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Achatinella fulgens

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In this moving essay on the Hawaiian tree snail Achatinella fulgens, Michael Wang explores the history of the species' decline and the unique portal that it offers into the cultural and biological richness of these islands.

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ACHATINELLA FULGENS

Islands occupy a unique place in the evolutionary imagination. They are testing grounds, petri dishes built to the scale of the globe. On a bare stage of volcanic rock, the dramas of adaptation and speciation play out as if for the first time. A stranded species might in time become dozens, like the twenty-six Darwin's finches all derived from a single species of grassquit. Each finds a niche to avoid competition and to take advantage of untapped resources. But this spectacular diversity persists only in isolation. A certain strain of Darwinian thinking views the island endemic as weak, coddled–ill-prepared for the harsh competition of the outside world, where every resource is exploited and interspecies competition the norm.

The genus *Achatinella*, land snails found only on the island of O'ahu, evolved on islands within an island. For these treebound snails, adapted to specific elevations, a high ridge or deep valley is a formidable barrier to species migration, impenetrable as the open sea. A unique *Achatinella* species might be constrained to a single mountain ridge. An individual snail is even more isolated, spending a lifetime confined to a single tree. Observing *Achatinella* segregation, the Darwinist and missionary John Thomas Gulick claimed that isolation itself led to the development of new species. Instead of "survival of the fittest," Gulick championed "non-adaptive" radiation. Green or gold, striated or whorled, the varied patterns of the Achatinella snails were formed not strictly in response to environmental pressures, but, to some degree, by chance.[i] Gulick saw each *Achatinella* as equally fitted to its environment, and perhaps this enhanced the beauty he saw in their shells: if the patterns are superfluous, they are purely aesthetic. Kant classed this kind of beauty, embodied in flowers or seashells, as "free" beauty — beauty without purpose.[ii]

A hundred years after Gulick's death, the environment that sustained the great variety of *Achatinella* snails has changed. Globalization links the world's land masses to form what ecologists have called a "New Pangaea," a supercontinent stitched together by transport and trade.[iii] The island endemic is no longer isolated. A cosmopolitan O'ahu has emerged. Its fertile lowlands now sustain species from nearly every continent: Malaysian flowering gingers, South American bougainvillea, Madagascar geckos, and North American cardinals thrive and multiply in an artificial Eden. The island supports a greater diversity of species than ever before. But in Hawai'i, the arrival of new species–and new peoples–is intertwined with the disappearance of others. Gulick's personal collection of 44,500 *Achatinella* shells represents thousands more snails than survive today.[iv] The 18th- and 19th-century mania for shell collecting itself played a part in their disappearance. Competition for novel varieties might have

completely eradicated forms known only from a few trees. But it was the arrival of new predators that nearly obliterated the genus. The arboreal black rat (*Rattus rattus*), a stowaway onboard European ships, could reach the tree-dwelling *Achatinella* to feed on their soft bodies, leaving mangled shells on the forest floor.[v] The 20th century brought an even more lethal predator, the rosy wolfsnail (*Euglandina rosea*). In 1936, a woman returning from Japanese Taiwan brought with her two giant African snails (*Lissachatina fulica*) which she released into her O'ahu garden. The snails, which can grow larger than a human hand, quickly colonized much of the island. In a fatal miscalculation, Hawaiian officials deliberately introduced the rosy wolfsnail to curb the giant African snail's spread.[vi] The rosy wolfsnail is a "cannibal snail," a specialized snail predator. But it rarely attacks larger snails, preferring to feed instead on the diminutive *Achatinella* and other native snails. As the wolfsnail ascended to steadily higher elevations, the remaining populations of *Achatinella* gradually vanished. Of the accepted forty-one species of *Achatinella*, only ten remain.

In 1991, the University of Hawaii began a captive breeding program for *Achatinella*. Now run by the state, the program occupies a single trailer permanently stationed at the end of a wet and winding road just beyond the hospital in Kailua. The species *Achatinella fulgens*, a snail with ivory shells looped with bands of cloudy-gray, mahogany or ebony, persists here and–as far as anyone knows–nowhere else. In 2018, seventeen snails occupied a plastic terrarium. During cleanings, they would be transferred to a single petri dish. Nearly all the adult snails were rescued from Pia Valley at the eastern edge of Honolulu. While *Achatinella* typically prefer native trees, in particular the Hawaiian endemic *ʻōhiʻa* (*Metrosideros polymorpha*), with its leathery leaves and tufted red flowers, this last remaining colony of *Achatinella fulgens* clung to the shiny stems of a few strawberry guava (*Psidium cattleyanum*), an invasive Amazonian tree that now forms a dense canopy throughout much of the valley. Conservationists routinely applied a mixture of salt and vaseline to the base of these trees in an effort to keep out predatory snails. But in November 2015, a landslide, triggered by record rains, swept the trees away. Only six snails were recovered.[vii]

The lab simulates the forest in fragments. Every two weeks, technicians add mountain-collected *ʻōhiʻa* leaves to the snail enclosures. *Achatinella* do not eat the leaves, but feed on an invisible layer of microbial fungi that form a thin film across the leaf surface. Wild fungi are supplemented with a pure fungal culture, a gray skin of cells propagated in the lab for decades. In the wild, these microbes are nourished by clouds. Inside the trailer, misters run on timers. Lights follow twelve-hour cycles, an eternal equinox.

Pia Valley, Honolulu, Hawaii, United States. Location where the last wild Achatinella fulgens were taken into a captive breeding program following a landslide.

The number of captive *Achatinella fulgens* fluctuates. In 2020, the population increased to around thirty snails. If the population reaches two hundred, there are plans to introduce a small number to one of several outdoor predator exclosures. Electrified fences keep rats and predatory snails out–and *Achatinella* in. While most snail exclosures are located in the wilder parts of O'ahu, in mountainous areas off-limits to hikers or on army land, the conservation program has recently constructed an exclosure on a ridge in Manoa valley, just upland from Waikiki. The exclosure was built specifically for *Achatinella fulgens*, the last of the lowland species. It is a long-term project. Building on a site overgrown with exotic plants, conservationists first cleared the land then replanted with Hawaiian natives. For now, the exclosure is devoid of snails.

At one time, *Achatinella* were nearly ubiquitous, a part of everyday life on O'ahu. An 1853 school newspaper mentions picnickers casually collecting thousands of shells over the course of an afternoon.[viii] Today, most Hawaiians have never seen an *Achatinella* snail. But the snails persist in the oral traditions of Hawaiian poetry and song. In these stories, land snails, called *kahuli*, are said to sing. In preface to the first scientific description of *Achatinella fulgens*, the malacologist and physician Wesley Newcomb quotes from a *mele*, or chant, what he calls the Achatinella's "vesper hymn":

Kahuli aku

Kahuli mai

Kahuli lei ula

Lei ako lea.[ix]

Kahuli far

Kahuli near

Red *kahuli lei*

Akolea fern *lei*[x]

"It is scarcely necessary to add," Newcomb continues, "that the singing and the song are alike imaginary." Twenty years later, the Reverend Henry Glanville Barnacle would travel to Hawai'i under the auspices of London's Royal Observatory to witness the transit of Venus. A shell enthusiast and collector, he spent time in the mountains in search of *Achatinella* and claims to have heard their song: "the grandest but wildest music, as if from hundreds of Aeolian harps."[xi] Over the last century, as the snails dwindled, competing theories sought to explain the legends. The most common explanation attributes their calls to crickets.[xii] But song is only one of the remarkable characteristics ascribed to *kahuli* in Hawaiian *mele*. Some snails, endowed with supernatural powers, can assume human form. The word "*kahuli"* itself can mean to "turn" or "change."[xiii] This double meaning shapes interpretations of Newcomb's "vesper hymn." Hawaiian scholar Mary Kawena Pukui translated this poem: "Turn over this way, Turn over that way. Turn with love to the fern fringed pond."[xiv]

Change is the basis of evolution. The *kahuli's* mutability produced the diversity of species that so entranced early evolutionists. In their monograph on the genus *Achatinella*, Henry Augustus Pilsbry and Charles Montague Cooke describe each Achatinella species as *internally* diverse, calling out *Achatinella fulgens* as particularly variable. "Many strikingly diverse color-mutations have arisen and become more or less generally spread throughout the *fulgens* area." Color plates with dozens of specimens illustrate the range of forms, and the authors employ an expansive vocabulary to denote each type. "Plumata pattern.

Finely streaked with vinaceous, purple drab or plumbeous gray." "Augusta pattern. Green or olive with a yellowish or white band below the suture." "Varia," "Diversa," and "Trilineata" name patterns in yellows, greens, and browns.[xv] Today, these fanciful names are no longer used. All *Achatinella fulgens* alive today trace back to a mere eight wild-captured adults. Gone are the deep greens and violets. The entire diversity of the species can be seen at once–held, literally, inside a single petri dish.

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This essay draws on Michael's larger project, *Extinct in the Wild,* which traces the passage of species from nature into culture. Extinction in the wild reveals the double-edged impacts of humans on other organisms: species that have disappeared from the environments in which they evolved–often as the result of human actions–now persist only under human care. No longer wild, they have been subsumed within various spheres of culture: horticulture, scientific research, conservation, or the pet trade. As part of this project, he is documenting locations where species classified as extinct in the wild were last observed in nature. He is also documenting these species in captivity or cultivation. While the category "extinct in the wild" necessarily draws a line between the natural and human worlds, the unique stories of these species reveal many possible relations between humans and other living beings.

[i] John T. Gulick, "On the variation of species as related to their geographical distribution, illustrated by the Achatinellinae," *Nature* 6 (July 18, 1872): 222-224.

[ii] "Flowers are free natural beauties. Hardly any one but a botanist knows what sort of a thing a flower ought to be; and even he, though recognising in the flower the reproductive organ of the plant, pays no regard to this natural purpose if he is passing judgement on the flower by Taste." Immanuel Kant, "The judgement of taste, by which an object is declared to be beautiful under the condition of a definite concept, is not pure," *Kant's Critique of Judgement,* translated by J.H. Bernard (London: MacMillan, 1914), 82-83.

[iii] Harold Mooney cited in Michael L. Rosenzweig, "The four questions: What does the introduction of exotic species do to diversity?" *Evolutionary Ecology Research* 3 (2001), 361-367.

[iv] Michael G. Hadfield. "Extinction in Hawaiian Achatinelline snails," *Malacologia* 27 (1986), 67-81.

[v] Michael G. Hadfield, Stephen E. Miller, and Anne H. Carwile, *Recovery plan for the O'ahu tree snails of the genus Achatinella* (Portland, OR: U.S. Fish and Wildlife Service, 1992).

[vi] Albert R. Mead, *The giant African snail: A problem in economic malacology* (Chicago: The University of Chicago Press, 1961).

[vii] David Sischo, personal interview with the author, 23 July 2020.

[viii] Michael G. Hadfield, "Extinction in Hawaiian Achatinelline snails."

[ix] Wesley Newcomb, "Descriptions of seventy-nine new species of Achatinella, Swainson, a genus of Pulmoniferous Mollusks, in the Collection of Hugh Cuming, Esq." *Proceedings of the Zoological Society of London* XXI (1853), 128-156.

[x] Author-modified text based on translation by Noelani Kanoho Mahoe, *E Himeni Hawai'i Kakou (Let's Sing Hawaiian Songs)* (Honolulu: Governor's Committee Hawaiian Text Materials, 1973).

[xi] Henry Glanville Barnacle, "Musical sounds caused by *Achatinellae*," *Journal of Conchology* IV (1883), 118.

[xii] Yoshio Kondo, "Memorandum to Dr. Force on the whistling or singing land snails of the Hawaiian islands," 30 August 1965, Bishop Museum Library, Honolulu.

[xiii] Aimee You Sato, Melissa Renae Price and Mehana Blaich Vaughan, "Kāhuli: Uncovering Indigenous Ecological Knowledge to Conserve Endangered Hawaiian Land Snails," *Society & Natural Resources* 31.3 (2018): 320-334.

[xiv] Yoshio Kondo.

[xv] Henry A. Pilsbry and C. Montague Cooke, *Manual of conchology, structural and systematic*, Second series, Vol. XXII, *Achatinellidae* (Philadelphia: Academy of Natural Sciences of Philadelphia, 1912-1914).

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