

CYST DEVELOPMENT AND PARATENESIS OF GORDIIDS (PHYLUM NEMATOMORPHA) IN FRESHWATER GASTROPODS. Ryan P. Shannon* and Matthew G. Bolek, Oklahoma State University.



ABSTRACT

Freshwater nematomorphs, or gordiids, are free-living aquatic worms that parasitize terrestrial arthropods. After emerging from their arthropod host, worms mate and females produce egg strings that develop and hatch in to larvae. The larvae reside on the bottom of streams and ponds where they are ingested by aquatic invertebrates. Once ingested by aquatic invertebrates, gordiid larvae develop into cysts. Some of these infected invertebrates act as paratenic (transport) hosts by carrying cysts to land where they are consumed by omnivorous or predatory arthropod hosts. However, one part of the life cycle that has not been examined in detail is the cyst formation process. In this study, we examined cyst formation of the gordiid, *Paragordius varius*, by exposing laboratory reared snails, *Physa gyrina* to larvae of *P. varius* and examining these snails for cyst formation. After exposure to *P. varius*, snails were fixed every few days and processed using standard histological techniques. Snails infected with cysts were then stained with H&E and Oil Red in order to examine any morphological changes in the gordiid larval pseudointestine an organ thought to be responsible for cyst formation. Additionally, we tested the ability of cysts of *Paragordius varius* and *Gordius cf. robustus* to transfer from snail to snail host, by feeding infected snails with cysts to uninfected snails. We found that development of *P. varius* cysts took at least 2-3 weeks in the snail host. Our histological study indicated that as soon as gordiid larvae penetrate the snail host morphological changes occur in the pseudointestine. Larvae emptied a portion of their pseudointestine during penetration however, no other morphological changes occurred in the pseudointestine during cyst formation. More importantly, 37% of *G. cf. robustus* and 47% of *P. varius* cysts from infected snails were transferred over to uninfected snails. Our study suggests that the function of the pseudointestine may be important in host infection but not cyst formation.

Question I

1) What is the function of gordiid larval pseudointestine in cyst formation?

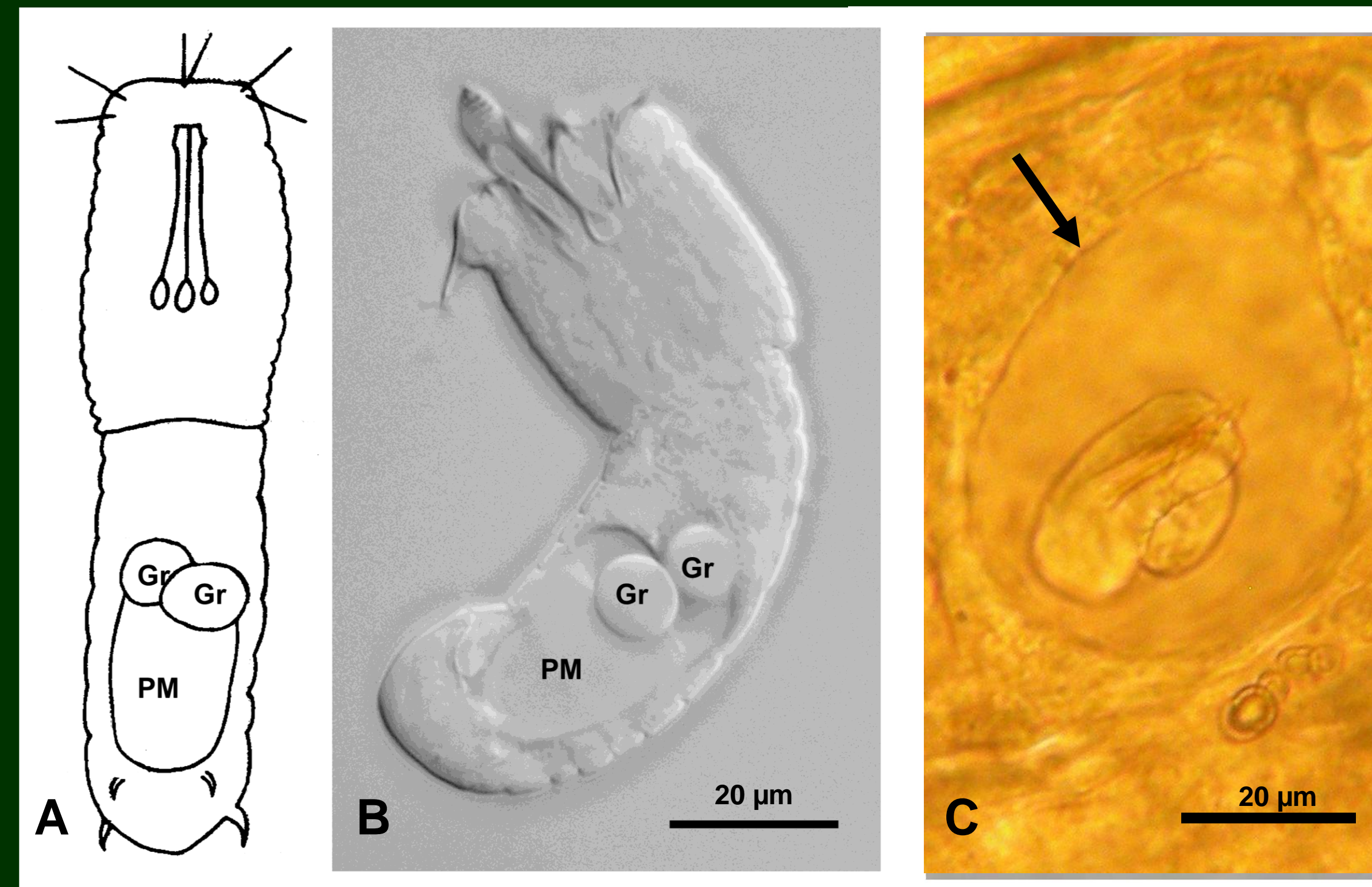


Fig. 2 (A) Drawing and (B) DIC photomicrograph of a *P. varius* larva showing the complex pseudointestine. (C) A formed *P. varius* cyst with a characteristic halo like structure (black arrow) surrounding the folded larva. Gr = granule; PM = posterior mass.

METHODS

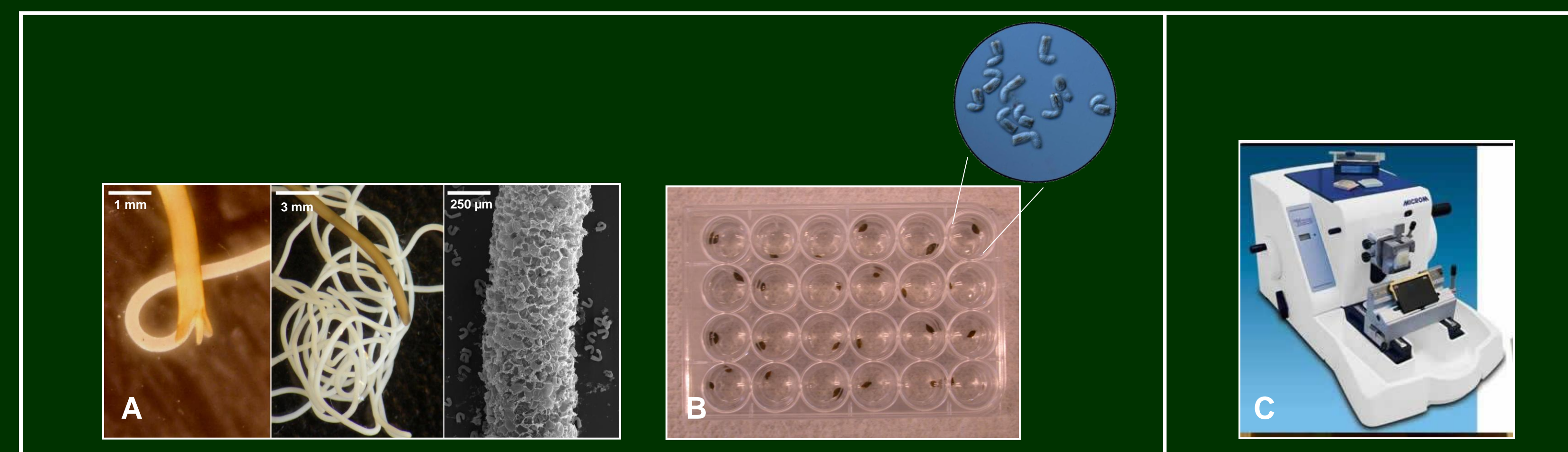


Fig. 3 (A) Larvae were collected from female *P. varius*; (B) snails were exposed to larvae; (C) snails were fixed every few days, sectioned and examined for cyst morphology.

RESULTS

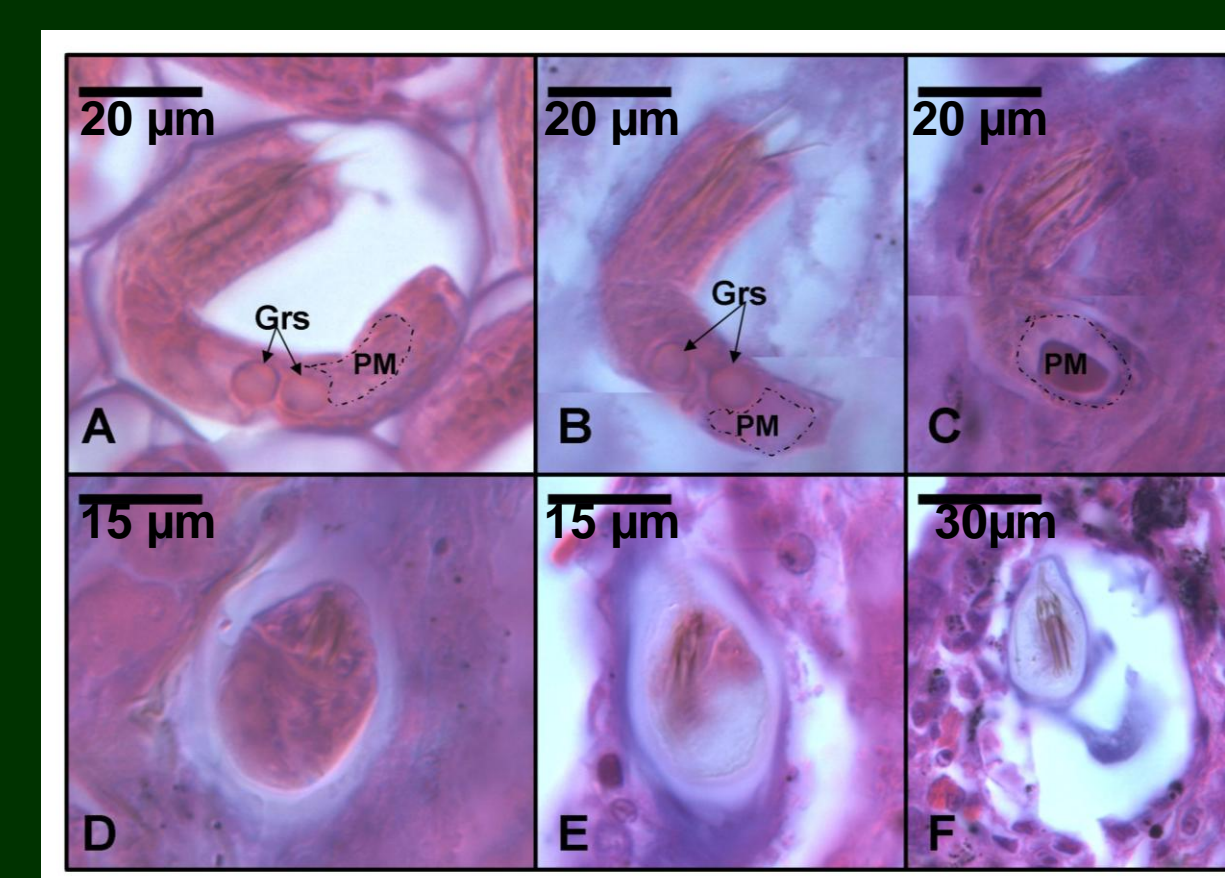
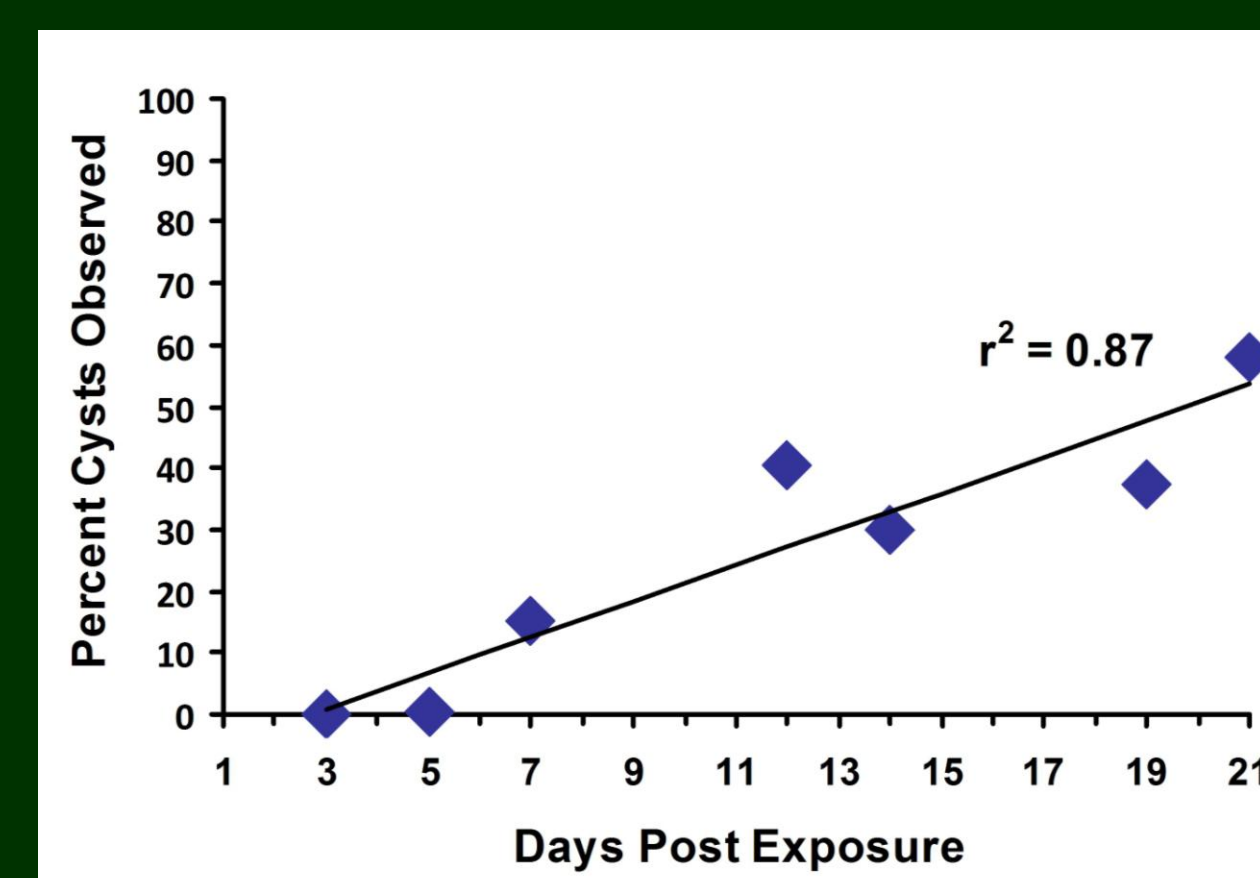


Fig. 4 Time versus development of *P. varius* cysts in experimentally infected *Physa gyrina*. (A) fully developed larva of *P. varius* inside an egg. Note the granules and posterior mass of the pseudointestine; (B) fully developed larva of *P. varius* in the gut of *P. gyrina*. Note the granules and posterior mass of the pseudointestine; (C) *P. varius* larva after penetrating snail tissue. Note that the two granules of the pseudointestine are empty; (D-F) *P. varius* larvae in the process of folding and forming cysts.

Question II

1) Can cysts of gordiids be transferred from snail to snail?

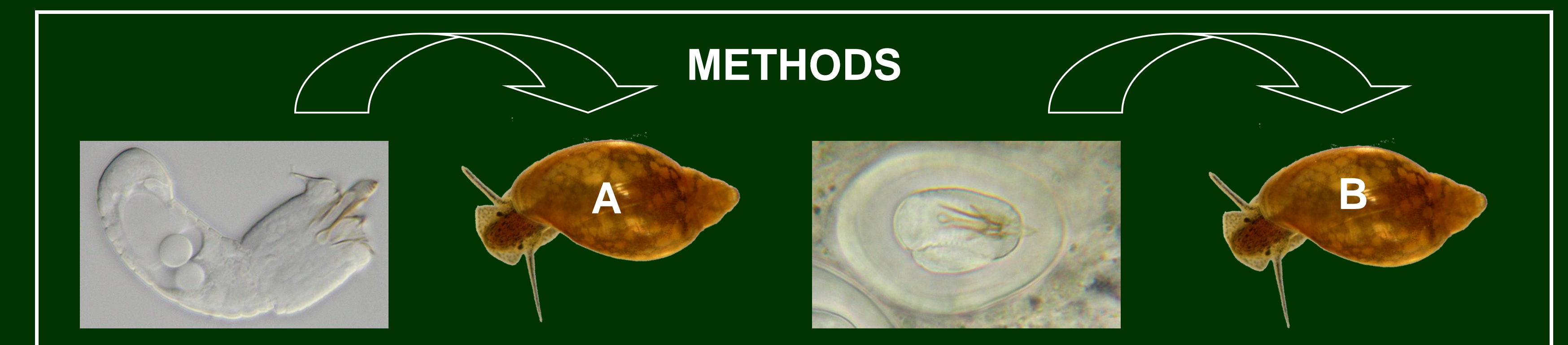


Fig. 5 (A) *Gordius cf. robustus* and *P. varius* larvae were fed to snails as previously described; (B) after most larvae developed to cysts, all snails were killed and snail tissue was fed to uninfected snails.

RESULTS

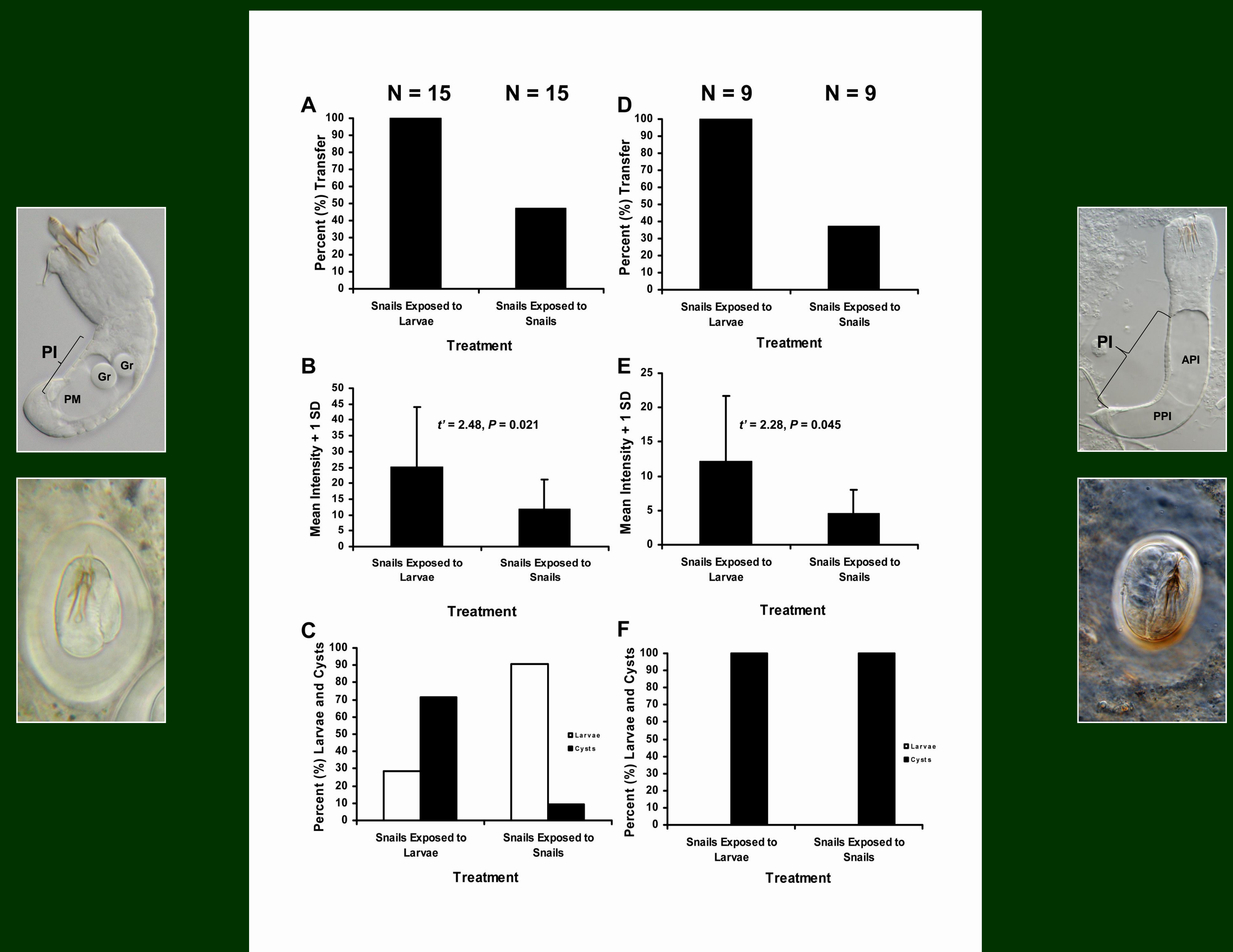


Fig. 5 All snails became infected in each treatment group, however not all cysts/larvae transferred over from snail to snail. (A-C) *Paragordius varius* larva and cyst transfer from snail to snail; (D-F) *Gordius cf. robustus* larva and cyst transfer from snail to snail. N = number of snails per group.

CONCLUSION

Our results indicate that the pseudointestine changes morphologically during snail penetration and that approximately 40% of gordiid larvae/cysts get transferred over from snail to snail.

ACKNOWLEDGMENTS

This work was supported by the National Science Foundation, award numbers DEB-0949951 and REU DEB-1214510 to MGB. We thank Cedar Point Biological Station, University of Nebraska-Lincoln for providing laboratory facilities during field work in Nebraska.

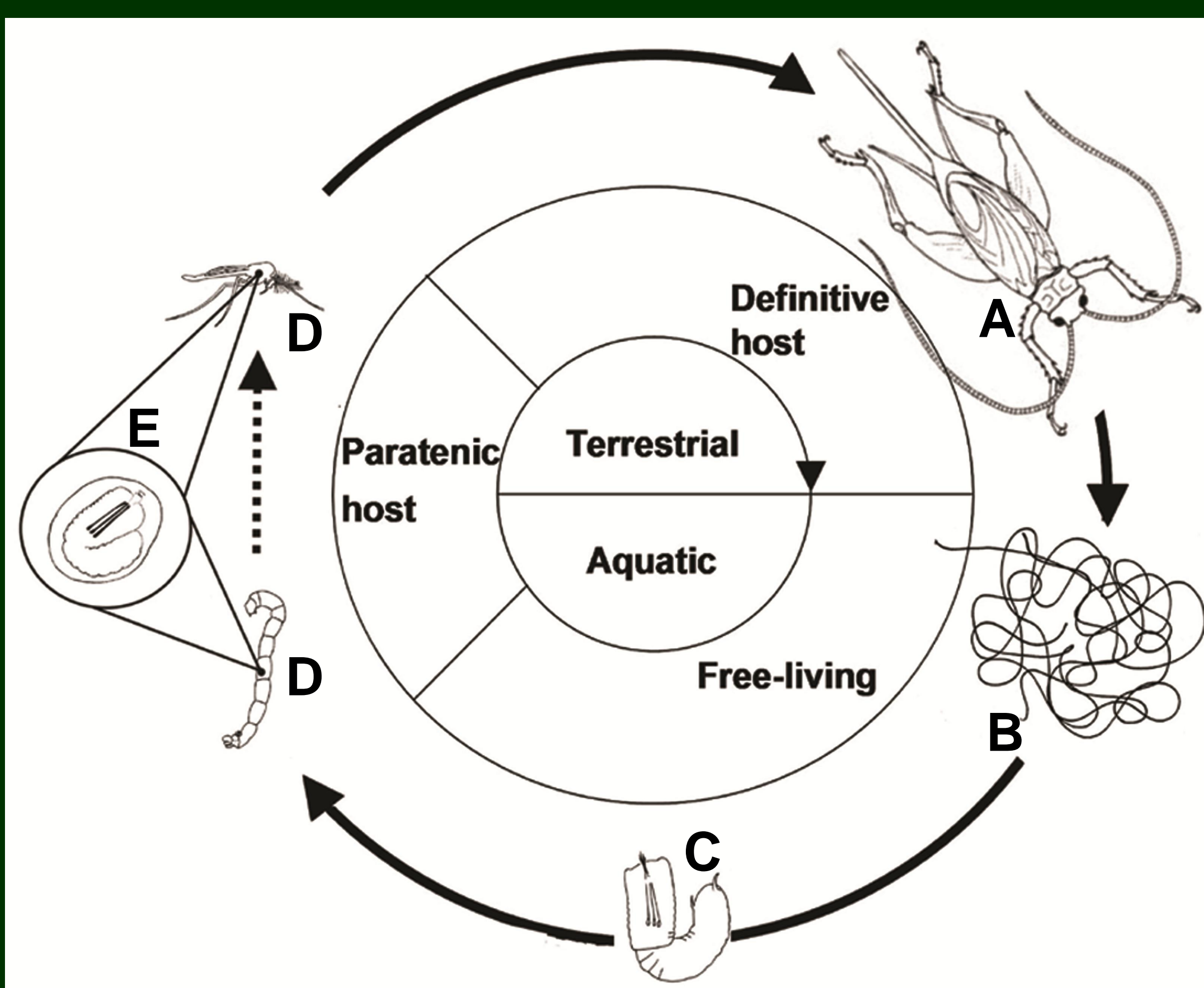


Fig. 1 (A) Cricket definitive host; (B) free living mature worm laying eggs; (C) free living larvae; (D) aquatic insect paratenic host; (E) mature infective cyst from snail.