

Encounters between forest hydrology, meteorology and philosophy of environmental education in the era of the Anthropocene

Nikolaos Proutsos¹, Dimitris Tigkas², Magdalini Tsevreni³, Irida Tsevreni^{4,*}

¹ Institute of Mediterranean Forest Ecosystems, Hellenic Agricultural Organization “DEMETER”, Athens, Greece

² Lab. of Reclamation Works and Water Resources Management, NTUA, Athens, Greece

³ Institute of Political Research, National Centre for Social Research, Athens, Greece

⁴ Department of Early Childhood Education, University of Thessaly, Volos, Greece

Abstract. The paper investigates water in the forest ecosystem through an interdisciplinary prism combining hydrology with meteorology, environmental education and environmental ethics. The research aimed at producing a pedagogical methodology of familiarising with the hydrological cycle in the forest, not with its stereotypical and knowledge-centred approach, but with a framework that would support an experiential, ecocentric and holistic way of environmental learning in the Anthropocene. The research process was implemented through a hybrid approach of action research and took place through research teams' encounters with water in the forest ecosystem of Dirfys, Evia. Our hydro-pedagogies in the forest manifest through a spiral pedagogical process of experiencing, feeling and thinking with water, which flows in four cycles: a) exploring with water, b) empathising with water, c) interconnecting with water, and d) reflecting with water. Our proposed hydro-pedagogies flow in the Hydranthropocene as an alternative view to pedagogical research and praxis with water visualising an ecocentric, watery common future.

1 Introduction

Teaching and learning about the environment in the Anthropocene is a challenging task for teachers and environmental education educators, having at the same time to be informed of the huge consequences of the ongoing ecological crisis, while being aware and working against human alienation from the natural world. This study is based on the exploration of these two dimensions in the human-nature relationship in the framework of environmental education, focusing on forest hydrology.

The exploration and protection of forest ecosystems have been traditionally included in the environmental education context. However, the water cycle in the forest as an educational topic has not been of particular interest in the framework of environmental education research and praxis. According to Bruce et al. [1], “*despite being the basis of all life, water is under-articulated when it comes to land-based, place-based, and field-based science education.*” This study emphasises the complex interactions of the water element in the hydrological cycle in the forest and how these hydrological processes can inspire the creation of a didactic methodology in the context of environmental learning.

We investigate water in the forest ecosystem through an interdisciplinary prism that combines hydrology with meteorology, environmental education and environmental ethics. The aim of the research is to create

and present an experiential, ecocentric pedagogical methodology with basic guidelines for including principal hydrological processes occurring in forest ecosystems.

2 Environmental learning in the Anthropocene

Environmental learning in the era of the Anthropocene is based mainly on the empowerment of children's contact and bond with the non-human world. Children should be allowed to interact with the natural world, to act with their body, to sense their feelings and to reflect on their experience, creating their own environmental knowledge [2, 3].

The empowerment of biophilia [4], human's innate attraction to the natural world, is a primary goal for environmental education where the human's alienation from the natural world is now a given [5]. A second objective is to approach the natural world, not as an “inanimate” tool for children's education, but from an ecocentric point of view [6, 7].

This approach, under the prism of a posthumanist pedagogical philosophy, supports the co-creation of environmental knowledge by human and non-human world [8]. In the context of the ecocentric pedagogical philosophy, the child's relationship with the natural world is placed at the centre of the educational process

* Corresponding author: itsevreni@uth.gr

and through a non-directive teaching philosophy the aim is to observe and highlight the qualities and values that emerge from this equal pedagogical relation.

Furthermore, an important dimension proposed in the context of learning in the Anthropocene is the holistic pedagogical philosophy that emphasises the cultivation not only of cognitive abilities, but also of the body, emotions and spirit [3]. Holistic pedagogy aims at the mental, emotional, physical, social, aesthetic and spiritual education of the child [9]. In this approach, children's personal experiences with the natural world are placed at the centre. Nowadays, there is a need to move away from the dominance of scientific concepts and didacticism to protect the environment and attempt to achieve a balance between mind, body, heart and spirit in interaction with the non-human world [2, 3].

Finally, the conditions of the ecological crisis also dictate considering environmental learning in the framework of climate change - the biggest environmental problem of the ecological crisis. To face the challenges of the climate crisis, we are obligated to engage children *“in learning, participating, acting and shaping the weather and climate world... to shift the environmental education paradigm towards attached, embodied and experiential learning in an intergenerational, transdisciplinary and healing framework”* ([10], p. 102).

3 Methodology (Researching with water)

Our research team, composed of scholars from different disciplines from natural and social sciences, forms an interdisciplinary basis that was able to analyse and synthesise the topic with multiple methodological tools derived from different scientific fields. The ultimate goal of the study was to redefine and redesign the process of familiarising with the hydrological cycle in the forest not with its abstract, stereotypical and knowledge-centred approach, but with an alternative perspective that would support an experiential, ecocentric and holistic way of environmental learning in the Anthropocene.

The research methodology is based on authentic experiential, multi-dimensional encounters between the researchers and the element of water in the forest ecosystem. This methodological approach is placed epistemologically and ontologically in a framework that asks the scientists and researchers to leave the office, the laboratory, the library and the PC, placing them in the natural ecosystem that they study, with the aim to authentically experience the natural world, rather than convey abstract scientific knowledge [11].

Our encounters with water in the forest took place through an outdoor, place-based/water-based project implemented through several visits to a forest site (Figure 1). The site is located near Steni village, a part of the broader ecosystem of Dirfys mountain on the island of Evia, Greece. The visits took place between winter and spring.

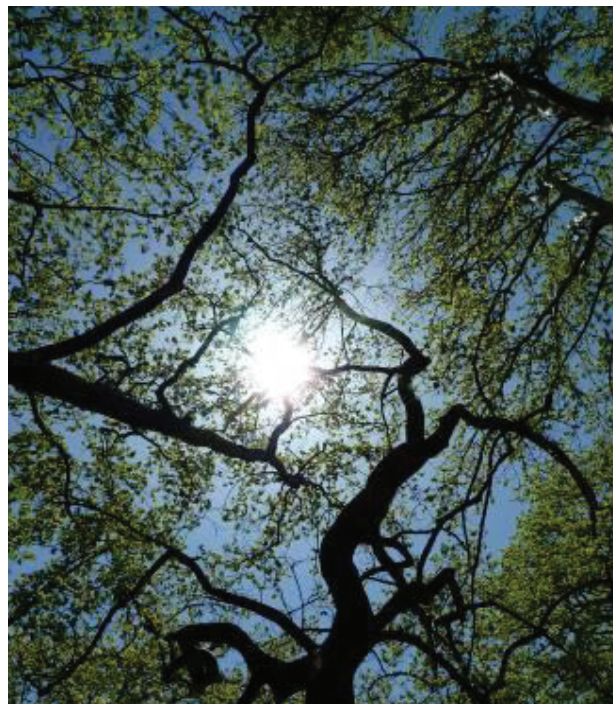


Fig. 1. The forest site of the research.

The research methodology is based on a hybrid approach of action research, following the basic guidelines of the interpretative approach by Elliott ([12, p. 69], who defined action research as *“the study of a social situation with a view to improving the quality of action within it”*. Elliott also mentions that *“action research ‘theories’ are not validated independently and then applied to practice. They are validated through practice.”* The research process followed the basic stages of action research, which include a spiral of self-reflective cycles of planning, acting and observing, and reflecting [13].

The initial stage of the research process and the research problem to be resolved were based on a concern of the fourth author of the article, in the context of teaching the Environmental Education course at a University Pedagogical Department. The students persistently expressed the need to include the hydrological cycle in environmental education activities and programs that they planned, but their approach was usually stereotypical, one-dimensional and lacking an interdisciplinary, ecocentric and holistic view. This abstract and knowledge-centred approach to water is typical in primary and secondary schooling [1]. Thus, the current research responds to the need of placing the hydrological cycle within an authentic natural ecosystem in interaction with the learners and not in an indoor school classroom.

The research team during and after the visits to the forest site used different methods such as walking, nature photography and nature journaling to collect and analyse data and ideas (Figures 2-3). The photographs presented in the current study belong to the authors' team and present researchers' encounters with water in the forest. The research team discovered, observed,

explored and empathised with different water entities, forms and phenomena (Figures 4-8 & 10).



Fig. 2. The research team exploring with water.



Fig. 3. Capturing water elements in the forest.

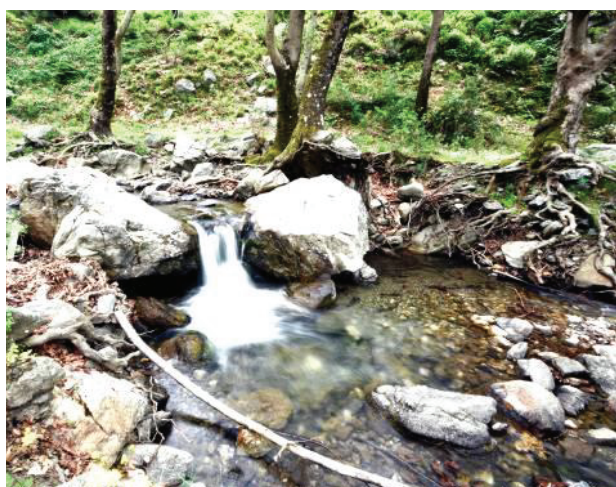


Fig. 4. Encounters with water.

4 Encounters with water in the forest

The research team observed and interpreted watery encounters through the prism of different disciplines which is revealed and presented in sections 4.1, 4.2 and 4.3.

4.1. Water in the forest

The water in the forest exists in multiple and interchangeable forms. It can be found in the form of a river flowing between trees and rocks, as mist, fog or dew inside the forest micrometeorological environment, as the snow covering the plants and the soil, inside the plant tissues, as rainfall, as throughfall (reaching the forest soil by traveling through the branches and trunks of the trees), as intercepted precipitation that is held by the trees canopy, after a rainfall, and then dripping down to the soil. The water turns into vapour form, evaporated from soil and through the transpiration process from the plants. In addition, the most important form of water is its quantities stored inside the soil, where plant roots exist, since its availability in the root zone, determines the plants' survival, growth or even phenology [14-16]. Accordingly, the amounts of water that will infiltrate deeper into the soil, will determine the water quantities that are stored in the aquifers and are essential for the well-being of the entire ecosystem.

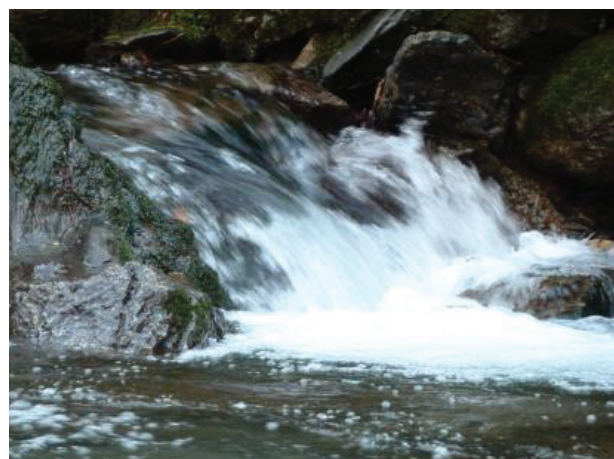


Fig. 5. Encounters with water entities.

Considering that natural forests are rainfed ecosystems, expanding in locations useless for other types of development (agriculture or city expansion) and that they usually grow above degraded soils, it is evident that they are quite vulnerable to water balance alterations especially in arid areas [15, 17]. However, those remarkable ecosystems, through millions of years, have developed adaptation mechanisms and interspecies interconnections that increased their tolerance to the constantly changing climate. Though, major or abrupt climate shifts can still dynamically alter the established interrelations of the ecosystem, leading to the substitution of vulnerable species with others, more adjustable or tolerant to the new conditions.

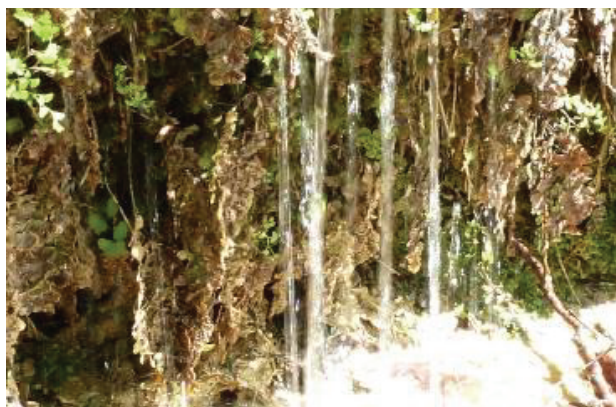


Fig. 6. Encounters with water entities.

Future global warming and aridity are expected to influence the water flows in the forests with impacts on their species composition, health, growth rates, etc, and is likely to trigger the forest migration to altitudinal higher or latitudinal northern locations where cooler and wetter conditions persist [18]. This migration will probably preserve some of the habitats, if the climate's changing pace is occurring slowly enough to allow the translocation of the plant species.

Also, the anticipated increase in the frequency and intensity of extreme hydrological phenomena, such as floods and droughts, is also expected to alter the existing balance of forest ecosystems [19].

4.2 Water in our conceptual understanding of the world

Since ancient times, water had a particular importance: the running water; the vastness of the sea; the raindrops; the water flux. The water, that changes in a liquid, solid or gas form was attracting the curiosity of philosophers and scientists. Water has been one of the four key elements of life in pre-Socratic philosophy [20], and had a particular significance in the understanding of the cosmos ever since. It has been said that water is the beginning of the world, a fundamental principle that set everything in motion (e.g. Thales, O'Grady).

But water, as a metaphor, has also served as a great way to talk about the unintelligible notions that characterise our conceptual understanding of the world [21, 22]. Water has been used as a metaphor or even as a symbol for movement, for change, for the concept of time. Heraclitus has famously said that "*No man ever steps in the same river twice*" and that "*everything flows*"; two water metaphors that marked human understanding on so many levels, and are still provoking debates [23].

In a philosophical approach to water, one can examine both its literal and figurative use. In both ways, that which remains a constant point of reference and a common feature is its dynamic character. Using water as a philosophical starting point, concentrating on a theoretical understanding of hydro-pedagogies transforms our world in a constantly changing environment, a place where every element is related to the other. In other words, from our ability to capture the

immediate data of consciousness [24] to the understanding of potency and action [25, 26], water can be at the centre of our interest.

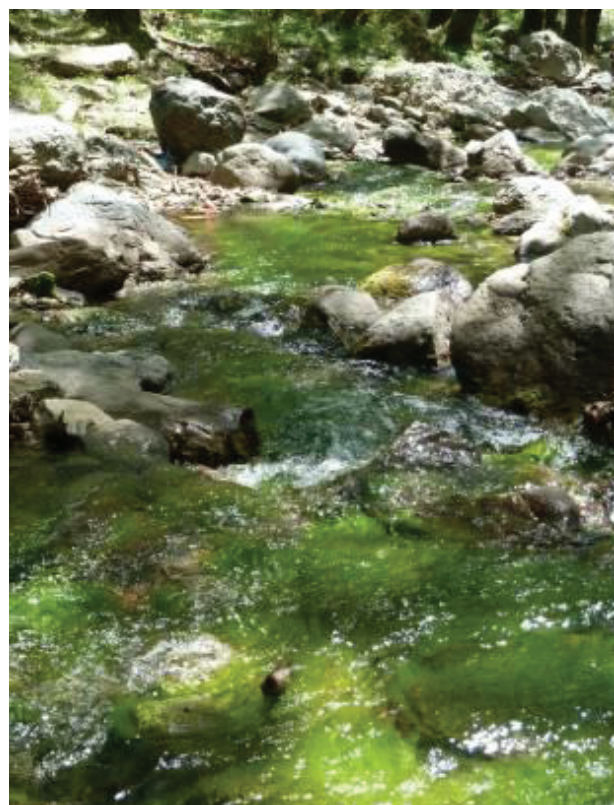


Fig. 7. Flowing with the watery forest.

4.3 Teaching and learning with water in the Anthropocene

Three main obstacles take children away from the water in the traditional approach to environmental education. First, dominant approaches to water education include learning about water and typically take place indoors, alienated from the natural world without "*giving children the opportunity to physically interact with water, much less water existing in a natural habitat (like an ocean, stream, or rain puddles)*" [1]. The learning process takes place without the authentic experience of the element of water.

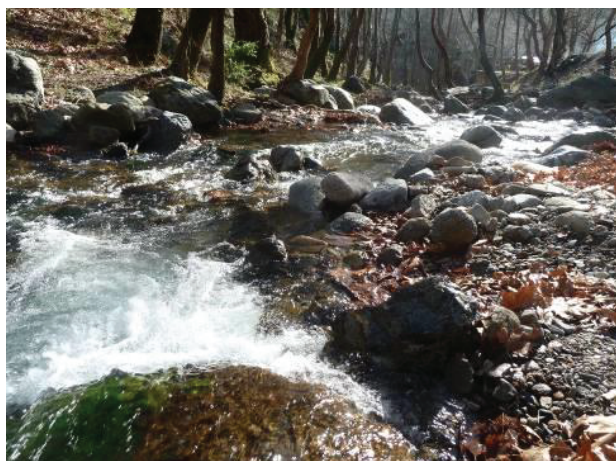


Fig. 8. Encounters with water entities.

Second, we teach about water elements, water entities and water phenomena without thinking that we ourselves consist of water. Third, the element of water is presented as an “inanimate” object, as an educational tool for children’s increase of cognitive abilities. We focus on the physical properties of water and its utility discouraging interaction with water [1]. The element of water is not engaged in the pedagogical praxis as an equal participant.

However, we are interdependent on water, we consist of water. We are all “*bodies of water*” [27]. On an educational basis, there is a need to rethink and reconsider the change of the didactic paradigm from learning *about* water to learning *from* and *with* water. To

be engaged with watery pedagogies that invite water to be an integral and energetic part of the learning experience [28, 29].

5 Hydro-pedagogies: Learning from and with water

Hydro-pedagogies in the current study consist of pedagogical principles and methods for an experiential, ecocentric and holistic (cognitive, embodied, sensory, spiritual and ethical) experience of learning from and with water in the natural world. It reveals how experiencing water in different forms (such as liquid, ice and vapour) and how hydrological parameters (such as precipitation, evapotranspiration, dew, humidity, dryness, etc.) can manifest in a relationship of interconnectedness between humans and the more-than-human world. It also discusses how this methodology can support the empowerment of environmental awareness and consciousness through thinking and sensing with water in the era of the Anthropocene.

Hydro-pedagogies in the forest can take place through a spiral pedagogical process of experiencing, feeling and thinking with water, which flows in four watery cycles: a) exploring with water, b) empathising with water, c) interconnecting with water, d) reflecting with water (Table 1).

Table 1: Hydro-pedagogies: experiencing, feeling and thinking with water in the natural world.

Water dimensions	Pedagogical methods and techniques
	<u>Exploring with water</u>
Different forms of water: e.g. liquid, ice, rain, vapour, fog. Experiencing water phenomena such as humidity and wetness. Observing in detail water forms.	<i>Embodied and sensorial explorations with water</i> <i>Playing and creating with mud</i> <i>Photographing watery moments such as dews.</i>
	<u>Empathising with water</u>
Experiencing water in forest and hydrological processes such as transpiration, dryness, etc.	<i>Flowing with water</i> <i>Transpiring with water</i> <i>Environmental contemplative learning</i> <i>(mindfulness meditation yoga, dancing, and poems writing)</i>
	<u>Interconnecting with water</u>
We are all water (plants, animals, humans). Learning from water.	<i>Conceptualising water.</i> <i>Art-based techniques (dramatisation, performance, watery ecological art)</i> <i>Mindfulness walking</i> <i>Guided meditations</i>
	<u>Reflecting with water</u>
Creating environmental knowledge with water.	<i>Nature journaling</i> <i>Reflective processes</i>

In the first stage of exploring with water, learners can experience the different forms of water through their senses and their body. This can be achieved through games and activities with water, based on sound, touch and smell that will encourage the embodied experience

of different dimensions of water. Experiencing with water can include embodied and sensorial familiarisation with different hydrological processes. Interacting with humidity can manifest through children’s encounters with mud, playing in the mud pits and creating with

mud. It can also include the detailed observation of different forms of water such as dews through a photographic impression on a small scale (Figure 9).



Fig. 9. Photographing dews.



Fig. 10. Encounters with water forms.

In the second stage, empathising with water, can take place by experiencing hydrological processes such as transpiration and dryness. Moving, flowing and transpiring with water can be experienced through

different techniques, including environmental contemplative learning methods such as mindfulness meditation, yoga, dancing, performance and poet writing (Figure 11) [30]. Empathising with water in the era of the climate crisis can take place through the experience of drought.



Fig. 11. Transpiring with the watery flowers.

The third stage is based on the interconnection with water, since it is of great importance that water, humans, and the more-than-human world are interlinked in a web in the ecosystems [1]. It is crucial to experience the interconnection between water, humans and the forest. In that way, the natural ecosystem will be closely related and associated with the learners and will be part of their existence; not a system that they just observe. This can be achieved through open and creative activities that empower critical thinking through conceptualising water with learners (reflection, analysis, and conceptual understanding of the multiple approaches of water and the direct or mediated human relationship with it) [31] and creating watery ecological art [32]. It can include contemplative techniques, such as mindfulness walking and guided meditation focusing on interconnectedness with our non-human others (Figures 12 & 13).



Fig. 12. Moving with the watery creatures.



Fig. 13. Paddling with watery creatures.

Finally, the last stage of reflecting with water is very important for the co-construction of knowledge in the context of experiential learning. This process can be achieved through nature journaling, which allows the empowerment of connection with the more-than-human, of holistic, experiential learning, collaboration, participation, reflection and enjoyment [3]. It enables learners to document their experience throughout the process and return to reflect and utilize this reflection to the creation of their own environmental knowledge [33].

Hydro-pedagogies create a watery basis to flow with water, with learners with human and non-human creatures, with teaching and learning methodology. Hydro-pedagogies do not follow a strict methodological framework since they aim at creating pedagogical possibilities and moments to connect and care for our watery common world.

6 Discussion and concluding remarks (Flowing in the Hydranthropocene)

The research emerged the concept of hydro-pedagogies: a transdisciplinary pedagogical methodology featuring educational guidelines and methods to support environmental educators to familiarise students with water elements, water phenomena and water dimensions, encouraging them to think, act and reflect with water in the natural world. We propose an ecocentric approach to healing our alienation from nature and support the creation of a common world of co-existence with our more-than-human others. This watery methodology attempts to extend beyond human exceptionalism and human centism and emphasise watery relations in the forest thinking of the well-being of the entire ecosystem [1].

Through the manifestation of hydro-pedagogies and experiencing, feeling and thinking with water in the natural world we attempt to co-create pedagogical experiences that could cultivate environmental connection and consciousness against the anthropocentric era of the Anthropocene. Scholars in the broad field of humanistic environmental studies have

proposed many terms that can replace Anthropocene [34] to envision a future common world [35] that will be less anthropocentric. These include, for example, Capitalocene [36], Plantationocene [37] and Planthropocene [38]. Bailey-Charteris ([39], p. 10) proposed the term Hydrocene to “*curatorial practice that recognises the connection between artistic practice and the climate crisis, through thinking with water.*”

Reflecting on our research results we created the neologism “*Hydranthropocene*”, to define the participatory learning process that encourages the creation of pedagogical moments of experiencing, feeling and thinking with water. Hydranthropocene is formed by three Greek words: ὕδωρ [ídor] (water), ἄνθρωπος [ánthropos] (human) and καινó [kenó] (new) and highlights the need to redefine our relationship with water and to visualise and organise partnerships and synergies of coexistence and collaboration towards a common world of human and non-human bodies of water.

Our proposed hydro-pedagogies flow in the Hydranthropocene as an alternative pedagogical research and praxis with water and paddles among water elements, water entities, hydrological phenomena and parameters, environmental education teachers, students and teaching and learning process, seeking to float towards a watery common future.

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