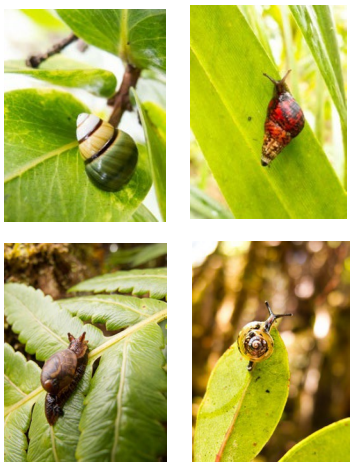
Upper left: *Achatinella byronii*, Upper right: *Laminella sanguinea*, Lower left: *Succinea* sp. Lower right: *Philonesia* sp. Photos by: D. R.



Terrestrial Invertebrates

Land snails

Orders Styl mmatophora, Archaeogastropoda

ORDERS INCLUDE:
44 Achatinelline species Federally/State Listed as Endangered
13
Native Families 750 + Native Species

GENERAL INFORMATION: The Hawaiian Islands hosted one of the most spectacular evolutionary radiations of land snails known to science with 99 percent of the 750 + valid species endemic to the islands. All but two families, Hydrocenidae and Helicinidae, are in the order Stylommatophora. The families Amastridae and Achatinellidae are the most speciose with 325 and 209 species, respectively. The family Endodontidae may contain as many as 200 undescribed species; to date only 33 are described. The phylogenetic and life history traits of some species in the family Achatinellidae, especially those in the genera *Achatinella* and *Partulina* are well understood, however the basic ecology of most other species is severely lacking.

DISTRIBUTION: Land snails are known from all Main Hawaiian Islands and Northwestern Hawaiian Islands.

ABUNDANCE: Because of declines in the availability and suitability of appropriate habitat, combined with the widespread presence of introduced predators, particularly non-native carnivorous snails (*Euglandina rosa and Oxychilus alliarius*), rats (*Rattus* spp.), and chameleons (*Chamaeleo jacksonii*), it is believed that 60 percent of native snail species are extinct, with remaining species in steep decline. While abundance estimates are available for most species in the genus *Achatinella*, and some species in the genera *Partulina*, *Perdicella*, *Newcombia*, *Laminella*, and *Amastra,* most other species are poorly understood because of a lack of systematic surveys.

LOCATION AND CONDITION OF KEY HABITAT: Hawaiian land snails occur in all native forests, including dry, mesic, and wet.

THREATS:

- Loss and degradation of habitat.
- Non-native invasive predators, particularly carnivorous snails, rats, and chameleons.
- Small population sizes and low reproductive rates makes them vulnerable to demographic and environmental stochastic threats such as loss of genetic diversity, inbreeding, hurricanes, fires, and disease.
- Global warming.

CONSERVATION ACTIONS:

- Survey across their range for undiscovered populations.

- Conduct phylogenetic assessments to confirm species identify and the phylogenetic relationships to other populations and species. As well as to assess the potential maintenance of genetic diversity and the reduction of inbreeding impacts.
- Conduct stop-gap predator control where possible to reduce impacts from introduced predators. Actions include rat trapping and the manual removal of *Euglandina* spp. and Jackson's chameleons.
- Establish captive populations to temporarily hold individuals for safe keeping or produce offspring for reintroduction or augmentation of wild populations.
- Increase capacity and redundancy for captive rearing by establishing populations at multiple facilities.
- Construct predator-proof fences to protect wild populations and to reintroduce populations from captivity.
- Establish populations within multiple predator-proof fences to create redundancy.
- Conduct direct translocations of populations to protected habitat when necessary.
- Conduct translocations of species outside of their historical ranges when recovery potential within their range is reduced due to, but limited to, climate change, predator load, or degradation of habitat, etc.
- Improve habitat at reintroduction sites by growing and planting host plants.
- Develop capacity for detection dogs to improve efficiency of predator-removal efforts from inside new predator-proof fences and during incursions at existing fence sites.

MONITORING:

- Implement scientifically robust monitoring of populations to assess trends and threats
- Cross reference population monitoring data with a detection probability index to more accurately measure population sizes.
- Continue predator detection surveys at regular intervals, adjusting predator exclusion and/or control accordingly.
- Continue population distribution surveys in known and potential habitats.

RESEARCH PRIORITIES:

- Develop and refine survey protocols to facilitate the collection of useful population data. Including research and development of improved capture-mark-recapture techniques, as well as improvement of relative abundance indices;
- Conduct investigations to assess the impacts of disease and parasites on wild and captive snail populations;
- Develop cryo-storage techniques for tissues lines or other genetic material for long-term storage;
- Conduct investigations on effective predator control strategies, particularly for Jackson's Chameleons, *Euglandina* spp., *platydemus manokwari*, and other predators found be to be depredating Hawaiian snails;
- Improve predator-proof fencing with research and development of more effective barriers and materials;
- Conduct investigations to improve the diet of captive snail populations by working towards development of a completely cultured or manufactured diet;
- Conduct investigations to determine life-history characteristics, such as growth rate, age at first reproduction, fecundity, longevity, etc;

- Conduct investigations on the impacts of herbicide on snail populations;
- Use a modeling approach to refine captive rearing methodology in terms of the size captive populations need to be, to be resistant to stochastic declines, the numbers and size classes that can be released into the wild, and at what intervals, as well as the best distribution of individuals between cages and between facilities to hedge against extinction.

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