



# Children in nature: sensory engagement and the experience of biodiversity

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## ABSTRACT

Given concerns for a severely diminished childhood experience of nature, coupled with alarm for a rapidly diminishing global biodiversity, this article considers the potential for childhood nature experience to be an important part of biodiversity understanding. Findings from two studies are integrated and presented as windows into childhood nature experience to illuminate important aspects of sensory rich learning. In one study from Sweden, semi-structured interviews with adults were conducted and analyzed to explore an understanding of the sensory experience of childhood collecting in nature via participant memories. In the second study, direct observations of children's play and exploration in an outdoor kindergarten in Norway were conducted and analyzed. Bringing these two studies together for shared analysis is useful for investigating biodiversity experience and understanding. Analysis supports the idea that the experience of biodiversity, actual childhood interaction with variation and diversity with living and nonliving items from nature allows children important learning opportunities, inclusive of biodiversity understanding. The results support practical implications for sensory rich environmental education and underscores the practical importance of childhood access to nature.

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## Introduction

I remember the troll forest ... the different kinds of smells, the damp moist smell of moss. The pine has a specific smell. And you know the ponds develop a kind of musty stink...

This quote is from a study participant's rich sensory memory of a childhood nature experience. The memory features imagination (calling the forest a 'troll forest') and highlights the importance and diversity of smell. The quote is from one of two distinct studies combined in this investigation of childhood nature experience to illuminate important aspects of childhood sensory rich learning. For the purpose of this study, sensory rich learning references learning opportunity from engaging, diverse, and intertwined auditory, olfactory, tactile, taste, and visual experiences. One of the two combined studies is an ethnographic study emphasizing children's experiences and voices from nature play and exploration. The other study is a phenomenological investigation of adult memories from childhood collecting in nature. The term 'collecting' is used to include the gathering of items from nature primarily for play, exploration, and interest but may include occasional consumption as well. Collecting refers to the self-motivated accumulation of natural objects, such as rocks, shells, feathers, and plant parts. The

definition also includes temporary collections of living creatures as well as consumable foraging (Lekies and Beery 2013). These uses are differentiated from non-recreational purposes in which collecting or foraging may be used to meet basic sustenance or cultural needs (Alexander, Cocks, and Shackleton 2015).

From memories of the gathering of shells on a special beach to observations of 'wild play' in a kindergarten forest, these two studies explore how sensory rich nature experience may contribute to the ways in which children come to know nature. This current investigation draws upon on a vast and diverse literature of child and nature experience emphasizing direct and sensory rich interaction with nature (Abram 1996; Carson and Pratt 1965; Chawla 1994, 2002; Cobb 1993; Lekies and Beery 2013; Nabhan and Trimble 1994; Sobel 2002; Wells and Lekies 2006), as well as a broader literature documenting the benefits of children and nature (Children and Nature Network Research Center 2016). What is useful in this current investigation, however, is an integration of data about childhood nature experience from different methodological approaches. The data was combined to investigate common aspects of sensory richness and embodied experience in the natural environments of childhood in response to growing concerns of a diminished experience of nature for many children in today's world. This concern is referred to as an 'extinction of experience' (Krasny 2015; Nabhan and St. Antoine 1993; Pyle 1993, 2002).

### **Extinction of experience**

The sensory reductive nature of contemporary life, as evidenced by extensive and often passive consumption of technology, an over-emphasis on the 'written word,' and indoor educational settings, appears to be contributing to human disconnection from nature (Faber Taylor and Kuo 2006; Kahn, Severson, and Ruckert 2009; Louv 2005; Pyle and Orr 2008; Taylor 2013). Thomashow (2002) has described the extinction phenomenon as '... a decline in specific qualities of attention, ways of learning and thinking about the natural world' (81). Similarly, other terms have been used to consider the experiential impact of a diminished direct, or first hand, nature experience. For example, the phrase 'environmental generational amnesia' has been used to describe a generalized acceptance of degraded environmental conditions as the non degraded norm (Kahn 2002, 93). One problematic outcome regarding this trend of diminished experience is the loss of opportunities for direct sensory interaction in which children, through their own agency, can make physical connections with the biotic/abiotic variety of nature (Affifi 2015; Jørgensen 2015; Malone 2015; Skår and Krogh 2009; Taylor 2013). Sobel (2008) highlights the importance of this concern with his argument that no level of virtual engagement with the natural world can replace the direct and embodied experiences he identifies as critical to children's cognitive, social, emotional, and moral development.

Related to concerns for a diminished human experience of nature is a concern for extinction of non-human species, i.e. a rapidly declining biodiversity across the planet (Butchart et al. 2010). Biodiversity indexing provides an alarming trend as representative of this dangerous trajectory. For example, The Living Planet Index, a global assessment based on more than 10,000 representative populations of amphibians, birds, fish, mammals, and reptiles shows a decline of 52% from 1970 to 2014 (World Wildlife Fund 2014). These alarming statistics coupled with the rapid rate of urbanization seen in the western world (the United Nations [2014] reports current levels of urban population in Europe and North America at 73 and 82% respectively) point to a potentially serious overlap. It has been noted that increased urbanization often corresponds with critical habitat destruction given the observation and projections that much of the earth's current and future urban expansion will take place in areas where protection of biodiversity is of high priority (Convention on Biological Diversity 2012). In addition, Guisti, Barthel, and Lars (2014) remind us that the '... socio-technical experience of the urban landscape has left the vast majority of urban citizens systematically deprived of *in situ* nature experiences, especially on a daily basis' (17). Miller (2005) contends that the global loss of biodiversity is linked to the reduced human experience of biodiversity and that action acknowledging the linkage has the potential to serve both human well-being and biodiversity conservation.

It is hoped that this article may be able to contribute to a discussion as to how address a rapidly declining biodiversity via attention to the problem of a diminished human experience of nature and

specifically, a diminished human experience of biodiversity. We propose that regular access to nature in childhood may be a significant part of the effort to confront the extinction challenge via supporting biodiversity experiences. More specifically, we will consider how nature experience in childhood seems to trigger children's curiosity for collecting, exploration, and play. Therefore, the specific aim of this research is to consider the possibility that this 'collecting, exploration, and play,' i.e. childhood nature experience, may be a critical part of an understanding of biodiversity and other environmental phenomena/concepts.

### ***Experiencing biodiversity and environmental education***

Biodiversity has long been framed a key idea in environmental education stemming largely from the 1992 Convention on Biological Diversity in which education was featured to encourage countries to act on behalf of global biodiversity conservation (Dreyfus, Wals, and Van Weelie 1999). The general definition of biodiversity provided by the Convention for Biological Diversity, states: '... the variability among living organisms from all sources including, *inter alia*, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species, between species and of ecosystems' (UN 1992, 3). This general definition serves as a base from which to consider necessary interaction to support the understanding of the concept, including experience of species variation, variations between species, and the variety of ecosystems supporting biodiversity. Sandifer, Sutton-Geier, and Ward (2015) provide a comprehensive typology of benefits of interacting with nature and bring the importance of biodiversity experience into their analysis. They stress the concern that just when we are coming to better appreciate the 'variety and complexity of human health benefits that stem from experiencing nature, and, more specifically, biodiversity' (2) we are also reaching a critical point in the acceleration of biodiversity loss. Coupling this concern with a perceived lack of research into the perception, experience, and valuation of diversity (Voigt and Wurster 2015) creates a sense of urgency and a heightened significance for the work of educators.

Van Weelie and Wals (2002) argue that environmental education has an important role in making biodiversity meaningful and concludes that despite ill-definition, the biodiversity concept allows learners to 'construct, critique, emancipate and transform their world in an existential way' (1154). As a possible example of this progression, Thomashow (2002) describes a process whereby learners progress from observing and experiencing the details and patterns of nature via day-to-day sensory experiences to the development of biosphere understanding. This overall progression is in line with a strong emphasis in environmental education, i.e. the recognized need to allow children to explore nature in order to build a personal and meaningful relationship with the natural world, an idea that is woven throughout the history of experiential education (Roberts 2012). For example, Dewey (1916) argued that the use of natural objects is necessary to allow children to procure knowledge about the very items, i.e. emphasizing that impressions are based upon the type of direct experiences we have. This emphasis on direct experience as a critical part of cognitive, affective, and psychomotor development is also a theme throughout early childhood environmental understanding research literature (Ernst and Tornabene 2012; Fjørtoft 2004; Herbert 2008; Samuelson and Kaga 2008). Similarly, Jørgensen (2015) describes this learning progression highlighting children's sensory experience as a part of an environmental consciousness including both imagination and knowledge.

Of specific interest to this current research, are previous studies directly addressing childhood collecting in nature and/or biodiversity experience. Lekies and Beery (2013) have provided insight and detail into the childhood play/explore phenomenon of collecting in nature, for example details about the widespread nature of this activity. Chipeniuk (1995) found that children's foraging for berries and mushrooms supported an understanding of concepts related to biodiversity, and Bixler, Floyd, and Hammitt (2002) described biodiversity understanding as incidental learning that occurs through the encounter with natural variation, i.e. large numbers of different insects, plants, and animals during foraging. They argue that such exploration may make '... the concept of biodiversity both easier to comprehend and personally relevant' (Bixler, Floyd, and Hammitt 2002, 799). These studies, emphasizing

the direct interaction with natural variation, highlight embodied experience as an important element in the learning process.

### ***Embodied experiences of biodiversity***

Childhood experience is an appropriate arena to consider how childhood nature exploration, which is often highly physical, combining bodily interaction and sensory attentiveness, may be able to provide insight on the role of embodied experience to stimulate curiosity, discovery, and biodiversity understanding. We use Gibb's (2003) description of embodiment as people's subjective and felt experiences of their bodies in action and the role of this interaction on meaning making to better understand sensory experience. For example, Linzmayer, Halpenny, and Walker (2013) identified the importance of sensory experiences for children visiting a botanical garden emphasizing how touch, sight, sound, smell, and taste were important in children's recollection of meaningful experiences at the garden, including the colors of flowers, the sounds of bees, the feeling of rain on the body, the taste of berries and the sight of butterflies. Similarly, James and Bixler (2008) identified the importance of novelty and sensory experiences, particularly touch, among children attending a coastal beach environmental education program. The ability to have direct sensory experience of the landscape, such as sand, shells, bird parts, and live reptiles enhanced children's learning and provided an opportunity for intimate interaction with natural objects and living creatures, making the experience meaningful (James and Bixler 2008). These are just two studies from a long line of Western educational thought describing embodied experience and learning (Taylor 2013).

The philosophical theories of Merleau-Ponty (1968) with the body as central for our 'being in' and perception of the world provides a theoretical foundation for understanding this idea. Merleau-Ponty emphasizes the role of the 'sensing body' for how we experience and the perceive of the world; lived experiences and the body in motion are important for how we create meaning (Ingold 2000; Merleau-Ponty 1968). A contemporary example of this idea of embodied experience relevant to our interest in biodiversity understanding is the work in health, environmental, and outdoor education (Wattchow et al. 2014). For example, Brown, Jeanes, and Cutter-Mackenzie (2014) describe a social ecological approach to education and illuminate the role of lived experience. They highlight that such an approach recognizes how the senses, emotion, and cognition are all intertwined and emphasize that the '... essence of lived experiences occurs through the body, where intrinsic and subjective qualities of experience provide us with opportunities for insight and understanding. This method or approach prioritizes how the body feels, sees, reacts, and thus knows and understands' (30). Nabhan (1994) provides a glimpse of just what this engagement looks like in his description of approaching a significant vista with his own young children: 'Whenever we arrived at such a promontory, Dustin and Laura Rose would approach it with me, then abruptly release their hands from mine, to scour the ground for bones, pine cones, sparkly sandstone, feathers, or wildflowers' (6). As the author of the passage enjoyed an expansive view, his children were afforded the opportunity to physically engage with the small details of the place. This scene of exploration is what Chawla (2002) describes as a baptism in the world by immersion: '... such as children in play who literally live close to the ground up and against the full sensory qualities of things...' (209).

Gibson and Pick (2000) note the simultaneous discovery of properties of the environment and agency as learners directly perceive and interact with the natural world using all five senses. Herbert (2008) would argue that self-willed and direct bodily interaction with nature provides an experience of learning, she writes:

In the early years, children's sense of wonder, and their desire to explore the real world, are the perfect vehicles for absorbing fundamental understanding about the Earth's cycles – how plants grow, how weather/climate affect our lives, how plants/animals/humans interact, and how the living and non-living worlds are interdependent (64).

This emphasis on the self-willed aspect of sensory childhood exploration highlights a key component of Education for Sustainable Development (ESD). Early childhood ESD educators have argued for the

important perception of children as active participants in their own learning, such as self directed play and/or collecting as part of everyday experiences (Davies, Engdahl, and Otieno 2009).

Considering the potential for the complexity and variation of nature to be experienced through the rich body-sensory impressions of self directed play, such engagement may also be a way to gain deeper understanding of biodiversity. If an understanding of how embodied and sensory rich experience may support learning, it will require on-going efforts to identify specific connections between the sensory rich experience and young learners. We wish, therefore, not to simply argue for embodied sensory rich experience, but to consider the details of specific childhood activity in nature.

## Methods

Two specific methods are used in order to explore a potential relationship between childhood nature experience and biodiversity understanding. One is a study of childhood collecting in nature via semi-structured interviews with Swedish university students from an on-going study of childhood collecting in nature (Brensinger, Lekies, and Beery 2016). The second study involves direct observation of the nature experiences of Norwegian kindergarten children from a broader ethnographic study of children's experiences of natural landscapes and their places (Jørgensen 2015). Specific methods for data collection along with details of how the two different studies were integrated for analysis are presented in this section.

### *Semi-structured interviews*

Thirteen semi-structured interviews were conducted with participants volunteering from a related survey (Brensinger, Lekies, and Beery 2016). Many of the survey participants indicated a willingness to participate in this follow-up study (approximately 25% of the 380 survey participants). Selection of participants for the semi-structured interviews, however, was based on schedule, access and a determination that a small sample of participants who self identified as having spent time collecting in nature as children would be sufficient. Of the 13 participants, nine grew up in Sweden, three grew up in a country other than Sweden and one grew up in both Sweden and another country. Eleven participants were male and two were female. Nine different fields of study were represented by the participant group. Interviews were conducted at two different university campuses in an attempt to manage time/distance factors (the university is largely a commuter campus with students commuting from throughout a large region to attend). Interviews lasted for 25–60 min with an average duration of 45 min. The interviews were recorded and recordings were then transcribed and analyzed using qualitative research guidelines from Hycner (1985). This process involved numerous stages of transcript review in an attempt to consider meaning from the researcher's perspective, the participants perspective, general meanings and meaning relative to the question of sensory experience. From this analysis, clusters of relevant meaning were determined and themes assigned.

Use of interviews based on adult memories of childhood raise important methodological considerations. For example, memory accuracy and memory bias must be considered and noted as potential concerns when using responses from adults regarding their personal childhood experiences. From such concern, however, comes potential strength. Consideration of possible limitations sharpens awareness and demands careful attention in the process of interpreting and analyzing data. Further, we can consider how such noted potential bias may actually serve the research process. For example, consider adult memory of childhood experience, where rich and detailed adult memories may speak to the importance of these memories. This importance has been noted by Chawla (1999), who advises environmental educators to find ways to foster the kind of experiences for children have that come to figure so prominently in memory, the kind of memories expressed and experiences noted by the participants in this study and other studies. For example, in a study of long-term impacts of participation in environmental education programs in the United States, Williams and Chawla (2015) noted that one-third of the participants discussed mementos such as feathers or rocks that they had

obtained during their outdoor experiences, now 5–40 years later. These items remained salient in the participants' memories and often remained meaningful in their lives over the years. Further support in related research can be found in Skår and Krogh's (2009) work exploring adult memories of childhood play and nature-based experiences.

### ***Observation and informal conversations***

The second research method employed was participating observation, photo documentation and informal conversations. Thirty-four children in a Norwegian municipal kindergarten, ages one to six, were observed on 30 occasions of 5–7 h each over a 10-month period during which the children were followed in their outdoor play and exploration. The observations are part of a broader ethnographic study of children's experiences of natural landscapes and their places (Jørgensen 2015). In addition to the parents' consent, in accordance with ethical standards of informed consent, the children were told why the researcher followed them. The communication with the children and the possibility to observe and accompany the children made it possible to come close to and describe the children's construction of meaning in their encounters with the natural landscapes. As a participating observant, the researcher experienced the environment together with the children. This is not meant to imply that the observer and children had the same experiences, but rather that the children and observer shared impressions of the same environment, which involved the sensory aspects of a specific place and time. The informal conversations were initiated by the researcher and also by the children themselves. Another source of conversations were photos taken of significant places from the kindergarten outdoor area, places often used by the children. Narrative analyzes from these data was a way to identify and create meaning from lived experiences (Bruner 1986, 1996; Connelly and Clandinin 2012; Van Manen 1997). The thick descriptions of narratives (Geertz 1993) are suitable to broaden the perspectives on childhood experiences and to gain a deeper sense into the importance of biodiversity.

### ***Methods synthesis***

Discussion between the researchers allowed for a consideration of the two data sources relative to each other. Specifically, four key themes were identified from the interview data: sensory experience, diversity, ecological ideas and environmental understanding. The themes were then used to review the narratives in consideration as to whether they provided for useful comparison or contrast. The results and preliminary analysis are presented together in a back and forth fashion in order to highlight how the two sources both support and enrich each other. Each theme from this analysis is provided in the following section with specific data from both methods to support (participant interview statements and observation field notes).

## **Results and preliminary analysis**

### ***Sensory experiences***

The theme of sensory experience emerged repeatedly from the responses of all of the adult interview participants. Consider the following examples from five of the interview participants:

- P4: ... we had a small cave and it smelled like rock ... And when you got up on top you felt a breeze from the ocean ... When we went down to the beach, you had different kinds of smells, you had both the trees and the seawater, I can feel all smells.
- P5: ... I had a rock I laid upon, it was always warm, against the stomach. It was along the shore, I usually would swim to it and lay on it.
- P6: Whenever I smell the resin from pines ... I must have been 6 or 5 and I remember being out in the woods walking and there is a moose in front of me, actually me and my mom, and we freeze ... I remember the smell of...pause...of pine.

P12: ... the forest has a specific smell I would say. Also like dirt... The smell and the fresh air and the whole experience, the colors, the wilderness, it is quiet, you only hear birds singing...

P13: We also went to their island and took their eggs (Skua) so they wouldn't reproduce. We ate them ... They are the best eggs you can find ... soft boiled and they are delicious.

The theme of sensory experience emerged in the analysis of the field notes of the kindergarten observations as well. Walking into the forest from the open and designed playground seemed to present new perspectives and possibilities for the children's play, activity closely connected to the children's sensory experiences. The children constantly moved to and from the path as they were playing. The children were observed hiding between bushes, balancing on stones and using cones, stones and branches for play purposes. Their playful approach towards the environment was nurtured by sensory impressions from uneven ground, shades and sunlight, the sound of the rustle in leaves and wet falling rain. Consider this field note observation:

Early October, it had been heavy rain for some days. As we walk through the wood, the sun approaches and the light through the leaves makes the drops of water visible. The children seek and seem to find every pond on their way, on and outside the path. There is loud laughter as some of the children makes the small trees move and in this way create rainfall. There is an excitement as some of the children recognize several spider nets early found decorated with small drops of water. Sticks collected on the way are transformed to fishing rods or simply used for investigating the ponds and wet ground.

The changes through the year were also a part of this sensory theme. Consider this field note observation:

This day I arrived the campsite of the forest group about an hour after the children. As I arrive, Elsa (4 years) comes running, greeting me: 'Hello! Did you see the stream today?' (She asks with excitement in her voice.) Me: 'The stream?' She, sounds disappointed: 'Yes, did you not slide?'

The stream they passed on the way into the forest was frozen and the children had used it for sliding on their journey into the forest. This is an example of the children's attention for changes in the environment. Frozen water is exciting, from the first thin layers of ice cracking when they stepped on it, up to the point it was solid and slide-able.

## **Diversity**

Another key theme noted by a majority of the interview participants, and also noted as significant to the kindergarten observations was participant interest in 'difference,' i.e. finding objects that were exotic, unique, strange, or showed interesting variation. Consider these examples from four different interviews:

P2: ... you discover that when you are at different places, like the stones, and then the earth was really red there! Maybe I didn't know what it was, probably the mineral is in the soil and then maybe you are in one place and have stones that are really dark and then you got another beach and have them in all colors...

P7: My dad worked in the forest and he knows everything about trees and so I tried to collect different kinds of leaves just to try to organize them, you know, what kind of species...

P9: ... there was a special place to find seashells, not fossils, river shells, but it was so exotic, because richer kids that that went to the seaside, the Black Sea, 400 km away (found shells there). We had no car and not a chance to see the Black Sea. But yeah, this is something that belongs to the seaside and not here, it was something real exotic.

P11: We used to build these bird houses ... and place them in the forest, so I used to know the different types of birds and we had a bird book and we looked in it quite often.

Memories of environmental differences, uniqueness and variety was also apparent in the kindergarten children's experience of the landscape, with the living organisms and the variation in terrain and vegetation important to the children. The first theme of sensory experience was intertwined with the theme of diversity. The diversity of the landscape inspired development of storylines and creation of new places. For example:

Thor, a three-year-old boy, leads me by the hand. He takes me along a narrow path, lets my hand go and asks me to follow him to some dangerous places. He says, 'By the way, we can also find blueberries there.' On the way we

do pass a stone, he names 'The Fortress.' There are small sticks placed on the stone. 'These are our weapons,' he tells me. The sticks had been placed there while the children were playing.

During this walk, not far from the campsite, there were places that were of a different meaning for Thor. The sticks added a functional meaning for the children's common play theme. They were stored in place as artifacts fulfilling a certain purpose. The sensory experiences included openness of the material and the atmosphere of the landscape and its places. Topography, stones for climbing upon (to get a view) and to provide shelter and vegetation with herbs such as blueberry bushes and a variety of trees afforded opportunities for hiding, climbing and foraging. The smell from the green leaves, the sweetness from the herbs and the characteristic smell of spruce and pine, the sound of wind in the trees and the differences of light and shadows were due to the variety and diversity within the landscape, with direct relevance to the children's attentiveness of their surroundings. The children interacted with the environment constantly: collecting, using, reducing and rebuilding new stores of sticks, stones, shells or cones. All items served for multiple purposes in common imaginative play themes, such as weapons and food (or even hairdresser equipment) to mention just a few. Observing the interaction between the children's moving, sensing bodies and the richness of the environment provides insight into the children's experiences of biotic/abiotic variation and diversity.

### ***Ecological ideas and environmental understanding***

Many interview participants shared stories of collecting that referenced a connection between the experience of collecting and broader environmental ideas. For example, five of the participants named 'cycle' or made reference to a natural cyclic process as something they experienced during their childhood collecting. One participant noted that he didn't learn a lot of names (identification of species while collecting), but that his frog egg collecting in the spring taught him that certain processes 'start over again... you know, it goes around.' Other examples of natural cycle references from an additional three participants include:

P3: Where I lived was a suburban area outside of Stockholm, we had a forest, well not a big forest, but for me as a child it was a big forest and it had ponds in there ... they had tadpoles, so I collected tadpoles and we had an aquarium at home so I brought them home and watched them develop to frogs and then released them at the pond.

P7: You get a feel for the cycle for the year, the buds, the leaves, then the leaves falling off and changing color and that kind of stuff.

P11: ... seeing the trees and listening to the birds and also the sound of this certain bird ... it is called a Gök, it goes 'cukcoo'. They pop up quite early in the spring...

A number of the participants considered the experience of their own environmental understanding as they explored memories of childhood collecting. Consider this reflection, a part of a lengthy description of an interest in shellfish and their adaptations:

P13: There were these puddles with the alive shells, the snails inside ... I just watched them and saw how they worked and the other shells ... close together, mussels and clams ... And then in my teen years I went to biology, I learned more about it from the teacher, how it worked and how they ate. Well, I was interested probably more than the other kids, I wanted to learn more about what I had been collecting...

The quote above also highlights how participants were even able to describe how details of the collecting experience became a part of learning and their interest or curiosity to learn more, other examples include:

P1: I don't know, the sea is mysterious for me, it is just ... where was it in the sea (animal from a shell), how did it come to the sand? Did it die in the water? Did it die on the beach? Things like that.

P6: ... it makes you wonder a lot why things are what they are. Why leaves turn brown in the fall and so on. I learned to ask from seeing the changing nature... you wonder about everything and keep asking, asking, and at last put some pieces together by yourself.

P11: We studied them ... you took in your hand and studied. (butterflies)



There was also a curiosity for other living organisms and awareness of ecological phenomena observed in the kindergarten children's investigation of their environment. Consider this field note detailing the observation of children looking for sea stars:

"Do you know that the sea stars have one eye on each arm?" One of the boys looks at me as he holds a sea star in his hand pointing at the arms and counting: 'One, two, three, four five...' The children waded in the sea they took the sea stars carefully up from the saltwater and placed them in plastic trunks or buckets with salt water. They discussed colors, how to take care of them and discussed which sea star belonged to whom. After a while, they let them go, into the sea again...

The focus of the children's interest on the living animals were especially directed towards smaller species that could easily be observed and touched. Collecting sea stars was not motivated from an interest for building a permanent collection but rather the children curiously explored the life form of these creatures. At the same time, they used them in their imaginative play. The sea stars were just one of the small animals that drew the children's attention, one of many wonders at the seashore. There were other small creatures, jellyfish and crabs in the sea and insects and earthworms in the woods, that constantly attracted the children's attention. By handling these animals, the children showed care and knowledge by being attentive and keeping them in an environment suited for their biological needs.

## Discussion

Early in this paper the concern for an 'extinction of experience' was noted and in response this study has attempted to provide a better picture of just what that childhood embodied nature experience looks like. A synthesis of key results presented in this paper highlight the importance of childhood sensory experiences as a point of departure for development of ecological ideas and embodied environmental understanding. Specifically, these results provide support for the idea that childhood nature collecting, play, and exploration is a rich avenue for sensory experience and environmental understanding. The sensory memories described and experiences observed in these combined studies illustrate the importance of human engagement with natural landscapes during child development. As detailed in the results, all of the adult participants were able to recall rich sensory experience: smells, sounds, taste, and the experience of touching. And for the small children, spending their everyday lives out of doors and visiting the same environments ensured that these sensory experiences were intertwined with their exploration and play. The strength of the sensory memories and the regular observations of rich sensory immersion highlight the potential value in direct experiences in which children, through their own agency, can make connections with the biotic/abiotic variety of nature. The small children's playful exploration in and of the environment were closely connected to ecological knowledge. The diversity of the landscapes and the experiences of other living creatures seemed intertwined with their play. As noted by Rautio (2013) these interactions in which children 'make themselves available to their material surroundings' (454) is of great value. Significantly, the memories of the adults corresponded with the way the children approached and interpreted their environment, and for both groups the embodied experiences were important. The body was central for their 'being in the world' and their perception of the world theoretical (Merleau-Ponty 1968).

## Implications for environmental education

The tensions surrounding a lack of nature experiences in childhood is also a concern for how our educational systems provide new generations rich experience as a tool to understand and appreciate biodiversity. While we have not measured specific knowledge of biodiversity understanding as a part of the experiences described, descriptions have been provided that are useful for a deeper consideration of just how important aspects of biodiversity and other complex environmental ideas may be experienced. Instead of looking for specific evidence about how children can learn about biodiversity, the examples offer a glimpse of the importance being in nature has for individual's experience of biodiversity and connection to the natural world. Observations and stories show how the transformation

of sticks, stones, cones, and shells to different purposes were a part of creative processes that have implications for learning; we propose that concepts such as biodiversity, cycle, or system come to life via leaves, tadpoles and sea stars.

This focus on biodiversity experience is one response to the critical state of biodiversity conservation in the world today. The complexity of the concept of biodiversity (specifically, the breadth of the concept, encompassing a range of meaning from genetic variability to ecosystem diversity), demands attention if we want the general public to have a meaningful or useful understanding of the idea. Embodied childhood nature experiences, as described in this study, may be a part of a useful educational strategy. For the adult groups looking back, the childhood experiences were paths towards an understanding of biodiversity and ecological ideas, just as the observation of the young children showed how they explored and experienced meaning of the environment and other species. The wonder of other living creatures, the curiosity and fascination of learning about the transformation of a butterfly, or the eyes and mouth of a sea star noted in this paper are not what we sometimes refer to as 'fun-facts'; it is knowledge built on existential experience. We draw inspiration from the broad educational ideals of Dewey (1938) and the specific environmental education ideas of Van Weelie and Wals (2002) regarding the role of education to help to make biodiversity meaningful; we assert that learning based on the combination of experiences and reflections upon the learning process can be brought together to create new knowledge. If we see such experience as important, it should also have implications for how we teach and within what environments we allow the children to explore and learn.

A part of the desired outcome for children to be have rich sensory experience as a part of their early environmental learning is the previously noted idea of agency that develops via self-willed exploration and interaction with other species and biotic/abiotic items. As proposed by Gibson and Pick (2000), there may be an overlap between the development of agency and sensory interaction of the environment by young learners. If the high level of attention and direction many children put into creative play and nature observation via collecting is the kind of interest and motivation we wish to see in the classroom (indoor or outdoor, formal or non-formal), we would be wise to take note. Action research involving practitioners in nature-rich educational settings may be useful for continued investigation of these ideas. And further, additional study that directly engages children in the research process (e.g. Jørgensen 2015) is needed in order to fully consider how we come to understand children's experiences and creation of meaning. Such opportunities for children as active participants in their own learning serves ESD efforts as well; children may be able to use their experiences and understanding to take action meaningful to their lives (Davies, Engdahl, and Otieno 2009). While this study has not investigated long-term biodiversity conservation behavioral outcomes, this is yet another important direction for continued research.

### ***Proximate access***

Another closely related and important implication of this research is the value of proximate access to nature in order to support the opportunity for quality childhood nature experience. We are reminded of the potential of such access by the interview participant who enthusiastically described her summertime access to nature with the simple description: 'I could just run off like crazy' and then went on to describe her adventures and discoveries. The current trend in access to nature, however, is a part of the contemporary challenges to direct childhood experience of nature addressed in the introduction. Therefore, a key role for educators, along with parents, public health officials, landscape planners, urban planners, etc. is securing proximate access to nature for children. Qualities of variation and diversity in biotic/abiotic features of access are important, yet this does not imply that only vast and wild settings can meet these access needs. Many accounts of childhood play in close to home abandoned lots or forgotten ditches provide rich stories of childhood nature experience of variation and diversity (Pyle 1993). However, beyond the opportunistic access to such 'waste places', a useful idea is that of 'biophilic cities' (Derr and Lance 2012, 115). This idea, described as children's environments that foster connections to nature, may be able to guide urban green space planning for proximate access to sensory rich nature

experience. Recent research to support this identified pedagogic role of access to nature in cities is illuminated in the preschool settings study of Matteo, Barthel, and Lars (2014) who found a significant relationship between the development of affinity with the biosphere with nature rich settings and nature rich routines in an urban context.

## Conclusion

An overarching outcome of a better understanding of childhood nature experience is the potential to serve child development while simultaneously addressing environmental quality concerns. As noted earlier by Miller (2005), we need to see the link between our human experiences of nature and the health of our natural systems. Raising biodiversity awareness and making biodiversity experientially accessible to people is an essential part of current and future biodiversity conservation. The 'extinction of experience' noted in the introduction must be seen as a part of the global biodiversity crisis and we urge consideration of just how human experience of biodiversity may be able to serve as a tool in current biodiversity conservation efforts. We do not propose that education is the sole factor in an enhanced biodiversity conservation effort, (other infrastructural, technological and managerial efforts must also be considered [Heberlein 2012]), we do, however, insist that education has an important role to play. Our future success with global biodiversity conservation may have more to do with our understanding of human learning and behavior than our understanding of ecology. Ultimately, we urge deeper consideration of how making biodiversity and other environmental ideas meaningful may start with childhood wild play, free exploration, and perhaps, a shell collection.

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No potential conflict of interest was reported by the authors.

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