SLIME TIME

Intro to Slugs and Snails

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Most “troublesome” snails and slugs are exotic escapees.

In 1960, John Burch wrote that 725 species of land snails and 40 slug species were recognized in the continental United States (US), of those 44 snails and 11 slugs were introduced.

By 2005, more than 80 alien gastropod species had established self-sustaining populations in the mainland United States and Canada.

Robinson, D.G., and Slapcinsky, J. 2005
Pathways of Introduction

Deliberate
- Aquarium industry 4%
- Baggage 4%
- Food 29%
  - Medicinal purposes (extracting compounds)
  - Biological control 16%
  - Pets
  - Aesthetics

Inadvertant
- Tile 23%
- Agricultural products (food) 7%
- Horticulture products (cut flowers, live plants, seeds, turf, leaves, etc) 29%
- Commercial and domestic shipments (attached to products or packaging or shipping containers) 16%
- Military shipments 1%
- Planes-trains-automobiles
- Soil
- Aquarium industry 4%
- Aquaculture

Cowie and Robinson. 2003

4,900 interceptions in the US from 1993 through 1998
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62 interceptions in Canada from 1963-1971
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- Horticulture products (cut flowers, live plants, seeds, turf, leaves, etc)
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22 interceptions in New Zealand from 1955-1978
Alien non-marine snails and slugs of priority quarantine importance in the United States: A preliminary risk assessment

Cowie et al 2009

- Range
- Phylogenetic relationships
- Adult size
- Egg/juvenile size
- Reproductive potential
- Semelparous or iteroparous
- Selfing, outcrossing

- Introduction pressure
- Invasion history
- Major pest
- A “multi-pest” elsewhere
- Economic potential
The Importance of Slime

- Suction – allows movement upside down and up trees and other vertical things

- Dispersal – reduces traction on ground and allows them to hang about
The Importance of Slime

- Defense – emit a thick mucus coating that allows slugs to shorten and fatten their bodies, making it more difficult to eat them and provides an unpleasant taste.
- Water retention – slime helps attract (hydroscopic) and retain water; helps them fit through a “tight squeeze.”
- Nutrition – sometimes eat slime and debris collected in the slime.
- Used in the mating process.
Biology

- algae
- animal feces
- carrion
- centipedes
- fungi
- green plants
- insects
- lichens
- worms
- other slugs
- Gastropoda = stomach, foot
- Mouth equipped with a radula
- Hermaphrodites (male and female gender)
- Exchange sperm packets
- Produce eggs
- Interrupt lifecycle by controlling before eggs are laid in the fall.

Would you mind telling me who's mucus that is on your collar?
Behavior

- Aestivation: snails secrete a mucus membrane
- Only 5% of slugs above ground in summer
- Slugs can damage root crops
- Snails and slugs can be arboreal
- Can sense humidity and move positively toward moisture
- Awareness of light and shadows
- They home in on scent trails for various purposes
Taxonomy

- Phylum: Mollusca
- Class: Gastropods (stomach – foot)
- Land snails: Pulmonata
- Order: Stylommatophora
Taxonomy

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Taxonomy

- Phylum: Mollusca
- Class: Gastropods
- Land snails: Pulmonata
- Order: Stylommatophora (Stalk-eye)
Identification
Slug Anatomy 101

- **Keel** (if present)
- **Mantle**
- **Pneumostome**
- **Genital opening** (under mantle)
- **Foot**
- **Anus** (under mantle)
- **Skirt**
- **Optic tentacles**
- **Sensory tentacles**
- **Mouth**
Identification
Snails

Claudia Groth
Rolland Arriza
Name that snail
Dispersal

- Snails may adhere to trucks and automobiles as well as other equipment.
- Active dispersal varies by snail species.
- Banana slugs have been clocked at 6 ½ inches/minute.
- The milky slug can move 40 feet in a single night.
- Mark/release/capture methods have shown dispersal as far as 38 m (124.6 ft) from the original release site after six months (Aubry et al., 2006).
- Most on-site damage is caused by local populations.
- Immigration can occur. Field edges, particularly near fallow or weedy sites, can have the most damage.

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Management

- Management of actionable species is usually under the jurisdiction of federal and state authorities.
- Be aware of destination quarantine requirements.
- Some states, such as California, have snail-free certification programs.
- Regulated snail species vary by state and country.
- Pesticide registrations vary by state, always check the label and with local authorities for legal uses.
Biological Control

- small mammals
- Snakes
- Spiders
- Amphibians
- Birds
- carnivorous beetles
- sciomyzid fly larvae
- microsporidians
- Predatory slugs
- humans
Cultural Control

- Cultivation
- Sanitation
- Trap Crops
- Barriers
- Physical removal
- Traps
- Irrigation
  - Drip irrigation
    - Morning vs evening irrigation
Irrigation

Trial on cabbage:

- With evening watering and no bait pellets, percent leaf loss ranged from 40 to 60%.
- Evening watering plus bait pellets resulted in 6-12% leaf loss.
- Morning watering with no bait applied also resulted in a 6-12% leaf loss (Speiser and Hochstrasser, 1998).
IF YOU ASK ME, READING IS WAY OVERRATED...
repellents

- “repellent” refers to a substance that deters surface contact (Hollingsworth, in press)

Monoterpenes
- geraniol (*Pelargonium graveolens*)
- carvone (oil from caraway seeds)

Copper
Garlic extract
Tex-R® is a matting material impregnated with copper for better exposure (98% reduction in snail activity/90% slug died). 93% less slugs, 90% less slug eggs, 68% fewer damaged leaves on Tex-R vs Mypex. 38% fewer snails but Tex-R had growth of algae (DEFRA 2002)

A 2.3% solution of insecticidal soap (containing potassium salts of fatty acids as the active ingredient) removed 88% of brown garden snails within 15 minutes following dipping (Parrella, 1985)
“anti-feedant” refers to substances in which the deterrence is associated with “tasting” of the substrate (Hollingsworth, in press)

Octenol (mushroom Clitopilus prunulus)

Limonene

Saponins from seeds of quinoa (Chenopodium quinoa von Willdenow)

Extracts of spinach (Spinacia oleracea L.)

Extracts of plants in the family Umbelliferae

Extracts of azadirachtin from neem

vulgarone B, a sesquiterpene (Artemisia douglasiana)
More potential products

- Caffeine (toxicant and repellent - highly soluble in water)
- uscharin (*Calotropis procera* )
Chemical Control

- Mostly carbamates:
  - Metaldehyde
  - Methiocarb = Mesurol

- Iron phosphate = Sluggo or Escargot
Chemical Control

Nursery site label
- Carbaryl
- Malathion
- Cinnacure
- Orange Guard

High rates of cinnamamide killed 100% of slugs, reduced snail activity and damage also reduced slug egg hatching rates. (DEFRA)
PACIFIC NORTHWEST NURSERY IPM

Snails/Slugs

New Pest Activity Alerts
@PNWNurseryIPM At Twitter.com

Snails and Slugs

Great new resource: Terrestrial Mollusk Tool ID tool.

Speeding slugs? You betcha. Check the link to see a great short film by Kurtis Hough called Moosagrowe. It was filmed here in Oregon.

Check out my article in the Digger Magazine, Slime and Punishment

Special Treat - OPR Field Guide Takes on Slugs! Check the link for their video of slugs in Oregon.

This section of the website is devoted to information for the identification and management of snails and slugs in Pacific Northwest nurseries. The Pacific Northwest is home to a variety of slugs and snails, native and exotic. The native species play a critical ecological role in the natural environment. Exotic species, though, tend to ravage our crops and landscapes in a sometimes irritating and often expensive manner. Knowing more about these pest species can aid in prevention and effective management. This is a growing area of the website and will continue to be updated.
Ray briefs the New Snails ...