CHAPTER
36

Management of Waterfowl

GWEN B. FLINCHUM, BS, MS, DVM

The order Anseriformes includes swans, ducks, geese and screamers. Numerous excellent references are available for specific medical and biological information on these birds.[1,9,11,12,13] Some basic biological facts of which veterinarians should be aware are discussed in the following sections.

Adult male ducks, geese and swans are referred to as drakes, ganders and cobs, respectively. Adult female ducks, geese and swans are called ducks, geese and pens. Young ducks, geese and swans (older than 3 weeks) are referred to as ducklings, goslings and cygnets.

FEATHER CHARACTERISTICS

Molting

Most waterfowl go through a complete molt following breeding season. This molt may last 3 to 6 weeks. During this time, flight feathers are lost, thus the birds are flightless. Most members of the subfamily Anatinae (eg, Shelducks, dabbling ducks, perching ducks, diving ducks) molt twice yearly. Birds of the family Anhimidae (screamers) and the magpie goose (*Anseranas semipalmata*) molt gradually and do not pass through a flightless period.

Feather Color and Sexual Dimorphism

Birds of subfamily Anserinae, ie, whistling ducks, swans, geese, Cape Barren geese (*Cereopsis novaehollandiae*) and freckled ducks (*Stictonetta naevosa*), have plumage that is monomorphic in all species. Magellan geese (*Chloephaga picta*) and kelp geese (*Cloephaga hybrida*) are the exceptions. Greater Magellan ganders have a white head, neck and breast, while females are reddish brown. Kelp geese males are pure white, while females are striped with different hues of brown. Birds of the subfamily Anatinae frequently have dimorphic plumage. Males typically have iridescent coloration with outstanding patterns. Ducks are usually sexually dimorphic

Fig 36.1 | A fence separates two sides of the aviary so birds are able to fly over the fence into the back of the aviary to escape other more aggressive birds.

Fig 36.2 | Back side of a two-sided aviary into which threatened birds may fly.

except for the Pekin, American black duck (*Anas rubripes*) and Mexican breeds. It is a hobbyist's theory that male ducks have a curl to their tail feathers at maturity that is not present in females.

ANATOMIC VARIATIONS

Trachea

Swans have an elongated trachea. The trachea of trumpeter swans extends into the sternum, turns on itself and then re-enters the syrinx. The ruddy duck (*Oxyura jamaicensis*) has an inflatable tracheal sac.

Syringeal Bulla

Most male ducks have a left-sided enlargement that can be visualized on radiographs.[10] This is called the syringeal bulla and should not be misinterpreted as pathologic. This structure is absent in swans and geese.

Phallus

Male Anseriformes have an erect phallus that is covered with papillae. By placing gentle pressure on the sides of the cloaca, the phallus can be exteriorized, thus determining the bird's sex as male. Females lack a phallus and instead have two small labia-like structures. Because this type of sexing necessitates turning the bird upside down, geese and swans are most easily done at a young age.

Husbandry

ENVIRONMENTAL/ENCLOSURE CONSIDERATIONS

Enclosed Versus Open Ponds

There are numerous advantages to keeping waterfowl in enclosed areas. The greatest advantage is protection from outside predators. In addition, it is more difficult for wild birds to enter enclosed areas, and this decreases the chances of introduction of disease into the collection. Another advantage is that birds in enclosed areas do not have to be pinioned. A disadvantage of enclosed areas is that the overall area is smaller than open enclosures, and this may lead to territorial aggression, harassment and injury to smaller birds by more dominant birds. This can be avoided by providing a tiered enclosure in which smaller, less dominant birds can fly up to the second level to escape harassment. It is important to avoid overcrowding in aviaries (Figs 36.1, 36.2).

Nylon netting[a,b,c] works well to enclose pens. In colder areas, the netting will be weighted down with snow or ice, which will cause damage to the netting. This can be corrected by having the netting attached to several wires (Fig 36.3). The wires are then connected to a hand crank. Loosening the netting with the crank alleviates tension, so that damage to the netting is less likely (Lubbock, personal communication[d]).

Open ponds provide more space and greater opportunity for grazing. However, birds in open areas are susceptible to predation, especially if they are unable to fly. In some cases, predation can be avoided by enclosing the area with a tall fence lined with electric wire. Furthermore, larger species such as mute swans can be very aggressive and are thus less likely to be attacked.

Protection from vermin also is an important consideration. Poisonous bait for rats, mice or roaches can be placed inside long plastic or metal tubes and put outside the reach of birds. However, there have been reports of warfarin toxicity resulting from the birds' ingestion of mouse droppings (Lubbock, personal communication).

Fig 36.3 | Nets with cable support.

Fig 36.4 | Skirting can be placed around the bottom perimeter of the cage to minimize rodent invasion.

Figs 36.5-36.7 | Various types of houses can be used for waterfowl.

In general, extreme care must be taken when using rodenticides or other poisons near an aviary. Other deterrents for vermin include a 2 to 3 foot (1 m) tall sheet of metal lined with electric wire at the bottom, placed around the bottom perimeter of the cage (Fig 36.4).

Smaller waterfowl can be provided with various types of houses for nesting (Figs 36.5, 36.6). These can be made from large, hollowed-out logs (Fig 36.7) or flat pieces of wood. One breeder has had success using slatted boxes (Fig 36.8) because small waterfowl normally build nests in reeds or grasses, and the staggered pieces of wood in slatted boxes simulate stalks of grasses or reeds. Apparently, this imparts a feeling of privacy and security for birds, thus facilitating nesting (Lubbock, personal communication[d]).

Ground cover is an important aspect of enclosure design. Hard surfaces such as concrete should be avoided, as these can contribute to bumblefoot. Grass or dirt surfaces are less irritating to feet, although they are harder to keep clean. A small (20 x 20 feet or 7.5 x 7.5 m) swan enclosure requires twice monthly re-sodding to keep the environment ideal (Montgomery, personal communication[e]).

Fig 36.8 | Slatted houses emulate reeds or grasses and impart a sense of privacy for nesting waterfowl.

Water Quality

In small enclosures, artificial ponds can be built. These are made of concrete, then painted with waterproof

Fig 36.9 | Small concrete pools are easy to clean and maintain.

Fig 36.10 | Swans and diving ducks require ponds 3–4 feet deep.

Fig 36.11 | Water aerator for a large pond.

Fig 36.12 | Reeds and water plants can be useful in water filtration.

epoxy pool paint (Fig 36.9). These types of pools can be drained and cleaned on a regular basis. A water depth of 2 feet is adequate for most Anseriformes. Swans and diving ducks require 3 to 4 feet of water (Fig 36.10). Water quality in larger ponds is affected by the amount of ammonia present. Ammonia forms near the bottom surface of the pond subsequent to the degradation of fecal matter, food and other organic substances. It then rises to the surface of the pond where it facilitates algae growth. Above-water aerator systems can be utilized to remove ammonia before it reaches the pond surface. A network of underwater pipes that is connected to a central fountain achieves this (Fig 36.11). The pipes carry water (and thus ammonia) from the bottom surface area to the fountain where it is discharged into the air. This eliminates ammonia and oxygenates the water, which results in cleaner, fresher water with less algae.

Filtration systems also can be utilized to maintain water quality. There are hundreds of systems available and many of these can be researched on the Internet.[f] The majority of these are for smaller ponds, with 25,000-gallon capacities being maximum size. Submersible filters are very effective in maintaining water quality. However, care must be taken when using these, as there have been reports of birds being pulled under water and trapped in the filtration system. Reeds and water plants can act as natural water filters when placed at exit and entry points of water flow (Fig 36.12). If water quality becomes out of balance—usually too much nitrogen and phosphorous combined with warm weather and bright sunlight—algae will bloom. A dark blue coloring agent[g] that blocks the light so algae cannot grow is available.

Species Compatibility

In general, the smaller the enclosure area, the more potential there is for territorial aggression. As previously mentioned, tiered cages will allow smaller species to fly away from more aggressive birds. Inbreeding can occur and should be avoided. Likewise, interspecies breeding is undesirable and can be avoided by not having many different species of geese or ducks in one pen. Table 36.1 lists waterfowl species that should not be mixed.

Table 36.1 | Waterfowl Species That Should Not Be Housed Together

Keep Isolated as a Single Pair	Exceptions	Specific Non-mix Combinations
Swans, especially: • Coscoroba	• Two pairs of black swans may be kept together if the area is large enough, as long as they are released together. • Never release a young pair into the territory of an established pair.	• Even on large lakes, never mix two pairs of trumpeter swans. • Never mix a pair of Bewick's swans with a pair of whistling swans.
Ducks, especially: • Screamer • Bronze-winged • Pink-eared • Hartlaub's • Comb • Shelducks • White-winged wood • Musk • Crested • New Zealand teals (brown teals or brown ducks)	• More than one pair of comb ducks and white-winged wood ducks can be released together if the area is large, but do not release new birds into an existing group. • Never release a young pair into the territory of an established pair.	• Avoid keeping any subspecies together.
Geese, especially: • Sheldgeese (Andean) • Egyptian • Cereopsis geese • Spur-winged	• Never release a young pair into the territory of an established pair.	• Hawaiian geese (Néné) and cackling Canada geese. • Avoid keeping any subspecies together.

Adapted from BSAVA Manual of Raptors, Pigeons, and Waterfowl, edited by Peter H. Beynon, Neil A. Forbes and Nigel H. Harcourt-Brown (1996) with permission of BSAVA.

Fig 36.13 | Royal mute swans (*Cygnus olor*).

Fig 36.14 | Black swans (*Cygnus atratus*).

Species Considerations for a Collection

Choosing which waterfowl to have in a collection depends on a number of considerations. These include price and availability of birds, aggression quotient (ie, larger birds such as swans can be quite aggressive during mating season), susceptibility to predation (smaller, pinioned birds are more likely to be attacked) and size of enclosure and water quality. Figs 36.13-36.18 show some commonly kept swans.

Banding Birds

Once birds are acquired, placing leg bands is recommended, especially if there are two or more birds. This helps identify birds for breeding and health monitoring. Bands that are placed on the upper part of the leg (on the tibiotarsus) have a lesser chance of getting caught and causing injury (Fig 36.19). In addition, bands can be placed on the left leg of females and the right leg of males for quicker sex identification. Plastic leg bands have an advantage over aluminum because they are expandable (Fig 36.20). Aluminum bands can become bent, thus placing pressure on the leg or causing constrictions. Metal leg bands increase the incidence of frostbite injury in cold climates.

Diet

There are several commercially formulated diets available for waterfowl.[h,i,j] These simplify meeting growing, maintenance and breeding nutritional requirements. Waterfowl kept on corn and lettuce diets frequently have dietary deficiencies that manifest as joint pain/lameness and bumblefoot. Grass and plants should be available for foraging.

Fig 36.15 | Whooper swan (*Cygnus cygnus*).

Fig 36.16 | Black-necked swans (*Cygnus melanocoryphus*).

Fig 36.17 | Coscoroba swans (*Coscoroba coscoroba*).

Fig 36.18 | Trumpeter swan (*Cygnus buccinator*).

Fig 36.19 | Bands placed on the upper part of the leg have less chance of becoming entrapped.

Fig 36.20 | Plastic leg bands are suitable for identification of waterfowl.

Fig 36.21 | A 50-foot ski rope can be wound on a reel to be used for swan capture.

Fig 36.22 | Rope-across-pond method of capturing swans: one person stands on each side of the pond holding an end of the rope.

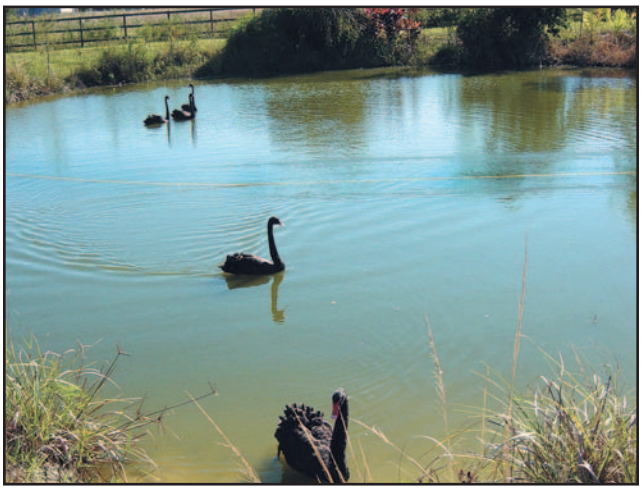

Fig 36.23 | The rope is stretched across the pond and moved toward the swans.

Fig 36.24 | As the rope is moved toward the swans, they are herded in the desired direction for capture.

Management of Patients

CAPTURE AND RESTRAINT

Capturing pinioned waterfowl for examination in an open environment can be challenging. Most are excellent swimmers but are not proficient runners; therefore, a primary goal is to manipulate the birds out of the water so they can be more easily captured on land. This can be accomplished in a number of ways.

Capture Methods

Rope-across-pond Method

This method (Figs 36.21-36.23) involves pulling a long rope across the diameter of the pond. The birds attempt to swim away from the rope and can be herded up onto shore (Fig 36.24). A 50-foot (yellow) nylon ski rope can be purchased from a hardware or boating store. This can be wound upon a reel (such as that used to wind an electrical extension cord) for easy access (see Fig 36.21). If a longer length is needed, two cords can be spliced together. A disadvantage of this method is that birds will quickly overcome their fear of the rope and learn to swim under or over the rope to avoid capture.

Net Restraint

Pole nets[k] can be used to capture waterfowl (Fig 36.25). This method actually works well for capturing swans and geese from a small boat.

Throw Nets

Circular nets with a weighted outer perimeter[l] can be thrown over birds (Fig 36.26). These are best used on land or in very shallow water. Throw nets should be inspected prior to use and damaged weights removed to avoid lead weights falling off in the pond.

Manual Capture

Swans and geese can be grasped gently but firmly by the base of the neck, then covered with a towel to prevent injury from the wings to the handler. Both large and

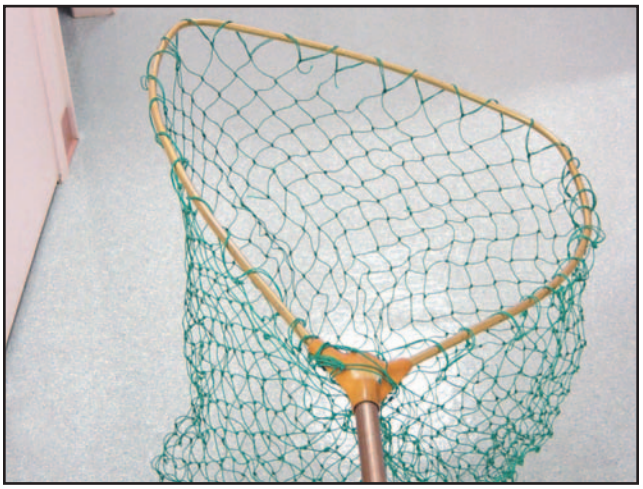

Fig 36.25 | A pole net can be used for capturing waterfowl.

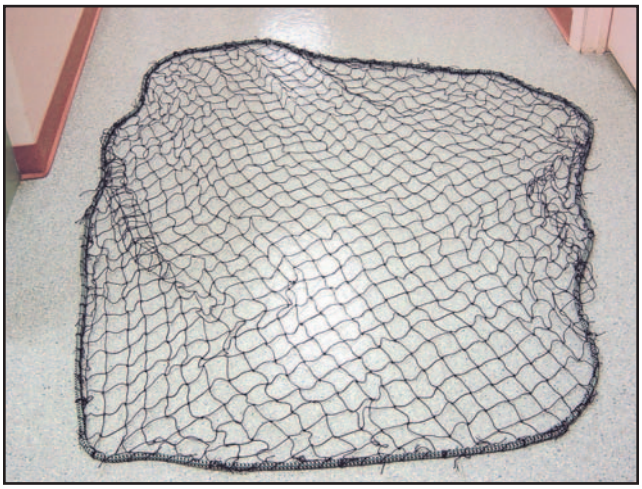

Fig 36.26 | Circular throw nets can be used for capture on land.

Fig 36.27 | Waterfowl can be restrained by grasping the humerus on each wing at the shoulder. Such restraint applied on the lower wing can result in injury.

Fig 36.28 | Large waterfowl should be carried under the arm with the head facing backward. Additionally, the head can be covered to avoid bites.

small waterfowl can be restrained by holding the base of the wings (Fig 36.27). Smaller birds can be carried in this manner; however, larger birds should be carried under one arm with the head facing backward and the body and feet supported with the other hand (Fig 36.28).

Restraint for Travel

Birds can be wrapped in a towel or pillowcase (Fig 36.29), then encircled with cohesive flexible bandage material.[m] Caution should be taken so that the bird is not wrapped too tightly. In addition, birds should be monitored for overheating in hot weather.

Drug Immobilization

Chemical immobilization has been reported for use in waterfowl; however, this has not proven to be an effective adjunct to capture for many reasons.[9] Drugged birds may go into the water and subsequently drown. When oral agents are mixed with food, over-consumption may cause an overdose with subsequent death. In addition, recovery from such drugs may be prolonged and may take up to 8 hours.

Fig 36.29 | Large waterfowl can be wrapped in a pillowcase to restrain for travel.

Fig 36.30 | Feathers of a healthy swan.

Fig 36.31 | Frayed, dirty feathers of an unhealthy bird.

Fig 36.32 | Bumblefoot in a mute swan.

Fig 36.33 | The feet of healthy swans have no cracked areas or lesions.

Dangers to Handlers During Capture and Restraint of Swans and Geese

Wings

Swans and geese use wings defensively. The distal humerus and olecranon can cause contusions. It is important to avoid having the handler's head anywhere near the wings, as serious injury can occur. This is true with any large bird, but especially dangerous when handling the spur-winged goose.

Toenails

Waterfowl have short but very sharp toenails. These can cause painful scratches.

Beak

Most waterfowl have serrations on the edges of their beaks. They are capable of causing bruises when they bite or pinch. Handlers also must beware of the potential for an eye injury from biting birds.

PHYSICAL EXAMINATION

Feather Quality

Feathers should be smooth and regular in appearance (Fig 36.30). Frayed, dirty, bent or broken feathers may indicate lack of preening or abnormal molting (Fig 36.31). Water should roll off normal feathers, and feathers should not have a wet appearance. Feather color should be consistent, ie, white feathers should be white, not brown or dirty.

Skin and Foot Quality

The skin is best examined over the chest muscle and on the feet and legs. Skin should not be cracked or flaky. The bottoms of the feet should be examined for bumblefoot lesions (Fig 36.32). Ideally, the bottoms of the feet should have small patterns of scale with no balding areas or scabs (Fig 36.33). Limping is generally a sign of joint or foot problems.

Body Weight

General body weights for waterfowl are available in table form.[9] Body weight should be recorded at every physical exam. Deviations from previously recorded weights may indicate disease. Many free-ranging waterfowl have palpable keel bones. A prominent keel bone indicates

excessive weight loss with probable disease. Large birds can be easily weighed using a human scale; obtain the holder's weight and then hold the bird, subtracting the difference of the two weights. This is an ideal way to weigh larger species.

Eyes, Nose, Mouth

Eyes should be clear with no redness or discharge. In collections where inbreeding is allowed, ocular abnormalities may be seen (corneal or ocular opacities). The nares should have no discharge and be bilaterally symmetrical. The oral cavity should be examined and should be free of excessive redness, white plaques or brown mucous. Breathing should not be open-mouthed or labored. Auscultation of lungs and air sacs should reveal little or no sound. Wheezing or crackling may indicate respiratory illness.

Feces

It is not unusual for waterfowl to have some loose feces, however, feces should not have a foul odor. Fecal color should be brown but will depend on diet. Excessively green feces, urine and urates may indicate liver disease.

Overall Behavior

Sick birds will sequester themselves away from other birds. Often, sick birds will be at the bottom of the pecking order, so their feathers will be more dirty, plucked and ragged than those of other birds. Another indication of illness is reluctance get up and move around. Sick birds spend inordinate amounts of time lying down or sleeping. Male swans will harass female and juvenile birds in an attempt to mate. If not interrupted, some infirm birds have been drowned by aggressive males.

TESTING RECOMMENDATIONS

Blood Testing

The recommendations for blood tests in waterfowl are similar to those commonly performed in other birds and include the following: complete blood count, advanced serum chemistry panel with bile acids, serum protein electrophoresis, chlamydial PCR testing and aspergillosis serology. Chlamydiosis serology has not been rewarding in waterfowl.

Blood Collection

The safest place for blood collection is the medial metatarsal vein (Fig 36.34). The cutaneous ulnar vein also can be used but there are more problems associated with using this vein. For example, birds do not like having the wing restrained and tend to struggle more during wing venipuncture. This can lead to head injury to the handler. Furthermore, hematoma formation is more

Fig 36.34 | Blood is easily collected from the medial metatarsal vein.

Table 36.2 | Hematology and Serum Chemistry Values for Waterfowl

Species	White-winged Wood Duck	Hawaiian Goose	Canada Goose	Swan
	n = 30	n = 10	n = 15	n = 50
RBC ($x10^{12}$/l)	2.6-3.48	2.35-2.89	2.25-3.35	1.96-2.9
PCV (l/l)	0.46-0.57	0.38-0.45	0.35-0.49	0.32-0.5
Hb (g/l)	122-181	129-170	122-172	110-165
MCV (fl)	163-177	156-161	162-178	164-200
MCH (pg)	46.6-51.9	54.9-59.3	47-58.7	52.9-65.5
MCHC (g/l)	270-321	340-380	342-363	290-365
WBC ($x10^9$/l)	4.7-9.4	6.2-13.4	3.0-5.15	6.3-22.0
Heterophils ($x10^9$/l)	2.7-5.6	0-5.57	0.5-2.7	3.33-14.67
Lymphocytes ($x10^9$/l)	0.65-4	0-7.74	0.8-3.8	0.9-9.77
Monocytes ($x10^9$/l)	0.15-0.76	0-0.28	0.15-0.8	0.05-1.39
Eosinophils ($x10^9$/l)	0-0.3	0-0.6	0-0.5	0.11-3.5
Basophils ($x10^9$/l)	0.1-0.09	0-0.6	0-0.25	0-0.82
Thrombocytes ($x10^9$/l)	—	—	—	—
Fibrinogen (g/l)	—	<3.5	—	—
	n = 18		n = 10	n = 50
Total protein (g/l)	34-54	—	37.3-56.3	35.5-54.5
Albumin (g/l)	10-25	—	17.5-23.6	12.0-21.5
Globulin (g/l)	26.4-29.41	—	20.3-42.6	23.0-35.5
A:G ratio	—	—	—	0.43-0.65
Urea (mmol/l)	0.76-1.05	—	0.8-3.56	0.1-2.4
Creatinine (umol/l)	6-14	—	4-11	18-89
Uric acid (umol/l)	165-691	—	—	126-700
Bile acids (umol/l)	—	—	—	—
ALT (SGPT) (u/l)	0-67.5	—	—	10.59
ALP (u/l)	0-198	—	0-149	—
GGT (u/l)	0-14	—	1-10.5	4.26
AST (SGOT) (u/l)	9.8-43.2	—	—	17-112
CK (u/l)	—	—	—	124-894
LDH (u/l)	—	—	145-435	165-724
Glucose (mmol/l)	8.0-13.4	—	—	6.2-12.6
Cholesterol (mmol/l)	—	—	—	3.0-7.8
Inorg phosphate (mmol/l)	0.55-1.66	—	—	0.7-2.36
Calcium (mmol/l)	2.01-2.52	—	—	2.19-2.89
Sodium (mmol/l)	—	—	—	132-150
Potassium (mmol/l)	—	—	3.9-4.7	3-5
Chloride (mmol/l)	—	—	101-133	—

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likely when using the cutaneous ulnar vein. The jugular vein is not commonly used for blood collection due to difficulty in visualization of the vein, especially in long-necked birds.

Blood Parameters

Hematology and serum chemistry values for waterfowl are listed in Table 36.2.

Fecal Tests

Direct fecal smears are a simple way to check for internal parasites. This is easily done by smearing a small amount of fresh feces on a microscope slide, adding a few drops of lactated Ringer's solution, adding a cover slip and examining under a microscope. *Giardia* spp. or other protozoan organisms as well as parasite eggs can be visualized on direct fecal smears. Fecal Gram's stains can be used to identify *Cryptosporidia* spp. and budding yeast. Gram-negative bacteria and *Clostridia* spp. are not unusual in Gram's stains of asymptomatic waterfowl and should not necessarily be treated.

Endoscopy

Endoscopy is routinely performed via the left or right lateral approach as with parrots. Because swans and geese have elongated tracheas, tracheal endoscopy is difficult, since few endoscopes will reach far enough to visualize the trachea in its entirety. A flexible endoscope can be used, as the trachea of most birds over 1000 g will pass a 3-mm scope.

Other recommended diagnostic tests include radiology, histopathology, necropsy and culture and sensitivity of feces, throat or skin lesions.

TREATMENT RECOMMENDATIONS

Fluid Therapy

Intravenous catheterization can be most easily done in the medial metatarsal vein. This vein is easy to access and not highly prone to hematomas, and birds tolerate catheter placement well there. The biggest disadvantage of using the medial metatarsal vein is that some agents injected into the legs will go through the renal portal system and be excreted by kidney tubules before entering the general circulation.[8] However, the author has experienced successful treatment results following fluid and antibiotic therapy administered via this method. Catheter placement is implemented in the same manner as with dogs and cats. A 20- to 24-gauge Teflon catheter can be used. It is recommended that catheters not be left in for more than 48 hours. If long-term catheterization is necessary, a vascular access device may be necessary.[6] Catheterization also may be done in the cutaneous ulnar vein; however, as previously mentioned, there is a greater possibility of hematoma, and this is more dangerous to the handler in larger birds. Jugular catheterization is difficult due to visualization difficulties discussed earlier.

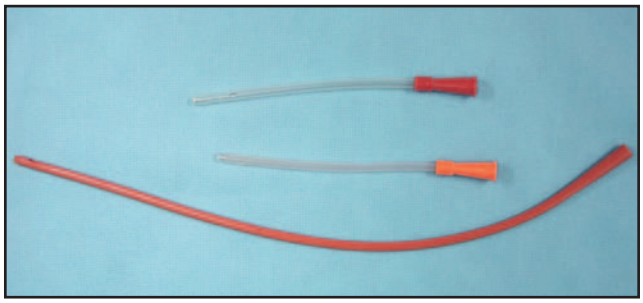

Fig 36.35 | Red rubber catheters or silicone feeding tubes can be used for gavage-feeding waterfowl.

Intraosseous catheterization can be performed in the tibiotarsus or ulna but is more painful than intravenous catheterization. Such catheter placement often necessitates anesthesia, and some patients may not be candidates for anesthesia. Bone infection may occur if the process is not done aseptically.

If a patient is not hypoproteinemic, subcutaneous fluids with hyaluronidase[n] have been preliminarily purposed to be as effective as intravenous fluids.[5]

Oral fluids should also be given in tube-feedings in mildly dehydrated birds.

Gavage-Feeding

Soft tubes work well for gavage feeding waterfowl. Swans and geese can be gavage fed with 14-Fr (16") red rubber catheters.[o,p] Smaller birds can be fed using silicone feeding tubes[o,p] (Fig 36.35). There are a variety of formulas available for nutritional support in debilitated patients.[q]

Medications

Table 36.3 lists medications commonly used for waterfowl.

SURGICAL PROCEDURES

Pinioning

Pinioning, the surgical removal of the tip of the wing from the alula distally to render a bird flightless, is a common procedure in waterfowl. When done early (at 2-3 days old), this procedure is virtually bloodless and stress free (Figs 36.36-36.38). Pinioning older birds is more difficult because stress and excessive bleeding can occur. The proper technique for pinioning is to remove metacarpals III and IV and leave the alula intact to cover the amputated area. If the alula is removed, repeated trauma to the stump can occur on a regular basis.

Table 36.3 | Medications Commonly Used for Waterfowl

Generic	Trade Name(s) and Manufacturer	Dosage(s) and Route(s)	Main Indications
ANTIBACTERIAL AGENTS			
Amoxicillin	Amoxinsol 50 soluble powder (Univet)	1 g/3 L drinking water* Medicated drinking water should be provided on alternate days for 3 days, ie, 2 days of medication.	Sensitive bacterial infections
Chlortetracycline	Aureomycin soluble powder (Cyanamid)	1000 ppm (18.2 g/kg feed) in feed for 45 days	Chlamydiosis
Co-trimazine (trimethoprim + sulfadiazine)	Cosumix Plus soluble powder (Ciba); Duphatrim Poultry Suspension (Solvay Animal Health) (*Bactrin, Roche*)	1 ml/5 L drinking water* for 5-7 days	Sensitive bacterial infections
Doxycycline	Ronaxan tablets (Rhône Mérieux) (Henry Schein, Roerig)	50 mg/kg PO BID for 3-5 days (45 days for chlamydiosis) or 240 ppm in feed for 45 days	Sensitive bacterial infections, especially chlamydiosis
	Steriject (Pfizer)	75 mg/kg IM once weekly for 6 weeks	Chlamydiosis
Enrofloxacin	Baytril 2.5% or 5% injection 2.5% or 10% oral solution or tablets (Bayer) (*Baytril 2.7%, Haver/Diamond*)	10-15 mg/kg IM or PO BID for 5-7 days	Sensitive bacterial infections. Useful for bacterial hepatitis or septicemia in neonates. Used widely in growing chickens and poultry of all ages without any incidence of articular cartilage problems: at normal therapeutic levels (10-15 mg/kg BID) it is unlikely to produce joint deformity in neonatal waterfowl (or in raptors or pigeons).
		4 mg in 20 ml saline for a 1-kg bird – daily nasal flushing for 10 days	Treatment of sinusitis
Lincomycin	Lincocin soluble powder (Upjohn)	10 g/5 L drinking water* for 5-7 days	Pasteurellosis, mycoplasmal tenosynovitis
Lincomycin/spectinomycin	Linco-Spectin 100 soluble powder (Upjohn)	3 g/4 L drinking water* for 3-7 days	Mycoplasmal tenosynovitis, sinusitis
Oxytetracycline	Various long-acting injections.	200 mg/kg IM daily for 5-7 days	Pasteurellosis and other sensitive bacterial infections
	Terramycin soluble powder (Pfizer)	37 g/15 L drinking water* for 5-7 days	
Tylosin	Tylan 50 or 200 injection (Elanco) (Butler)	20-30 mg/kg IM TID for 3-7 days; or 100 mg in 10 ml saline, daily nasal flush for 10 days.	Mycoplasmosis
	Tylan tablets (Elanco)	20 mg/kg PO TID for 3 days	
	Tylan soluble powder (Elanco)	2.5 g/5 L drinking water* for 3 days	
ANTIFUNGAL AGENTS			
Itraconazole	Sporanox capsules (Janssen)	10 mg/kg PO SID for 7-10 days for prophylaxis, or BID for 4-6 weeks for therapy	Aspergillosis
Nystatin	Nystan oral suspension (Lagap) (*Myco 20, Squibb*)	300,000 units (3 ml)/kg PO BID for 7 days	Candidiasis
ANTIPROTOZOAL AGENTS			
Clazuril	Appertex (Harkers)	5-10 mg/kg PO every 3rd day on 3 occasions	Coccidiosis
Co-trimazine (trimethoprim + sulfadiazine)	Cosumix Plus soluble powder (Ciba); Duphatrim poultry suspension (Solvay Animal Health) (Bactrin, Roche)	60 mg/kg (combined constituents) PO BID, 3 days on, 2 days off, 3 days on	Coccidiosis Do not use in dehydrated birds
	Duphatrim 24% injection (Solvay Duphar)	30 mg/kg SC, 3 days on, 2 days off, 3 days on	
Pyrimethamine	Daraprim (Glaxo-Wellcome)	0.25-0.5 mg/kg PO BID for 30 days	*Sarcocystis* spp., toxoplasmosis
Pyrimethamine/ sulfaquinoxaline	Microquinox (C-Vet Livestock Products)	60 mg/L drinking water*, 3 days on, 2 days off, 3 days on	Coccidiosis
Toltrazuril	Baycox (Bayer) (Bayvet)	1 ml of 2.5% solution/2 L drinking water* for 48 hours	Coccidiosis
ENDOPARASITICIDES			
Chlorsulon	Curatrem (MSD Agvet)	20 mg/kg PO 3 times at 2-week intervals	Control cestodes and trematodes
Fenbendazole	Panacur 2.5% or 10% liquid, 8-mg capsules (Hoechst)	20 mg/kg PO once	Control nematodes
Flubendazole	Flubenvet (Janssen)	240 ppm (2.4 kg/ton) in feed for 7 days	Control nematodes
Ivermectin	Ivomec 1% cattle injection (MSD Agvet)	200 μg/kg SC or PO once	Control nematodes and nasal or duck leeches
Levamisole	Various, eg, Levacide (Norbrook) (*Ripercol-L, American Cyanamid*)	25-50 mg/kg SC once	Control nematodes

Table 36.3 | Medications Commonly Used for Waterfowl (Continued)

Generic	Trade Name(s) and Manufacturer	Dosage(s) and Route(s)	Main Indications
ENDOPARASITICIDES (continued)			
Mebendazole	Mebenvet (Janssen) (*Telmin, Pitman-Moore*)	5-15 mg/kg PO daily for 2 days	Control *Syngamus* trachea
		120 ppm (1.2 g/ton) in feed for 14 days	Control nematodes
Praziquantel	Droncit (Bayer) (*Bayvet*)	10-20 mg/kg SC or PO once. Repeat after 10 days	Control cestodes
		10 mg/kg SC or PO daily for 14 days	Control trematodes
MISCELLANEOUS			
Atropine	Atropine injection (C-Vet)	0.1 mg/kg IV or IM every 3-4 hours	Anticholinesterase poisoning, eg, carbamate
D-penicillamine	Distamine (Dista) (*Cupramine, Merck; Depen, Wallace; Titratabs, Wallace*)	55 mg/kg PO BID for 7-14 days	Heavy metal poisoning
Dexamethasone	Dexafort (Upjohn)	2 mg/kg SID for 2 days only	Treatment of shock, or anti-inflammatory
Diazepam	Valium (Roche)	0.5-1.0 mg/kg IV or IM, BID or TID, as required	Control of fits
Dinoprost tromethamine (PGF 2, alpha), $PGE_{1 or 2}$	Lutalyse (Upjohn)	0.02-0.1 mg/kg IM or topically onto cloacal mucosa, once	Egg binding
Doxapram	Dopram injection (Willows Francis) (*Robins*)	10 mg/kg IV once	Respiratory stimulant
Iron dextran	Vet Iron injection (Animalcare) (*Butler, Lextron, Vedco*)	10 mg/kg IM. Repeat in 1 week	Anemia
Ketoprofen	Ketofen (Rhône Mérieux) (*Fort Dodge/Aveco*)	1 mg/kg IM SID for 1-10 days	Pain relief, arthritis
Magnesium sulfate crystals	Magnesium sulfate (various)	0.5-1.0 g/kg PO SID for 1-3 days	Increase gut motility. Aid passage of lead if present in intestines
Metoclopramide	Emequell (Pfizer) (Reglan, Robins)	2 mg/kg IV or IM TID as required	Anti-emetic. Control of gut stasis, eg, sour crop
Oxytocin	Oxytocin S (Intervet); Oxytocin (Leo) (*Butler, Lextron, Vedco*)	3-5 IU/kg IM	Egg binding
Pralidoxime mesylate	Contact National Poisons Bureau regarding availability (*Protopam, Wyeth-Ayerst*)	100 mg/kg IM. Repeat once after 6 hours	Organophosphate and acetyl-cholinesterase poisoning, eg, carbamate
Sodium calcium edetate	Sodium Calcium edetate (Strong) (Animalcare) (*Calcium Disodium Versonate, 3M Pharmaceuticals*)	10-40 mg/kg IV or IM BID for 5-10 days with concurrent fluid therapy	Lead poisoning. No need to dilute

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**Ed. Note - To be effective, drink water medication needs to be administered to waterfowl with no water to swim in and the source elevated to avoid bathing.*

Another advantage to pinioning birds at a young age is that birds can be easily sexed before pinioning. Subsequently, the wing pinioned can indicate the sex of the bird, ie, females will be pinioned on the left wing and males will be pinioned on the right.

Tendonectomies of the *extensor carpi radialis* tendon or the insertion point of the superficial *pectoralis* muscle are surgeries that have been described for rendering birds flightless. These techniques are not always effective.[9] Furthermore, most waterfowl owners feel that it is not cost effective to do these surgeries.

Displaced Tendon Repair (Luxation of the Achilles Tendon)

Surgeries have been described for the repair of Achilles tendon luxation.[2,9] Depending on the cause (which is often due to malnutrition), prognosis for recovery is poor, especially in heavier birds. Placement of the affected bird in a sling apparatus to take weight off the legs may improve prognosis.

Orthopedic Repairs

Leg fractures in swans and geese may carry a more guarded prognosis for healing due to large body size and short legs. Immobilization is imperative and may cause stress to the patient. Otherwise, fracture treatment and repair is identical to that done in other birds.

Reproduction

Average Biological Data

Table 36.4 lists sexual maturity, clutch size and incubation period of various waterfowl.

Generally incubation periods are: ducks, 28 to 30 days;

Fig 36.36 | Cygnets if they are to be pinioned it should be done at 2 to 4 days of age.

Fig 36.38 | Pinioning metacarpals III and IV are cut as close to the alula as possible with sterile clippers.

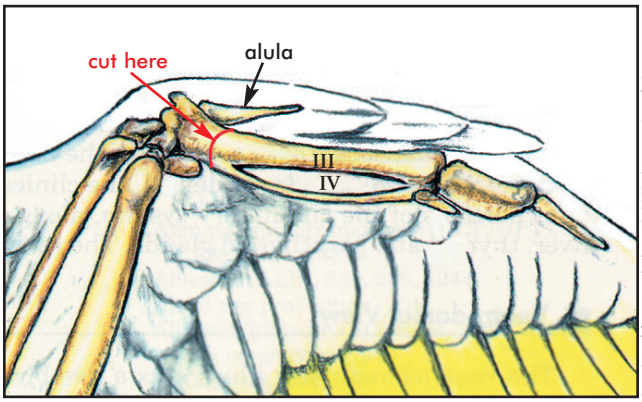

Fig 36.37 | Anatomy for pinioning. The alula is identified as a landmark and spread away from the carpus. Metacarpals III and IV are shown.

Table 36.4 | Waterfowl Reproductive Data

Species	Sexual Maturity (years)	Clutch Size	Incubation Period (days)
Mute swan	5	4-8	35-40
Pink-footed goose	2	3-5	26-27
Bar-headed goose	2	4-6	27
Hawaiian goose	2	3-5	29
Red-breasted goose	2	3-7	23-25
European wigeon	1	7-11	23-25
Mallard	1	8-12	23-29
Common eider	1	3-6	25-30
Tufted duck	1	6-14	23-25
Mandarin duck	1	9-12	28-30
Muscovy duck	1	8-15	35
European goldeneye	1	9-11	27-32

geese, 20 to 28 days; swans, 30 to 40 days; and Shelducks, 27 to 30 days.

Age of Sexual Maturity

Most ducks are sexually mature at 1 year of age. Geese usually mature in about 2 years. Swans reach sexual maturity at about 5 years.

Artificial Incubation

There are a variety of incubators (Fig 36.39, 36.40), brooders and hatchers (Fig 36.41) available that are suitable for waterfowl.[r,s,t,u] For artificial incubation in waterfowl, incubator temperatures of 99.3° F (37.3° C) and 85% humidity are desirable.

Brooder rooms should be designed so they are easy to clean with adequate ventilation, heating and cooling capacities (Fig 36.42). A heat source (such as a 150-watt heat lamp) should be provided in one area such that the young birds can get close to or back away from the heat as needed. The temperature should be about 95 to 99° F (35-37.2° C) initially, and then gradually decreased over a 3-week period.[9] Never allow chicks to become chilled.

Food and water should be placed at the end opposite from the heat source. Large colored marbles may be placed in water dishes to encourage the birds to learn how to drink. It is not advisable to use hay, shavings, straw or newspaper in the enclosure, as these may be consumed.

Young birds may be ready for outside pens at 2 to 4 weeks of age. Concrete pens with epoxy-painted pools can be constructed. Shallow pools three-fourths inch deep are recommended to acclimate the young birds to water (Fig 36.43). A heat source can be provided in the pen. The pens pictured have doors that can open to outside pens (Fig 36.44). These help acclimate birds as they are going from the controlled indoor environment to the less-controlled environment of outside pens. Once acclimatized to the outdoor pens, the birds can then be moved to larger growing pens.

Waterfowl Diseases

An extensive table of bacterial, fungal, viral and parasitic diseases of Anseriformes is available elsewhere.[9] Listed

Figs 36.39, 36.40 | Different types of incubators are available for waterfowl.

Fig 36.41 | Hatcher for waterfowl eggs.

Fig 36.42 | Brooder room.

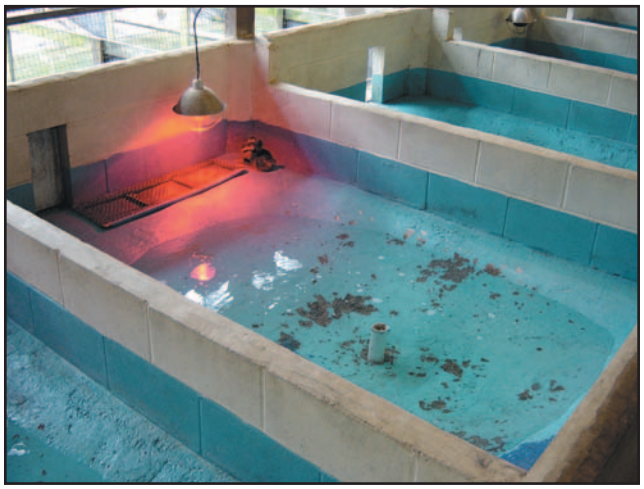

Fig 36.43 | Shallow ponds help acclimate young birds to water.

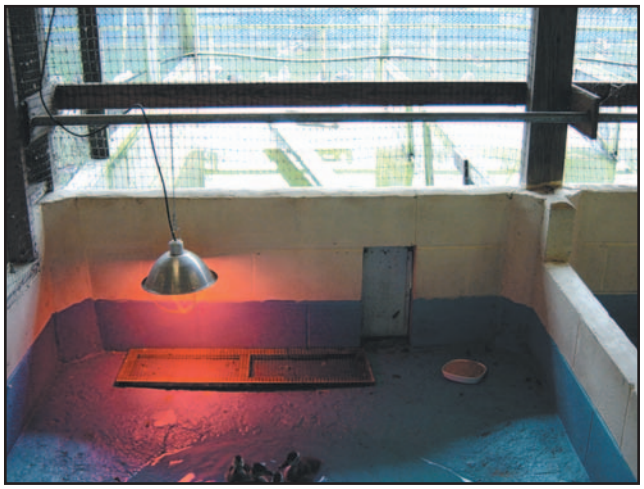

Fig 36.44 | Indoor pens that open to outdoor pens make excellent transition housing.

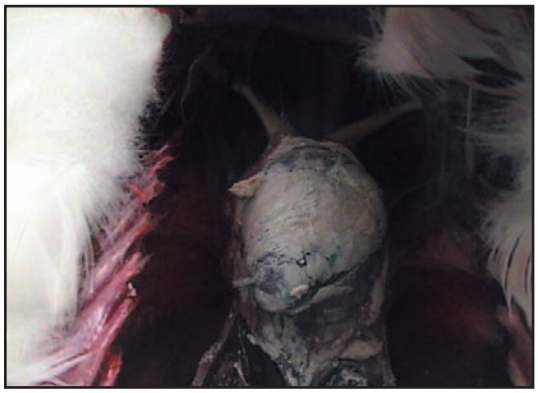

Fig 36.45 | Heart of a mute swan with gout secondary to bacterial septicemia.

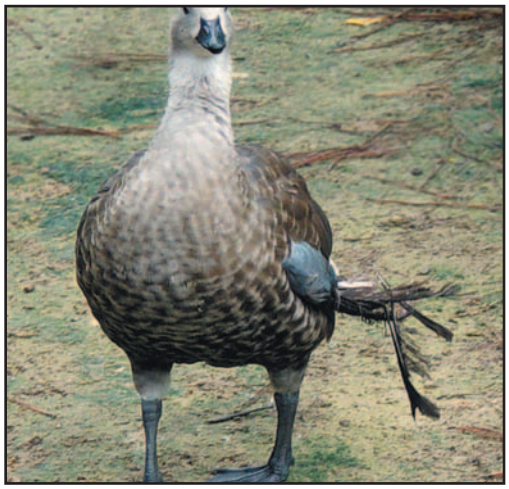

Fig 36.46 | Angel wing in an adult Abyssinian blue-winged goose (*Cyanochen cyanopterus*).

below are some of the most commonly observed disease syndromes.

Malnutrition

Dirty, broken, frayed feathers that do not repel water effectively evidence malnutrition. Frequently, affected birds have secondary bumblefoot due to dietary insufficiencies. Leg and joint lameness with a reluctance to move are other clinical signs, especially in younger birds. Hepatic lipidosis is common in malnourished birds. These birds also are frequently immunosuppressed and thus have secondary bacterial infections. The use of balanced, formulated diets appears to mitigate, if not alleviate, many of these clinical signs.

Bumblefoot

Many waterfowl with bumblefoot (see Fig 36.32) show no signs of lameness. In fact, many cases are not noticeable until the bird is restrained and examined. The underlying cause is usually malnutrition, although rough surfaces and excessive egg laying also can be contributing causes. Because bumblefoot is usually a chronic inflammatory condition, amyloidosis is a common sequela.

Trauma

Most of the larger waterfowl cannot survive if injury, such as that incurred from a dog, alligator, raccoon or turtle attack, results in the disuse of one leg. Heavy body size is not supported well by the one remaining leg. *Pasteurella multocida* is a frequent concern from scratch or bite wounds of predators.

Amyloidosis

Amyloidosis is a condition in which normal organ cells are replaced with a proteinaceous amorphous, eosinophilic, acellular material. Although the exact pathogenesis is unknown, amyloidosis is thought to be associated with stress of close confinement, chronic primary diseases or inflammatory conditions. Acute death frequently occurs, and liver and kidney biopsies are currently the only antemortem diagnostic tests. Where clinical signs occur, affected birds appear lethargic, have a lack of appetite, and are reluctant to stand. Gout is seen frequently subsequent to kidney failure associated with amyloidosis.

Gout

Gout (Fig 36.45) occurs secondary to renal failure. Causes of renal failure include toxicoses, chronic infection and amyloidosis.

Angel Wing

Angel wing (Fig 36.46) is a condition in which the distal portion of the wing appears flipped outward. Young swans and geese are most susceptible to this condition. Angel wing is caused by excessively rapid growth of feathers in relation to muscle development. As a result, growing flight feathers cause excess stress (weight) on carpal muscles, making the carpal portion of the wing hang and twist outward. Possible causes for angel wing include manganese or vitamin E deficiency, hypovitaminosis D_3, genetic factors, over-feeding and excessive dietary protein. If angel wing is noticed soon after the condition develops, it may be corrected by taping the wing in a normal position for 3 to 5 days. However, if the condition is left uncorrected until adulthood, the carpus can become traumatized, with amputation the best solution.

Non-specific Joint Inflammation/Lameness

Clinical signs of non-specific joint disorders include lameness or reluctance to move. This is seen frequently in young birds that are fed primarily "scratch grains"

(cracked corn, wheat, barley or oats) or large amounts of lettuce. In these cases, improvement is seen when the birds are switched to a pelleted diet. This condition also is seen in older birds (especially swans) as arthritis or septic joint infections. Depending on the cause, some decrease of pain and inflammation can be seen with flunixin-meglumine (1-10 mg/kg IM). Carprofen (5-10 mg/kg PO q 24 h) also may be effective. Frequently, bumblefoot develops or worsens as a result of excessive weight placed on the unaffected leg.

Fire Ant Stings

Fire ants are common in Florida. Stings manifest as necrosed areas on the foot web. When healed, these areas show up as defects in the foot web. In the aviary, 5% carbonate dust will help control fire ants. Improperly applied this can be toxic to birds.

Maggot Infestation

Maggot infestation occurs when old wounds (cuts or bites) go undetected or neglected. Infestation can occur in as few as 24 hours. Hydrogen peroxide helps flush out maggots, or they can be removed manually with forceps. Prognosis for tissue recovery depends on the amount of necrosis and length of time the wound has been left unattended. Carcasses that harbor maggots may be a source of botulism toxins if maggots are consumed.[9]

Products and Personal Communications Mentioned in the Text

a. Toprite Netting, Lakewood, NJ, USA; jacissel@Compuserve.com; 1-800-631-2234
b. Mike Gamebird Netting and Sight Barriers, Blue Mountain, AL, USA; 1-256-237-9461
c. BF Products Inc., Harrisburg, PA, USA; 1-800-255-839
d. Sylvan Heights Waterfowl II, M Lubbock and A Lubbock, Scotland Neck, NC, USA; 252-826-5038
e. Montgomery, R, Palm Beach, FL
f. Pinnacle filter, MacArthur Water Gardens, Bethesda, MD, USA
g. Pond Algae Blocker - Destroyers. Algae Fix. Aquarium Pharmaceuticals, www.aquariumpharm.com/pcalgae.htm, 1-800-847-0659, Chalfont, PA. www.macarthurwatergardens.com; 1-800-695-4913
h. Mazuri, PMI Foods, St. Louis, MO, USA; www.mazuri.com; 1-314-768-4592
i. Reliable Protein Products, Palm Desert, CA, USA; www.zoofood.com; 1-760-321-7533
j. High Potency Fine Pellets, Harrison's Bird Foods, Brentwood, TN, USA;1-800-346-0269; www.harrisonsbirdfoods.com
k. Tomahawk Mighty Net, Tomahawk Live Traps and Equipment, Tomahawk, WI, USA; 1-800-272-8727, www.livetrap.com
l. Tomahawk Throw Net, Tomahawk Live Traps and Equipment, Tomahawk, WI, USA; 1-800-272-8727, www.livetrap.com
m. 3M Vetwrap, 3M Worldwide, www.mmm.com; 1-888-364-3577
n. Wydase, www.tricarepharamacy.com
o. Feeding Tube and Urethral Catheter, Sovereign, Sherwood Medical, St. Louis, MO, USA
p. 17 Fr, 5.5 mm disposable silicone tubes, Veterinary Specialty Products, Boca Raton, FL, USA; www.vet-products.com; 1-800-362-8138
q. Emeraid Products, Lafeber Company, Cornell, IL, USA; www.Lafeber.com; 1-800-842-6445
r. Petersime Incubator Company, Gettysburg, OH, USA; 1-888-255-0067
s. Lyon Electric Company, Chula Vista, CA, USA;1-619-216-3400
t. Brinsea, Titusville, FL, USA; www.brinsea.co.uk; 1-888-667-7009
u. Humidaire Incubator Company, Madison, OH, USA; hatch@bright.net; 1-800-410-6925

References and Suggested Reading

1. Beynon PH, Forbes N, Harcourt-Brown NH (eds): Manual of Raptors, Pigeons and Waterfowl. Shurdington, Cheltenham, BSAVA, 1996.
2. Brown CS: An innovative repair method for slipped tendon. Proc Assoc Avian Vet, 2000, pp 127-131.
3. Carpenter JW, Mashima TY, Rupiper DJ: Exotic Animal Formulary. Philadelphia, WB Saunders Co, 2001, pp 109-194.
4. Game Bird and Conservationists' Gazette magazine, www.gamebird.com.
5. Griffin C, Snelling LR: Use of hyaluronidase in avian subcutaneous fluids. Proc Assoc Avian Vet, 1998, pp 239-240.
6. Jenkins J: Hospital techniques and supportive care. *In* Altman RB, Clubb SL, Dorrestein GM, Quesenberry K (eds): Avian Medicine and Surgery. Philadelphia, PA, WB Saunders Co, 1997, p 240.
7. Johnson-Delaney CA. Poultry and waterfowl. *In* Exotic Companion Medicine Handbook. Lake Worth, FL, Zoological Education Network, 2000.
8. Lumeij JT: Nephrology. *In* Ritchie BW, Harrison GJ, Harrison LR (eds): Avian Medicine: Principles and Application. Brentwood, TN, HBD Intl, Inc 1999, p 539.
9. Olsen JH: Anseriformes. *In* Ritchie BW, Harrison GJ, Harrison LR (eds): Avian Medicine: Principles and Application. Brentwood, TN, HBD Intl, Inc 1999, pp 1236-1275.
10. McMillan MC: Imaging techniques. *In* Ritchie BW, Harrison GJ, Harrison LR (eds): Avian Medicine: Principles and Application. Brentwood, TN, HBD Intl, Inc 1999, p 277.
11. Todd F. The Natural History of Waterfowl. Vista, CA, Ibis Publishing Co, 1997.
12. Flinchum G: Exotic pet care: Swans. Exotic DVM 2(1):36-38, 2000.
13. Gardner G, et al: Selected Topics in captive swan medicine and surgery. Exotic DVM 5(4): 33-38, 2003.