



In Search of Lost Snails

Storying Unknown Extinctions

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Abstract The Hawaiian Islands were once home to one of the most diverse assemblages of terrestrial snails found anywhere on earth, with more than 750 recognized species. Today, however, the majority of these species are extinct, and most of those that remain are headed swiftly in the same direction. But this is just the crisis that we know about, that we can in some way quantify. In Hawai'i, and all over the world, a diversity of species—many of them invertebrates—are being lost while they still remain unknown to science. In fact, for every described species that blinks out, the best estimates indicate that roughly another four extinctions take place entirely unknown to us. This article focuses on the particular case of Hawai'i's snails and the efforts of taxonomists to catalog them as a way into this broader unknown extinction crisis. Snails have particular lessons to offer in understanding and responding to this situation. This article seeks to draw out those lessons, thinking through some of the challenges for storytelling in summoning up these unseen others and in opening up a space for ethical encounter with living and dead beings that must, in important ways, remain beyond the edges of our knowledge.

Keywords extinction, taxonomy, ethics, storytelling, snails

Each new drawer we opened revealed another set of wonders, another surprising color or variation in shape or size. In one drawer we encountered the tiny, delicate, translucent shells of *Succinea lumbalis*, in another the grey conical forms of *Newcombia cumingi*. In other drawers, the tiny zebra-striped shells of *Laminella aspera*, not more than a few millimeters in length when fully grown and yet intricately patterned, nonetheless. In many other drawers, we found the colorful shells of the *Achatinella* tree snails in every shade of yellow, green, and brown, some with bands and stripes, others sporting designs reminiscent of tweed or tortoise shell. Drawer after drawer, cabinet after cabinet, row after row, we moved through the malacology collection of the Bernice Pauahi Bishop Museum in Honolulu, ultimately seeing only a tiny selection of their shells.

I have to admit that I did not really know what I was looking at. I had then, and still have now, nothing like the trained eye of a taxonomist, honed to the craft of identifying

and categorizing species. The longer I spent staring at this diversity of land snail shells, the more convinced I became that I lacked almost entirely the ability to discern the subtle differences of form that matter to the experts in telling apart two closely related species.

My guide was Nori Yeung, curator of this incredible repository of more than 6 million snail shells from all over Hawai'i and the broader Pacific region. I had asked Nori to show me the collection and tell me about its history and significance. In particular I wanted to speak to her about her taxonomic research: an effort to refine the comprehensive inventory of snail life in the Hawaiian Islands. Drawing on this remarkable collection of shells and a broad array of other resources, Nori, her partner Ken Hayes, and their colleagues are working to improve our understanding of just how many Hawaiian snail species there once were as well as how many of them are still left.

It is not well-known that, among its many biological riches, Hawai'i is a land of snails. While snails can be found all over the world—indeed they inhabit every continent and island archipelago outside the arctic—very few other places supported anything like the variety found in this island chain. To date, more than 750 species of Hawaiian land snails have been described and recognized as valid by taxonomists.¹ But this number is subject to ongoing change, both as new species are discovered, and as species formerly identified—some of them well over a hundred years ago—are revised. The actual number is thought by most scientists working in the area to probably be somewhere in the region of one thousand species.² But even at 750, the tiny patches of land that form these islands were once home to roughly two-thirds the number of snail species that have been described from the whole of continental North America, a landmass about seventeen hundred times the size. What is more, almost all of Hawai'i's species—roughly 99 percent—were endemic to these islands, found nowhere else.³ By any reckoning, Hawai'i is a remarkable place when it comes to snails.

Sadly, however, museum collections like this one are now the only place that most of these species—or rather their shells—can still be found. Of the more than 750 recognized species, roughly 450 are thought to be extinct, the majority of them having been lost in the past hundred years or so.⁴ The most comprehensive picture of the current snail situation in Hawai'i has been produced by Nori, Ken, and their colleagues, drawing on thousands of hours in the field looking for snails at sites throughout the islands, informed by historical survey materials held in this museum and others around the world. Equally as concerning as those species already lost, their preliminary survey

1. Cowie, Evenhuis, and Christensen, *Catalog*; Yeung and Hayes, "Biodiversity and Extinction."

2. Interviews with snail specialists in Hawai'i, including Nori Yeung, Ken Hayes, David Sischo, Mike Hadfield, and Brenden Holland, conducted between 2017 and 2020.

3. Yeung and Hayes, "Biodiversity and Extinction."

4. Yeung and Hayes, "Biodiversity and Extinction."

work has shown that the remaining three hundred species are in a great deal of trouble, with a grand total of eleven categorized as “stable.”⁵

The causes of this decline are complex. In the past, Hawai‘i’s snails suffered from extensive habitat loss as land was cleared for farming and ranching, and then for urban, tourist, and military developments. For a hundred years or so, beginning shortly after the arrival of Europeans and Americans, a shell-collecting craze also decimated many species, a period that some locals at the time referred to as “land shell fever”⁶—and a period that, somewhat ironically, contributed many of the shells now held in the Bishop Museum and elsewhere that are today providing vital information about snail decline and conservation. Those species remaining today are threatened primarily by a variety of predators introduced to the islands by humans, including rats, chameleons, and even a carnivorous snail.⁷

In the midst of this incredible and ongoing loss, Nori and Ken are focused on snail taxonomy. Basic taxonomic research—identifying and describing species—is often taken for granted in conservation efforts, especially when we are dealing with vertebrate animals like mammals and birds where we generally have a pretty good sense of who is who, and even of their life histories and distributions. As we will see, however, when it comes to snails and many other invertebrates there is so much that we do not know, meaning that we often cannot even say whether conservation efforts are necessary, let alone how to go about them.

But this taxonomic research also reveals that, alongside the many disappearing species that we know about, numerous others, unknown to science, are also slipping away. The extinction of unknown species is a pervasive and largely undiscussed feature of our current period of global biodiversity loss. This article is an effort to grapple with this unknown extinction crisis. It explores the “invertebrate bias” that shapes contemporary taxonomy and conservation efforts, detailing how Hawai‘i’s snails come to be known to science, or not, and some of the consequences, challenges, and limitations of these processes.

My interest in these questions goes beyond the practices of scientists. At its core, this article is an effort to explore the role of “lively storying” or “ethography” in the

5. Figures shared at Hui Kāhuli meeting organized by David Sischo, Bishop Museum, Honolulu, March 9, 2020.

6. Kay, “Hawaiian Natural History.” This period of shell collecting began in the 1820s with the arrival and permanent settlement of Christian missionaries and their families from the United States, but it really took off from the 1850s. While the activity was taken up by a broad range of people, of all ages, it was particularly popular among school-age boys and young men. Many of these private shell collections included thousands of specimens; some of them had tens or hundreds of thousands. This activity continued into the early twentieth century. In other work I have explored this history and the way in which shell collecting in Hawai‘i—alongside other natural history activities—was intimately entangled with the larger processes in which these outsiders came to “settle” themselves into this place (to know and order it) as well as with the eventual overthrow of the Hawaiian monarchy and annexation of these islands as part of a growing US Pacific empire at the end of the nineteenth century. See van Dooren, *World in a Shell*.

7. USFWS, “Recovery Plan”; Holland et al., “Tracking Behavior.”

context of unknown loss. Much of my research has been grounded in the conviction that stories can do important ethical work in responding to extinction, providing openings into the remarkable worlds of the disappearing and the disappeared, including the many ways in which they are tangled up with and significant to others. But for countless unknown species of snails and other invertebrates, these are stories that we cannot really tell.

This article is prompted in large part by Michelle Bastian's thoughtful challenge to think more about the possibilities and difficulties of storying unknown extinctions.⁸ In this work, Bastian's primary interest is in the extinction of "creatures that have been, and will remain, unknown"—but, importantly, who we might reasonably surmise once existed, and even point to basic details such as the ecologies within which they likely occurred.⁹ My central focus in this article is somewhat different. Specifically, I am interested in the diverse grey areas around the edges of our taxonomic knowledge in which species and extinctions slip in and out of both our comprehension and our concern. These are spaces of taxonomic discovery and revision, including the description of numerous "new" species—unknown to science—after the fact of their extinction (generally based on their remains).¹⁰ As Rick De Vos has explored, the borders demarcating what will and will not count as a legitimate species, borders that shift with taxonomic practices (albeit with some taxa more than others), play a vital role in determining which individuals' "lives and ways of living," and by extension which absences, come to matter in our accounts.¹¹

In exploring these more ambiguous spaces of knowledge, I aim to draw these species into the discussion of extinction storytelling. While these species are themselves worthy of our consideration, as I will argue in the final section of this article, my hope in focusing on them is that they might also provide some avenues into the spaces of complete unknowability, of "profound absence," that are the focus of Bastian's discussion.¹² In taking up these themes, this article itself offers a scattered narrative of sorts, one that aims to attend to, to make some sense of, losses that we cannot really know.

Importantly, this article focuses explicitly on the work of contemporary taxonomic science. This focus should not be taken to imply that this is the only way of classifying the living world. All communities utilize their own particular taxonomic systems and "common names" that align with and diverge from those of scientific taxonomy in

8. Bastian, "Whale Falls." Also see Smith, "Dis(appearance)."

9. Bastian, "Whale Falls," 454.

10. Bastian refers to those losses that are her central concern as "unknown extinctions." I prefer to think about these as "unknowable extinctions" and to view them as a subset of the former category, which might include the species that are unknown/undescribed at the particular point in time that they are thought to have gone extinct. I am mindful, however, that the border between these two categories of absence must, at least in practice, be an unstable one, as extinctions that are thought to be "unknowable" at one point might (with shifts in taxonomic approaches, for example) become knowable in some way.

11. De Vos, "Extinction in a Distant Land," 107.

12. Bastian, "Whale Falls," 459.

different ways. In other work I am exploring the names that Kānaka Maoli (Native Hawaiians) have given to snails and how these might intersect with, but also be covered over by, the naming practices of taxonomic science.¹³ Alongside these differing human modes of classification, other living beings also make their own “taxonomic” distinctions among themselves, deciding in a host of ways who is and is not one of their kind, or one of a variety of other relevant kinds that is a meaningful part of their world.¹⁴ Among their various modes of making such distinctions, snails, for example, use slime trails to determine who might be a potential mate, companion, or meal.¹⁵ As such, my discussion of scientific taxonomy’s domains of knowing and not knowing, of the named and the unnamed, should not be taken to represent an account of anything like the absolute, or universal, limits of such possibilities. Rather, it is an account of one particular set of practices, at one particular point in time, albeit, as we will see, a set of practices that represents a highly consequential mode of understanding and ordering life.

Lively Storing

Among all the shells I encountered at the Bishop Museum that day, those of *Carelia turricula* stood out. This species of ground-dwelling snail is thought to have been the largest found in the Hawaiian Islands. The conical shells of their kind filled several drawers with their diverse shades of purple and brown. Some of the adult shells I saw were about two inches in length, but others as long as three inches have been reported. These snails were once widely distributed on the island of Kaua‘i. Today shells in drawers like these are all that remains of them. As I looked down on these shells that day, they seemed so improbably large and awkward. I tried to imagine a snail moving along the ground with a narrow three-inch protuberance sticking out behind it. Then I tried to imagine a landscape thick with these incredible creatures. I asked Nori about them, and she replied with the same sense of speculative wonder: “Just to see them alive and crawling would have been so amazing.” But try as I might, I cannot quite imagine that sight.

What is lost with the disappearance of *Carelia turricula*? What has been, and is being, lost with the extinction of so many other species of land snails in these islands? There are many answers that might be given to this question, many layers of disruption, of ending, of transformation, at work here. Perhaps, as Vinciane Despret has argued, we must ultimately conclude that it is an entire world that is lost in extinction, perhaps even a constellation of worlds.¹⁶ While the full substance and complexity of this loss cannot be conveyed in words, some of its rich contours can be.

To appreciate the significance of Hawai‘i’s snails, it might make sense to start with the question of where this incredible diversity of gastropods came from. Land snails,

13. van Dooren, *World in a Shell*. For further discussion of the importance of native Hawaiian knowledge in taxonomy, see Gomes, “Reclaiming Native Hawaiian Knowledge.”

14. For a fuller discussion of nonhuman modes of taxonomic classification, see Kirksey, “Species”; Rose and van Dooren, “Encountering.”

15. van Dooren, “Snail Trails.”

16. Despret, “It Is an Entire World.”

after all, are not known for their propensity to undertake long journeys, so how did they all end up on this oceanic archipelago? The most likely answer, according to scientists, is that the first snails arrived by bird. These journeys would have been made by tiny ancestral forms of species like *Carelia turricula*, perhaps hunkered down within a bird's feathers. In these travels, snails were aided by their remarkable capacity to seal up in their shells behind a layer of mucus, insulated from the elements. On arrival, the hermaphroditic reproduction of most species, able to self-fertilize, or in other cases to store sperm from copulation for later use, would have given these animals an advantage in successfully establishing in a new land. Over millions of years, a handful of individuals arrived in Hawai'i and did just this. From them, an incredible radiation of diversity evolved, and hundreds of new species spread out across the islands, producing snails of all colors, shapes, and sizes.

These snails struck up a variety of relationships with the other animals and plants of these islands. Unlike the leaf-eating garden snails more familiar to most of us, there are no known snail species from the Hawaiian Islands that consumed living vegetation. Instead, they took up one of two other possibilities: some were detritivores, living on the ground and breaking down dead vegetation to return to the soil, while others took to the trees and bushes, specializing in the consumption of the fungi and other microorganisms that they could scrape from the surface of living leaves. While we cannot know for certain what ecological significance these activities might have had in ancient forests, it seems likely that some of these snails played an important role in maintaining the islands' soils, while—more speculatively—the leaf cleaners may have helped limit the spread of pathogenic surface microbes that can harm plants.¹⁷

With the arrival of Polynesian peoples to these islands around one thousand years ago, snails entered into a new set of relationships. In varied ways, they wove themselves into the lives and culture of these islands' first peoples, the Kānaka Maoli. Snails often appear in traditional mo'olelo and oli (stories and chants). When they do, without doubt, the most consistent theme is that of their singing in the forest at night. In fact, one of the main Hawaiian names for snails references this singing, pūpū-kani-oe, literally translating as "shell sounding long." But these stories also tell us that snails do not just sing at any old time. Rather, their singing is said to be deeply meaningful, often occurring as a sign that after a series of adventures, changes, or turbulence, all is pono again—all is righteous, correct, and good.¹⁸

* * *

In past work, often in collaboration with the late Deborah Bird Rose, I have advocated for the importance of storytelling in responding to extinction. We have argued for "lively ethnographies": stories that allow us to thicken the presence of these beings at

17. O'Rorke et al., "Not Just Browsing"; Meyer, Ostertag, and Cowie, "Influence of Terrestrial Molluscs."

18. Sato, Price, and Vaughan, "Kāhuli."

the edge of extinction, to add flesh to the bones of the dead and dying. As we learn about snail biogeography and evolution, about their reproductive and other behaviors, these creatures become something more than another Latin binomial on a long list. They emerge as distinctive ways of life.¹⁹

At the same time, these kinds of stories are also able to draw out how these particular ways of life mattered for others; that as they disappear, they unravel whole constellations of relationships that cut across any simple division between “nature” and “culture.” In the case of Hawai‘i’s snails, diverse trees, soils, birds, and humans are drawn into this process of loss. We have called these complex, multifaceted consequences of extinction its “entangled significance.”²⁰ In storying particular species losses in this way, we have worked to highlight that there is no singular extinction phenomenon: each species lost is its own unique happening. In fact, we have aimed to particularize the process of extinction even more than this, insisting that for any given extinction there is no singular meaning or experience.

More than simply recounting this complexity, we have argued that stories offer a particularly rich mode of grappling with it; that storytelling is, or can be, a fundamentally ethical work. The kinds of extinction stories we have advocated for have emphasized the importance of allowing multiple meanings to travel alongside one another, holding open possibilities and interpretations and refusing the kind of closure that prevents others from speaking or becoming.²¹ While stories can certainly be crafted in an effort to shut down this kind of complexity and force through particular conclusions—for example the kind of “invasive narratives” that Susanna Lidström and colleagues have explored²²—they can also be vital technologies for other, more open and ongoing, engagements with the world. As Megan Craig notes: “Narratives have many threads, multiple voices. Though we may discern a dominant thread that helps us follow and understand a story as it unfolds, we should also be suspicious of narratives that present themselves as completely self-assured and single-minded, . . . as utterly resolved.”²³

It is this capacity of storytelling to summon up a thicker sense of the diverse, overlapping, and sometimes conflicting meanings and consequences of extinction that we have found so ethically productive. Grounded in established critiques of ethics as a calculable and generalizable domain, we have worked to hold open questions of what or who matters and why—to relentlessly ask, with others, what does this loss mean, for whom, and what else is possible here?²⁴ In this context storytelling is an effort to draw

19. van Dooren and Rose, “Lively Ethography”; Rose, van Dooren, and Chrulew, *Extinction Studies*. For a discussion that seeks to complicate the distinction between narratives and databases of extinction, see Heise, *Imagining Extinction*, 62–86.

20. Rose, van Dooren, and Chrulew, *Extinction Studies*, 3.

21. Smith, “Hermeneutics and the Culture of Birds.”

22. Lidström et al., “Invasive Narratives.”

23. Craig, “Narrative Threads.”

24. Lawlor, *This Is Not Sufficient*; Haraway, *When Species Meet*; Rose, “Slowly”; Stengers, “Cosmopolitical Proposal”; Ginn, Beisel, and Barua, “Flourishing with Awkward Creatures.”

ever more voices and perspectives into the discussion, to attend to the situated complexity of *this* extinction, *this* encounter, and in so doing craft a response—albeit one that is necessarily partial, contestable, and open to revision.²⁵ As Isabelle Stengers has put it: “What you are responsible for is paying attention as best you can, to be as discerning, as discriminating as you can about the particular situation. That is, you need to decide in this particular case and not to obey the power of some more general reason.”²⁶

There is an important role for more generalizing approaches to animal, environmental, and intrahuman ethics in cultivating our capacities to be discerning and discriminating in particular cases, asking, for example, why and how some individuals or species have value or might be harmed. But within an extinction story, these approaches cannot simply be “applied”; they must be stretched, brought into dialogue, and redone or even undone in the particular context of this extinction.²⁷ In short, this is an emergent ethics, not an applied one.²⁸ This kind of storytelling demands an engagement with an empirical context that can surprise, demand, and twist what we thought we knew. Here, theorizing becomes inseparable from the work of description; it becomes, as Donna Haraway has put it, a theory that takes the form of an effort to “re-describe something so that it becomes thicker than it first seems,” an effort to weave the world together differently, in new ways, to produce alternative understandings and so possibilities.²⁹ In taking up such an approach, we work to unsettle the power of more abstract theorizing, allowing the wider world to push back, “giving the issue the power to oblige [us] to think.”³⁰

In an important sense my focus in this article on unknown extinctions was determined by the snails in just this way. While questions of taxonomy lingered around the edges of my earlier work on avian extinctions, as I shifted my attention to snails, I learned that they are front and center in gastropod conservation, as they are with most invertebrates. Likewise, as we will see, snails—through their own specific morphologies, in particular their readily preserved shells—have a distinctive capacity to render these extinctions visible after the fact. It is precisely these kinds of particularities that a storied, emergent ethics aims to recognize, to be compelled and guided by.

In sharing multiplicitous, layered stories of this kind we take up the work of attending to the world, both as teller and as listener. This attention pushes storytelling beyond the simple act of transmission, that of communicating ethical findings or conclusions. No doubt, stories are often powerful modes of conveying information of all kinds, made so in large part by their memorable, accessible, and engaging format.³¹ But

25. Haraway, “Situated Knowledges.”

26. Stengers, “Introductory Notes,” 188.

27. For a discussion of animal ethics “in context,” see Palmer, *Animal Ethics in Context*.

28. van Dooren, *Wake of Crows*, 10.

29. Haraway and Goodeve, *How like a Leaf*, 108.

30. Stengers, “Cosmopolitical Proposal,” 998.

31. Rose, “Slowly.” On the particular power of ending narratives—stories of the last members of species—see Jørgensen, “Endling”; Bezan, “Endling Taxidermy of Lonesome George.”

they are more than this. Storytelling is also transformative. As Craig notes, “The stories we tell and those we hear bear profoundly upon the texture of our lives and our openness or closedness to other forms of life.”³² In summoning up other beings and their worlds of relationship, stories draw us into a situated encounter, into new understandings and with them new response-abilities.³³ In this context, stories can be opportunities to test and explore, “to cultivate the intellectual, emotional, and critical capacities necessary to recognize our own implication in the world, the consequences of our actions, and possibilities for other kinds of futures.”³⁴

The Invertebrate Bias

Talking to the staff at the Bishop Museum, I got my first real sense of the “invertebrate bias” at the heart of our current biodiversity crisis. It is difficult to adequately express just how little we know about the planet’s invertebrates. In part, this is simply a question of their sheer voluminous diversity: invertebrates make up the vast majority of the animal kingdom, probably somewhere on the order of 99 percent.³⁵ But it is also a question of interest and research focus: despite their much smaller numbers, a tiny subsection of the planet’s vertebrate species attracts the vast majority of the funding for both basic research and conservation.³⁶ As a result, most of the world’s invertebrates still have not even been described by science. But this work is ongoing, with somewhere in the region of ten thousand such discoveries taking place each year.³⁷

The taxonomic work involved in describing a new species draws together a variety of strands of information. In the earliest days of snail taxonomy, many new species were declared solely on the basis of their distribution and shell morphology. On the basis of close examination of shells, snail species went in and out of (taxonomic) existence as their validity was revised by subsequent analysis. Gradually, from the final decades of the nineteenth century, studies of internal anatomy were added to this picture.³⁸ Today the tools of molecular biology have also joined the lineup. Importantly, new approaches to taxonomy have not simply superseded the old. Instead, they have been layered over one another to produce an integrative approach that is now considered by many to be a requirement for good taxonomic work.³⁹

When a new species is discovered, it formally enters the space of scientific knowledge through the act of being described in a published article. This practice dates back to the eighteenth century Swedish botanist Carl Linnaeus and the birth of modern

32. Craig, “Narrative Threads,” 439.

33. Haraway, *When Species Meet*, 86–90.

34. van Dooren and Rose, “Lively Ethography,” 90.

35. Lunney and Ponder, *Other Ninety-Nine Percent*.

36. Cowie et al., “Measuring the Sixth Extinction”; Stuart et al., “Barometer of Life.”

37. González-Oreja, “Encyclopedia of Life.”

38. Cameron, *Slugs and Snails*, 19.

39. Dubois, “Describing New Species,” 7.

taxonomy, but over the centuries it has been increasingly formalized.⁴⁰ It was Linnaeus who refined and popularized the system of binominal nomenclature whereby each species is given a two-part Latin-esque name that includes its genus and species name—and in so doing began a more unified effort to name and order the great *Systema Naturae*.

But, despite centuries of taxonomic work since Linnaeus, a great deal remains to be done. While estimates vary considerably, some reasonable working figures are that taxonomists have identified somewhere in the region of 2 million of the roughly 10 million species of plants, animals, and fungi with which we share this planet. This leaves about 8 million unknown species—the majority of which are thought to be invertebrate animals, especially insects.⁴¹

These unknown species are not simply a puzzle for curious taxonomists. In our present time, a period that many are now describing as the sixth mass extinction event since complex life evolved on this planet,⁴² countless species that have never quite managed to appear to us in the first place are disappearing forever. The fact that science has not yet described a species does not afford it any kind of special protection from extinction. Instead, there is every reason to believe that these unknown species are being lost at least as quickly as those that we do know about. In fact, most scientists who have spent time thinking about how to make sense of the level of extinction among unknown species have reached the conclusion that, if anything, they are likely to be disappearing more quickly than the species we do know about.⁴³

But even among those invertebrates that have been described, there is a readily discernible bias in what we know about them. Importantly, most of these species lack the data to allow their conservation status to be assessed. One study found that, while the conservation status of 90 percent of the mammals, birds, and amphibians had been evaluated, among the described mollusks the figure was 3 percent, and for insects closer to 0.08 percent.⁴⁴ This means, as Nori summed it up, that the conservation status of fewer than 1 percent of the world's invertebrate species has been assessed. For all the others, we just do not know enough to say how they are doing.

As Ken explained to me, snails and other invertebrates present conservationists with a really difficult situation in this regard: “We don’t know how to save them because we can’t even name most of them. We don’t even *have* a name for them, we don’t know if that’s the same species as this one here. And if we can’t name it, we can’t tell you anything about its biology. We can’t tell you how many offspring it has per year, we don’t know how it mates, we don’t know what it eats, we know almost nothing about them.”

40. In the case of animals, much of this process is now governed by the International Code of Zoological Nomenclature (ICZN). On the history of taxonomy, see Ritvo, *Platypus and the Mermaid*.

41. Mora, Rollo, and Tittensor, “Comment”; González-Oreja, “Encyclopedia of Life.”

42. Barnosky et al., “Has the Earth’s Sixth Mass Extinction Already Arrived?”

43. Purvis, “Million Threatened Species?”

44. Baillie, Hilton-Taylor, and Stuart, *Global Species Assessment*; Régnier, Fontaine, and Bouchet, “Not Knowing.”

The designation and naming of a species is an essential part of the work of care as it is practiced in contemporary biodiversity conservation. As Joshua Trey Barnett has noted, taxonomic work brings species into the world in some sense, as distinct, concrete, entities: “The act of naming delivers ‘species,’ which strictly speaking cannot be observed, over to us as something we can consciously consider, think about, write on, and care for.”⁴⁵ While this is true in some sense for all species, it is particularly the case for many invertebrates among whom distinctions between species are very far from obvious, and certainly not readily visible.

Of course, the relationship between description and conservation is not straightforward. Description is neither a sufficient nor a necessary condition for conservation: many described species are not conserved, and some species are conserved without being described (for example if they happen to reside within a protected area). In fact, in some cases being described can increase the threats to a species by making it noticeable to collectors and others. And yet, in a variety of ways, taxonomic names have today become a precondition for vital forms of visibility and care, including for the kind of basic research that Ken is describing as well as for the allocation of conservation funding under the species-centric regimes like the US Endangered Species Act that now dominate conservation efforts in many parts of the world.

The state of our current knowledge with regard to invertebrates reminds us that for a species to be “known” in a meaningful sense requires much more than its simply having been described and recognized as a valid species. The division between the known and the unknown is not a black-and-white one, but a space comprising many gradations of grey. As the biologist Alain Dubois has noted, “It would be misleading to consider that these 1.75 million ‘named’ species are ‘known to science’ [now closer to 2 million]. Actually, many of them (in an unknown proportion) have only been the subject of a single scientific publication, providing the original description of the type specimen (s), and are scarcely more than *mere nomina on lists*.”⁴⁶

Taxonomy takes on a very particular form when it comes to invertebrate groups, such as Hawai‘i’s snails, that are highly diverse and relatively understudied but also rapidly disappearing. In contrast to birds and mammals, in which almost all species are thought to be described, snails and many other invertebrates are in the midst of ongoing discovery and revision. In this context, the taxonomy cannot simply be assumed—it does not sit quietly in the background, largely settled, rearing its head every now and again when, for example, a species is reclassified as a subspecies. Instead, for snails and many other invertebrates, taxonomic work takes place within the ongoing folds of conservation efforts. It is, as Ken put it, a practice of “triage taxonomy”: identifying species in an effort to save them, focusing on groups which there is still time to help, and then describing them with as much useful information as possible so that they might be added to the list of those in need and perhaps one day even officially listed as threatened.

45. Barnett, “Naming, Mourning,” 294.

46. Dubois, “Relationships between Taxonomy,” S10.

Traces of an Unknown Extinction Crisis

Not all of the snail shells held at the Bishop Museum are to be found in the Malacology Collection's carefully organized and labeled cabinets. In dark corners and cupboards, other shells are waiting. Some of them, Nori told me, were collected more than a hundred years ago: some were donated by private collectors, others were gathered on museum expeditions. Either way, they arrived without the time or resources to adequately catalog them. These shells now sit in cardboard boxes, old Mason jars, and an assortment of other containers. Alongside these uncatalogued shells, the collection also includes a large number of specimens that technically have been catalogued but are in need of closer attention. Some of them were labelled with a tentative species name at the time of arrival; others might only have been identified at the family or genus level. Either way, no one is quite sure exactly what, or who, they are. Importantly, there are, without doubt, numerous "new" species—unknown to science—waiting to be described among these shells. We should expect, however, that when and if these species are one day described, most of them will already be extinct when this happens. Their shells will serve only as an announcement of a loss that was not known at the time.

Indeed, over roughly the last decade or so, a number of concrete examples have emerged of recent snail extinctions of previously unknown species. Some of these species have been discovered through specimens in museum collections; others have been discovered as shells deposited in the landscape. In one recent study, nine new species from the Gambier Islands of French Polynesia were discovered. Shells from all of them had been collected in the 1930s and had sat, undescribed, within the Bishop Museum collection since. By the time they were described, however, follow-up surveys could find no living trace of them in the environment.⁴⁷

It is hard to make sense of these unknown extinctions, of species that are discovered already lost. A species bursts into existence, ready to be named, described, and hopefully admired; but at the same time, it is already a former species, a lingering remnant such as a shell now being the only record of its having lived at all. We can make intuitive sense of it when these discoveries involve fossils—brontosaurus and mammoths that roamed the earth long before our time—but it is somehow a more unsettling prospect when these unknown losses become contemporary companions.

As odd as the phenomenon of unknown extinctions may seem, however, it turns out to actually be the norm—indeed, overwhelmingly so. When you think about it, how could things be otherwise, with roughly four times as many undescribed species as there are described ones? As a result, the incredible loss of diverse plants and animals that we do know about, that we can name in some way, is only one face of our contemporary crisis. While there is without doubt much that remains unseen—even actively ignored—about all the species being lost today, it is vital that we appreciate that there

47. Richling and Bouchet, "Extinct Even before Scientific Recognition."

is something else going on here as well: an unknown extinction crisis that is at once both larger and more thoroughly beyond the scope of our comprehension.⁴⁸

What is unique then about stories of snails that went extinct before discovery is not this fact in itself but that their existence and extinction have come to be known at all. In most cases, when the last of a species dies—especially an invertebrate species—all record of it vanishes with these individuals. From the diverse ecologies of soil biota that have likely disappeared with changes in agriculture that have pumped more and more synthetic chemicals into our soils, and the diverse species and communities of stygofauna that have been lost to mining and other extractive impacts on groundwater systems, to the complex communities of specialists that once fed on the whale carcasses that fell to the deep-sea floor, before commercial whaling led to their removal from the oceans: within recorded history, numerous species in these and various other ecosystems have no doubt disappeared without a trace.⁴⁹

But snails have a particular advantage over many other species when it comes to being discovered postextinction. Unlike the majority of other invertebrates, whose soft bodies mean that they frequently leave no earthly trace, snails possess a remarkable calciferous remainder. In their shells they leave behind a record of their presence, even if a thoroughly imperfect and incomplete one. While, as noted above, taxonomists these days prefer to look at a variety of other factors in addition to shell morphology, when the shells are all that is left it is still often possible, albeit slower and more difficult, to describe species in this way.

A snail shell is a miraculous thing. For hundreds of millions of years snails have been wandering the planet—its oceans, rivers, and lands—their fleshy, porous bodies protected by these sturdy calcium carbonate structures. These shells provide a record of a life. The apex, or innermost point of the spiral, is the oldest part of any shell. When a terrestrial snail is hatched or born, it begins life with this tiny shell. As it grows, it secretes calcium carbonate and other chemicals from its mantle, to build up around the aperture and incrementally extend the outermost whorl of the shell. Unlike arthropods and many other invertebrates that have an exoskeleton that must be shed to allow growth, snails have evolved protection that can expand with them, never requiring a period of vulnerable exposure—albeit one that consumes as much as half of the energy they invest in their growth.⁵⁰ If you allow your eyes to trace that spiraling

48. The effort to make some sense of these unknown extinctions sits strangely alongside a developing conversation in the environmental humanities about “spectral” and “haunted” ecologies that seeks to explore thick, relational forms of species absence in the world—asking what it means to live with missing presences. See Searle, “Anabiosis”; McCorrstine and Adams, “Ghost Species”; van Dooren, “Spectral Crows”; Hatley, “Walking with Ōkami.” Unknown extinctions are in many ways akin to these other species, albeit ones that take an even more speculative, and perhaps sometimes spectral, form.

49. See Smith, “Dis(appearance)”; Woolaston and Akhtar-Khavari, “Apathy vs. Compassion”; Bastian, “Whale Falls.”

50. Cameron, *Slugs and Snails*, 38–48.

pattern of a snail's shell outward, from apex to aperture, you are retracing the life history of this tiny being, condensed into this solid form.

In a variety of ways, these shells can be read to provide information about the lives they once contained, and indeed were. The thickness of a snail's shell can vary greatly, depending on the nutrition available in the environment, while periods of life in which growth ceased altogether can be marked with a little scar called a vax. At a much longer temporal scale, shells also record some of the features of the life of a species, with specific adaptations reflecting things such as the habitat they occupied, their dietary specializations, and the predators they lived among. For those who are able to read them, shells can not only announce the former presence of a now extinct species but also provide us with some important glimpses into its former existence.

To be sure, other creatures can also leave important traces after extinction. With the aid of climate-controlled museums, even the tiniest and most fragile species are now sometimes able to be discovered long after they have disappeared; perhaps a butterfly pinned to a board, or a sample of leaves and flowers pressed between pages. But, courtesy of their shells, snails are among that small club of invertebrates that do not require museums. As Ira Richling and Philippe Bouchet, the biologists who discovered the nine new snail species in the Gambier Islands, have put it: "Documenting extinction when it has taken place even before scientific collecting is limited essentially to vertebrates, snails and, to some extent, crustaceans. These taxa have in common that they leave postmortem remains (bones, shells and carapaces) that can be traced in the archaeological record or in discrete soil or cave horizons."⁵¹

There are no precise figures available on how long shells endure in this way: a great deal depends on the size and thickness of the particular shell as well as the soil, climatic, and other environmental conditions. Up in the topsoil, some shells have been shown to be badly degraded in as little as a few months, while others have lasted decades, perhaps even a century.⁵² Tucked away a little deeper though, as subfossils, some land snail shells have been shown to survive largely intact for tens or even hundreds of thousands of years.⁵³

In this way snails—more than most other living beings, perhaps more than any other—have the capacity to interrupt the pervasive phenomena of unknown extinctions, to draw our attention toward and allow us to see previously unnoticed losses. As a highly diverse and highly threatened taxa with a durable remainder, snails find themselves positioned somewhere between the invertebrates and the vertebrates: possessing the abundance of species found among the former, and the hard architecture of many of the latter. It is this unique position that makes snails not only an emblem but also, with a little luck, potentially a powerful disrupter of our rapidly unfolding unknown extinction crisis.

51. Richling and Bouchet, "Extinct Even before Scientific Recognition," 2434.

52. Richling and Bouchet, "Extinct Even before Scientific Recognition," 2442.

53. Cameron, *Slugs and Snails*, 330–32.

Storying the Unknown

Our current planetary predicament requires a concerted effort to get to know as many of earth's creatures as possible, not only to document their existence but also to understand their conservation status and their needs. But these efforts to know are also not enough. The reality is that in the coming decades innumerable undescribed species will become extinct—we simply will not be able to describe them, let alone produce meaningful knowledge about them, in time. Amid a long list of other difficult insights that Ken shared with me in our conversations, one of the most sobering was that at the current rate of taxonomic progress it will take roughly another five hundred years to describe all the world's invertebrate species. At current rates of extinction, hundreds of thousands, perhaps millions, more of them will be gone by then.⁵⁴

How might we learn to appreciate, to care for, and perhaps even to conserve, these unknown others? One obvious response is that we need to move away from, or at least supplement, species-centric approaches to conservation with an emphasis on protecting, and perhaps restoring, whole ecosystems that involve many more players and processes than we can possibly account for.⁵⁵ There is an ongoing discussion taking place in conservation biology, the environmental humanities, and related fields about this balance, including the extent to which charismatic “umbrella species” might actually enable the conservation of whole areas, such that, as Jean Christophe Vie, the deputy head of the International Union for Conservation of Nature's Species Programme has suggested, these two approaches might in effect be “doing the same thing but with different packaging.”⁵⁶ This is a complex topic that cannot be pursued here. It seems important to note, however, that if we want to be able to determine whether ecosystem-level conservation programs are working for species, then we will still need a good sense of who inhabits these places, and how our actions are impacting them. And so, there will ultimately be no getting away from the necessity of taxonomic research.

As a storyteller of extinction, however, all these unknown extinctions have weighed on me in another way, too. It is to these specific issues that I would like to turn in the final section of this article. As noted above, the extinction stories that have animated much of my work have aimed to draw us into disappearing worlds, to allow us to see and appreciate the intimate particularities of disappearing or disappeared ways of life. In large part, these stories might do this through conveying something of the lives these creatures live and the diverse ways in which they matter to a broader community of life, human and not. It is in this way that this kind of storytelling might cultivate a sense of curiosity and connection that draws us into new accountabilities—into an ethical encounter. But for the multitude of unknown others, we are missing precisely this information about them and their worlds—indeed, this is the case too even

54. González-Oreja, “Encyclopedia of Life.”

55. Conniff, “Conservation Conundrum”; Andelman and Fagan, “Umbrellas and Flagships.”

56. Moses, “Species vs Ecosystems.”

for many of those species that have been named by taxonomists. What role might stories play in this context? As Bastian has asked, what would it mean to “tell ethical stories of becoming with the unknown and unrecognizable?”⁵⁷

In this context, it seems to me that we need expansive storying practices. Part of this work lies in cultivating more deliberate efforts to story into and around the edges of the unknown. Such stories, in collaboration with taxonomists and other knowledge holders, aim to attend to the many species that we do not yet know (enough) about, to make some sense of who they are and why they matter, perhaps to point to the kinds of ecosystems in which they are likely to occur—at the very least, to acknowledge their threatened existence. This article offers one such story.

At a more fundamental level, however, I think that many of the extinction stories that I and others have told are already grappling with these unknown others in important ways, or at least creating avenues into care for them. Importantly, in this regard I do not see our lack of physical proximity, the impossibility of a face-to-face encounter with these unknown others, to be a significant barrier to our own entering into, and indeed drawing others into, an *ethical encounter*.⁵⁸ Far more significant for these storying practices is the need for some sort of meaningful knowledge about others—but here, I think that in practice there might be more flexibility in the forms this knowledge can take and what we can do with it than has always been made explicit in my own and others’ accounts. In this regard, I would like to suggest that there are three key ways in which the kind of extinction stories I have described in this article are attempting to do an expansive storying-work that is about much more than the particular species that reside at their centers. Whole worlds spiral out from these storied cores.

In the first instance, many extinction stories seek to account for and hold on to both the connectivities and the uncertainties that pervade the living world and our

57. Bastian, “Whale Falls,” 456.

58. While Bastian has emphasized the space of “embodied encounter” in Rose’s and my descriptions of “lively ethography,” my own view is that this kind of literal, physical encounter is not a requirement for this work. The vast majority—but not all—of the extinction stories I have told have concerned species that I have spent some time with, or at least met in passing. But these interactions are only ever one part of the “ethical encounter.” In all these cases, I have been drawn into the (nonliteral) presence of another’s suffering and death through diverse literatures, through conversations with concerned people, through experiences of relevant landscapes, and more. It is these same resources that I have then assembled to offer a thicker, entangled sense of who these beings are, one that seeks to do justice to multiple perspectives. As such, my own encounters with disappearing animals share much of the “constructedness” of the narrative encounters that I have sought to craft and draw others into. It must be acknowledged, however, that, while my own physical interactions with these animals are not essential to my ethical encounters with them, they have in many cases become central to the stories that I have subsequently told (although in some cases others’ interactions have taken their place, or my own interactions with a remainder [like a shell], a closely related species, or a visit to a key site). The intimate connection between the craft of storytelling and the work of ethics is at play here, as these recounted encounters of one form or another are often a core part of what makes a story compelling: both in the sense of bringing the reader into the narrative and of allowing its ethical analysis and other conclusions to convince (a point that Barry Lopez has made about the power of descriptions of place in nature writing in “Landscape and Narrative”).

knowledge of it. These stories begin with snails or other creatures, but they aim to draw us out from there—perhaps into an appreciation of the uniqueness of the particular landscape and ecosystems, or into a discussion of deep cultural relationships with local people. These tales can only ever capture a small part of what is significant about others. In some cases, this is a product of a lack of knowledge: for example, we just do not know in what ways and to what extent snails mattered to the soils and trees of ancient Hawaiian forests. While we can speculate, much will escape our knowing. In this way, these stories are always already stories about and for a host of others, known and unknown. They help us to appreciate that “nothing comes without its world,” and that to care for a species is to be drawn into, to become accountable for, a diverse web of lives and relationships.⁵⁹

Beyond these embodied connectivities, the particular stories that we tell are openings in other ways too. Life is not without its patterns of similarity and difference. Learning to appreciate the intricacies of a *Carelia turricula* shell is, in many ways at least, a transferable skill. It enables us to see and understand the shells of other snail species in new ways; perhaps, through a consideration of differences of function or formation, it might also draw us into a consideration of everything from the exoskeletons of insects to the slowly accreted calciferous tusks of an elephant. Likewise, understanding other facets of snail life and behavior might attune us in new ways to the wonders of diverse modes of inhabiting and experiencing the world, beyond our own capacities and proclivities. Countless other unknown species likely share some of these features in their own distinctive ways. As such, telling stories about the snails we already know a little or a lot about might help cultivate appreciation for a host of others, gastropod and not, known and unknown.

Taken together, these two openings produce a third. They help us see that learning to appreciate a particular snail species in a particular place can never be an isolated act. The aim of telling this kind of story is not to add yet another snail species, or even a handful of species, to the list of extinctions we now know and care about; nor would it be simply to add Hawaiian forest ecologies, or all gastropods, to such a list. Rather, the work of extinction stories is to draw us into an expansive space of response-ability, to contribute to a broader reorientation of thought and action in our relationships with our living world. In short, the work of telling extinction stories is *not cumulative but transformative*—not about creating a growing inventory of concern that might in some strange way mirror the efforts of taxonomists, but about cultivating an opening. It is about learning to see the world differently, learning to appreciate differently, and ultimately about becoming ourselves different in the process.

In all three of these ways—relational connectivities, patterned similarities, and ethical transformation—extinction stories reach out beyond the particular species whose lives they recount to draw us into responsibility and care for others, both known

59. Puig de la Bellacasa, “Nothing Comes without Its World.”

and unknown. To some extent, I think that this expansive storying is already at the heart of the extinction stories that I and others have aimed to tell. Like many things, however, our practice benefits from careful attention, from the effort to make explicit what we do and why, and will benefit more still from efforts to direct additional attention toward the countless unknown others disappearing around us. In this way, our extinction stories might also add some limited, speculative contour to the undifferentiated mass of the unknown that Bastian has described.⁶⁰

Returning to those drawers full of shells in the Bishop Museum, I am more convinced than ever of both the importance of getting to know this diversity intimately, and of the need for modes of appreciation and storying that exceed our direct knowing. Years after my first encounter with these shells, I find myself not much better equipped as a taxonomist, albeit with a much greater appreciation of some of the many things that I do not know enough about. While working to know more matters profoundly—it challenges us and expands our capacity to care for, to conserve, and ultimately to live well with others—in this era of escalating loss, our knowledge cannot mark the limits of our care. In addition, we need to find new, expansive ways to make sense, to make connections, and to narrate, into the vast and threatened worlds of all those incredible beings that are buzzing, crawling, whirring, and yes, sliming, around us unseen and unappreciated.

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60. Bastian, "Whale Falls."

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