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The Underfoot Eco-fiction toys

A design exploration.

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Abstract

The implementation and play effect of eco-fiction design criteria applied to designing a range of character toys is an important but under-evaluated field. Using an eco-fiction toy framework enables the designer to embed ecological principles within the character toy design process. Children engage in less outdoor play than previous generations. This global trend has impacted a child's ability to understand and form a relationship with the natural world. Described as 'nature deficit' disorder, the decline in nature play can affect a child's ability to self-actualise and develop relationships with non-human living beings. Well-designed commercial character toys can be powerful agents for environmental awareness and interconnectedness with the natural environment. The toys used in this study, referred to as Underfoot (the creatures beneath our feet) Toys and designed for children aged 5-7 years, demonstrate how character toys can embody eco-fiction narratives and simultaneously be designed as an ecosystem to encourage and stimulate imaginative play. The designs suggest the potential for a new genre of character toy specifically enhanced by outdoor play. Playtesting sessions were conducted with a focus group of 10 New Zealand Aotearoa children through video analysis, observation, field notes and post-play parent interviews. The results are compared to interview appraisals by international toy industry designers on the effectiveness of the final design's environmental engagement. Initial findings indicate that using an eco-fiction framework within the design of character toys can enhance environmental engagement for children and encourage them to develop unique ecological narratives in simultaneous play with the toys.

Keywords: Eco-fiction, small worlds play, character toy design, nature play, toy prototyping

This paper discusses the design and evaluation of eco-fiction character toys through the design of the Underfoot range of five character toys. It proposes a new genre of character toy design specifically activated through outdoor play. The eco-fiction narrative framework guides the design process for the Underfoot toys, which operate as an ecosystem of interlinked products that utilise natural materials and environments as an extension of the play product. Natural biotic and abiotic species within living soil ecosystems influence the design of the toy characters. The Underfoot toys are based on real-world creatures and environments but employ magical realism storytelling modes to encourage imaginative play. The velvet worm, a “missing link” creature from Aotearoa¹, New Zealand, is situated here as a key character due to its ecological uniqueness and potential for characterisation.



Figure 1: The Underfoot character toys - Oke Velvet Worm, Wiggle and Leafy Boat. Photo by Tanya Marriott.

Research indicates a steady decline in childhood outdoor play and engagement. A UK Study revealed that children could better identify Pokémon characters than local flora and fauna (Robinson et al., 2016). The Child and Nature

¹ Aotearoa is the te reo Māori-language name for New Zealand. Its use here is in respect to and acknowledgement of the first peoples of this land.

Network (Louv, 2008) coined an umbrella term for these negative impacts: 'Nature Deficit Disorder' Louv indicates, "Children today play outside less often, and for briefer periods, they have a more restricted home range and have fewer, less diverse playmates" (p. 34). Increased structured activities, sports, after-school classes, and steady access to digital devices have influenced the decline in nature play.

Key areas relevant to this research include the impact of nature deficit on the child's ability to imaginatively and creatively play and the relationship children form with the natural world through these modes of play. The subsequent effect is a documented decline in the independent freedom to roam and play that a child of previous generations experienced. The Underfoot research considered what constitutes meaningful outdoor toy play and designed methods that encourage children to understand the interconnections between humans and the natural world. As initiatives are sought to encourage children back outside, a new genre of doll and action figure toy designed for outdoor play could encourage nature-based play. The more significant challenge this paper discusses is how to design these toys.

Eco-Fiction

Eco-fiction is a literary framework that defines a "new way of seeing and understanding the consequences of the destruction of the natural world, humanity's impact on the environment, and the possible solutions to environmental degradation" (Baratta, 2011, p.3). Eco-fiction narratives importantly challenge anthropocentric viewpoints by centring an environmental theme where humans are not the central focus; instead, they play a background role within a broader ecosystem.

Eco-fiction has a rich history in literature, animation, and game design, underpinning the Underfoot toy's narrative design and how they have been designed for play within nature. Dwyer (2010), in his field guide 'Where the Wild Books Are', defines Eco-fiction criteria based on the framework developed by Buell and his thematic analysis of hundreds of environmentally significant texts. Texts including *Walden* (Thoreau, 1910 [1854]) to *Watership Down* (Adams, 1972) centralise animals as defined characters within their world who explore the world through their perspective. Eco-fiction is not just about environmental narratives; at its core, the subject encourages people to understand the consequences of our dominant human relationship with other species, privileging other species' stories and exploring the world as an interrelated system.

Eco-Fiction Narratives

Eco-fiction narratives were particularly prevalent within early licensed toys such as My Little Pony (Hasbro), She Ra (Mattel), Care Bears (Hasbro) and Transformers (Hasbro, Takara Tomy), which strongly emphasised human-creature hybrids and narratives that advanced an interconnected relationship between characters and the environment. The first generation (G1) My Little Pony toys included several feature films and an animated TV series where the ponies lived in a guardian relationship with their environment, which was regularly put to the test by other less likeable magical creatures. *My Little Pony: The Movie* (Joens, 1986) sees the ponies mobilise and fight against a toxic waste called the 'smooze' by encouraging the other creatures to restore balance within the landscape (Connelly, 2017). In girls' cartoons, the toxic wasteland narrative motivates the characters to pull together to save the day (Seiter, 1995). Eco-fiction narratives are in high demand for contemporary children's animation, with children wanting to see environmental themes in their media to understand humanity's environmental impact (Williams 2022.). Environmental narratives can be particularly inspirational when animation or games are linked to character toys.

Nature Play

Seminal research conducted by cultural anthropologist Edith Cobb (2022 [1977]) outlined the many benefits of playing outdoors for imaginative childhood experiences. Through over 300 autobiographies of childhood reminiscence, she suggested how children built their narratives within the natural environment, which is crucial to a stronger sense of self-actualisation in their relationships with other living beings. As we consider how to cultivate environmental responsibility with the challenges of climate change, building an understanding of the functions of natural systems is crucial to forming a concise worldview of how to respect and better nurture the earth.

Benefits of nature play

Collado and Sorrel (2019) argue that "human actions are largely responsible for environmental problems such as global warming" (p. 43) and caution that "children will be the ones to grapple with environmental issues in the future" (p. 43). Albrecht (2007) refers to 'Solastalgia' as a fear of mental distress caused by environmental change and the overwhelming concerns of global warming. In

discussing the potential for children's literature to explore climate anxiety, Illustrator Hoare (2020, as cited in Barkham, 2020) suggests that "fiction is a more powerful vehicle for raising environmental awareness". Shugarman (2020) recommends fostering a "sense of wonder in nature" (p. 94-96) to combat climate anxiety in young children. Louv (2008) also supports this argument - "Natural spaces and materials stimulate children's limitless imagination and serve as the medium of inventiveness and creativity" (p. 87). Chalwa's (2020) study of forming natural connections indicates that a child's physical and mental well-being benefits from engaging in natural spaces. Children become better socialised, empathetic to other beings, and more likely to think of and take responsibility for the natural well-being of these spaces. Chawla (2002), in reviewing Cobb's earlier work, observed, "Some people believed these experiences showed them the integration of nature and human life" (p. 214). Nature play is currently one of the most desired forms of play, and this has caused a spike in parents seeking toy products that encourage unstructured and unmediated modes of play.

Character toys

Character license toys are doll and action figure-based toys derived from or aligned to an accompanying media such as television, film or games. (Kline, 1993, p.139). The story worlds children create for their imaginative toy play are motivated by both the child's reality and the toy stories within consumed media. Children use play to form connections within the natural world, and character toys are the tools they use to interact with the ecosystem. Character toys can be used as agents for play in whatever narrative the child chooses and is an invaluable way for children to engage in imaginative play.

Character Toy Narratives

Fleming (1996) describes the "narrativisation" of toys as a means of providing a "familiar set of story ideas and character relationships informed by playing with the toy" (p.102). Children absorb narratives from multiple sources, and watching animation, reading books, and playing games exposes them to a diverse array of often complex fictional narratives that "describe situations, themes, and characters that take place outside of the child's realm of experience" (Chang, 2019, p.16) and suggests that "low-realism objects elicit more pretend play themes" (p.12). The importance of storytelling within the current My Little Pony media licence is

described by Begin and Hasbro (2013) as, “the connective tissue that binds our collective imagination and instils our passionately held beliefs.” Luisa Magalhães and Jeffrey Goldstein (2017) describe character toys as “interfaces to a world of motivations [where] the character toys need to be staged in a specific story, purposely written for the toy” (p. 291). Amanda Gummer, founder of *The Good Toy Guide* describes children’s play with character toys as “children will usually begin by imitating the character, scripted play soon turns into imaginative play as their story develops” (Mauthoor, 2017, p. 2). This research is significant in determining the Underfoot toys' aesthetic design and defining the relationship between toy and narrative.

Outdoor character toys

Despite the importance of narrative in character toys, outdoor toy designs often focus on physical or seasonal play. Those that cater to imaginative environmental play are predominantly educational toys and loose parts, which have a role in environmental advocacy but cannot compete with the market popularity and proliferation of dolls and action figures. Nature-based toys are often highly-priced, and their educational aspect is less appealing to children who want the play to be freely actioned and not defined as a learning activity. Character-licensed toys (dolls and action figures) comprised 31% of global toy sales during 2023 (Lynch, 2023) and have appeal as storytelling objects. Andrew McClary (2004) writes that, historically, children took their dolls everywhere (p.128). However, outdoor dolls and action figure play are not specific design categories within the toy industry, and my conversations with parents through this and earlier research indicate they are reluctant for children to take their toys outside in case they become lost or damaged.

Small world play

Small world play (Sobel, 2008) is used as a mode of outdoor play for this research due to the capacity for children to play intimately within the landscape. Character toys are used within small world play, where children build miniature worlds to control and understand their space in a more intimate context. Small world play is a cosy form of play that encompasses the immediate space around where the child sits. When small world play is conducted outside, the child breathes in the environment around them and uses this to inform the fantasy play world with which they engage. Using tools and objects within natural spaces enables children to shape and disrupt the landscape to understand their relationship to and within it.

Small world play is a way for children to play "god" over the terrain they engage in, and it can give children a sense of security and a way to map out the world with a sense of organisation and structure. Children who play freely outdoors learn how to respond, feel confident in those spaces, and find familiarity within the environment. Small world play also enables children to experience living creatures like insects, plants, fungi, and elements of the natural world that do not exist in a domestic interior world.

Changing play habitats

Nabhan and Trimble (1995) voice concern that children are growing up in habitats that are only shaped for and by humans and that play in natural spaces has been replaced with play in playgrounds "dominated by machine-like recreational equipment, structured games and paved-over areas" (p. 8). Any free playtime they have is carefully bookended by structured activities and a "scholarisation of childhood" as free play has been "eroded in favour of academic, sporting and cultural activities" (Weale, 2021, p.1). Nature deficit disorder (Louv, 2008) documents various reasons for the decline in nature play, including busy lifestyles, a lack of time, aversion to dirt, challenges with weather, and a fear of strangers encountering unsupervised children.

The Underfoot Design Process

Design methodology

The Underfoot toys were developed through a nuanced study of ecological relationships (product, eco-fiction and ecosystem) so children could connect with natural settings through play. The research employed Christopher Frayling's (1993) into, through and for design methodology as a framing device for the methods used across the entire research and Nigel Cross's (2007) framework in *Designerly Ways of Knowing* for the design development of each Underfoot toy. Cross's methodology explores the tacit knowledge of first principles within the design process, which enables the designer to break the design process down into design fundamentals; this enables a more flexible design process that matches the hybrid design aspects of Underfoot toys.

Design development

Initial research included informal discussions with ecologists and entomologists from Massey University and stakeholders from the Kiwi Conservation Club, Little Kiwis Nature Play, Bush School and Wellington City Council helped define a broader understanding of how children engaged in nature and the toys they used. The consensus was that toys were not part of a nature play toolkit, with nature play advocates preferring natural materials and loose-part over character toys, which they felt were inappropriate due to their perception of non-nature advocacy. Parents I spoke with felt that character toys were best for indoor play. Field studies of the local bush ecosystem were conducted to attune the toy design to the details of the space and provide an understanding of the natural ecosystem of play.

Visual mapping, story development and defining the eco-fiction framework in practice involved non-conventional design processes that differed across design disciplines and were adapted to challenge typical design processes for developing character toys. Sketching, digital diagramming, and cardboard modelling were the primary modes of early design exploration to define what an eco-fiction toy may manifest. Thematic drawings were used to explore the storytelling of the Underfoot world, drawing the toys as characters in their environment to understand who they were as living entities within the ecosystem.

Prototyping was conducted outside with leaves and other natural materials incorporated into the prototype process to link the design directly with using natural materials in play. Prototypes were staged in scenarios outside to predict how children may interface the toys with natural media. The design process moved into 3D-modelled prototypes and fitment models in anticipation of playtesting.

Demographic

The Underfoot toy series was developed for children aged 5-7 as this age range is a peak for imaginative play (Piaget 1999 [1962]). Children at this age are developing independence from their caregivers and have developed physical, motor and cognitive skills relevant to this mode of character-toy play. This research is situated in Wellington, Aotearoa, New Zealand. Children involved in the playtesting were recruited through the Kiwi Conservation Club², meaning the

² This is the junior conservation division of Forest and Bird in Aotearoa, New Zealand. Members aged 5+ years engage in nature advocacy and awareness projects with regional chapters. <https://kcc.org.nz/>

demographic was already nature aware. Most Aotearoa, New Zealand children will have already been introduced to Tikanga Māori and, more specifically, Kaitiakitanga and a Māori worldview on ecology and guardianship with indigenous perspectives in early childhood (Te WhārikiHe whāriki mātauranga mō ngā mokopuna o Aotearoa Early childhood curriculum) and primary school education.

Eco-fiction framework

The Underfoot character toys are designed to be played with outside in the dirt and undergrowth within the garden. Together, they make an ecosystem of toys, each influencing the others in a larger cycle of narrative play. The first steps involved unpacking the eco-fiction criteria and recontextualising from literature to design to inform a character toy design model.

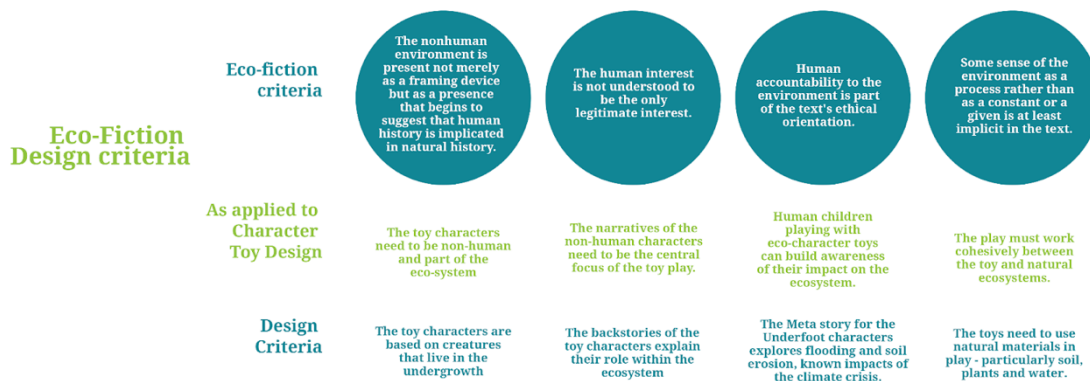


Figure 2: The eco-fiction criteria for toy design.

While eco-fiction criteria, as defined by Dwyer (2010), pertains to literature and media forms, I have reinterpreted it here through the lens of a toy designer to inform character toy design (See Fig. 2). Preliminary design criteria were derived from the perceived relationship between eco-fiction criteria and the needs of character toy design. In developing preliminary tests, the four-part Eco-fiction criteria were used to consider how all elements of the toys could be designed concurrently, including the ecological system, character stories, and the environment itself. All aspects of the eco-fiction criteria are non-hierarchical, so no element takes precedence. The list below describes the influence of the eco-fiction criteria on specific aspects of the design and the preliminary design criteria.

- **The toy characters**—To inform the characters, species in soil and undergrowth were analysed against the nitrogen and ecological trophic cycles. As this design specifically focused on Aotearoa /New Zealand children, the project looked for unique and fascinating species and a balance of rare and easily recognised creatures.
- **Meta Story** - The meta-narrative for the toy world must indicate the relationship between humans and the ecosystem - or the children as human agents and the toys themselves.
- **The backstories** - These are the methods children use to access the overarching narrative of the Underfoot character, which is demonstrated through tangential representation within the toy design, pamphlets, and back-card narratives.
- **Natural materials** - The availability of natural materials within the toy play was intrinsic to the Underfoot design, making them function best when children were involved in small world outdoor play.

Competitor analysis

A competitor analysis of mainstream character toys was conducted between 2019 and 2023, including a sample of 50+ toys from local toy stores. The most prevalent modes of play and storytelling that involved animals or a nature focus within the dataset were as follows.

- Hatching an animal
- Riding an animal
- Protecting an animal
- Fighting on or against an animal
- Catching/keeping an animal

Character toy products were analysed in a chart and ranked for their effectiveness in meeting the six criteria in figure 04. None of the toys met the outdoor play criteria, and very few met the environment or ecosystem play criteria. The most prevalent eco-fiction modes of play were toys that were animals or had a relationship with animals. In this context, the human relationship was overwhelmingly dominant.

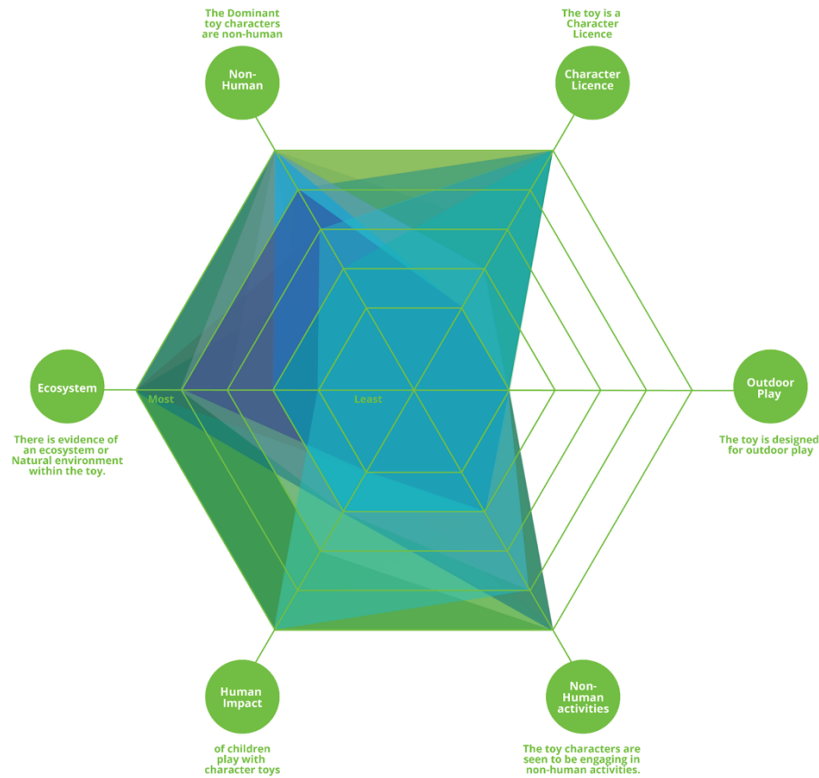


Figure 3: Radial diagram consolidation of all toy appraisal data collected between 2018 - 2023.

Nature Authenticity

The 4th eco-fiction criterion describes a need to explain the environment as a system. An ecosystem comprises diverse species and interactions that enable the cyclic systems to function. Through design exploration, nature cycles would be an appropriate scaffold for the Underfoot design system. Extensive explorations into the four core natural cycles (Nitrogen, Oxygen, Carbon, Hydrologic) were carried out to help define interaction systems that could inform the systemic relationship between each toy. The design process for the world of character toys is like the game design process. Salen (p. 51) describes systems in a game as objects, attributes and internal relationships that affect each other within an environment, as a dynamic system. Understanding the dynamic systems within natural ecosystems and how they can manifest as modes of play interaction is core to the Underfoot designs.

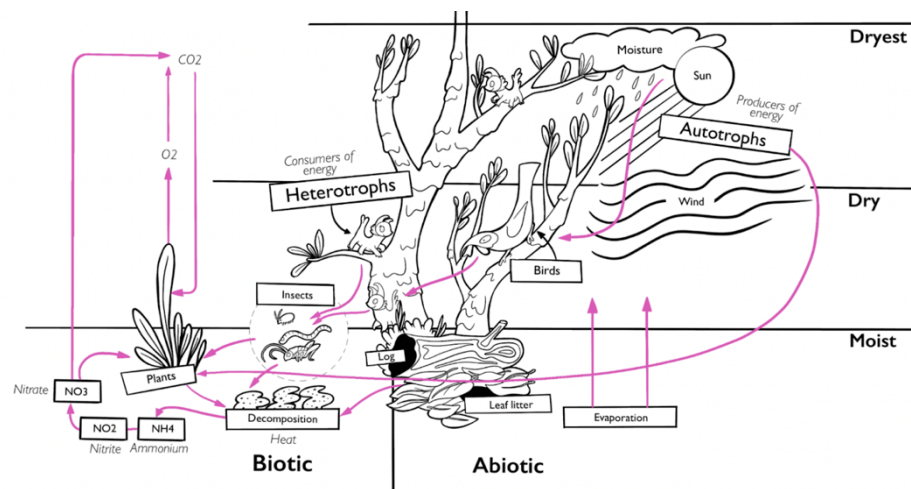


Figure 4: Ecological system drawing of the environment cycle story world.

The dynamic natural systems manifest within the story of the toys, the way each toy integrates with the other toys, and how children enact the natural system during play. For the Underfoot range, the nitrogen cycle was chosen because most of the cycle action takes place in the ecosystem of the forest floor, which is the natural home for the hero character. Most small worlds play takes place on the ground.

Hero character

Most character licence toys have a hero character; He-Man (Mattel), Strawberry Shortcake (Hasbro), and the Mane Six (My Little Pony, Hasbro) are examples. The hero character is the main protagonist in the narrative. Using the Eco-fiction framework to explore the “otherness” of potential characters, it was decided to use an explicitly non-human character species. I looked at species that live in the leaf litter ecosystem and was also influenced by conservation messaging for species advocacy. I chose the velvet worm as it is both unique in character and has an interesting form, being long with multiple sets of legs. Brightly coloured and nocturnal, they feed on unsuspecting insects by shooting sticky threads from their heads to stun and feed on their prey.



Figure 5: The velvet worm, Ngāokoke, Peripatus: hero character for the Underfoot. Photo (left) by Tanya Marriott. Photo (right) by Danilo Hegg (2020) <https://www.southernalpsphotography.com>

The Story world

The story world is embodied in the product's toy, packaging, story snippet, and character artwork. Care was taken to weave a narrative that connects the characters as believable entities and tangentially explores the Nitrogen cycle. The short story snippets for each character defined their personality and characteristics and matched their interactions within the ecosystem with potential play mechanics for the toys. Developing a story world helped to maintain consistency during the design process between the toy, its play mechanics, and its relationship to the natural world. Framing a story around these elements also helped to define how each toy related to the next as a family of products. I used the following three criteria to define the meta-story for the world.

- The characters live in a home tree.
- The character relationships can have tensions and challenges.
- The ecosystem is affected by flooding.



Figure 6: The final story scene of Oke Velvet Worm.

In an authentic ecosystem, the creatures that inspired the Underfoot toys are tiny, so it was appropriate that they all live in a similar location. Having a home tree builds on the notion of the tree house but leaves room for scale – in this instance, the “home tree” is vast compared to the characters, giving space for each character's family to have its locale. The home tree also provides a single location for small world play to happen. The flood narrative creates tension and defines the characters' key motivations. Changes in moisture, water levels, and stream flow are also easily witnessed within natural spaces, which helps children develop ecological understanding. Children understand that mud comes after the rain.

The final toys

Key Design criteria

The following key design criteria were defined through exploration of the creative practice and used as criteria for the final designs.

- The toy range needs to be an ecosystem.
- The toys need to function best when playing outdoors.
- Natural materials need to be incorporated into the toy play.
- The toys should have appealing and empathetic character shapes.
- Each toy needs to contribute to the natural cycle and further the cycle along.

- Using a meta-narrative defines the story world for the toys and maintains consistency between character play mechanics and ecological purpose.

Final Designs

Through this exploration, relevant first principles (Cross, 2007) were defined as a system intersection between ecology, story and play – as this is where the toy innovation lies and what this research defines as the identifying factor for an Eco-fiction toy design. Character is the modality with which the product is defined. The ecological process (Nitrogen cycle) was examined when designing each toy in the range, and an organism from that system (a biotic or abiotic) was chosen. This organism was then developed into a character, interpreting elements from the ecological system as character characteristics.

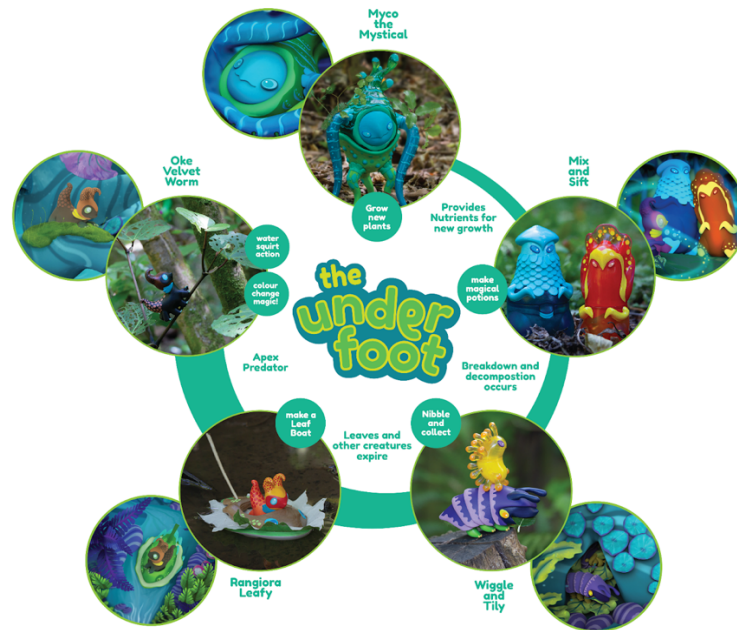


Figure 7: The Underfoot Toy range showing the Toy designs and the corresponding narrative moments.

Attributes are explored as play actions once the character is fleshed out, so there is a direct link between the ecological system and play action. The last step is to narrativise the character, play action and ecological process to refine the story for the character and how they fit in the toy world.

Playtesting and Appraisal

The Sesame Workshop playtesting (Ganz Cooney, n.d.) resource was used to develop and assess the playtesting sessions. I also used a checklist system discussed by Justin Canty and Biret in their presentation “Backyard Backstories: Building and Evaluating Nature Play and Learning Spaces” at the 2019 Child in Nature Network conference. Playtesting was held at a local regenerated forest with a running stream. A follow-up interview was conducted with available parents regarding continued play with the toys. Go-pro footage was taken of each of the children during the session and analysed alongside the checklist to chart the results (Figure 8).



Figure 8: Image documentation of the first playtesting session.

Playtesting 01

In the first session, each character toy was introduced through a short character story. A new character toy playset was introduced to the play every fifteen minutes, from smallest to largest. Four toy designs were introduced during the session. Each child received their own set of character toys. At the end of the play session with each toy, all the children were brought together to give their thoughts on the toys. At the end of the session, the children chose two toy prototypes to take home. The

grey model playtested the toys' core functions and how the children responded to the characters. Children became engrossed by mixing matter into potions and floating their Oke velvet worm in leafy boats in the creek. One boy developed narrative extensions for the characters, referring to himself as the character. Inspired by the Underfoot flood narrative, he had made a short comic about the velvet worm saving people from a landslide.

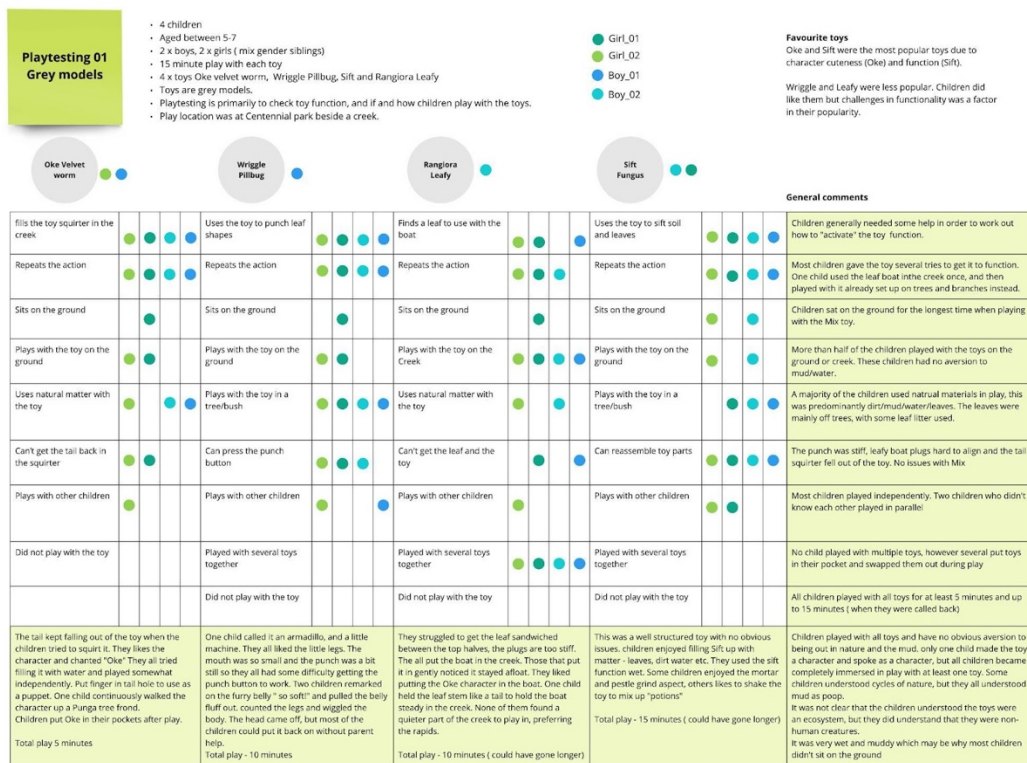


Figure 9: Video and checklist analysis from the first playtesting session.

Playtesting 02

The second session gave the children more time with the toys, allowing for a more sustained immersion in the characters. Playtesting was conducted in smaller groups over several sessions with two children at a time. Children were briefed on the characters' stories and then given a pamphlet for each character explaining their role in the ecosystem. Children were shown all toys at once and could choose what they wanted to start playing with. Each child had their own set of toys, but both pairs joined the toy sets together and played with duplicate characters. The play activity lasted 40 minutes, and the children were called back to discuss the toys. At the end of the session, the children were given a grey model velvet worm to take

home. The children observed ecological phenomena during play around the water level in the stream and other species in the forest. One child made the velvet worms homes within separate hollows within a tree and dressed the "home" with collected foliage to shelter them from the sun. All children were given a character to take home, and she continued to play with the velvet worm, but only on natural materials such as the wood pile, a branch she took home from the forest and the dog's fur. She kept the toy on her special object shelf.



Figure 10: Image documentation of the second playtesting session. Photos by Tanya Marriott.

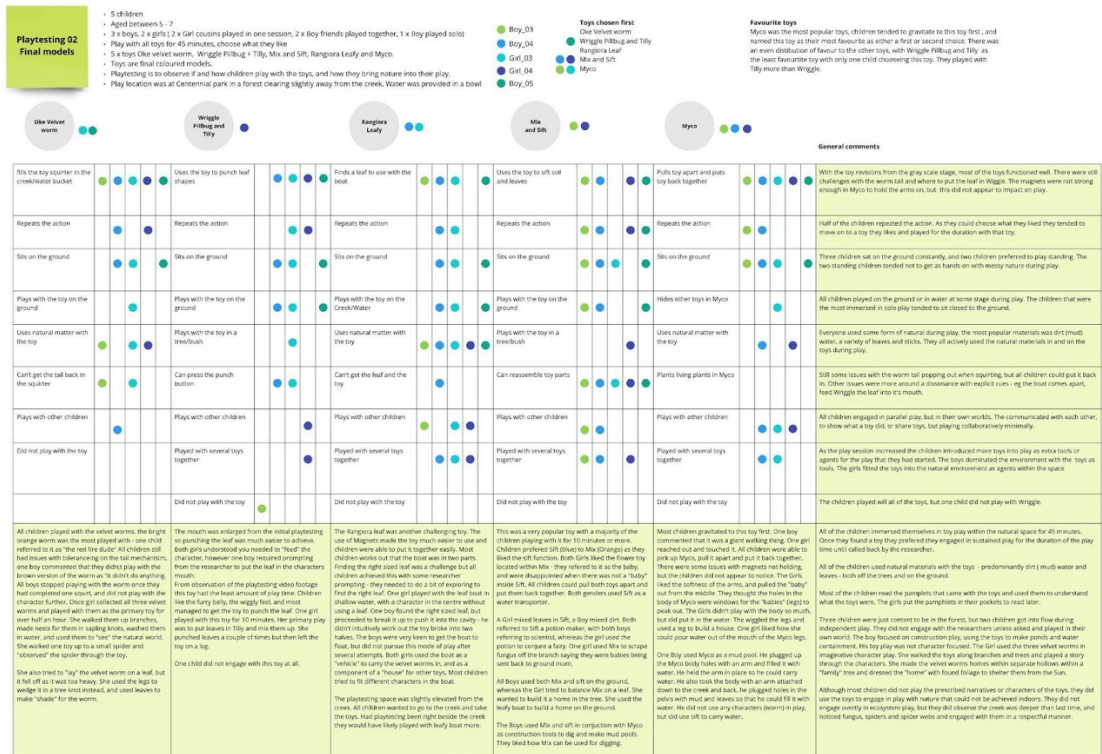


Figure 11: Video and checklist analysis from the second playtesting session.

Industry reviews

I interviewed three toy designers with 30+ years of experience in the industry (based in the UK and USA) to ascertain the industry's perspective on outdoor character toy play and asked them to appraise the Underfoot. All felt this was an exciting opportunity for outdoor play and acknowledged that the toy industry has yet to find solutions for this mode of play despite an interest in it. They felt that the toy industry needed to do more to encourage children to play outside. When asked what features they would focus on, they suggested secret hiding places, animal behaviours and stories. The story would be vital to building excitement around the product. There were mixed views about the colours, with some thinking that the colours worked well for the toys as the range is fantastical and extends reality. Another felt the bright colours would make toys easier to find outdoors if children lose them during play. They felt that "even if they [the children] do not understand the principles of symbiotic relationships, it is just them becoming explorers in their own way with creatures that are fun and colourful." (Toy Designer 3).

Conclusion and findings

Using an eco-fiction toy framework enabled ecological principles to be embedded within the character toy design process. The Underfoot toy designs demonstrate how a character toy can embody an eco-fiction narrative and simultaneously be an ecosystem to encourage and stimulate nature-inspired play. The Underfoot toys' design development gives the toy designer greater agency to oversee the entire product pipeline from narrative to end toy, enabling seamless integration of the eco-fiction narrative so all media threads are enriched. This is evidenced in the visual and thematic cohesion between the story world and the toys.

Toy design is an interdisciplinary practice, and this project utilises a broad range of design insights to develop a depth of knowledge within eco-fiction toy design. The toy designer becomes a world-builder, storyteller, and play object creator through this design method. The playtesting sessions demonstrate a sustained interest in small worlds play with the toys and an ability for the toys to enable children to slow down and spend more immersive time playing in nature. The Underfoot design contributes to new knowledge and innovation in character design. Designing toys for play in natural spaces as an integral feature challenges industry assumptions about the difficulties of designing outdoor toys. It proposes new integrated approaches to design development that support the need to create a new genre of toy design that sits at the intersection between outdoor toys, dolls, and action figures.

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