

Appendix A

Sample specimen history form

Submitter's name:

Affiliation:

Address:

Telephone:

E-mail:

Date collected:

Method of collection: [found dead, euthanized (describe method) etc.]

Collector's name:

Specific die-off location:

State:

County:

Latitude/longitude:

Environmental factors: (Record conditions such as storms, precipitation, temperature changes, or other changes that may contribute to stress.)

Disease onset: (The best estimate of when the outbreak started.)

Species affected: (The diversity of species affected may provide clues to the disease involved.)

Age/sex: (Any selective mortality related to age and sex.)

Morbidity/mortality: (Ratio of sick animals to dead animals.)

Known dead: (Actual pickup figures.)

Estimated dead: (Consider removal by scavengers or other means.)

Clinical signs: (Any unusual behavior and physical appearance.)

Population at risk: (Number of animals in the area that could be exposed to the disease.)

Population movement: (Recent changes in the number of animals on the area and their source or destination, if known.)

Problem area description: (Land use, habitat types, and other distinctive features.)

Comments: (Additional information/observations that may be of value such as past occurrences of disease in area.)

Appendix B

Sources of wildlife diagnostic assistance in the United States

Assistance in obtaining a diagnosis of wildlife illness or death is available from a variety of sources. However, it is advisable to make inquiries before the need arises about available services, the estimated response time for completing work, and who to contact when assistance is required.

The following wildlife disease programs can offer information, assistance, and services.

Wildlife Disease Programs

1. U.S. Department of Interior, U.S. Geological Survey, Biological Resources Division National Wildlife Health Center 6006 Schroeder Road Madison, WI 53711 Telephone (608) 270-2400 Web site: <http://www.emtc.usgs.gov/nwhchome.html>
2. State fish and game agencies. Several States have wildlife disease programs. Among those are Alaska, California, Colorado, Florida, Idaho, Michigan, New Jersey, New York, Wisconsin, and Wyoming. Contact the State fish and game agency headquarters to inquire about assistance.
3. Regional wildlife disease programs. Two regional programs are presently affiliated with universities:
 - Southeastern Cooperative Wildlife Disease Study College of Veterinary Medicine University of Georgia Athens, GA 30602 Telephone (706) 542-1741
 - Northeastern Research Center for Wildlife Diseases University of Connecticut Department of Pathobiology Storrs, CT 06269-3089 Telephone (860) 486-4000
4. University programs. Several other universities, for example, the University of Florida—Gainesville and Virginia Polytechnical Institute and State University—Blacksburg, are involved in wildlife disease activities. Inquiries at schools of veterinary medicine and departments of veterinary or animal science at universities throughout the United States will reveal additional sources of wildlife disease diagnostic assistance.
5. Private sector. Some private consultants also deal with wildlife disease problems.

Domestic Animal Disease Programs

1. U.S. Department of Agriculture, Animal and Plant Health Inspection Service National Veterinary Services Laboratories P.O. Box 844, Ames, Iowa 50010 Telephone (515) 239-8600.

This facility accepts diagnostic specimens that have been referred to it through appropriate State or Federal channels.

2. State departments of agriculture. Animal disease diagnostic laboratories exist to serve domestic animal needs, but will often accept wildlife specimens.
3. Private sector. Veterinarians in private practice often have both interest and expertise in wildlife diseases and may become involved with these problems.

Additional sources of assistance for investigating wildlife mortality events when chemical toxins are suspected.

Federal Government

U.S. Fish and Wildlife Service (FWS)

The Division of Environmental Contaminants (DEC) is the FWS focal point for issues associated with chemical toxins. Information on contaminants can be obtained from the Central Office in Washington, D.C.

Telephone: (703) 358-2148

Web site: <http://www.fws.gov/~r9dec/ecprog.html> and from DEC staff in the seven FWS Regional Offices.

DEC biologists are assigned to field offices throughout the FWS Regions. They work on specific contaminant issues in each Region and are available to provide information and assistance regarding mortality event investigations.

Toxic spill coordinators are located in each Regional Office, providing a focal point for response actions.

FWS Regional Offices are located in:

Portland, Ore.; Albuquerque, N. Mex.; Fort Snelling, Minn.; Atlanta, Ga.; Hadley, Mass.; Denver, Colo.; and Anchorage, Alaska.

U.S. Geological Survey, Biological Resources Division (BRD)

The National Wildlife Health Center, which is the BRD Science Center in Madison, Wis., provides information about and assists in investigating wildlife mortality events.

Telephone: (608) 270-2400

Web site: <http://www.emtc.usgs.gov/nwhchome.html>

Research on chemical toxins is carried out at several BRD Science Centers. Those Centers maintain in-depth technical knowledge regarding the fate and impacts of chemicals in the environment. The Patuxent Wildlife Research Center in Laurel, Md. is an internationally recognized source of information on the effects of contaminants, particularly on avian species.

Telephone: (301) 497-5500

Web site: <http://www.pwrc.usgs.gov/>

U.S. Environmental Protection Agency (EPA)

Office of Solid Waste and Emergency Response

Telephone: (703) 308-8413

Web site: <http://www.epa.gov/epaoswer/>

The Office of Pollution Prevention and Toxics (OPPT) assesses the hazards and risks posed by industrial chemicals to human health and the environment. The Environmental Effects Branch in OPPT can provide information on the toxicity of chemicals to aquatic and terrestrial organisms.

Telephone: (202) 260-1268

Office of Pesticide Programs maintains the Ecological Incident Information System, which is a data base on mortality of non-target organisms caused by pesticides.

Telephone: (703) 305-5392

State Government

Many State natural resource agencies have environmental contaminant programs that provide a mechanism to report suspected chemical toxin problems. Some States have groups that investigate mortality events associated with chemicals, and that may be able to provide field assistance and chemical analysis.

Natural resource agencies in several States maintain wildlife health programs, which respond to wildlife mortality events.

State veterinary diagnostic laboratories often have toxicologists on staff who have specific knowledge of toxic problems within the region.

Poison Control Centers

The National Animal Poison Control Center at the University of Illinois College of Veterinary Medicine provides a fee-based service directed to prevention and treatment of adverse effects of chemical exposures in animals. This service is staffed by veterinary health professionals who have access to a wide range of information specific to animal poisoning.

Telephone (800) 548-2423, (900) 680-0000

Web site: <http://www.cvm.uiuc.edu/NAPCC/NAPCC.html>

The American Association of Poison Control Centers (AAPCC) has certified about 40 regional poison information centers throughout the U.S. that focus on human exposure to chemical toxins. These centers function to provide poison information, telephone management and consultation, collect pertinent data, and deliver professional and public education. The national AAPCC office is in Washington, D.C.

Telephone: (202) 362-7217. A directory of the regional centers is available at Web site: <http://www.pitt.edu/~martint/pages/rpiclist.htm>

Colleges of Veterinary Medicine

Most colleges of veterinary medicine have toxicology departments staffed with experts in the area of animal toxicology.

Analytical Laboratories

Choosing an analytical laboratory requires attention to methods used, quality assurance/quality control (QA/QC), and cost. Laboratories should be using methods that are appropriate to the analysis required in the matrix (material being analyzed) that is submitted. Minimum quality control data provided by the laboratory should include:

- (1) The results of analysis of spiked samples, or recovery. A known amount of the compound being analyzed for is added to the appropriate matrix. The recovery is the amount of the compound that was recovered in the analysis, and it is expressed as a percentage of the amount of compound added.
- (2) A replication of results, or an agreement of analyses of duplicate samples.
- (3) The results of blank samples, or an absence of the compound being analyzed for in a "clean" sample of the appropriate matrix.
- (4) The results of analysis of standard reference samples. A sample with a known quantity of the compound is prepared by an independent laboratory, and this sample is then analyzed by the laboratory being evaluated. Although good QA/QC adds to the expense of analytical work, the alternative may be an incorrect diagnosis.

Some of the analytical laboratories that have been used by the FWS DEC and others include:

For inorganic analyses:

Environmental Trace Substance Laboratory
University of Missouri - Rolla
101 USBM Bldg., 1300 North Bishop Ave.
Rolla, MO 65409-0530
Telephone: (314) 341-6607

Research Triangle Institute
3040 Cornwallis Road, Bldg. 6
Research Triangle Park, NC 27709-2194
Telephone: (919) 541-6896

Geochemical & Environmental Research Group
833 Graham Road
College Station, TX 77845
Telephone: (409) 690-0095

For organic analyses:

Geochemical & Environmental Research Group (see above)

Mississippi State Chemical Laboratory
Mississippi State University
Hand Chemical Lab, Rm 201, Morrill Road
Mississippi State, MS 39762
Telephone: (601) 325-3251

The above listing is not intended to be comprehensive, nor does it constitute endorsement by the Federal government. Rather, it illustrates the diversity of possible sources of assistance. Individual circumstances and events dictate which of these sources will be most useful in specific situations.

Appendix C

Sources of supplies used for collecting, preserving, and shipping specimens

Company	Address and telephone	Item
Scientific Products	319 West Ontario Chicago, IL 60610 Tel: (800)323-4515	Whirl-Pak® bags, formalin, wide-mouth, plastic jars, indelible markers
Curtis Matheson Scientific, Inc.	P.O. Box 1546 Houston, TX 77251 Tel: (713)820-9898	Whirl-Pak® bags, wide-mouth, plastic jars, indelible markers
Fisher Scientific Co.	711 Forbes Ave. Pittsburgh, PA 15219 Tel: (800)766-7000	Whirl-Pak® bags, formalin, indelible markers
Thomas Scientific	P.O. Box 99 Swedesboro, NJ 08095 Tel: (609)467-2000	Whirl-Pak® bags, wide-mouth, plastic jars, indelible markers
VWR Scientific	P.O. Box 66929 O'Hare Amp Chicago, IL 60666 Tel: (800)932-5000	Whirl-Pak® bags, indelible markers
Local hospital and medical supply businesses		Whirl-Pak® bags, wide-mouth, plastic jars
Some pharmacies		formalin
Freund Can Co.	167 W. 84th Street Chicago, IL 60620 Tel: (312)224-4230	metal paint cans with lids
U.S. General Services (gov't agencies only)	GSA Customer Supply Center Administration (GAS) 5619 W. 115th St. Worth, IL 60482 Tel: (800)262-0570	filament strapping tape, plastic bags, indelible markers
GSA Federal Supply Service	1500 E. Bannister Rd. Kansas City, MD 64131 Tel: (816)926-7315	filament strapping tape, plastic bags, indelible markers

Company	Address and telephone	Item
Local hardware, sports, and discount stores		Styrofoam®, shipping coolers, indelible markers, ice packs, filament strapping tape
Polyfoam Packers Corp.	2320-T Foster Avenue Wheeling, IL 60090 Tel: (800)225-7443	biomedical shippers and mailers

Protective clothing, gloves, and disinfectants can also be obtained from many of the sources listed above. The above list is not intended to be comprehensive, nor does it constitute endorsement by the Federal government.

Appendix D

Normal brain cholinesterase activity values

Species	Mean ¹	Standard deviation	Sample size
Avocet, American	19.4	2.9	5
Blackbird, Red-winged	24.5	1.2	5
Bobwhite, Northern	16.3	2.1	7
Brant, Black	14.4	0.8	5
Coot, American	20.5	5.0	12
Cormorant, Double-crested	29.3	2.4	5
Cowbird, Brown-headed	19.7	2.6	5
Crane, Mississippi Sandhill	16.6	2.3	15
Crane, Sandhill	17.5	1.4	8
Crane, Whooping	15.1	1.5	9
Dove, Mourning	22.8	3.3	11
Duck, American Wigeon	10.5	1.0	12
Duck, Blue-winged Teal	19.5	3.6	6
Duck, Green-winged Teal	13.5	2.0	17
Duck, Kola	11.0	1.2	9
Duck, Mallard	11.0	1.6	75
Duck, Muscovy	11.6	3.5	8
Duck, Northern Shoveler	14.7	1.2	5
Duck, Pintail	11.6	1.3	24
Duck, Ruddy	13.4	1.4	8
Duck, Wood	10.2	1.5	9
Eagle, Bald	16.0	2.6	156
Eagle, Golden	16.0	2.2	57
Egret, Common	17.4	1.9	5
Egret, Snowy	25.0	1.3	5
Falcon, Peregrine	18.6	3.2	27
Goldfinch, American	17.8	1.5	10
Goose, Canada	11.9	2.0	36
Goose, Canada (Aleutian)	14.0	3.6	8
Goose, Ross	14.2	2.3	9
Goose, Snow	13.6	2.6	42
Goose, White-fronted	12.1	1.2	9
Grebe, Eared	14.7	1.4	17
Grosbeak, Evening	20.3	3.1	5
Gull, Ring-billed	23.9	6.5	8
Hawk, Red-tailed	17.5	1.4	7
Hawk, Sharp-shinned	21.5	2.0	6
Heron, Black-crowned Night	15.6	3.0	5
Heron, Great Blue	13.3	2.1	8
Loon, Common	17.3	4.4	5
Owl, Great-horned	15.5	2.0	7
Owl, Screech	18.7	1.4	5
Owl, Spotted	14.6	2.0	9

Species	Mean ¹	Standard deviation	Sample size
Parrot, Puerto Rican	19.4	2.0	6
Pelican, American White	13.0	1.3	13
Pelican, Brown	11.2	1.2	16
Sandpiper, Semipalmated	14.1	1.1	5
Siskin, Pine	16.9	2.3	16
Stork, Wood	18.7	4.2	8
Swan, Trumpeter	11.3	1.3	10
Swan, Tundra	11.6	1.7	14
Tern, Least California	44.1	9.1	5
Woodcock, American	16.8	1.1	5
Woodpecker, Red-cockaded	38.4	4.8	5

¹ Cholinesterase activity is expressed as micromoles acetylthiocholine hydrolyzed per minute per gram of wet weight brain tissue (Hill, E.F. and Fleming, W.J., 1982, Environmental toxicology and chemistry 1:27-38).

Milton Smith

Appendix E

Common and scientific names of birds in text

Albatrosses, shearwaters, and petrels (Order Procellariiformes)

Albatrosses (Family Diomedidae)

Black-footed albatross (*Diomedea nigripes*)

Laysan albatross (*Diomedea immutabilis*)

Shearwaters and petrels (Family Procellariidae)

Northern fulmar (*Fulmarus glacialis*)

Petrels (*Pterodroma* sp, *Oceanodroma* sp, *Oceanites* sp)

Sooty shearwater (*Puffinus griseus*)

Cormorants, pelicans, and tropicbirds (Order Pelecaniformes)

Cormorants and Shags (Family Phalacrocoracidae)

Brandt's cormorant (*Phalacrocorax penicillatus*)

Cape cormorant (*Phalacrocorax capensis*)

Double-crested cormorant (*Phalacrocorax auritus*)

Great cormorant (*Phalacrocorax carbo*)

Shags (*Phalacrocorax* sp)

Gannets and boobies (Family Sulidae)

Gannet (*Morus bassanus*)

Pelicans (Family Pelecanidae)

Brown pelican (*Pelecanus occidentalis*)

White pelican (*Pelecanus erythrorhynchos*)

Tropicbirds (Family Phaethontidae)

Red-tailed tropicbird (*Phaethon rubricauda*)

White-tailed tropicbird (*Phaethon lepturus*)

Cranes, coots, and rails (Order Gruiformes)

Cranes (Family Gruidae)

Brolga crane (*Grus rubicunda*)

Common crane (*Grus grus*)

Demoiselle crane (*Anthropoides virgo*)

East African crowned crane (*Balearica regulorum gibbericeps*)

Greater sandhill crane (*Grus canadensis tabida*)

Hooded crane (*Grus monacha*)

Lesser sandhill crane (*Grus canadensis canadensis*)

Manchurian crane (red-crowned crane) (*Grus japonensis*)

Mississippi sandhill crane (*Grus canadensis pulla*)

Sarus crane (*Grus antigone*)

Stanley crane (blue crane) (*Anthropoides paradisea*)

White-naped crane (*Grus vipio*)

Whooping crane (*Grus americana*)

Rails, coots, and gallinules (Family Rallidae)

American coot (*Fulica americana*)

Common moorhen (*Gallinula chloropus*)

Sora (*Porzana carolina*)

Emus and ostriches (Order Struthioniformes)

Emu (Family Casuariidae, *Dromaius novaehollandiae*)

Ostrich (Family Struthionidae, *Struthio camelus*)

Grebes (Order Podicipediformes, Family Podicipedidae)

Eared grebe (*Podiceps nigricollis*)

Western grebe (*Aechmophorus occidentalis*)

Grouse, quail, and partridges (Order Galliformes, Family Phasianidae)

Grouse (Subfamily Tetraoninae)

- Blue grouse (*Dendragapus obscurus*)
- Ptarmigan (*Lagopus* sp)
- Red grouse (*Lagopus lagopus scoticus*)
- Ruffed grouse (*Bonasa umbellus*)
- Sage grouse (*Centrocercus urophasianus*)
- Sharp-tailed grouse (*Tympanuchus phasianellus*)

Quail (Subfamily Odontophorinae)

- Bobwhite quail (Northern) (*Colinus virginianus*)
- California quail (*Callipepla californica*)
- Coturnix quail (*Coturnix coturnix*)
- Japanese quail (*Coturnix japonica*)
- Scaled quail (*Callipepla squamata*)

Partridges and pheasants (Subfamily Phasianinae)

- Chukar partridge (*Alectoris chukar*)
- Gray partridge (Hungarian partridge) (*Perdix perdix*)
- Common peafowl (*Pavo cristatus*)
- Ring-necked pheasant (*Phasianus colchicus*)

Turkeys (Subfamily Meleagridinae)

- Wild turkey (*Meleagris gallopavo*)

Guinea fowl (Subfamily Numidinae, *Numida* sp)

Hawks, falcons, and vultures (Order Falconiformes)

Hawks, eagles, and kites (Family Accipitridae)

- Eurasian sparrowhawk (*Accipiter nisus*)
- Bald eagle (*Haliaeetus leucocephalus*)
- Booted eagle (*Hieraaetus pennatus*)
- Cooper's hawk (*Accipiter cooperii*)
- Common buzzard (*Buteo buteo*)
- Ferruginous hawk (*Buteo regalis*)
- Golden eagle (*Aquila chrysaetos*)
- Northern goshawk (*Accipiter gentilis*)
- Imperial eagle (*Aquila heliaca*)
- Northern harrier (marsh hawk) (*Circus cyaneus*)
- Red-shouldered hawk (*Buteo lineatus*)
- Red-tailed hawk (*Buteo jamaicensis*)
- Rough-legged hawk (*Buteo lagopus*)
- Sharp-shinned hawk (*Accipiter striatus*)
- Steppe eagle (*Aquila nipalensis*)
- White-tailed eagle (*Haliaeetus albicilla*)
- Osprey (*Pandion haliaetus*)

Falcons and caracaras (Family Falconidae)

- American kestrel (sparrowhawk) (*Falco sparverius*)
- Gyr falcon (*Falco rusticolus*)
- Peregrine falcon (*Falco peregrinus*)
- Prairie falcon (*Falco mexicanus*)
- Red-headed falcon (*Falco chicquera*)
- Saker falcon (*Falco cherrug*)

Vultures (Family Cathartidae)

- California condor (*Gymnogyps californianus*)
- King vulture (*Sarcoramphus papa*)
- Turkey vulture (*Cathartes aura*)

Herons, ibises, and storks (Order Ciconiiformes)

Flamingos (Family Phoenicopteridae)

Greater flamingo (*Phoenicopterus ruber*)

Herons, egrets, and bitterns (Family Ardeidae)

Bitterns (*Botaurus* sp, *Ixobrychus* sp)

Black-crowned night heron (*Nycticorax nycticorax*)

Great blue heron (*Ardea herodias*)

Great egret (common or american egret) (*Casmerodius albus*)

Snowy egret (*Egretta thula*)

Ibises and spoonbills (Family Threskiornithidae)

Glossy ibis (*Plegadis falcinellus*)

White ibis (*Eudocimus albus*)

White-faced ibis (*Plegadis chihi*)

Storks (Family Ciconiidae)

Wood stork (*Mycteria americana*)

Loons (Order Gaviiformes, Family Gaviidae)

Common loon (*Gavia immer*)

Pacific loon (*Gavia pacifica*)

Red-throated loon (*Gavia stellata*)

Owls (Order Strigiformes)

Typical owls (Family Strigidae)

Barred owl (*Strix varia*)

Eagle owl (*Bubo bubo*)

Eastern screech owl (*Otus asio*)

Great-horned owl (*Bubo virginianus*)

Long-eared owl (*Asio otus*)

Short-eared owl (*Asio flammeus*)

Snowy owl (*Nyctea scandiaca*)

Spotted owl (*Strix occidentalis*)

Barn-Owls (Family Tytonidae)

Barn owl (*Tyto alba*)

Parrots, parakeets, and macaws (Order Psittaciformes)

Parrots (Family Psittacidae)

Budgerigar (*Melopsittacus undulatus*)

Cockatiel (*Nymphicus hollandicus*)

Hawk-headed parrot (*Deroptryus accipitrinus*)

Lories (*Lorius* sp)

Lorikeets (*Trichoglossus* sp)

Lovebirds (*Agapornis* sp)

Macaws (*Ara* sp)

Puerto Rican parrot (*Amazona vittata*)

Rosellas (*Platycercus* sp)

Yellow-naped parrot (*Amazona auropalliata*)

Perching birds (Order Passeriformes)

Finches (Family Fringillidae)

American goldfinch (*Carduelis tristis*)

Apapane (*Himatione sanguinea*)

Cassin's finch (*Carpodacus cassinii*)

Eurasian bullfinch (*Pyrrhula pyrrhula*)

Evening grosbeak (*Coccothraustes vespertinus*)

Goldfinches (*Carduelis* sp)

House finch (*Carpodacus mexicanus*)

Pine siskin (*Carduelis pinus*)

Purple finch (*Carpodacus purpureus*)

Wood-warblers, tanagers, grosbeaks, sparrows, and blackbirds (Family Emberizidae)

Brown-headed cowbird (*Molothrus ater*)

Chipping sparrow (*Spizella passerina*)
 Common grackle (*Quiscalus quiscula*)
 Dusky seaside sparrow (*Ammospiza nigrescens*)
 Northern cardinal (*Cardinalis cardinalis*)
 Orioles (*Icterus* sp)
 Red-winged blackbird (*Agelaius phoeniceus*)
 Rufous-sided towhee (*Pipilo erythrophthalmus*)
 Chickadees (Family Paridae)
 Chestnut-backed chickadee (*Parus rufescens*)
 Crows, jays, and magpies (Family Corvidae)
 American Crow (*Corvus brachyrhynchos*)
 Blue jay (*Cyanocitta cristata*)
 Eurasian jay (*Garrulus glandarius*)
 Jackdaw (*Corvus monedula*)
 Magpie (*Pica* sp)
 Raven (*Corvus corax*)
 Rook (*Corvus frugilegus*)
 Steller's jay (*Cyanocitta stelleri*)
 Waxwings (Family Bombycillidae)
 Cedar waxwing (*Bombycilla cedrorum*)
 Weavers (Family Ploceidae, *Ploceus* sp)
 Old world sparrows (Passeridae)
 House sparrow (English sparrow) (*Passer domesticus*)
 Larks (Family Alaudidae)
 Horned lark (*Eremophila alpestris*)
 Mockingbirds and thrashers (Family Mimidae)
 Northern mockingbird (*Mimus polyglottos*)
 Thrashers (*Toxostoma* sp)
 Nuthatches (Family Sittidae, *Sitta* sp)
 Shrikes (Family Laniidae, *Lanius* sp)
 Starlings (Family Sturnidae)
 European starling (*Sturnus vulgaris*)
 Mynas (*Acridotheres* sp, *Gracula* sp)
 Swallows (Family Hirundinidae, *Hirundo* sp, *Tachycineta* sp, *Riparia* sp, *Stelgidopteryx* sp)
 Martins (*Progne* sp)
 Thrushes, solitaires, and bluebirds (Family Muscicapidae)
 American robin (*Turdus migratorius*)
 Bluebirds (*Sialia* sp)
 Eurasian blackbird (*Turdus merula*)
 Thrushes (*Turdus* sp, *Ixoreus* sp, *Hylocichla* sp, *Catharus* sp)
 Estrildid finches (Family Estrildidae)
 Java finch (*Padda oryzivora*)
 Penguins (Order Sphenisciformes, Family Spheniscidae)
 Blackfooted penguin (*Spheniscus demersus*)
 Pigeons and doves (Order Columbiformes, Family Columbidae)
 Band-tailed pigeon (*Columba fasciata*)
 Mourning dove (*Zenaida macroura*)
 Ringed turtle dove (*Streptopelia risoria*)
 Rock dove (common pigeon) (*Columba livia*)
 White-winged dove (*Zenaida asiatica*)
 Wood pigeon (*Columba palumbus*)
 Shorebirds (Order Charadriiformes)
 Gulls, terns, skuas, and skimmers (Family Laridae)
 California gull (*Larus californicus*)

Common tern (*Sterna hirundo*)
 Franklin's gull (*Larus pipixcan*)
 Glaucous-winged gull (*Larus glaucescens*)
 Herring gull (*Larus argentatus*)
 Kittiwakes (*Rissa* sp)
 Laughing gull (*Larus atricilla*)
 Least California tern (*Sterna antillarum*)
 Ring-billed gull (*Larus delawarensis*)
 Royal tern (*Sterna maxima*)
 Skua (*Catharacta skua*)
 Auks, murres, and puffins (Family Alcidae)
 Common murre (*Uria aalge*)
 Guillemots (*Cephus* sp)
 Murres (*Uria* sp)
 Puffins (*Fratercula* sp)
 Razorbill (*Alca torda*)
 Plovers (Family Charadriidae, *Charadrius* sp, *Pluvialis* sp)
 Sandpipers, turnstones, surfbirds, and phalaropes (Family Scolopacidae)
 American woodcock (*Scolopax minor*)
 Curlews (*Numenius* sp)
 Long-billed dowitcher (*Limnodromus scolopaceus*)
 Marbled godwit (*Limosa fedoa*)
 Pectoral sandpiper (*Calidris melanotos*)
 Ruddy turnstone (*Arenaria interpres*)
 Semipalmated sandpiper (*Calidris pusilla*)
 Spotted sandpiper (*Actitis macularia*)
 Western sandpiper (*Calidris mauri*)
 Stilts and avocets (Family Recurvirostridae)
 American avocet (*Recurvirostra americana*)
 Black stilt (*Himantopus novaezelandiae*)
 Black-necked stilt (*Himantopus mexicanus*)
 Waterfowl (Order Anseriformes, Family Anatidae)
 Dabbling ducks
 American wigeon (*Anas americana*)
 American black duck (*Anas rubripes*)
 Blue-winged teal (*Anas discors*)
 Gadwall (*Anas strepera*)
 Green-winged teal (*Anas crecca*)
 Koloa duck (*Anas wyvilliana*)
 Laysan duck (*Anas laysanensis*)
 Mallard (*Anas platyrhynchos*)
 Mottled duck (*Anas fulvigula*)
 Muscovy duck (*Cairina moschata*)
 Northern pintail (*Anas acuta*)
 Northern shoveler (*Anas clypeata*)
 White Pekin duck (*Anas platyrhynchos*)
 Wood duck (*Aix sponsa*)
 Diving ducks
 Bufflehead (*Bucephala albeola*)
 Canvasback (*Aythya valisineria*)
 Common goldeneye (American goldeneye) (*Bucephala clangula*)
 Greater scaup (*Aythya marila*)
 Harlequin duck (*Histrionicus histrionicus*)
 Lesser scaup (*Aythya affinis*)

Oldsquaw (*Clangula hyemalis*)
Redhead (*Aythya americana*)
Ring-necked duck (*Aythya collaris*)
Ruddy duck (*Oxyura jamaicensis*)

Sea ducks

Black scoter (common scoter) (*Melanitta nigra*)
Common eider (*Somateria mollissima*)
Common merganser (*Mergus merganser*)
Mergansers (*Mergus* sp, *Lophodytes* sp)
Red-breasted merganser (*Mergus serrator*)
Spectacled eider (*Somateria fischeri*)
Surf scoter (*Melanitta perspicillata*)
White-winged scoter (*Melanitta fusca*)

Geese (Tribe Anserini)

Aleutian Canada goose (*Branta canadensis leucopareia*)
Bean goose (*Anser fabalis*)
Black brant (*Branta bernicla nigricans*)
Brant (*Branta bernicla*)
Canada goose (*Branta canadensis*)
Hawaiian goose (nene goose) (*Nesochen sandvicensis*)
Ross' goose (*Chen rossii*)
Snow goose (*Chen caerulescens*)
White-fronted goose (*Anser albifrons*)

Swans (Tribe Cygnini)

Bewick's swan (*Cygnus columbianus bewickii*)
Black swan (*Cygnus atratus*)
Mute swan (*Cygnus olor*)
Trumpeter swan (*Cygnus buccinator*)
Tundra swan (whistling swan) (*Cygnus columbianus*)
Whooper swan (*Cygnus cygnus*)

Whistling ducks (Tribe Dendrocygnini)

Fulvous whistling duck (*Dendrocygna bicolor*)

Woodpeckers (Order Piciformes, Family Picidae)

Red-cockaded woodpecker (*Picoides borealis*)

Sources

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- Howard, R. and Moore, A. 1991. A complete checklist of the birds of the world, (2nd ed.): San Diego, California, Academic Press, 622 p.
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Appendix F

Common and scientific names other than birds

Mammals

African lion (*Panthera leo*)
Bears (*Ursus americanus*; *U. arctos*; *U. maritimus*)
Beaver (*Castor canadensis*)
Bighorn sheep (*Ovis canadensis*)
Bison (*Bison bison*)
Bobcat (*Felis rufus*)
Caribou (New World and Siberia) (*Rangifer tarandus*)
Chipmunks (*Tamias striatus* and *Eutamias* sp.)
Cottontail rabbit (*Sylvilagus floridanus*)
Coyote (*Canis latrans*)
Deer (*Odocoileus* sp.)
Elk (*Cervus elaphus*)
Foxes (*Vulpes* sp., *Urocyon* sp., and *Alopex lagopus*)
Fur seal (*Callorhinus ursinus*)
Jackrabbits (*Lepus* sp.)
Lynx (*Felis lynx*)
Mink (*Mustela vison*)
Muskrat (*Ondatra zibethicus*)
Nutria (*Myocaster coypus*)
Pronghorn antelope (*Antilocapra americana*)
Puma (Mountain lion) (*Felis concolor*)
Raccoon (*Procyon lotor*)
Rats (*Rattus* sp.)
Reindeer (Old World and Greenland) (*Rangifer tarandus*)
Sea lions (*Zalophus californianus* and *Eumetopias jubata*)
Voles - small, mouse-like mammals primarily of the genera *Clethrionomys* and *Microtus*.
Weasels (*Mustela* sp.)

Invertebrates

Asian tiger mosquito (*Aedes albopictus*)
Black widow spider (*Latrodectus mactans*)
Caecal worm (*Heterakis gallinarum*)

Fish

Rainbow trout (*Salmo gairdneri*)

Plants

Choke cherry (*Prunus virginiana*)

Appendix G

Chemical names

Common Names	Chemical Names
1080	Sodium monofluoroacetate
2-PAM	Pralidoxime chloride
Alachlor (Lasso®)	2-Chloro-N-(2,6-diethylphenyl)-N-(methoxymethyl)acetamide
Aldicarb (Temik®)	2-Methyl-2-(methylthio)propanal O-[(methylamino)carbonyl]oxime
Aldrin	1,2,3,4,10,10-Hexachloro-1,4,4a,5,8,8a-hexahydro-1,4:5,8-dimethanonaphthalene
Antimycin	3-Methylbutanoic acid 3-[3-(formylamino)-2-hydroxybenzoyl]amino-8-hexyl-2,6-dimethyl-4,9-dioxo-1,5-dioxonan-7-yl ester
Aroclor®	Group of polychlorinated biphenyls
Atrazine	6-Chloro-N-ethyl-N'-(1-methylethyl)-1,3,5-triazine-2,4-diamine
Avitrol®	4-Aminopyridine
Bayluscide®	5-Chloro-N-(2-chloro-4-nitrophenyl)-2-hydroxybenzamide compound respectively with 2-aminoethanol(1:1)
Beuthanasia-D-Special®	Sodium pentobarbital
Bomyl®	3-[(Dimethoxyphosphinyl)oxy]-2-pentenedioic acid dimethyl ester
Brodifacoum (Talon®)	3-[3-(4'-Bromo[1-1'-biphenyl]-4-yl)-1,2,3,4-tetrahydro-1-naphthalenyl]-4-hydroxy-2H-1-benzopyran-2-one
Captan	3a,4,7,7a-Tetrahydro-2- [(trichloromethyl)thio]-1H-isoindole-1,3(2H)-dione
Carbofuran	2,3-Dihydro-2,2-dimethyl-7-benzofuranol methylcarbamate
Chlorophacinone	2-[(4-Chlorophenyl)phenylacetyl]-1H-indene-1,3(2H)-dione
Chlorpyrifos	Phosphorothioic acid O,O-diethyl O-(3,5,6-trichloro-2-pyridinyl) ester
Chlordane	1,2,4,5,6,7,8,8-Octachloro-2,3,3a,4,7,7a-hexahydro-4,7-methano-1H-indene
Clophens®	Group of polychlorinated biphenyls
Coumaphos	Phosphorothioic acid O-(3-chloro-4-methyl-2-oxo-2H-1-benzopyran-7-yl) O,O-diethyl ester
DDD	Dichlorodiphenyl dichloroethane
DDE	Dichlorodiphenyldichloroethylene
DDT	Dichloro diphenyl trichloroethane
Demeton (Systox®)	Phosphorothioic acid O,O-diethyl O-[2-(ethylthio)ethyl] ester mixture with O,O- diethyl S-[2-(ethylthio)ethyl]phosphorothioate
Diazinon	Phosphorothioic acid O,O-diethyl O-[6-methyl-2-(1-methylethyl)-4-pyrimidinyl] ester
Dicrotophos	Phosphoric acid 3-(dimethylamino)-1-methyl-3-oxo-1-propenyl dimethyl ester
Dieldrin	(1 α ,2 β ,2 α ,3 β ,6 β ,6 α ,7 β ,7 α)-3,4,5,6,9,9-Hexachloro-1a,2,2a,3,6,6a,7,7a-octahydro-2,7:3,6-dimethanonaphth[2,3-b]oxirene

Common Names	Chemical Names
Dimethoate	Phosphorodithioic acid O,O-dimethyl S-[2-(methylamino)-2-oxoethyl] ester
Diphacinone	1,3-Indandione, 2-diphenylacetyl
Diquat®	Dipyrido(1,2-a:2',1'-c)pyrazinedium, 6,7-dihydro
Disulfoton	Phosphorodithioic acid O,O-diethyl S-[2-(ethylthio)ethyl] ester
EDTA	Ethylenediaminetetraacetic acid
Endosulfan	6,7,8,9,10,10-Hexachloro-1,5,5a,6,9,9a-hexahydro-6,9-methano-2,4,3-benzodioxathiepin 3-oxide
Endrin	(1 α ,2 β ,2a β ,3 α ,6 α ,6a β ,7 β ,7a α)-3,4,5,6,9,9-Hexachloro-1a,2,2a,3,6,6a,7,7a-octahydro-2,7:3,6-dimethanonaphth[2,3-b]oxirene
Enflurane	2-Chloro-1-(difluoromethoxy)-1,1,2-trifluoroethane
Famphur	Phosphorothioic acid O-[4-[(dimethylamino)sulfonyl]phenyl] O,O-dimethyl ester
Fenamiphos	(1-Methylethyl)phosphoramidic acid ethyl 3-methyl-4-(methylthio)phenyl ester
Fenbendazole	[5-(Phenylthio)-1H-benzimidazol-2-yl]carbamic acid methyl ester
Fencloors®	Group of polychlorinated biphenyls
Fensulfothion	Phosphorothioic acid O,O-diethyl O-[4-methylsulfinyl]phenyl] ester
Fenthion	Phosphorothioic acid O,O-dimethyl O-[3-methyl-4-(methylthio)phenyl] ester
Fonofos	Ethylphosphonodithioic acid O-ethyl S-phenyl ester
Formalin	Formaldehyde solution
Halothane	2-bromo-2-chloro-1,1,1-trifluoroethane
HCN	hydrogen cyanide gas
Heptachlor	1H-1,4,5,6,7,8,8-Heptachloro-3a,4,7,7a-tetrahydro-4,7-methanoindene
Hexaconazole	(RS)-2-(2,4-dichlorophenyl)-1-(1H-1,2,4-triazol-1-yl)-hexan-2-ol
Hexane	C ₆ H ₁₄
Isazophos (Triumph®)	Phosphorothioic acid O-[5-chloro-1-(1-methylethyl)-1H-1,2,4-triazol-3-yl] O,O-diethyl ester
Isoflurane	2-Chloro-2-(difluoromethoxy)-1,1,1-trifluoroethane
Ivermectin	22,23-Dihydroabamectin
Kanechlor®	Group of polychlorinated biphenyls
Lindane	(1 α ,2 α ,3 β ,4 α ,5 α ,5 β)-1,2,3,4,5,6-Hexachlorocyclohexane
Methamidophos	Phosphoramidothioic acid O,S-dimethyl ester
Methiocarb	3,5-Dimethyl-4-(methylthio)phenyl methylcarbamate
Methoxyflurane	2,2-Dichloro-1,1-difluoro-1-methoxyethane
Mirex	1,1a,2,2,3,3a,4,5,5,5a,5b,6-Dodecachlorooctahydro-1,3,4-metheno-1H-cyclobuta[cd]pentalene
Monocrotophos	(E)-Phosphoric acid dimethyl [1-methyl-3-(methylamino)-3-oxo-1-propenyl] ester
Nitrapyrin	2-Chloro-6-(trichloromethyl)pyridine
OC	Organochlorine
OP	Organophosphate

Common Names	Chemical Names
Oxamyl	2-(Dimethylamino)-N-[[[(methylamino)-carbonyl]oxy]-2-oxoethanimidothioic acid methyl ester
PAH	Polycyclic aromatic hydrocarbon
Parathion	Phosphorothioic acid O,O-diethyl O-(4-nitrophenyl) ester
PCB	Polychlorinated biphenyl
Permethrin	3-(2,2-Dichloroethenyl)-2,2-dimethylcyclopropanecarboxylic acid (3-phenoxyphenyl)methyl ester
Phenoclor®	Group of polychlorinated biphenyls
Phenol	C ₆ H ₆ O
Phorate	Phosphorodithioic acid O,O-diethyl S- [(ethylthio)methyl] ester
Phosmet	Phosphorodithioic acid S-[(1,3-dihydro-1,3- dioxo-2H-isoindol-2-yl)methyl] O,O-dimethyl ester
Phosphamidon	Phosphoric acid 2-chloro-3-(diethylamino)-1- methyl-3-oxo-1-propenyl dimethyl ester
Pyralenes®	Group of polychlorinated biphenyls
Rotenone	[2R-(2 α ,6 α ,12 α)]-1,2,12,12a-Tetrahydro-8,9-dimethoxy-2-(1-methylethenyl)[1]benzopyrano[3,4-b]furo[2,3-h]benzopyran-6(6aH)-one
Sleepaway®	Sodium pentobarbital
Starlicide®	3-Chloro-p-toluidine hydrochloride
Strychnine	C ₂₁ H ₂₂ N ₂ O ₂
Terbufos (Counter®)	Phosphorodithioic acid S-[[[(1,1-dimethylethyl)thio]methyl] O,O-diethyl ester
Thiabendazole	2-(4-Thiazoyl)-1H-benzimidazole
Thiram	Tetramethylthioperoxydicarbonic diamide
Toxaphene	Chlorinated camphene
Warfarin	4-Hydroxy-3-(3-oxo-1-phenylbutyl)-2H-1-benzopyran-2-one
Zectran®	4-(Dimethylamino)-3,5-dimethylphenol methylcarbamate (ester)
Ziram	(T-4)-Bis(dimethylcarbamodithioato-S,-S')zinc

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Appendix H

Conversion table

The units of measurement that are used by laboratories for recording the results of scientific or diagnostic tests are reported in this Manual in the metric or SI units (from the French “Le System International d’Unites”) that are customary for those results. Other units of measurement, such as those that are used in the field for reporting area or length, are reported in the inch-pound units that are common in the United States. The lists of conversion factors and abbreviations below are for those who are interested in converting the basic units of measurement that are used in this Manual to the system of choice. For temperature, use the equations provided.

To convert SI to inch-pound

	<i>Multiply</i>	<i>By</i>	<i>To obtain</i>
Length			
millimeters (mm)		0.039	inch (in.)
centimeters (cm)		0.39	inch (in.)
meter (m)		3.28	foot (ft)
meter (m)		1.09	yard (yd)
kilometer (km)		0.62	mile (mi)
Weight			
kilogram (kg)		2.21	pound (lb)
metric ton		1.10	short ton
Volume or capacity			
milliliters (mL)		0.03	fluid ounce (fl. oz)
microliters (µL)		0.003	fluid ounce (fl. oz)
Temperature			
°C, degrees Celsius, to °F, degrees Fahrenheit			$9/5 \times ^\circ\text{C} + 32 = ^\circ\text{F}$

To convert inch-pound to SI

	<i>Multiply</i>	<i>By</i>	<i>To obtain</i>
Length			
inch (in.)		25.4	millimeters (mm)
foot (ft)		2.54	centimeters (cm)
mile (mi)		0.3048	kilometer (km)
Area			
acre	4,047		square meters (m ²)
Weight			
pound (lb)	0.4356		kilogram (kg)
short ton	0.907		metric ton
Temperature			
°F, degrees Fahrenheit, to °C, degrees Celsius			$(^\circ\text{F} - 32) \times 5/9 = ^\circ\text{C}$

Other abbreviated units of measurement used in this Manual:

- cc cubic centimeter, a unit of measurement that indicates the dosage of a drug or substance that is administered intravenously or by injection.
- µg/g micrograms per gram
- mg/kg milligrams per kilogram

Conversion table for units of measurement that are frequently used with the toxicology of pesticides:

Concentration of compound in tissue, food, or water, in SI units	Concentration of compound in tissue, food, or water, in parts per million (ppm)
1 nanogram per gram (1 ng/g)	0.001
1 microgram per 100 grams (1 μ g/100 g)	0.01
1 milligram per kilogram (1 mg/kg)	1
1 microgram per gram (1 μ g/g)	1
1 microgram per 100 milligrams (1 μ g/100 mg)	10
1 milligram per 100 grams (1 mg/100 g)	10
1 milligram per gram (1 mg/g)	1,000
Concentration of compound in air, in SI units	Concentration of compound in air, in parts per million (ppm)
1 microgram per liter (1 μ g/L)	1

Glossary

Abdomen — the portion of the body that lies between the thorax and the pelvis.

Abdominal cavity — the space that contains the abdominal viscera (the liver, spleen, intestines, etc.).

Abdominal wall — the layers of muscles lying between the skin and the abdominal cavity.

Absorption — to take in a substance through the pores or cells of a tissue. The substance must pass through the tissue to be absorbed.

Acanthocephalans — cylindrical, unsegmented worms that attach to the host by a retractable proboscis with sharp hooks.

Acaricides — substances, such as pesticides, that kill mites.

Acariasis — infestation of the body by mites.

Accipiters — short winged, long-tailed hawks; North American species are goshawk, Cooper's hawk, and sharp-shinned hawk.

Acute — sharp or severe, such as an illness with a sudden onset and a relatively short course.

Air sacs — thin-walled sacs that communicate with the lungs and are part of the avian respiratory system.

Airsacculitis — inflammation of the air sacs in birds.

Alcids — typically, pelagic colonial nesting seabirds, including species such as auklets, guillemots, murre, murrelets, and puffins.

Algae — a special form of plant life that lacks true roots, stems, or leaves, and that ranges in size from microscopic single cells to multicellular structures, such as seaweeds.

Alimentary canal — the digestive tract.

Allergic disease — development of a hypersensitivity of the host to substances foreign to the body, primarily antigens and other proteins.

Altricial — refers to newly hatched birds that require care in the nest for some period of time.

Ambient temperature — room or environmental temperature.

Amino acids — organic compounds of specific composition from which proteins are synthesized.

Amphibians — coldblooded animals characterized by moist, smooth skin that live both on land and in water at various life stages and that have gills at some stage of development,

that is, frogs, toads, salamanders.

Amplification host — a host in which disease agents, such as viruses, increase in number.

Amyloid deposit — a complex protein material that grossly resembles starch and that in certain abnormal conditions accumulates in various body tissues causing cellular damage and injury to the affected organ.

Anaerobic — absence of oxygen; often refers to an organism that grows, lives, or is found in an environment devoid of oxygen, such as the cellular form of *Clostridium botulinum*, which causes avian botulism.

Analgesia — the absence of normal sensitivity to pain, typically, being in a semiconscious state induced through an anesthetic.

Anemia — a reduction in the normal number of red blood cells, or erythrocytes, in the body.

Anesthetic — a drug used to temporarily deaden pain.

Anesthetic induction time — the time between administering an anesthetic chemical and the actual time when target nerves are deadened.

Animal pathogens — organisms such as viruses, bacteria, and parasites, that are capable of invading and infecting animal hosts and causing disease.

Annelids — a group of invertebrates characterized by the segmented worms, including those in marine and freshwater and earthworms in addition to leeches.

Anorexia — lack of appetite.

Anoxia — a total lack of oxygen caused by several mechanisms that prevent oxygen from reaching the mitochondria of cells. Anoxia indicates a level of oxygen in animal tissues that is below normal in the presence of an adequate blood supply.

Antibody — a specialized serum protein produced by the immune system in response to an antigen in an attempt to counteract the effects of the antigen; antibodies in the blood indicate exposure to specific antigens or disease agents.

Antidote — substances that counteract or prevent the action of a poison.

Antigen — any foreign substance (generally proteins) to which the body reacts by producing antibodies. Antigens may be soluble substances such as toxins, particulate matter such as pollen, or microorganisms such as bacteria and viruses.

Antiserum — a serum containing antibodies to specific antigens; can be used to test biological samples for the presence of specific antigens.

Antitoxin — any substance that counteracts the action of a toxin or poison; generally, a specific type of antibody produced in experimental animals as a result of exposure to a specific toxin. Botulism antitoxin, for example, can be produced by exposing an animal to low levels of botulism toxin over a long period of time and then harvesting serum from that animal to treat other animals.

Arbovirus — a virus that is transmitted by invertebrates of the phylum Arthropoda [insects, arachnids (spiders, mites, ticks, etc.) and crustaceans].

Arthropod — members of the phylum Arthropoda (insects, arachnids, and crustaceans).

Ascites — accumulation of fluid in the abdominal cavity.

Aseptic — free from infection; sterile.

Asexual reproduction — the formation of new individuals without the union with cells of the opposite sex and usually by an individual.

Asymptomatic — without visible signs of illness; an asymptomatic carrier is an organism that harbors a disease agent, but that shows no outward signs.

Ataxia — incoordination.

Avicides — chemical substances used to kill or repel birds.

Avirulent — not virulent, does not cause disease.

Bacterin — a vaccine consisting of killed bacteria that is used for protection against infection by a specific bacterial disease.

Bacteriophage — a virus that infects a bacterium.

Bacterium — singular for bacteria. Any of a group of microscopic, unicellular organisms that have distinct cell membranes and that lack a distinct nucleus surrounded by a nuclear membrane.

Barbiturate — a type of sedative or anesthetic that is chemically derived from barbituric acid.

Bay diving ducks — typically, ducks that feed in deep bodies of water, usually in coastal bays and deep lakes. Species include canvasback, goldeneyes, redhead, and scaup.

Benign — noninvasive, that is, tumors that do not spread to other parts of the body; not malignant.

Big game — hunted species of large mammals (from deer to elephants).

Bile — yellow-brown to greenish liquid secreted by the liver and stored in the gallbladder before excretion by way of the intestine. Bile is composed of metabolic breakdown products derived from hemoglobin and other metabolic waste products.

Bioaccumulation — the accumulation of long-lived toxins, such as chlorinated hydrocarbons, as a result of repeated exposure or of exposure from a variety of sources.

Biomagnification — an increase in concentrations of long-lived contaminants in animals at higher positions in the food chain.

Biota — the plant and animal life of an area.

Biotoxins — poisons produced by and derived from the cells or secretions of a living organism, either plant or animal.

Birds of prey — synonymous with raptors; includes eagles, hawks, falcons, kites, and owls.

Bitinglouse — see Hippoboscid flies.

Blackflies — small, bloodsucking, biting flies of the genus *Simulium*; vectors for *Leucocytozoon* infections.

Blood flukes — trematode parasites that are found in the blood cells of the host.

Brineflies — species of flies whose larvae live in brine.

Brooding — care of young birds by the adult.

Buffered formalin — a 3.7 percent solution of formaldehyde (equal to 10 percent formalin) to which sodium phosphate buffers have been added. Buffered formalin is the best overall fixative for tissue for later microscopic study.

Bumblefoot — an inflammation and, often, swelling of the foot of birds as the result of a bacterial infection.

Bursa of Fabricius — a saclike outgrowth of the cloaca of birds that is part of the avian immune system.

Buteos — a subfamily of the hawks characterized by soaring behavior, broad, rounded wings, and a broad, fanned tail, such as the red-tailed hawk.

Caecum (British; plural caeca) or cecum (American; plural ceca) — a large, blind pouch or sac (often a pair) at the junction of the small intestine and the large intestine.

Calcification — the process by which tissues become hardened by the deposition of calcium salts.

Canidia — fungal spores.

Canker — synonymous with trichomoniasis in doves and pigeons.

Capture myopathy — a state of immobility resulting from damage to skeletal and cardiac muscles caused by extreme physical exertion, struggle, or stress; may occur in wildlife as they are chased in capture attempts; may appear later when captured wildlife are under physical restraint; or may appear after they have been released.

Cardiac muscle — heart muscle.

Cardiovascular system — the heart and blood vessels by

which blood is pumped and circulated through the body.

Carnivores — refers to flesh-eating mammals in the Order Carnivora and includes dogs, skunks, weasels, cats, raccoons, etc.

Carrion — dead and decaying flesh.

Caseous — resembling cheese or curd.

Central nervous system — the brain and spinal cord.

Ceratopogonid flies — very small, bloodsucking gnats commonly known as punkies, no-see-ums, or sand flies.

Cercaria — the final free-swimming larval stage of a trematode parasite.

Cestodes — flattened, usually segmented, parasitic worms; tapeworms.

Chelating chemical — a chemical that combines with a metal ion in a firm, ringlike band and that prevents the metallic ion from having any further biochemical effect.

Chlorinated hydrocarbons — organic compounds characterized by the presence of chlorine; commonly refers to persistent chemicals with insecticidal properties; DDT and dieldrin are common examples.

Choana — one of the paired openings on the inner side of the maxilla (upper beak), near the back of the oral cavity, that opens into the nasal cavity.

Cholinesterase enzymes — enzymes that are particularly important in the transmission of nerve impulses; the activity of these enzymes is inhibited by exposure to organophosphorus and carbamate compounds, and death results when activity is greatly reduced.

Chronic — persisting for a relatively long time.

Chronic losses — mortality of attrition; small numbers of continual losses over extended periods of time.

Clinical sign — an abnormal physiological change or behavior pattern that is indicative of illness. Signs are externally observable, as contrasted with symptoms, which are subjective.

Cloaca — a common passage for the fecal, urinary, and reproductive discharges of most lower vertebrates (birds, reptiles, and amphibians).

Coalescence — the fusion or growing together of tissue damage from a disease agent.

Coldblooded vertebrates — species such as fishes and reptiles, which have blood that varies in temperature to approximately that of the surrounding environment.

Colibacillosis — infection with the bacterium *Escherichia coli*.

Colon — the large intestine.

Colonial nesters — birds that nest in large groups.

Comatose — in a coma or coma-like state; an abnormal state of continuous deep unconsciousness.

Congener — a member of the same taxonomic grouping, such as polychlorinated biphenyls, that possess similar chemical structures.

Congenital abnormality — usually an anatomical malformation that results from incomplete growth during embryonic development. Also refers to an abnormal biochemical pathway caused by a genetic factor.

Congestion — the abnormal accumulation of blood in a tissue or organ; often causes a reddening of the affected area.

Contagious — capable of being transmitted from animal to animal, such as a contagious disease.

Coccidiasis — the presence of coccidia, protozoa of the subphylum Sporozoa.

Coccidiosis — a disease caused by coccidia, protozoa of the subphylum Sporozoa.

Cornea — the transparent tissue on the front of the eyeball that covers the iris and pupil, through which light passes to the interior.

Coronary band — a fatty band encircling the heart; in hooved animals, the germinal layer beneath skin at the junction of the skin and hoof.

Cracker shell — a shotgun shell that is loaded to produce a visible burst and loud sound in order to frighten animals.

Crop — a dilation of the esophagus at the base of the neck of some birds.

Crustacea — a specialized group of invertebrates that includes such diverse species as lobster, shrimp, barnacles, wood lice, and water fleas.

Cygnets — a young swan.

Cyanobacteria — a genus of bacteria composed of the blue-green algae; like the dinoflagellates, cyanobacteria are important sources of environmental toxins that can cause illness and death in humans and wildlife.

Cyanosis — a bluish discoloration of the skin and mucous membranes due to an excessive concentration of deoxygenated hemoglobin in the blood.

Cystocanth — an infective juvenile stage of thorny-headed worms (acanthocephalan parasites).

Cytoplasm — the aqueous part of the cell that is outside of the nucleus but that is contained within the cell wall. The cytoplasm is the site of most of the chemical activities of the cell.

Dabbling ducks — Ducks that feed on the surface or in shallow

low water, including mallard, American black duck, gadwall, American wigeon, northern pintail, northern shoveler, and teal. Also referred to as puddle ducks.

Definitive host — an organism in which sexually mature stages of a parasite occur.

Dehydration — a condition that results from excessive loss of body fluids.

Depopulation — the destruction of an exposed or infected group of animals.

Dermatophytosis — a fungal infection of the skin.

Dessication — the act or process of drying a substance.

Digestive tract (alimentary canal) — the organs associated with the ingestion, digestion, and absorption of food, such as the esophagus, stomach, and intestines.

Dinoflagellates — aquatic protozoa that are an important component of plankton. These single-celled organisms may be present in vast numbers, causing discoloration of the water referred to as “red tide.” Some species secrete powerful neurotoxins.

Dioxins — a chemical component of defoliants, such as agent orange, that are considered to be carcinogenic (cause cancer), teratogenic (cause fetal abnormalities), and mutagenic (cause abnormal mutation rate).

Direct life cycle — a parasitic life cycle that requires only a single host for its completion.

Diurnal — active during the day.

Diving ducks — synonymous with bay diving ducks.

Domestic duck — ducks typically raised for market, such as the white Pekin.

Drive-trapping — capture of flightless birds during the molt and of other animals by herding them into a netted or fenced containment area.

Drop nets — suspended nets used to capture animals by remote release of the nets or triggering mechanisms at the net site.

Dyspnea — labored breathing.

Ecchymotic — a hemorrhagic, irregular-shaped area in tissues that is bruise-like in appearance and, often, in color.

Ecology — the study of the interrelationships between living organisms and their environment.

Ectoparasite — a parasite that lives on the external surface, or in the integument, of its host.

Ectotherms — species that rely on sources of heat outside themselves (i.e., coldblooded species).

Edematous — swelling of tissues due to abnormal accumulation of fluid in the intercellular tissue spaces; seepage of

these fluids may result in accumulations within the body cavity.

EDTA — ethylenediamine tetra-acetic acid; a chelating agent that binds with lead and that is used in the treatment of lead poisoning.

EEE — eastern equine encephalomyelitis; a viral disease.

ELISA — a molecular-based enzyme-linked immunosorbent assay; a type of test used to detect either antigen or antibody.

Emaciation — a wasted condition of the body; excessive leanness.

Emasculatome — a veterinary instrument designed for bloodless castration of cattle or sheep; has been used for euthanasia of birds by cervical dislocation.

Encrustation — forming a crust or a covering; for example, salt encrustation.

Endemic — a disease that commonly is present within a population or a geographical area.

Endogenous phase — developmental phase of the life cycle of a parasite that occurs within the host.

Endoparasite — a parasite that lives within the body of its host.

Endotherms — warmblooded vertebrates; species able to internally regulate their body temperatures.

Enteritis — inflammation of the intestine.

Enzootic — an animal disease that commonly is present within a population or geographical area.

Epicardium — the outer covering of the heart.

Epidemic — the presence of a disease in a population or in an area in a higher than expected prevalence, or rate.

Epithelial cells — cells that cover the external and internal surfaces of the body.

Epizootic — a disease affecting a greater number of animals than normal; typically, occurrences involving many animals in the same region at the same time.

Epizootiology — the study of the natural history of disease in animal populations.

Erosion — wearing away; gradual disintegration.

Erythrocytes — red blood cells; serve to transport oxygen throughout the body.

Esophagus — the passage extending from the mouth to the stomach.

Estrogenic — possessing characteristics of the hormone estrogen; estrogenic compounds may elicit the development of feminine characteristics in male animals.

Etiologic agent — any living or nonliving thing, power, or

substance capable of causing a disease.

Eutrophication — the excessive growth, caused by an over-supply of nutrients, of plants and algae in bodies of water.

Exotic disease — a disease that normally does not occur within a particular area.

Exotoxin — a toxin formed and excreted by bacterial cells.

Exsanguination (bleeding out) — the draining of blood from an animal.

Fastidious — refers to the very specific requirements for the culture of some bacteria.

Fauna — the animals of an area.

“Feather edge” — a long, shallow edge of a body of water that gradually deepens offshore.

Femur — the thigh bone of humans; the upper legbone in hooved mammals and birds. The bone between the pelvis and the knee.

Feral pigeon — rock dove.

Fibrin — an insoluble protein that forms a network of fibers during clotting of the blood.

Fibrinoperitonitis — fibrin-coated inflammation of the surfaces of the peritoneal cavity.

Fibrinous — a pathologic term referring to a threadlike sheet of material that may occur on surfaces of organs in some disease conditions; clotting factors in blood contribute to the structure of this material.

Flatworms — the common name for parasites of the phylum Platyhelminthes, flukes or trematodes.

Flukes — parasitic flatworms; also referred to as trematodes.

Flylarvae — maggots.

Fomite — an object that is not in itself harmful, such as a wooden object or article of clothing, but that may harbor pathogenic microorganisms and serve to transmit an infection to a living organism.

Food chain — ascending trophic levels within an ecosystem in which species at the lower level are the primary food base for the species at the next highest level.

Formalin — a liquid solution of formaldehyde that is used as a tissue fixative, usually to prepare tissues for microscopic examination.

Fossorial — refers to digging animals that live in burrows.

Frounce — synonymous with trichomoniasis in raptors.

Fungicides — chemicals that kill fungi.

Gallinaceous birds — heavy-bodied, chickenlike land birds. Includes ring-necked pheasant, quails, grouse, and wild turkey.

Gamete — one of two cells produced by a gametocyte; the union of male and female gametes initiates the development of a new individual during sexual reproduction

Gametocyte — an undifferentiated cell that develops into a gamete.

Gangrene — tissue death due to a failure of the blood supply to that tissue area followed by bacterial invasion and putrefication.

Gapes — see gapeworm.

Gapeworm — parasites of the trachea of birds; synonym for tracheal worms.

Gastrointestinal tract — the tubular organs that form a digestive pathway from the mouth to the vent, including the stomach and intestines.

Geographic information system — a specialized computer system for storage, manipulation, and presentation of layers of geographical information.

Gizzard — the enlarged muscular ventriculus (stomach) of many birds.

Granuloma — refers to a tumorlike mass or nodule; often associated with a response to an infection.

Haemoproteus — blood parasites transmitted by louse flies of the family Hippoboscidae and midges of the family Ceratopogonidae.

Hatchet-breast — a common term to describe the prominent, protruding breast keel seen as the result of the atrophy of the breast muscles. “The keel appears as sharp and as prominent as the back of a hatchet.”

Hawaiian forest birds — native and introduced avifauna of the forested areas of the Hawaiian Islands. Includes such species as sparrows, finches, cardinals, honeycreepers, and thrushes.

Helminths — parasitic worms.

Hemosporidia — protozoan blood parasites.

Hemoglobin — the oxygen-carrying pigment of red blood cells.

Hemozoin — a dark pigment produced from the hemoglobin in the host's red blood cells by malarial parasites that collect in tissues, such as the spleen and liver, causing those organs to appear grayish to dark brown or black.

Hepatitis — inflammation of the liver.

Hepatomegaly — enlargement of the liver.

Herbicides — chemicals used to kill unwanted vegetation.

Hermaphroditic — organisms that possess both male and female functional reproductive organs.

Herpesvirus — one of the major groups of related viruses that have DNA nucleic acids and that are further characterized by similar size, shape, and physiochemical reactions.

Herpetologists — those who study the natural history and biology of reptiles.

Heterogenous organism — one that is derived from a combination of different types of parent organisms.

Hippoboscid flies — a group of wingless and winged parasitic flies found on birds and mammals.

Histoplasmosis — a disease of humans caused by inhalation of the fungus *Histoplasma capsulatum*.

History — as it refers to wildlife disease investigations, a record of background information and chronological events associated with a die-off.

Homeostasis — the tendency toward equilibrium; refers to the capacity of living organisms to maintain internal body environmental conditions necessary for survival.

Husbandry practice — the care and maintenance of animals.

Hydropericardium — an excessive amount of fluid within the sac surrounding the heart.

Hypersensitivity — greater than normal sensitivity to stimuli or to biological agents.

Hypothermia — greatly reduced body temperature.

Hypovolemic shock — shock resulting from insufficient blood volume to maintain adequate cardiac output and blood pressure; caused by acute hemorrhage or excessive fluid loss.

Ichthyologists — those who study the natural history and biology of fishes.

Immune — being resistant to a disease.

Immunosuppressive therapy — a medical treatment that suppresses the normal immune response.

Impaction — an abnormal accumulation of food or other ingested materials that become lodged in a section of the digestive tract.

Immune system — the combination of host body defenses that guard against infectious disease.

Inapparent — an infection in which the infectious agent exists within the host but that causes no recognizable signs of illness; the infectious agent may or may not be shed at irregular times.

Incidence — the number of new cases of a disease occurring in a population within a certain time period.

Inclusion body — a structure within the cytoplasm or nucleus of a cell; a characteristic of some viral diseases, inclusion bodies occur in only a few species.

Incubation period — the time interval required for the development of disease; the time between the invasion of the body by a disease agent and the appearance of the first clinical signs.

Indigenous — native to a particular area.

Indirect life cycle — a life cycle that requires more than one host for its completion.

Infection — the invasion and multiplication of an infectious agent in host body tissues.

Infectious agent — a living organism capable of invading another.

Infective — capable of producing infection.

Infestation — parasitic invasion of external surfaces of a host.

Insecticides — pesticides used to kill insects.

Intermediate host — an organism in which a parasite undergoes a stage of asexual development.

Intracellular parasite — a parasitic organism, usually microscopic, that lives within the cells of the host animal.

Involuntary muscle — muscle that is not under the control of the individual.

Isolate — refers to microorganisms; the separation of a population of organisms that occur in a particular sample (verb); for example, to isolate a bacterial or viral organism from a sample. As a noun, refers to the organism that was isolated; for example, a bacterial isolate was obtained from a sample.

Isopods — crustaceans with flattened bodies, such as sowbugs, pillbugs, and wood lice.

Joint capsule — the thick, fibrous capsule surrounding a joint, as around the knee.

Keel — the narrow middle portion of a bird's sternum.

Kites — hawk-like birds.

Lacrimal discharge — a discharge from the tear glands near the eye.

Laparotomy — a surgical procedure in which an incision is made into the abdominal cavity, often to determine the sex of birds for which plumage and other characteristics cannot be used for that purpose.

Larva — an immature parasitic life cycle stage; typically, the form of the parasite is unlike the mature stage.

Larynx — the musculocartilaginous structure at the upper part of the trachea; it guards the entrance to the trachea and secondarily serves as the organ of voice.

Latent — dormant or concealed; a latent infection refers to the situation in which a disease condition is not apparent.

Lentogenic — refers to a form of Newcastle disease virus

that is mildly virulent as measured in chickens.

Leucocytozoon — blood parasites transmitted by black flies of the family Simuliidae.

Lesion — an abnormal change in tissue or an organ due to disease or injury.

Lethargy — abnormal drowsiness or stupor.

Lousefly — see Hippoboscidae flies.

Lyme disease — an infectious disease that is caused by the spirochete *Borrelia burgdorferi* and transmitted by ticks.

Lipophilic — having an affinity for fat; such as chemicals that accumulate in fat and fatty tissues.

Livestock — domestic animals raised for food and fiber commonly refers to animals such as hogs, sheep, cattle, and horses.

M-44 — a predator-control device that uses cyanide as the toxic component.

Macrocyt — a large cyst; a large spore case (fungi); an encapsulated reproductive cell of some slime molds.

Macrogamete — the female sexual form of the malaria parasite that is found in the gut of the mosquito vector.

Maggot — a soft-bodied larva of an insect, especially a form that lives in decaying flesh.

Malarias — infectious diseases caused by protozoan parasites that attack the red blood cells.

Malignant — spread from the location of origin to other areas; that is, tumors that are invasive and that spread throughout the body.

Marek's disease — an important infectious disease of poultry, that is caused by infection with a herpesvirus.

Marine birds — birds of the open ocean, typically pelagic, and often colonial nesters, such as alcid, shearwaters, storm petrels, gannets, boobies, and frigatebirds.

Meningoencephalitis — inflammation of the transparent covering (meninges) of the brain.

Mergansers — a group of waterfowl that are commonly referred to as "fish ducks" due to their food habits.

Meront — an asexual stage in the development of some protozoan parasites that gives rise to merozoites.

Merozoite — a stage in the life cycle of some protozoan parasites.

Mesogenic — refers to a form of Newcastle disease virus that is moderately virulent as measured in chickens.

Metabolic rate — an expression of the rate at which oxygen is used by cells of the body.

Metacercaria — the encysted resting or maturing stage of a trematode (flake) parasite in the tissues of an intermediate host.

Microgamete — the male sexual form of the malaria parasite found in the gut of the mosquito vector.

Migratory birds — all birds listed under the provisions of the Migratory Bird Treaty Act.

Minamata disease — mercury poisoning of humans; named after an incident resulting from contamination within Minamata Bay, Japan.

Miracidium — the first larval stage of a trematode parasite, which undergoes further development in the body of a snail.

Mobilization — refers to the tendency of lipophilic chemicals [environmental contaminants, such as chlorinated hydrocarbons, that have an affinity for storage in adipose (fat) tissue] to be released into the bloodstream as fat stores are depleted.

Mollusks — species of the phylum Mollusca; includes snails, slugs, mussels, oysters, clams, octopuses, nautilus, squids, and similar species.

Molt — the normal shedding of hair, horns, feathers, and external skin before replacement by new growth.

Moribund — a visible, debilitated state resulting from disease; appearing to be suffering from disease and close to death.

Motility/motile/nonmotile — these terms refer to whether or not a bacterial organism moves on a particular culture medium; such movement reflects the presence of flagellae. Thus, the absence or presence of motility is a useful characteristic for identifying bacteria.

Motor paralysis — paralysis of the voluntary muscles.

Mucosa — a mucous membrane.

Mucous membrane — the layer of tissue that lines a cavity or the intestinal tract and that secretes a mixture of salts, sloughed cells, white blood cells, and proteins.

Mucosal surface — a layer of cells lining the inside of the intestinal tract or other body part that secretes mucus.

Myocarditis — inflammation of heart muscle.

Myocardium — the middle and thickest layer of the heart wall; composed of cardiac muscle.

Mycosis — fungal infection.

Mycotoxin — a poison produced by various species of molds (fungi).

Myiasis — infestation of the body by fly maggots.

Nares — the external openings on the top of the bill of birds; the external orifices of the nose; the nostrils.

Nasal gland — a specialized gland of birds and some other species that serves to concentrate salt and secrete it from the body.

Nasal cavity — the forward (proximal) portion of the passages of the respiratory system, extending from the nares to the pharynx and separated from the oral cavity by the roof of the mouth.

NDV — Newcastle disease virus.

Necropsy — the methodical examination of the internal organs and tissues of an animal after death to determine the cause of death or to observe and record pathological changes.

Necrosis — the death of cells in an organ or tissue.

Necrotic — dead; exhibiting morphological changes indicative of cell death; in this Manual, necrotic lesions refer to areas of dead tissue.

Nematocides — chemicals used to kill nematode worms.

Nematodes — unsegmented, cylindrical parasitic worms; roundworm.

Neoplasm — see tumor.

Nervous system — specialized components of vertebrates, and, to a lesser extent invertebrates, that control body actions and reactions to stimuli and the surrounding environment.

Neurotoxin — toxins that cause damage to or destroy nerve tissue.

Nictitating membrane — the so-called third eyelid, a fold of tissue connected to the medial (side closest to the midline) side of the eye, which moves across the eye to moisten and protect it.

Nocturnal — species that are active during evening (nondaylight) hours.

Nodule — a small mass of tissue that is firm, discrete, and detectable by touch.

Nontoxic shot — shotshells with shotpellets that are not made of lead or other toxic metals; typically, soft iron is used, and is referred to as steel shot.

No-see-ums — see Ceratopogonid flies.

Occlusion — a blockage or obstruction; the closure of teeth.

Oligochaetes — the earthworms and aquatic forms of the class Oligochaeta.

Oocyst — the encysted or encapsulated zygote in the stage of some protozoan parasites; often highly resistant to environmental conditions.

Opisthotonos — abnormal spasm of the neck and back muscles resulting in a body position in which the head and heels are involuntarily thrown back and the body is arched forward.

Osmoregulation — adjustment of osmotic pressure in relation to the surrounding environment.

Osteoporosis — loss of bone structure.

PAH — an acronym for polycyclic aromatic hydrocarbons.

Panzootic — a disease involving animals within a wide geographic area such as a region, continent, or globally.

Parasitism — an association between two species in which one (the parasite) benefits from the other (the host), often by obtaining nutrients.

Paratenic host — a host that has been invaded by a parasite, but within which no morphological or reproductive development of the parasite takes place; a “transport” host.

Paresis — partial paralysis.

Passerines — small- to medium-sized perching birds.

Pathogenic — the ability to cause disease.

Pathological — an adjective used to describe structural or functional changes that have occurred as the result of a disease.

PCB — acronym for polychlorinated biphenyls, a group of chlorinated aromatic hydrocarbons used in a variety of commercial applications. These compounds have long environmental persistence and have been a source for various toxic effects in a wide variety of fauna.

Pelagic — refers to living in or near large bodies of water, such as oceans or seas; typically, this term refers to avian species that only come to land areas during the breeding season.

Pericardium — the fibrous sac surrounding the heart.

Pericarditis — inflammation and thickening of the sac surrounding the heart.

Peritoneal cavity — the abdominal cavity, which contains the visceral organs.

Phage — a virus that has been isolated from a prokaryote (an organism without a defined nucleus, having a single double-standard DNA molecule, a true cell wall, and other characteristics). Most phages are bacterial viruses.

Pharynx — the musculomembranous passage between the mouth and the larynx and esophagus.

Pigeon milk — the regurgitated liquid that an adult pigeon feeds its young.

Pinnipeds — aquatic mammals that include the sea lions, fur seals, walruses, and earless seals.

Plaque — a patch or a flat area, often on the surface of an organ.

Plasmodium — blood parasites transmitted by mosquitos of the family Culicidae.

Plumage — the feather covering of birds.

Postmortem — examination and dissection of animal carcasses performed after the death of the animal. Also, changes that occur in tissues after death.

Poultry — domestic avian species, such as chickens and domestic ducks, geese, and turkeys.

Prefledglings — birds of the current hatch year that have not become feathered enough to fly.

Prevalence — the number of cases of a disease occurring at a particular time in a designated or defined area; rate.

Proboscis — a tubular process or structure of the head or snout of an animal, usually used in feeding; in this Manual, the tubular process of Acanthocephalan parasites is used for attachment to the host and feeding from it.

Protoporphyrin — a component of hemoglobin; useful in the diagnosis of exposure to lead.

Protozoan — a one-celled animal with a recognizable nucleus, cytoplasm, and cytoplasmic structures.

Psittacines — parrots, parakeets, and other species within the family Psittacidae.

Puddle ducks — see dabbling ducks.

Proventriculus — the first, or “glandular,” stomach of a bird.

Puddle ducks — synonymous with dabbling or surface-feeding ducks.

Punkies— small, biting midges of the genus *Culicoides*; vectors for *Haemoproteus* infections. See ceratopognid flies.

Purulent — containing pus, as in a purulent discharge.

Range — the geographic distribution of a population or the area within which an individual animal moves (as in home range).

Raptors — synonymous with birds of prey. Birds, including hawks, owls, falcons, and eagles, that feed on flesh.

Reactivation — refers to the process by which cholinesterase enzyme activity returns to normal after carbamate exposure.

Rendering — a process by which animal carcasses are converted into fats and fertilizer.

Reptiles — coldblooded vertebrates that belong to the class Reptiles; such as., snakes, turtles, lizards.

Reservoir host — the host that maintains the disease agent in nature and that provides a source of infection to susceptible hosts.

Respiratory system — the collection of organs that provide oxygen to the organism and result in the release of carbon dioxide; typically, the trachia and lungs.

Ricebreastdisease — synonym for sarcocystis.

Rocket nets — remotely triggered, weighted firing devices that are propelled through the air by an explosive force carrying the netting to which they are attached over the birds or other animals being captured.

Rodenticides — toxic substances used to kill rodents.

Rodents — mammals that have chisel-like, ever growing incisor teeth that are used for gnawing; i.e., mice to beavers.

Rookery — a nesting area for some colonial birds, such as herons and egrets.

Roost sites — typically, locations where birds congregate at night in trees and other locations.

Rough fish — a term given to bottom-feeding freshwater fish with large scales, such as carp, buffalo, and similar species.

Roundworms — see nematodes.

Ruminants — hooved mammals possessing a rumen or first stomach, from which food or a cud is regurgitated for further chewing. Includes deer, elk, sheep, cattle, etc.

Salivary glands — the glands of the mouth that produce saliva.

Saltgland — see nasal gland.

Sandflies — see punkies.

Scavengers — animals that feed on dead, sick or injured prey. Includes crows, vultures, gulls, eagles, hawks, etc.

Schizogony — a type of asexual reproduction in some protozoan parasites in which daughter cells are produced by multiple nuclear divisions of the parasite (schizont).

Schizonts — the multinucleate, intermediate parasite stage that develops into merozoites within a host cell.

Scoliosis — an abnormal lateral curvature of the spine.

Sea ducks — ducks that frequent open ocean, although some species may be found on coastal bays or inland waters. Includes oldsquaw, eiders, scoters, and harlequin duck.

Secondary poisoning — intoxication of an animal as a result of eating a poisoned animal; for example, the poisoning of an eagle after it has fed on a duck that was poisoned by a chemical in treated grain. This differs from biomagnification, which involves increasing concentrations of toxic compounds within the body of organisms at increasing higher levels of a food chain.

Section 7 consultations — the Endangered Species Act requires discussion and evaluation of any proposed Federal activity, program, or permit that might affect an endangered species.

Sedated — chemically quieted.

Septicemia — the presence of pathogenic microorganisms or toxins in the blood.

Serosa — refers to the outside layer of an organ, such as the serosal surface of the intestine, or the lining of a body cavity.

Serosal surface — the external surface of an organ or a tissue within the body.

Serotype — a taxonomic subdivision of a microorganism, based on characteristic antigens or proteins.

Serovar — a taxonomic subdivision of a microorganism similar to serotype (above) but usually more specific.

Shorebirds — birds that feed at the edge of shallow water, along mudflats, and in shallow wetlands. Typically, these birds feed on invertebrates and include such species as American avocet, black-necked stilt, curlews, plovers, phalaropes, sandpipers, yellowlegs, and sanderling.

Signs — observable evidence of disease in animals (similar to symptoms in humans).

Sloughing — shedding of dead cells or dead tissue from living structures or tissues.

Slugs — terrestrial, snail-like mollusks that have a long, fleshy body and only a rudimentary shell.

Small mammals — mice to rabbits, racoons etc.; a general term used in wildlife management to group species of small to moderate size.

Small rodents — see rodents; rodents of small size, such as rats and mice.

Songbirds — small perching and singing birds, typically of the order Passeriformes, including sparrows, finches, and cardinals.

Sowbugs — see isopods.

Splenomegaly — enlargement of the spleen.

Spore — refers to a resistant stage, usually of bacteria or fungi, by which some microorganisms survive unfavorable environmental conditions and then develop into active life forms during favorable environmental conditions.

Sporogony — sporulation that involves multiple fission of a sporont (schizogony), resulting in the production of a sporocysts and sporozoites.

Sporont — a zygote of coccidian protozoa.

Sporozoite — the elongate nucleated infective stage of coccidian protozoan parasites.

Sporulation — the formation or liberation of spores.

Squab — a nestling pigeon that has not fledged.

Sternum — the breastbone.

Subcutaneous — under the skin.

Systemic — affecting the entire body.

Tapeworms — segmented parasitic flatworms; also referred to as cestodes.

Teal — small, swift-flying waterfowl of the genus *Anas*.

Tegument — the covering of an organ or the body.

Tenosynovitis — inflammation of the tendon sheath.

Teratogenic — causing embryonic deformities due to abnormal differentiation and development of cells.

Thermoregulation — regulation of the internal temperature of the body by various physiological processes.

Thorax — the part of the body between the neck and the respiratory diaphragm (in mammals), encased by the ribs.

Thorny-headed worms — acanthocephalan parasites.

Thymus gland — a lymph-gland-like organ involved in cellular immunity, located in the neck or upper thoracic cavity.

Torticollis — twisting or rotation of the neck causing an unnatural position of the head.

Toxic — poisonous.

Toxicosis — the condition of being poisoned.

Trematodes — flat, unsegmented parasitic worms; flatworms, flukes.

Trichomonids — protozoan parasites of the genus *Trichomonas*.

Trophic level — refers to an animal's position in the food chain. Species at higher trophic levels are, to a greater or lesser extent, dependent upon species in preceding trophic levels as sources of energy.

Tumor (neoplasm) — growths within organs and tissues of the body that result from the abnormal progressive multiplication of cells in a manner uncontrolled by the body.

Ubiquitous — found everywhere.

Ulceration — crater-like lesions in the skin and other tissues.

Ungulates — hoofed mammals.

Unthrifty appearance — an expression used in animal husbandry to describe an animal that is unkempt and dirty. Usually hair or feathers are soiled by excrement.

Upland gamebirds — game birds found in terrestrial habitats. Includes species such as ring-necked pheasant, quails, grouse, wild turkey, etc.

Upper digestive tract — the portion of the gastrointestinal tract that extends from the anterior opening of the esophagus in the region of the mouth to the stomach, but not including the intestines.

Ureter — the tubular structure that transports urates from the kidneys to the cloaca of birds.

Vascular system — blood circulation system.

Vector — an insect or other living organism that carries and transmits a disease agent from one animal to another.

Vegetative form — in bacteria, an active, growing, multiplying stage of development as opposed to a “spore,” or a resistant resting stage.

Velogenic — refers to highly virulent strains of Newcastle disease virus that are capable of producing severe disease in the host.

Ventriculus — the stomach of a bird.

Verminous peritonitis — inflammation of the peritoneal cavity caused by parasites, usually nematodes.

Vertebrates — animals with backbones.

Viremia — the presence of virus in the blood.

Virulence — the disease-producing ability of a microorganism, generally indicated by the severity of the infection in the host and the ability of the agent to invade or cause damage or both to the host's tissues.

Virulent — the degree to which an infectious agent produces adverse effects on the host; a highly virulent organism may produce severe disease, including death.

Virus shedding — discharge of virus from body openings by way of exudate, excrement, or other body wastes or discharges.

Viscera — the internal organs, particularly of the thoracic and abdominal cavities.

Viscerotropic — possessing an affinity for visceral organs; a disease that acts primarily on the soft internal tissues of the body such as the heart, lungs, liver, and digestive tract.

Voluntary muscle — muscle normally under control of the individual.

Voucher specimen — specimens deposited in scientific collections that are representative of a species or a subgrouping of a species.

Wading birds — long-necked, long-legged birds that feed by wading in wetlands and catching prey with their bills. Includes egrets, herons, ibises, roseate spoonbills, flamingos, and bitterns.

Waterbirds — birds that require aquatic habitat.

Waterfowl — species of the Family Anatidae; ducks, geese, and swans. Does not include American coot.

Whistling ducks — the fulvous whistling duck or the tropical black-bellied tree duck.

Yeasts — single-celled, usually rounded fungi that produce by budding.

Zooplankton — minute animal organisms that in combination with counterparts from the plant kingdom constitute the plankton (minute free-floating organisms) of natural waters.

Zygote — a cell resulting from the union of a male and a female gamete, until it divides; the fertilized ovum.