The White Garden Snail

An Old but Potentially Serious Pest of Landscape Ornamentals

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The white garden snail (WGS) (*Theba pisana*), sometimes known as the Italian white snail, can be a serious pest of landscape ornamentals, including trees, shrubs, groundcovers, and herbaceous plants. Established in California for at least 100 years, it has mostly been inactive over this period although a few episodes of rather intense activity have occurred rather close to where it had originally established. In the last few years it has once again become more active in southern California (**Fig. 1**). We are concerned that, if this activity continues to increase, the WGS will again become a major pest and do serious harm to landscape plants, especially in coastal California. Here we provide a summary of its history in southern California, distribution and ecology, damage, identification and biology, and possible management strategies. Cowie (2009) is an incredibly detailed and exhaustive reference on this pest and is readily available on-line.

History

The WGS is one of the worst snail pests of agriculture and horticulture ever introduced into North America (Mead 1971). It is the most frequently intercepted foreign land snail (Hanna 1966, Mead 1971), and typically is intercepted on shipments from the Mediterranean region (Deisler et al. 2015). The WGS is especially worrisome because of its small size, making it difficult to detect; proclivity to climb; ability to survive long, arduous journeys (Deisler et al. 2015); and explosive reproductive rate, up to 3,000 snails on a tree in less than five years (Chace 1915, Cowie 2009, Orcutt 1919). The California Department of Food and Agriculture has given it a B rating, which has the following definition: a pest of known economic or environmental detriment and, if present in California, it is of limited distribution. If found in the state, they are subject to state endorsed holding action and eradication only to provide for containment, as when found in the nursery. At the discretion of the individual county agricultural commissioner they are subject to eradication, containment, suppression, control, or other holding action.

Two common synonyms of *Theba pisana* are *Euparypha pisana* and *Helix pisana* although many more exist (Cowie 2009). The preferred common name is the white garden snail, and numerous other international common names (English, Spanish, French) and local common names (Germany, Israel, Italy, South Africa) are known (Cowie 2009).

1.The WGS, which has become more active recently, is conspicuous when it congregates and masses together on upright surfaces as here on *Pimpinella ansium*, during estivation. A few larger but similar milk snails (see text below) are here also (Oceanside, CA).

The WGS was first detected in California in La Jolla near San Diego in 1914 (Chace 1915, Basinger 1923). It soon spread to Los Angeles County but was purportedly eradicated by 1940 (Armitage 1949, Garrison 1993). Another serious eruption occurred in Los Angeles County in 1966 (Mead 1971) but was again purportedly eradicated by 1972 (Deisler et al. 2015). It was found again in San Diego in a 17-square-km area in August 1985 (Cowie 1987, Deisler et al. 2015). It is now officially established in coastal and inland areas of San Diego County (Wilen pers. obs.) (**Fig. 1**) and at a coastal site in Los Angeles County (Arakelian pers. comm.). It has been detected in Orange County (Wilen and Flint 2018). In 2017 the WGS seemed to be expanding its range dramatically, at least in coastal San Diego County (Wilen 2017).

Distribution and Ecology

The WGS is native to the Mediterranean coastal regions of Europe, Africa, and the Middle East (Pilsbry 1939, Burch 1960), although the extent to which this range is natural is uncertain (Cowie 2009). A species of coastal Mediterranean habitats of warm to hot, arid climates, it has spread into cooler and more moist coastal habitats in northwestern Europe (Cowie 2009), where it occurs along the coasts of western and northern France, Belgium, and the Netherlands and also in southern Great Britain and Ireland (Cowie 2009, Kerney and Cameron 1979, Schultes 2011).

Although generally a coastal species, the WGS extends inland in Spain, Portugal, western and southern France, Italy, Algeria, and Morocco but is less frequent than near the coast (Cowie 1990). Naturally a species of sunny areas, not shaded or forests, its principal habitat is coastal dune lands, dry scrublands, and recently recovering disturbed habitats like roadsides, railway embankments, construction sites, agricultural land, vacant fields, unkempt lots, and even maintained landscapes (Cowie 1986, Cowie 2009).

Humans have spread the WGS, intentionally or not, outside its natural range to California by 1914, the central Atlantic islands (Madeira and Canary Islands), Africa in 1881 (Somalia and South Africa), and southeastern Australia in the 1890s (including Tasmania) (Cowie 2009, Schultes 2011).

Damage and Signs

WGSs feed on an unusually broad range of plants, including cereals, pastures, orchards, vegetables, and ornamentals (Cowie 2009). Feeding damage is typical of that of all snails and slugs. It makes irregular holes with smooth edges primarily on leaves or on the margins of leaves but also on flowers. It also feeds on seedlings, ripening fruits, and young plant bark (Wilen pers. obs.). We have observed it at the San Diego site in Oceanside devouring foliage

2. The WGS feeds on *Gazania rigens* (Oceanside, CA).

3. The WGS nearly completely defoliated these stems of *Gazania rigens* (Oceanside, CA).

4. Contrast the damage caused by the WGS on the *Gazania rigens* in the upper left with that of the undamaged areas in the right and bottom (Oceanside, CA).

5. Feeding WGSs truncated the tips of this *Senecio serpens* (Oceanside, CA).

6. The WGS feeding on newly sprouted weed *Pimpinella anisum* (Oceanside, CA).

7. The WGS feeding on the weed *Salsola tragus* (Oceanside, CA).

8. The WGS congregating along the main stem of the weed *Salsola tragus* (Oceanside, CA).

9. WGSs and milk snails (see text below) estivating on *Nicotinia glauca* (Palos Verdes Peninsula, CA).

and leaving mostly bare stems of the groundcover *Gazania rigens* (**Figs. 2-4**), truncating fleshy tips of the succulent groundcover *Senecio serpens* (**Fig. 5**), and gouging stems and eating leaves of the weeds *Pimpinella anisum* (anise) (**Fig. 6**) and *Salsola tragus* (tumbleweed, Russian thistle) (**Figs. 7-8**). At the Los Angeles site in the Palos Verdes Peninsula, we observed it on *Nicotinia glauca* (tree tobacco) (**Fig. 9**), *P. anisum* (**Fig. 10**), S. tragus (**Fig. 11**), often with the similar but larger milk snail (see below), all in a weedy field near homes where residents told us that at times the WGS would invade their yards and mixed-ornamental landscaping. Because the WGS has an exceedingly high reproductive rate and thousands can amass on one tree, severe defoliation and eventual death are possible, which makes this snail a major pest (Mead 1971). Pests, such as earwigs, caterpillars, and other chewing insects, can cause similar damage but will not produce the telltale silvery mucous trails of the WGS. (Wilen and Flint 2018).

Identification and Biology

The description is taken from Cain (1984), Cowie (1984a, 2009), Deisler et al. (2015), Taylor (1906-1914), and Wilen (2017). The shell of the WGS is unusually variable in appearance, especially in the dark bands and other markings, and has led to the naming of numerous species, all of which are synonyms of *Theba pisana* (Cowie 2009). The adult WGS has a medium-sized shell about the size of a nickel or dime, 10-15(-25) mm in diameter and 9-12(-20) mm high (**Fig. 12**) (it is significantly smaller than that of the common brown garden snail [*Cornu aspersum*]) (**Fig. 13**). The shell is subglobose to depressed globular (wider than high) with a moderately depressed spire, 5.5-6 convex whorls with shallow sutures, opaque, finely striate vertically, moderately solid, and has a narrow umbilicus partially to entirely covered by an expansion of the columella. As the common name implies, the non-glossy shell is typically ivory white (rarely pink), but can be light tan and usually has a variable number of narrow, dark brown, solid or variably broken and discontinuous, spiral bands. Shell color is a variable trait and likely correlates with microhabitat (Johnson 1980). The first or very center 1.5 whorls are typically darker in color, appearing as a dark dot on the shell apex. The rounded, lunate, slightly oblique aperture has a typically sharp lip or rim and is light colored inside.

A similar looking but much less damaging snail, the milk snail (*Otala lactea*), sometimes occurs with the WGS and can be confused with it. The milk snail tends to be larger, up to 3 cm in diameter (**Fig. 14**), the inside of the aperture is dark colored (**Fig. 14**), and the rim of the aperture is thickened (**Fig. 15**).

Unlike most snails and slugs, the WGS climbs (perhaps to escape hot ground temperatures) and estivates (is in a dormant state) on the cooler and least wind-exposed sides of vertical surfaces (Cowie 1985) during the hot, dry season, being able to survive for long periods by forming a wall of dry mucus, called an epiphragm, to seal the shell aperture and reduce water loss

10. The WGS estivating on *Pimpinella anisum* (Palos Verdes Peninsula, CA).

11. The WGS estivating on *Salsola tragus* (Palos Verdes Peninsula, CA).

12. The adult WGS has a medium-sized shell about the size of a nickel or dime (Oceanside, CA).

13. The WGS is significantly smaller than the common brown garden snail (upper right) Oceanside, CA).

14. The WGS (bottom) is smaller than the similarly colored and marked milk snail (top). Also, the inside of the aperture of the milk snail is dark colored where it is white or light colored in the WGS (Palos Verdes Peninsula, CA).

15. The edge of the aperture of the larger milk snail is thickened and sometimes flange-like (Palos Verdes Peninsula, CA).

(Deisler et al. 2015). While most other snails and slugs estivate under logs, stones, wood, or other objects in the landscape and garden, the WGS estivates in the open, climbing trees (**Fig. 9**), shrubs (**Figs. 1, 10, 11**), fences, posts (**Fig. 16**), walls, and other vertical surfaces (Deisler et al. 2015), where they typically congregate massed together in great numbers in a more or less exposed, conspicuous manner to "ride out" the hot, dry season until the return of more suitable conditions in the fall.

After the first rains of the season, usually in November in California, the WGSs, cross-fertilizing hermaphrodites (Deisler et al. 2015), terminate estivation, become more active, mate, and descend to the ground from their vertical estivation sites to lay eggs (Pilsbry 1939) and/or forage. It deposits eggs one to two cm under the soil or humus in cavities dug by the snails (Basinger 1927), and hatching occurs after 20 days or can be delayed during dry weather (Deisler at al. 2015). The WGS has a relatively short life span, one to two years, is semelparous (breeds only over a single season), and produces a large number of eggs (up to 4566 eggs per pair (Cowie 1984b, 1984c; Baker 1991). Whether one or two seasons are necessary for completions of its life cycle mostly depends on whether the WGS was forced into lengthy estivation by hot, dry periods or hibernation by cold conditions (Cowie 2009).

At the Oceanside site, which had experienced a significant rain event in early October 2018, we observed a mass descent of WGSs by the end of the month from a green metal fence into a maintained landscape of the groundcovers of *Gazania rigens* and *Senecio serpens* to forage (**Figs. 2-5**). In an adjacent abandoned field, however, only a few WGSs had descended from their estivation sites on live or dead *Pimpinella anisum* stems; in most cases the rain was apparently insufficient to prompt germination and growth of an understory of fresh, green grasses and other weeds that would have provided forage. The same October rain event seemed to activate the WGS slightly at the Palos Verdes Peninsula site although most still appeared to be estivating.

We also observed at the Oceanside and Palos Verdes Peninsula sites that during the long, sunny summer estivation that the shells tend to become somewhat faded or "bleached" and the dark markings less distinctive. However, once they become active after the first rains, the shells are again a rich white and the markings dark and distinct.

Temperature and precipitation ranges of the WGS are generally about those of a Mediterranean climate, from about 0 to 50°C and 250 to 850 mm annually, respectively (Cowie 2009).

10. The WGS estivating on a street lamp post (Oceanside, CA).

Management

Control of WGSs can be long, difficult, and costly because of their high reproductive rate, the manner in which they can climb rather high up surfaces and objects, and their ability to estivate or long periods until conditions are suitable for feeding activity and reproduction (Deisler et al. 2015). Effective management of the WGS must rely on a combination of methods, including exclusion, early detection, and perhaps a variety of treatments (Wilen and Flint 2018).

As it is for most land snails, natural dispersal is limited for the WGS and most movement is by accidental or occasionally intentional human activity. To exclude the WGS from your area carefully check crates, boxes, and plants shipped from infested areas. To detect the WGS search plants, fences, posts, walls, and other vertical surfaces.

Because the WGS estivates for long periods, traditional measures used to manage other snails, such as sprays, baits, traps, and barriers, would only be effective when the snail is active and foraging on or near the ground. However, unlike other snails, the WGS estivates in the open where they are visible and conspicuous, perhaps offering the best opportunity for their control; thus, hand-picking, knocking down, and then sweeping or vacuuming might be the best option, especially with limited infestations and/or at small landscape sites. Because the WGS can estivate in vacant fields or unkempt areas adjacent to landscape sites, the former should be carefully checked. In some situations, WGSs estivating in vacant or unkempt fields could be burned or, at the very least, the sites mowed.

When WGSs are active and foraging on or near the ground, methods used to control other types of snails, as well as slugs, might be effective. Wilen and Flint (2018) provide an excellent review of these various methods, including habitat modification, hand-picking, traps, barriers, and biological and chemical control, which we summarize below.

Habitat Modification

Eliminate places where snails can hide during the day, including boards, stones, weeds around tree trunks, and dense groundcovers. Removing hiding places can lower snail populations and concentrate survivors in fewer places, making them easier to control. All hiding places cannot be eliminated, such as low ledges of fences, underside of wooden decks, and utility meter boxes, so check these places regularly and remove the snails as necessary. Snails can also be found on the leaves and stems of shrubs. Where WGSs are a problem, plants that appear to be good habitat for WGSs should be removed.

Drip rather than sprinkler irrigation and irrigating before sunrise reduces moisture on plants and allows plant and soil surfaces to fry out more, making less suitable snail habitat. Soil solarization can kill snail eggs and shallow cultivation brings eggs to the surface where they can

dry out or be targets of predators. Where possible avoid snail-susceptible plants, such as seedlings and those with soft, succulent leaves and/or fruit. Instead, use plants with highly aromatic and/or thick, hard, durable leaves, both of which seem less susceptible to snails .

Hand-Picking

Hand-picking during times when the WGS is active and foraging on or near the ground can also be effective for smaller outbreaks if done thoroughly and regularly. Carefully check potential hiding places and vertical surfaces where the WGSs could estivate. Put them in a bucket of soapy water or 5 to 10% ammonia solution until dead or place them in a sealed plastic bag and dispose of them in the trash. Snails can also be crushed and left in the landscape or garden.

Traps

Traps, like cleated boards or overturned flower pots under which snails can hide and then be easily hand-picked and destroyed, are effective against most snails but might only be of limited success against the WGS because hiding in this manner is contrary to their behavior. Beer- or yeast-baited traps buried at ground level might attract and drown WGSs when they fall into it. These deep, straight-sided, covered traps, which can be bought at a garden supply store or made, must be checked and replenished regularly.

Barriers

Barriers will not be too effective if WGSs has established in a tree or shrub and only descend to lay eggs. Nonetheless, copper flashing or screen has been effective at excluding snails until the copper becomes tarnished and then it must be cleaned with a vinegar solution. Copper barriers are effective probably because the copper reacts with the snail's slime secretion, disrupting the nervous system similar to an electric shock. Apply copper flashing along the edges of planter boxes but first ensure the soil within the box is snail free first. Copper flashing can also be used to band the trunks of trees and shrubs. When doing so cut the copper sufficiently long to give an eight-inch overlap, attach one end of the band to the trunk with a staple, then overlap and fasten the other end with two large paper clips, which allows the band to slide and expand as the trunk enlarges. Prune back any branches that touch the ground or adjacent, un-banded shrubs or trees, which would have allowed the snails to bypass the band and gain access to the canopy.

A barrier of dry diatomaceous earth one inch high and three inches wide can temporarily stop snails but is not too practical in the landscape or garden because it loses its effectiveness when it becomes damp. Crushed egg shells and coffee ground are ineffective in stopping snails.

Biological Control

Snails have many natural enemies in the landscape including raccoons, opossums, rats, domestic and wild birds, toads, turtles, snakes, insects, and some pathogens (Barker 2004, Cowie 2009) but these typically do not provide satisfactory control and some can be destructive in their own right.

In California a large Staphylinid beetle, the devil's coach horse (*Ocypus olens*) is an effective predator of snails but will also feed on ripening or decaying fruits. The predatory decollate snail (*Rumina decollata*), is sometimes used to control snails and can be very effective. Unfortunately, they can also feed on seedlings and small tender plants and flowers, they are incompatible with poison baits, and legal and practical reasons restrict or discourage their use because of their impact on native, often endangered, mollusk species.

Chemical Control

Several types of snail poison baits are available; however, they are ineffective for long-term control and are best used in conjunction with the strategies previously summarized.

Available under many trade names, iron phosphate baits are safer to use around children and domestic and wild animals, can be used for organic gardening in some formulations, and is a good choice for an integrated pest management approach. Iron phosphate baits typically kill snails slowly, up to about seven days, allowing them to go into hiding before they die. Baits containing ferric sodium EDTA kill in a similar manner and are faster, usually killing in about three days but are not labeled for organic use.

Baits containing metaldehyde are available under many trade names; however, they are particularly poisonous to cats and dogs. The 4% active ingredient is more effective than the 2%. Avoid using metaldehyde formulated with carbaryl, which was added to kill a broad spectrum of ground dwelling insects and other arthropods, because it will also kill earthworms and other beneficial, soil dwelling insects. Metaldehyde baits are most effective during warm or dry periods and will kill snails within a day. Water can reduce the effectiveness of metaldehyde baits; use products that are resistant to moisture.

Bait placement can be critical for success. Apply in late afternoon or early evening after lightly moistening the area. Scatter the bait near areas where snails congregate or seek shelter, or will cross to move from shelter to food source. Consider moist, protected sites and close to fences and walls. Baits are less effective during very hot, cold, or dry periods. Although moist conditions favor snail activity and feeding, water can reduce bait effectiveness and make it less attractive.

Much work on control of the WGS has been done in Australia but mostly due to the pest's significant negative impact on agronomic grain crops (Baker 1986, 2002). Cowie (2009) provided a summary of these measures, some of which, such as sanitary measures like maintaining open weed-free areas and use molluscicide "barriers" along fences for exclusion, could be adapted for landscape use.

Word of Caution

Use rubber or latex gloves when picking or handling snails and vegetation with their slime trails, and wash hands thoroughly because snails and slugs are intermediate hosts of rat lungworm disease, which is likely present but not yet officially detected in California. A parasitic nematode, which attacks the brain and spinal cord, causes this disease.

Literature Cited

Armitage, H. M. 1949. State Calif. Agric. Bull. No. 38.

Baker, G. H. 1986. The biology and control of white snails (Mollusca: Helicidae), introduced pests in Australia. CSIRO, Div. Ent. Tech. Paper No. 25.

Baker, G. H. 1991. Production of eggs and young snails by adult *Theba pisana* (Müller) and *Cernuella virgata* (da Costa) (Mollusca: Helicidea) in laboratory cultures and field populations. Austral. J. Zoo. 39(6): 673-679.

Baker, G. H. 2002. Helicidae and Hygromiidae as pests in cereal crops and pastures in South Australia, pp. 193-215 *In*: G. M. Barker (Ed.), Molluscs as Crop Pests. CABI Publishing, Wallingford, UK.

Barker, G. M. 2004. Natural enemies of terrestrial molluscs. CABI Publishing, Wallingford, UK.

Basinger, A. J. 1923. A valuable snail poison. J. Econ. Ent. 16: 456-458.

Basinger, A. J. 1927. The eradication campaign against the white snail (Helix pisana) at La Jolla, California. Bull. Calif. Dept. Agric. 16(2): 51-77.

Burch, J. B. 1960. Some snails and slugs of quarantine significance to the United States. Agric. Res. Ser., U. S. Dept. Agric. ARS 82-1.

Cain, A. J. 1984. Genetics of some morphs in the land snail *Theba pisana*. Malacologia 25: 381-411.

Chace, E. P. 1915. *Helix pisana* Mueller in California. Nautilus 29: 72.

Cowie, R. H. 1984a. Density, dispersal and neighbourhood size in the land snail *Theba pisana*. Heredity 52: 391-401.

Cowie, R. H. 1984b. Ecogenetics of *Theba pisana* (Pulmonata: Helicidae) at the northern end of its range. Malocologia 25: 361-380.

Cowie, R. H. 1984c. The life cycle and productivity of the land snail *Theba pisana* (Mollusca: Helicidae. J. Animal Ecol. 53: 311-325.

Cowie, R. H. 1985. Microhabitat choice and high temperature tolerance in the land snail *Theba pisana* (Mollusca: Gastropoda). J. Zoo. (A) 207: 201-211.

Cowie, R. H. 1986. Reduction in the distribution of the land snail *Theba pisana* in Dyfed. Nature in Wales 4: 66-70.

Cowie, R. H. 1987. Rediscovery of *Theba pisana* at Manorbier, South Wales. J. Conchology 32: 384-385.

Cowie, R. H. 1990. Climatic selection on body colour in the land snail *Theba pisana* (Pulmonata: Helicidae). Heredity 65: 123-126.

Cowie, R. 2009. *Theba pisana* (white garden snail). CABI Invasive Species Compendium. On-line: *https://www.cabi.org/isc/datasheet/62094*

Deisler, J. E., L. A. Stange, and T. R. Fasulo. 2015. White Garden Snail, *Theba pisana* (Müller) (Gastropoda: Helicidae). Univ. Florida/IFAS Extension Publ. EENY-197.

Garrison, R. 1993. New agricultural pest for Southern California/White garden snail (*Theba pisana*). Pest Bulletin, Los Angeles County Agricultural Commissioner.

Hanna, G. D. 1966. Introduced mollusks of western North America. Occ. Papers Calif. Acad. Sci. 48: 1-108.

Kerney, M. P. and R. A. Cameron. 1979. A Field Guide to the Land Snails of Britain and Northwest Europe. Willkiam Collins Sons and Co., Ltd., London.

Mead, A. R. 1971. Helicid land mollusks introduced into North America. Biologist 53: 104-111.

Orcutt, H. A. 1919. Shells of La Jolla. Nautilus 33: 62-67.

Pilsbry, H. A. 1939. Land Mollusca of North America (north of Mexico). Acad. Nat. Sci. Philadelphia Monographs 3: 1-573.

Schultes, F. W. 2011. Species summary for *Theba pisana*. AnimalBase. On-line: *http://www.animalbase.uni-goettingen.de/zooweb/servlet/AnimalBase/home/species?id=1365* Accessed: 14 October 2018.

Taylor, J. W. 1906-1914. Monograph of the Land and Freshwater Mollusca of the British Isles. Zonitidae. Endodontidae. Helicidae. Taylor Bros., Leeds, UK.

Wilen, C. A. 2017. Italian white snail on the move in San Diego County. On-line: *https://ucanr.edu/blogs/blogcore/postdetail.cfm?postnum=24586* Accessed 14 October 2018.

Wilen, C. A. and M. L. Flint. 2018. Snails and Slugs. Univ. Calif. IPM Pest Notes Publ. 7427. On-line: *http://ipm.ucanr.edu/PDF/PESTNOTES/pnsnailsslugs.pdf*

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