Oncicola
(acanthocephalan)

Overview

Acanthocephalans have pseudocoelomate unsegmented tubular bodies and are commonly called thorny-headed worms due to the possession of a retractable anterior proboscis armed with rows of hooks for attachment. They undergo protostomial embryonic development but do not moult during growth. They are classified within the Lophotrochozoa but do not have jawed mouthparts or digestive tracts, instead they absorb nutrients through their eutelic syncytial cuticles. All species are parasites in the intestinal tracts of vertebrates and they have indirect life-cycles, involving aquatic or terrestrial arthropods as intermediate hosts. Female worms produce mature eggs that float freely in the body cavity and are passed through a unique uterine bell into the uterus to be voided with host faeces. The eggs have thick shells comprised of 4-5 membranes and contain a larval stage (acanthor) armed with hooks and spines which is infective to an invertebrate intermediate host. When ingested by arthropods, the acanthor migrates to the haemocoel and develops into an acanthella which matures into an infective cystacanth. When the arthropod is ingested by the vertebrate host, the cystacanth attaches and matures in the intestinal tract. The species *Oncicola pomatostomi* apparently uses small birds as paratenic hosts for cystacanths, and infections are predominantly found in cats.

Classification:

Domain:	Eukaryota (membrane-bound nucleus)
Supergroup:	Amorphea (unikonts with single flagellum, or nonflagellated amoebae)
Kingdom:	Metazoa (multicellular eukaryotes, heterotrophs, notably animals)
Group:	Protostomia (triploblastic, spiral cleavage)
Subgroup:	Lophotrochozoa (lophophore feeding structure or trochophore larva or neither)
Clade:	Syndermata (eutelic syncytial epidermis)
Phylum:	Acanthocephala (thorny-headed worms, pseudocoelomate, retractable proboscis with hooks, indirect cycles, eggs with acanthor, acanthella develops in arthropod IH (or PH))
Class:	Archiacanthocephala (oval thick-shelled eggs, body wall lacunar canals dorsal & ventral (or just dorsal))
Order:	Oligacanthorhynchida (proboscis subspherical, short rows of several hooks, protonephridial organs present)
Family:	Oligacanthorhynchidae (single family)
Genus:	*Oncicola* (parasitic in small intestines of cats/foxes/dingoes)
Species:	various species cause enteritis in companion animals

Parasite biodiversity and host range: Most Metazoa are multicellular triploblastic animals with differentiated tissues, many being bilaterally symmetrical with a body cavity. Most invertebrate animals are protostomes as their embryonic development involves spiral determinate cleavage. Those that do not moult during their life-cycles are grouped together in the enigmatic clade Lophotrochozoa, including the platyhelminths, rotifers, lophophorates, annelids and molluscs. In addition to the parasitic flatworms (platyhelminths), other metazoan worm-like groups live as endoparasites in vertebrate hosts. Acanthocephalans have pseudocoelomate unsegmented round-flattened bodies and are commonly called thorny-headed or spiny-headed worms due to the possession of an anterior spherical-cylindrical invaginable proboscis bearing rows of recurved hooks used for attachment. They undergo protostomial embryonic development but do not moult during growth, thus belonging to the Lophotrochozoa (embryos with spiral mosaic cleavage) rather than the Ecdysozoa. On the basis of molecular evidence, they are classified within the clade Gnathifera even though they do not have complex cuticular jaws. They lack digestive tracts and absorb nutrients across their eutelic (constant number of nuclei) syncytial (multinucleate) epidermis, and have been grouped together with the Rotifera into the clade Syndermata.

Over 1,400 species of acanthocephalans have been described worldwide as endoparasites with adult stages living in the intestinal tracts of a wide range of fish, amphibians, reptiles, birds and mammals. They have indirect life-cycles with arthropods always acting as intermediate hosts for larval stages. Female worms pass thick-shelled eggs containing an acanthor armed with hooks and spines. When ingested by aquatic crustaceans or terrestrial insects, the acanthor migrates to the haemocoel and forms an acanthella which matures into an infective cystacanth. When the arthropod is ingested by the vertebrate host, the cystacanth attaches and matures into an adult in the intestinal tract. Within the phylum Acanthocephala, four classes are recognized: Archiacanthocephala with terrestrial cycles involving mammals/birds and insects; Palaeacanthocephala with aquatic cycles in fish/birds/seals and crustaceans; Eoacanthocephala with aquatic cycles in fish/amphibia/reptiles and crustaceans; and Polyacanthocephala with aquatic cycles in fish/crocodiles and crustaceans.

Order	Environment	Definitive hosts	Intermediate hosts	Characters
Class: Archiacanthocephala (proboscis hooks in concentric circular rows, trunk lacking spines)				
Oligacanthorhynchida	terrestrial	birds, mammals	insects	subspherical proboscis
Gigantorhynchida	terrestrial	birds, mammals	insects, millipedes, crustaceans	conical proboscis, truncated, bipartite
Moniliformida	terrestrial	birds, mammals	insects	cylindrical proboscis
Apororhynchida	terrestrial	birds	unknown	globular proboscis
Class: Palaeacanthocephala (proboscis hooks in alternating longitudinal rows, trunk with or without spines)				
Echinorhynchida	aquatic	fish, amphibians, reptiles	crustaceans	variable proboscis (globular, cylindrical, claviform)
Polymorphida	aquatic, terrestrial	birds, mammals, amphibians, reptiles	crustaceans	variable proboscis (bulbous, spherical, oval, cylindrical)
Heteramorphida	aquatic, terrestrial	shore birds	unknown	spindle-shaped proboscis
Class: Eoacanthocephala (proboscis hooks in radial rows, trunk with or without spines)				
Gyracanthocephala	aquatic	fish	crustaceans	small spheroid proboscis
Neoechinorhynchida	aquatic	fish, amphibians, reptiles	crustaceans	variable proboscis (globular-cylindrical)
Class: Polyacanthocephala (proboscis hooks in longitudinal rows, trunk with spines)				
Polactorhynchida	aquatic	fish, crocodiles	crustaceans	long claviform proboscis

The class Archiacanthocephala contains 4 orders of terrestrial acanthocephalans whose body walls contain dorsal (and sometimes ventral) lacunar canals, usually 8 uninucleate cement glands, few elongated or branched subcuticular (tegumental) nuclei, and with ligament sacs inside the pseudocoel. Worms in the order Oligacanthorhynchida possess a subspherical proboscis with short rows of several hooks and they have protonephridial organs. The order contains a single family Oligacanthorhynchidae with 13 genera (*Oncicola, Cucullanorhynchus, Echinopardalis, Heptamegacanthus, Macracanthorhynchus, Multisentis, Neoncicola, Nephridiacanthus, Oligacanthorhynchus, Pachysentis, Paraprosthenorchis, Prosthenorchis, Tchadorhynchus*). The genus *Oncicola* contain over 20 species parasitizing domestic and wild animals which become infected by consuming larval stages in intermediate hosts (insects, particularly beetles) or sometimes small vertebrate paratenic hosts (birds, amphibians, lizards).

***Oncicola* species**	**Definitive hosts [adults in intestines]**	**Intermediate hosts, IH; (larval acanthellae then cystacanths in tissues) [plus paratenic hosts, PH]**	**Distribution**
O. angolense	Carnivora: canid (jackal)		Africa
O. atrata	Carnivora: herpestid (Egyptian mongoose), felid (cat), canid (fox)		Middle East
O. bursata	Carnivora: felid (Asian golden cat)		Indonesia
O. campanulata (syn. *Echinorhynchus, E. ovatus)*)	Carnivora: felid (ocelot, Geoffroy's cat, jaguar, puma, tiger cat), mustelid (honey badger)		Americas, Asia
O. canis (syn. *Echinorhynchus*) (canine thorny-headed worm)	Carnivora: canid (dog, coyote, red fox, side-striped jackal), felid (cat, bobcat, ocelot)	Coleoptera: scarabaeid (dung beetles); [plus PHs Cingulata: dasypodid (nine-banded armadillo), Galliformes: phasianid (turkey)]	Americas
O. chibigouzouensis	Carnivora: felid (ocelot)		Brazil
O. decrescens	Carnivora: felid (margay)		Americas
O. dimorpha	Carnivora: felid (leopard)		Asia
O. fraterna	Carnivora: felid (leopard)		Asia
O. gigas	Carnivora: felid (black panther, leopard)		Asia
O. macrurae	Carnivora: felid (margay, bobcat), mephitid (eastern spotted skunk)		North America
O. malayana	Carnivora: felid (panther)		Indochina
O. martini	Carnivora: felid (Geoffroy's cat)		Paraguay
O. magalhaesi	Carnivora: felid (puma)		Brazil
O. michaelseni	Carnivora: felid (leopard)		Asia
O. micracantha	Carnivora: mephitid (Molina's hog-nosed skunk)		Brazil

O. paracampanulata	Carnivora: felid (jaguarundi)		Brazil
O. pardalis	Carnivora: felid (cat, ocelot, cougar, Geoffroy's cat, jaguar, tiger cat), mustelid (honey badger)		Americas, Asia
O. pomatostomi (syn. *Echinorhynchus*, *Oligacanthorhynchus*)	Carnivora: felid (cat), canid (fox, dingo)	arthropod IH: [plus PHs: Passeriformes: acanthizid (southern whiteface, chestnut-rumped heathwren, redthroat, spotted scrubwren), climacterid (white-throated treecreeper, brown treecreeper), cinclosomatid (cinnamon quail-thrush, chestnut quail-thrush), pachycephalid (Gilbert's whistler), pomatostomid (chestnut-crowned babbler, white-browed babbler, grey-crowned babbler, red-breasted babbler); Galliformes: phasianid (king quail); Gruiformes: rallid (buff-banded rail); Charadriiformes: pedionomid (plains-wanderer)]	Australia, Philippines, Borneo, Malaya
O. schacheri	Carnivora: canid (fox), mustelid (badger)		Europe
O. skrjabini	Carnivora: canid (wolf)		Asia
O. travassosi	Carnivora: felid (cat)		Middle East
O. venezuelensis	Carnivora: felid (ocelot)		Venezuela
Reassigned species			
O. confusa (now *Prosthenorchis*)	Primates: cebid (capuchin monkey)		Brazil
O. freitasi (now *Prosthenorchis*)	Primates: cebid (capuchin monkey)		Brazil
O. juxtatesticularis (now *Prosthenorchis*)	Primates: callitrichid (white-headed marmoset)		Brazil
O. luehei (now *Prosthenorchis*)	Carnivora: procyonid (ring-tailed coati); Didelphimorphia: didelphid (American opossum)		South and Central America
O. machadoi (now *Prosthenorchis*)	Primates: cebid (tufted capuchin)		Brazil
O. oncicola (now *Prosthenorchis*)	Carnivora: felid (jaguar, jaguarundi, margay, Geoffroy's cat)	arthropod IH: [plus PHs: Galliformes: phasianid (chicken), odontophorid (bobwhite quail); Columbiformes: columbid (white-tipped dove); Cingulata: chlamyphorid (armadillo)]	Americas
O. sigmoides (now *Prosthenorchis*)	Carnivora: mustelid (grison); Primates: callitrichid (common marmoset, lion tamarin, black tamarin), cebid (squirrel monkey)		South America
O. spirula (now *Prosthenorchis*)	Primates: cebid (tufted capuchin, squirrel monkey), callitrichid (golden lion tamarin)	Blattodea: blaberid (South American cockroach, Madeira cockroach), ectobiid (German cockroach), blattid (Oriental cockroach)	South America

Parasite morphology: Acanthocephalan worms form three different developmental stages: eggs; larvae (acanthor, acanthella, cystacanth) and adults. The eggs are oval in shape, measuring 60-75 x 40-50 μm, brown in colour, thick-shelled and embryonated. Eggs hatch in intermediate hosts to release the first larval stage (acanthor) which is membrane-bound and spindle-shaped with an anterior spined invagination (aclid organ). Acanthors moult to form second stage larvae (acanthellae) which are the main growing developmental stages that ultimately form encysted infective stages (cystacanths). These stages come to resemble miniature adult worms which contain all tissues and structures except mature reproductive organs. Adult worms are white-grey in colour, elongate measuring from 1-5 cm long, the body tapering posteriorly and possessing a subspherical anterior proboscis armed with 12 longitudinal rows of 3 hooks. In larval stages, the proboscis is invaginated (retracted) within the body (in a proboscis receptacle) while in adults, it is everted and used to attach to host tissues. Worms do not possess a digestive tract and nutrients are taken up through the body wall. Mature worms are dioecious, with females being slightly larger than males. Mature males have two testes lying on either side of the genital ligament, each with a vas deferens bearing diverticula, cement glands and an ejaculatory duct terminating in a copulatory bursa. During copulation, sperm ejected into the vagina escape into the pseudocoelom via the genital duct and the male then plugs the vagina using the cement glands to prevent further copulation. Ovaries dehisce (break down) in cystacanth or adult female stages to form ovarian balls that float freely in the body cavity. Fertilized eggs are brought to the uterus through a unique funnel-shaped uterine bell while immature eggs are returned to the body cavity for further maturation.

Site of infection: Adult *Oncicola* spp. infect the small intestines of their definitive hosts (carnivores and primates) while larval stages (acanthellae and cystacanths) occur in the body cavity of their intermediate hosts (beetles and cockroaches) and the internal tissues (esp. subcutis) of their paratenic hosts (mostly birds).

Pathogenesis: Adult worms absorb nutrients through their body walls and do not feed on host tissues. However, they embed their armed proboscis in the intestinal mucosa causing trauma, focal lesions and inflammation. Nevertheless, few clinical signs have been associated with infections, except for occasional peritonitis when the parasite proboscis penetrates through to the peritoneum. Concomitant infections with other gut parasites have been shown to contribute to enteric signs including diarrhoea, anorexia and weight loss.

Developmental cycle and mode of transmission: Although the life-cycles of most *Oncicola* spp. are not known, studies on several species have shown them to have indirect life-cycles involving cyclic transmission between vertebrate definitive hosts (infected by adult stages), arthropod intermediate hosts and avian paratenic hosts (harbouring larval cystacanths). Mature female worms lay eggs which are passed in the faeces of the definitive hosts (carnivores and primates). The eggs are ingested by intermediate hosts (arthropods including beetles and cockroaches) wherein they hatch releasing the enclosed acanthor stages. These larvae penetrate to the body cavity (haemocoel) and form the main growing stages (acanthellae) before becoming infective as cystacanths after 6-12 weeks. When infected arthropods are ingested by definitive hosts, the cystacanths evert their proboscis, attach to the gut wall and mature into adult worms over several months. If the arthropods are ingested by paratenic (non-definitive) hosts, the cystacanths may migrate through host tissues, re-encyst and await ingestion by carnivorous definitive hosts. Several *Oncicola* spp. have been found to use wide range of birds as paratenic hosts, especially Passeriformes. Mature female worms can be highly fecund producing thousands of eggs per day but they are thought to only live for several months.

Differential diagnosis: Patent infections may be detected by coprological examination of faecal sediments for characteristic acanthocephalan eggs which are relatively heavy and do not float well except in high specific gravity salt or sugar solutions. Most infections, however, have been detected incidentally during post-mortem examination of definitive hosts (adults found in gut samples) or paratenic hosts (cystacanths found in bird tissues).

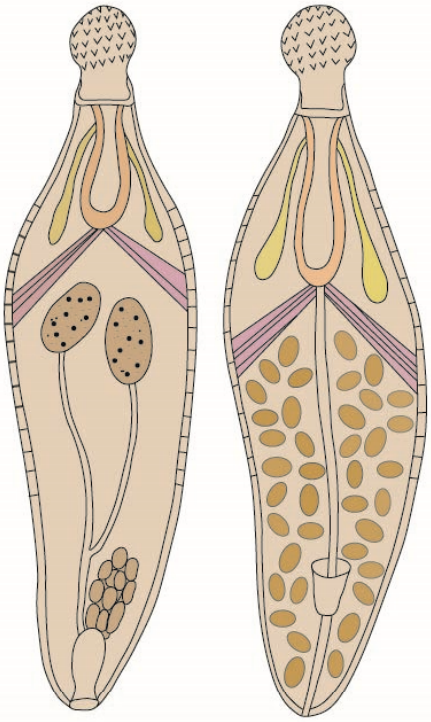
Treatment and control: Infections in carnivores (mostly dogs and cats) have been successfully treated with fenbendazole, ivermectin, doramectin or selamectin, while infections in captive primates (tamarins) responded well to treatment with albendazole. It is important to identify infected animals to institute appropriate quarantine and hygienic measures so that contact with intermediate and paratenic hosts can be reduced.

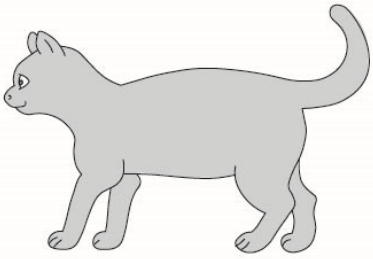
Oncicola

intestines
(trauma,
inflammation)

adult male
(~ 40 mm)

adult female
(~ 40 mm)





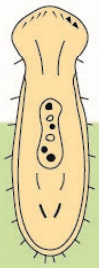
Definitive Hosts
(carnivores, esp. felids)

excretion

egg
(~ 70 µm)

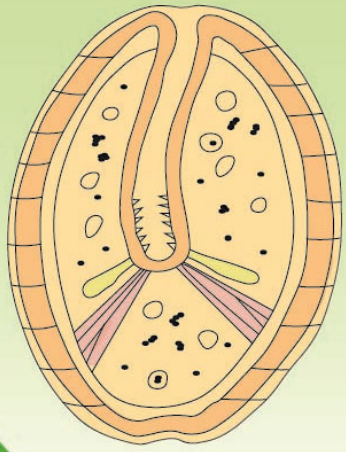
ingestion

terrestrial cycle

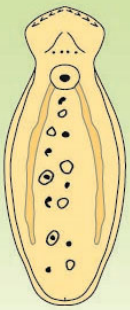


ingestion

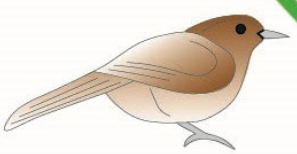
acanthor
(~ 100 µm)



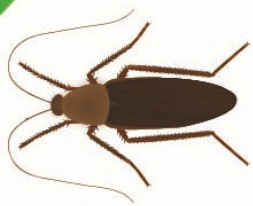
cystacanth
(~ 20 mm)



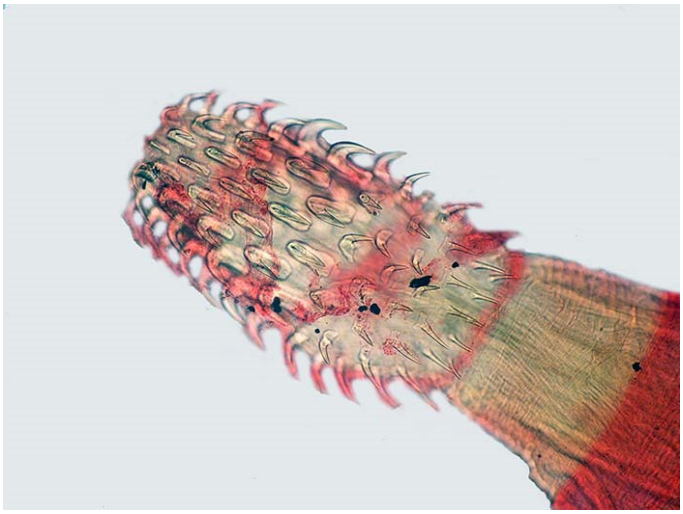
acanthella
(~ 5 mm)



Paratenic Hosts
(small birds e.g. babblers)
(tissue cysts, lesions)



Intermediate Hosts
(arthropods, esp. cockroaches)
(body cavity)



Oncicola proboscis