Control and management of slug and snail vectors, with special reference to species in Hawaii

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Outline

- Chemical control options
- Cultural control and trapping
- Habitat management considerations
- Semi-slugs in Hawaii as an example of a high-risk, difficult-to-control species

Why should you care?

- Doctors → $ → Big Gardens
- Educators → Like to inform → everybody is interested in how to kill slugs
- Molecular types → like molecules → molecules are found in baits that kill slugs
- Northern Mariana Islands → Rota → Terribly Infested with Cuban Slugs

Why should you care?

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One size fits all

- In the humid tropics, species of slugs and snails in the landscape present a rat lungworm risk for both home gardeners and commercial vegetable producers.
- Even ordinary homeowners and their pets are potentially in harm's way.
- Recommended control measures are similar in each of these cases and rely mainly on the use of poison baits, trapping, and habitat manipulation.

- Gastropods are generally nocturnal feeders, and much of the damage to crops attributed to insects may be actually caused by snails and slugs feeding at night when they are not observed.

Slug/snail feeding damage

Slug/snail feces

Caterpillar frass

Chemical Control: Molluscicides

- By far, the most commonly used active ingredients for control of slugs and snails are metaldehyde, methiocarb and iron phosphate.
- The most frequent formulation method used is incorporation into food bait pellets

Common bait products, left to right:
Sluggo (food bait containing 1% iron phosphate);
Durham 7.5% metaldehyde granules;
Metarex (metaldehyde food bait)
Deadline (metaldehyde food bait).
Note: blue color reduces attraction to birds.

Metaldehyde

- In pure form, is a white, crystalline solid.
- In some countries, tablets of the pure material are used as fuel for campstoves.

- At least two modes of action:

- (1) poisoning of mucus glands, usually associated with the consumption of poison baits; and
  (2) irritation to the skin upon contact, causing excess mucus production, leading to death by dehydration.

Metaldehyde

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Metaldehyde product formulations

- Food baits (attract and kill)
- Granulars (rely on contact poisoning)
- Liquids (*e.g.*, for drenching potted plants)

Limitations

- Do not apply metaldehyde baits to food crops after the edible portion has formed in the crop.
- Metaldehyde is toxic to fish, and should not be used near bodies of water.

Safety of metaldehyde

- Molluscicides containing metaldehyde are relatively safe to the applicator if not eaten or inhaled.
- Metaldehyde quickly breaks within a period of several days to a week.
- Ducks, geese, chickens and dogs are the animals most likely to find the poison bait attractive. The poison damages the liver.
- If baits must be used in areas where domesticated animals are present, place the baits under boards or rocks in the area near the crop to be protected.

Methiocarb

- Methiocarb is a carbamate chemical which is also used as an insecticide.
- It is a potent nerve poison.
- Most formulations of methiocarb are classified as “restricted use pesticides.”
- Like metaldehyde, methiocarb is frequently as an ingredient in food bait pellets (especially in Europe).
- Methiocarb pellets may work better under cool, moist conditions.

1% Iron phosphate

- Occurs naturally in the soil
- First used in Europe, registered in the United States since 1997
- Ingestion causes cessation of feeding eventual death
- Main advantage is greater safety to domesticated animals
- Disadvantages are cost and (sometimes) lower efficacy

Considerations for use

- Food baits are best applied in the late afternoon
- Under humid conditions, food baits will only be effective for 3-4 days before mold grows over them.
- Several bait applications about a week apart may be necessary to control slug and snail pests in a particular area.
- Rain or heavy dew may cause pellets to swell and break apart.
- Some formulations are more resistant to water than others, and the palatability of different food baits varies according to the slug or snail species in question.

Which type of bait product do I use?

- Metaldehyde bait products are usually most economical
- Under cool, moist conditions, methiocarb baits (if available) may be more effective
- Iron phosphate can be tried around homes and in ecologically sensitive areas

GARDENER'S
SUPPLY COMPANY
Earth-Friendly Pest Controls

"Natural" Slug Control: Internet Methods

- Water less often
- Copper bands around plants
- Attract with fruits or shelter material then kill slugs
- Diatomaceous earth
- Seaweed borders around plants
- Beer traps
- Hand picking
- Salt or ammonia applied directly to slugs

Beer traps

Cultural Control

If thinking of slugs and snails as “enemies “

Enemy Strengths

True omnivores

Large animals; difficult to kill with contact poisons

Can live for a long time without feeding

Can hide in potting medium or soil

Enemy Weaknesses

Need lots of water

Some species can be controlled by hand-picking (larger species)

Most Useful Cultural control and Trapping Strategies

- Limit the number of moist hiding and breeding places (e.g. remove concrete blocks or wood in contact with ground)
- Employ moist hiding places or vegetable matter baits in “attract and kill” strategy
- Make the environment drier or less suitable (e.g. do not overwater plants, modify drainage, reduce shade or favorite food species)

The giant African snail (GAS) – *Achatina fulica* – is perhaps the best known invasive snail species. Introduced into the Pacific Basin just prior to WWII, it has been spread throughout the islands, both intentionally and as an unintended hitchhiker.

On some islands, it has already declined to the point of being a minor pest. On others, such as Kosrae (FSM), it has only recently been introduced and it may soon have serious consequences for the island's agriculture.

GAS has been an important vector of disease in the Pacific Basin.

Slide credit: Dr. David Robinson

Others are newly introduced and represent major threats to garden crops and subsistence agriculture and to human and animal health.
Of greatest concern is the Cuban slug – *Veronicella cubensis*.

Photo: David Robinson

The Cuban slug is so variable in external appearance that some scientists have incorrectly classified different morphological types into different species, based mainly on differences in color and patterns.

The **Asian semi-slug** – ***Parmarion* cf. *martensi*** – is established in the Hawaiian Islands, specifically on O‘ahu and Hawai‘i (“Big Island”).

It feeds on papaya fruit, *Hibiscus*, and lettuce and dead plant matter.

This semi-slug is believed to be an important vector of rat-lungworm disease on the Big Island.

New Pest in East Hawaii Island

- Was called out to investigate new slug species in Dec ‘04 following illnesses
- Slug density was very high
- Slugs were heavily infected with *Angiostrongylus cantonensis*

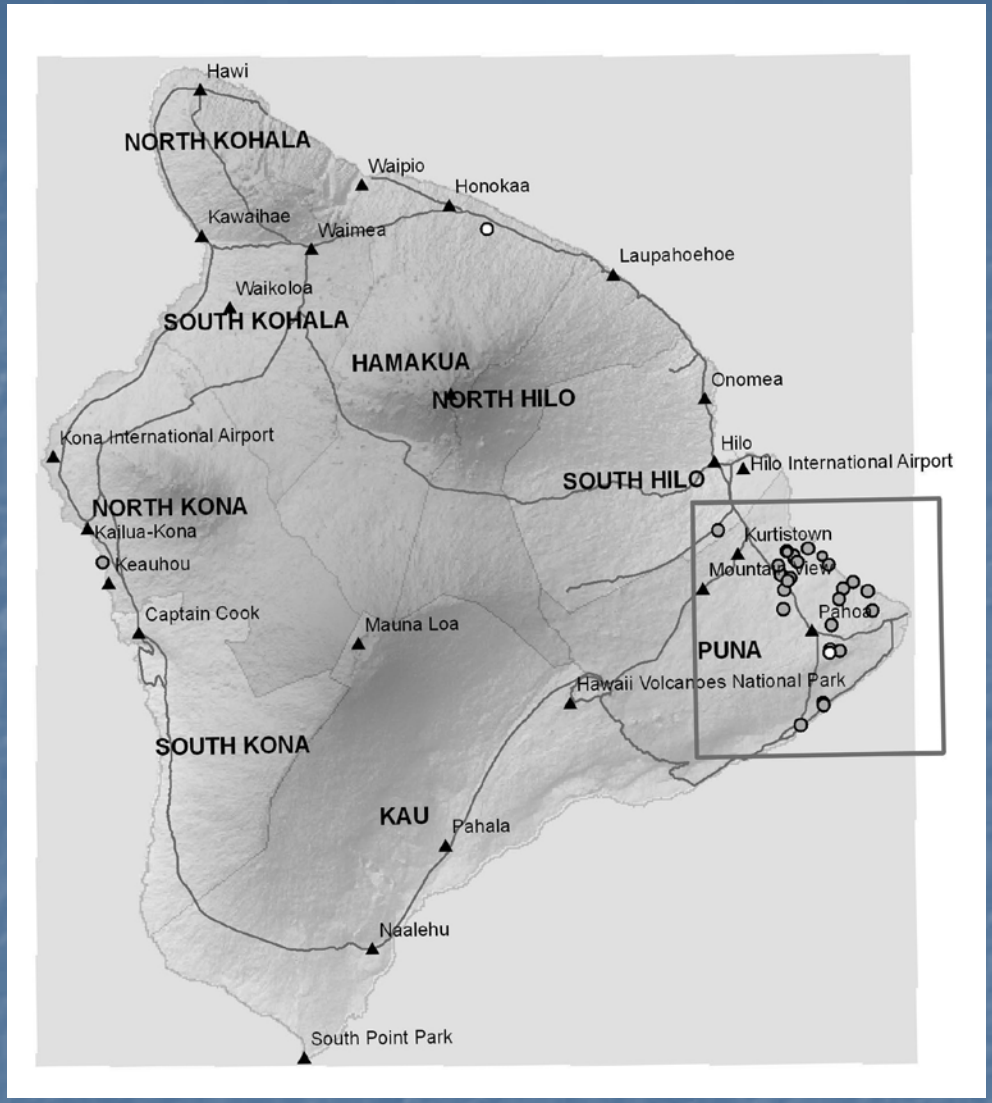

Figure 1. Survey locations for *P. martensi* in Hawaii Island (circular markers). White circles indicate sites where *P. martensi* was searched for, but not found. Inset shows Puna district.

Distribution of *Parmarion* cf. *martensi* (Pulmonata: Helicarionidae), a New Semi-Slug Pest on Hawai‘i Island, and Its Potential as a Vector for Human Angiostrongyliasis

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Types of habitat where *P. martensi* was observed by survey participants (day and night observations).

Location	No. of reports
On green plants (lettuce, fennel, sweet potato, banana, passionfruit, lemongrass, *Heliconia*)	10
On fallen fruit (avocado, guava, citrus, papaya, mango)	9
On/under plastic or plastic-like materials, including black plastic sheeting, tarps, drain pipes or plant pots	8
In compost (especially covered compost) or inside trash cans	6
In food preparation and sink areas (outdoor sinks, on dishes, grills, on toothbrush)	5
In pet food bowls or eating spilled pet food	5
On deck or stairs	5
On concrete, tile or asphalt	5
On walls of home	4
On palm fronds or trunks or under coconut shells	4
On catchments tank (on outside, under black saran cover at top)	3
On ripe papaya fruits (on tree)	2
In plant debris other than palms	2

Percent infection[a] by *A. cantonensis* in slugs collected from 5 sites in Hawaii Island.

Slug species	Size	% infected[a]	N
V. cubensis	small	0%	9
	medium	0%	2
	large	34.6%	26
	all sizes	24.3%	37
P. martensi	neonate	100%	1
	small	25%	4
	medium	76.9%	13
	large	86.4%	22
	all sizes	77.5%	40

[a]Infection determined by PCR and confirmed by sequencing of PCR amplicons.

Observations related to disease risk potential

- In Okinawa, Japanese scientists concluded that both *P. martensi* and *Platydemus manokwari* were important vectors of *A. cantonensis*
- They noted that *P. martensi* has low-density muscle tissue, and hypothesized that this was related to high worm burdens.

Platydemus manokwari (slug and snail predator, paratenic host)

Life History Observations

- *P.martensi* is attracted to and breeds in dead palm fronds
- Populations peak in late winter/early spring, when adults lay egg clusters then die in immediate vicinity
- Does the life history of *P. martensi* lead to higher levels of *A. cantonensis* in neonate *P. martensi* and flatworms?

QUESTIONS?