie. Some other hybrids may occur between some species of wild grouse.

Basic biology
The Galliformes are mainly terrestrial birds, and are found in a variety of habitats (Table 13.1). However, all these birds feed mainly on the ground, searching for food by scratching with the feet (except for the eared and monal pheasants, which prefer to use the beak for digging) for seeds, fallen fruit, nuts, roots and invertebrates. The latter are particularly important for growing chicks. Some adult birds are more specialized feeders, such as red and willow grouse, which eat freshly growing shoots of heather (Calluna spp.); the spruce grouse, which consume pine shoots; or the sage grouse, which feed on sage tips (Artemisia spp.).
Although spending much of their time on the ground, Galliformes, except for those species inhabiting treeless landscape (tundra, moorland, prairie or desert), all prefer to roost in trees.

In all cases the nest is simple, with the grouse, guinea fowl and quail being satisfied with a scrape in the ground. Pheasants and turkeys will embellish the scrape with a few leaves or twigs. In all cases, the eggs are white or monochrome. Average clutch size and incubation times are indicated in Table 13.2. The downy chicks are nidifugous and able to feed themselves from the time of hatching. In all cases the remiges of the chicks grow rapidly, and all chicks can fly before they are fully grown. Quail fly at 7 days and grouse at 10 days of age, whilst wild turkey chicks are 2 weeks old before they fly.

Husbandry

Housing

All Galliformes need dry frost- and weatherproof shelters or huts placed away from prevailing wind and direct hot sunshine. Some species, such as the Siamese fireback pheasant, are particularly liable to frostbite. For some species the birds need to be indoors in more substantial buildings supplied with supplementary heating during the winter months: this applies to bobwhite and Chinese quail and also to Palawan peacock pheasants. Some guinea fowl and francolins also need good winter protection, although the helmeted guinea fowl, a domesticated bird, is fairly tough provided it has frost protection. In contrast, some of the pheasants (such as Swinhoe’s, silver, golden, Lady Amherst’s and monal pheasants) are much more hardy and need only an open-fronted shelter with high off-the-ground perches, situated away from direct wind and hot sunshine. The common peafowl is also a hardy bird, in contrast to the green peafowl and the Congo peafowl, both of which need good protection and supplementary heat in severe winter weather.

All shelters and housing should provide appropriate perches, which, in the case of Reeves’s and argus pheasants and peafowl, need to be well above ground level so that the long tail feathers do not become damaged. Also, all such shelters and housing should be attached to suitably sized and spacious aviaries. These should provide a minimum of 2–3 square metres of floor space per bird for birds the size of pheasants. About half this floor space should be provided for shelter accommodation. Outside aviaries should be on dry and well-drained ground and preferably have a concrete base, which can be covered with a good layer of sand or peagravel that can periodically be cleared out. However, some species (such as the eared and monal pheasants) like to dig with their beaks in the ground in search of roots and invertebrates. This activity helps to maintain the beak to the correct length, and if these birds cannot dig the bill tends to become overgrown.

The mesh of aviaries should be small enough to prevent the entry of rodents and small predators such as rats and weasels. Loose nylon fish netting placed across the top of an aviary (height approximately 2 m) instead of the more rigid wire netting may help to prevent startled birds that suddenly take off from injuring themselves by collision with an unyielding obstruction.

Galliformes do not require water in which to bathe, but most species appreciate a dust bath. Dust baths are particularly important for francolins and Roul Roul partridge.

The aviary can be provided with suitable plants, shrubs and grasses, preferably planted in tubs or shallow pots. These will give some shade and security, enabling birds to hide if they feel the need. This facility is particularly appreciated by such species as Bob White, harlequin and rain quail.

Mixed species aviaries

In general it is not good avicultural practice to mix species, although with experience and foreknowledge large mixed aviaries can successfully be maintained. In mixing species there is always a risk of inter-species aggression. There is also the danger of the transmission of infectious disease from a species that is relatively resistant and a latent carrier of a pathogen to a species that is much more susceptible (e.g. turkeys can be latent carriers of Histomonas, to which other species are more susceptible).

Intra- and inter-species aggression

Jungle fowl usually mix well with any of the pheasants, and most pheasants and the blue and California quail are safe with arboreal Passeriformes. In contrast, bobwhite quail, Japanese quail and partridges are not safe with any other birds. The Chukar partridge will even attack larger species. The male green peafowl is a particularly aggressive bird which not only attacks other birds but also mammals and even humans, using its spurs with devastating effect. In some species the male birds are not safe even to members of their own species, especially to the chicks when the cock bird is in breeding condition. This applies to blue, Californian and Chinese painted quail, and also to the monal pheasants. The cock silver pheasant will try to fight through the wire of an adjoining aviary, and some monogamous grouse will even attack the female bird if the two are confined in too small an aviary. Breeding pairs of some species need to be housed out of sight and sound of similar pairs. In contrast to these aggressive species, all species of guinea fowl do much better if kept in family groups.
**Table 13.2** The breeding biology of representative species of Galliformes

| Genera/species                        | Mono- or polygamous | Clutch size | Incubation time in days | Particular characteristics and any special requirements                                                                 |
|---------------------------------------|---------------------|-------------|-------------------------|--------------------------------------------------------------------------------------------------------------------------|
| PHASIANIDAE                           |                     |             |                         |                                                                                                                           |
| With few exceptions (where indicated) mostly polygamous in captivity: one male to four or five females. |                     |             |                         |                                                                                                                           |
| Gallus sp. (jungle fowl)              |                     | 5-10        | 20-21                   | Most pheasants do not make good mothers. They tend to scatter the eggs. Many semi-domesticated species have lost their normal breeding behaviour and the eggs have to be artificially incubated. |
| Lophura sp.                           |                     |             | 22-27                   |                                                                                                                           |
| (silver pheasant                      |                     |             |                         |                                                                                                                           |
| Swinhoe's pheasant                    |                     |             |                         |                                                                                                                           |
| Siamese pheasant                      |                     |             |                         |                                                                                                                           |
| Crossoptilon sp. (white, brown and blue eared pheasants) |                     | 4-12        | 24-28                   |                                                                                                                           |
| Syrmaticus sp. (Reeve's pheasant)     |                     | 8-12        | 24-25                   |                                                                                                                           |
| Chrysolophus sp. (golden and Lady Amherst's pheasant) | Monogamous | 6-12        | 23-24                   | Good mothers: the female matures at 1 year, the male at 2 years. Both sexes quite aggressive during breeding season.       |
| Tragopinae, e.g. Satyr tragopan       | Monogamous          | 4-10        | 27-37                   | Often nests in trees. May need to incubate the eggs artificially.                                                            |
| Lophophorinae, e.g. Himalayan monal pheasants | Monogamous | 4-6         | 27-28                   | Male bird aggressive to female and needs a large aviary.                                                                  |
| Argusianinae, e.g. peacock pheasants  |                     | 2           | 18-23                   | All species can be difficult breeders. Both male and female pheasants will defend breeding territory.                    |
| Argus pheasants                       |                     |             | 24-25                   | It is wiser to restrict the time the male is left with the female.                                                           |
| Parvoninae: Parvo sp. (common peafowl) |                     | 3-8         | 28-30                   | Male matures at 3 years, female matures at 2 years.                                                                      |
| Green peafowl                         |                     |             |                         | Male green peafowl are very aggressive.                                                                                    |
| Afroparvo sp. (Congo peafowl)         | Monogamous          | 3-4         | 26-27                   | Nest in trees.                                                                                                             |
| Tetraonidae, grouse: willow/red grouse, ruffed, hazel, spruce and blue grouse, rock ptarmigan | Monogamous | All are monogamous | All species a minimum of 9 with some species laying up to 30 | The wild species will hybridize if a male of the same species is not available but that of a related species with similar plumage and behavioural characteristics is at hand, e.g. female capercaillie will mate with a male blackcock |
| Family | Species | Breeding System | Eggs/Year | Notes |
|--------|---------|----------------|-----------|-------|
| **Galliformes** | Black grouse, sharp-tailed and sage grouse, capercaillie, prairie chicken | All are polygamous and associate in lecking grounds | 5–15 | 24–29 |
| | Meleagridinae: common turkey, ocellated turkey | Polygamous | 8–15 | 28 |
| | Perdicinae: Coturnix sp. (Japanese, harlequin, rain quail) | May be polyandrous in the wild | 6–14 | 24–29 |
| | Exafactena sp. (Chinese painted quail) | | 5–12 | 16 |
| | Partridges: Rollulus sp. (Roul Roul, crested green and wood partridge) | | 2–4 | 18–20 |
| | Alectoris sp. (red-legged and Chukar partridge) | Monogamous | 8–16 | 24–26 |
| | Galloperdicine: Francolinus sp. (black francolin) | | 4–8 | 19–23 |
| | Odontophorinae: Callipea sp. (blue quail) | | 10–12 | 22–23 |
| | Lophortyx sp. (Californian quail) | | 10–15 | 22–23 |
| | Colinus sp. (bobwhite quail) | Captive varieties are partially polygamous; one male to two females | 6–30 | 22–25 |
| | NUMIDIDAE: Acryllium sp. (vulturine guinea fowl) | Polygamous | 8–20 | 23–28 |
| | Numida sp. (helmeted guinea fowl) | | 8–20 | 24–28 |
Diet and feeding

The diet provided for captive birds should be as near to their natural diet as possible. However, apart from the domesticated species (domestic chickens, turkeys and, to some extent, guinea fowl, quail and reared pheasants and partridge) for which commercial diets at various age ranges, etc. are available, little scientifically based information is documented. Much of the following data is derived from the practical experience of aviculturists (Woolham 1987) and the staff of the North of England Zoological Society.

For Galliformes the following general principles apply:

1. Birds should not be overfed. Obese birds do not breed. Captive grouse species do better if the diet has plenty of roughage during the winter non-breeding period.
2. Protein needs to be increased during the breeding season and for growing chicks, then gradually reduced.
3. Any changes to the diet should be made gradually, since all birds tend only to accept food that they recognize.
4. Commercial poultry foods containing coccidiostats may upset the caecal autochronous flora of some species for which they were not designed, and may even prove toxic.
5. Growing chicks need abundant live food.
   For instance, in the wild, Chukar partridge and grouse will take many kinds of invertebrates such as small snails, slugs and earthworms, and the larvae or pupa of a variety of insects.
   As the chick grows it gradually changes from a protein-dominated diet to one containing more energy-producing constituents, which again reduces as the bird reaches adult weight.
   As an alternative to live food, some aviculturists use cottage cheese or hard-boiled egg for growing chicks.

The following give an indication of suitable diets for more specific groups of Galliformes.

Diet A – suitable for adult pheasants, monals, guinea fowl, wild turkeys, jungle fowl and peafowl

Equal parts of cereal grains composed of wheat, maize, corn and barley together with game bird pellets. It is probably best to feed late in the day and let the birds actively search the ground for food early in the day.
Some green food such as spinach, cabbage, lettuce, diced carrot, dandelion leaves, clover, chickweed, chives and wild berries (e.g. rowan and bilberry) should be included.

Diet B – suitable for Californian, blue, bobwhite and Japanese quail

Four parts of plain canary seed (i.e. mixed millet), four parts of chick starter crumbs, three parts of wheat, three parts of split or kibbled maize (i.e. corn) and one part groats (i.e. crushed oats). Some fresh green food such as cress, spinach leaves and a little lettuce should also be included. A vitamin–mineral supplement manufactured for avian species should also be given.

This diet can also be used for Chukar and red-legged partridge, francolins and peacock pheasants if some live food and wild berries (when available) are added. Live food, either by itself or mixed with a commercial live food substitute (e.g. Nekton Products), can be used. Suitable live food includes mealworms reared on a bran diet, wax moth larvae (these are soft bodied and easily digestible), crickets, locusts and fruit flies. Note that both mealworms and maggots pupate and eventually produce adult insects and, if maggots are fed to birds kept inside, the flies will infest the building. Maggots are probably best avoided because of the danger of botulism, especially if they have been cultured on carcasses. If they are used, let the maggots pupate and then feed the pupae to the birds; however, it may take birds some time to recognize these pupae as food.

Diet C – suitable for harlequin and Japanese painted quail (i.e. the smallest Galliformes)

Three parts of each of canary seed, yellow millet, white millet and panicum millet. Green food and a vitamin–mineral supplement should be included as in Diet B.

This diet is also suitable for the Roul Roul partridge if some mixed fruit (for example, four parts diced pear or apple together with three parts sliced tomato and one part sliced grape) is included. Live food should also be provided as in Diet B.

Diet D – suitable for tragopans, captive grouse species and snowcocks

All these birds feed almost entirely on fairly coarse vegetation. They can be fed on branches of willow and birch (catkins and leaves), raspberry plants (leaves and berries), grass, berries, fresh vegetables, fruit (apple), spinach, lettuce and cucumber. A little grain (e.g. oats) or commercial game bird pellets can be added.

General

All species need an adequate supply of mixed composition grit of a size suitable for the particular species concerned. This should regularly be completely changed, as the birds tend to select the parts they require. Mixed grit should be composed of limestone chips, oyster shell and cuttlefish bone.
The management of red grouse on grouse moors

Unlike pheasants and partridge, grouse for game shooting cannot be reared and subsequently successfully released onto the moor. Numbers of grouse for shooting have to be encouraged by the management of their natural habitat. Red grouse feed predominantly on heather (Calluna vulgaris and Erica spp.), but will also eat the shoots and flower heads of other plants and the berries of bilberry (Vaccinium spp.). The flower heads of cotton grass (Eriophorum spp.), which is really a sedge and not a grass, are particularly important for the egg-laying female bird, as the plant contains twice the amount of crude digestible protein as heather.

To encourage the new growth of heather for the grouse to feed on, controlled burning of the plant takes place in the late winter or early spring. The top growth is burnt off, leaving the root stock unharmed. The heather is fired in strips approximately 40 m wide, and this is carried out on a 12–15-year cycle so that a patchwork of varying growth is produced. Fresh nutritious shoots are produced in the spring, whilst taller stands of heather are left for cover in which the grouse can nest. Mammals, especially sheep, carry ticks (Ixodes ricinus), and these arthropods carry louping ill virus, which affects both sheep and grouse. The population density of ticks varies regionally, and is affected by moisture, temperature and the underlying vegetation. In some regions louping ill in grouse can be reduced by vaccinating the sheep. In other areas the ticks are maintained at too high a density by feeding on deer, hares and other small mammals.

Another important factor affecting the numbers of grouse on the moor is predation. Predators have traditionally been controlled by gamekeepers, but this activity is now limited in the UK by the Wildlife and Countryside Act 1981. Principal among the predators is the fox, the numbers of which tend to be influenced by the availability of rabbits. The peregrine falcon (Falco peregrinus) is also an important predator, as is the occasional hen harrier (Circus eyaneus). Both bird species are fully protected by law in the UK.

Grouse numbers are influenced by the nematode Trichostrongylus tenuis, which infects the birds’ caeca and can prove fatal in heavy infections – or at least reduce fertility in female birds. Heavily parasitized birds are also more liable to predation. Survival of the parasite is favoured by warm, moist conditions, and its numbers tend to rise as the grouse population increases. The larvae of the worm crawl up the heather plants and are ingested by the grouse.

In conclusion, it can be appreciated that the numbers of grouse on the moor can be affected by a complex web of influences. These include the many single-interest human activity groups such as sheep farmers, foresters, deer stalkers, hill walkers, bird protection societies interested in the protection of falcons and hen harriers and, of course, the gamekeepers.

Pheasant and partridge management on shooting estates

During the nineteenth century large numbers of grey partridge (Perdrix perdix) were shot as game birds on big private estates in the UK, and hand rearing of some birds occurred up to the beginning of the Second World War. However, with the reduction in the numbers of gamekeepers employed together with the legal restrictions of the Wildlife and Countryside Act 1981 (amended by the Countryside and Rights of Way (CRoW) Act 2000 in England & Wales and the Nature Conservation – Scotland – Act 2004), there has been a consequent increase in the numbers of natural predators such as foxes, stoats, weasels and aerial raptors. This change has occurred simultaneously with changes in farming practice, such as the removal of hedgerows and the marginal land surrounding arable crops, and the intensive use of selective herbicides to control weeds – which has at the same time reduced insect food suitable for partridge chicks. Furthermore, all types of insect life have been reduced by the use of pesticides on crops. The net result is fewer and less-suitable cover and nesting sites for partridge, with little, if any, insect larvae for growing chicks.

Grey partridge are not an easy species to rear in captivity and release successfully. On the other hand, the red-legged partridge (Alectoris rufa) is in some ways less vulnerable to these changes and easier to hand rear. The chicks are much less dependent on insect food from the time of hatching, and will eat grass and search for weed seeds. Red-legged partridge hens will lay two separate clutches of eggs, one of which she will incubate whilst her mate, the cock bird, simultaneously incubates the second clutch. Productivity is therefore doubled. In the wild, however, red-legged partridge are not so good at hiding their nests, so they are more susceptible to predation. Up until 1992, red-legged partridge were crossed with the related Chukar partridge (Alectoris chukar) and the hybrids were very successfully released; however, this practice has now been stopped because it was having a detrimental effect on wild-bred red-legged partridge.

Undoubtedly the most important game bird to be hand reared in large numbers is the common pheasant (Phasianus colchicus). These birds can be reared intensively using the techniques of the commercial poultry industry, with artificial incubators and large hatchers dealing with up to 1500 eggs at a time. The newly hatched chicks can then be placed in heated brooders and gradually given access to outside runs. They are subsequently placed in release pens at 6–7 weeks, where they can familiarize themselves with the surrounding habitat. Eventually the birds are released into suitable
woodland and game crops. Throughout this period the chicks will be fed on a variety of commercially developed diets, and some feeding often continues after release to retain birds on the estate. Many pheasants still breed in the wild on shooting estates, particularly where farming practices are such that suitable cover for nesting birds is provided and the ground living predators controlled, and where modern farming procedures have not devastated the insect life.

A suitable balance between hand-reared and wild-bred birds has to be maintained, as evidence suggests that artificially reared birds are not so viable for the following reasons:

1. Truly wild birds are more alert and will react quicker to predators.
2. Wild birds take and survive better on a greater range of wild foods.
3. Hand-reared birds are less resistant to the parasite *Heterakis* spp.
4. Muscle development in hand-reared birds is heavier and take-off flight is therefore less rapid and at a shallower angle.

In the past game birds’ eggs have been incubated and hatched under bantam hens, but it has been shown that the behavioural responses to predator attack learned from the bantam hen may be inappropriate to the game bird chick; hence mortality rates were higher.

When investigating disease in all game birds, it is essential that the veterinarian takes a broad holistic view and is aware of the complexity of environmental influences on the overall health of these birds.

### Breeding and sexing Galliformes

Most species of Galliformes are markedly sexually dimorphic, with the male having more colourful plumage, often a larger body size, a longer tail and the presence of combs or wattles. In a few species of Phasianidae, which are not so easy to distinguish, the cock birds have spurs on their legs. In guinea fowl that are not sexually dimorphic the male usually has a voice with a greater range of sound, and in the helmeted and plumed guinea fowl the appendage on the head is slightly larger. In many Old and New World quail, the sexes are similar in appearance but have behavioural differences. Most galliform chicks are not sexually dimorphic and can only be sexed, like domestic poultry, by the meticulous examination of the cloaca by a skilled technician. However, grouse chicks are distinguishable, the males being slightly larger.

Some species of Galliformes are monogamous, whilst in other species a cock bird can be kept with several hens. In some species the cock birds are particularly aggressive during the breeding season, not only to other species of birds but also to their own hen birds – particularly if they can see or hear another cock.

### Some general principles when breeding Galliformes

1. When introducing a new cock bird to an unfamiliar hen, always place the hen in the aviary first.
2. Many male birds will chase the female during normal courtship behaviour, but the female does need a sufficiently large aviary to escape if she so desires. It also may be helpful to clip the cock bird’s wings. If there is a definite difference in size between male and female, the two sexes can be kept in adjoining aviaries with a connecting passage only just large enough for the hen bird to pass through. This system can be used for capercaillie.
3. Most Galliformes lay their eggs in a primitive nest on the ground but some species are tree nesters, and these should be provided with a flat wooden tray or basket containing hay, moss and dried leaves and situated approximately 1–2 m above the ground level. Typical tree-nesting species include the Congo peafowl, bronze-tailed peacock pheasant and crested argus pheasant. All nesting sites, whether in trees or on the ground, should be provided with visual security.
4. In some species, greater breeding success is achieved if the eggs are incubated artificially. Such species include the New World quail, blue quail, Californian quail, bobwhite quail and also Japanese quail from the Old World.
5. Fostering using a broody bantam or Japanese silky hen to incubate and rear the chicks is a practice used by many aviculturists when a particular species is difficult to breed in captivity. If the foster hen is sitting quietly and tight, her eggs are exchanged for those to be hatched after 3 days. Species where this technique has been used include the common pheasant, partridges (Chukar, red-legged, Roul Roul and green wood), tragopans and Palawan peacock pheasants, and grouse.
6. After the chicks have hatched and dried, they should be placed in boxes approximately 50 × 100 cm with a heat source so as to maintain a floor temperature of 40°C. A 150 W infrared lamp can be used. Damp cloths can be used on the sides of the box to maintain a relative humidity of 60%. Placing the chicks on towels (changed frequently) spread on the floor will help to prevent splayed legs. After 8–12 days, the chicks can be placed in a large rearing pen outside if the weather is suitable. This is best provided
with a wire mesh floor to prevent slipping and splayed legs.

**The investigation of infertility in a breeding pair of birds**

1. In some birds, particularly grouse, the hen chooses the cock bird with which to mate. If the male bird provided is not of her choice or is incompatible, mating will not take place even though infertile eggs may be laid.

2. If male or female have recently been acquired from different countries which are at different latitudes so influencing the number of daylight hours, even if the birds are of the same species, their breeding cycles may not be synchronized so that they may not breed.

3. If two cock birds spend all their time fighting through the wire of their adjoining aviaries, they may not have time to mate with their hens.

4. The age and general condition of the bird should be considered. Aged and particularly obese hens do not breed.

5. Finally, infectious disease should be ruled out.

**Disease in Galliformes**

The important infectious diseases of Galliformes are listed in Table 13.3 and organized according to their presenting clinical signs. Each disease in these notes has been numbered to make cross-referencing easier.

**Considerations when investigating disease**

First consider whether the problem is primarily management related or a serious epizootic disease of birds. The latter, particularly viral infection, is usually seen in birds kept in flocks through which disease can spread rapidly.

Rarely is any disease syndrome entirely due to a single pathogen. Often bacteria isolated and identified on a culture may not be the primary pathogen but are only secondary invaders. Usually the condition originates from a multiplicity of causes, some of which may be management related. It is essential to consider all possible predisposing factors.

Standards of hygiene are not always high, nor is prophylactic vaccination or regular systemic control of parasites always routinely carried out. However, it should be noted that current thinking by some workers is that an ongoing low level of parasitic infection may be conducive to a healthy immune system in the host.

**Management problems**

Inadequate housing, hygiene and diet can predispose to disease.

**Inadequate housing**

Housing must be suitable for the species. Some species require supplementary heating in winter. Overcrowding of birds in a corner of a house in cold weather not only results in smothering but can also lead to a localized build-up of ammonia fumes, causing coryza, corneal ulceration, blindness and a predisposition to respiratory problems. Accommodation should be completely wind- and weather-proof. Perches must provide adequate space between perched birds, be periodically renewed and be the correct height from the ground. There should be sufficient floor space and space in the outside aviaries. Overcrowding leads to increased stress, aggression, feather picking and cannibalism, which in some cases may need to be controlled by plastic spectacles or beak clipping. Overcrowding in aviaries can also result in an unsustainable parasite load. However, in cases with low parasite levels and in otherwise healthy stock this can sometimes confer a degree of resistance to parasitism.

**Hygiene**

Before new stock is introduced the housing should be thoroughly cleaned out and disinfected and the outside aviaries sufficiently rested so they become free of living parasites or their eggs. Very many pathogens (see disease Nos. 3, 4, 6, 7, 10, 12, 18, 19, 20, 21, 22, 23, 25, 27, 28, 29, 30, 35, 38, 44, 45, 48, 70, 76 and 77 in Table 13.3) are environmentally persistent in dirty wooden buildings with faeces, exudate and fomites. Water supplies and food containers easily become contaminated, particularly by some pathogens (e.g. disease Nos. 2, 4, 6, 10, 17, 22, 23, 37, 38, 52, 54 and 70). Invertebrate vectors may help in maintaining disease in empty enclosures by either transmitting or themselves causing disease (e.g. disease Nos. 12, 15, 34, 47, 49, 66, 67, 70 and 77). Vermin and wild free-living wild birds may carry disease, and can infect an aviary with their faeces or exudate if these are allowed to enter the bird enclosure (e.g. disease Nos. 4a, 6, 20, 23 and 39).

**Diet**

This must be adequate in quantity and properly balanced, particularly for the growing stage of chicks or in relation to the breeding cycle. Food should be stored properly so that it is not mouldy or contaminated with the droppings of vermin or with forage mites (note: some mycotoxins, besides being overtly poisonous, can be immunosuppressive). A sudden increase in the number of cases of visceral gout in a flock may be the result of a faulty water supply or dietary imbalance. All fresh vegetables must be adequately washed (they may be contaminated by wild bird faeces, very small minute molluscs, industrial aerial pollution, pesticides or herbicides used during cultivation).
### Table 13.3  Avian diseases

| No. | Disease | Primary cause | Species susceptible | Particular disease characteristic | Diagnosis |
|-----|---------|---------------|---------------------|-----------------------------------|-----------|
| 1.  | **Mycoplasmosis** ('roup') | *Mycoplasma* spp. Many species and strains. Primary spread by close contact. Latent carriers. Turkeys are infected venereally | All species of Galliformes | May be an asymptomatic infection. This is often a secondary infection but may govern the severity of the disease process. Usually the infraorbital sinuses are swollen, but the bird’s joints may also be affected | PM, histopathology, serology, culture (use special transport media) |
| 2.  | **Chlamydophilosis**  
Ornithosis.  
Important zoonosis | *Chlamydia* sp. Several strains. Intermittently shed in faeces | All Galliformes but particularly turkeys | Respiratory signs may be accompanied by diarrhoea. Some birds may exhibit only a vague debility | PM, note particularly an enlarged spleen, histopathology, serology, cytology, culture |
| 3.  | **Infectious laryngotracheitis** | Herpesvirus carried by latently infected birds. Can persist in fomites for at least 3 months | Mainly chickens and pheasants but also pheasants and turkey poult | Can be a mild or subclinical to a severe infection with birds having extended head and neck, gasping for air. May die in 2–3 days. The sinuses may be swollen (compare to No. 1) and the birds may cough a bloody mucus. Oropharynx and trachea may show diphtheritic membranes | PM, histopathology, virus isolation |
| 4.  | **Newcastle disease**  
(fowl pest)  
Zoonosis | Group I paramyxovirus. Virus is contained in infected faeces | All species of Galliformes, particularly backyard fowl. All grouse tend to be fairly resistant and in partridges the infection may be asymptomatic | Respiratory signs may be accompanied by a greenish, watery diarrhoea and some birds exhibit CNS signs. Grouse may only show a conjunctivitis together with loss of weight | PM, serology, virus isolation |
| 4a. | **Pigeon paramyxo disease**  
 grup I paramyxovirus (pigeon variant) | Can affect chickens, pheasants and peafowl | In UK many wild pigeons are carriers. Signs similar to Newcastle disease |
| 5.  | **Turkey rhinotracheitis**  
(swollen head syndrome) | Pneumovirus. Related to the paramyxoviruses | Principally turkeys but also pheasants, chickens, guinea fowl. Can cause egg drop in chickens | Upper respiratory signs with swollen sinuses (compare to Nos 1 and 3) and conjunctivitis. Morbidity and mortality can be high | PM, serology, virus isolation |
| 6.  | **Avian influenza**  
(fowl plague of the 1890s; also known as ‘fowl pest’)  
An important zoonosis, strains such as H5N1 may cause pandemics after occurrence of antigenic shift primarily occurring after virus has infected pigs | Influenza A viruses. Many strains (varying combinations of the 16 haemagglutinin binding factors and the 9 neuraminidase characters) of the virus. Environmentally stable in faeces and static water. Free-ranging domestic and wild fowls act as a reservoir of the virus | All Galliformes but particularly farmed poultry also pheasants, and Japanese quail. May also infect a number of mammalian species including domestic cats, dogs, horses, cetaceans, mustelids (e.g. otters, pine martens), fox and possibly other fur-bearing animals | The subtypes (H and N) of the virus are continually changing so that morbidity and mortality (high and low pathogenic types) vary together with secondary infections. Massive sudden die-offs can occur. Respiratory signs vary from mild to severe. Oedema of the head and neck may occur (compare to Nos. 1, 3 and 5) as well as egg drop syndrome | PM, virus isolation |
| No. | Disease                          | Primary cause | Species susceptible | Particular disease characteristic                                                                                                                                                                                                 | Diagnosis                                      |
|-----|----------------------------------|---------------|---------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------|
| 7   | Fowl adenovirus (vent gleet)     | Group I fowl adenovirus | Chickens, particularly backyard fowl, also guinea fowl and Japanese quail and pheasants | Infection can be subclinical to a moderately severe respiratory disease accompanied by mucoid pasty white droppings causing an offensive smell and adherent to the vent. Mortality can be 10–30%. There may be an egg drop syndrome. Guinea fowl can develop a pancreatitis or marble spleen-like disease (No. 9). Pheasants may die suddenly with no premonitory signs. | Serology, virus isolation, PM, histopathology (oviduct) |
| 8   | Quail bronchitis                 | Group I adenovirus | Bobwhite quail      | 100% of very young chicks under a week old may suddenly die. Older chicks up to 6 weeks show severe respiratory signs with greenish diarrhoea and the occasional dropped wing and die in 24–48 hours. | Serology                                       |
| 9   | Marble spleen disease            | Group II adenovirus | Pheasants, guinea fowl, chickens | This is not primarily a respiratory infection but the grossly enlarged spleen may cause dyspnoea through pressure on the air sacs (see No. 27 for more detail).                                                                 | See No. 28                                    |
| 10  | Infectious bronchitis (blue comb of turkeys) | Coronavirus. Virus shed in faeces, spreads in contaminated water and food or from poultry-manured fields. Different serotypes in chickens, pheasants, guinea fowl, Japanese quail, turkeys | All Galliformes but particularly pheasants | Respiratory signs may be mild with only a drop in egg production. Pheasant chicks (8–10 weeks) may sustain a 40% mortality. Guinea fowl may develop an enteritis and pancreatitis and chicks as young as 3 days old may die but are usually protected by maternal antibody. | PM, serology                                   |
| 11  | Aspergillosis (brooder pneumonia) | Aspergillus fumigatus | All Galliformes, particularly turkey and pheasant | Usually seen in chicks up to 4 weeks old. Can vary from sudden death to a chronic wasting disease with some respiratory signs. Occasional paralysis in older birds.                                                                 | PM, serology, culture                          |
| 12  | Syngamiasis (gapes)             | Syngamus spp. Transport hosts, e.g. earthworms, slugs and beetles | All Galliformes particularly those in overstocked grass aviaries | Typical gasping for air (compare to No. 3) cough, head shaking, anorexia and loss of condition. Usually individual birds affected sporadically.                                                                                                                                                  | Faecal exam, visual exam                      |
| 13  | Trichomoniasis                  | Protozoan      | All Galliformes but particularly pheasants | Dysspnoea may result from exudate obstructing the airway (see No. 36).                                                                                                                                                         | See No. 36                                    |

(continued)
| No. | Disease                                | Primary cause                                                                 | Species susceptible                      | Particular disease characteristic                                                                 | Diagnosis                           |
|-----|----------------------------------------|-------------------------------------------------------------------------------|------------------------------------------|--------------------------------------------------------------------------------------------------|-------------------------------------|
| 14. | Crytosporidiosis                       | A coccidial protozoan parasite which grows on all mucosal epithelia. Ingestion or inhalation of sporulated oocyst. Resistant to many disinfectants | Recovered from the respiratory tract of many Galliformes | May be a primary pathogen but often a secondary invader of immunosuppressed birds causes inflammation and typical upper respiratory signs also diarrhoea (see No. 32). | PM, faecal exam (Giemsa stained)    |
| 15. | Avipox                                 | Fowl pox virus infects pheasants and peafowl. Qual pox distinct virus but can infect chickens and turkeys. Biting insects may act as transport vectors | All Galliformes                           | Lesions on skin dry. Diphtheritic lesions on respiratory mucosa. May cause severe respiratory signs and death. May be egg drop. Can cause up to 30% mortality in quail | Culture, cytology                   |
| 16. | Infectious coryza                      | *Haemophilus* spp.                                                            | All Galliformes but usually chickens, turkeys and pheasants | Often cultured as a secondary infection from other primary disease. Signs include rhinitis, sinusitis, air sacculitis and pneumonia | PM, culture                         |
| 17. | Turkey coryza                          | *Alcaligenes* spp. *Bordetella* spp. Shed in faeces and contaminate water and food supply | Usually turkeys                           | Opportunistic pathogens, sometimes occurring as secondary invaders associated with turkey rhinotracheitis (see No. 5) | Culture                             |
| 18. | Cryptococcosis, torulosis, blastomycosis, histoplasmosis. A zoonosis | Saprophytic fungus which may occur in old wooden and insanitary avanes. Inhalation of spores | All Galliformes                           | Can cause gelatinous granulomatous lesions on the mucous membranes of respiratory and gastrointestinal tracts. Also systemic lesions in the viscera. Individual birds affected sporadically | Faecal exam, culture, histopathology |
| 19. | Avian mycobacteriosis                  | *Mycobacterium avium*                                                         | All Galliformes                           | Peafowl are documented as having been presented with rattling sounds due to granulomas in the trachea (see No. 69) | Culture, histopathology             |
|     | A zoonosis particularly in immunosuppressed humans |                                                                                |                                          |                                                                                                   |                                     |

Many commonly known bacteria such as *Staphylococci* spp., *Streptococci* spp., *E. coli* and *Klebsiella* spp. act as secondary invaders of avian respiratory disease.

### Diseases primarily presented with signs of alimentary disorder (i.e. diarrhoea in varying forms) occasionally vomiting accompanied sometimes by malaise and loss of condition

| No. | Disease                                | Primary cause                                                                 | Species susceptible                      | Particular disease characteristic                                                                 | Diagnosis                           |
|-----|----------------------------------------|-------------------------------------------------------------------------------|------------------------------------------|--------------------------------------------------------------------------------------------------|-------------------------------------|
| 20. | Salmonellosis. Zoonosis                 | *S. typhimurium, S. enteritidis*. Faecal dust, carriers: wild birds, rodents. Vertical transmission and latently infected birds | All Galliformes, particularly backyard fowl | Depression and diarrhoea, resulting in death but death may occur without any premonitory signs | PM, culture                         |
| 21. | Pullorum disease, bacillary white diarrhoea | *S. gallinarum, S. pullorum*. Latent carrier birds. Poor hygiene           | All Galliformes, but common in backyard fowl | Enteritis, malaise. In pullorum disease malformed ovules occur in the ovary, also enlarged liver and spleen | PM, culture, serology               |
| No. | Disease                  | Primary cause                                                                 | Species susceptible                  | Particular disease characteristic                                                                 | Diagnosis                        |
|-----|-------------------------|-------------------------------------------------------------------------------|--------------------------------------|--------------------------------------------------------------------------------------------------|----------------------------------|
| 22. | Coli bacillosis.        | *Escherichia coli*. Ingestion and inhalation of faecal dust. Some strains produce a potent toxin. Can be a primary or secondary pathogen | All Galliformes, but particularly backyard fowl. Also turkeys, peafowl, partridge and capercaillie | Coliform septicaemia may cause acute deaths or a brownish diarrhoea with stunted growth and poor feathering. Birds may develop coliform granulomas in the liver and spleen and a peritonitis and air sacculitis due to coli septicaemia. | PM, culture                      |
| 23. | Campylobacteriosis.     | *Campylobacter* spp. Many serotypes shed in faeces, which contaminate food and water supplies. Poor hygiene | All Galliformes | Weight loss, yellowish, sometimes bloody diarrhoea (caused by hepatosis) and eventual death. At PM, focal necrosis of the liver. Spontaneous recovery and relapse are not uncommon. Spread through a flock is often slow. | PM, culture (special transport media) |
| 24. | Clostridial enterotoxaemia | *Clostridium perfringens* | All Galliformes but particularly game birds, i.e. grouse and New World quail | In young birds (10 days and over) a haemorrhagic enteritis leads to bloody diarrhoea with polydipsia and death. In older birds the infection is more chronic with gradual weight loss before death. At PM, hepatomegaly and necrotic enteritis. | PM, culture, toxin identification |
| 25. | Chlamydophilosis.       | *Chlamydia* sp. Intermittently shed in faeces.                               | All Galliformes, but only well documented in turkeys | Diarrhoea, respiratory signs, unthriftiness (see No. 2). | See No. 2                        |
| 26. | Newcastle disease.      | Group I paramyxovirus, also Group I paramyxovirus (pigeon)                  | All Galliformes | May be a greenish diarrhoea together with or without respiratory and CNS signs (see Nos. 4 and 4a) | See No. 4                        |
| 27. | Fowl adenovirus disease | Group I fowl adenovirus. In faeces. Persistent in the environment. Hygiene important | Chickens, guinea fowl, Japanese quail | An enteritis with white pasty mucoid droppings adherent to the vent and causing an offensive smell (see No. 7). | See No. 7                        |
| 28. | Turkey haemorrhagic enteritis | Group II adenovirus. Shed in faeces. Very environmentally persistent | Turkeys, chickens, pheasants | Only documented in domesticated birds, not in wild turkeys. Affects young birds from 4 to 12 weeks causing up to 60% mortality. Can be asymptomatic or cause severe and haemorrhagic enteritis. | Serology                         |
| 29. | Pheasant marble spleen disease | Group II adenovirus. Virus may persist in the environment for months. Good hygiene is imperative, particularly in rearing pens | Primarily pheasants, but can also affect guinea fowl and chickens, and blue grouse | Mostly documented in captive birds, not in wild free-living birds but has been documented in blue grouse. Affects young birds 3–8 months old causing highest mortality (i.e. 20%) in young birds. Pheasants may die suddenly or become anorexic, depressed and show diarrhoea and dyspnoea (see No. 9). | PM, serology                     |
| No. | Disease                          | Primary cause                                      | Species susceptible                                      | Particular disease characteristic                                                                 | Diagnosis       |
|-----|---------------------------------|---------------------------------------------------|----------------------------------------------------------|-----------------------------------------------------------------------------------------------------|-----------------|
| 30  | Coccidiosis                      | *Eimeria* spp. Protozoan parasites generally host-specific so cross-species infection does not usually take place. Can be environmentally persistent. | All Galliformes, particularly young birds circa 3 weeks. Adults may act as latent carriers.         | Disease may be exhibited as anything from a vague pathogenic syndrome causing listlessness to a severe enteric disease with mucoid bloody faeces dependent on parasite load and other predisposing causes. | Faecal exam     |
| 31  | Crytosporidiosis. Zoonosis       | *Crytosporidium* spp. A coccidial protozoan.      | All Galliformes                                           | Invades the whole of the alimentary tract, causing diarrhoea and malabsorption (see No. 14).         | See No. 14      |
| 32  | Hexamitiasis                    | *Hexamita* spp.                                   | Turkeys                                                  | Can cause heavy loss in turkey poults around 3 weeks of age, causing diarrhoea and unthriftiness.    | Faecal exam     |
| 33  | Quail herpes or Colinus disease | Herpesvirus                                        | Bobwhite quail under 4 weeks                             | Depression, anorexia and diarrhoea and death in 3-4 days. Focal necrosis of enlarged liver and spleen. | PM, serology    |
| 34  | Histomoniasis (blackhead)       | *Histomonas meleagridis*. A protozoan carried by the ova of caecal worms *Heterakis* spp. Earthworms may act as vector. | All Galliformes but particularly turkeys, pheasants, Partridge if in close contact with chickens. | Yellowish diarrhoea (because of hepatopathy). Sometimes birds just unthrifty. Particularly common without regular deworming. | PM, faecal exam |
| 35  | Helminth worm infestation       | *Ascaridia* spp., *Capilaria* spp. *Heterakis* spp. Ova persist in environment. | All Galliformes                                           | All helmints may cause a mucoid diarrhoea or just general unthriftiness. Occasional sudden death.     | PM, faecal exam |
| 36  | Candidiasis                      | *Candida albicans*. Opportunistic yeast            | All Galliformes, especially young turkeys, partridge and captive grouse. | Primary or secondary pathogen of upper alimentary tract results in delayed crop emptying and vomiting with sporadic death. | Cytology        |
| 37  | Trichomoniasis                  | *Trichomonas gallinæ*. A flagellated protozoan. Thrives in poor hygiene. | All Galliformes, but particularly pheasant chicks in crowded conditions. | Causes cheesy exudate in oropharynx resulting in vomiting, diarrhoea, dyspnoea. Unthriftiness and sporadic death, particularly in chicks. | Cytology        |
| 38  | Gumboro disease (infectious bursitis) | A birna virus disease so called from first identification at Gumboro, USA. Very environmentally persistent in contaminated faeces. | Chickens 3-6 weeks old. Pheasants (up to 80% mortality), turkeys. | Necrotic bursa of Fabricius results in severe immunosuppression resulting in secondary infection. Affected chicks may be anorexic with watery diarrhoea and die. | PM, histopathology, virus isolation |
| 39  | Spirochaetosis                  | *Borrelia gallinarum*. Transport host, ticks. Also sometimes mosquitoes. | All Galliformes. Young chicks 4-8 days reared on rough pasture inhabited by ticks. | May be sudden death or dullness with yellow diarrhoea, ataxia and then death. Mortality up to 100%. Hepatomegaly with necrotic foci. | PM, serology, stained blood smear |
| 40  | Tagoviruses                      | See disease No. 47                                | All Galliformes                                           | Sometimes cause diarrhoea (see No. 47)                                                              | Virus isolation |
| No. | Disease | Primary cause | Species susceptible | Particular disease characteristic | Diagnosis |
|-----|---------|---------------|---------------------|-----------------------------------|------------|
| 41. | Stunting and runting syndrome (viral enteritis) | Reo- and rotaviruses | All Galliformes | Infection sometimes results in diarrhoea (see No. 64) | Virus isolation |
| 42. | Reticuloendotheliosis | Reticuloendothelial virus | All Galliformes | Infection occasionally exhibits signs of an enteritis (see No. 65) | Virus isolation |
| 43. | Helminth worms in grouse | Trichostrongylus tenius. Worm thrives in warm moist heather | Grouse | Worm invades and severely damages the caecal mucosa causing a haemorrhagic enteritis. Birds usually found dead. May be unthrifty with bloody diarrhoea | PM, faecal counts not reliable |
| 43a. | Vitamin C deficiency in grouse chicks | Young growing chicks up to 4 weeks do not produce sufficient endogenous vitamin C. Need to obtain it from wild berries, etc. | Only documented in willow ptarmigan, but may be a factor in other grouse chicks | Weight loss, petechiae in muscles, weakness, enteritis, fractures and bone dystrophia, death | PM |

Diseases presented with clinical signs related to either the nervous or locomotor systems (i.e. torticollis, opisthotonus, dropped or trailing wings, paralysis, lameness, etc.)

| No. | Disease | Primary cause | Species susceptible | Particular disease characteristic | Diagnosis |
|-----|---------|---------------|---------------------|-----------------------------------|------------|
| 44. | Marek’s disease | Herpesvirus. Very environmentally persistent in feather debris. Latently infected chickens maintain infection. Tends to be geographically localized | All Galliformes | Young chicks under 3 weeks rarely affected. Usually affects female birds 6-12 weeks up to time of laying. Lymphoid thickening of peripheral nerves and visceral tumours. Results in lameness, dropped wing, paralysis, emaciation, death. Vaccine breakdowns occur. Compare Nos. 67 and 45 | PM, histopathology, serology, virus isolation |
| 45. | Avian sarcoma leucosis syndrome | Caused by a number of RNA viruses. Very environmentally stable. Disease may flare up in periods of stress. Latently infected birds | All Galliformes, especially chickens and pheasants. In contrast to Marek’s disease (No. 44) usually affects birds over 14 weeks old | Note: partridge and quail affected by a distinct species-specific virus. Female birds more susceptible. Multiple tumours seen throughout body. Clinical signs similar to Marek’s (No. 44) but vary with site of neoplasm. Tumours may cause thickening of legs | PM, histopathology, serology |
| 46. | Newcastle disease (‘fowl pest’). Zoonosis | Group I paramyxovirus, also pigeon variant | All Galliformes, particularly backyard fowl | A variety of CNS signs, together with respiratory and enteric disease signs (see Nos. 4 and 4a) | See No. 4 |
| 47. | Eastern and western equine encephalitis and similar infections. Zoonotic diseases | Togaviruses, EEE and WEE virus. Currently restricted to USA. Similar viruses occur in other parts of the world. Transmitted by biting insects, e.g. mosquitoes, therefore a seasonal disease | All Galliformes. Mortality in turkeys 6%, pheasant 5–8%, quail 40–90%, partridge 30–90% | Can be asymptomatic. Mortality is highest in those species non-indigenous to a region. A variety of clinical signs of CNS as well as anorexia, ruffled feathers, diarrhoea and sudden death | Histopathology, virus isolation |
| No. | Disease                                      | Primary cause                                                                 | Species susceptible                                      | Particular disease characteristic                                                                                          | Diagnosis        |
|-----|---------------------------------------------|-------------------------------------------------------------------------------|----------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------|------------------|
| 48  | Specific avian encephalomyelitis (epidemic tremor) | An entericorna virus shed in faeces. Can persist in litter for years. Both vertical and horizontal transmission | All Galliformes, but not in free-living wild birds | Young birds up to 16 weeks, particularly 2-4 weeks old. Acute epidemic with variety of CNS signs. Survivors exhibit persistent eye lesions. Adult birds show drop in egg production. Note: folic acid deficiency can be responsible for paralysis of the neck in turkey poults | Serology         |
| 49  | Louping ill (so called because infected sheep 'loup' or stagger) | A flavirus, transport host ticks. Restricted to British Isles | Grouse and pheasants on tick-infested rough pasture and woodland also grazed by mammals | Produces a variety of CNS signs. A serious problem on some grouse moors. May be asymptomatic, birds just found dead | Serology         |
| 50  | Turkey meningio-encephalitis virus          | A flavirus, only so far documented in Israel and South Africa. Vector unknown | Turkeys over 10 weeks, mortality 10-80%, also in Japanese quail and chickens | Virus recovered from free-ranging wild birds, causes paralysis and a drop in egg production | Serology         |
| 51  | Fowl adenovirus infection                   | Group I fowl adenovirus                                                                 | Chickens, particularly backyard fowl, guinea fowl, Japanese quail | In addition to other clinical signs, may cause CNS signs (see No. 7) | Virus isolation   |
| 52  | Botulism                                    | *Clostridium botulinum* Toxin, may be contained in maggot-infested carcasses or in sewage | All species, particularly backyard fowl | Not nearly so common in Galliformes as in waterfowl. May cause paralysis, usually found dead | Serology         |
| 53  | Bacterial encephalitis                      | A variety of pathogens and resulting from a systemic infection | All Galliformes | A variety of CNS signs usually with accompanying other clinical signs. Possibly also signs of trauma | Histopathology, PM, culture |
| 54  | Toxins                                      | A great variety of agricultural and industrial chemicals may pollute water supplies or the atmosphere. Misused chemotherapeutics | All species | Free-ranging wild birds may be affected at the same time. A variety of CNS and other clinical signs are seen, often just found dead | Deep frozen, separately wrapped tissues |
| 55  | Reovirus ('stunting and runting' syndrome)  | Reo- and rotaviruses                                                          | All Galliformes, particularly chicks                  | Infection may produce a tenosynovitis and arthritis with enlarged hocks and ruptured gastrocnemius tendons (see No. 64) | See No. 64       |
| 56  | Reticuloendotheliosis                       | Reticuloendothelial virus                                                     | All Galliformes, particularly chickens 3-8 weeks       | Apart from other clinical signs may show lameness, dropped wings and other CNS signs (see No. 65) | See No. 65       |
| 57  | Bumblefoot                                  | A pododermatitis caused by a variety of pathogenic bacteria invading a traumatized foot in unhygienic conditions | All Galliformes, but particularly backyard fowl kept in unhygienic conditions | Swelling of the foot and occasionally the hock. Lameness and loss of condition. Old birds on worn out or unsuitable perches | See No. 65       |
| No. | Disease                                      | Primary cause                                                                 | Species susceptible | Particular disease characteristic                                                                 | Diagnosis                                                                 |
|-----|---------------------------------------------|-------------------------------------------------------------------------------|--------------------|-----------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------|
| 58  | Fractures                                   | Usually caused by rough handling or accident                                   | All Galliformes    | Lameness, paralysis, dropped wing                                                                   |                                                                          |
| 59  | Poultry disease                             | See disease No. 20                                                             |                    |                                                                                                     |                                                                          |
| 60  | Colibacillosis                              | See disease No. 21                                                             |                    |                                                                                                     |                                                                          |
| 61  | Spirochaetosis                              | See disease No. 39                                                             |                    |                                                                                                     |                                                                          |
| 62  | Ornithosis                                  | See disease No. 2                                                              |                    |                                                                                                     |                                                                          |
| 63  | ILT                                         | See disease No. 3                                                              |                    |                                                                                                     |                                                                          |
| 64  | Marek’s disease                             | See disease No. 44                                                             |                    |                                                                                                     |                                                                          |
| 65  | Avian sarcoma leucosis syndrome             | See disease No. 45                                                             |                    |                                                                                                     |                                                                          |
| 66  | Pox virus infection                         | Avipox virus may be spread by biting insects. Virus in faeces. Fowl pox virus infects only chickens, grouse and pheasants. Turkey pox, quail and pheasant pox and peafowl pox viruses infect chickens | All Galliformes. Common in unvaccinated flocks of pheasants. Some free-living wild bird pox viruses infect chickens. E.g. sparrow pox, starling pox, magpie pox, some pigeon pox. Free-ranging wild turkey pox infects domestic birds | Sometimes an apparently asymptomatic subacute to chronic infection. Yellowish brown scabs on skin of head and legs. Diphtheritic lesions in oropharynx and trachea cause dysphagia and asphyxia (see No 15). Compare to disease Nos. 3, 11, 35 and 36. Tends to occur seasonally when biting insects (mosquitoes, mites) are abundant. Morbidity in wild free-ranging New World quail is quite high. Mortality in captive quail can up to 40% | Histopathology, virus isolation, faecal exam. by electronic microscopy, culture, serology |
| 67  | Stunting and runting syndrome (viral enteritis) | Reo- and rotaviruses. Adult birds may act as latent carriers. Biting insects may spread viruses, which are environmentally stable | All Galliformes, the young being more susceptible: chickens 4-10 days, partridge 6-56 days | An immunosuppressive disease affecting alimentary mucosa causing malabsorption. May also be abnormal feathering. May have diarrhoea, secondary infection produces other signs | PM, virus isolation, faecal exam. by electronic microscopy, serology |
| 68  | Reticuloendothelial virus                    | Reticuloendothelial virus                                                      | All Galliformes, particularly chickens 3-8 weeks. Mortality may be 100% | Weight loss, anaemia, growing feathers fail to exsheath. Subcutaneous nodules on head and oral mucosa or sinusitis. Multivisceral neoplasms. Compare to diseases Nos. 44 and 45 | Histopathology, virus isolation, serology |
| 69  | Aspergillosis                               | *A. fumigatus*                                                                 | All Galliformes     | Can be presented as a chronic wasting disease (see No. 11)                                          | Culture, serology                                                        |

Diseases that may show few, if any, premonitory signs but which may cause unthriftness and loss of condition

59. Pullorum disease  See disease No. 20
60. Colibacillosis  See disease No. 21
61. Spirochaetosis  See disease No. 39
62. Ornithosis  See disease No. 2
63. ILT  See disease No. 3
64. Marek’s disease  See disease No. 44
65. Avian sarcoma leucosis syndrome  See disease No. 45
66. Pox virus infection  Avipox virus may be spread by biting insects. Virus in faeces. Fowl pox virus infects only chickens, grouse and pheasants. Turkey pox, quail and pheasant pox and peafowl pox viruses infect chickens
67. Stunting and runting syndrome (viral enteritis)  Reo- and rotaviruses. Adult birds may act as latent carriers. Biting insects may spread viruses, which are environmentally stable
68. Reticuloendothelial virus  Reticuloendothelial virus
69. Aspergillosis  *A. fumigatus*
| No. | Disease                                                   | Primary cause                                                                 | Species susceptible               | Particular disease characteristic                                                                 | Diagnosis                  |
|-----|-----------------------------------------------------------|-------------------------------------------------------------------------------|-----------------------------------|----------------------------------------------------------------------------------------------------|----------------------------|
| 70. | Avian tuberculosis and paratuberculosis. Zoonosis (see No.19 above) | Mycobacterium avium. 3 subspecies. Infected birds shed large numbers of organisms in faeces. Environmentally persistent. Ectoparasites act as a vector | All Galliformes, particularly backyard fowl | Chronic wasting disease. Birds often quite alert, appetite unaffected. Anaemia, dull plumage. Possibly sporadic diarrhoea and occasional lameness. May be granulomas in oropharynx or in conjunctival sac. Compare to disease Nos. 3, 11, 35, 36 and 65 | PM, culture, histopathology |
| 71. | Coccidiosis                                               |                                                                                |                                    |                                                                                                    |                            |
| 72. | Cryptococcosis                                            |                                                                                |                                    |                                                                                                    |                            |
| 73. | Histoplasmosis                                            |                                                                                |                                    |                                                                                                    |                            |
| 74. | Hexamitias                                                |                                                                                |                                    |                                                                                                    |                            |
| 75. | Leucocytosis                                              | A haemoproteozoan parasite. Leucocytozoon spp. transmitted by biting flies Simulium spp. and Culicoides spp. | All Galliformes, particularly young birds | Can cause anaemia, unthriftiness and anorexia                                                   | Haematology                |
| 76. | Helminthias                                                | Ascaridia spp. Proventricular and gizzard worms, capillariasis, heterakis (caecal worms), trichostrongyliasis (in grouse) | All Galliformes                      | All these helminth infections may cause loss of condition without any other clinical signs            | Microscopy                 |
| 77. | Ectoparasitosis. All may act as mechanical vectors of other pathogens | (i) Lice                                                                      | All Galliformes                      | Only heavy infection important, usually species-specific therefore cross-species infection unlikely. Whole life cycle carried out on the host |                            |
|     |                                                           | (2) Fleas, a number of types                                                  |                                    | Not so species-specific as lice but eggs and larvae environmentally persistent                     |                            |
|     |                                                           | (3) Dermanyssus spp. (red mite, roost mites)                                  | Feed nightly.                       | Can cause severe anaemia, unthriftiness and death in young. Environmentally persistent            | Diagnosis, examination of birds and environment using a shaded light at night |
|     |                                                           | (4) Ornithonyssus spp. (fowl mites)                                           | As above                           | Signs as for Dermanyssus spp. but parasite never leaves host, therefore more pathogenic. High mortality |                            |
|     |                                                           | (5) Trombicula spp. (harvest mites)                                           | As above                           | Seasonal, causing pruritus and damage to plumage                                                  |                            |
|     |                                                           | (6) Knemidocoptes spp. (scaly leg)                                            | As above                           | Causes pruritus. Compare to disease No. 65                                                        |                            |
|     |                                                           | (7) Ticks (Ixodes spp. and others)                                             | Pruritus, anaemia, occasional fatal toxin kills chicks                                           |                                                                                                    |                            |

PM, post-mortem
First thoughts when considering a possible infectious disease problem

**Age group affected**
First consider whether the problem is confined to a certain age group of birds.

**Chicks from hatching up to approximately 10 days of age**
Some of these chicks may be weak, not feeding properly and failing to thrive. This can be due to faulty incubation (humidity may be wrong), or they may just be genetically small. Small chicks easily get chilled (or can overheat) if in the brooder or with a bad hen. The artificial brooder ventilation may be faulty; there may be a build-up of fumes (ammonia, possibly carbon monoxide). All these predisposing causes may be presented as an *E. coli* or aspergillosis infection. Alternatively, poor incubator hygiene may be seen as umbilical or yolk sac infection.

Chicks in this age group that fail to thrive may be affected by an acute form of runting syndrome (see disease No. 67 in Table 13.3). Sudden death in very young quail chicks may be caused by an adenovirus (disease No. 8). Sudden death in young chicks of all species in outside aviaries could be due to spirochaetosis (disease No. 39).

**Disease in older chicks from about 10 days to approximately 11 weeks**
These birds are also liable to Runting syndrome (disease Nos. 67 and 68), Marek’s disease (disease No. 44) and Gumboro disease (disease No. 38). All these diseases are immunosuppressive, so the clinical signs may be caused by a secondary infection. Other disease problems in this age range include coccidiosis (disease No. 30), necrotic enteritis (disease Nos. 24 and 28) and infectious bronchitis (disease No. 10). Hexamitiasis can be a problem in turkey poults (disease No. 23). The possibility of mycotoxins should always be considered.

**Conditions affecting older growing birds over about 11 weeks of age**
This age group may also be affected by Marek’s disease (disease No. 44), particularly if they are female birds coming up to lay. However, they are more likely to be affected by the avian sarcoma leucosis virus (disease No. 45). Pheasants in this age group are often severely affected with marble spleen disease (disease No. 29). Both candidiasis (disease No. 36) and trichomoniasis (disease No. 37) can be a problem in young growing birds, particularly turkeys, pheasants, partridge and captive grouse.

**Mixed species collections**
Mixing widely different taxa of birds is never a good idea because some species are much more susceptible to certain diseases, whilst others can be asymptomatic and act as latent sources of infection (e.g. disease Nos. 4, 7, 10 and 34).

**Quarantine**
Owners of backyard flocks often purchase their stock from a variety of sometimes dubious sources – markets, pet shops or poultry shows – or acquire them from friends or relations. Most of these birds will be unvaccinated, and many will be carrying parasites. Some will be sero-positive for adenoviruses and mycoplasma, and may be latent carriers of disease. All new stock should be adequately quarantined from the main flock for at least 90 days. When newly acquired chicks are all obtained from one source, a period of 30 days may sufficient.

**Use of vaccines**
Appropriate prophylactic vaccination is good practice, but some live vaccines may exacerbate a problem if given to birds infected with an immunosuppressive virus. A vaccine administered in the water supply may be inactivated by chlorine. The vaccine used should always be licensed for the particular species concerned.

**Seasonal occurrence of disease**
Some diseases, particularly those transmitted by biting insects, only occur or are prevalent when the weather and/or the presence of nearby standing water is conducive to an increase in the number of insects (for instance the mosquito *Simulium* spp.), e.g. disease Nos 39, 47, 49, 52, 66, 67, 75 and 77.

**Specific diseases according to clinical signs**
To make differential diagnosis easier, these diseases are listed in Table 13.3 according to their commonly presented clinical signs. Zoonotic diseases and suggested diagnostic routines for each disease are also indicated.

**Egg drop syndrome**
The following causes can be responsible for a drop in egg production and production of malformed eggs:

1. Specific egg drop syndrome adenovirus – affects many species besides Galliformes; environmentally persistent in faeces
2. Infectious bronchitis virus – see disease Nos. 4 and 4a (Table 13.3)
3. Newcastle disease virus – see disease Nos. 4 and 4a
4. Influenza A virus – see disease No. 6
5. Fowl adenovirus Group I – see disease No. 7
6. Pullorum disease – see disease No. 20
7. Specific avian encephalomyelitis Picorna virus – see disease No. 48
8. Turkey meningio-encephalitis virus – see disease No. 49
9. Turkey rhinotracheitis pneumovirus – see disease No. 5
10. Diet – take into account the nutritional content of the diet
11. Husbandry – is the husbandry, housing, etc. satisfactory? Are stressors operative?
12. Egg stealing – always note the possibility of egg stealing, particularly in backyard flocks
13. Neoplasms and torsions – in single birds, note the possibility of neoplasms and torsion of the oviduct and other causes of egg binding.

References

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