Strigiformes (Owls)

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Introduction

The Order Strigiformes consists of two Families; *Tytonidae* (barn owls) and *Strigidae* (typical owls). The *Tytonidae* consist of two genera with 16 species and 63 taxa. Five species of *Tytonidae* are considered threatened. The *Strigidae* have twenty five genera with 189 species and 548 taxa. Twenty one species of *Strigidae* are threatened. Four species and 2 subspecies of Strigids have become extinct.

Owls are distributed over diverse habitats worldwide. They inhabit all continents with the exception of Antarctica. A single species, *Tyto alba*, may be found worldwide. Their distinctive physical traits of forward-facing eyes, a large head with a rostral disk, a seemingly intelligent, expressive gaze, and a sober demeanor have made owls symbols of wisdom in many cultures. They are favorite animals in stories and legends around the world. To early Mesoamerican cultures, the owl was the harbringer of death, and called out the name of the person soon to be deceased.

Biology

Owls are crepuscular to nocturnal, with few exceptions. *Athene cunicularis*, the burrowing owl, is diurnal. Most owls inhabit woodlands or forests, except for the burrowing owl, who is a ground nester and hunts insects, reptiles, and small mammals during the day. Table 1 describes the basic biology and distribution of a few select owl species.

Unique Anatomy

The rostrum of most owl species has the shape of a disk, which acts as a concave bell, amplifying and re-directing sound towards the ears. Owls possess assymetrical external and middle ears, which allow for acoustic triangulation and pinpointing of sounds emmited by prey. Some owls may hunt in absolute darkness or by diving into deep snow drifts, accurately locating their prey by sound alone. Most owls have tubular shaped eyes, with elongated mid-sections and large, semi-spherical fundi. The pecten (Fig.1) and iridocorneal angle are normally clearly visible with an indirect ophthalmoscope. The fundus lacks a tapetum, so during fundic exam, the coroidal vessels are visible through the retina.

As with most raptors, owls possess a “talon-locking” mechanism, involving the flexor tendons of the feet and the ligaments between phalanxes. Once the claws are closed, it is very difficult to defeat the animal’s clutch, even if pulling digits apart individually.

Special Physiology

Most owls possess unusually large numbers of cervical vertebrae; over 23 in the case of some of the larger species. This allows for over 280 degrees of rotation of the head. The ocular muscles of owls are extremely small, and the eyes are relatively fixed in their orbits. Most owls will direct their rostrums directly toward sounds that attract their interest.

Some owl species have relatively large, functional ceca, which they evacuate periodically as a single, separate bowel movement every few days to weeks. The small, dark, extremely fetid stool is known as a "cecal mute", and is normal in a healthy, well fed animal. In some cases keepers who are unfamiliar with this will mistake the stool for a sign of disease.

Special Housing Requirements

There is no single design of cage or enclosure that is adequate for all owl species. Caging for hospitalized animals should allow the animal to stand fully erect and to partially, if not fully, extend its wings. The cage or enclosure should contain an adequate perch for the species, and should be made of a material that may be easily cleaned and fully disinfected (metal, plastic, or fiberglass; wood should be covered with an epoxy- based paint). Zoo or rehabilitation facilities housing owls should have enclosures that allow the birds to fly, even if it is for a short distance. Animals should be able to avoid rain, wind, direct sunlight, or cold, should they choose to do so. The enclosure may be glass, wire, wood, tensile wire, concrete, or wood. Proper perching design is key to foot health and the prevention of pododermatitis. Numerous perches at several levels should be provided. Areas designated for reproductive activity need to allow for flight and sunlight. They should also permit privacy, and contain suitable nesting materials and surfaces for the species being managed. Some species prefer platforms while others prefer hollow trunks or cavities. Some enclosure designs are "donut shaped", with a "hollow" center, which allows for the owls to fly in circles. Owls being rehabilitated for release need flight pens that permit the animal to develop coordination, muscular tone, and physical conditioning necessary for flight. A 20 by 30 meter flight cage can have a central rodent tub of at least 2 by 2 meters with a depth of 50 cm. An experienced hunter and an inexperienced animal of the same species may be housed together. The younger animal will usually learn to hunt by imitation of the more experienced, older animal.

Feeding

In the wild, smaller species of owls have a diet consisting of invertebrates, amphibians, reptiles, and small mammals, while the larger species tend to consume small birds (including smaller owls), rodents, and lagomorphs. Owls play a vital role in the control of rodents worldwide. Captive owls are generally maintained on a diet that mimics their natural prey. Insectivorous species can be maintained with mealworms (*Tenebrio sp.*) and crickets (*Acheta domestica*). Most captive owl species are maintained on diets consisting of whole adult rat or mouse without any other supplementation. Day-old chicks and laboratory rodents that have been humanely euthanized with carbon monoxide gas are frequently stored in a freezer until they are thawed for feeding. Chicks and immature rodents do not have enough minerals in their bones to provide adequate calcium levels. Calcium should be supplemented when feeding immature prey items. Owls need access to sunlight to metabolize Vitamin D. If none is available to them, they must receive Vitamin D_3 as a nutritional supplement. Occasionally, animals will refuse to eat dead items. Live prey must be fed to rehabilitated animals prior to their release to reinforce and confirm their predatory abilities. Raw meat, fish, meat mixes, or chicken necks are sometimes fed to owls. The balance of calcium, phosphorous, Vitamin D_3, and energy contents of the food are critical. Young owls being fed

exclusively meat products without an adequate mineral balance can develop metabolic bone disease in a matter of days. Meats and meat mixes provide low calcium and high phosphorous levels, while chicken necks contain mostly minerals (ash) with poor energy and protein contents. Commercial raptor diets are fed in North American zoos. The meat based mixes are mineral and energy balanced, but only available in large amounts (2 kg packages), which can make their use inconvenient when feeding small groups of animals. Owls in the wild generally kill and eat fresh prey. Occasionally, however, some owl species will eat carrion and road kill.

Restraint and handling

The physical examination of owls follows the same guidelines as those recommended for all raptors. It is necessary to maintain control of wings, talons, and head, so the assistance of an experienced restrainer is advised. Owls defend themselves with their talons and by biting aggressively. Proper restraint is essential for a safe exam. A towel can be thrown over an owl. Then the restrainer must rapidly gain control of the feet and wings. Many owl species defend themselves by biting, so special care must be taken when restraining larger species. If the restrainer is grasped by the animal's talons in its grip, it will become necessary to gently extend the owl's tarso-metatarsal joint to defeat the tendon-locking mechanism. This physiologic mechanism is in place as long as the leg remains flexed, and is meant to secure prey. Some owls will lay on their backs while attempting to claw or bite the restrainer. Since a large owl's talons can go through a leather glove, a towel or empty glove can be used as a decoy to entice the animal to clutch and grab the object. The owl's talons may then be controlled by grabbing and controlling the metatarsi. Once restrained, small to medium sized owls may be placed inside a surgical stocking net to control the entire body while keeping the wings flexed.

A systematic approach in examination is useful to avoid omitting organs or systems. Full fundic ocular exams, though somewhat difficult with a standard ophthalmoscope, are possible in Strigiformes. The posterior aspect of the tubular eyes is clearly visible through the ears of larger owl species. The oral cavity must be carefully examined, since hypovitaminosis A, candidiasis, trichomoniasis, pox, capillariasis and aspergillosis may all have oral presentations or visible lesions. Careful examination and palpation of all accessible organs and systems may be invaluable to the trained practitioner. Most fractures are palpable to the practiced clinician, and the information gained can be critical in establishing a proper course of action. Skeletal and articular abnormalities, localized inflammation, abnormal limb posture, range of motion of limbs, and hydration may all be evaluated by careful palpation.

Surgery and Anesthesia

Trauma is the most common reason that owls are presented for treatment. Cephalic trauma is frequently seen in small strigiformes, such as screech owls, and neurologic sequelae may impair full functional recovery (Fig. 2). Ocular trauma may lead to corneal laceration, iris degeneration (Fig 3.), lenticular proptosis, or partial to total retinal detachment. The large size a of an owl's eye, when compared to the proportionate size of the skull, make ocular trauma and intraocular hemorrhage a frequent problem. Treatment with antibiotics and parenteral anti-inflammatory drugs may be effective, but vision is difficult to evaluate once the animal has recovered. Enucleation requires the collapse of the intraocular ossicle ring, and careful removal of the remaining, collapsed structure. Special care should be taken when removing the eye not to cause intraoperative damage to the relatively short optic nerve, since excessive manipulation or pulling of the nerve can cause avulsion or tears of the optic chiasma, and neurologic blindness in the opposite, healthy eye. Diurnal owls with vision in a single eye may be impaired in their ability to hunt prey. Their release

following successful rehabilitation is not advised. The release of nocturnal species with one eye is controversial.

Anesthesia is achieved with the same techniques, products, and routes as recommended for raptors in general (Table 2). Fractures of the long bones are frequent in owls. The techniques for repair have been extensively described, but proper triage and prompt surgical intervention increase the odds of a successful repair. At present, external fixators, or the combined use of external and internal fixation techniques seem to be effective. New lightweight plastic materials have made external devices effective, strong, and relatively easy to apply. Post operative care must include a structured and consistent exercise program for full return to function prior to release.

Diagnostics

Methods of collection of blood and tissue samples in owls are the same as in most raptors. Blood may be obtained from the right jugular vein in smaller species. The brachial vein, as it crosses the humero-radio-ulnar joint, the humeral vein, and the medial metatarsal vein are the preferred vessels for blood collection in larger species. Claw or talon clipping is not a reliable method for blood collection, since the sample is frequently clotting as it is collected, and owls rely on sharp talons for successful hunting. Bone marrow can be collected by following the same technique as that used for intraosseous fluid administration. It involves placing a long needle in the ulnar marrow through the distal ulnar epiphysis.

Hematology and Serum Biochemistries

The hematological values of owls vary according to species, condition, and sampling technique. In general, comparatively high heterophil counts can be expected in the larger owl species. Heterophils vary widely in their stain uptake in many owl species when using commercial stain sets for in-house differential counts. Blood and serum chemistry values of several captive owl species are presented in Table 3.

Radiography is accomplished with the same techniques as with other avian species.

Other diagnostic modalities

Endoscopy in owls follows the same general principles as it does in other avian species. Sexual dimorphism is sufficient in many species to allow for correct sexing by an experienced observer.

Infectious Diseases of Owls (Table 4)

Viral diseases

Owls are susceptible to Herpes virus (hepatosplenitis; Marek's disease) and rabies. Rabies has been reported primarily in great horned owls.

Hepatosplenitis or Herpesvirosis

Owl herpesvirus infection is characterized by hepatitis and splenitis. The virus is presumed to be transmitted by infected prey, primarily other birds. Passerines and Columbiform birds are strongly suspected to be hosts or reservoirs for the disease. Infection in owls has up to 100% mortality, and is characterized by intranuclear inclusion bodies found by histopathology. Clinical course may be hyperacute to acute, and is characterized by heteropenia and small, tan colored, punctate oral and pharyngeal lesions. At present no treatment seems effective. Prevention is limited to feeding animals of known colonies. Infection by Herpesvirus may resemble Salmonellosis on a macroscopic level, so culture and histopathology are recommended in suspect cases.

Rabies

Great horned owls can shed rabies virus for prolonged periods of time after ingesting rabid prey, although no clinical evidence of the disease is apparent. Since skunk is a common prey item for this animal, caution in dealing with wild birds is warranted. Serological evidence of rabies exposure has been found in very few wild owls. It is presently considered to be an extremely rare problem, though more studies on serological evidence of exposure are needed.

Bacterial Diseases include pasteurelosis, salmonelosis, colibacillosis, avian tuberculosis and the organisms associated with bumblefoot (pododermatitis). These are reviewed in other chapters dealing with raptors.

Mycotic diseases include candidiasis and aspergillosis. They are detailes in the chapters dealing with special clinics.

Parasitic diseases of owls

Parasites are common in wild and captive Strigiformes. Owls may have myasis, coccidiosis, trichomoniasis, cestodiasis, trypanosomiasis, trematodiasis, nematodiasis, and infections by *Plasmodium, Leucocytozoon, Hemoproteus, Sarcocystis, Acanthocephala,* as well as numerous ectoparasites. Table 6 lists the most common parasites and their treatment.

Non Infectious Diseases

Nutritional diseases include hypovitaminoss A, B, and D_3, as well as metabolic bone disease. Information is available in the special diseases section.

Nutritional deficiencies and deficits tend to be common in owls kept in captivity by inexperienced or misinformed people. Proper nutrition may require supplementation, especially in birds whose

natural diet is whole prey based, and who are fed all meat diets without sufficient calcium and phosphorous.

Hypovitaminosis A

Owls are unable to convert carotenoid precursors to active vitamin A. In the wild, the prey's liver is the greatest source of vitamin A, so deficiencies are seen most often in birds fed exclusively meat diets without access to viscera. Vitamin A is indispensable in maintaining the integrity and function of epithelial tissues, and its deficiency is most often expressed as hyperkeratosis or metaplasia of squamous cell tissue. Oral, esophageal, and infraorbital gland hyperplasia, as well as syringeal, tracheal, bronchial and nasal or lachrimal gland metaplasia account for the most obvious clinical signs. Hyperkeratotic oral plaques are frequently confused with lesions associated with oral trichomoniasis or candidiasis. Keratin accumulation may deform the infraorbital sinuses and conjunctival sacs, and can be mistaken for sinusitis or focal aspergillosis. Hyperkeratotic plugs in the trachea frequently cause inspiratory dyspnea. Visceral and articular gout associated to renal failure induced by hypovitaminosis A has been reported. Adding liver, egg yolk, cod-liver oil, or commercial vitamin A supplements to the diet is usually sufficient to prevent and treat the problem. Cadaveric levels of vitamin A in raptors should be between 9,000 and 13,000 μg, so postmortem diagnostics can be performed if hepatic levels are measured.

Hypovitaminosis B

Owls fed exclusively day old chicks, meat, or eviscerated prey, as well as animals fed frozen fish diets which may be affected by thiaminase activity, tend to present neurological deficits; typically opisthotonos and ataxia, and can eventually develop axonal and neuronal degeneration. Clinical signs dramatically improve or disappear in response to parenteral thiamin supplementation. Dramatic improvement following thiamin supplement injection may lead to a diagnosis based on clinical response. Episodes of toxicity with insecticides, as well as viral, bacterial, or mycotic encephalitides may present with similar clinical signs, and may obscure the diagnosis. There are few reports of riboflavin deficiency in owls. Treatment with an injectable supplement at doses recommended for small mammals has reportedly led to dramatic improvement in a short time, and may be considered diagnostic.

Hypovitaminosis D and mineral imbalance are covered in chapters dealing with the disease process in other avian species.

Hypovitaminosis E and Selenium Deficiency

Hypovitaminosis E and selenium deficiencies are extremely rare, but can occur in owls fed exclusively meat. Diagnosis is usually performed post-mortem by histopathology, where characteristic lesions of skeletal muscle and hyalin degeneration are noted. The lesions are usually indicative of nutritional myopathy. The myocardium, fat, and liver are usually not affected. At present, there are no antemortem diagnostics or treatment. A complete and properly balanced diet is the only preventive.

Reproduction

Most owl species have highly characteristic breeding displays and courtship behavior. Most owls nest in cavities or other birds nests, but rarely add to the nest or cavity themselves. Great horned owls (*Bubo virginianus*) lay clutches of one to four eggs that are incubated for 28 to 30 days.

Clutch sizes may vary depending of food availability. Chicks spend 3 weeks in the actual nest, before going on to a three month fledging phase. Barred owls *Strix varia*) produce two to three eggs and incubate them for 28 to 33 days. The nestling phase can last up to 7 weeks and the fledging may take until late summer or fall. Eastern screech owls (*Otus asio*) lay four to six eggs in a clutch, also in a cavity or hollow. The nestling phase lasts four weeks and the animals are fledged in 6 to 8 weeks. All of these animals produce only one brood per season. Reproducing owls in captivity depends greatly on allowing the animals to be relatively isolated and unbothered, and also on a flight cage design that permits for courtship flight and cagemate segregation when necessary. A large cage with a "cut out" center that allows the animals to fly in circles has been found to be extremely successful with some species.

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Figure 1. The pecten of owls is usually visible during ophthalmologic exam.

Figure 2. Anisocoria in owls can be physiologic or traumatic. In some cases of trauma, it may be associated with paresis. In this case, the animal is unable to lift the ear tuft in the affected side of the rostrum.

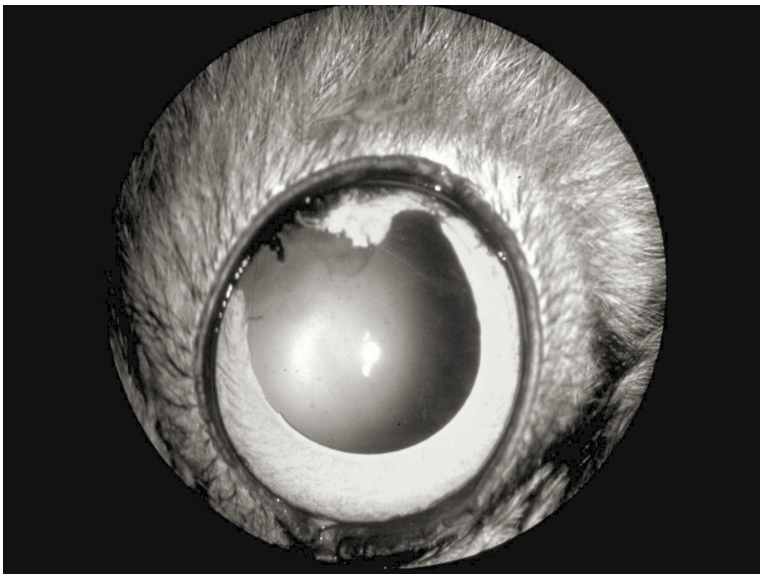

Figure 3: Tears of the iridocorneal angle of the eye are common following episodes of cephalic trauma. Detached myofibrils will heal, but may give the iris a deformed appearance.

Table 1. Basic Biologic Data for Select Species of Owls.

Scientific name	Common name	Distribution	Habitat	Diet
Tyto alba	Barn owl	W. hemisphere; S. Canada southward to tip of S. America; Europe; Europe; NE Africa; Africa south of Sahara; except for rain forest regions and Somalia, India and SE Asia, Islands of East Indies, Australia.	Open habitats including desert, grassland, moors, coastal plains, parkland, otherwise widespread in lightly wooded and cultivated habitats, towns and cities.	Various vertebrates, especially small nocturnal rodents, shrews, small birds
Tyto capensis	Grass owl	S. Africa, India, SE China, Philippines, Celebes, E. New Guinea, E. Australia, Fiji Islands.	Grassland	Various vertebrates
Otus choliba	Choliba screech owl	C. America: Costa Rica	Open woodland, forest edge, second growth, savanna, towns, bamboo stands.	Various vertebrates
Otus asio	Eastern screech-owl	N. America; SE Alaska, S. Canada to C. Mexico	Open woodland, deciduous forest, towns, scrub, riparian woodland.	Various vertebrates, especially small nocturnal rodents.
Bubo virginianus	Great horned owl	N. America south of tundra, C. America and S. America to straits of Magellan	Forest, second growth, swamps, woodland, towns, mangroves, desert.	Various vertebrates, including hares and rabbits
Bubo bubo	Eurasian eagle owl	Eurasia, including India, N. Africa and S. Arabia, China, SE Asia	Forest, woodland, desert, farmlands.	Various vertebrates, including hares and rabbits.
Bubo nipalensis	Spot bellied eagle owl	Asia; India and SE Asia, Ceylon, SW China.	Humid and riparian forest.	Various vertebrates.
Nyctea scandiaca	Snowy owl	Circumpolar in Artic tundras of N. America and Eurasia	Tundra in migration in open country, fields and prairie.	Various vertebrates including hares and rabbits

Table 1. Basic Biologic Data for Select Species of Owls (Cont)

Scientific name	Common name	Distribution	Habitat	Diet
Strix aluco	Tawny owl	Paleartic from British Isles, S. Escandinavia and W,C,SW Russia to NW Africa and Mediterranean region	Forest, woodland, towns.	Various vertebrates especially small nocturnal rodents and invertebrates
Strix varia	Barred owl	N. America: S. Canada,U.S., C. America into Honduras.	Dense woodland, swamps, riparian forest.	Various vertebrates especially small nocturnal rodents and invertebrates
Strix nebulosa	Great grey owl	Circumboreal: Eurasia and N. America	Circumboreal	Various vertebrates and invertebrates
Surnia ulula	Northern hawk owl	Circumboreal, coniferous belts of N. America and Eurasia	Boreal forest, edge, swamps, second-growth woodland, muskeg.	Various vertebrates
Glaucidium (passerinum) gnoma	Northern pygmy-owl	N.America: SE Alaska, W. Canada, W. USA, Mexico into Guatemala and honduras	Forest, edge, pine-oak woodland.	Small nocturnal vertebrates and invertebrates
Athene noctua	Little owl	Europe, C. Asia including Mongolia and N. Africa, N. China, Arabia	Steppes, stony semi-desert, farmlands, open woodland, town.	Small nocturnals vertebrates and invertebrates
Speotyto cunicularia	Burrowing owl	N.America: W.Canada and US Florida; Mexico, Bahamas, Hispanola, Central and South America	Grassland, savanna, desert, farmlands	Various vertebrates
Aegolius funereus	Boreal owl	Circumboreal in coniferous forests of N. America and Eurasia	Boreal and subalpine forest, mixed woodland.	Various vertebrates
Asio otus	Long-eared owl	N. America, Eurasia	Coniferous and mixed forest, second growth.	Various vertebrates

* based on Fowler, ME and Cubas, ZS, reference 8.

Table 2: Sedatives, anesthetics, and restraint agents used in owls.

	Agent	Dosage	Comments
Parenteral	Ketamine/ Medetomidine	(K) 2-4mg/kg (M) 25-75g/kg(IV) (K) 3-5mg/kg (M) 50-100mg/kg(IM)	Recommended for short procedures Reversible with 5:1 atipamezole IV or IM
	Ketamine/Diazepam	(K) 10-30mg/kg/(IV) (D) 1.0-1.5mg/kg(IM)	
	Tiletamine/Zolazepam	10mg/kg (IM)	
	Butorphanol Tartrate	3-4mg/kg/(IM) 0.5 mg/kg/IM	Light sedation analgesia, reduces isoflurane requirements. For pre-, intra- and postsurgical analgesia.
Inhaled	Halotane	-	Not recommended
	Isofluorane	4-5% induction 2.0-2.5% maintenance	Anesthetic of choice
	Sevofluorane	Incremental increases up to 7% prn Rapid induction and recovery	Anesthetic of choice/expensive
Vaso-active Compounds	Glycopirrulate	0.01 mg/kg/IM, IV	Most species, for increasing arterial pressure. Rarely indicated.

* Based on Carpenter, JW, Mashima, TY, and Rupiper.

Table 3. Reference ranges for hematologic parameters of nine species of owls.

Test	Units	*Asio flammeus* Short-eared owl	*Athene cunicularia* Burrowing owl	*Bubo bubo* Eurasian eagle owl	*Bubo virginianus* Great horned owl	*Nyctea scandiaca* Snowy owl	*Otus asio* Common screech owl	*Pulsatrix perspicillata* Spectacled owl	*Strix nebulosa* Great grey owl	*Strix varia* Barred owl	*Tyto alba* Common barn owl
White Blood Cell Count	*10^9/L	9.021	8.869	14.60	14.47	10.41	12.79	11.36	14.96	13.36	14.42
Red Blood Cel Count	*10^12/L	2.70	2.23	1.89	2.08	2.69	2.53	1.48	-	2.79	2.46
Hemoglobin	g/L	120	159	112	146	126	122	127	79	119	172
Hematocrit	L/L	0.422	0.451	0.378	0.417	0.432	0.440	0.389	0.422	0.403	0.438
Mcv	fL	150.8	199.9	232.8	212.8	161.2	183.0	260.4	-	168.5	189.1
Mch	pg/cell	45.3	70.7	-	66.8	45.7	54.9	101.8	-	41.9	83.8
Mchc	g/L	300	301	287	368	284	288	354	200	303	326
Heterophils	*10^9/L	5.141	3.777	7.720	7.950	5.252	5.124	4.861	3.848	6.268	8.038
Lymphocytes	*10^9/L	3.370	3.234	5.879	4.674	4.312	4.931	4.691	9.679	5.439	5.266
Monocytes	*10^9/L	0.841	0.476	0.354	1.023	0.542	0.911	0.434	0.632	0.660	0.581
Eosinophils	*10^9/L	0.101	0.926	1.091	1.663	0.533	2.119	1.357	0.898	0.975	1.330
Basophyls	*10^9/L	0.201	0.495	0.395	0.450	0.328	0.650	0.487	0.199	0.991	0.438
Calcium	mMol/L	2.30	2.18	2.45	2.45	2.35	2.20	3.05	2.38	2.40	2.20
Phosphorus	mMol/L	2.58	1.36	2.81	1.87	1.32	1.36	1.78	1.91	1.42	1.20
Sodium	mMol/L	157	150	166	159	152	152	156	152	150	153
Potassium	mMol/L	2.9	3.2	2.8	2.5	2.8	3.0	2.6	3.5	3.3	2.8
Chloride	mMol/L	136	111	132	121	117	116	119	119	110	118
Magnesium	mMol/L	1.119	-	-	0.823		1.029	-	-	-	-
Blood Urea Nitrogen	mMol/L	1.428	4.641	2.142	2.142	0.7140	3.213	2.142	1.785	3.213	1.785
Creatinine	µMol/L	44	44	27	44	53	44	44	44	71	44
Uric Acid	µMol/L	0.339	0.559	0.732	0.702	0.541	0.482	0.518	0.988	0.470	0.649
Total Bilirrubin	µMol/L	$10x10^3$	$21x10^3$	$3x10^3$	$3x10^3$	$3x10^3$	$5x10^3$	$3x10^3$	-	$212x10^3$	$7x10^3$
Glucose	mMol/L	16.26	18.26	18.48	19.15	18.87	18.59	18.09	17.54	16.48	13.93
Cholesterol	mMol/L	5.957	6.475	5.569	5.491	5.465	5.439	6.527	5.802	5.361	5.957
Triglyceride	mMol/L	1.729	1.469	1.175	1.198	1.153	1.356	7.379	-	1.300	2.689

Table 3. Reference ranges for hematologic parameters of nine species of owls (Cont)

Test	Units	*Asio flammeus* Short-eared owl	*Athene cunicularia* Burrowing owl	*Bubo bubo* Eurasian eagle owl	*Bubo virginianus* Great horned owl	*Nyctea scandiaca* Snowy owl	*Otus asio* Common screech owl	*Pulsatrix perspicillata* Spectacled owl	*Strix nebulosa* Great grey owl	*Strix varia* Barred owl	*Tyto alba* Common barn owl
Creatinine Phosphokinase	U/L	301	573	830	794	678	1006	399	850	709	2386
Lactate Dehydrogenase	U/L	315	721	651	551	337	803	189	1186	530	857
Alkaline Phosphatase	U/L	28	75	24	71	75	76	278	31	66	112
Alanine Aminotransferase	U/L	70	91	62	21	47	68	73	66	51	19
Aspartate Aminotransferase	U/L	199	460	207	177	252	268	211	238	221	168
Amylase	U/L	64.94	54.95	94.54	54.39	42.74	59.76	-	-	71.60	99.16
Total Protein (Colorimetry)	g/L	32	38	38	39	37	37	43	34	45	32
Globulin (Colorimetry)	g/L	19	19	21	24	24	21	28	20	25	16
Albumin (Colorimetry)	µM/L	217.35	217.35	246.33	246.33	202.86	275.31	260,82	217.35	289.8	231.84
Body Temperature:	°C	39.0	38.5	-	38.0	39.0	38.0	-	-	38.9	-

* based on Physiological Data Reference Values, International Species Identification System.

Table 4. Selected infectious diseases of owls.

Disease	Etiology	Signs	Diagnosis	Management
Infectious hepatosplenitis (Herpesvirosis)	Owl herpesvirus, Strigid HV 1	Acute death, anorexia, depression, weakness, inability to perch, diarrhea	Intranuclear inclusion bodies in hepatocytes and spleen at necropsy	Isolation of sick birds, insect control.
Tuberculosis	*Mycobacterium avium/Mycobacterium intracellulare*	Emaciation, diarrhea	Granulomas(3-25mm) in viscera and occasionally lungs. Acid fast rods from impression smears. Culture, histopatology	Difficult to contain; sanitation, quarantine. Treatment has been unsuccessful
Infectious pododermatitis (Bumblefoot)	*Staphylococcus aureus*, miscellaneus gram negative rods.	Swelling and ulceration of foot pads, difficulty in perching.	Radiography, culture, and sensitivity.	Provide suitable perches for the species exhibited, antibiotics, surgery, intensive wound care.
Velogenic viscerotropic Newcastle disease	*Paramyxovirus*	Central nervous system effects, tremors, paresis, paralysis	History, signs, viral culture, serology	Quarantine, sanitation
Rabies	Lyssavirus	No evident signs	Hemagglutination (PHA)	No treatment, euthanasia