

NATIONAL

# SLUGS IN CROPS



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# THE BACK POCKET GUIDE

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## Introduction

Slugs have become an important pest group attacking Australian grain crops as farming practices have changed. Slug infestations cause crop damage and yield loss from their feeding and incur significant field control costs. Expenditure on molluscicides in the Australian market continues to increase annually by more than \$440,000, indicating slug and snail threats are increasing.

All species found in Australian agricultural areas are exotic, originating from Europe and America. Of these, only a few species are considered major crop pests: black keeled slug, grey field slug and, to a lesser extent, brown field slug, which comprises two species that cannot be distinguished without dissection.

The main slug species do differ in appearance and can co-exist in the same area. Incorrect identification can lead to ineffective control as timing of controls misses peak activity or controls are applied to non-pest species. A simple key and guide are provided to assist growers in the identification of the most commonly observed slug species found in Australian cropping regions. Distribution maps for the main slug species encountered from a GRDC survey are included.

# Slugs do not have a distinct life cycle

Slugs are hermaphrodites therefore both individuals of a mating pair lay eggs. Slugs will breed whenever moisture and temperature conditions are suitable, which varies depending on the species. Breeding is generally over winter and spring.

Each individual will lay eggs in clutches over one to two months when the soil surface is moist enough. Generally, eggs are laid when soil moisture is greater than 25 per cent volumetric water content. Optimum soil temperature for egg development is between 10°C and 16°C for grey field slugs.

Eggs will hatch within three to six weeks as neonates, which grow slowly. Development continues as juveniles can grow quickly depending on moisture, temperature and food availability. Generally, juveniles develop at 4°C to 21°C and reach sexual maturity after 10 to 40 weeks depending on species/conditions. Juveniles' size varies greatly and can be the same as adults.

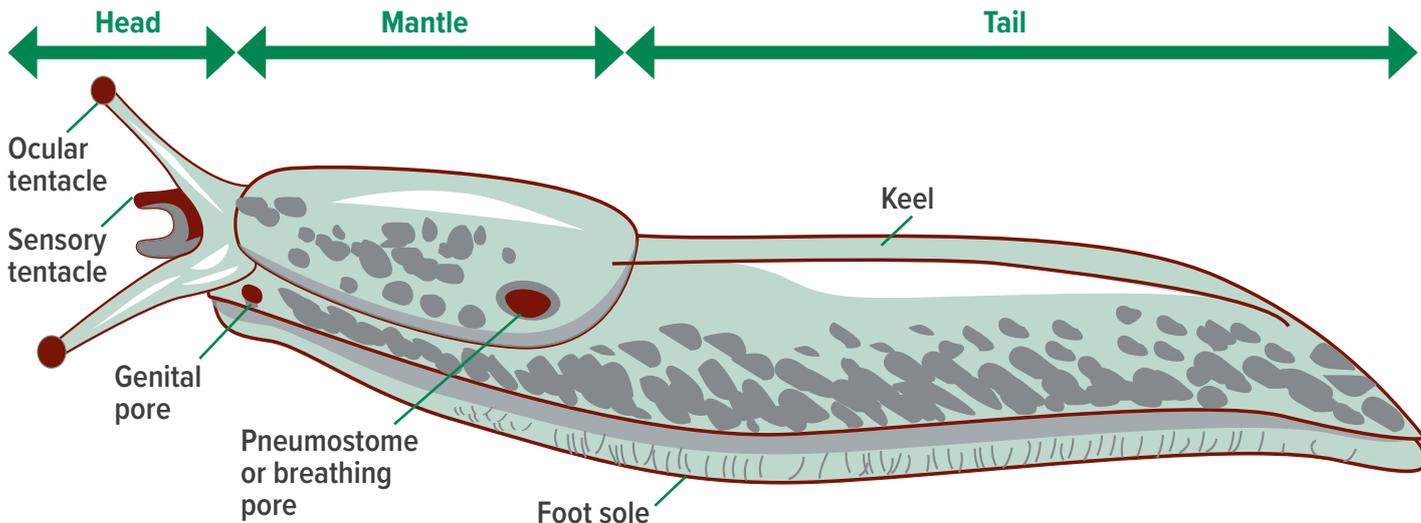
Development times vary between individuals hatched from the same clutch, that is within a population there are slow and quick breeders. Their staggered breeding is an adaptation to survive difficult conditions.

Slugs survive dry conditions as adults by seeking refuge in the ground and lowering their metabolism, re-emerging once the subsurface wets up. Generally, this occurs after 75 to 100 millimetres of rain, but is often staggered, with not all slugs of a population being active on the soil surface at the same time.

## Basic slug anatomy

The basic external characteristics of a slug are illustrated in Figure 1. Many of these features are referenced throughout the key that follows. The tubercles – raised humps on the back of slugs that give the appearance of ridges and grooves on the body – are omitted from this illustration to make it easier to follow.

Figure 1. Basic external slug features.



Source: McDonnell R, Paine T and Gormally M (2009). *Slugs: A Guide to the Invasive and Native Fauna of California*. 10.3733/ucanr:8336

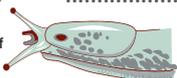
# Key to slugs encountered in crops – southern Australia

## 1. PNEUMOSTOME

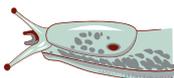
Front of mantle .....see 2. Arionidae mucous colour

Back of mantle .....see 4. Keel

Pneumostome in front of middle of the mantle



Pneumostome behind posterior third of the mantle



## 2. ARIONIDAE MUCOUS COLOUR

Yellow/orange .....see 3. Body colour

Clear .....*Arion ater* (rare)

## 3. BODY COLOUR

Light, yellow/grey to orange sole.....*Arion intermedius* (page 7)

Dark, orange sole .....*Arion hortensis* group (rare)

## 4. KEEL

Present .....*Milax gagates* (page 8)

Absent .....see 5. Stripes/spots

## 5. STRIPES/SPOTS

Yes .....see 6. Limacidae markings

No .....see 8. *Deroceras* spp.

## 6. LIMACIDAE MARKINGS

Markings: Stripes.....*Ambigolimax* spp. (page 9)

Spots.....see 7. Mucous

## 7. MUCOUS

Yellow .....*Lehmannia flava* (rare)

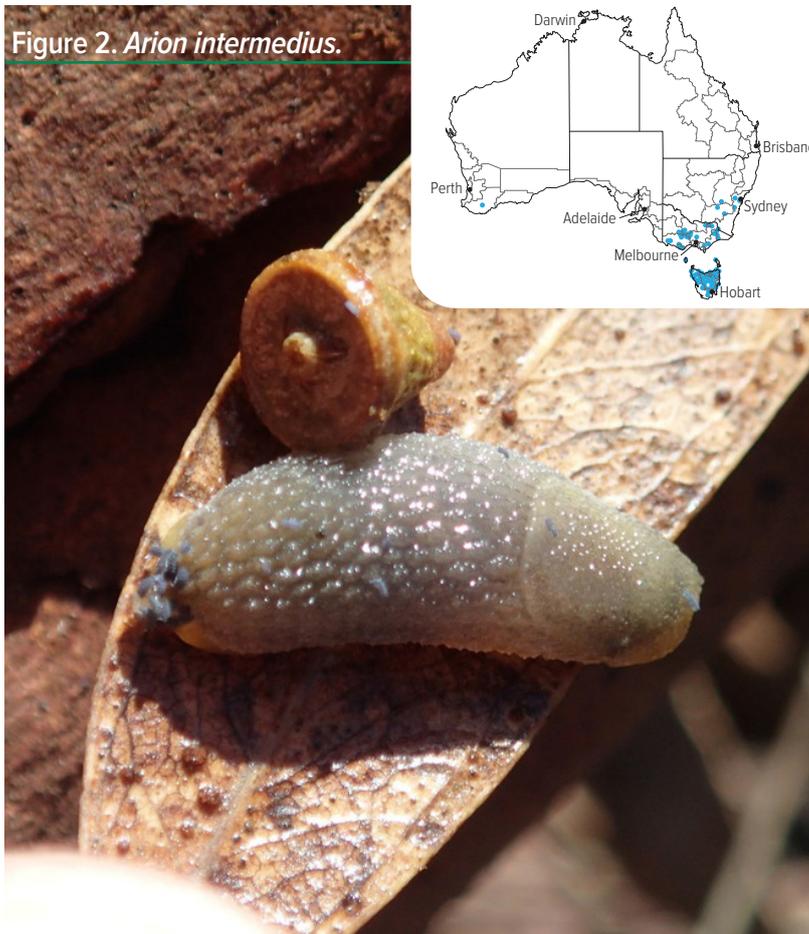
Clear .....*Limax maximus* (rare)

## 8. DEROCERAS SPP.

Mucous: White .....*D. reticulatum* (page 10)

Clear .....*D. invadens* (page 11)

or *laeve* (page 12)

Figure 2. *Arion intermedius*.

## Family Arionidae

Details are only provided for *Arion intermedius* as other species are rarely encountered in crops.

### *Arion intermedius* (Normand, 1852) (see Figure 2)

#### Common names:

Hedgehog Arion or glade slug.

#### Distribution in Australia:

Rarely encountered in crops, common in pastures. Found in all disturbed habitats throughout high-rainfall regions of NSW, Victoria, Tasmania and WA.

#### Ecology:

Small slug that tends to be solitary. Optimum temperature for development is 16°C to 18.5°C, breeding in warm conditions. Can reproduce by self-fertilisation.

#### Description:

Predominant body colour is light grey-yellow with distinctly darker tentacles. Other colour morphs can occur. The sole is greyish yellow and the body mucus is golden yellow. It is most reliably separated from other species based on the presence of small spikes on the tubercles, which give the slug a prickly appearance when it is contracted.

#### Crops damaged:

Wheat and pasture.

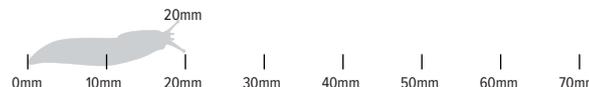


Photo: Helen Schofield

Figures 3a and 3b.  
Adult *Milax gagates* and eggs.



## Family Milacidae

*Milax gagates* (Draparnaud, 1801) (see Figures 3a and 3b)

**Common names:**

Greenhouse or black keeled slug.

**Distribution in Australia:**

Commonly found in Australian cropping environments.

**Ecology:**

Has a wide ecological range where rainfall is above 450mm. It is chiefly a subterranean slug that is active on the surface over winter once soil is wet down to depth. It becomes active after 50mm to 100mm of rain depending on soil texture. Optimum temperature for development is 17°C, minimum and maximum temperatures for activity are from 6°C to 18°C. Neonates take 240 days to reach maturity.

**Description:**

Medium-sized slug without markings. Body colour is usually dark grey to black, but lighter colouring can occur. The keel, which runs from the end of the mantle to the tip of the tail, is similar in colour to the body. The body and sole mucus are colourless.

**Crops damaged:**

Damage can be wrongly attributed to other invertebrates present as slugs do not always use surface refuges. All crops and pastures.



Photo: Michael Nash

Figure 4. *Ambigolimax* spp.

## Family Limacidae

These two species cannot be determined without dissection. They were previously known as *Lehamnia nyctelius*.

***Ambigolimax waterstoni* (Hutchinson et al., 2022) and *Ambigolimax valentianus* (Férussac, 1822) (see Figure 4)**

### Common name:

Striped field or striped greenhouse slug.

### Distribution in Australia:

Commonly found in Australian cropping environments.

### Ecology:

They feed on plants and decomposing plant material; however, they are not considered a pest of crops. These species appear to be intolerant of cold conditions. They are more active in drier conditions than other species encountered.

### Description:

Colour is very variable but is usually cream, although it can also be dark brown. These species can be identified by the presence of two distinct, dark 'tram' lines on the back, often running the full length of the body (see Figure 4). There may also be a less distinct median band. The mucus of these species is watery, copious and colourless.

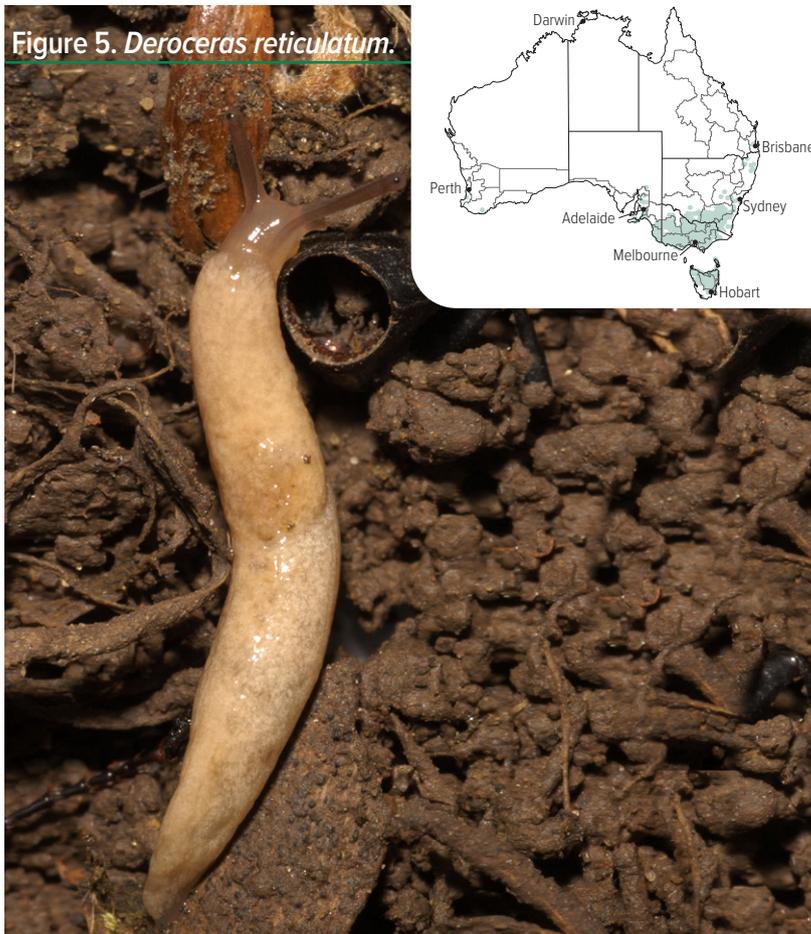
### Crops damaged:

None.



Photo: Michael Nash

Figure 5. *Deroceras reticulatum*.



## Family Agriolimacidae

### *Deroceras reticulatum* (Müller, 1774) (see Figure 5)

**Common name:**

Grey field slug.

**Distribution in Australia:**

Commonly found in Australian cropping environments.

**Ecology:**

Has a wide ecological range where rainfall is above 525mm. Optimum temperature for development is 17°C to 19°C and for activity is from 0°C to 5°C up to 25°C. Optimum gravimetric soil moisture for egg laying is greater than 25 per cent. Neonates take 138 days to reach maturity.

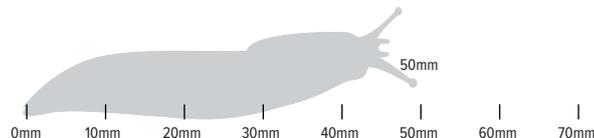
**Description:**

Mucus is milky-coloured when the slug is continuously disturbed (test by prodding the slug with a sharp object).

**Crops damaged:**

All crops and pastures.

Photo: Michael Nash



Figures 6a and 6b.  
*Deroceras invadens*

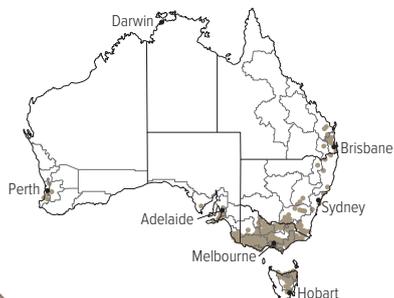


Photo: Michael Nash

## Family Agriolimacidae

*Deroceras invadens* (Reise, Hutchinson, Schunack and Schlitt, 2011) (see Figures 6a and 6b). Was previously known as *D. panormitanum*.

### Common name:

Brown field slug (can be easily confused with marsh slug/ meadow slug).

### Distribution in Australia:

Commonly found in Australian cropping environments.

### Ecology:

Has a wide ecological range, often found with *D. reticulatum*. Optimum temperature for development is warmer than *D. reticulatum* and optimum soil moisture for egg laying is lower. Neonates take 115 days to reach maturity.

### Description:

Mucus is colourless. The body is usually brown but can also be grey. Body wall appears to be thin, which gives specimens a translucent appearance. In profile, the tip of the tail rises vertically from the sole. Moves quickly when disturbed and often 'flicks' its tail. This species cannot be differentiated from *D. laeve* without dissection.

### Crops damaged:

All crops and pastures.



Figure 7. *Deroceras laeve*.



## Family Agriolimacidae

### *Deroceras laeve* (Müller, 1774) (see Figure 7)

**Common name:**

Marsh slug and meadow slug.

**Distribution in Australia:**

Widespread throughout temperate regions into the subtropics along eastern Australia and can be found in pasture and crops.

**Ecology:**

Occupies a huge range of habitats, can tolerate freezing temperatures and is partially amphibious. It feeds on living and dead plants, faeces, carrion and living animals such as earthworms and aphids. Invasive populations occur in all crop types therefore it should be considered a crop pest.

**Description:**

Small, slim slugs up to 25mm in length. Mantle is approximately one-half the length of the body. Mucus is colourless. The body is usually dark brown but can be grey, light brown or black. Sole tends to be light brown. Can be easily confused with *D. invadens*.

**Crops damaged:**

All crop types.

Photo: Michael Nash

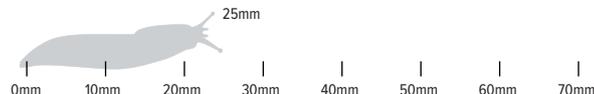
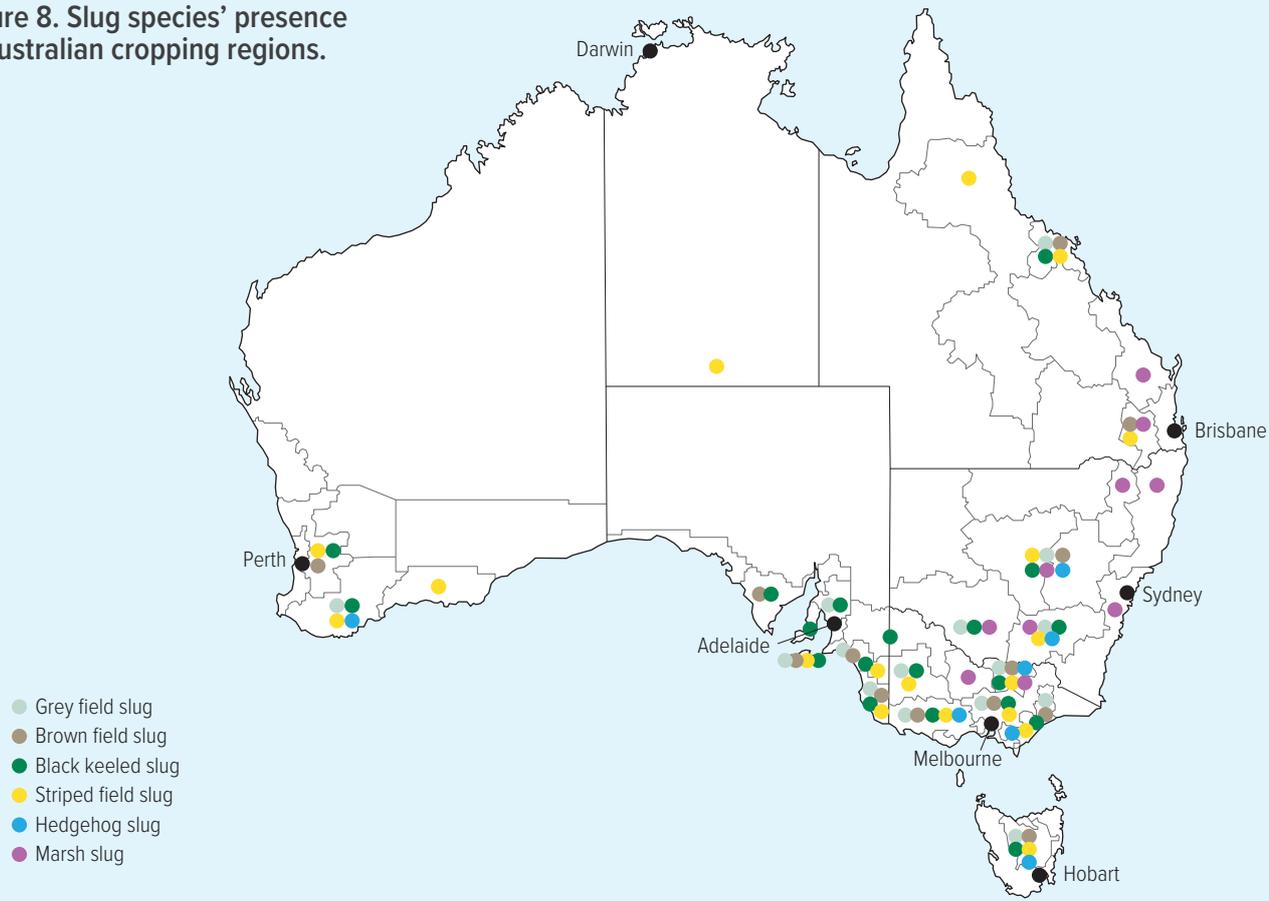


Figure 8. Slug species' presence in Australian cropping regions.



Source: GRDC







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## Useful resources

- **A Snug Blog, [asnugblog.wordpress.com](https://asnugblog.wordpress.com)**
- **Snail Bait Application Fact Sheet, [grdc.com.au/resources-and-publications/all-publications/factsheets/2015/01/snail-bait-application](https://grdc.com.au/resources-and-publications/all-publications/factsheets/2015/01/snail-bait-application)**
- **Slug Control Fact Sheet, [grdc.com.au/resources-and-publications/all-publications/factsheets/2022/slug-control-identification-and-management](https://grdc.com.au/resources-and-publications/all-publications/factsheets/2022/slug-control-identification-and-management)**
- **Paddock Practices: Be on alert for slugs in the HRZ, [grdc.com.au/news-and-media/news-and-media-releases/south/2021/march/paddock-practices-be-on-alert-for-slugs-in-the-hrz](https://grdc.com.au/news-and-media/news-and-media-releases/south/2021/march/paddock-practices-be-on-alert-for-slugs-in-the-hrz)**
- **Slug control cross southern Australia podcast, [grdc.com.au/news-and-media/audio/podcast/slug-control-across-southern-australia](https://grdc.com.au/news-and-media/audio/podcast/slug-control-across-southern-australia)**
- **Cesar Australia: Black keeled slug, [cesaraustralia.com/pestnotes/slugs/black-keeled-slug](https://cesaraustralia.com/pestnotes/slugs/black-keeled-slug)**
- **Cesar Australia: Grey field slug, [cesaraustralia.com/pestnotes/slugs/grey-field-slug](https://cesaraustralia.com/pestnotes/slugs/grey-field-slug)**
- **GRDC GCTV17: Slug Bait Monitoring Test, [youtube.com/watch?v=0E306BteGGs](https://youtube.com/watch?v=0E306BteGGs)**

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