

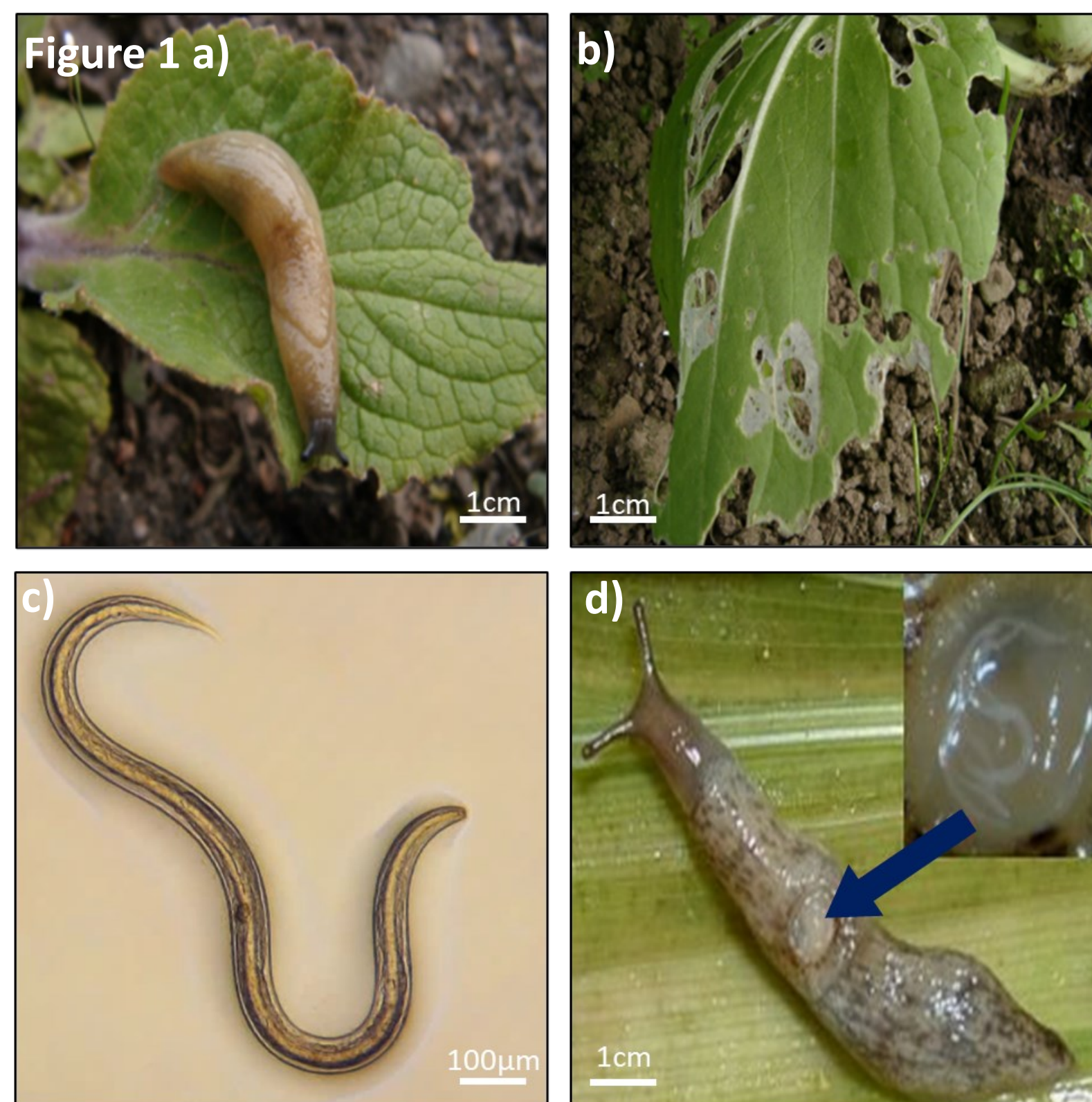
The Relationship Between Worms, Bacteria and Their Slug Hosts

Understanding Biological Control

Introduction

Slugs are prevalent pests, damaging crops across the world (Figure 1 a & b).

Harsh chemicals are used to control slugs but have many negative effects.



Biological control is the process of managing pests by introducing their natural enemy. *Phasmarhabditis hermaphrodita* is a nematode (a microscope worm) and a deadly parasite to slugs (Figure 1 c & d).

This nematode has been formulated into a product (Nemaslug®) available across Northern Europe for over 25 years.

It is thought that this nematode kills by introducing bacteria into the slug host, but this is poorly understood. Understanding the bacterial associations of this nematode could lead to improvements to the biological control of slugs in turn helping to prevent crop loss.

Aims and Methods

Aim

To investigate the bacterial associations of biological control agent *Phasmarhabditis hermaphrodita*.

Methods

Three different species of *Phasmarhabditis* were used in this study, *P. hermaphrodita*, *P. californica* and *P. neopapillosa*. All have been shown to kill slugs.

Host slug species *Deroceras invadens* was infected with nematodes then after 5 days mortality recording commenced.

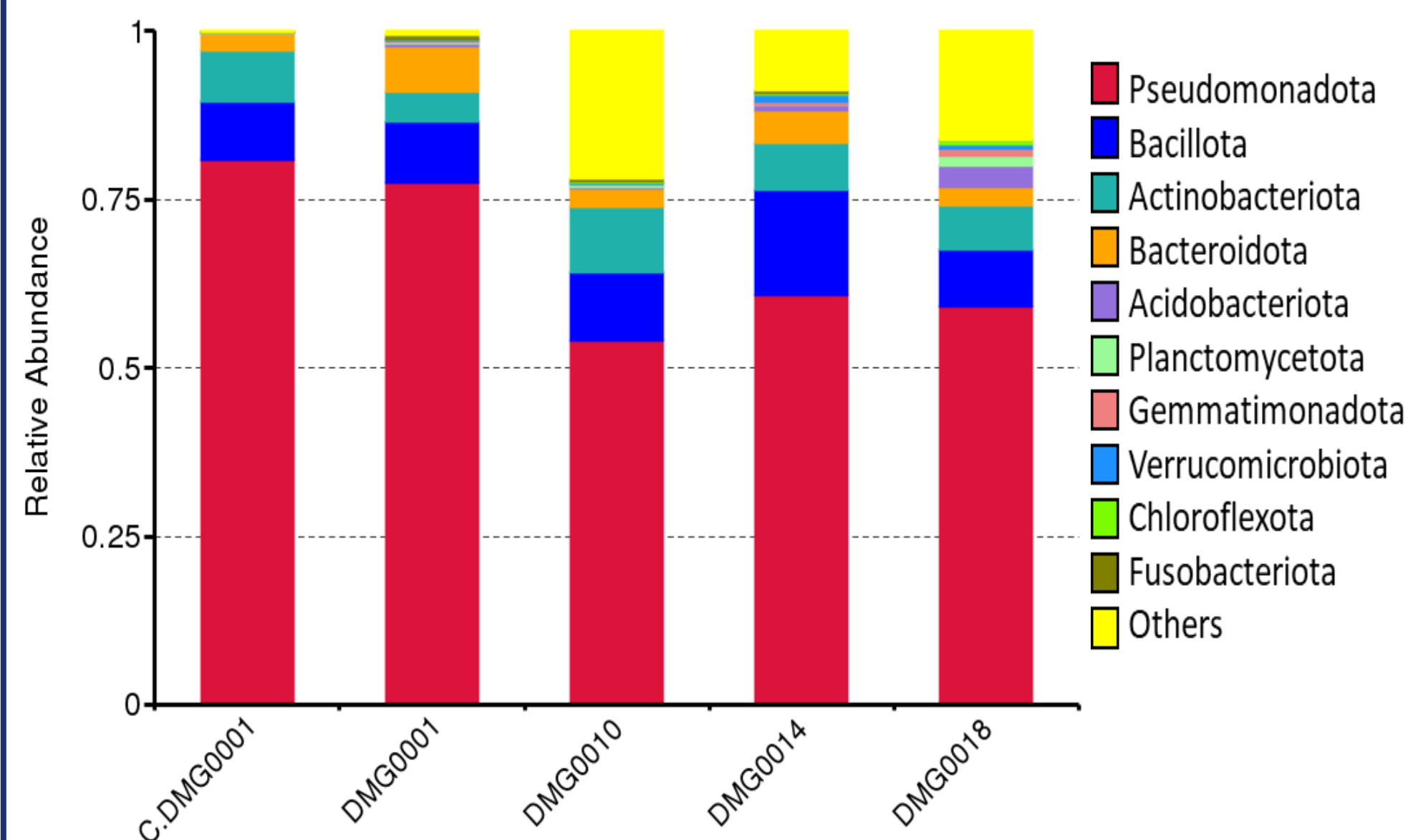
After 14 days nematodes which successfully killed the slug hosts were collected for DNA extraction and metagenomic sequencing.

Metagenomic sequencing allows the identification of bacterial species from DNA, this provides a much more accurate view of the bacteria present as not all bacteria can be cultured in the lab.

Evidence of Diverse Bacterial Associations

Figure 2 shows an abundance of bacteria associated from across many different phyla.

Figure 2



There is not a single bacterial species present. In fact, a diverse range of bacteria are present after killing their slug host.

The Core Microbiome of *Phasmarhabditis*

The metagenomic sequencing revealed that *Phasmarhabditis* associates with a diverse set of bacterial species.

Figure 3

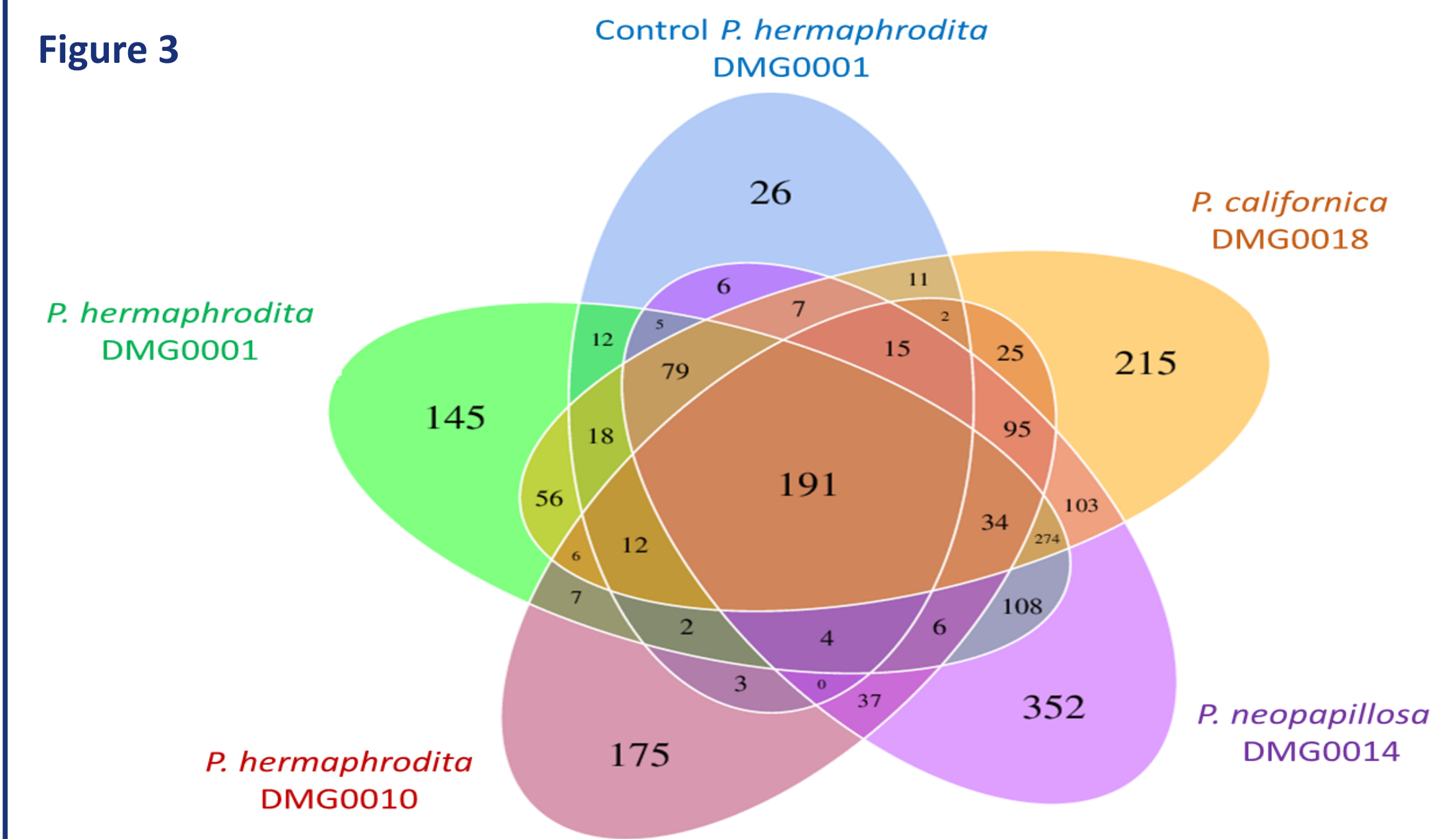


Figure 3 indicates how many bacterial species were identified and shared between the different nematode species.

The three species of *Phasmarhabditis* were found to share a core microbiome of 191 bacterial species.

Lowest diversity was seen in the control (DMG0001) which did not kill a slug host. Whilst the highest diversity is seen from nematodes that have kill a slug host.

These results indicate that interaction with a slug host increases diversity of the bacterial association of these nematodes (see Sheehy et al 2022).

Conclusion

There is no evidence to suggest a selective symbiotic relationship with a single bacterial species.

These nematodes associate with a diverse range of bacteria which does not affect their ability to kill slug hosts.

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