Chapter 29

Eustrongylidosis

Synonyms

Verminous peritonitis

Cause

Eustrongylidosis is caused by the nematodes or roundworms *Eustrongylides tubifex, E. ignotus,* and *E. excisus. Eustrongylides* sp. can cause large die-offs of nestlings in coastal rookeries, especially of egrets and other wading birds.

Life Cycle

The three species of *Eustrongylides* that cause disease in birds have similar indirect life cycles that require two intermediate hosts (Fig. 29.1). Four developmental stages of the parasite are required from egg to sexually mature worm. The first larval stage develops within the eggs that are shed in the feces of the bird host and are eaten by freshwater oligochaetes or aquatic worms. The oligochaetes serve as the first intermediate host. The eggs hatch within the oligochaetes, where they develop into second- and third-stage larvae. Minnows and other small fish, such as species of *Fundulus* and *Gambusia,* feed upon the infected oligochaetes and serve as the second intermediate host. The third-stage larvae become encapsulated on the internal surface areas of the fish, develop into infective fourth-stage larvae, and await ingestion by birds. Predatory fish, which consume infected fish, can serve as paratenic or transport hosts when they are fed upon by birds. Amphibians and reptiles have also been reported as second-stage intermediate hosts and serve as paratenic hosts. Larvae that are infective for birds can penetrate the ventriculus (stomach) within 3–5 hours after a bird ingests an intermediate or paratenic host, and the larvae quickly become sexually mature worms that begin shedding eggs 10–17 days postinfection.

Species Affected

E. tubifex has been reported from four different bird families, *E. ignotus* from three, and *E. excisus* from three (Fig. 29.2). Young wading birds are the most common species to have large mortalities from eustrongylidosis (Table 29.1). *Eustrongylides* sp. have also been reported in birds of prey.

Distribution

Eustrongylides sp. have been reported from birds throughout much of the world. *E. tubifex* and *E. ignotus* are the species reported within the United States (Table 29.2). Eustrongylid infections within the United States have been reported from many areas (Fig. 29.3). Typical rookeries where birds are infected with *Eustrongylides* sp. are found in coastal areas and consist of dense populations of birds nesting on low islands, often surrounded by canals or ditches. Nesting habitat often includes stands of low trees, such as willows, with an understory that may be submergent, semisubmergent, or upland mixed-prairie species. Inland rookeries are usually adjacent to lakes or rivers, and nesting trees, particularly those used by great blue herons, may be much higher than those in coastal rookeries. Several wading bird species may nest in these areas, but typically one or two species account for most of the birds in the rookery (Fig. 29.4).

Seasonality

Birds can harbor infections yearround. Mortality usually is reported in spring and summer and birds less than 4 weeks old are more likely to die than adults. Disease in older birds tends to be of a more chronic nature and infection may be seen at any time of the year.

Field Signs

Disease results in a variety of clinical or apparent signs that are not specific to eustrongylidosis. However, consideration of the species affected, the age class of birds involved, and the full spectrum of signs may suggest that eustrongylidiosis is the cause of mortality. Very early in the infection as the worm is penetrating the ventriculus, some birds will shake their heads, have difficulty swallowing, have dyspnea or difficult or labored breathing and, occasionally, regurgitate their food. Anorexia or loss of appetite has been noted in experimentally infected nestlings. It has been speculated that anorexia in combination with sibling competition for food may contribute to the emaciation seen in naturally infected birds. Infected nestlings also may wander from the nest predisposed to predation or trauma or both. Affected nestlings observed during one mortality event became progressively weakened and showed abdominal swelling. Palpation of worms on the ventriculus has been useful for detecting infection in live nestlings.

Gross Lesions

Birds that have been recently infected often have large, tortuous, raised tunnels that are visible on the serosal surface of the proventriculus, ventriculus, or intestines (Fig. 29.5A). The nematodes reside within these tunnels, which are often encased with yellow, fibrous material, and maintain openings to the lumen of the organ so that parasite eggs may be passed out with feces into the environment. A fibrinoperitonitis or fibrin-coated inflammation of the surfaces of the peritoneal cavity (the area containing the organs below

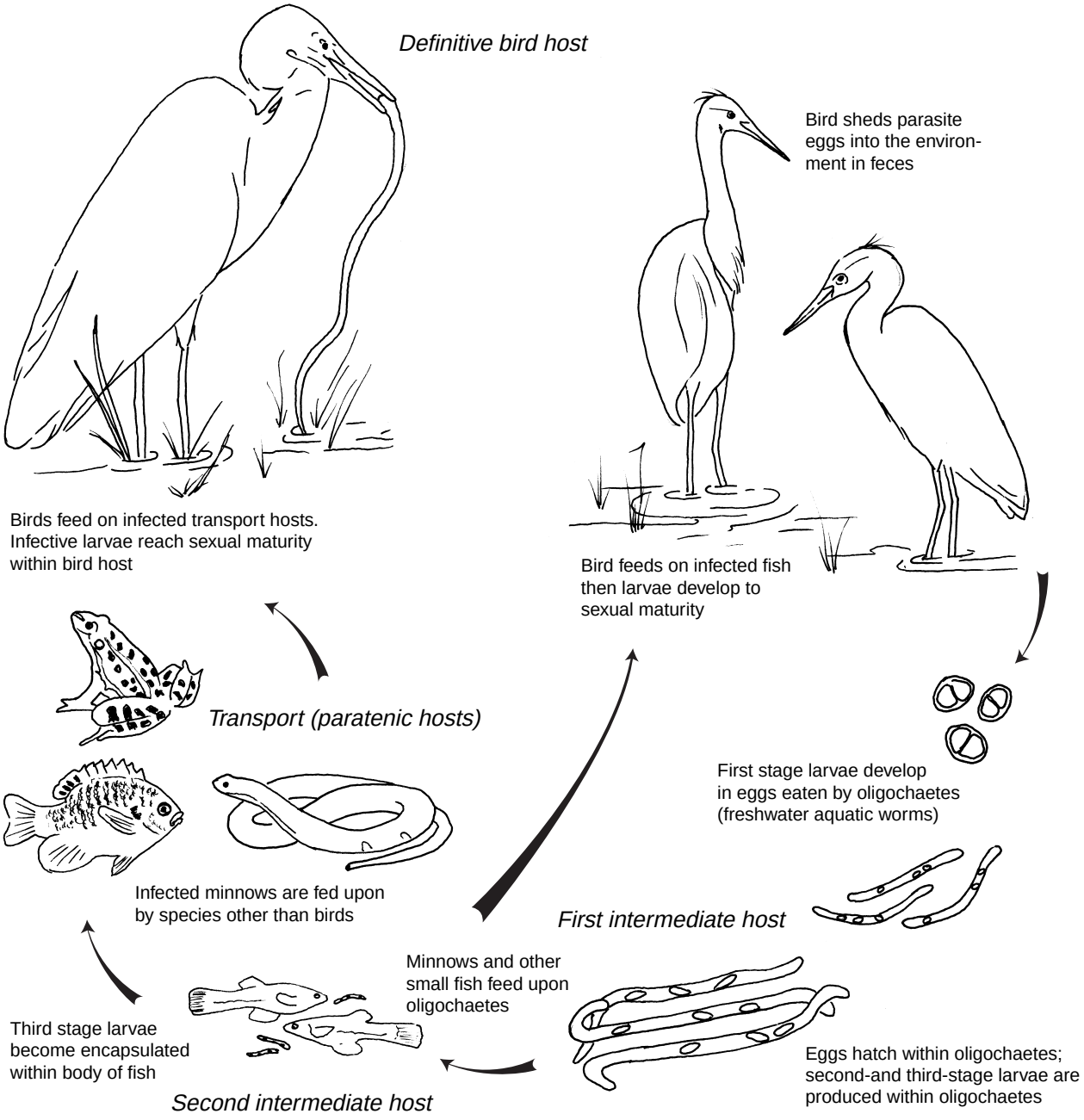

Figure 29.1 *Life cycle of* ***Eustrongylides*** *sp.*

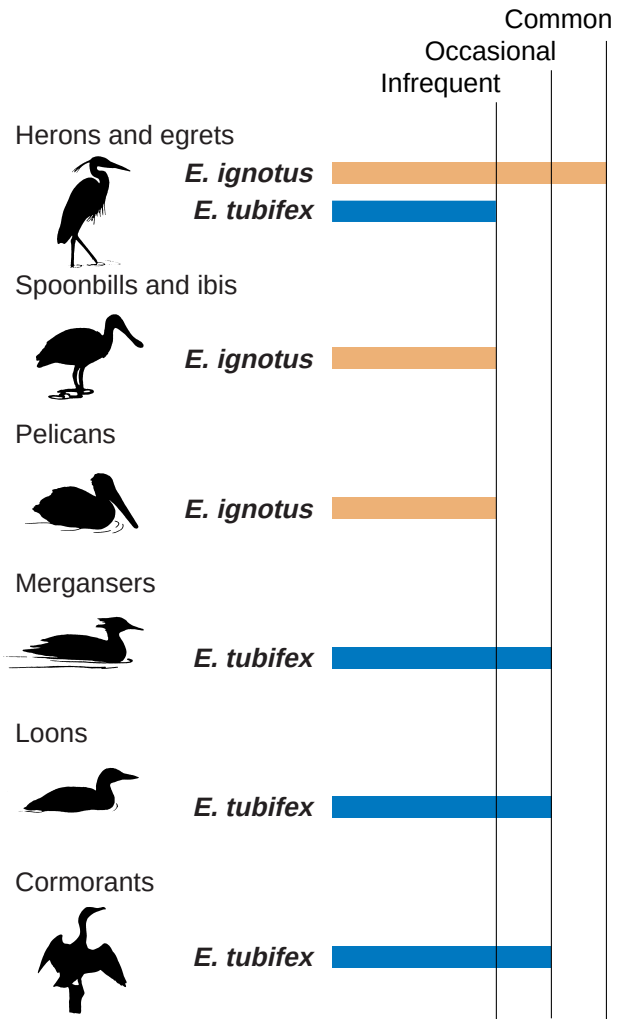

Figure 29.2 *Groups of water birds reported to be infected with* ***Eustrongylides*** *sp.*

the heart and lungs) and the intestinal surfaces may be present when larvae or adult worms have perforated the surface of the intestines (Fig. 29.5B). Movement of bacteria from the lumen of the digestive tract to the body cavity results in bacterial peritonitis and secondary infections that can cause the death of an infected bird. Thick-walled granulomas, which are firm nodules consisting of fibrous tissue that forms in response to inflammation with necrotic (dead) centers, caseous (cheesy) airsaculitis or inflammation of the air sacs and intestinal blockages have also been reported. The presence of the parasite is also striking when carcasses are examined. Adult worms can be quite large (up to 151 millimeters in length and 4.3 millimeters in width) and are reddish.

Lesions in chronic or resolving infections are less remarkable and appear as raised, yellow or tan-colored tunnels filled with decomposed worms or worms encased with yellow fibrous material. Some lesions will not have recognizable worm structures intact. Lesions seen in bald eagles that were examined at the National Wildlife Health Center were in the esophagus and were much less severe than those in other fish-eating birds.

Diagnosis

Large tortuous tunnels on the surface of the proventriculus, ventriculus, or intestine of fish-eating birds are most likely due to *Eustrongylides* sp. However, the presence of eustrongylid worms is not diagnostic of the cause of death, especially in older nestlings and adult birds. Therefore, entire carcasses should be provided for disease diagnosis. If interest is limited to confirming the presence of *Eustrongylides* sp., then infected organs and the gastrointestinal tract should be removed and shipped chilled on cool packs to an appropriate laboratory. If shipment is not possible within 24–48 hours, the organs can be frozen or preserved in 10 percent neutral formalin and shipped. Speciation of worms requires a diagnostician who has appropriate training.

Control

Control of eustrongylidosis depends on the difficult task of disrupting the parasite life cycle, which is further complicated by the length of time that the eggs can remain viable and that intermediate hosts can remain infective. Under experimental conditions, *Eustrongylides* sp. eggs have remained viable up to 2.5 years and freshwater fish and oligochaetes have been reported to remain infected for more than 1 year. Also, the rather quick maturation of the parasite (once it is inside the bird definitive host), along with the long time period that intermediate and paratenic hosts can remain infected, are a perfect parasite strategy for infecting transient or migratory birds. Thus, the birds in a rookery can quickly infect intermediate/paratenic hosts, which can maintain the parasite until next season's nesting.

It is known that eutrophication and warm water temperatures (20–30 °C) create optimal conditions for the parasite. It has been reported that infection among fish is highest where external sources of nutrients or thermal pollution alter natural environments. Therefore, water quality is an important factor that in some situations is subject to actions that may decrease transmission of the parasite. Water-quality improvement as a means of disease prevention should be taken into consideration relative to land-use practices and wastewater discharges that may negatively impact egret and heron rookeries and feeding areas for wading birds.

Food sources used for birds being reared in captivity or being rehabilitated for return to the wild should be free of infection with *Eustrongylides* sp. The types of fish and the sources of those fish should be considered before they are used to feed birds.

Table 29.1 *Examples of reported wild bird mortality attributed to eustrongylidiosis.*

Geographic location	Primary species affected	Time of Year	Parasite species	Comments
Virginia Beach, Va.	Red-breasted merganser	Dec.	***E.*** sp.	50 dead, 95 moribund; mature birds were affected.
Madison County, Ind.	Great blue heron	May	***E. ignotus***	25 dead and moribund; most birds had fledged the previous year.
Pea Patch Island, Del.	Snowy egret	May-July	***E. ignotus***	Approximately 300 hatchlings in one outbreak; most deaths occurred within the first 4 weeks after hatching; other outbreaks have been reported for this location.
Avery Island, La.	Common egret	May	***E.*** sp.	Minimum loss of 400 hatchlings at just prefledging age.
Goat Island, Texas	Snowy egret Great egret	Not reported	***E.*** sp.	Nestlings and young of undetermined numbers; high infection prevalence in colony.
Several colonies in central and southern Florida.	Snowy egret Great egret	Not reported	***E. ignotus***	More than 250 nestlings during one event; this geographic area has recurring losses from this parasite.

Table 29.2 *Reported geographic occurrence in wild birds of* ***Eustrongylides*** *sp.*

	Eustrongylides sp.		
Geographic area	***E. tubifex***	***E. ignotus***	***E. excisus***
United States	●	●	—
Canada	●	—	—
Brazil	●	●	—
Europe	●	—	●
Russia	●	—	●
Middle East	—	—	●
Taiwan	—	—	●
India	—	—	●
Australia	—	—	●
New Zealand	—	●	—

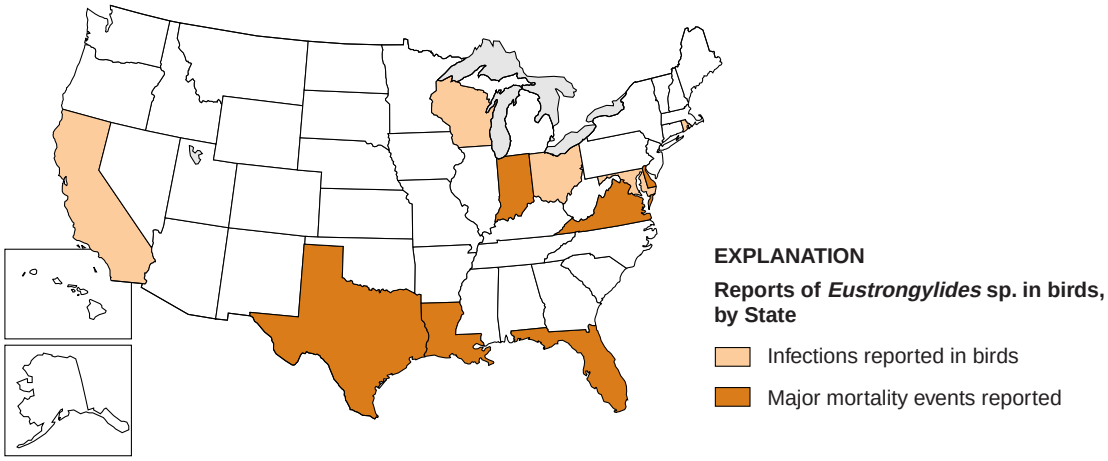

Figure 29.3 *States where* ***Eustrongylides*** *sp. infections in wild birds have been reported.*

Photo by J.Christian Franson

Figure 29.4 *Although many species may nest in wading bird rookeries, one or two species are often predominant.*

Photo by J. Christian Franson

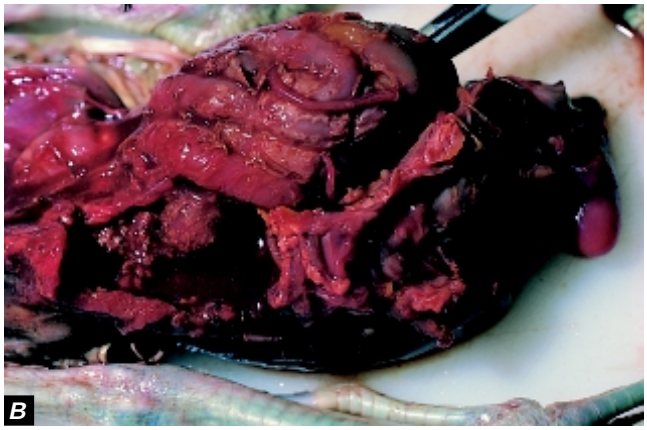

Photo by James Runningen

Figure 29.5 ***(A)*** *Raised tunnels caused by* ***Eustrongylides*** *sp. on intestines of a snowy egret.* ***(B)*** *The debris on the intestinal surfaces of this snowy egret is characteristic of the peritonitis often caused by* ***Eustrongylides*** *sp. infection.*

Human Health Considerations

Humans who have consumed raw or undercooked fish that carry the larval stages of the parasite have experienced gastritis or inflammation of the stomach and intestinal perforation requiring surgical removal of worms.

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Supplementary Reading

Franson, J.C. and Custer, T.W., 1994, Prevalence of eustrongylidosis in wading birds from colonies in California, Texas, and Rhode Island, United States of America: Colonial Waterbirds, v. 17, p. 168–172.

Measures, L.N., 1988, Epizootiology, pathology and description of *Eustrongylides tubifex* (Nematoda: Dioctophymatoidea) in fish: Canadian Journal of Zoology, v. 66: p . 2212–2222.

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Wiese, J.H., Davidson, W.R., and Nettles, V.F., 1977, Large scale mortality of nestling ardeids caused by nematode infection: Journal of Wildlife Diseases, v. 13, no. 4, p. 376–382.