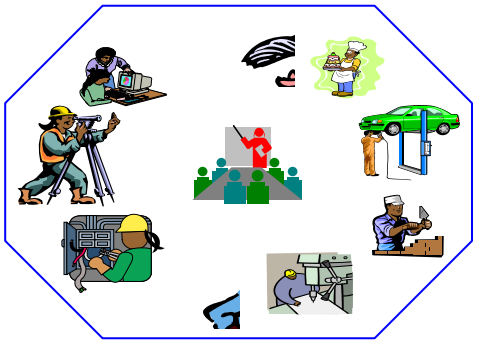
Animal Health Care Service

Level- IV

Based on March 2018, Version 3 Occupational Standards



Module Tittle: Identifying and Handling Diseases of Wild Animals

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LG # 47	LO # 1- Identify Hazard and risks

Instruction sheet

This learning guide is developed to provide you the necessary information regarding the following content coverage and topics:

- Maintaining personal hygiene and cleanliness standards
- Collecting and assessing information regarding hazard identification and risk control
- Recognizing and reporting hazards in the workplace
- Recognizing and taking action on risks to self, bystanders, the public and animals

This guide will also assist you to attain the learning outcomes stated in the cover page. Specifically, upon completion of this learning guide, you will be able to:

- Maintain personal hygiene and cleanliness standards
- Collect and assess information regarding hazard identification and risk control
- Recognize and report hazards in the workplace
- Recognize and take action on risks to self, bystanders, the public and animals

Learning Instructions:

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described below.
3. Read the information written in the “Information Sheets”. Try to understand what are being discussed. Ask your trainer for assistance if you have hard time understanding them.
4. Accomplish the “Self-checks” which are placed following all information sheets.
5. Ask from your trainer the key to correction (key answers) or you can request your trainer to correct your work. (You are to get the key answer only after you finished answering the Self-checks).

Information Sheet 1- Maintaining personal hygiene and cleanliness standards

1.1 Introduction

Hygiene generally refers to the set of practices associated with the preservation of health and healthy living. Personal hygiene is practices performed by an individual to care for one's bodily health and wellbeing through cleanliness. Many people equate hygiene with 'cleanliness' but hygiene is a broad term including personal habits choices as how frequently to bath, wash hands, trim fingernails and change clothing. Also includes keeping the environment clean and pathogen free. Personal hygiene is a concept that is commonly used in medical and public health practices. It is also widely practiced at the individual level and at home. Personal hygiene is personal, as its name implies. In this regard, personal hygiene is defined as a condition promoting sanitary practices to the self. Generally, the practice of personal hygiene is employed to prevent or minimize the incidence and spread of communicable diseases.

Difference between cleanliness and hygiene is: the term cleanliness should not be used in place of hygiene. Cleaning in many cases is removing dirt, wastes or unwanted things from the surface of objects using detergents and necessary equipment. Hygiene practice focuses on the prevention of diseases through the use of cleaning as one of several inputs. Sanitation addresses the cleaning and disinfection when necessary of people, equipment, animals and material.

Some form of cleaning and disinfection should be done before people and their clothing, equipment, supplies, and larger items such as vehicles and heavy equipment cross from dirty or low risk (the farm perimeter) to clean or higher risk areas. Entry and exit routes from buildings and a property have the potential to bring and take away disease-causing organisms. Proper Personal Hygiene includes the following:

- Wash hands before and after animal handling
- Do not eat or drink in the animal housing areas
- Wear coveralls, farm specific clothing or laboratory coats when handling animals.

- Avoid handling sick animals or animals with lesions unless gloved
- Wear a mask if you are allergic to animal hair or dander or if feed or bedding dust is present
- Routinely wear gloves when cleaning animal area

1.2 Occupational Health and safety (OHS)

Occupational health and safety is one of the most important aspects of human concern. It aims an adaptation of working environment to workers for the promotion and maintenance of the highest degree of physical, mental and social well-being of workers in all occupations. It includes:-

- Safe animal handling systems and procedures including zoonoses control
- Identify hazards, assess and report risks.
- Safe manual handling systems and procedures.
- Safe systems and procedures for outdoor work including protection from solar radiation.
- Appropriate use of PPE clothing and equipment.

Self-check 1: Written Test

Name…… ID…… Date…….

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Short Answer Questions

1. Give the definition of personal hygiene (2 points)
2. Explain the difference between personal hygiene and cleanliness standards (3 points)
3. _____ is generally refers to the set of practices associated with the preservation of health and healthy living (1 points)
4. Discuss occupational health and safety procedures implemented in management of wild animals (2 points)

Note: **Satisfactory rating – ≥ 4 points** **Unsatisfactory - below 4 points**

You can ask you teacher for the copy of the correct answers.

Information sheet 2: Collecting and assessing information about hazard identification and risk control

2.1 Definition of terminologies

Hazard: Anything (e.g. condition, situation, practice, behavior) that has the potential to cause harm, including injury, disease, death, environmental, property and equipment damage. A hazard can be a thing or a situation.

Hazard Identification: This is the process of examining each work area and work task for the purpose of identifying all the hazards which are “inherent in the job”.

Risk: The likelihood, or possibility, that harms (injury, illness, death, damage etc) may occur from exposure to a hazard.

Risk Assessment: Is defined as the process of assessing the risks associated with each of the hazards identified so the nature of the risk can be understood. This includes the nature of the harm that may result from the hazard, the severity of that harm and the likelihood of this occurring.

Risk Control: Taking actions to eliminate health and safety risks so far as is reasonably practicable. Where risks cannot be eliminated, then implementation of control measures is required, to minimize risks so far as is reasonably practicable. A hierarchy of controls has been developed and is described below to assist in selection of the most appropriate risk control measure/s.

Monitoring and Review: This involves ongoing monitoring of the hazards identified, risks assessed and risk control processes and reviewing them to make sure they are working effectively.

2.1 Hazard Identification and Assessment

One of the "root causes" of workplace injuries, illnesses, and incidents is the failure to identify or recognize hazards that are present, or that could have been anticipated. A

critical element of any effective safety and health program is a proactive, ongoing process to identify and assess such hazards.

To identify and assess hazards, employers and workers:

- Collect and review information about the hazards present or likely to be present in the workplace.
- Conduct initial and periodic workplace inspections of the workplace to identify new or recurring hazards.
- Investigate injuries, illnesses, incidents, and close calls/near misses to determine the underlying hazards, their causes, and safety and health program shortcomings.
- Group similar incidents and identify trends in injuries, illnesses, and hazards reported.
- Consider hazards associated with emergency or nonroutine situations.
- Determine the severity and likelihood of incidents that could result for each hazard identified, and use this information to prioritize corrective actions.

Many wild animals can inflict serious, if not fatal, injury. The first concern when dealing with wild animals should be the safety of human beings. To think otherwise is foolhardy, and those who grandstand or show off by manipulating dangerous animals without benefit of proper restraint may injure themselves or bystanders. Those who own or have administrative responsibility for wild animals must recognize that the animal, no matter how valuable, cannot be handled in such a way as to jeopardize the safety of those who must work around it. Techniques are known that when properly used can safeguard both animal and operator.

Self-check 2- Written Exam

Name…… ID…… Date…….

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Short Answer Questions

1. _____is the likelihood, or possibility, that harms (injury, illness, death, damage etc) may occur from exposure to a hazard (2 points)
2. Explain the difference between hazard identification and risk assessment (4 points)
3. Write the responsibility of employer and employee to identify and assess hazards (4 points)
4. _____ is the process of assessing the risks associated with each of the hazards identified so the nature of the risk can be understood (2 points)

Note: **Satisfactory rating – ≥ 6 points** **Unsatisfactory - below 6 points**

You can ask you teacher for the copy of the correct answers.

Information sheet 3- Recognizing and reporting hazards in the workplace

3.1 Hazards Working with Wildlife

Most wildlife biologists, technicians, and veterinarians complete their tasks safely and uneventfully every day. However, some significant risks exist in this line of work, and injuries, illnesses, and accidental deaths among wildlife workers do occur. Although rare, serious zoonotic infections also happen. Being mindful of occupational hazards and zoonoses and the various ways to minimize these risks, can help workers stay safe and healthy on the job. Work involving direct contact with both live and dead wildlife presents unique risks and hazards that require specialized education and awareness to prevent harm. Occupational hazards of working with wildlife include the following.

- Physical hazards
- Chemical hazards
- Biological hazards
- Zoonotic disease hazards
- Mental health and workplace stress

a. Physical Hazards

- Being stung by an insect or attacked, bitten, kicked, or gored by an animal
- Animal bites, stings and scratches
  - ✓ Care should be taken when handling animals to avoid bites, sting or scratches. All inflicted injuries (even superficial ones) should be appropriately treated as soon as possible to ameliorate possible allergic reaction, prevent infection and promote healing. To improve safety, field personnel should be aware of the treatment for snakebite and carry appropriate pressure bandages. Personnel should also have up-to-date tetanus vaccinations.
- Dangers of working in or around water bodies
- Temperature extremes
- Ergonomic challenges of working in the field

- ✓ Slips, trips, and falls
- ✓ Visual impairment at night or in poorly lit environments
- ✓ Sun exposure/ultraviolet radiation

- Man-made concerns
  - ✓ Transportation hazards including airplanes, helicopters, trucks, and cars
  - ✓ Elevated noise exposures
  - ✓ Firearms and remote delivery systems
  - ✓ Handling scalpels and needles
  - ✓ Workplace violence

b. Chemical Hazards

Many wildlife workers are exposed to chemical hazards while working in the field or in the laboratory. If chemicals are not stored or handled properly, they have the potential to cause adverse health effects, and these effects depend on the route and duration of exposure. Specific information about the hazards of a chemical product can be found on the material safety data sheets provided by the manufacturer, importer, or distributer of the product. Some of the potential chemical hazards for wildlife workers include the following:

- Disinfectants
- Formalin
- Pharmaceuticals (for example, anesthetics, antibiotics)

c. Biological Hazards

Many biological hazards pose risks to wildlife workers

- Harmful algal blooms and other waterborne exposures and diseases
- Toxic plants
- Venomous animals and insects
- Zoonotic disease

d. Zoonotic Diseases

Some serious zoonotic diseases that are commonly associated with wildlife include hantaviruses, plague, rabies, and tularemia. Depending on location, vector-borne

diseases, such as anaplasmosis, erhlichiosis, Lyme disease, tickborne relapsing fever, and various arboviruses are of considerable concern as well. Risk factors for zoonoses that have been identified in wildlife workers include the following.

- Working outside
- Insect bites
- Contact with the following materials
  - ✓ Deceased canids
  - ✓ Fish tissue/fluids
  - ✓ Reptiles and reptile feces
  - ✓ Rodents and rodent urine/feces

Being aware of the potential zoonotic diseases in the area where field work is taking place and implementing appropriate protective measures are important factors in limiting disease exposures.

e. **Allergies**

Some personnel may develop allergies when they come in contact with animal materials such as hair and dander. Personnel known to develop allergies should wear gloves when handling animals and long sleeved pants/shirt. People with severe allergies associated with animals, with immune deficiency diseases or on immunosuppressant therapy should not engage in the handling of wildlife.

e. Mental Health and Workplace Stress

Mental health and workplace stress are frequent challenges many veterinarians and wildlife workers face. Veterinarians experiencing psychological distress are less likely to receive treatment than the general public. Veterinarians perceive greater stigma for mental illness and have a higher prevalence of depression and suicide ideation compared to the general public.

3.2 Recordkeeping

Maintaining work-related injury and illness records is in keeping with best practices. Examples of records include the following:

- ✓ Work-related injuries and illnesses that result in time away from work, restricted work, loss of consciousness, or medical treatment beyond first aid.
- ✓ Work-related fatality, inpatient hospitalization of one or more employees, an employee's amputation, or an employee's loss of an eye.
- ✓ Other significant work-related health outcomes, diagnosed by a healthcare professional.

Self-check 3- Written Exam

Name…… ID…… Date…….

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Choose the correct answer from the given alternatives (2 points each)

1. One of the following is not biological hazards encountered when working with wild animals

   a. animal bite b. hantaviruses c. rabies d. tularemia

2. Many wildlife workers are exposed to pharmaceutical products while working with wild animals. The exposure of this product is known as_____ hazard.

   a. allergies b. chemical hazards c. biological hazards d. none

3. Human being is exposed to zoonoses disease from wild animals as a result of contact with one of the following materials

   a. feaces b. urine c. discharge from animals d. all

Note: **Satisfactory rating – ≥ 3 points Unsatisfactory - below 3 points**

You can ask you teacher for the copy of the correct answers.

Information sheet 4- Recognizing and taking action on risks to self, bystanders, the public and animals

4.1 Recognizing risks to self, bystanders, the public and animals

Hand-washing

Hand-washing is considered the most important practice in preventing the spread of disease for visitors to animal contact areas. Infectious diseases may be spread from either animals or their environment to people via contaminated hands. Good hygiene practices, such as the correct hand-washing technique and washing hands at appropriate times in the animal contact area, will decrease the risk of disease. Always wash hands with soap and running water:

- After touching animals, their enclosures or food containers.
- Any part of the animal or its surrounds can be contaminated
- After being licked or bitten by animals
- After having contact with soil, urine or faeces in an animal contact area.
- Always wash hands before eating, drinking or smoking.
- Always alert about the behavoir of animal

4.2 Avoiding activities with a higher risk

While visiting animals do not:

- Touch mouth with hands, or lick fingers
- Eat food intended for animals eat inside the animal contact area (although there can be exceptions to this where the operator implements control measures to mitigate zoonotic disease risk in a visitor eating area)
- Leave open wounds uncovered
- Wipe hands on clothing, if avoidable
- Use dummies, spill-proof cups or baby bottles in the animal contact areas
- Return dummies or toys that have fallen on the ground or been in contact with animals to children until they have been washed with soap and water.

Self-check 4- Written Exam

Name…… ID…… Date…….

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Short answer question

1. Describe methods implemented to reduce risks to self, colleague and public while working with wild animals(4 points)
2. Explain activities to be conducted after visiting animals to reduce risks to others (2 points)

Note: **Satisfactory rating – ≥ 3 points** **Unsatisfactory - below 3 points**

You can ask you teacher for the copy of the correct answers.

LG # 48	LO # 2- Identify and handle major infectious disease of wild animals

Instruction sheet

This learning guide is developed to provide you the necessary information regarding the following content coverage and topics:

- Identifying major infectious diseases of wild animals
- Capturing, restraining and handling of wild animals
- Signs of stress in wild animals
- Undertaking diagnosis of wild animal disease
- Identifying diseases causing micro organisms
- Prescribing and carrying out wild animal treatments
- Identifying prevention and control methods of wild animal disease
- Identifying public and economic importance of wild animal diseases

This guide will also assist you to attain the learning outcomes stated in the cover page. Specifically, upon completion of this learning guide, you will be able to:

- Identify major infectious diseases of wild animals
- Capture, restrain and handle wild animals
- Signs of stress in wild animals
- Undertake diagnosis of wild animal disease
- Identify diseases causing micro organisms
- Prescribe and carry out wild animal treatments
- Identify prevention and control methods of wild animal disease
- Identify public and economic importance of wild animal diseases

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Information sheet 1- Identify major infectious diseases of wild animals

1.1 Introductions

Wildlife means feral animals, captive wild animals and wild animals. **Feral animal** is an animal of a domesticated species that now lives without direct human supervision or control. **Captive wild animal** is an animal that has a phenotype not significantly affected by human selection but that is captive or otherwise lives under direct human supervision or control, including zoo animals and pets. **Wild animal** is an animal that has a phenotype unaffected by human selection and lives independent of direct human supervision or control.

1.2 Major Bacterial Disease of Wild Mammals and Birds

Diseases caused by bacteria are a more common cause of mortality in wild birds than are those caused by viruses. In addition to infection, some bacteria cause disease as a result of potent toxins that they produce.

a. Avian Cholera

Synonyms: Fowl cholera, avian pasteurellosis, avian hemorrhagic septicemia

Etiology: Avian cholera is a contagious disease resulting from infection by the bacterium Pasteurella multocida. Acute *P. multocida* infections are common and they can result in bird deaths 6–12 hours after exposure, although 24–48 hours is more common. Susceptibility to infection and the course of disease whether or not it is acute or chronic is dependent upon many factors including sex, age, genetic variation, immune status from previous exposure, concurrent infection, nutritional status, and other aspects of the host; strain virulence and other aspects of the bacterium; and dose and route of exposure.

Species Affected: More than 100 species of free-ranging wild birds are known to have been naturally infected with *P. multocida* in addition to poultry and other avian species being maintained in captivity. As a group, waterfowl and several other types of waterbirds are most often the species involved in major avian cholera mortalities of wild

birds. Scavenger species, such as crows and gulls, are also commonly diagnosed with avian cholera, but deaths of raptors, such as falcons and eagles, are far less frequent. Disease that is easily spread through susceptible hosts can be devastating when bird density is high, such as for poultry operations and wild waterfowl aggregations.

Route of transmission: Environmental contamination from diseased birds is a primary source for infection. High concentrations of *P. multocida* can be found for several weeks in waters where waterfowl and other birds die from this disease. Wetlands and other areas can be contaminated by the body discharges of diseased birds. Potential means for transmission of avian cholera to free ranging wild birds are as the following.

- Bird-to-bird contact: The disease can be transmitted by direct bird-to-bird contact, either between infected and noninfected live birds, or between infected carcasses that serve as “decoys” and noninfected live birds. Secretions from infected birds shedding *P. multocida* are the main sources of pathogens. Requires close contact, such as when individuals struggle over aquatic plants that they are feeding upon.
- Aerosol transmission: In wetlands where avian cholera breaks out, the highest concentrations of *P. multocida* are found near the water surface rather than deep in the water column. Birds landing, taking flight, bathing, and otherwise causing disturbance of the water surface cause bacterialaden aerosols, this can serve to infect those birds.
- Ingestion: Probably most common route for transmission. Consumption of diseased carcasses by scavengers and predators. Ingestion of *P. multocida* in food and water from contaminated environments.
- Insects: Biting insects that feed on birds after having fed upon contaminated carcasses or contaminated environments (ticks, mites, flies). Insects fed upon by birds (maggots, flies) following ingestion of *P. multocida* by the insect when feeding
- Fomites (inanimate objects): Contaminated cages, equipment, and clothing used in field operations can serve as mechanical transport mechanisms for introducing *P. multocida.* Environmental persistence of *P. multocida* is sufficient for this to be

a consideration when personnel and equipment are used to combat an avian cholera outbreak and then are to be redirected for other activities.

Distribution and occurrence: The frequency and severity of avian cholera outbreaks vary greatly among areas. It distribution is throughout the world. Losses can occur at any time of the year.

Clinical sign

Few sick birds are seen during avian cholera outbreaks because of the acute nature of this disease. However, the number of sick birds increases when a die-off is prolonged over several weeks. Sick birds often appear lethargic or drowsy and can be approached quite closely before attempting escape. When captured, these birds often die quickly, sometimes within a few seconds or minutes after being handled. Other birds have convulsions, swim in circles, or throw their heads back between their wings and die. These signs are similar to those seen in duck plague and in some types of pesticide poisoning. Other signs include erratic flight, such as flying upside down before plunging into the water or onto the ground and attempting to land a foot or more above the surface of the water.

Always suspect avian cholera when large numbers of dead waterfowl are found in a short time, few sick birds are seen, and the dead birds appear to be in good flesh. When sick birds are captured and die within a few minutes, avian cholera should also be suspected.

Gross lesion: Under most conditions, birds that have died of avian cholera have substantial amounts of subcutaneous and visceral fat. The most prominent lesions seen at necropsy involve the heart and liver and sometimes the gizzard. Hemorrhages of various sizes are frequently found on the surface of the heart muscle or the coronary band. Hemorrhages are also sometimes visible on the surface of the gizzard. Areas of tissue death that appear as small white to yellow spots are commonly seen within the liver. The lower portions of the digestive tract (below the gizzard) commonly contain thickened yellowish fluid that is heavily laden with P. multocida.

Diagnosis: isolation of the causative agent is required for a definitive diagnosis. Submitting a whole carcass provides the diagnostician with the opportunity to evaluate gross lesions seen at necropsy and also provides all appropriate tissues for isolation of P. multocida. When it is not possible to send whole carcasses, tissues should be sent that can be collected in as sterile a manner as possible in the field. The most suitable tissues for culturing are heart blood, liver, and bone marrow. Pasteurella multocida persists for several weeks to several months in bone marrow. The wings of badly scavenged or decomposed carcasses should be submitted whenever avian cholera is suspected as the cause of death and more suitable tissue samples are not available.

Control: Spread of avian cholera through waterfowl and other migratory bird populations is enhanced by the gregarious nature of most waterfowl species and by dense concentrations of birds that result from habitat limitations. Various methods are applied to control avian cholera in wild birds. This are:

- Early detection of avian cholera outbreaks should include frequent surveillance of areas where migratory birds are concentrated, as a first line of defense in controlling this disease.
- Collection and incineration of carcasses as standard procedures. Carcass collection contributes to avian cholera control in several ways. Care must be exercised during carcass collection to minimize the amount of fluid discharged into the environment from the mouths of birds. Pick birds up head first, preferably by the bill, and immediately place in plastic bags. Prompt carcass removal also prevents scavenging by birds that can mechanically transport infected material to other sites or by feeding or drinking at other locations following consumption of infected tissue.
- Destruction of migratory birds infected with this disease can be justified only under special circumstances and conditions.
- Habitat management is another useful tool in combating avian cholera outbreaks. In some instances it may be necessary to prevent further use of a specific wetland or impoundment because it is a focal point for infection of waterfowl migrating into the area.

- Under extreme conditions, disinfection procedures to kill P. multocida may be warranted in wetlands where large numbers of birds have died during a short time.
- Vaccination and postexposure treatment of waterfowl have both been successfully used in combatting avian cholera. As yet, there is no practical method of immunizing large numbers of free-living migratory birds against avian cholera. However, captive propagation flocks can be protected by this method. Endangered species can be trapped and immunized if the degree of risk warrants this action.
- Avian cholera is not considered a high risk disease for man because of differences in species susceptibility to different strains of P. multocida.

B. Anthrax

Etiology: Bacillus anthracis (spore forming, non-motile, Gram positive rod)

Distribution: World-wide, especially in areas with neutral or alkaline calcareous soils. Outbreaks can occur after soil disturbance following drought or flood conditions.

Susceptible animal groups: Domestic and wild ruminants are most commonly affected. However equids and other mammals such as elephants are susceptible. Suids and carnivores may develop subacute to chronic gastrointestinal type disease after eating infected carcasses. It has been reported in ostriches and rheas. Scavenging birds and mammals, primarily carrion feeders, are known to pass spores through their digestive system without becoming infected as vegetative cells are killed in their acidic stomachs. Humans affected via contact with diseased carcasses or via animal products (meat, bone meal, leather, wool, bristles)

Transmission: Ingestion of spores that can come from soil, infected carcass, soil contaminated forage or blowfly contaminated browse. Usually direct transmission, possibly biting flies.

Clinical Signs: Incubation period is 3-7 days (range 1-14 days). Spores may be inactive in lungs for several weeks before causing disease. Sudden death, fever

followed by death, excitement followed by stupor, respiratory and cardiac distress, colic, diarrhea and vomiting, edema.

Necropsy finding: Carcass presented with absence of rigor mortis and rapid decomposition. Dark blood may ooze from mouth, nostrils, eyes, ears, vulva and anus. Edema may be apparent. Carcass will show lack of blood clotting and hemorrhages of serosal surfaces. Organs, particularly the spleen will be congested and enlarged. Oropharyngitis, pharyngeal edema, diptheritic membranes or ulcers of tonsils are seen in suids and carnivores. Gastrointestinal inflammation and mesenteric lyphadenitis may be seen in suids and carnivores. Hemorrhagic lymphadenitis is histopatholgic observation.

Diagnosis: isolation and identification of *B. anthrax* in dried blood sample. Laboratory technique used are PCR, culture, IFA and ELISA.

Treatment: Immediate antibiotic therapy. Numerous classes of antibiotics are effective: oxytetracycline, penicillins, aminoglycosides, fluoroquinolones, macrolides, and sulfonamides.

Prevention and control: carcass disposal, treatment and movement of adjoining animals, removal of contaminated feed or items, vaccination and site decontamination.

C. Tuberculosis

Synonyms: Tuberculosis, TB

Etiology: Mammalian tuberculosis is caused by*Mycobacterium bovis*. Avian tuberculosis is usually caused by the bacterium *Mycobacterium avium*.Other types of Mycobacterium rarely cause tuberculosis in most avian species; however, parrots, macaws, and other large perching birds are susceptible to human and bovine types of tuberculosis bacilli.

Distribution and Occurrence: Avian tuberculosis is a ubiquitous and cosmopolitan disease of free ranging, captive, and domestic birds. Distribution of this disease in free-ranging wild birds is inferred from birds submitted for necropsy; however, the sampling

under represents both the geographic distribution and the frequency of infection for individual species. Avian tuberculosis likely exists in small numbers of free-ranging wild birds wherever there are major bird concentrations. Seasonal trends of tuberculosis in wild birds have not been documented. The chronic nature of this disease guarantees its presence yearround for both wild and captive birds. Factors that may influence seasonal exposure to tuberculosis in migratory birds are changes in habitat used, food base during the year, and interspecies contacts. Contaminated sewage and wastewater environments containing tubercle bacilli are more likely to be used by waterfowl during fall and winter than during warmer months.

Species affected: Free ranging wild animals are rarely affected by Tuberculosis.All avian species are susceptible to infection by *M. avium.* Humans, most livestock species, and other mammals can also become infected. It is generally accepted that pigs, rabbits, and mink are highly susceptible to *M. avium*; deer can also become infected. Dogs appear to be quite resistant to the avian type of tuberculosis. In captivity, turkeys, pheasants, quail, cranes, and certain birds of prey are more commonly infected than waterfowl. In free-ranging wild birds, avian tuberculosis is found most often in species that live in close association with domestic stock (sparrows and starlings) and in scavengers (crows and gulls).

Transmission: Avian tuberculosis generally is transmitted by direct contact with infected birds, ingestion of contaminated feed and water, or contact with a contaminated environment. Inhalation of the bacterium can cause respiratory tract infections. Environmental conditions can greatly affect the susceptibility of birds to tuberculosis and the prevalence of tuberculosis in captive birds. Captive birds that are on an inadequate diet and that are maintained in crowded, wet, cold, poorly ventilated, and unhygienic aviaries have increased susceptibility to tuberculosis.

Clinical sign: No clinical signs specifically identify avian tuberculosis. Advanced disease and clinical signs are seen most often in adult animals because of the chronic, insidious nature of the disease. Infected animals are often emaciated, weak, and lethargic, and they exhibit wasting of the muscles. Other signs depend on which body system is affected and signs may include diarrhea, lameness, and unthrifty appearance.

Gross lesion: Typical cases tuberculosis involve emaciated carcasses with solid-to-soft or crumbly, yellow to-white or grey nodules that are less than 1millimeter to several centimeters in size and that are deeply embedded in infected organs and tissues. The liver most often contains such nodules, but the spleen, lung, and intestines may also contain similar nodules. Aggregations of these nodules may appear as firm, fleshy, grape-like clusters. Abscesses and nodular growths have been reported on the skin of birds in the same locations where pox lesions are commonly seen around the eyes, at the wing joints, on the legs, side of the face, and base of the beak. Other birds have died of avian tuberculosis without any obvious clinical signs or external lesions.

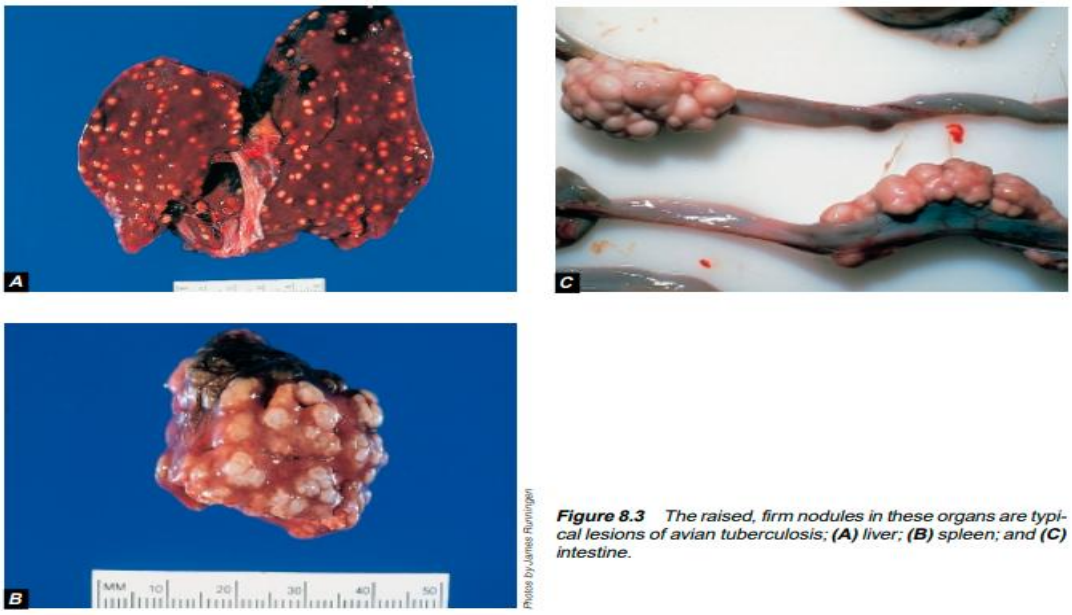

Figure 8.3 *The raised, firm nodules in these organs are typical lesions of avian tuberculosis; **(A)** liver; **(B)** spleen; and **(C)** intestine.*

Figure 1: Gross lesion of tuberculosis in various organs

Diagnosis: Typically, tuberculosis is discovered in captive animals during routine investigation of mortality, and during carcass examinations associated with die-offs due to other causes. Definitive diagnosis is based on bacteriological isolation and identification of the organism. Because *M. bovis* and *M. avium* is slow-growing and other bacteria can easily overgrow it, a non-contaminated sample is needed for examination. The bacterium can also be isolated from infected tissues that show gross lesions. Microscopic studies can provide a diagnosis of tuberculosis, although such

studies cannot determine the species of Mycobacterium. Because this disease is transmissible to humans, extra care must be taken when handling infected carcasses.

Control: Tuberculosis is difficult to detect in free-ranging animals despite its broad geographic distribution. Tuberculosis rarely causes a major die-off, and there are no practical nonlethal testing procedures for mobile wild birds and mammals. Therefore, there is no focal point and, hence, no method developed for disease control in wild animal populations. Close monitoring of the health of animal populations free ranging or captive is an essential first step toward detecting tuberculosis so that control efforts can be developed and initiated when feasible. Habitat manipulation, such as drainage can sometimes be used to deny animal use of areas where tuberculosis outbreaks occur.

Avian tuberculosis is generally considered non-contagious from an infected person to an uninfected person. Infection is more likely to occur in persons with preexistent diseases, especially those involving the lungs, and in persons whose immune systems are impaired by an illness, such as AIDS or steroid therapy.

d. Salmonellosis

Etiology: Genus Salmonella, *Salmonella Typhimurium*. Avian salmonellosis is caused by a group of bacteria of the genus salmonella. Pullorum disease, (*Salmonella pullorum*) and fowl typhoid (*Salmonella gallinarum*) are two classic and distinctive diseases of poultry. Wild birds have been infected with pullorum disease and fowl typhoid, but wild birds are more commonly infected by the variants of salmonellae that are collectively referred to as paratyphoid forms, of which *S. typhimurium* is a prominent representative.

Distribution and occurrence: Extensive and prolonged control programs have essentially eliminated pullorum disease as a disease confronting commercial poultry production in most of the world and fowl typhoid from most Western countries. In contrast, salmonellosis due to paratyphoid infections occurs worldwide and is increasingly prevalent among wild birds in a wide variety of habitats. The geographic distribution of salmonellosis in free-ranging mammals and wild birds is closely

associated with sources of environmental contamination that enters the food web of animals

Species affected: Non-typhoidal salmonellosis causes natural infection in all vertebrates. Reptiles are important carriers, but multiple exotic pet species have been implicated in human disease outbreaks. All species of birds should be considered susceptible to infection by salmonellae. The outcome of salmonella infections is reported to be highly dependent upon the age of the animals, concurrent stress, serovar and strain virulence, and susceptibility of the host species.

Transmission: Salmonella infections can be transmitted in many ways, and the importance of different modes for transmission varies with the strain of salmonellae, behavioral and feeding patterns of the animal species, and husbandry practices when human intervention becomes part of the hatching and rearing processes. There are various means of transmission of salmonellosis in wild animals. These are:

- Vertical (from parent to offspring): Through contaminated eggs from infected female; embryo may be infected or surface of egg becomes infected as it passes down oviduct
- Horizontal
  - ✓ Animal-to-animal contact: Infected birds shed organism in feces. Birds in close contact inhale salmonellae that become airborne or ingest salmonellae when pecking at contaminated surfaces of infected birds.
  - ✓ Contaminated environments: Multiple sources of fecal contamination from a wide variety of warm- and coldblooded species results in ingestion of salmonellae when pecking at contaminated feathers, litter, and other materials. Infected birds and other animals that are fed upon by birds with predatory and scavenging food habits become exposed to salmonellosis. Animals that feed in landfills, dung piles, wastewater discharge areas, and sewage lagoons are at highest risk to acquire infections.
  - ✓ Contaminated feeds: Salmonella contaminated feed has been the source of salmonella outbreaks in animals. Little is known about levels of salmonella contamination in commercial feed used at feeding stations.

- ✓ Inapparent infections: Stress of translocation or conditions causing animals to be brought into rehabilitation can result in shedding of salmonellae by carrier animals or result in clinical disease subclinical infections. Disease can be transmitted to other birds in close proximity; contamination of the environment can result in further transmission, and release of actively shedding birds can serve to spread the disease and contaminate other environments.

Clinical sign:

- Acute: gastroenteritis (including vomiting and diarrhea), pyrexia, and anorexia.
- Severe/septicemic: lethargy, polydipsia, dehydration, petechial hemorrhages on cutaneous and mucosal surfaces, joint pain (polyarthritis), abdominal pain, respiratory signs, neurological signs; possibly death
- Chronic: reduced productivity such as egg and milk production, suppressed growth, decreased fertility, decreased hatchability, and abortion.

Gross Lesions: Most common findings during gross necropsy include signs of dehydration, gastroenteritis, hepatomegaly with or without miliary white foci, splenomegaly, and mesenteric lymphadenopathy. Pneumonia can be observed more often in birds and calves. In cases of septicemia, petechial hemorrhages can occur in multiple organs, with muscular necrosis typically involving myocardial and gizzard (in avian species) muscle, nephropathy, polyserositis, and synovitis commonly found.

Diagnosis: Diagnosis requires laboratory isolation and identification of Salmonella sp. from infected tissues in conjunction with pathological findings. Culture of fresh fecal material is still the most commonly used diagnostic tool to detect Salmonella shedding. PCR can be used to evaluate shedding with a quicker turn-around time than culture.Salmonellae are often confined to the gut. Egg shells and shell membranes can also be cultured for salmonellae; this is an effective means of detecting salmonellae in eggs that have hatched, provided that the egg fragments have not been subjected to environmental conditions that would destroy the bacteria.Molecular techniques such as pulsed-field gel electrophoresis now allow for more exact epidemiologic tracing. Serological examinations can be used to establish presence of Salmonella on herd

basis, but are not reliable for individual animal status identification, although have been used to evaluate vaccination response and flock exposure.

Treatment: Mild infections are self-limiting. Antibiotics are generally used for suspected sepsis or in immunocompromised or young animals where sepsis is likely.

Control: Disease prevention should be practical at animal feeding stations; the public should be educated to maintain clean feeders and to remove spilled and soiled feed from the area under the feeder. The potential for contaminating migratory bird habitat with Salmonella sp. should be considered when wastewater is intentionally used to create wetland habitat; when existing wetlands are used to receive wastewater discharges; when agricultural fields on wildlife areas are to receive manure and slurries as fertilizer; and when development of landfill, livestock, and poultry operations are proposed in areas where contamination of environments used by migratory birds is likely. Strict sanitation measures need to be instituted and judiciously followed. All birds that die should undergo necropsy and appropriate laboratory testing to determine the cause of mortality and any actions required to prevent further losses.

d. Chlamydiosis

Etiology: Chlamydiosis refers to an infection with organisms of the genus Chlamydia sp., which are bacteria that live within animal cells. *Chlamydia psittaci* is the species generally associated with this disease in birds. The severity of the disease differs by the strain of *C. psittaci* and the susceptibility of different species of bird.

Distribution and occurrence: Among free-living birds, avian chlamydiosis has been found worldwide. Individual cases may occur at any time because of healthy carriers and latent infections within bird populations. Shipping, crowding, chilling, breeding, and other stressors have been attributed to active shedding of the infectious agent among captive birds with latent infections. Groupings of wild birds together in flocks, such as during spring and fall migrations, may facilitate the transmission of chlamydiosis.

Species affected: Chlamydial infections have been reported from at least 159 species of wild birds in 20 orders, but most isolations have been made from six groups of birds. Waterfowl, herons, and pigeons are the most commonly infected wild birds.

Chlamydiosis also occasionally infects gulls and terns, shorebirds, songbirds, and upland gamebirds.

Clinical sign: Signs of infection depend on the species of bird, virulence of the strain of Chlamydia sp., the physiological condition of the bird as influenced by stressors, and route of exposure to the organism. Chlamydiosis in wild birds is often inapparent and infected birds can serve as asymptomatic carriers. Infection may also result in an acute, subacute, or chronic form of disease. *C. psittaci* can cause severe, acute disease that may be rapidly fatal in highly susceptible species. Birds often become weak, stop eating, and develop purulent (fluid containing pus) discharges of the eyes and nares. Birds tend to become motionless, remain in a fixed position, huddled up with ruffled feathers. Birds may have diarrhea, sometimes rust-colored because of the presence of blood, and respiratory distress is common. Feces from birds that stop eating are often dark green.

Gross lesion: The most common anatomical change in infected birds is an enlargement of the spleen or splenomegaly or of the liver or hepatomegaly or both, up to three-or-four times normal size. Pericarditis, which is an inflammation and thickening of the pericardial sac that surrounds the heart, is a striking lesion sometimes seen with acute or sub-acute chlamydiosis. The air sacs may be thickened and the lungs are often congested, appearing darker than normal.

Diagnosis: Diagnosis is based upon the isolation of Chlamydia sp. from tissues of infected birds. The lungs, spleen, liver, and affected air sacs are the preferred tissues for microbial examination. Because *C. psittaci* is also a human pathogen, care must be taken in handling carcasses and tissues.

Treatment: Recommended treatment period for most avian species has traditionally been 45 days with doxycycline, however some birds may require treatment for as long as 60 days.

Control:*Chlamydia sp.* are present in the tissues, feces, discharges from the eyes and nares, and may also be present on plumage of infected birds. When the excreta and discharges dry, the resulting material can become airborne. Infection may be

transmitted by direct contact with affected birds, or by inhaling dried bird fecal material or respiratory exudates that contain *Chlamydia sp.* organisms. Sick birds should be collected and euthanized and carcasses should be picked up. The removal and incineration of carcasses will help reduce the amount of infective material in the area.

e. Mycoplasmosis

Synonyms: Chronic respiratory disease, infectious sinusitis, house finch conjunctivitis

Etiology: Mycoplasmosis is caused by infection with a unique group of bacteria that lack cell walls but possess distinctive plasma membranes. Mycoplasmal infections of birds are caused by *Mycoplasma gallisepticum* (MG), *M. meleagridis* (MM), and *M. synoviae* (MS). Only ***Mycoplasma gallisepticum*** is of known importance for wild birds.*M. ovipneumoniae* - bighorn sheep, mountain goats, musk oxen, *M. agassizii*, *M. testudineum*– tortoises. Many other Mycoplasma spp. exist and new ones are being identified in connection with disease syndromes in mammals, birds, and reptiles

Distribution and occurrence: World-wide, often host species specific.Because mycoplasmas in poultry are commonly transmitted through the egg and are present in carrier birds, there is no distinct seasonality associated with disease in those species.

Species affected: Chickens and turkeys are commonly infected with *Mycoplasma gallisepticum*, and direct contact of susceptible birds with infected carrier birds causes outbreaks in poultry flocks. Wild songbirds are rarely affected.

Transmission: Chickens and turkeys are commonly infected with *Mycoplasma gallisepticum*, and direct contact of susceptible birds with infected carrier birds causes outbreaks in poultry flocks. Aerosol transmission via dust or droplets facilitates spread of *Mycoplasma gallisepticum* throughout the flock. Transmission through the egg is also important for poultry, and *Mycoplasma gallisepticum* is thought to spread by contact with contaminated equipment.

Clinical sign: The prominent field signs are puffy or swollen eyes and crusty appearing eyelids. A clear to somewhat cloudy fluid drainage from the eyes has been reported for some birds. Birds rubbing their eyes on branches and birdfeeder surfaces have also

been reported. Other observations of infected birds include dried nasal discharge, severely affected birds sitting on the ground and remaining at feeders after other birds have departed, and birds colliding with stationary objects due to impaired vision. Irregular breathing, wheezing, and a mucous discharge from the nose and beak were seen in this bird along with anorexia or loss of appetite. These signs are typical of mycoplasmosis in poultry.

Figure 2: Typical clinical sign of mycoplasmosis in wild birds.

Gross lesion: Infected house finches typically have a mild to severe inflammation of one or both eyes and the surrounding area including swollen, inflamed eyelids; a clear to a cloudy, thickened discharge from the eye; and drainage from the nares of the bill.

Diagnosis: Mycoplasma is among the most difficult organisms to grow from clinical specimens because of their fastidious nature, intimate dependence upon the host species they colonize, and slow growth on artificial media. The greatest success in isolating MG from house finches has been when tissue swabs were obtained from live trapped, freshly killed, or fresh dead birds.

Treatment: Treatment: Azithromycin, erythromycin, tulathromycin; enrofloxacin; beta lactam antibiotics are not effective due to an absent cell wall.

Control: Routine cleaning and disinfection of birdfeeders with household bleach is recommended to prevent mycoplasmosis and other diseases that can be transmitted at birdfeeders. Consideration must give for poultry carcasses and waste disposal.

f. Leptospirosis

Etiology: A bacterial infection that affects humans and animals following exposure to species of Leptospira spp. bacteria. Bacteria are excreted into the environment in the urine of infected animals and can survive for up to several months in contaminated soil and for several weeks in contaminated mud slurries, although they do not survive well in river water. The primary reservoir hosts for most Leptospira species are wild mammals, particularly rodents, in which they cause little or no clinical disease. Species of bacteria from the genus Leptospira, including *L. grippotyphosa*, *L. canicola*, *L. hardjo*, *L. pomona*, *L. bratislava, L. icterohaemorrhagiae* and *L. interrogans* arecommonly described as serovars causing disease.

Distributions and occurrence: Occurs worldwide but most commonly in temperate or tropical climates with high rainfall. The highest concentrations of cases are often in developing countries where wet farming and rodent populations combine and where freshwater floods may occur. Leptospirosis is particularly prevalent in warm and humid climates, marshy or wet areas, and in regions with an alkaline soil pH. The importance of each species differs between geographical regions.

Species affected: All terrestrial and marine mammals appear to be susceptible. Most commonly found in many species of wild and domestic animals including rodents, cattle, sheep, goats, pigs, horses and dogs. Humans, particularly those working in or close to water, are very susceptible to illness caused by certain strains. Infection in reptiles, amphibians and birds is rare.

Transmission: Infection is acquired through direct contact with infected urine or indirect contact with urine-contaminated water/soil/vegetation or food. Bacteria gain entry across intact mucous membranes or broken skin. Occasionally, infection can spread through the inhalation/ingestion of aerosolised urine or water. Transmission may also occur through contact with infected normal, aborted or stillborn foetuses, or vaginal discharge and placental fluids.

Clinical sign: In reservoir wildlife hosts infection is likely to be asymptomatic, with little clinical disease. In accidental hosts symptoms may be very variable, and depend, in

part, on the bacterial strain involved. Initial clinical signs are generally non-specific and include lethargy and anorexia, associated with fever. Seals and sea lions may suffer from fever, abortions and neonatal deaths.

Diagnosis: Demonstration of the presence of the organism or an antibody response to the organism. Bacteria may be isolated from blood and cerebrospinal fluid in the first seven days and from urine during the second and third week of illness. An antibody response may be detected in the blood from 5-7 days after infection. A rising antibody level confirms current infection. In dead animals, the liver, lung, brain, kidney, genital tract and the body fluid of foetuses can be used for detecting bacteria.

Prevention and control: Sporadic cases occur in free-ranging wildlife, but are likely to go unnoticed. Wildlife species are more important as asymptomatic carriers of infection. Rodent control from a pest perspective may be important in this context, although prevention of contamination of feed, bedding and water, and water treatment, as discussed, may be more appropriate.

2. Fungal Diseases of Wild Mammals and Birds

Fungi are important causes of disease in wild birds and other species. Three basic types of disease are caused by these agents: mycosis, or the direct invasion of tissues by fungal cells, such as aspergillosis; allergic disease involving the development of a hypersensitivity of the host to fungal antigens; and mycotoxicosis, which results from ingestion of toxic fungal metabolites.

a. Aspergillosis

Etiology: Aspergillosis is a respiratory tract infection caused by fungi of the genus Aspergillus, of which *A. fumigatus* is the primary species responsible for infections in wild birds. Aspergillosis is not contagious (it will not spread from bird to bird), and it may be an acute, rapidly fatal disease or a more chronic disease. Both forms of the disease are commonly seen in free-ranging birds, but the acute form is generally responsible for large-scale mortality events in adult birds and for brooder pneumonia in hatching birds.

Aspergillus sp. also produce aflatoxins, but the significance of those toxins in the ability of the fungus to cause disease in birds is unknown.

Aspergilli are saprophytic (live upon dead or decaying organic matter) molds that are closely associated with agriculture and other human activities that make nutrients available to fungi. *A. fumigatus* commonly grows in damp soils, decaying vegetation, organic debris, and feed grains. High numbers of spores (called conidia) are released into the atmosphere and are inhaled by humans, birds, and other animals.

Distribution and occurrence: Aspergillosis in birds is reported nearly worldwide. Most aspergillosis outbreaks in waterfowl happen in fall to early winter; individual cases can occur at any time, particularly among birds stressed by crippling, oiling, malnutrition, recent capture, and concurrent disease conditions. Environmental factors also contribute to the time of year when aspergillosis is seen.

Species Affected: A wide variety of birds have died of aspergillosis and probably all birds are susceptible to it. Loons and marine birds that are brought into rehabilitation, captive raptors, and penguins being maintained in zoological parks and other facilities commonly die from aspergillosis. Young birds appear to be much more susceptible than adults.

Transmission: The source of infection in some instances has been contaminated litter. Also, infection of broken eggs prior to hatching provides an ideal growth medium for the fungus and the subsequent production of massive numbers of spores for infection of newly hatched birds. Inhaled spores initiate a cellular response in the lungs that results in the air passages soon becoming obliterated by cellular material and branching fungal filaments.

Clinical sign: The typical aspergillosis-affected bird is emaciated, and it frequently exhibits severe and progressive difficulty in breathing by gaping or rapid opening and closing of the bill. Birds often appear to be unthrifty, and their wings may droop. Infected birds are usually weak and may fail to try to escape.

Gross Lesions: Birds infected with the more typical chronic form of aspergillosis usually have variously sized lesions in their lungs and air sacs. Typically, these lesions

appear as flattened, yellow plaques with a cheesy appearance and consistency. There may also be an extensive fungus growth on tissue and air sac surfaces that appears similar to bread mold. In cases of acute aspergillosis, the birds are usually in good flesh and have good-to-moderate deposits of fat. Air sacs are usually thickened, but the most striking lesion is a dark red, firm lung that is often studded or peppered with small, 1–2 millimeter, yellow nodules.

Diagnosis: Diagnosis is based on finding the typical lesions and on isolating the fungus from the tissues. *Aspergillus sp.* can be identified by microscopically examining material from fungal mats and from tissue sections that have been specially stained. However, the specific species of Aspergillus cannot be identified by these means.

Treatment: Antifungal drug classes that have been used to treat aspergillosis include polyenes (amphotericin B) and azoles (voriconazole, itraconazole, ketoconazole). Supportive care, treatment of concurrent disease, and removing any sources of stress or immunosuppression are also important components of treatment.

Control: The spores of the mold *A. fumigatus* are widely distributed and are often present in moldy feeds, unclean brooders and incubators, moldy straw, and rotting agricultural waste. Avoid using moldy or dusty straw, silage, or feed, and dumping moldy waste grain in areas where waterfowl and other birds feed. Birds should be denied the use of fields where moldy agricultural waste products such as waste corn, peanuts, straw, or hay have accumulated. People who feed birds should be educated to periodically clean their feeding stations.

b. Candidiasis

Etiology: Candida albicans, yeast-like fungi, is the primary cause of candidiasis or candidiosis. *C. albicans* is a normal inhabitant of the human alimentary canal, as well as that of many species of lower animals.

Distribution and occurrence: Candidiasis is found worldwide. There is no known seasonal occurrence. Life-cycle patterns for bird populations are likely to influence any temporal occurrence for this disease because young birds are generally more susceptible to infection.

Species affected: There have been few reports of candidiasis causing disease in free-ranging wild birds and few investigations of its prevalence. Therefore, little can currently be said about its occurrence in wild species. Candidiasis is an occasional disease of importance within some poultry flocks, and it has been reported as a disease or an intestinal infection in numerous species of wild birds being raised in captivity.

Clinical sign: There are no unique signs of disease. Affected poultry have retarded growth, stunted appearance, are listless, and have ruffled feathers.

Gross Lesions: Lesions are generally confined to the upper areas of the digestive tract. The mouth, esophagus, and, primarily, the crop, may have grayish-white, loosely attached, plaque-like areas on their internal surfaces. Circular, raised, ulcerative nodules that appear as rose-like clusters may be within the crop.

Control: Cages, equipment, and other materials in contact with infected birds should be disinfected because of the broad host range of species that can become infected.

3. Viral disease of wild mammals and birds

a. Avian pox

Etiology: Avian pox is the common name for a mild-to-severe, slow developing disease of birds that is caused by a large virus belonging to the avipoxvirus group, a subgroup of poxviruses.

Distribution and occurrence: Avian pox occurs worldwide, but little is known about its prevalence in wild bird populations. Although wild birds can be infected by pox virus yearround, disease outbreaks have been associated with the environmental conditions, the emergence of vector populations, and the habits of the species affected. Environmental factors such as temperature, humidity, moisture, and protective cover all play a role in the occurrence of this disease by affecting virus survival outside of the bird host. Avian pox virus can withstand considerable dryness, thereby remaining infectious on surfaces or dust particles. Mosquitoes that feed on birds are the most consistent and efficient transmitters of this disease.

Species affected: Approximately 60 free-living bird species representing about 20 families have been reported with avian pox. However, the frequency of reports of this disease varies greatly among different species. Avian pox has rarely been reported in wild waterfowl.

Transmission: Avian pox is transmitted when a mosquito feeds on an infected bird that has viremia or pox virus circulating in its blood, or when a mosquito feeds on virus-laden secretions seeping from a pox lesion and then feeds on another bird that is susceptible to that strain of virus. Contact with surfaces or exposure to air-borne particles contaminated with poxvirus can also result in infections when virus enters the body through abraded skin or the conjunctiva or the mucous membrane lining that covers the front part of the eyeball and inner surfaces of the eyelids of the eye.

Clinical sign: Birds with wart-like nodules on one or more of the featherless areas of the body, including the feet, legs, base of the beak, and eye margin should be considered suspect cases of avian pox. The birds may appear weak and emaciated if the lesions are extensive enough to interfere with their feeding. Some birds may show signs of labored breathing if their air passages are partially blocked. Although the course of this disease can be prolonged, birds with extensive lesions are known to completely recover if they are able to feed.

Gross Lesions: The most common form is cutaneous and it consists of warty nodules that develop on the featherless parts of the bird.

Diagnosis: A presumptive diagnosis of avian pox can be made from the gross appearance of the wart-like growths that appear on body surfaces. However, these observations must be confirmed by examining lesions microscopically for characteristic cellular inclusion bodies. Avian pox is confirmed by virus isolation and serological identification.

Control: The fundamental principle for controlling avian pox is to interrupt virus transmission. Vector control (primarily mosquitoes) in and around the disease area should be considered first.

b. Avian Influenza

Wild birds, especially waterfowl and shorebirds, have long been a focus for concern by the poultry industry as a source for influenza infections in poultry. Human health concerns have also been raised.

Etiology: Avian influenza is usually an inapparent or nonclinical viral infection of wild birds that is caused by a group of viruses known as type A influenzas. These viruses are maintained in wild birds by fecal-oral routes of transmission.

Distribution and occurrence: These viruses are found throughout the world.Influenza virus has been found in wild birds throughout the year, but waterfowl are the only group in which these viruses are found year round. The highest occurrence of infection is in the late summer months in juvenile waterfowl when they assemble for their first southward migration

Species affected: Avian influenza viruses have been found in many bird species, but are most often found in migratory waterfowl, especially the mallard duck. Although influenza tends to is most commonly detected in birds that use the major waterfowl flyways.

Transmission: These viruses are maintained in wild birds by fecal-oral routes of transmission. This virus changes rapidly in nature by mixing of its genetic components to form slightly different virus subtypes. In domestic birds, the signs of disease are not diagnostic because they are highly variable and they depend on the strain of virus, bird species involved, and a variety of other factors including age and sex. Signs of disease may appear as respiratory, enteric, or reproductive abnormalities. Included are such nonspecific manifestations as decreased activity, food consumption, and egg production, ruffled feathers, coughing and sneezing, diarrhea, and even nervous disorders, such as tremors.

Diagnosis: Infected birds are detected by virus isolation from cloacal swabs in embryonated chicken eggs, and by serological testing of blood for antibody. The last test indicates that a bird was exposed to these viruses rather than if it is infected or carries the disease.

Control: Avian influenza viruses in wild birds cannot be effectively controlled because of the large number of virus subtypes and the high frequency of virus genetic mixing resulting in new virus subtypes. Also, virus has been recovered from water and fecal material in areas of high waterfowl use. In the domestic bird industry, preventing the entry of the virus into poultry flocks is the first line of defense. Killed vaccines are selectively used to combat less virulent forms of this disease.

c. Newcastle Disease

Newcastle Disease (ND) in domestic poultry is a focus for concern throughout much of the world's agricultural community because of severe economic losses that have occurred from illness, death, and reduced egg production following infection with pathogenic or disease causing strains.

Etiology: Newcastle disease is caused by infection with an RNA virus within the avian paramyxovirus-1 group. NDV is highly contagious and there is great variation in the severity of disease caused by different strains of this virus. NDV strains that cause mild or inapparent respiratory infections in chickens are classified as lentogenic or low virulence. Lentogenic strains do not usually cause disease in adult chickens, but these forms can cause serious respiratory disease in young birds.

Distribution: Different strains of Newcastle Disease Virus (NDV) exist as infections of domestic poultry and within other species of birds throughout much of the world.

Transmission: highly pathogenic strain isolated from wild birds may be less hazardous for poultry and vice-versa. ND may be transmitted among birds by either inhalation of contaminated particulate matter or ingestion of contaminated material.

Species affected: Captive reared gamebirds, such as pheasants and Hungarian partridgeare susceptible for ND.

Clinical signs: observed only in sick juvenile doublecrested cormorants, include torticollis or twisting of the head and neck, ataxia or lack of muscular coordination, tremors, paresis or incomplete paralysis including unilateral or bilat eral weakness of the

legs and wings, and clenched toes. Mildly enlarged livers and spleens and mottled spleens have been noted.

Diagnosis: Virus isolation and identification, supported by characteristic microscopic lesions in tissues, is necessary to diagnose ND as the cause of illness or death.

Control: strict biosecurity procedures should be followed.

d. Rabies

Etiology: Rabies is caused by the rabies virus Family Rhabdoviridae of Genus Lyssavirus.

Distribution: Worldwide. Several countries have been declared canine rabies-free. However, the of such declaration is to facilitate waiving the rabies vaccination requirement as these are countries that have not reported recent cases of rabies in land animals and that have adequate disease surveillance for rabies cases, as determined by the Center for Disease Control.

Susceptible Animal Groups: All mammals are susceptible. Major reservoirs are dogs, raccoons, skunks, foxes, and vampire bat.

Transmission: Bites or scratches of infected animals. Saliva into open wounds and mucous membranes

Clinical Signs: Incubation is prolonged and variable. The virus typically remains at the inoculation site for a considerable time. Animals will show inappetence, cranial nerve deficits, ataxia, salivating, drooping of lower jaw, acute behavioral changes, such as altered vocalization, aggression, docility, coma, and progressive paralysis.

Necropsy findings: Gross lesions are often undetectable. Negri bodies, intracytoplasmic eosinophilic inclusions, may be seen in neurons.

Diagnosis: Rabies diagnosis should be performed in accordance with the established national standardized protocol for postmortem rabies testing by a qualified laboratory.

Rabies diagnosis in animals is accomplished through the direct fluorescent antibody test. Brain tissues examined must include medulla oblongata and cerebellum.

Treatment: No known antivirals currently effective.

Prevention and Control: Vaccination is primary means of prevention.

e. Foot and mouth disease

Etiology: Foot and mouth disease virus (FMDV) is caused by Aphthovirus in family Picornaviridae. Multiple serotypes (O, A, C, SAT 1, SAT 2, SAT 3, Asia 1). Some strains primarily affect certain species (e.g., the pig O Cathay strain); Immunity to one serotype does not protect from other serotypes.

Distribution and occurrence: FMD is Endemic in parts of Asia, Africa, Middle East and South America.

Susceptible animal groups: Artiodactylids (cloven-hoofed animals), e.g., cattle, swine, cervids, antelope, buffalo, sheep, goats, giraffe, as well as a few members of other orders (e.g., Asian, but not African, elephants).

Transmission: Contact with affected animals (high concentrations of virus are present in FMD vesicles) or their bodily fluids (e.g., saliva, milk, semen), mechanical vectors (including people), ingestion (e.g., common source water or feed), insemination and aerosol (respiratory or oral) are the means of transmission.

Clinical signs: Incubation period ranges from 2-14 days Fever (2-3 days); vesicles followed by erosions/ulcers on the tongue, lips, oral mucosa, teats and between the hooves; abundant stringy saliva if mouth is significantly affected; decreased appetite, lameness, abortion; sudden death from myocarditis in newborns; rare instances of sudden death in adults, especially in some severely affected wildlife species. The pattern of illness varies between species, and some species (e.g., sheep) can have minimal signs. Shedding may occur before the onset of clinical signs. Cattle may be persistently infected in the pharynx, but no evidence that they transmit infection. African buffalo can be long term shedders and transmit the virus.

Diagnosis: Grossly, it is indistinguishable from other vesicular diseases (vesicular stomatitis, swine vesicular disease, Seneca virus A, vesicular exanthema of swine). Other differential diagnoses include diseases with mouth and/or foot signs such as traumatic stomatitis, bovine virus diarrhea, bluetongue, malignant catarrhal fever, contagious ecthyma, and epizootic hemorrhagic disease of deer. Lab detection of FMDV is based upon virus isolation, antigen ELISA, and rRT-PCR. Serology tests for detecting exposure include virus neutralization and various ELISA assays.

Necropsy findings: Tongue/Oral: blanched foci to vesicles to complete ulceration with fibrin. Interdigital redness, vesicles or ulceration and similar on coronary bands are seen. Vesicles or erosions may also be found on udder, occasionally other sites. Myocardial pallor or streaking may be observed; young animals with myocardial lesions may not have vesicles. Lesions are species dependent, less severe in sheep and goats than cattle or swine. Location of lesions can also vary between species.

Treatment: Depending on the phase and type of outbreak, infected animals and herds may be slaughtered. In a large outbreak, animals may be allowed to recover with palliative care.

Prevention and Control: Importation bans (raw hides, trophies, unpreserved or uncooked animal products), surveillance test and slaughter, or quarantine until recovered and disinfection of premises. Conducting strategic vaccination is necessary.

f. Canine distemper virus (CDV)

Etiology: Canine distemper virus is caused by family Paramyxoviridae, genus Morbillivirus. Related to measles, rinderpest, and peste des petits ruminants. Distemper can cause serious illness and death in these animals. It does not cause illness in cats or people

Distribution: Worldwide.

Species affected: It can infect dogs, raccoons, skunks, foxes, and large cats such as lions and tigers.

Transmission: Highly contagious. Aerosol of respiratory exudate is primary mode but other body excretions and secretions may be infective.

Clinical signs: Incubation period is 7-18 days in domestic dogs. Variable with species and across individuals but estimated 1 week to 1 month. Signs associated with respiratory, gastrointestinal, integumentary, ophthalmic, and the central nervous systems are commonly seen. Which system(s) is/are affected depends on species, as well as strain virulence and environmental conditions. Animals are often depressed with mucopurulent, oculonasal exudates. Nasal and digital hyperkeratosis (hard pad) and involuntary muscle twitching are characteristic in domestic dogs. Acute conjunctivitis and occasionally uveitis, but in less severe cases, keratoconjunctivitis sicca and chorioretinal lesions are common. Differential diagnoses must include rabies and other viral encephalitides, respiratory infections, toxoplasmosis, canine parvovirus, lead poisoning, and bacterial enteritides.

Necropsy findings: Most significant gross lesions are pneumonia, depletion of lymphopoietic organs, and hyperkeratosis of the nose, foot pads, and eyelids. Often lymphoid depletion, diffuse interstitial pneumonia, and perivascular lymphoplasmacytic infiltration in areas of demyelination and neuronal degeneration of the CNS.

Diagnosis: Clinical signs, especially hyperkeratosis of foot pads and nose, and myoclonus are highly suggestive of CDV. Cytological evaluation and/or immunofluorescence of conjunctival scrapes, buffy coat smears, CSF skin or foot pads may also demonstrate intracytoplasmic inclusion bodies.

Treatment: No specific therapy for animals with clinical canine distemper is available. Nonspecific treatment is supportive and includes fluids, antibiotics (for secondary bacterial infections), and medications to minimize CNS inflammation and seizure activity.

Prevention and control: Vaccination is the mainstay of prevention. In non-domestic species, recombinant vaccines are the safest. Exclusion of reservoir species from zoo sites, whenever possible, is important. Quarantine all animals suspected of being infected with CDV.

Self-check 1- Written Exam

Name…… ID…… Date…….

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Part 1: Short answer question

1. Write zoonotic disease of wild animals affecting humans (4 points)
2. _____ is a bacterial disease of wild birds caused by *Mycobacterium avium (*2 points)
3. List bacterial, viral and fungal disease of wild ruminants (8 points)
4. Describe wild animal disease interaction with domestic animal disease outbreak (6 points)

Part 2: Choose the correct answers from the given alternatives (2 points)

1. Rabies is the most common disease of wild carnivorous caused by_____
   a. aphtous virus b. neethling virus c. lyssa virus d. morbilli virus
2. _____ is a respiratory tract infection caused by fungi of the genus Aspergillus
   a. candidiasis b. aspergillosis c. canine distemper d. avian influenza
3. FMD is a viral disease affecting one of the following wild ruminants
   a. cattle b. sheep c. buffalo d. horse

Note: **Satisfactory rating – ≥ 13 points Unsatisfactory - below 13 points**

You can ask you teacher for the copy of the correct answers.

1. Introduction

Restraint is measure or condition that keeps someone or something under control. The wild animals are often required to catch and restraint for various kinds of routine operations like detailed examination, treatment, shifting and crating of animal. In some countries ranching and private owning of wildlife is a big business. Knowledge of the different methods of restraint is important for successful wildlife management. Animal capture and translocation have become specialized and well-organized procedures in wildlife conservation and management. Animal capture can be carried out using traps, nets or snares (known as Physical restraint), or by using chemical agents/drugs that are injected into the body to control wild animals (known as Chemical restraint/immobilization).There are various kinds of equipment's and techniques used for capturing and restraining of wild animals. These technique are explained as follows.

1.2 Physical (manual) restraint

Simple procedures such as brief examination, injection or venipuncture can be carried out using physical restraint alone for captive animals. Most of the zoos has squeeze cages where animal is allowed to feed and restrained its movements for veterinary care. Other devices of physical restraint are:

- **Traps:** Traps are routinely used to capture mass population of wild animals that are laid at places where the animals frequently visit such as water holes. The traps are laid in a funnel shape where the animals are driven from large area leading it into the trap. Sometimes, food or live bait (e.g. goat for carnivore sp. or large felids) is kept near traps to attract animals for capture.Cage traps are also used for many carnivores, and carcasses or pieces of meat are often used to lure the animal inside. Even the opposite sex animal can also be used to attract the counterpart. In case of animals in zoos, the traps are used in their feeding cell or night shelter.

- **Nets:** Variety of nets such as mist net, drive net, projection or cannon net or bait net can be used to capture aggressive or injured animals. Net gun can be used from a helicopter or from the ground, and based on the low mortality rates of the captured animals, net gunning is considered as a relatively safe technique especially in ungulates compared to other capture methods. The device is held by a person who shoots a net at the animal.Drop-net capture is used for relatively small species such as small sized antilopes or birds when trying to capture multiple individuals at the same time. Drop-net can be set using cables and poles, and the net with its attachments collapse either passively or manually when animals move underneath it. After getting entangled the animals may be chemically tranquillized.In challenging environments, such as in very dense vegetation or urban areas, where darting or use of drop net is not practical, drive nets can be functional for some species. Attention must be payed to the mesh size of the net and speed when driving animals towards the nets: the holes must be small enough to prevent animal getting entangled from it's legs or antlers, and driving the animals towards the net should be done slow enough to prevent abrasions and other injuries from the impact with the net.
- **Snares:** Snares can also be used to capture problematic animal but the snares needs to be monitored for long hours so that as soon as the animal is trapped in snares, it has to be relieved immediately from the snares to prevent strangulation. Foothold traps and foot snares are used for species that are difficult to approach: these have been used successfully when capturing for example large felids such as lynx and lions. However, the foothold traps used in legal live captures are carefully and humanely designed equipment different from harsh wire snares used for illegal bush meat hunting.

1.2.1 Methods of capturing wild birds

a. Use of Nets Dip and Throw Nets

- The common fish dip net has been used for capture or recapture of radiotagged birds for many years. Unlike commercial nets, dip nets used to capture wildlife are usually constructed by the investigator. Constructed nets usually have a larger diameter hoop (~ 1.5 m) and a longer handle (3-

4 m), with mesh size being dependent on the type of animal being captured. Throw nets have been used to capture wildlife, but more skill is involved with this technique. These cast-nets are usually used with night lighting to capture birds.

b. **Mist Nets:** Mist nets continue to be an effective method for sampling bird populations.
c. **Dho Gaza Nets:** A dho gaza net is a large mist net between 2 poles; the net detaches as a bird hits the net and falls to the ground with the bird caught in it. A fixed dho gaza has a similar mechanism, bur the net does not disconnect from poles; instead it falls in as the whole set.
d. **Box and Cage Traps:** Box and cage traps have been used for years to capture a variety of bird species
e. **Nest Traps:** This trap featured a swinging false floor, entrance bame, and counter balance. A scaled down version of this trap can be used to capture smaller cavity-nesting birds.
f. **Drive Nets and Drift Fences:** This trap was inexpensive, portable, and simple to assemble

1.2.2 Limitations of physical restraint

These physical (manual) restraint methods have several limitations. For instance, physical restraint needs long term planning and it is very expensive to perform physical capture in the wild such as hiring of helicopters and other vehicles for driving/chasing animals. Individual subject animal (such as aggressive animal) from a group of animals cannot be tracked and anaesthetized independently using physical restraint. Also, physical method cannot be applied in captive animals especially while dealing examining and offering veterinary care to the sick and injured animals. It leads to serious stress in the animals kept in captivity and sometimes, it may prove fatal. Thus, in such instances, chemical capture and handling would be an ideal capture method for immobilizing zoo captive animals.

1.3 Chemical immobilization or restraint

Chemical restraint is a form of animal restraint technique in which a drug or a chemical is used to restrict the movement (walking, running, aggression) of an animal or sometimes just to sedate or to calm down the animal. Chemical restraint is a safe and effective capture method when applied correctly and with due precaution. Chemical restraint is advantageous over physical capture because it allows examining and treating sick and injured animals or animals caught in snares or traps in the wild by poachers. It enables restraint of selected aggressive animals within a group of animals, and the equipment required for chemical restraint is easy to transport from one place to another in the field. However, chemical capture may have disadvantages such as occasional failure of the equipment on site, undesirable side effects of drug in unknown excited or diseased animal, improper darting of an animal due to occasional operator"s mistakes. Further, chemical capture method cannot be applied for mass capture of animals within a group. Nonetheless, chemical restraint has become a valuable tool in wildlife health, researchand management since it facilitates the handling of animals as and when required for medical procedures and experimentation. However, the state of chemical restraint may vary from immobilization (restricting animal movements), to tranquilization (calmness), to complete anaesthesia (complete loss of consciousness).

Chemical immobilization can be delivered as a remote injection, injection by close distance or oral ingestion. Oral drugs can be hid in baits.

1.3.1 Terminologies used in chemical restraining of animals

- Anaesthesia: is state of total loss of sensation in a body, induced by a drug that depresses activity of nervous tissue peripherally (local and regional anaesthesia) or centrally (general anaesthesia).
- Analgesia: The loss of sensibility to pain (relief pain) without loss of consciousness.
- Narcosis: State of sleep accompanied by analgesia.
- Hypnosis: Artificially-induced sleep like state from which the animal can be aroused by stimuli.

- Sedation: Calming due to mild degree of depression of central nervous system, most sedative cause drowsiness.
- Tranquilization: A state of behavioural changes in which the animal is relaxed and unconcerned by his surroundings.
- Local analgesia (anaesthesia): It is a loss of sensation in a defined area of the body.
- Regional analgesia: Loss of sensation in a larger but limited body area.
- General anaesthesia: It is complete unconsciousness produced by a process of controlled, reversible intoxication of central nervous system in which there is muscle relaxation and diminished response to external stimuli.

1.3.2 Anaesthetic drugs used for chemical restraining

A variety of drugs have been used for chemical restraint of zoo and wild animals. As such, there is no perfect drug or an anaesthetic that will suit to variety of animal species. Some of these drug used are listed below.

- Neuromuscular blocking drugs (Succinylcholine, Tubocurarine and Nicotine): Neuromuscular blocking drugs act at the neuromuscular junction and paralyze muscle from functioning. These are some of the first drugs used for chemical immobilization of wildlife.
- Central Nervous System (CNS) Depressants: These drugs have an effect predominantly on the CNS. The effects range from calmness (tranquilization), depression (sedation), loss of pain (analgesia) to a complete loss of consciousness (anaesthesia). In this category of drugs, some drugs (for example diazepam) which act as tranquilizer at a lower dose may work as an anaesthetic, although it is not recommended.
- Tranquillizers/Sedatives (Acepromazine, Diazepam, Xylazine, Medetomidine, Azaperone): Tranquilizers produce calmness, loss of aggression and loss of alertness which is generally required during transportation.
- Dissociative Anaesthetics (Ketamine hydrochloride, Tiletamine, Etorphine): Anaesthetics are used when an animal needs to be unconscious and unaware

for an extended period of time, such as for surgery or performing assisted reproductive techniques.

Pole syringe is usually used when the drug is hand-injected but from a safe distance; this method is useful for example for animals in a trap or in a cage. For longer distances dart gun is often the best choice and there are many options and manufacturers of various dart guns and darts. The darts are lightweight, two chambered syringes powered by compressed gas in the back chamber, whereas the drug itself is placed in the anterior chamber. There is a tiny hole in the needle body covered by a plastic stopper which moves backwards when the dart hits the animal and allows the compressed air pressure to push the drug forward in the needle and to the muscle tissue of the animal. When the distance is short the drugs can be delivered by a blowpipe, which is practical roughly up to approximately 10 meters distance.

Figure 3: Dart gun and syringes used for chemical restraining of wild animals

Self-check 2- Written Exam

Name…… ID…… Date…….

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Short answer questions

1. Define restraining of animals (2points)
2. Write the two methods of wild animal restraining(2 points)
3. Explain the physical methods of wild mammals and birds restraining (4 points)
4. What is the function of darting gun?(1 point)
5. Give some example of drugs used as a chemical restraining for wild animals (3 points)
6. Discuss the limitations of physical restraining of wild animals (3 points)

Note: **Satisfactory rating – ≥ 7.5 points** **Unsatisfactory - below 7.5 points**

You can ask you teacher for the copy of the correct answers.

Information sheet 3- Signs of stress in wild animals

3.1 Introduction

Stress can be broadly defined as a change in the psychological, physiological and/or physical wellbeing of a living organism as a result of exposure to any biological and/or environmental factor that acts as a stressor (challenge to regulatory capacity). Wildlife encounter a range of stressors or threatening processes ranging from habitat loss to climate change, which may activate the hypothalamic pituitary adrenal (HPA) axis (stress response). The threat is a stressor (stress-producing factor), and it is important to recognize that a psychological perception of a threat may be as important as the response to a physical stressor. Stress responses play a key role in allowing animals to cope with change and challenge in the face of both environmental certainty and uncertainty. The biological responses brought about by stress are adaptive, directed at coping with environmental change, and every animal is subject to stress whether free-ranging or in captivity. Intense or prolonged stimulation may induce detrimental responses (distress). Somatic stressors (stimulation of the physical senses) include temperature changes, strange sights, and unfamiliar sounds and touches, or odors, thirst, and hunger.

3.2. Sign of stress in wild mammals and birds

Assessing Vocalizations

Vocalizations are natural reactions to pain in many animals and can be used as a guide to the degree of pain. An animal might squeal, bark, or otherwise phonate when handled. Vocalization also includes groaning, grunting, whimpering, whining, and growling. Some noises indicative of pain are characteristic of a particular species; they are usually more than momentary and are often repeated. Vocalizations associated with pain can be used to measure an animal's reactivity to pain. Attempts to restrain pigs and non-human primates that are in pain can cause vocalizations, but these and other animals also vocalize in association with feeding or the presence of a familiar person or strangers. In many species, vocalizations differ enough to convey specific meanings to

careful observers. However, vocalizations are not definitive and reliable indicators of pain in some animals, and the absence of vocalization is not an invariable indicator of the absence of pain.

Other types of stress sign in wild mammals and birds in clued the following

Birds:

- Excessive struggling
- Defecation
- Increase in heart rate
- Panting/heat stress

Mammals:

- Clenching of teeth
- Self-biting
- Attempts to escape
- Increase in heart rate
- Panting/heat stress
- Animal is limp or closes its eyes (mammals)
- Aggression
- Urination/defecation
- Excessive struggling
- Cyanosis (bluing) of the nose and/or lip

Self-check 3- Written Exam

Name…… ID…… Date…….

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Short answer questions

1. Define stress in wild animals (2 points)
2. Write hormone released by stressed animals (2 points)
3. Describe sign of stress in wild mammals and birds (4points)

Note: **Satisfactory rating – ≥ 4 points** **Unsatisfactory - below 4 points**

You can ask you teacher for the copy of the correct answers.

4.1 Wildlife Disease Surveillance

Wildlife disease surveillance can be a useful and complementary component of human and animal disease surveillance, monitoring, prevention and control programmes, as well as conservation efforts. In the context of animal health, wildlife disease surveillance may provide information of domestic and wild animal morbidity and mortality, identify changes in patterns of disease occurrence over time, and assist in early detection of disease outbreaks, including those linked to emerging diseases. Many of the pathogens on the world organization of animal health (OIE) List can infect and be maintained for long or short periods of time in wild animals. Since there are many species of wildlife, there are varied risks of bi-directional disease transmission in different regions or areas, which are dictated by the wildlife species and types of livestock interfaces present. Thus, national wildlife disease surveillance programmes are crucial for understanding local risks to animal health and potential zoonotic disease transmission.

“Wildlife disease surveillance” may also refer to pathogen surveillance in wildlife, given that infection with pathogen(s) may not always produce visible clinical signs associated with disease in a given species or at a given point of time. The objective of a surveillance programme should be clearly defined as to whether it is aimed at disease or pathogen detection.

4.2 Core Components of disease surveillance

There are four essential core components of all disease surveillance programmes. Specific considerations for wildlife are noted below:

- Detection of pathogens and diseases: These efforts may require broad participation from many stakeholders to gain access to samples. Training of stakeholders can greatly improve detection.
- Identification of pathogens and diseases: Many pathogens infecting wildlife are readily identified by diagnostic capacity of well-equipped veterinary diagnostic

laboratories established for domestic animals. Some wild animal pathogens or diseases may be rare or new to science, and their identification may require follow-up analysis (e.g. genetic sequencing).

- Analysis and communication: Review of information obtained from surveillance and analysis in various ways requires input from epidemiologists, wildlife biologists and ecologists
- The validity and accuracy of test results should be carefully considered, especially if the sensitivity and specificity of the diagnostic tests used have not been validated in wildlife
- Information Management: At least a minimum level of data should be collected; for example, data should be recorded on the disease incident or sampling event, date, latitude and longitude coordinates, observation of mortality or sickness, specimen identification numbers, animal species, laboratory identification numbers, and diagnos(es) with associated detection method. Feasible data collection requirements should be determined before a programme is initiated, as additional information may provide further context, but requires greater effort and may not always be necessary to achieve surveillance goals. Some of the information routinely collected from domestic animal surveillance may not be available in wildlife disease surveillance.

4.3 Wildlife Disease Surveillance Programme Strategies

There are two main categories of wildlife disease surveillance. Both are designed with the same four essential components, but have the following distinctions, which largely affect sample collection methods:

- General or Scanning wildlife disease surveillance (sometimes referred to as “passive” surveillance) is aimed at detecting disease and pathogens in wild animals, rather than obtaining statistical data on one or a few pathogens, such as pathogen prevalence estimates. A wide range of stakeholders (such as hunters, wildlife rangers, conservation organisations, etc.) might be involved in an opportunistic disease detection network for general surveillance.

- Targeted wildlife disease surveillance (sometimes referred to as “active” surveillance) is focused on one or more particular pathogens in one or more wild animal species typically is used to obtain statistical data on prevalence, age and sex distribution of infection, or geographic distribution of the pathogen. Although there are often challenges in getting a representative sample base, this approach can more precisely estimate prevalence or incidence.

The specific goals of a wildlife disease surveillance system should be clearly defined.

Self-check 4- Written Exam

Name…… ID…… Date…….

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Short answer questions

1. Discuss the purpose of wild animal disease surveillance (3 point)
2. Write the strategies implement to undertake wild animal disease surveillance (3 points)

Note: **Satisfactory rating – ≥ 3 points** **Unsatisfactory - below 3 points**

You can ask you teacher for the copy of the correct answers.

Information Sheet 5: Identifying diseases and collecting specimen appropriately

5.1. Disease caused by microorganism

A. Bacteria

- Wild life diseases are given more priority in the recent days due to the fact that conservation of any wild fauna cannot be achieved fully, unless due efforts are equally given pertaining to the assessment of health status and the disease management, in the concerned wild animal species.
- Bacterial diseases are in plenty in case of wild animals' esp. the captive wild animals and they pose problems in the diagnosis as well as the treatment.
- Hence, one should have a thorough understanding of various bacterial disease conditions that affect commonly the wild animals belonging to multiple taxonomic classes or groups.

Significant bacterial diseases

1. Tuberculosis

- The disease is chronic in nature and is caused by Mycobacterium tuberculosis, Mycobacterium bovis and Mycobacterium avium.
- This disease caused by *Mycobacterium bovis* is very common in general.
- These organisms are acid-fast in nature.

Species affected

- Almost all species are affected in general. The disease is somewhat widely prevalent in a captive wild animal atmosphere.
- Commonly affected species are given below:
  - ✓ Mammals (Non-human primates, deer, antelopes, felids, ursids, canids, elephants etc)
  - ✓ Aves (Raptors, Psittacine birds, Passerine birds, Anseriform birds etc.)

Mode of spread and significance

- Discharges from the body like vaginal discharge, exudates from the fistulous tracks, milk, sputum and excreta like feces and urine get contaminated with these microbes.
- The bacterial organisms are also shed in exhaled air also.
- This disease is zoonotic in nature.

Symptoms

- Emaciation despite moderate to good nutrition
- Anorexia
- Weakness
- Mild pyrexia
- Low pitched cough may be seen

Specimen collected

- Blood
- Nasal/pharyngeal swabs

Diagnosis and therapy

- By culture tests, ELISA tests, PCR tests etc. Tuberculin tests may have false positive results some times.
- In dead animals, the tubercles may be seen in various organs esp. the ***lungs.*** Smears from the lesions may be subjected to the staining for the diagnostic purpose.
- The therapy consists of usage of combination of drugs like isoniazid, ethambutol, pyrizanamide and rifampin. Enrofloxacin may also be used in the combination.

2. Pasteurollosis

- Pasteurellosis is a bacterial infection that is commonly encountered in case of multiple species of wild animals.

- *Pasteurella multocida* is the commonly encountered etiological agent in this and however, the pasteurellosis in marsupial like species may also have affections by *Pasteurella haemolytica* organisms.
- Avian cholera caused by pasteurella organisms is found commonly around the monsoon period in the captive semi-aquatic and aquatic aviary species. The incidence of pasteurellosis is a worldwide one.

Species affected

- This disease is documented in various species of animals including elephants, cervids, antelopes, ursids, felids, elephants etc.
- Even marsupials like kangaroo get affected by this infection.

Mode of spread and significance

- Organisms get passed through contaminated food materials by infected rodents etc. Overcrowding and strenuous events like a prolonged transport etc. lead to the precipitation of this disease condition in case of wild animals. It is not uncommon to find the peracute occurrence of this disease condition.
- This is a highly infectious disease in general.

Symptoms

- In elephants, the symptoms may be similar to those of anthrax. The death occurs within 12 hours in case of acute cases.
- The clinical symptoms are often related to the pleuropneumonia, dyspnoea, gastroenteritis in addition to the pyrexia, anorexia and depression.

Specimen collected

- Whole blood
- tissue samples
- Feathers

Diagnosis and therapy

- By PCR, examination of the heart blood-smear, biological test and culture from oral or nasal mucus and sometimes from feces help the diagnosis, in addition to the ELISA based tests etc.
- Post mortem reveals splenomegaly, petechial hemorrhage on lungs, epicardium, kidneys etc. Respiratory tract (upper regions)infections including tracheitis and red hepatization of the lungs are the common findings. Are common and if aversare

affected, it may be having necrotic foci on liver along with the petechial hemorrhage on epicardium and lungs.

- Tetracyclines, sulphonamides and fluoroquinolone compounds may assist the treatment of this condition in a successful manner.

3. Leptospirosis

- This is a significant disease that is caused by multiple serovars of the leptospires. Affected animals whether it is wild in free ranging or captive status become highly dull and lethargic.
- This disease has been documented in multiple species of wild animals, in general.

Species affected

- Most of the wild animal species get affected like ruminants, ursids, proboscids, felids,canids, marsupials and monotremes, peccaries and suids, procyonids, rodents and lagomorphs, rodents, viverrids, insectivores, pinnipeds etc.
- Outbreaks have been documented in case of non-human primates esp. the baboons and macaques. Rodents including mongooses act as carriers for this disease.

Mode of spread and significance

- Spread is mainly by the contaminated urine sample by rodent-urine etc.
- This disease is of zoonotic significance and affected human may reveal symptoms like myalgia, head ache, fever, sore throat, joint and neck pain, abdominal cramps etc.

Sample collected

- whole blood
- urine
- swab from body discharges
- tissue samples

Diagnosis and therapy

- Serological examination, culture, MATS, PCR finding of the organisms in the tissues etc.
- Therapy consists of usage of compounds like streptomycin, penicillin, tetracyclines esp. doxycyclines etc.

4. **Anthrax**

- Anthrax itself is a well-known disease with a great degree of public significance.
- In case of elephants, sub-cutaneous oedema may be found, along with bursting of few swellings on body.
- However, bloody discharge from natural orifices is a commonly found symptom in case of wild bovids, cervids, antelopes etc.
- This disease has been documented in felids, canids, perissodactylids, primates, wild suids etc.

Sample collected

- Whole blood

5. **Brucellosis**

- This has marked public health significance and the reports on the documentation of this dangerous disease among wild stock are many.
- This disease has been documented in case of chital, blackbuck etc. In general, it can be quoted that the hooved mammals, lagomorphs, rodents and canids get affected by this disease condition.

Sample collected

- Whole blood
- urine, faces
- swab from body discharges,
- tissue samples

7. **Botulism**

- This is caused by *Closridium botulinum* that affects the anseriformes and mink.
- The ingestion and wound infections are the primary routes of this infection in case of wild animal species.
- Affected species may reveal the neurological symptoms that are often fatal.

Sample collected

- Whole blood
- tissue swab

8. **Klebsiella infections**

- *Klebsiella* and other vector borne gram negative bacteria (pseudomonas) are primary opportunists affecting non-human primates.

- Klebsiella is present in stagnant water, dirty drinking receptacles and soil and as flora of alimentary tract.

Sample collected

- Whole blood
- stagnant water

9. **Colibacillosis**

- These infections are caused by Escherichia coli organisms affecting the wide variety of birds as well as the mammals' esp. the neonatal animals.
- Incidences have been found throughout the world among the various wild animal species.
- Fecal-oral route is the mode of transmission of these organisms, in most of the conditions.
- Enteritis occurs in the affected wild animal species. The culture tests may assist the confirmation of this microbial infection.

Sample collected

- Feacal
- Cloacal Swabs
- Blood
- Feather Swabs

10. **Salmonellosis**

- This is more common in most of the animal species esp. in case of non-human primates and reptiles.
- The affected animals may suffer from severe diarrhea and is of zoonotic significance.
- In wild animals like felids, *salmonella typhimurium* and other species cause this disease condition the gastro intestinal signs in addition to septicemia occur.
- Documentations are available on isolation of the most serious human pathogens of the groups namely *Shigella dysenterriae type I* and *Salmonella typhi.*
- Symptoms comprise weakness, edema of face and neck and diarrhea with mucus and /or blood.

Sample collected

- blood
- swab from body discharges

11. **Campylobacteriosis**

- This was earlier classified as a member of the family vibriacae but recently re-classified as a separate group.
- Campylobacter *jejuni* causes entero-*colitis* in a variety of mammals and birds including man. This is frequently reported in non-human primates.

Sample collected

- Blood
- Tissues Sample
- Intestinal Contents

B. VIRUS

- Viral diseases causing problems to the routine performance of the wild animals are caused substantially by many viral agents also.
- In both the captive and free ranging wildlife regions, the diseases caused by different viral agents are being documented throughout the world.
- However, the research findings are still to be improved in this regard due to various reasons.

1. FMD

- This disease occurs in case of wild ruminants and other artiodactylids, in general. Affected wild animal species may have lesions in the foot and mouth.
- This disease may lead to severe morbidity among the hooved stock
- This disease has been documented in herbivores like gaurs, cervids, suids etc. and is common among wild fauna but needs documentation in most of the cases.
- Elephants are also affected.

Sample collected

- Blood
- Nasal/oral swabs

2. Rabies

- Rabies has been documented in chital, rhino, elephants etc. Even oral infection has been documented in foxes and skunks by experimental means, following the ingestion of mouse carcasses infected by rabies virus.
- It is noteworthy to mention that the exposure to rabies virus in peripheral nerves could potentially occur when a person with wounds on the hands does not wear any protective covering or gloves while skinning rabies suspected captive wild animal.

Sample collected

- Saliva
- cerebrospinal spinal fluid

3. Measles (Rubeola), viral hepatitis, Kyasanur forest disease (KFD) and others

- Measles is one of the most frequently reported viral diseases of non-human primates and upon infection; the virus is shed and can re-infect man.
- This is a highly infectious exanthematous viral disease of children. This has been documented in marmosets, tamarins, owl monkeys etc. and is fatal to them.
- Several outbreaks of viral hepatitis have been documented in primate handlers and primate practitioners.
- The virus causing human infectious hepatitis (hepatitis A) can infect chimpanzees, patas, wooley monkey, gorilla, tamarins, cebus etc.
- KFD hasbeen reported in non-human primates and is of zoonotic importance.

Sample collected

- Whole blood
- serum

4. Herpes virus and pox virus infections

- Herpes virus infections are documented in non-human primates, elephant calves etc. In man, herpes B virus can be fatal, causing an acute ascending myelitis.
- Rhesus macaques and cyanomolgus are considered as the primary natural hosts.

- Lesions in non-human primates are mostly confined to the mucosa of buccal cavity.
- Ulcers or vesicles do occur around the lips and external nares and the most common site is the tongue. Monkey bites and laboratory accidents lead to the most human infections.
- Pox virus infections often are classified into four types in non-human primates, elephants etc. All these four diseases are infectious to man but it is to be remembered that the monkey pox is the most frequent one.
- Pox virus was documented in chimpanzee under captive condition reared at zoological garden.

Sample collected

- serum

5. Respiratory infections

- These are common in case of felids. Feline viral rhinotracheitis is the most common of the diseases that affect the felid group.
- Transmission is through the saliva and respiratory secretions contaminating the feed resources.
- Incubation period of this viral infection is two to four days. In case of calci viral infections of felids, it is one to two days.
- Symptoms comprise the weight loss, signs of dehydration, anorexia, fever and salivation along with sneezing and reluctance to drink.

6. Canine distemper

- This is a viral disease affecting the canids as well as the felids.
- The occurrence of canine distemper in case of felids as an outbreak has been documented among the free ranging lions in Africa.
- Affected ones reveal dullness, ataxia or deranged gait, anorexia, thick muco-purulent discharge etc. in general.

7. **Haemochromatosis and amyloidosis in captive birds**
    - In aviary species, abnormal accumulation of iron mainly in liver, with lesser amounts in heart, kidney and pancreas occurs (mynahs are most commonly affected by this metabolic disease condition) and there is no specific therapy.
    - Deposits of shapeless material in liver , spleen , adrenal and renal tissues occur in amyloidosis and has been documented in case of aquatic birds like swans, flamingos and ducks. Older birds are specifically affected by this condition.
8. **Parasitic diseases**
    - Natural areas in tropical and sub-tropical climates are more likely to enhance development of parasitic loads because of the fact that there are variations in climates of these areas in addition to the variations in the type of vegetations and species of wild fauna.
    - The parasitic diseases have caused serious problems in captive animals and it is to be accepted that some of the diseases bear Zoonotic significance.
    - Hence, treatment and prevention against parasites gain significance always in the wild animal health and disease management.
    - In non – human primates, the following parasites are more commonly encountered, i.e. Strongyles, Strongyloides spp, Trichuris spp, Entamoeba spp and Balantidium spp are zoonotically important ones.
    - In carnivores, especially in felids, the parasites are numerous leading to harmful features to different systems in the body and depending on the load and pathogenesis, animals suffer, in general. The common internal parasites in felids are Toxocara cati, Ancylostoma spp, Taenia spp, Dirofilaria immitis, Spirocerca lupi and the common blood protozoa parasites that are often encountered comprise Trypanasoma evansi, Toxoplasma gondii and Hepatozoa spp. Similarly, fleas like Ctenocephalides spp and the ticks are also more common.
    - The trematodes like Fasciola hepatica and Fasciola jacksoni have been reported in Asian elephants, whereas Protofasciola robusta was reported in African elephants. There are numerous nematode parasites in the elephant like ascarids, oxyurids, strongylids, paraphistomes, ancylostomes, syngamids and filarids. Cestodes like Anoplocephala manubriuta are also reported. The protozoan

disease like Trypanosomosis is a serious problem in Asian elephant caused by Trypanasoma evansi. Flea and tick infestations are more common in elephants. Amblyomma tholloni ticks (elephant tick) are found through out the body. Haematomyzus elephantis (elephant louse) are generally found in the base of the tail and behind the ears.

Internal parasitres are more common in wild ruminatnts also. The common parasites are Haemonchus spp, Ostertagia spp, Trichostrongylus sp, Oesophagostomum spp, Strongyloides spp, Trichuris spp, Taenia spp, Ascaris spp, Eimeria spp, Fasciola spp, and protozoan diseases like Babesia spp, Theileria spp, Trypanasoma spp etc are more common in wild ruminants.External parasites mange and tick ingestion are also common. Psoroptes spp, Sarcoptes spp and demodex spp are caused mange infestation in wild ruminants.

In case of reptiles like snakes, tick infestation is more common. The common ticks are Aponomma sp, Amblyomma spp, and Hyalomma spp .Internal parasites like Capillaria spp, Rhabdius spp. Ophidascaris spp, Isospora spp, Eimeria spp, Kalicephalus spp, Polydephis spp are similarly encountered in them.

Clinical examination of birds

- Just observe the bird and its movements
- Patiently hear about the history about the problem in the bird species.
- Rule out any abnormal activity like circling, star-gazing etc.
- Trace for evidence of any trauma like limping, reduced speed of gait etc.
- Find out any loss of proprioception with head tilt or nystagmus which may indicate the central vestibular lesions.
- Observe for any evidence of blood in mouth, ears, eyes etc.
- Look for any evidence of feather loss or mutilated area of skin/feathers
- Rule out erythema, discoloration of areas or discharge from outer ear etc.
- Look for any ventral odema (ventral edema may be due to thiamine or selenium or vitamin E deficiency in case of birds in addition to the protein deficiency or trauma, in general)

- Look for haematuria (This is considered as one of the indications in case of lead toxicosis in case of Amazon parrots).

Sampling in birds

- Sampling in case of birds need special care and management measures. In general, the bird should not be held tightly.
- Always use gentle methods during the holding procedures in case of any aviary species.
- Maintain calmness at the place of sampling to avoid the excitement of the bird under investigation
- Cover the eyes of the bird regardless of the species to minimize the stress factors that may act on the concerned aviary species.
- Plan about the kind of samples required well in advances

Gadgets required for sampling

- Gloves (rubber gloves or thick cloth based gloves)
- Disposable tuberculin syringe
- Disposable syringe(2ml / 5ml)
- Antiseptic solutions
- Capillary tubes
- Glass slides and cover slips
- Glass tubes for larger sized aviary species.

Collection of blood sample

- Total blood volume of the aviary species is approximately 10% of their body weight, in general and always you have to take care of this factor, while you attempt to collect the blood sample.
- Hence, a bird with 30 gm body weight may have 3 ml of blood and in this up to 10% (0.3ml) can be safely removed without any detrimental effects.
- In certain bird species (Corvidae, Gruidae, Struthionidae and Alcedinidae), mixing of blood in EDTA causes progressive hemolysis of red blood cells and hence, lithium heparin may be the better anticoagulant to be used for the collection of blood samples in such types of birds.
- There are generally four methods are there for the collection of blood samples in case of birds

- ✓ Toenail clipping method
- ✓ Jugular venipuncture
- ✓ Bacilic venipuncture
- ✓ Medial metatarsal venipuncture

Toenail- clipping technique

- Restrain the bird carefully and without any excitement
- Using aseptic technique, make a small cut at the end of the toenail.
- Use capillary tube for collection of blood sample
- Use absorbable cotton for the arrest of blood after the completion of collection by using this route.

Jugular venipuncture-technique

- Carefully extend the neck of the bird without much excitation.
  - ✓ Identify the location of right jugular vein.
  - ✓ Wet the area of this vein by alcohol-swab
  - ✓ Carefully insert a disposable 21 gauze needle attached with a disposable 2 ml or 5 ml syringe depending on size of the aviary species and collect the blood sample.
  - ✓ Apply light pressure while you withdraw the needle
  - ✓ Transfer the contents into tube with anticoagulant as well as into tube without any additive for serological examination.
  - ✓ This route is of useful in case of large sized birds in particular like cranes, storks etc.

Basilic venipuncture or Wing vein based venipuncture

- Restrain the bird properly
- Extend the wing carefully
- Wipe the medial elbow (humeral radio-ulnar joint) with alcoholic swab
- Apply pressure by fingers in a gentle manner above the site of collection, so as to enhance the visibility of engorging blood vessel.
- Then insert a disposable 21 gauze needle attached with a disposable 2 ml or 5 ml syringe depending on size of the aviary species and carefully collect the blood sample.
- Apply light pressure while you withdraw the needle

- Useful mostly in medium to large sized aviary species like dove, pigeon, younger barn owl etc.

Medial Metatarsal venipuncture

- Locate the blood vessel (medial metatarsal vein) at the dorso-medial leg, just above or below tarsal joint. For this you have to spread the wing well.
- Apply pressure over this point to enhance the visibility of filled vessel
- Use 23 gz or 25 gz needle attached with tuberculin syringe and collect blood sample.
- Apply light pressure while you withdraw the needle
- Use antiseptic soaked cotton for antiseptic purposes.

Self-Check – 5	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Test I: Short Answer Questions

1. List the sample that required for anthrax and rabies (5pts)?
2. List the sample types that may be collected from wild animals (2pts)?

Note: **Satisfactory rating – 3.5 points** **Unsatisfactory - below 3.5 points**

You can ask you teacher for the copy of the correct answers.

Information Sheet 6- Carrying out prescribedanimal treatments

6.1 Drug prescription

Few drugs are approved for use in wild animals (zoo) species, but extra-label drug use laws allow drugs to be legally used in species for which they are not licensed. Providing quality medical care to zoo animals requires that medications be used without documented therapeutic benefit, dosage, treatment schedule, contraindication, and toxicity data in these species. Antibiotic, antifungal, and analgesic treatments, as well as anesthetic dosages, are becoming less empirical because of increasing species-specific knowledge resulting from pharmacokinetics studies in zoo species. When using a drug on a group of animals for the first time, it is often wise to initially administer it to just one or two individuals. If no adverse effects are seen, the rest of the group can then be treated. The types of drug prescribed for zoo animals are:

1. For capture, restraining and reversal

Table 1: Drug used for capture, restraining and reversal

Drug type	**Purpose**	**Examples**
Anesthetics	To immobile and restrain	Ketamine, titetamine, carfentanil
Sedatives	To facilitate safer immobilization	Xylazine, medetomidine
Tranquilizers	To facilitate immobilization	Diazepam, zolazepam
Reversal (antagonist) drugs	To reverse immobilization	Yahimbine, tolazoline

2. For disease conditions and injury

Table 2: Diseases and injury causing drug

Drug types	Purpose	Examples
Antibiotics	To prevent or treat bacterial infection	Penicillin, oxytetracycline
Antiheminthes	To prevent or treat by parasitic worm (cestode and nematodes)	Ivermectin, levamisole
Vaccines	To prevent viral infection	Rabies vaccine
Anti-inflammatory	To treat muscle and skeletal injury	Ketaprofen

Vitamin-E and selenium	To reduce the onset of capture myopathy	Selepherol

Self-Check – 6	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Test I: Short Answer Questions

1. Write the drug prescription techniques for wild life (3pts)?
2. List at least the types of drug uses for wild life (2pts)?

Note: **Satisfactory rating – 3.5 points** **Unsatisfactory - below 3.5 points**

You can ask you teacher for the copy of the correct answers

Information Sheet 7- Identifying disease prevention and control methods

7.1 Introduction

- There are many diseases that occur in a frequent manner in captive wild animal atmosphere and vaccinations are being given for some.
- However, more research aspects have to be carried out in this regard to strengthen the protective measures in captive wild animals.
- The prevention and control method of diseases caused by microorganism are:

A. Prophylactic (vaccination)

- **Prophylaxis:** treatment given or action taken to prevent disease.
- **Vaccine:** a substance used to stimulate the production of antibodies and provide immunity against one or several diseases, prepared from the causative agent of a disease, its products, or a synthetic substitute, treated to act as an antigen without inducing the disease. 'Every year the flu vaccine is modified to deal with new strains of the virus.
- **Drug:** a medicine or other substance which has a physiological effect when ingested or otherwise introduced into the body.

I. Immunization (vaccination) of wild animals

- Vaccination is a practice of artificially building up in the animal body immunity against specific infectious diseases by injecting biological agents called vaccines.
- The term vaccine is used to denote an antigen (substance form organisms) consisting of a live, attenuated or dead bacterium, virus or fungus and used for the production of active immunity in animals.
- The term also includes substances like toxins, toxoids or any other metabolites etc. produced by microbes and used for vaccination.
- The wild animals and young ones should be vaccinated at regular intervals at appropriate times.
- Vaccination should be done with consultation of veterinarians.

Notes: E.g. the successful vaccination of foxes in against rabies was achieved through the aerial dispersal of edible bait containing rabies vaccine. The vaccine bait also contained a tetracycline antibiotic marker that, when ingested by the fox, produced a fluorescent mark on the teeth. By examining their dentition the level of vaccine uptake by the fox population could be monitored.

II. Deworming wild animals

- It is essential to deworm wild animals regularly.
- The individual zoo animals should also try to keep his herd worm-free.
- The most suitable time of deworming is the early stages of infection when the worm load is less.
- The local veterinarian should be consulted for all suggestions regarding dewormers and deworming.
- In adult animals deworming is done on examination of dung.
- It is good to deworm adult females after parturition.
- All the animals should preferably be fasted for 24 hours before giving the anthelmintic.
- Young animals should preferably be dewormed every month using a suitable anthelmintic.

B. Therapeutic treatment

- Limiting the contact between intermediate and final hosts by improvements in management.
- Direct action may be taken to reduce or eliminate intermediate host populations.
- Reduction in the number of snail intermediate host by chemical (molluscides) or biological control (ducks, Maris species of snails).
- Reduction in the number of snail intermediate hosts by drainage, fencing and other management practices.
- Reduction in the number of insect and tick vectors by chemical (insecticides/acaricides), biological control (hymenopterous insects, entomopathogenic fungi and Bacillus thuringiensis) and genetic control (sterile male technique, chromosomal translocation).

- Use of vaccines (Tick Gard) at appropriate times may control the vector population.
- Destruction of reservoir hosts is important in controlling certain parasites, e.g., rodents for Leishmania and antelopes for African trypanosomes.

C. Isolation of sick animals

- Isolation means segregation of animals, which are known to be or suspected to be affected with a contagious disease from the apparently healthy ones.
- Segregated animals should be sick in a separate isolation ward situated far away from the normal animal houses.
- The isolation ward should never be at a higher level than that of the healthy shed.
- If a separate accommodation is not available the animals concerned should be placed at one end of normal animals' buildings, as far away from healthy stock as practicable
- The isolated animals should be brought back into the herd only when the outbreak ends and they are fully recovered.

D. Quarantine

- Quarantine is the segregation of apparently healthy animals (especially animals being brought into the herd for the first time), which have been exposed to the risk of infection from those animals, which are healthy and unexposed to the risk of infection.
- In recent years the translocation and release into the wild of wild-caught and captive-bred wild animals (mammals, birds, reptiles, amphibians and fish) has become a common practice, ostensibly for rehabilitation or conservation purposes. These wild animals comprise many varied taxa and the objectives of translocation and release may include:
  - ✓ reintroducing a species that has become extinct in its natural range
  - ✓ restocking or reinforcing a population which has become depleted; and
  - ✓ Rehabilitating wild animals and birds which have been illegally captured and subsequently confiscated by Customs or national wildlife authorities.

Welfare organizations also receive sick and injured wild animals from the public and some of these can be restored to health and released.

- ✓ Each year very large numbers of wild animals also undergo both local and transcontinental translocation for release in new and strange habitats for sporting purposes. For example, hares (*Lepus europaeus*) are regularly translocated from Argentina to France and from Eastern Europe to Italy.

- The idea is to give sufficient time for any contagious disease that the quarantine animals may be having, to become active and obvious. Hence, the quarantined period depends on the incubation period of a disease. But in practice a quarantine period of 30 days covers almost all diseases.
- **For rabies**, the quarantine period should be about six months.
- During the quarantine period, animals should be thoroughly screened for parasitic infestation by faecal examination and de-worming carried out on the 23rd/24th day, if need be.
- The animals should also be subjected to dipping or spraying on the 25th/26th day for removing ectoparasites if any.

E. Movement control

- Segregate sick animals.
- Stop all animals, animal products, vehicles and persons coming into and out of the farm.
- Call a veterinarian for advice, adopt containment vaccination.
- Avoid grazing in a common place.
- Ban all visitors to the farm.
- Provide foot dips containing disinfectants at the entry of the farm and gear up sanitation and hygiene.

F. Burying or incineration of dead body

- The most common method of carcass disposal is burial.
- This is a reasonably safe method if done deeply enough and in soil from which there is no drainage to neighboring places.
- Deep burial is necessary to prevent worms carrying bacterial spores to the surface as well as to prevent carnivorous animals from digging up the carcass.

- The carcass should be carried to the burial place in a trolley and never by dragging it over the ground.
- The burial pit should be got ready before the carcass is taken there.
- The pit should be so dug that the highest part of the carcass must be at least 1.5 m below the level of the land surface.
- Bedding used for the dead animals, its excreta, feed left over by it and the top 5 cm soil form where the dead animals was lying (if the floor is not cemented) should also be buried along with the carcass.
- Drainage of water out of the burial place can be checked by seeing to it that the burial place is an area where the general water level is at least 2.5 m below the ground.

G. Improve wild animal protection

- Improve animal's genetics to adapt to good environment by suppling drug
- Good nutritional supplement for wild life
- Keep their environmental survival by control chemical disposing and reforestation.

Self-Check – 7	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Short Answer Questions

1. Define the term prevention and control in concepts of infectious diseases (3pts)?
2. List the methods of diseases prevention and control methods in wild animals (2pts)?
3. Is vaccination of wild animals possible? How it apply (3pts)?

Note: **Satisfactory rating - 4 points** **Unsatisfactory - below 4 points**

You can ask you teacher for the copy of the correct answers.

2.8 Zoonotic diseases and its economic impacts

a. Anthrax

- Zoonotic importance
- The loss of species of endemic wild animals
- Anthrax bacilli sporulate only if exposed to oxygen.
- Vegetative forms present in tissues and body fluids die out, if the carcase is not opened.
- Vaccination as the Preventive Measures captive felids like tigers, lions and panthers are routinely protected by preventive vaccination against anthrax, calci virus, feline pan leukopenia and feline rhino tracheitis.
- Similarly, in endemic areas of specific disease like HS or FMD or Anthrax, the periodical vaccination needs to be carried out against such diseases, in the susceptible hooved stock.

b. Tuberculosis

- Isolate the reactors or the tested ones that are suspected to be positive.
- Avoid congestion of number of animals in a single enclosure.
- Multiple drug combination with isoniazid may be given but the serological monitoring of biochemical parameters should be carried out to assess the health status of the concerned wild animal species.
- Zoonotic importance
- The loss of species of endemic wild animals
- Cost of treatment and control

c. Other diseases

1. Pasteurellosis in mammals

- Carry out the vaccination in the endemic areas against hemorrhagic septicemia.
- Oil adjuvant vaccine protects animals against the attack of the disease for a long time, than the case with alum precipitated vaccine.
- The loss of species of endemic wild animals

- Cost of treatment and control

d. *Fowl cholera*

- **I**n aquatic and semi-aquatic birds, this disease may occur.
- Good management, sanitation and hygiene are the preventive steps to be taken with regard to this disease condition.
- Zoonotic importance
- The loss of species of endemic wild animals
- Cost of treatment and control

e. *Leptospirosis*

- Zoonotic importance
- The loss of species of endemic wild animals
- Cost of treatment and control
- Efficient control of wild rodents should be carried out.
- Maintenance of hygienic standards to prevent the contamination of food resources and in particular the water resources with urine.
- Detection of the infected animals by serological and bacteriological tests and their separation from healthy animals should be carried out.
- Immunization may be carried out in case of carnivores esp. in the endemic areas.

f. *Black quarter*

- Hygienic maintenance is the specific preventive step against the occurrence of this disease.
- Destruction of carcases by burning and cleaning and effective treatment of wounds should be carried out as preventive steps of minimizing the spread.
- The loss of species of endemic wild animals

g. Salmonellosis

- Culture of diarrhoeic animals will reveal the diseased ones and isolate the diseased animal as one of the preventive step to minimize the spread of the problem.
- It is important to remove all the possible sources of infection, carrier animals, rodents, contaminated.
- Zoonotic importance
- The loss of species of endemic wild animals
- Cost of treatment and control

h. *Coli bacillosis*

- This is common in case of young ones.
- Provide hygienic management measures.
- Avoid over crowding of animals of one species
- Zoonotic importance (E. coli O157H, shiga toxin, K^{88}, k^{99})
- The loss of species of endemic wild animals
- Cost of treatment and control

i. Dermatophytoses (Ringworm)

- Contaminated enclosures, equipment and bedding should be disinfected by spraying copper sulphate solution or 5 % lime sulphur solution. This helps to diminish the reservoir of infection.
- Fallen skin crusts have to be disposed off to check the spread of infection from diseased to other.
- Zoonotic importance
- Cost of treatment and control

Self-Check – 8	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Test I: Short Answer Questions

1. List the zoonotic diseases from wild animals (1pts)?

2. What is an economic importance of tuberculosis (4pts)?

Note: **Satisfactory rating – 2.5 points** **Unsatisfactory - below 2.5 points**

You can ask you teacher for the copy of the correct answers.

Operation sheet- Perform restraining of wild animals

Procedure for physical and chemical restraining of wild mammals

1. Specify objectives of restraining you are going to conduct
2. Prepare necessary materials (i.e. darting gun, darting syringe and anesthetic agents used for restraining purpose
3. Implement anesthetizing of animals first by chemical agent by injecting anesthesia with darting gun
4. Perform physical restraining after animal is anesthetized
5. Carrying out diagnosis, sample collection and treatment or transport animals according to your objectives

LAP Test- Performance Test

Name……. ID……..
Date…….

Time started: _____ Time finished: _____

Instructions: Given necessary templates, tools and materials you are required to perform the following tasks within 20 minutes. The project is expected from each student to do it.

Materials required for physical and chemical restraining of wild mammals

Darting gun, darting syringe, anesthetic agents, metal chain, cage

Task 1: Perform chemical restraining of wild mammals

Task 2: Perform physical restraining of wild mammals

LG #49	LO #3- Identify and handle non-infectious disease of wild animals

Instruction sheet

This learning guide is developed to provide you the necessary information regarding the following **content coverage** and topics:

- Identifying non-Infectious diseases of wild animals
- Identifying prescribed treatments for the diseases and their usage protocol
- Identifying and outlining diseases prevention and control methods
- Identifying and advising economic importance of the diseases

This guide will also assist you to attain the learning outcomes stated in the cover page. Specifically, **upon completion of this learning guide, you will be able to**:

- Identify non-Infectious diseases of wild animals
- Identify prescribed treatments for the diseases and their usage protocol
- Identify and outline diseases prevention and control methods
- Identify and advice economic importance of the diseases

Learning Instructions:

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described below.
3. Read the information written in the “Information Sheets”. Try to understand what are being discussed. Ask your trainer for assistance if you have hard time understanding them.
4. Accomplish the “Self-checks” which are placed following all information sheets.
5. Ask from your trainer the key to correction (key answers) or you can request your trainer to correct your work. (You are to get the key answer only after you finished answering the Self-checks).

Information Sheet 1- Identifying non-Infectious diseases of wild animals

3.1 Introduction

Wildlife disease interest, activity, and reporting have primarily concentrated on parasitology and infectious diseases; disease entities with specific and identifiable etiologies. In the relatively new field of wildlife diseases this is understandable, and is based upon modern trends in human and veterinary medicine. With the discovery of pathogenic agents in the 19th century, a narrowing of the definition of disease from the time of Hippocrates was embraced. Hippocrates defined disease as disharmony within the body, between the body and mind, and between man and animal and the environment. The 20th century redefinition espoused that disease resulted from a collision between a pathogenic agent and a susceptible individual. The common non-infectious diseases of wild animals are **allergies, chemical toxicities, genetic, metabolic, nutritional, neoplastic, physical traumas** and etc.

A. Allergies

Animal allergies are common, particularly in people who have other allergies or asthma. People may have an allergy to any animal, especially those with fur or feathers. However, most animal allergies result from a person coming into contact with cats and dogs. People with animal allergies usually react to harmless proteins that are present in an animal's:

- dander
- saliva
- urine
- feces

Dander is tiny flakes of dead skin cells in an animal's fur, hair, or feathers that may induce allergy. Like cats and dogs, smaller mammals, such as ***rats, guinea pigs, hamsters, rabbits, and birds,*** also shed dander. Allergens are substances that cause an allergic reaction. Pet hair itself is not an allergen. However, it may collect dander, saliva, and urine and carry other allergens, such as pollen or dust. ***Animals without fur,*** such as reptiles, amphibians, and fish, do not shed dander and have less chance of triggering an allergic reaction. The number of people with animal allergies is increasing, and so is ownership of pets.

Causes

- When an allergen, such as animal skin flakes, pollen, or mold, causes inflammation inside the nose, allergic rhinitis occurs.
- Allergic rhinitis happens when the immune system mistakenly identifies a harmless allergen, such as a specific animal protein, as a threat. People with allergies to animal proteins inhale them or have them touch their skin, the immune system may trigger a reaction.
- The immune system responds to an allergen by releasing histamine. Histamine is a chemical in the body that causes the nose, throat, and skin symptoms that people associate with an allergic reaction.
- Antihistamines, such as Benadryl and Zyrtec, are medications that may help alleviate allergy symptoms.
- Some people with animal allergies may experience allergic contact dermatitis. This type of dermatitis occurs when an allergen contacts the skin and causes an allergic reaction.
- Proteins from animals may become airborne on microscopic particles. Dander may remain airborne for long periods or collect on furniture or clothing.
- Animal saliva may stick to furniture, clothing, and carpets and become airborne once dry.

Symptoms

Animal allergies produce an inflammatory response in the nasal passages, lungs, or skin. Nasal passage and lung symptoms of an animal allergy may include:

- itchy nose, eyes, roof of the mouth, or throat
- runny nose
- stuffy nose
- sneezing
- red or watery eyes
- blue-tinted skin under the eyes
- difficulty breathing

- wheezing when exhaling
- interrupted sleep due to shortness of breath

Skin symptoms of an animal allergy may include:

- raised red patches, or hives
- itchy skin
- eczema
- a burning sensation
- swelling or tenderness

Treatment and management

Managing an animal allergy involves avoiding the allergy-causing animal whenever possible. Minimizing exposure to the animal may help reduce allergic reactions and their severity. To help control symptoms, a doctor may recommend medications, such as:

- **Antihistamines:** These may reduce the amount of histamine causing an allergic reaction and alleviate itching, runny nose, and sneezing.
- **Corticosteroids:** These steroid nasal sprays may reduce inflammation and ease sneezing and a runny or stuffy nose.
- **Decongestants:** These lessen swelling in the nasal passages, which makes breathing through the nose easier.
- **Leukotriene modifiers:** A doctor may prescribe these when antihistamines and corticosteroids are not a suitable option. They block the actions of certain chemicals the body releases, and they reduce inflammation and nasal congestion.
- **Immunotherapy:** This involves exposure to incremental increases of an allergen, which may reduce sensitivity to the substance over time.

B. Chemical and toxicity

Many kinds of potentially harmful chemicals are found in environments used by wildlife. Some chemicals, such as pesticides and polychlorinated biphenyls (PCBs), are synthetic compounds that may become environmental contaminants through their use and application. Other materials, such as selenium and salt, are natural components of some environments, but contaminants of others. Natural and synthetic materials may cause direct poisoning and death, but they also may have adverse effects on wildlife

that impair certain biological systems, such as the reproductive and immune systems. This section provides information about some of the environmental contaminants and natural chemicals that commonly cause avian mortality; microbial and other biotoxins are addressed in the preceding section.

Table 5: Examples of chemical toxins to which wildlife may be exposed.

Pesticides This group includes chemicals that are used to kill or repel organisms that are unwanted in particular situations. Insecticides are generally the best known pesticides but others, their target organisms, and examples of compounds within those groups include the following:		
Pesticide type	**Target organisms**	**Compounds**
Acaricides	Mites, ticks, spiders	Permethrin, Phosmet, Methiocarb, Bomyl®, Carbofuran, Demeton (Systox®)
Algacides	Algae	Copper sulfate, Potassium bromide, Chlorine
Antibiotics	Bacteria	Phenol, Nitrapyrin
Avicides	Birds	Avitrol®, Fenthion, Compound 1080, Starlicide®
Fungicides	Fungi	Thiram, Ziram, Captan, Hexaconazole
Herbicides	Plants	Diquat®, Alachlor (Lasso®), Atrazine
Molluscicides	Snails and slugs	Bayluscide®, Methiocarb, Zectran®
Nematocides	Nematodes (worms)	Terbufos (Counter®), Isazofos (Triumph®), Aldicarb (Temik®), Carbofuran, Diazinon
Piscicides	Fish	Rotenone, Antimycin
Repellents	Mammals, Birds	Thiram, Methiocarb
Rodenticides	Rodents	Warfarin, Diphacinone, Brodifacoum (Talon®), Chlorophacinone

Metals Wildlife may be exposed to metals when they are components of pesticides, such as mercury and cadmium in fungicides, or through other routes, such as aquatic food chains with high mercury levels.	
Metal	**Source**
Arsenic	Used as an insecticide and preservative; present in wastes from metal smelting and glass manufacturing.
Cadmium	Used as a fungicide; waste from electroplating and production of plastics and batteries.
Copper	Industrial effluents from ore refinement, chemical processing.
Copper	Used as a fungicide, an algicide, and in agriculture.
Lead	Mine tailings, ingestion of particulate lead deposited during sporting activities.
Mercury	Used as a fungicide in paper mills and other industrial and agricultural uses; combustion of fossil fuels.
Selenium	Irrigation drain water from soils with high selenium concentrations; combustion of fossil fuel; sewage sludge.
Zinc	Found throughout the environment; higher levels in areas of industrial discharge.
Petroleum Wildlife may be exposed to many forms of petroleum, ranging from crude oils to highly refined forms, such as fuel oil.	
Others Many manufactured compounds, such as antifreeze (ethylene glycol) and certain drugs (such as euthanasia agents), present hazards to exposed wildlife	

C. Metabolic and Nutritional

Metabolic Diseases mean the diseases that occur due to the “imbalance between the rate of ‘input’ of dietary nutrients and the ‘output’ of products (product like new born, milk for young one etc.) and lead to the occurrence of metabolic derangements in the affected wild animal species.

Malnutrition (poor or inadequate nourishment) and its negative consequence starvation are the most prevalent disease syndromes in freeroaming mammal populations. **Starvation** is a **severe deficiency in caloric energy intake**, below the level needed to maintain an organism's life. Both can occur at any time of year.

Causes (Etiology)

- Injuries
- Poor Teeth
- Parasitism
- Disease
- Foreign Bodies In The Digestive Tract
- Tumors
- An increased motility of the digestive tract
- Inadequate in one or more of the required nutrients
- Winter is when mortality usually occurs due to the negative energy balance brought about by the cold weather, deep snow, increased energy demands, snow covered food, and human and predator induced stress.
- Winter season, scarcity as result of land cultivation or vegetation. E.g. ungulates and other herbivores
- Developed experience greater food storage behaviors. For example, wolves (Canis lupus) on the Kenai Peninsula depend primarily on moose (Alces alces) for food, and are aided in their predation by deep crusted snow and peak pack organization. During summer the pack is less organized (whelping and pup raising) and of course there is no snow. Weight, general condition, and blood

parameters in summer are lower than in winter from Kenai Peninsula wolves (Paterson and Franzmann, unpub).

Clinical signs

- Eliminates the young, old, weak, and sick animals by eating or starving those milkers
- Mass death
- Clinically, **mammals** suffering from malnutrition or starvation are lethargic, unsteady, listless, and unafraid of humans.
- The skin may appear loose, the hair coat erect, dull, and rough and the body more angular
- The animal may have a humped or sagged back, a swollen appearing face, sunken eyes, and a small tucked up abdomen.
- Due to atrophy (shrinkage) of the muscles, there is usually an increased prominence of the bones of the shoulders, ribs, vertebrate, and pelvis.
- The muscles appear more prominent, but usually do not appear full, and consequently a definite demarcation may be seen between the neck and shoulders and the upper forelegs and chest.
- ***Clinical signs of an avian species*** dying from malnutrition or starvation are listlessness, unsteady locomotion, ruffled feathers, and a lack of fear of humans.

Pathology

Pathological changes which occur in a starved animal are many and varied. The most striking gross change is:

- A ***lack of fat*** in the subcutaneous, visceral, and bone marrow locations, and atrophic changes which occur in the musculature.
- ***Serous atrophy***, a reddish gelatinous appearance to the fat tissue.
- The organs of the ***body decrease in size and weight***.
- The ***digestive tract*** of most species is empty and/or shrunken with dark green bile staining of the lining and contents.

- The ***stomachs of ruminant*** species usually contain food, but the contents are often dry and of poor quality.
- The **rumen lining** may be ulcerated, have erosions present and shrunken villi.
- The ***femur marrow***, due to a lack of fat present, will be red or yellow in color, transparent, and gelatinous in a starved animal.
- ***Avian starvation and malnutrition*** pathological changes:

  - ✓ Severe weight loss (up to 50%)
  - ✓ Absence of fat deposits and atrophy of the musculature, with breast muscle atrophy being the most noticeable.
  - ✓ The digestive tract is shrunken and/or empty with dark green stained linings, and there is a marked increase in the size (possibly 2 to 3 times normal) of the gall bladder due to an accumulation of bile.
  - ✓ Increase the susceptibility of the bird to parasitic infection (lice and other end parasites are more common), and may result in the drawing of contaminants from the fat deposits being used, thereby resulting in the circulating and redistribution of these compounds.
  - ✓ Chronic infections of aspergillosis and lead poisoning are highly developed.

Diagnosis

Starvation can be diagnosed either by field techniques through gross examination, or by laboratory analyses. To grossly diagnose starvation, the overall physical condition of the animal must be determined by examining for the presence or lack of adipose tissue (fat deposits) in the various subcutaneous and visceral locations. In ruminants, the femoral or mandibular bone marrow fat can be examined, and the percentage of fat present estimated visually. Some care must be taken when examining the femur marrow as it is used for fat storage in adult animals but serves as a production area for red blood cells rather than fat storage in young animals.

Post Mortem signs

Fat deposition in most ungulates first disappears over the rump, chronologically followed by the:

- disappearance of subcutaneous fat, kidney and mesenteric fat and pericardia
- Other indices of carcass fat such as bled carcass weight, eviscerated carcass weight, kidney fat index, carcass density, percentage of carcass fat, and depth of back fat
- Femur marrow fat values below 10% dry weight may reliably identify moose that have starved
- Fat deposits can be used as a direct measure of an animal's condition by reflecting its physiological adjustment to the environment.
- Skeletal ratios were used to reflect range related growth differences in black-tailed deer. Histopathological changes in starved Wisconsin white-tailed deer were described as; abundant hemosiderin in the spleen, decreased fat in marrow, a reduction in number and size of follicles in the spleen and fatty degeneration of the heart.
- Signs and causes of neonatal starvation were reported for white tailed deer .

Rickets and Osteoporosis

- Rickets occurs due to malformation of the growing bone (bowing of limbs/curving in limbs) due to lack of vitamin D3 and there is a failure of hardening of bone.
- In case of rickets, the mineralization and mineral absorption are not in a match.
- Osteoporosis occurs in both the adults and juveniles (but may be frequent in senile female reptiles), where the already hardened bones become weakened by the withdrawal of calcium for metabolic purposes and the wild animals become more prone for the development of fractures.
- This is a condition of bone wherein there is more resorption of osteoid than the deposition of new tissue.

- Hence, there is reduction in the organic matrix of bone. Protein deficiency also may have some influencing effect on the occurrence of osteoporosis.

Osteomalacia and fibrous osteodystrophy

- These disorders are often seen in the young hatchlings of crocodiles which subsequently reveal failure of hardening of bones due to lack of calcium.
- Among mammals, bone eaters (e. g. hyaena) if deprived of bones during feeding (like hyaenas) will end up in metabolic bone diseases.

Etiology

- Feeding diet with less calcium (provision of mince with liver and heart without bone or with less bones)
- Failure in proper absorption of calcium (diseases of GI tract / excessive phosphorus in diet)
- Insufficient calcium supplement and hormonal imbalances due to multiple causes
- Lack of vitamin D especially in indoor-kept wild animals.
- Prolonged storage of ration leads to less vitamin D3

Clinical signs

Crocodiles get often affected by the metabolic bone diseases. The signs are:

- Persisting of kyphokoliosis (hunch backed appearance) esp. in sub-adults and adult crocodiles
- Weakness of hatchling to walk on land while they still can move freely if in water or can swim freely in water.
- Falling of teeth and poor calcification of teeth
- Jaw bones become more pliable as evidenced in case of hatchlings(rubber jaws)
- Weakness in hatchlings along with sluggish movements
- Teeth becomes diaphanous like shards of glass (glassy teeth)

- In chelonians, lump like appearance of carapace(compare with normal nearby chelonian)

Diagnosis

- Serum estimation of calcium and phosphorus in addition to the radiographical examination and clinical signs and history of feeding and management

Note

- In this context, it is to be remembered that especially in the periods of production of egg shells, the calcium mobilization from bones is at peak and hence, the reptiles when hypocalcemic during these periods will have difficulties in maintaining muscular tonicity and as a result, prolapse of uterus may occur in crocodiles.
- Hence, whenever prolapse occurs in crocodiles or any reptiles, correlation with the metabolic derangements of calcium need to be paid attention.

Metabolic bone disease in captive aviary species

- Rickets is encountered in growing bird's esp. in birds which have long or large legs and is caused by Ca and Ph. Imbalance and deficiency of vitamin D. But osteomalacia is a disease of adult birds and causes are same as the previous ones.

Clinical signs

- Weakness, anorexia, polydipsia, intermittent loose droppings
- Poor feather growth and chewing at plumage
- Hunch backed appearance if thoracic cage reveals collapse.
- Upper and lower beaks may not oppose each other properly and prehension of food is faulty.
- Hyperaesthetic and reveal muscle spasms
- Improper calcification of eggs (eggs become more soft)

- Retention of eggs without laying due to lack of calcium

Gout

- This condition is more common in captive birds and reptiles in particular.
- Among the aviary species, especially raptors like hawks, eagles, kites, vultures, falcons are highly susceptible in addition to ostrich, cassowary, peafowls, budgerigars, love birds, parakeets, cormorant, goose, duck etc.
- Broader classification and the specific classification of gout should be known for a good understanding about this disorder.

Broader classification

- *True gout*
  - ✓ Deposition of monosodium urate crystals
- *Pseudo gout*
  - ✓ This is formed by deposition of any crystal other than sodium urate.

Specific classification

Table 6: Classification gout in wild animals

Visceral gout *(usually occurs as acute form)*	• Deposition of whitish urate or uric acid crystals (end products of nitrogenous metabolism or protein metabolism) in case of reptiles and birds (urate crystals are deposited as white colored powder or foci often on epicardium and liver mainly and also on kidney and sometimes on peritoneum) • Note ✓ Localization of urate crystals may vary from individual to individual
Articular gout or synovial gout*(usually occurs as chronic form)*	• Urate deposition in and around the joints. • Deposition of urate crystals form in joints form small white nodules called as tophi or tophus which is clearly visible to

	the unaided eyes.

Etiology

- *Renal problems* (infection/inflammation/renal lesions due to nephrotoxic substances like gentamicin and anti-inflammatory drugs like salicylates, probenecids, phenylbutazone etc.) are the basic cause because liver and esp.the renal tissues are involved in production of urate crystals.
- *Nutrition* (increased protein intake with provision of water, increased protein intake without provision of water or incorrect balance of aminoacids in the feed).
- *Stress leading to dehydration or dehydration* due to diseases all lead ultimately reduced renal blood flow and thereby renal efficiency is lots and ultimately gout occurs.
- *Congenital causes* might be the causal factors as documented in case of nile crocodile hatchlings.

Clinical signs and diagnosis

- Elevated serum uric acid helps the diagnosis in general, in addition to the specific examination for urate crystals in joints.
- In crocodiles or lizards or chelonians affected by gout, general depression is there but antemortem-diagnosis is difficult in visceral gout.
- In articular gout, the affected leg joints become painful and the animal is reluctant to move.
- In advanced arthritic gout, the swollen joints can be easily seen or palpated.
- In captive aviary species, affected by visceral gout, antemortem- diagnosis is difficult as in case of many species.
- In particular gout, urate tophi may be seen esp. in advanced cases (seen as whitish areas at joints).

Hypothyroidism

Hypothyroidism in captive wild mammals

This may occur in any species of wild mammals.

- *Clinical signs*
  - ✓ Obesity, alopecia, dullness with lethargic movements and lowered serum cholesterol are the major features in this hypothyroidism.

Hypothyroidism in captive aviary species (documented in budgerigars etc.)

- Goiter in birds due to iodine deficiency may lead to hypothyroidism because the iodine is a must for the development of thyroid gland.
- Due to iodine deficiency, there may be hypertrophy of thyroid gland resulting in goiter.
- ***Clinical signs***
  - ✓ The affected birds will reveal change of voice i.e. a respiratory noise heard as a characteristic 'click' and this is due to the pressure of the enlarged thyroid on syrinx and the lower trachea.
  - ✓ In addition to the obesity and dullness, there may be ruffled feathers in the affected bird.

Diabetes mellitus in mammals and birds

- Differentiate insulin dependent diabetes mellitus from non-insulin dependent diabetes mellitus. Mostly, insulin dependent diabetes mellitus occurs. This condition is recorded in non-human primates in particular.(polyuria, polydipsia, polyphagia and glycosuria in addition to the dullness, anorexia, unconsciousness in extreme stages and staggering may be noticed in the affected animals)
- Other mammals may also get affected by this condition. However, this needs a more detailed but a specific study esp. in case of aged wild animal species.
- Further, this condition has been documented in case of captive birds also (ruffled feathers, polyuria, polydipsia, polyphagia, glycosuria and weakness are the consistent clinical signs in the affected birds).

Fatty liver in mammals and birds

- This may occur in captive mammals and aviary species like budgerigars (male budgerigars especially have increased incidences of fatty liver and multiple metabolic causes might be assigned as etiological factors.

Neonatal hypoglycemia in wild mammals

- This occurs mainly due to in-sufficient intake of colostrums or milk from mother due to multiple reasons and this causes metabolic derangements and hypoglycemia occurs in the affected wild animal species.
- Pale skin, weakness, recumbences, hypothermia, incoordination with terminal convulsions are the clinical signs revealed.
- Monitoring the infant for proper feeding (ensure for proper energy intake) and monitoring of the mother on proper nursing may help for the prevention of this problem in case of wild animals.

Ketosis (Acetonemia) in wild ruminants

- In ruminants whether it is domestic or wild (giraffe, deer, antelope, wild goat, wild sheep and wild bovid), the dietary carbohydrates are fermented in the rumen to short chain fatty acids (acetate in majority amount, propionate in moderate amount and butyrate in lesser amount).
- Hence, the glucose needs in these animal species are largely met by gluconeogenesis and it is to be understood that propionate and amino acids are the major precursors for gluconeogenesis.

Clinical signs

1. **In wasting form**
    - Woody appearance of the animal due to apparent wasting and loss of cutaneous elasticity
2. **In nervous form (rule out rabies)**

- Animal walks in circles, head-pushing, apparent blindness, aimless walking, vigorous licking of objects and skin, depraved appetite, chewing movements with salivation.

Lactation tetany in wild equids

- This can be anticipated in case of wild equids reared under captive conditions. Zebras, wild asses and wild horses may get affected by this condition and often, it occurs in the lactating equids, either at about 10^{th} day, after giving birth or 1 to 2 days after the weaning of the young one for management reasons.
- Even after the prolonged transport or after the severe exertion, this condition may occur.

Clinical signs

- Stiff gait and the tail may be raised.
- Incoordination and tetany.
- Sweating in profuse manner
- Rapid and labored respiration with wide dilatation of pupils which may be accompanied by a distinct thumping sound from the thorax due to spasmodic contraction of the diaphragm.
- Muscular fibrillation esp. of the masseter and shoulder region and trismus without prolapse of membrana nictitans unlike in tetanus disease.
- Reduced peristalsis and suspended urination and defecation.
- May attempt to drink but unable to swallow.
- Lowered calcium diet during the pre-stress period may help to avoid the excess gastro-intestinal absorption of calcium.

Parturitient paresis(milk fever) in wild ruminants

- Though there is no systematic study of this disease condition in wild cervids, this condition can be anticipated in the newly fawned deer or antelopes that have given

birth. Especially when there are twin births, this can be anticipated. However, this can affect surely the gaur, mithun etc.

- This condition commonly occurs within two days of parturition and this may also occur few weeks before or after the parturition.

Clinical signs and diagnosis

Clinical signs

- Hypothermia, dilated pupils, dry muzzle, suspended urination and defecation along with lethargic movements or dullness.
- Weak heart sounds (rule out immobilization effects) and anorexia.

Diagnosis

- Serum estimation of calcium helps to diagnose the condition.

Calcium related metabolic derangements in wild birds

- Other than bone related disease, some abnormalities are encountered in captive birds due to deranged calcium metabolism and are furnished below:
  - ✓ *Egg binding* is commonly encountered in many aviary species and along with other causes, calcium deficiency due to multiple metabolic derangements play a significant role. Hence, in egg bound aviary species, calcium borogluconate is given by I/V or S/C route and this helps in the improvement of the tonicity of the musculatures and helps in the rapid expulsion of egg
  - ✓ *Malformed egg* esp. shell less egg or partially shelled egg or soft shelled egg may be laid by multiple aviary species reared under captive conditions. In addition to the salpingitis, the etiological factor for this might be the existence of imbalance in calcium and phosphorus levels.
  - ✓ An imbalance in calcium, phosphorus and vitamin D is commonly encountered in **parrots** and the problem arises as a result of their customary diet of high oil-bearing foods such as sunflower and peanuts. This in addition to the metabolic

derangements produce a variety of clinical expressions in the affected wild birds reared in captivity.

Colic as a result of metabolic derangments

- Colic is more commonly encountered in case of elephants in severe metabolic derangements like acidosis.
- Feeding of unaccustomed food material, excess feeding of the routine food materials, obstruction anywhere in the gastro-intestinal tract and lesser exercise with non-provision of adequate amounts of water for the drinking purposes- all may precipitate the colic condition, in general.

Signs of colic

- restlessness
- constipation
- depression
- disobedience / aggression
- Absence of signs of health, in general.
- Acute abdomen is a non-infectious disease condition that can affect any wild animal species, in general. However, this problem is more encountered in case of llamas. Camelids often experience this problem.

Clinical signs

- Dullness
- Temperature may be normal to sub-normal
- Anorexia
- Increased pulse and pain due to colic
- Normal to cyanotic mucosa
- Decreased defecation
- Decreased motility of stomach
- Increased respiration

Wounds, abscesses and injuries

- These are very common among wild animal species esp. the captive ones. In-fighting is the common cause often.
- Abscesses may occur if immediate treatment is not done due to multifaceted causes.
- Long time persisting wounds are common among elephants in particular and routine treatment protocol needs to be adapted in all these cases.

Self-Check – 1	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Short answer questions

1. How we can differentiate non- infectious from infectious diseases (6pts)?

2. List an example of non-infectious diseases in wild aviary (4pts)?

3. List the nutrition diseases caused in wild animals' disease (1pts)?

Note: **Satisfactory rating – 5.5 points** **Unsatisfactory - below 5.5 points**

You can ask you teacher for the copy of the correct answers.

Information Sheet 2- Identifying prescribed treatments for the diseases and their usage protocol

Administration of medicaments

- One has to be thorough in case of administration of different kinds of medicaments in aviary species.
- Routes used were given below

4. Oral route

- Administration of medicines by oral route
- The medication may be given by food or water.

Merit

- Easy to administer
- Animal keeper or the owner himself can administer

Demerit

- There is no assurance that the bird will take adequate amount of drug mixed water or food esp. while in sick status.
- Some birds rarely drink water in general.
- Tastes of the drug have influence on the intake of water or water containing the drug.

5. Intra-muscular route Intra-venous route

Administration of medicines by intramuscular route and Sub-cutaneous route

- In general, preferably the pectoral muscles or quadriceps muscle areas are used for the depositing of drugs in case of intra-muscular injections.

Birds	**Volume of drug to be given by I/M route at a site**
Budgerigars, canaries, finches etc.	0.1ml
African gray parrot or Amazon parrot	0.5ml
Cockatiel, small conure etc.	0.2ml
Birds weighing more than 1.5 Kg	Volume up to 1.5 ml per site can be given

- Sub-cutaneous route is chosen at the axillary region or loose skin in shoulder.

6. Sub-cutaneous route

Administration of medicines by I/V

- This route is mainly used in case of emergency or in case of larger sized birds like cranes, storks etc.
- Take care of the hematoma development or bleeding that may often occur.
- This is very important esp. in case of smaller sized aviary species.
- The veins to be used for the administration of medicaments are dealt under the chapter of 'Collection of blood sample'.

7. Intra-nasal route

Administration of medicines by intra-nasal route

- Intra-nasal route may be of useful in birds but bulk volume of drugs may be difficult to administer during usage of this route.
- This route is used for nasal flushing also as done in case of infra orbital sinus infection in which cases 1-3 ml of chosen drug is used in budgerigars and up to 10-15 ml is used for cockatoo or larger macaw and may be even up to 40 ml in case of falcons.

8. Intra-osseous route

Administration of medicines by intra-osseous route

- This is useful when I/V route or S/C route is not possible to be used due to smaller size of the birds etc.
- Intra-osseous cannula is used to administer blood, fluids, colloids etc.

Site

- Proximal tibia for short-term therapy
- Distal ulna in medium –sized to large birds that requires days of therapy.

Merits

- Reduced patient-resistance is observed during the adaptation of this route of administration of drugs.
- Less stress is experienced when compared to the repeated venipunctures.
- In birds in which the venin cannot be traced as in case of highly sick birds or in smaller sized birds, this route may be of tremendously useful for drug administration.

9. Intra-sinal route

- *Cloacal route* may be chosen in case of administration of enemas with liquid paraffin etc. This route is more useful during the infection of lower gastro-intestinal ract esp. in raptors or in suspected urolith conditions that might have lead to impaction of cloaca.
- *Nebulization* is used for therapy of air sacs and it is to be borne in mind that air sacs are the 1seat of infections like aspergillosis, mycoplasmosis, E' coli infections etc. Doxycycline, enrofloxacin, cefotaxime, amikacin sulfate, tylosin etc. are the commonly used nebulizing agents in aviary species, in general.

10. Other routes of administration

- *Infra-orbital sinus* may be the chosen site (in the medial canthus of ocular region) for the administration of drugs in birds through the intra-sinal route. This route is used in case of therapy of sinusitis. Also this is useful to collect samples from the sinus for cytology, culture and sensitivity.
- *For intra-tracheal route* the tracheal cartilaginous ring is the site for this injection. This route may be of much useful for respiratory infections in general.
- *Intra-peritoneal route* is to be done with much care to prevent the infection of visceral organs in the abdomen.

Self-Check – 2	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Test I: Short Answer Questions

1. How we can prescribe drug for wild animals (3pts)?
2. List some example and its uses of drug used for wild animals (4pts)?

Note: **Satisfactory rating – 3.5 points** **Unsatisfactory - below 3.5 points**

You can ask you teacher for the copy of the correct answers

Information sheet 3 – Identifying and outlining diseases prevention and control methods

3.1 General Disease Prevention and Control Measures

Prevention is the first line of defense against disease. At least four preventive techniques are available for use in the prevention of disease in an animal population. One is the exclusion of causative agents of disease from specific geographic areas, or quarantine. A second preventive tool utilizes control methods such as environmental control, and chemical agents to protect specific animal populations from non-infectious diseases, diseases normally present in an area. The third preventive measure concerns the mass education of people about disease prevention. Finally, early diagnosis of illness among members of an animal population is important so that disease manifestations do not become too severe and so that affected animals can bemore easily managed and treated.

3.2 Specific disease prevention and control

Preventive Medicine in metabolic bone disease

- If wild animals are fed a diet with imbalanced calcium – phosphorous ratio or if they have chronic intestinal malabsorption, metabolic bone disease may occur in them, especially in case of species that are bone eaters like hyaena.
- To avoid this, access to sun light may be provided for the prevention of this disease.
- Provision of supplemental drugs enriched with calcium and phosphorous may be carried out as one of the effective preventive medicine, against the occurrence of metabolic bone disease.
- Keeping animals' environment from contamination and chemical releases.

Allergy

It can be challenging to eliminate exposure to animal allergens, particularly if the animal is a pet or the person works with animals. People may also encounter animal allergens

that other people carry around on their clothing. The following suggestions may help reduce exposure to animal allergens:

- **Create a pet-free zone:** Making chosen areas of the house pet-free can help lessen allergens in those areas.
- **Remove furnishings that attract dander:** Pet dander collects on carpets, curtains, and horizontal blinds. If possible, replace carpet with tile, vinyl flooring, or wood that cleans easily.
- **Clean the carpet frequently:** Choosing carpets with a low pile and regularly steam cleaning them may help reduce pet dander in the room.
- **Wash pets frequently:** Washing a pet every week may decrease airborne allergens.
- **Ask for help:** Ask someone without a pet allergy to clean the pet's bedding, cage, or litter tray. The helper could also brush the pet outside to remove some dander.
- **Change clothing:** After spending long periods with a pet, change clothing to reduce allergen exposure.
- **Try high-efficiency filters:** High-efficiency particulate air purifiers may decrease the amount of airborne allergens.

Metabolic and nutritional

Supplemental feeding of starving wildlife is an alternative to allowing wildlife species to die. This, however, involves a philosophical question of maintaining wildlife populations at a level above their normal carrying capacity, interfering with nature's checks and balances on populations and encouraging transmission of diseases (bovine tuberculosis). It may also be cost prohibitive. If a feeding program is to be used to maintain a high plane of nutrition it needs to be started early in the winter, continued throughout, and a surplus of food must be provided. If food is not provided (especially in ruminants) until malnutrition is in its advanced stages, the animal will probably die anyway. This is because once food is made available, the ruminant must be able to live in a negative energy balance for up to 2 weeks, before its digestive tract can adjust to the new diet and change to a positive energy balance. Generally, starved ruminants do not eat large quantities of food when sudden access to unlimited food occurs. However,

due to an altered microbial population in the stomachs, it is possible to observe mortality in deer when shelled corn is overeaten. The reason for this is that lactic acid from the fermentation of starch accumulates to toxic levels. High quality palatable feed is essential in a feeding program: feed which contains readily available carbohydrates, roughage, minerals, and vitamins. Pelleted formulated feeds are the best ration that can be provided for ruminants. Elk can survive on high quality second or third cutting alfalfa, but deer have greater difficulty in obtaining adequate energy from roughages like this that are high in fiber. If baled hay is all that is provided for deer, it must be high quality alfalfa fed at a level where the deer do not have to consume anything but the leaves and small stems.

Self-Check – 3	Written test

Name…….. ID…… Date…….

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Test I: Short Answer Questions

1. Explain the methods of diseases control and prevention (4pts)?
2. White the term prevention is better than treat (3pts)?

Note: **Satisfactory rating – 3.5 points** **Unsatisfactory - below 3.5 points**

You can ask you teacher for the copy of the correct answers

Information sheet 4- Identifying and advising economic importance of the diseases

4.1 Introduction

The wild life can be used to earn money and as human food also. Wild plant products like food, medicine, timber, fibres, etc. are of economic value and the wild animal products such as meat, medicines, hide, ivory, lac, silk, etc. are of tremendous economic value. Wildlife provides us the raw and basic material to start any industry , factory etc for our earnings . Wildlife is also considered to be the one of the greatest factor for increase and better development of word trade and increase in national income. It also helps the farmers the most by providing a better way in ploughing and other techniques .Therefore, wildlife is of immense value to all in economic development . Since wildlife is the source of income to many they play a vital role in their life as the economic factor.An economic importance are:

- The loss of species of endemic wild animals
- Cost of treatment and control
- Mass death and pollute our enviroments
- Loss foreign currency for tourism
- Reduce wild life production and by products E.g. corcodile
- Drug interaction (loss).
- Decrease our enviromental beauty and healths.

Self-Check – 4	**Written test**

Name…… ID…… Date…….

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Test I: Short Answer Questions

1. Explain the term ‘economically important diseases’ (6pts)?
2. List an example and define an economically important disease in wild animals (3pts)?

Note: **Satisfactory rating – 3.5 points** **Unsatisfactory - below 3.5 points**

You can ask you teacher for the copy of the correct answers.

Reference Materials

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