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Exploration and the Environmental Imagination in *Hollow Knight* and *Rain World*

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Abstract

Metroidvania games are characterized by highly interconnected levels that open up as the player acquires new skills or knowledge of the game world. In this article, we argue that the spatial interconnectedness of the Metroidvania genre strongly resonates with ecological theories foregrounding human–nonhuman enmeshment as well as nonhuman autonomy. Discussing two recent Metroidvania titles, *Hollow Knight* (Team Cherry, 2017) and *Rain World* (Videocult, 2017), we show how these games consistently challenge the player's environmental imagination, and particularly notions of human mastery over the nonhuman world. They do so on multiple levels: by evoking rich postapocalyptic settings that resist the player's attempts to project anthropocentric assumptions onto the games; by confronting players with nonhuman characters and lore that remain unreadable and opaque; and by creating dynamically evolving game worlds in which nonhuman behavior feels unruly and unpredictable. Most importantly, though, the two games suggest ecosystemic interconnectedness by defamiliarizing the players' understanding of exploration as the linear traversal of spaces that can be fully controlled and depleted. Through this discussion, we aim to situate Metroidvania games within the growing archive of ecogaming, explaining what is so unique about the genre's approach to the environmental imagination.

Keywords

Catastrophe; difficulty; ecocentrism; ecogaming; environmental imagination; nonhuman; vulnerability

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One of the most significant areas of discussion in today's game studies relates to how video games explore and negotiate environmental issues (e.g. Chang, 2019; Op de Beke et al., 2024). This work on "ecogaming" has taken many different forms, including for instance content and formal analysis as well as more design-oriented or empirical approaches. The premise is that video games are both implicated in

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ideologies of human mastery over the natural world and capable of questioning those ideologies along two routes: through the direct representation of environmental issues (various forms of pollution and environmental disruption, climate change, natural disasters, etc.) and by capturing the causes of environmental degradation on the level of game mechanics.[1] For instance, pollution is directly represented by games such as the *SimCity* franchise (Maxis, 1993); mechanically, though, pollution is made likely by the limitations imposed on the player's resources.

Scholars of ecogaming have focused on a wide range of genres. Strategy and city-building games like *SimCity*, open-world action games such as *Red Dead Redemption 2* (Rockstar Games, 2018), and adventure games including *Kentucky Route Zero* (Cardboard Computer, 2020) have all been explored for the way in which they build on, complicate, or enrich the player's environmental imagination. "Environmental imagination" is Lawrence Buell's (1995) term for the way in which particular individuals and cultures understand the relationship between human communities and the nonhuman world. Games belonging to the popular genre known as "Metroidvania" haven't been featured in these discussions, however, which is surprising given their marked tendency to foreground ecological systems. This article argues that Metroidvania games are particularly well positioned to speak to questions about human–nonhuman relations in times of climate crisis.

Focusing on two Metroidvania titles, *Hollow Knight* (Team Cherry, 2017) and *Rain World* (Videocult, 2017), we explore the ecological value of three dimensions of the Metroidvania genre: the representational level of the game world and its nonhuman inhabitants, the interaction with AI-controlled systems, as well as the gradual opening up of the game world as new mechanics and knowledge are added to the player's repertoire. This last feature constitutes the defining aspect of the Metroidvania genre: some areas of the game world can only be accessed when the player has unlocked a specific skill or mechanic (e.g., a double jump that allows them to reach ledges located too high up for a single jump) or acquired a deeper understanding of the game world. In the former case, an area is simply inaccessible until the player-character has gained the relevant skill somewhere else in the game world. In the latter, a hidden area is accessible from the outset, but the player is unaware of how to interact with the game world in order to reach it.

Either way, the typical Metroidvania gameplay loop involves revisiting locations that have already been explored by the player, thus breaking with the sequential spatiality of many game genres (including the platformers from which, arguably, the Metroidvania genre derives). Instead of linear exploration, Metroidvania games encourage (and in some cases require) the player to backtrack to earlier locations to discover the new possibilities afforded by recently acquired skills or knowledge of how

[1] For more on the definition of mechanics in video games, see an influential article by Sicart (2008).

the game world works. Our core claim is that the basic structure of this loop is inherently ecological in the sense of James J. Gibson's (1986) psychology. Gibson's work emphasizes the interconnectedness between a perceiving organism and the physical environment in which the organism is located. This interconnectedness is, for Gibson, *ecological* in that it involves a system of organism-world relations. More clearly than other game genres, Metroidvania games use recursive traversal to capture ecological relations within a dynamically evolving game world. In this process, Metroidvania-style gameplay also resonates with the ecological imagination in a more specific sense: it disrupts an anthropocentric ideology of mastery, staging notions of human–nonhuman interconnectedness but also of nonhuman autonomy from human values and perspectives. This dimension of the genre's basic structure is amplified by the games' representational strategies (on the level of setting, characters, and atmosphere) and also by the simulation of ecosystemic relations, which is particularly pronounced in *Rain World*'s procedurally generated animation and complex AI.

We start by introducing Metroidvania games and positioning our case studies within this popular genre, which has spawned a number of successful titles, particularly in the "indie" space. In a second step, we expand on the ecological relevance of Metroidvania exploration, with examples from both *Rain World* and *Hollow Knight*. We then turn to their representational strategies as well as *Rain World*'s simulation of environmental dynamics to further specify their significance as ecogames.

Mapping Metroidvanias: Recursive exploration and opacity

The term *Metroidvania* is a portmanteau of the titles of the two Japanese games that are thought to have inaugurated the genre in the late 1980s: *Castlevania* (Konami, 1986) and *Metroid* (Nintendo R&D4, 1987).[2] The genre has evolved significantly in the course of its history, but one feature has remained fairly constant: namely, the nonlinearity of the player's traversal of the game world, which sets the Metroidvania genre apart from more sequential platforming games. The design of most Metroidvania games favors expansive and highly interconnected levels. This set-up can be considered a version of what Huaxin Wei, Jim Bizzocchi, and Tom Calvert (2010) call a "network" layout, with the player being able to move from one location to another along multiple routes. However, the network only becomes available during the course of gameplay: initially, the level design feels more linear because the player doesn't have access to many routes yet.

[2] This lineage is not uncontested, however: Koji Igarashi, a producer associated with *Castlevania* games, points to the *Legend of Zelda* franchise (Nintendo, 1986) as inspiration for that series instead of Nintendo's science fiction-themed *Metroid* (see Mitchell, 2014).

In a study of *Castlevania: Symphony of the Night* (Konami Computer Entertainment Tokyo, 1997), one of the most influential games in the genre, Paul Martin (2011) talks about "recursive performance" to characterize the typical gameplay experience of Metroidvanias, with the maze serving as a guiding metaphor for the game's spatial layout: "a character must go back and forth through a maze which opens itself up as the character collects equipment and becomes more powerful" (2011, p. 77). This gradual opening up of the game world has to do with the fact that some of the spatial connections only become available when the player-character has acquired certain in-game skills or, alternatively, when the player has obtained knowledge of how to interact with the game world in order to unlock new paths. This type of level design is usually referred to as "gating": certain areas of the game world are locked until the player has the requisite skill or knowledge. In *Hollow Knight*, for example, the player discovers that attacking a certain type of mushroom (visually distinct from other mushrooms) while landing on it results in the player-character bouncing higher than would be possible with a normal jump. Using this technique (called "nail-jump" by the community) unlocks areas of the game world that wouldn't be accessible until much later in the playthrough, when the player has acquired a double jump ability ("Monarch Wings" in the game's terminology). Thus, the opening up of the game's spatial network can depend on either contextual knowledge that builds on skills available from the outset (jumping and attacking) or on the acquisition of new abilities. This leads to an emphasis on spatial discovery: when revisiting an earlier location (Martin's "recursive performance"), the player is likely to realize that the newly acquired abilities or knowledge grant them access to locations that they previously saw as inaccessible (or, in some cases, even part of the game's background art).

As new routes or entire areas are added to the game's network, its overall spatial complexity increases significantly. This places considerable demands on the player's memory of the game world and thus ability to navigate it. Luke Arnott (2015) has discussed these challenges in relation to the *Metroid* franchise. Arnott argues that *Metroid* games have become more sophisticated in their use of visual maps that complement the player's mental mapping of game space, allowing them to keep track of important locations but also of unexplored areas that might be made accessible by the newly added skills. However, Arnott observes that in the best mapping systems the cartographic representation of the game world remains fundamentally incomplete. In *Super Metroid* (Nintendo R&D1 & Intelligent Systems, 1994), for example, only

> map rooms, save rooms, and energy and missile recharge rooms are marked explicitly. Doors and other passages are not marked and only the general location of some items appears on the map. The maps in *Super Metroid* are therefore still abstract enough that they require the player to read the space of the gameworld in tandem with the mapped spaces. (2015, p. 11)

This coordination between the player's recursive exploration and the cartographic aids provided by the game system is another distinctive feature of the Metroidvania genre.

The indeterminacy of in-game maps is also closely related to the opacity that is flaunted by many Metroidvania games. Daniel Vella's (2015) concept of the "ludic sublime," which Vella developed to discuss the gameplay and narrative difficulties posed by *Dark Souls* (FromSoftware, 2011), clearly applies to Metroidvania games as well. The Metroidvania genre often presents narratives grounded in ambiguity, the withholding of information, and environmental storytelling rather than cutscenes and dialogue.[3] Games in this genre also often maintain a certain opacity in communicating their mechanics and how they can be combined in interacting with the game world. For instance, in both *Hollow Knight* and *Rain World*, the tutorial sections are notably minimal, teaching only the most basic mechanics while leaving it up to the player to uncover how these mechanics interact and how the surrounding environment responds to the player-character's actions. Beyond *Hollow Knight*'s nail-jump, this opacity is also evident in the way *Rain World's* ecosystem reacts to the game's core mechanics. During the tutorial, players learn that they can grab and throw objects. However, some nuances of this mechanic are never explicitly explained. For example, the game's most common enemies, the lizards, can be struck on various parts of their bodies, each with a different damage absorption level. Most of the time, lizards face the player, and their heads—being the most damage-resistant part—absorb the most damage. Players may discover that throwing a rock at a lizard will cause it to turn around, exposing its vulnerable back.

This type of discovery is so rewarding because games like *Rain World* have a marked tendency to underexplain their mechanics. The resulting experience of opacity, as we will see in the next sections, ties in with the games' tendency to resist anthropocentric assumptions and perspectives in favor of a more ecocentric approach–that is, an approach in which the ultimate source of value isn't human life but a sense of ecosystemic connectedness criss-crossing the human–nonhuman divide, and in some instances even leaving the human on the sidelines.[4]

Loops of exploration

Spatial exploration is one of the most basic activities in many video game genres: it provides mechanical rewards (e.g., upgrades) as well as aesthetic pleasures (for instance, through impressive vistas or environmental variety), and it is typically required to advance the narrative. Exploration involves openness to discovery but also

[3] For more on environmental storytelling in games, see Henry Jenkins's (2004) chapter, which introduced the term, and more recent work by Clara Fernández-Vara (2011).

[4] On the definition of ecocentrism and how ecocentric values can emerge in the context of computational intelligence, see Torrance (2011).

to failure; in that respect, it captures the thrilling uncertainties of gameplay (see Costikyan, 2013). But video games' focus on exploration is also ideologically problematic insofar as it inevitably draws upon a colonial imaginary of territorial expansion and resource extraction. Put bluntly, the attractions of exploration are closely bound up with a specific environmental imagination whereby the nonhuman world must be brought under control in order to harvest its resources (upgrades, experience points, etc.). This understanding of exploration, which is arguably the dominant one in Western modernity, is of course only a tendency, not something that many games spell out, with the exception perhaps of strategy games such as the *Civilization* series, which comes close to an explicit endorsement of this ideology (see Ford, 2016). Yet, even when it remains implicit, this tendency shapes the imagination of developers and players alike; accordingly, it has been observed and critiqued by many game scholars. For instance, drawing on seminal work by Mary Fuller and Henry Jenkins (1995), Soraya Murray writes that "much of game design organizes the representations of its spaces and their traversability through its direct use-value for the player" (2024, p. 149).

The Metroidvania games we explore in this article function as ecogames precisely because of how they systematically challenge this ideology of "direct use-value" by imposing significant constraints on exploration. These constraints fall into three categories, each of which can be understood as reshaping or disrupting players' fantasies of environmental mastery: first, the already mentioned "gating" of the game world and how overcoming those obstacles requires an expansion of the player-character's skills (as well as of the player's knowledge); second, the general difficulty of traversing non-gated areas; third, the opacity and indeterminacy of the in-game maps, which only partially supplement the player's mental representations of the game world.

We can start by drawing on the ecological psychology of James J. Gibson (1986), which revolves around the possibilities of interactions afforded by the environment (also known as "affordances"). These affordances are not an inherent property of the environment but reflect the makeup and sensorimotor abilities of a particular organism. For instance, a tree affords climbing for animals of a certain size and agility; but for more land-bound creatures a tree is simply an obstacle to be avoided. Thus, from Gibson's ecological perspective, the environment isn't a stable background but a dynamic space that affords different types of movement depending on the perceiving organism's makeup. This unstable quality of the environment is directly staged by Metroidvania games through the expanding repertoire of the player's skills and knowledge: as Arnott puts it, "a seeming dead end occasionally signifies a secret" (2015, p. 8). This means that the player's perception of the environment changes dramatically based on the player-character's possibilities of interaction: a double jump, as already mentioned, makes accessible what had previously looked like a dead end. The game world's gating system thus disrupts the player's understanding of the environment as a backdrop that can be fully controlled: instead, they are constantly made aware of how the path forward could be contained

in previously visited locations—a loop of exploration that significantly challenges the assumption that game spaces can be depleted by simply visiting them once.

Even beyond the gating of certain areas, Metroidvania games consistently make exploration difficult and potentially even frustrating at times. Mechanical difficulty in games is typically discussed in relation to challenging boss encounters (e.g., in FromSoftware games) or complicated gameplay systems (see Jagoda, 2018). Games like *Rain World* and *Hollow Knight* can feature punishing combat, but more often than not their difficulty is a function of traversal: simply put, many levels or areas can be successfully traversed only through increasingly difficult gameplay, which can involve precise inputs or careful exploration. *Hollow Knight* features a number of grueling sections in which the player-character is required to make their way through a labyrinth of thorns, deadly crystals, invincible enemies blocking the way, etc. (see Figure 1). Accidentally bumping or falling into one of these obstacles returns the player-character to the start of the maze (or even kills the player-character, if their health is low). Successful traversal requires a long sequence of timed inputs (such as double jumps, dashes, etc.), with an extremely small margin of error. These parkour-like sections foreground the way in which the environment, far from being a mere backdrop to the player's interactions, can function as the antagonist: it actively resists the player-character's tendency to take "traversability" for granted or equate it with "direct use-value" (to borrow again Murray's terminology).

Figure 1. Difficult traversal in *Hollow Knight*. To make progress, the thorns and electric clouds must be avoided through a sequence of timed jumps and dashes.

In *Rain World*, the challenges of spatial exploration are amplified by a time-based mechanic. An indicator at the bottom left of the screen shows how much time is left to explore the world. As soon as time runs out, a torrential rain kills every living being in its path, including the player-character. To avoid death, players must reach one

of the hibernation shelters scattered throughout the levels (see Figure 2). Hibernation allows the player-character to survive the rain: when they wake up, a new temporal cycle starts. Each successful hibernation increases the player's Karma level, a cryptic mechanic never explained by the game. The higher the Karma, the more doors can be unlocked by the player. This intricate system of interconnected mechanics gives rise to a varied gameplay loop whereby a player goes in and out of hibernation until the level of Karma required to unlock the doors is reached. However, for the hibernation to be successful, the player-character must have eaten, which forces the player to keep exploring, leaving the safety of the hibernation shelter and exposing themselves to the risk of rain or predators.

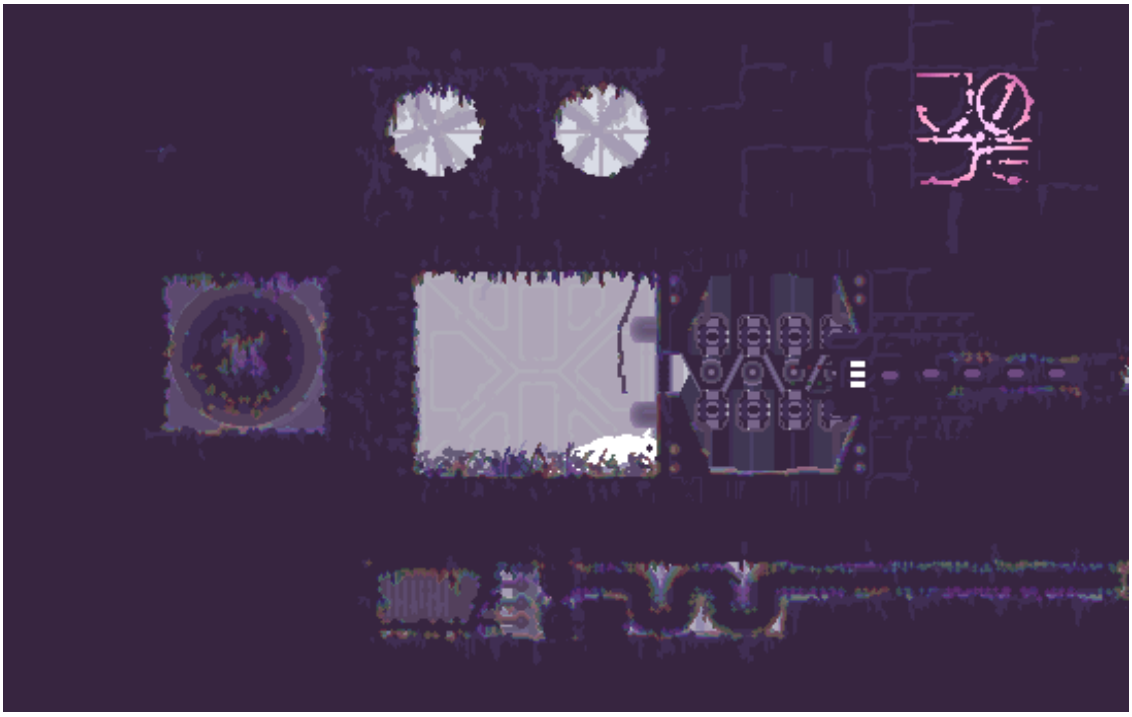

Figure 2. Resting in a hibernation shelter in *Rain World*.

Spatial traversal, in other words, is never a given in Metroidvania games. The player needs time to develop motor skills and acquire in-game abilities that facilitate the navigation of an environment that remains challenging, surprising, and opaque–in other words, an environment that resists the player's mechanical or intellectual mastery. The fast travel systems that can be unlocked in *Hollow Knight* (a tram and a network of "stag stations") are similarly imperfect, never guaranteeing instant access to other regions of the game world. In *Rain World* the fast travel system is even more limited. There is no fast travel system between the various hibernation shelters. However, upon completion of specific quests, the player-character is rewarded with a one-time teleportation "ticket." These quests are typically very difficult: for example, one of them requires the player to observe a vegetarian diet for six hibernation cycles. Such systems are designed to assist the player's navigation without eliminating the difficulty of traversal completely. In this way, recursive gameplay offers an opportunity of experiencing ecological significance by destabilizing the link between

exploration and the physical or ideological control of space. In *Rain World*, if players fail to hibernate and get caught by the rain, the game's graphics appear faded and washed out—a visual stand-in for environmental opacity. The player-character becomes even hard to see at times, suggesting that the physical environment is seeping into the slugcat's body, as if the organism-world differentiation was about to break down.

As mentioned in the previous section, the scale and "gated" layout of the game world create unique spatial complexities, turning in-game maps into an essential navigational resource for the player of Metroidvania games. But these maps are often as hard to read or use as the games' environments are difficult to traverse. In *Hollow Knight* for example, the map of each area is obtained by locating a (typically well-hidden) cartographer nonplayer character (NPC) who has explored the area before the player-character. Once obtained, the map is not as helpful as one might expect it to be: it is incomplete and only presents a general representation of the area, without showing all the viable routes and interconnections between the various areas. Moreover, the in-game map is updated only when the player-character rests at a checkpoint (a bench): the result is that the map can never be used in real time, but only after a time delay that significantly slows down exploration. A further complication is that the map does not automatically display the position of the player-character when opening it. The position is shown only when the player equips a specific amulet, which takes up a slot that could be used to wear another amulet, thus forcing the player to make a choice between ease of orientation in space and their defensive or offensive powers. Orientation in space thus becomes a mechanically costly choice. Something similar happens in *Rain World*, where the map updates as the player explores the game world and functions only as a visual support of the exploratory effort that has already been made without the help of the map.

Through these multiple levels of difficulty, the map system highlights the overall environmental opacity of Metroidvania games.[5] The network formed by the game's locations consistently challenges the player's comprehension, particularly as the newly acquired abilities open up routes that complicate the player's existing mental model of the game world. To keep track of these spatial connections, the player is forced to rely on imperfect visual representations (in-game maps) or on time-intensive and repetitive loops of exploration. The linearity of the player's spatial progress is thus radically disrupted, revealing how the environment changes dynamically as a result of the player-character's abilities. Affectively, this is communicated by the games' insistence on the expansiveness of the game world, which is another source of ludic sublime, in Vella's terminology: the player-character's body is dwarfed by the size and complexity of the world they find themselves in (more on this world in the next section).

[5] For an alternative perspective on opacity in video games, focusing on issues of mediality and mediation, see Schwingeler (2012).

Environmental opacity, instability, and vastness of scale thus go hand in hand: together, they destabilize ideologies of exploration-as-domination, contributing to keeping the players on their toes throughout gameplay. Through multiple routes, then, Metroidvania games implement mechanical strategies that undermine the possibility of anthropocentric mastery over the environment. This critique of anthropocentrism, as we'll see in the next section, is supported by representational devices that foreground postapocalyptic situations and put a great deal of pressure on the human form.

Postapocalyptic setting and nonhuman vulnerability

Both *Hollow Knight* and *Rain World* are set in worlds that brim with lore for willing players to uncover.[6] *Hollow Knight*, in particular, was clearly inspired by the rich world-building of FromSoftware games such as the *Dark Souls* series.[7] It displays many of the features that make *Dark Souls* narratives unique: sparse use of language, intricate backstories, environmental storytelling with plenty of gaps for players to fill in imaginatively (see Author a; Author b). It is hardly a coincidence, then, that *Hollow Knight* and *Rain World* have given rise to lively fan communities dedicated to the reconstruction and discussion of these worlds' backstories.

Also like the *Dark Souls* franchise, *Hollow Knight* and *Rain World* evoke ruined or postapocalyptic situations. The first settlement encountered by the player in *Hollow Knight*, the town of Hallownest, lies in ruins. Scattered throughout the world are traces—statues, artifacts, and relics—left behind by an ancient civilization that worshipped a mysterious entity called the Void. This information is gradually revealed to the player as they interact with NPCs as well as specific objects or locations. What emerges is a world that feels depleted and diminished, "hollow" as the game's title suggests. It's not a coincidence that the world's capital is named the City of Tears, an intensely atmospheric location whose bleakness is underlined by the perpetually falling rain drops. This atmosphere reinforces the sense of the player-character's insignificance vis-à-vis the scale and threat of the environment they are engaging with. The setting of *Rain World* is even more explicitly postapocalyptic: an ecological catastrophe has ravaged the locations explored by the player-character. The rain that gives the game its title was caused by the enormous amounts of pollution generated by powerful computers known as "Iterators". These past events are part of the lore that can be disclosed by the player using key items called "Colored Pearls". These objects are very rare and can only be found in specific locations: after finding

[6] Lore is to be understood here as an archive of information (for instance, concerning characters, locations, etc.) that remains in the background, unlike the game's plot. See Krzywinska (2008).

[7] The titular "knight" and the many references to well-worn fantasy tropes are also clearly inspired by the *Souls* series. However, this knight is visibly nonhuman, which introduces an ironic counterpoint to the seriousness of the title and its associations with strength, honor, etc.

them, they can be given to an NPC who unlocks several pieces of information about the past of the game world and its lore.

Players willing to engage with these worlds' backstories are asked to take on the role of amateur archeologists, discovering what caused widespread destruction on the basis of scant and partial spatial traces.[8] The catastrophic scenarios evoked by both games tie in with one of the most significant framings of today's ecological crisis: human impact on the nonhuman environment is understood through the lens of the disasters that are unfolding around us, or that are bound to unfold in the (near) future if governments don't take action (see Horn, 2018). On a representational level, then, the games' foregrounding of ruined landscapes amplifies the ecological significance of the mechanics examined in the previous section.[9]

There is something even more radical about the games' postapocalyptic imagination, though. If the environmental storytelling of these games leaves many questions open, one aspect is unmistakably clear: human beings are largely absent in these games. *Rain World* does refer to a mysterious group of "Ancients", who are depicted in vaguely humanoid terms by a number of murals throughout the game.[10] It is implied that the catastrophe that caused the titular rain is linked to this Ancient civilization. Very little else in the world of *Rain World* is anthropomorphic in nature: the posthuman setting speaks to the fantasies of "worlds without us" explored by Alan Weisman (2007) in a famous thought experiment on what would happen if humanity disappeared overnight. The player-controlled character also resists anthropocentric readings: known as "slugcats", they have a cat-like head and ears, two arms, and an elongated, amorphous tail. *Hollow Knight* contains even fewer traces of the human form: the protagonist—referred to simply as "the Knight" in-game—is a vaguely insect-like creature. The many NPCs and enemies they encounter in the course of the game—including a few knights identical to the player-controlled one—are also similar to bugs in appearance.

Animal life is thus visually highlighted by both games, but this isn't a realistic exploration of what it is like to be an animal. We are far from the kind of aspirational identification with animals discussed and critiqued by Michael Fuchs (2021) in relation to *Bear Simulator* (Farjay Studio, 2016). Because of the knight's and slugcat's mysterious nature and obscure backstories, no such straightforward identification is possible here. Instead, the player's interaction with the avatars is guided by an experience of vulnerability, a concept theorized by animal studies scholar Anat Pick

[8] See also Caracciolo (2022) on the archeological attitude such games can elicit in players and Andriano (2025) and Caracciolo (2024) for broader discussions about the role of the interpretation in lore-based narrative games such as the Soulsring games.

[9] The link between *Rain World* lore and the climate crisis emerges explicitly in online discussions: see, e.g., SparrowWingYT (2024).

[10] More information, including a screenshot of one of the murals, can be found at the game's wiki ('Lore', 2025).

(2011).[11] As Pick posits, vulnerability reaches across the divide between human beings and nonhuman animals: in this case, it brings together the player (who is mechanically in control) and the nonhuman avatar, but crucially it does so without attempting to erase their differences.

The knight and the slugcat are repeatedly presented as feeble and dispensable creatures, as suggested by the countless loops of death and resurrection they go through. (In *Hollow Knight*, this point is reinforced by the numerous beings identical to our player-controlled knight-'vessels', in the game's terminology–we encounter throughout the game world.) This sense of vulnerability is amplified by the 'cute' aesthetics that informs the game world and its inhabitants. Timothy Morton has argued that the aesthetics of cuteness is "obviously an obstacle to the ecological thought" (2010, p. 15), since it privileges individual animals (and attractive animal species) over the ecological systems they are embedded in. However, in *Hollow Knight* and *Rain World* cuteness and vulnerability enter a productive tension with the games' emphasis on repetitive loops of exploration. The player-characters' visual appeal is counterbalanced by the realization that death is an integral part of spatial traversal. This blend of vulnerability, cuteness, and acceptance of failure is central to players' engagement with the avatar: the attachment we develop for the knight and the slugcat (partly through their endearing qualities) is modulated by awareness of their fallibility, which encourages a more distanced stance towards the player-characters.[12]

In sum, vulnerability is an important ecological affect evoked by both games. It creates an imaginative bridge between the human player and the nonhuman life we are controlling (mechanically) without fully grasping (narratively). This affective strategy reinforces the player's connection with the avatar (and with their surroundings) without giving in to the illusion that the human player can simulate, and thus fully master, a nonhuman animal. Like the environment and the narrative of which they are a part, the player-characters' identities remain out of reach but distinctly nonhuman in nature, with their vulnerability echoing the larger environmental catastrophes that struck these game worlds. We will see in the next section that *Rain World* goes even further than *Hollow Knight* by implementing sophisticated AI systems that evoke a vision of ecological interconnectedness transcending the player-character.

Environmental simulation

The world of *Hollow Knight* remains fairly consistent throughout gameplay, but there are some elements of unpredictability: enemy movement and attack patterns can be haphazard, for example, and key NPCs like Quirrel can be encountered at various

[11] See also Tom Tyler's (2022) discussion of the ethical intricacies inherent in the representation of animal life in video games, a discussion that also draws on Pick's (2011) work.
[12] For discussion of the complexities of character engagement in games, see Newman (2002) and Vella (2013).

(and seemingly random) locations throughout the game world. Moreover, an important world event occurs after the player-character defeats one of the three Dreamers (which is the main objective we are given early on): the starting area, the Forgotten Crossroads, is profoundly transformed by an outbreak known as the Infection. The layout of this region changes dramatically, blocking access to certain routes and spawning a host of stronger, mutated enemies. These minor and major departures from the player's expectations lend the game world of *Hollow Knight* a certain dynamic quality, but that environmental unpredictability pales in comparison with the procedural complexity of *Rain World*.

The media attention surrounding the latter game's release was primarily driven by the recognition of two unusual features (see Skrebels, 2017): procedural character animation within the game world and the simulation of a believable ecosystem enabled by highly complex AI governing NPC behaviors.[13] In procedural animation, the animation corresponding to the player's input is generated in real-time by drawing from a general pool of algorithmic rules.[14] This is different from how, in most video games, the player's input is mapped onto a narrow set of preprogrammed animations representing specific actions. Procedural animation gives *Rain World* its distinctively flow-like aesthetic in terms of movement execution (see Figure 3). It also makes the player-character harder to control, limiting the predictability of movements corresponding to player inputs and emphasizing the sense of opacity and vulnerability we discussed in the previous section. Crucially for our purposes, the mechanical difficulty of controlling a nonhuman avatar highlights the separation between the player's human perspective and nonhuman behaviors. The unpredictability of animations and the sense of traversing a nonhuman world further complicates interactions with other creatures encountered in the game world, whose bodily movements are also often unusual or erratic. This creates challenges in planning defensive or offensive actions due to the fluidity of the current situation and its possible outcomes.

Figure 3. Grabbing a fly while jumping in *Rain World*: an example of procedural animation.

[13] In addition to scholarly work, online discussions also address the topic of how ecosystems can be represented through video game mechanics. For instance, the YouTube channel Curious Archive (https://www.youtube.com/@CuriousArchive) analyzes the topic, also in relation to *Rain World*.

[14] See also GDC Festival of Gaming (2017), where *Rain World* developers Joar Jakobsson and James Therrien explain how they implemented procedural animation in the game.

The difficulty of predicting character movements is further compounded by another distinctive feature of *Rain World*: AI implementation. It has been argued that "game AI offers an alternative, less-linear and less-teleological trajectory for the emergence of cognitive and creative possibilities, bringing to the fore dynamics and ecologies of distributed agency, relationality and processuality" (Giddings, 2020, p. 115). *Rain World* is well known for employing a complex AI system that governs animal behaviors dynamically, enabling unpredictable interactions between the various AIs controlling individual organisms as well as entire species.[15] That approach creates a "less-teleological trajectory" in the simulation of nonhuman behaviors, which means that the nonhuman is framed as unruly and resistant to human control.

Moreover, *Rain World* simulates an ecosystem that does not revolve around the player-character but of which the player-character is only a part. The most obvious one is that the game's system tracks each animal's behavior regardless of whether they are shown on the screen: their behaviors and life patterns are generated independently of the player's actions.[16] While traversing the game world, it is not uncommon to encounter scenes of combat between other animals, giving the player the sense of algorithmically driven nonhuman autonomy and immersion in a complex ecosystem that does not depend upon their presence.

This AI system takes on ecological significance in the player's experience and interpretation of the game. The design creates an impression of ecosystemic interconnectedness or "enmeshment" (Morton, 2010): the player traverses a world that simulates the development of autonomous life, a world in which animals move freely and independently of the player-character's decisions. Animals do not occupy specific positions awaiting a player-triggered response, as occurs, for instance, in the *Dark Souls* franchise, where enemy placement is a significant design element and has strategic implications for the player.

The credibility of the AI system is further reinforced by numerous complications added to the independence of individual animal behaviors. For example, the game features a reputation system: the player's tactical choices have consequences for the behavior of other creatures towards them. Avoiding aggressive behavior towards Scavengers, a particularly aggressive lifeform, increases the player's reputation in their eyes, enabling trading or simply reducing these creatures' aggressiveness towards the player. In other cases, the reputation system is even more explicit:

[15] This contrasts with the way many AI systems (particularly Large Language Models) are trained on human-produced data and thus, in a sense, reliably anthropocentric. We would like to thank one of the peer reviewers for this astute observation.

[16] In an interview (Priestman, 2017), Jakobsson states that "instead of the AI creatures just existing as a player obstacle, they exist in their own right, they exist there for themselves". He also adds that "instead of thinking 'how can I make this creature act and serve as an obstacle in the game' I went at it from the angle 'how can I make this creature behave in such a way that it can find food and move around and get back to its home before the night comes'".

the player can feed a lizard, which then acts as a protective companion, following the player across the game map. Another behavioral modifier illustrating the multilayered interactions between various AIs is the personality system. Depending on the personality of certain creatures, they may behave more friendly or aggressively, regardless of the player's or other creatures' actions, introducing further complexities to the ecosystem's interaction system.

What must be noted is that, in all these cases, whether involving the reputation system or personality traits, information about the state of particular NPCs or their relationship with the player is never transparent: it can only be inferred from various visual and behavioral cues. This serves as an example of the opacity characterizing Metroidvania ecogames, both representationally (as discussed in the previous section) and mechanically. The complex system of interconnected AI facilitates a shift from an anthropocentric paradigm, directing attention away from the player-character and toward the ecosystem as a whole. The mechanics of *Rain World*, in conjunction with its AI system, carry ecological significance because they place the player in a world they can never fully control, where they are perpetually decentralized, and where the actions of individual creatures have repercussions across the entire ecosystem. Similarly, the game's lore depicts a civilization that has faced ecological disaster due to its failure to respect and understand the ecosystemic consequences of the actions of a single species.

Conclusion

An established tradition of "human-centered" game design argues that games should cater to the sensorimotor and cognitive needs of human players (see Bostan, 2020). However, other approaches to interactive design in more general terms (not strictly game design), have highlighted the insufficiency of this design paradigm, advocating the importance of "post-anthropocentric" design choices (Borthwick et al., 2022). Our analysis of Metroidvania ecogames in this article is consistent with this post-anthropocentric philosophy. In the two indie games discussed here, *Hollow Knight* and *Rain World*, game mechanics, rules, and narrative create gaming experiences that, while aimed at human players, propose representational strategies and simulations that cultivate ecocentric perspectives rather than anthropocentric ones. More specifically, the representational dimension of these games—with its focus on postapocalyptic environments and nonhuman vulnerability—converges with two formal and mechanical features: the difficulty of spatial traversal and (particularly in *Rain World*) the simulation of dynamic environments. The result is a systematic critique of the environmental imagination dominant in Western modernity, an imagination that emphasizes human mastery and agency over ecological responsibility and interconnectedness.

The Metroidvania ecogames we explored here offer players challenges and frictions that disrupt ideologies of human domination by positioning players within worlds

that are impossible to fully grasp and control. These games create systems that transcend the player-character and decentralize human assumptions, instead focusing on nonhuman creatures and the workings of the ecosystem as a whole. They simultaneously offer a set of mechanics and rules emphasising the importance of ecological interconnectedness and a narrative that portrays the consequences of ignoring it. *Hollow Knight* and *Rain World* are not alone: other recent Metroidvania games, for instance *Animal Well* (Shared Memory, 2024) and *Ultros* (Hadoque, 2024), operate in very similar ways. The formula of "gated" environmental exploration of the Metroidvania genre is thus particularly well suited for the staging of ecological issues. This is due to how the player-character's interactions with the game world are consistently defamiliarized by their growing repertoire of abilities and environmental knowledge: space cannot be taken for granted or simply depleted through exploration. Instead, it must be revisited in gameplay loops that—together with other representational or simulative features of the games—encourage a rethinking of established patterns of environmental awareness, foregrounding human–nonhuman interconnection as well as individual vulnerability.

It is important to spell out that our argument only identifies a *tendency* in the Metroidvania genre: we are not claiming that all Metroidvania games can be read as ecogames, and neither are we suggesting that all players exposed to games like *Hollow Knight* or *Rain World* will necessarily recognize their ecological dimension. As scholars in the field of empirical ecocriticism have highlighted (see Schneider-Mayerson, 2018), the influence of environmental representations—in fiction but also arguably in games—is complex and mediated by social contexts and a wide range of cultural assumptions. Ultimately, grasping the ecological significance of these games is a matter of encountering them in social contexts that draw players' attention to this significance. However, it should be clear that the Metroidvania genre represents an important addition to discussions on ecogaming: when framed from an ecological perspective (in scholarship but also in educational settings), the genre can yield significant and, in some ways, unique insights into the possibilities and limits of human–nonhuman connection. These insights are simultaneously affective and conceptual, and they are grounded in both the representational world of Metroidvania games and in the mechanics they implement.

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