

# Nodule worm of sheep

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## Introduction

*Oesophagostomum* is a genus of parasitic nematodes (round worms) belonging to the superfamily Strongyloidea. They are commonly known as 'nodule' or 'nodular worm' and are found worldwide. Adult worms live in the large intestine. Host species for this genus of worms include ruminants, pigs and other animals. Primates including humans can also be affected, with most human cases being reported from Africa.

Nodule worm (*Oesophagostomum columbianum*) is a parasite of the large intestine of sheep and goats, and a number of wild antelopes.

**Figure 1. Nodules in small intestine of sheep due to *Oesophagostomum columbianum* ('nodule worm').**



Image credit: Jane Lamb, Invetus, Armidale.

In the summer rainfall areas of northern NSW and Queensland, this parasite was once second only to barber's pole worm (*Haemonchus contortus*) in importance. Its prevalence has decreased considerably since the 1960s with the advent of modern anthelmintics and increasing use of improved pastures (Cole, 1986). However, nodule worm can still be a significant cost for meat processors, with condemnation of 'sheep runners' (intestines) due to 'pimply' or 'knotty gut' caused by migrating larvae.

The situation regarding large bowel worm (*Oesophagostomum venulosum*), which is closely related to nodule worm, is quite different. It is widely distributed in New Zealand and all temperate areas of Australia, including winter rainfall areas. Also large bowel worm rarely causes problems for its host species, which includes sheep and cattle (KM Dash, personal communication).

## Life cycle and effects

Adult nodule and large bowel worms are found in the colon where they feed on gut contents and cause few problems except possibly for transient diarrhoea. Nodule worm is stout, white and 12-24 mm long. Its anterior or head end is curved or 'hooked'. Large bowel worm is similar in appearance but without a hooked head.

With adequate warmth and moisture on pasture, eggs ('strongyle'-type eggs) passed in the faeces by these worms hatch and produce larvae. These develop through stages until they become third stage (L3) infective larvae.

**Figure 2. 'Strongyle'- type egg seen under the microscope. Approx. size: 80 x 40 microns.**



Image credit: Anne Oakenful / Manual for NSW DPI Profarm Worm Egg Counting course

A feature of nodule worm is that its free-living stages (eggs and larvae on pasture) are even more susceptible to cold and desiccation than barber's pole worm (*Haemonchus contortus*). This explains why nodule worm is mostly restricted to summer rainfall areas in Australia.

Once ingested, the third-stage larvae of both nodule and large bowel worms lose their sheaths then enter glands in the wall of the ileum (lower small intestine) and colon, where they become encapsulated. Generally they then develop to early fourth-stage larvae, migrate back to the intestinal lumen, and pass down to the large intestine (caecum and colon).

So, in the case of large bowel worm (*Oes. venulosum*), fourth-stage larvae continue development to the adult stage in the large intestine.

But, in the case of nodule worm (*Oes. columbianum*), some fourth-stage larvae stay in the wall of the ileum or enter a second tissue ('histotrophic') phase in the wall of the large intestine where they are captured in thick-walled, caseous ('cheesy') nodules.

**Figure 3. Nodules in large intestine of sheep due to *Oes. columbianum* (nodule worm).**



Image credit: Jane Lamb, Invetus, Armidale.

These nodules in the large intestine are 0.5 -1.0 cm across and may become mineralised. This excessive tissue response may occur because sheep are 'unnatural' hosts of nodule worm, the 'natural' hosts being African antelopes (KM Dash, personal communication).

The inflammatory response, which causes most of the pathology or damage, is greater in animals previously exposed to migrating larvae. This response includes the formation of nodules (chronic granulomas), peritonitis if nodules rupture, intestinal malabsorption, anaemia, diarrhoea and low blood protein (hypoproteinaemia).

In addition to the nodules in the walls of the small and large intestines, nodules can also be found in the lung, liver, mesentery (a fold of tissue that

anchors organs to the body wall) and mesenteric lymph nodes.

The intestinal lining is damaged (reddening, thickening) as larvae progress to adult stage. This, along with nodule formation, makes the intestines useless for by-products such as sausage skins and specialised surgical thread.

The prepatent period is about 5 weeks. This is the time from ingestion of infective larvae, maturation through to the adult stage, reproduction taking place, and eggs appearing in the faeces. Clinical signs of nodule worm infection may occur within this period, i.e., before eggs appear in the faeces. Diagnosis in such cases is largely based on clinical signs. Heavy infections are mostly seen in weaners and result in diarrhoea, usually developing in the first or second week of infection. Mucus and blood may also be passed. Other signs include emaciation, a humped appearance, and a stiff gait.

In heavy *Oes. columbianum* infections, worm egg counts may be 500–1000 eggs per gram of faeces. Worm counts around 100 are considered pathogenic in weaners, 200–300 in adults. The egg output of this worm is 5,000–12,000 per female per day, similar to barber's pole worm (*Haemonchus contortus*).

**Figure 4. Stout white adult worms (12-24 mm long; anterior end curved or 'hooked') in sieved gut contents: *Oes. columbianum* (nodule worm).**



Image credit: Jane Lamb, Invetus, Armidale.

## Significance

Because the free-living stages (eggs and larvae) of nodule worm do not tolerate cold and desiccation, this parasite has virtually disappeared from higher rainfall areas (e.g. northern NSW tablelands and slopes), which have relatively cold winters and frequent anthelmintic ('drench') treatments.

Its niche seems to have been largely occupied by the relatively harmless large bowel worm. (Nodules associated with *Oes. venulosum* occur infrequently, are small, and occur mainly in the caecum and colon).

However, at the very least, nodule worm still occurs west of the Great Dividing Range in flocks on the slopes and plains of north western NSW and southern Queensland. Processors sourcing sheep from those areas can suffer significant economic losses due to condemnation of intestines ('runners') affected by 'pimply' or 'knotty' gut' caused by nodule worm.

In 2001, for example, one NSW processor had 9% of sheep runners condemned at the abattoir because of pimply gut. At the time, each set of runners, sold overseas as sausage casings, was worth \$2–\$3. With almost 200,000 runners condemned, this was a significant loss (Love and Hutchinson, 2003).

Figure 5. Head or anterior end of *Oes. columbianum*. Magnification: 400x.



Image credit: Jane Lamb, Invetus, Armidale.

## Control and prevention

As discussed, climate, drenching practices and improved nutrition have decimated nodule worm populations in the decades since the 1960s.

But if treatment specifically for nodule worm is deemed necessary in particular situations, an effective drench after the onset of frosty weather would likely have the biggest impact. If the winter is cold enough, i.e. frosts are common, few if any eggs and larvae will survive on pasture, making rates of reinfection of sheep after treatment very low. Unlike barber's pole and other sheep worms, the infective larvae of nodule worm on pasture do not survive freezing.

A disadvantage of treating for nodule worm at this time is that selection for drench resistance may be higher. This is because there are few worms 'in refugia', that is, worms not exposed to the drench, which generally means the free living stages on pasture. If most of the population of nodule worm on a farm is exposed to the drench, and there are drench resistant survivors remaining in the sheep after treatment, then a large proportion of the next generation of worms will be carrying resistance genes.

Figure 6. Posterior end of *Oes. columbianum*. Magnification: 400x.

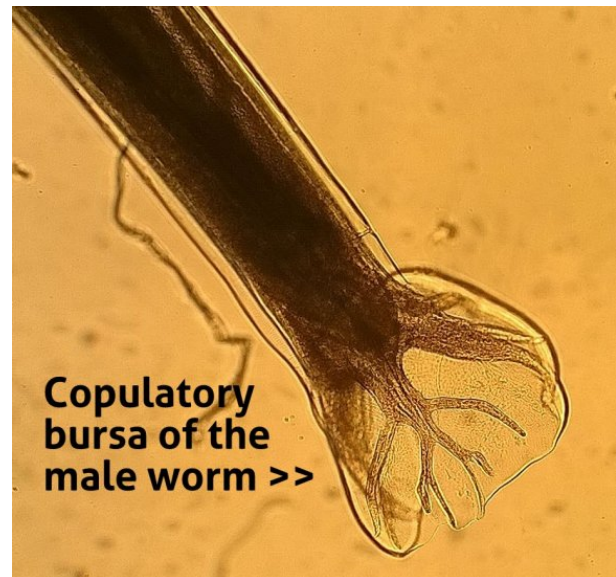


Image credit: Jane Lamb, Invetus, Armidale.

## Anthelmintic resistance

Resistance of *Oes. dentatum* in pigs has been found to benzimidazoles, levamisole and pyrantel, with cases being found as early as the 1980s (Merck Veterinary Manual).

According to Parasitipedia, there are reports of confirmed resistance of *Oesophagostomum radiatum*' (nodular worm of cattle) and *Oes. columbianum* (nodule worm of sheep) to most of the commonly used anthelmintics (benzimidazoles, ivermectin, levamisole, etc.). However, so far resistance of these worms

seems to be less severe and widespread than resistance to other gastrointestinal roundworms of ruminants (e.g. *Haemonchus* spp, *Cooperia* spp, *Ostertagia* spp, etc.).

## More information

Veterinarians with the Department of Primary Industries or Local Land Services, or other advisers expert in livestock parasitology.

NSW DPI PrimeFacts on animal health:

<http://www.dpi.nsw.gov.au/content/agriculture/livestock/health>

WormBoss.com.au

## References and further reading

Cole VG (1986). Helminth Parasites of Sheep and Cattle. Animal Health in Australia, Volume 8. Australian Agricultural Health and Quarantine Service, Department of Primary Industry, Canberra, p.255.

Lamb J, 2017. *Oesophagostomum columbianum* - a view from the laboratory. Invetus, Armidale, March 2017. Accessed April 2017 at <http://www.wormboss.com.au/news/articles/worms-and-other-parasites/oesophagostomum-columbianuma-view-from-the-laboratory.php>

Love, S and Hutchinson, GW (2003). 'Pathology and diagnosis of internal parasites of ruminants' in Gross Pathology of Ruminants, Proceedings 350, Post Graduate Foundation in Veterinary Science, University of Sydney, Ch. 16, pp. 309–38.

[http://www.dpi.nsw.gov.au/\\_\\_data/assets/pdf\\_file/0003/34608/lh-pathol-int-para.pdf](http://www.dpi.nsw.gov.au/__data/assets/pdf_file/0003/34608/lh-pathol-int-para.pdf) Accessed November 2015.

Merck Veterinary Manual.

<http://www.merckvetmanual.com>. Accessed August 2015.

NSW DPI PrimeFacts on animal health:

<http://www.dpi.nsw.gov.au/content/agriculture/livestock/health>

NSW DPI Profarm faecal worm egg counting course:

<http://www.dpi.nsw.gov.au/content/agriculture/profarm/courses/faecal-egg-counts>

Parasitipedia.

[http://parasitipedia.net/index.php?option=com\\_content&view=article&id=2629&Itemid=2906](http://parasitipedia.net/index.php?option=com_content&view=article&id=2629&Itemid=2906) .

Accessed November, 2015.

WormBoss: [www.wormboss.com.au](http://www.wormboss.com.au) (Australian Wool Innovation and Australian Sheep Industry Cooperative Research Centre). Nodule worm

information:

<http://www.wormboss.com.au/worms/roundworms/nodule-worm-and-large-bowel-worm.php>. Accessed November 2015.

## Acknowledgments

The contribution of Dr Keith Dash in this and other areas is gratefully acknowledged. Dr Dash is a veterinarian and former CSIRO scientist and parasitologist. His PhD was on *Oesophagostomum*. He is perhaps better known as the 'father' of the WormKill sheep worm control program (northern NSW, 1980s-1990s), the first of the modern sheep worm control programs in Australia.

My thanks also to NSW DPI Principal Research Scientist, Dr Sue Hatcher, for her expeditious proof-reading and refereeing of the second edition.

This third edition is a 'light' revision of the second edition (November 2015; PUB08/127), the changes mostly consisting of excellent images kindly supplied by Jane Lamb, of Invetus ([invetus.com](http://invetus.com)), Armidale, formerly Veterinary Health Research. Veterinary Health Research has merged with other companies to form Invetus Proprietary Limited, an Australasian veterinary contract research organisation (CRO) with sites throughout Australia and New Zealand.

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