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Contents

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A stream of meaning flowing through life

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As we have often stated, the issues and editorials prefacing *Visions for Sustainability* have endeavoured to contribute to humanity's dialogue with nature (Prigogine & Stengers, 1984). Dialogue (*dia*: "through" – *logos*: "word" or "signifier") is described by Bohm (1996) as "a stream of meaning flowing among and through and between us" (p. 6). The stream of meaning that creates the flow of humanity's dialogue has always been shaped by the evolution of human language and the way in which "we human beings exist and operate as human beings as we operate in language: languaging is our manner of living as human beings" (Maturana, 2002, p.27). Moreover, the sustainability of life itself depends on language as a means of creating the flow, the exchange and the processing of information that enable the biological processes that are vital for all living organisms.

Life as biolanguaging

Indeed, languaging is not only *our* way of living as human beings. Nor is the "stream of meaning […] between *us*" a flow existing only between *us* as human beings, but rather between *us* as all living organisms and the biosphere *we* inhabit together. All life exists and operates as *Biolonguaing*, seen as a complex flow of information between interconnected living organisms, a *biodialoguing* involving a multiplicity of signifiers that goes way beyond the words of human language. An increasing body of research – more commonly referred to in terms of *biocommunication* (Gordon & Seckback, 2017) – has reached the conclusion that operating through biolanguaging involves processes of predicting, interpreting, decision-making, coordinating and organizing based on interaction and information processing. This process encompasses dialoguing between abiotic and biotic elements, animals, plants, fungi, eukaryotes, akaryotes and viruses, and can involve interorganismic (interspecific and intraspecific) languaging

or intraorganismic (intercellular or intracellular) languaging.

Human languaging as our manner of living is thus an infinitesimally small part of biolanguaging as all living organisms' manner of living. Humanity's dialogue with nature is dwarfed by the immensity of life's dialogue with nature and across the vast spectrum of life there are innumerable ways of languaging that are inevitably very different from those of human languages. In terms of *why*, *how* and *what* languaging takes place, such a multiplicity is potentially infinite within the *n*-dimensional linguistic hyperspace of life.

Moreover, even within human languages, there are vast numbers of language families and individual varieties that are largely incomprehensible to users of other languages. Human language is a biocultural evolutionary system and in our multilingual world every single language is a particular example of the immense diversity that such a system can generate. Within the vast spectrum of human multilingual diversity, each language has a special way of creating the processes of sense-making and the intricate texture of meanings by which its users live (Dodman, 2014).

Language comes from the land

At the same time, operating in language is a highly complex and often contradictory process of context-dependent meaning building, since language is "both the constricting horizon and the energising atmosphere within and by which all human activity must be understood (Said 1975, p.284). Language both conditions our courses of action and our way of understanding that action. While, as our energising atmosphere, language has the meaning potential to enable infinite processes of signification, as our constricting horizon, language inevitably creates a setting that limits these processes. Indeed, "where we are is in a sentence" (Spicer, 1975, p. 175), both in terms of the particular lexicogrammatical features of a given language that furnish us with our cognitive tools and of how this confines all our vision and action within certain frames of reference.

Moreover, increasing language mortality, together with the consequent loss of diversity and spread of uniformity, risks creating tunnel vision and inflexibility, an incapacity to adapt and a reduced potential for life. The inability on the part of any living organism to understand and use the information contained within the composite flow of biolanguaging is an evolutionary disability. All our attempts both to proceed with and understand the flow of meaning that constitutes our dialogue – and to put it in the context of the dialogue of all other living organisms – risk being hampered by the limits of the very human languaging on which we depend. Important conditions for continuing our dialogue must be recognizing those limits and developing awareness of what they imply, endeavouring to realize more fully the energizing horizon of human meaning potential and ensuring that we take into account an overall biolanguaging perspective. An important point of departure for this enterprise would profitably be that which is often expressed by users of many indigenous languages from various continents, "language comes from the land […] Words are given to us by the land […] the land needs words, the land speaks for us, and we use language for this. Words make things happen — make us alive" (Turner, 2010, p. 16). Rediscovering this bond with the *oikos* as the place where life can "take place" is essential in order put human languaging within the stream of meaning of biolanguaging.

The emergence of new trajectories

According to the WHO (2021), 2020 was "a year that changed the world". Going into detailed discussion of what is meant by such a statement is quite beyond the scope of this editorial, but we could say that the Covid-19 pandemic will come to be seen as a watershed, the characteristics and extent of which still remains to be defined. During the emergency (*e-mergere*: "come to the surface", "let what was hidden be seen"), all the fragility of humanity's current dominant structures and trajectories has indeed re-emerged, not merely as direct social, economic and political consequences of the global spread of a virus, but, more importantly, as an outcome of our inability to understand information. If an important part of the function of information in living systems (Rohr, 2014) is interpreting it within its environment, using it to make predictions and adapt to changing circumstances, then we have clearly been unable to do so.

The WHO document concentrates on (the lack of) preparedness and response strategies in the

face of a pandemic, and at the same time there have been notable achievements on the part of healthcare systems and the scientific community in terms of diagnostics and treatment, as well as the development of vaccines. The point, however, is to understand causes and not just to react to consequences, mitigate risks that ensue from the environmental perturbations for which we are often largely responsible, take action to enable equitable and effective participation in preventative action as well as access to treatments and vaccines.

Any consideration of what changes and how it changes must necessarily start from asking to what extent the emergency has produced conditions that are favourable for re-thinking (thereby re-languaging) in order to extend the breadth and depth of our dialogue with nature, provided that discourse takes account of each of these conditions. The concept of resilience has come to be used ever more frequently. In this respect, it is essential that we bear in mind that resilience "is not only about being persistent or robust to disturbance. It is also about the opportunities that disturbance opens up in terms of recombination of evolved structures and processes, renewal of the system and emergence of new trajectories" (Folke, 2006).

Exploring the meaning potential of "ecological"

There has recently been widespread talk of the need for an *ecological transition*. The way in which this term is often used seems, however, to ignore the fact that ecology is the study of the interactions between living organisms and their physical environment. Since these interactions are constant and unceasing, this means that from the very birth of life on Earth our biosphere has always been characterized by transition (*transire* = to go across), both a process of changing or a period of changing from one state or condition to another. Life is ongoing ecological transition and biolanguaging can be seen both as existing and operating as living organisms and as exercising the specific ecological roles this entails. Moreover, what we have come to call the Anthropocene has already produced potentially one of the most devastating period of ecological transition Earth has ever known. Our constant striving for what is apparent progress in every sphere of our lives has actually produced a massive reduction in our ways of being and exploring the meaning potential of language.

The point therefore is *what kind* of ecological transition can we play a part in, paradoxically undoing that for which we have been responsible during a brief, but increasingly aberrant period of our existence in which we have forgotten that the exercise of an ecological role must be within a defined niche constituted by specific conditions, resources and interactions, and increasingly treated the entire biosphere as an unlimited resourcesphere to manipulate and exploit, unaware or heedless of the range of potential ecological transitions we have impeded by our emphasis on a "growth-based" model of living. In defining our role, we must always remember to recognize our responsibilities and act accordingly, assuming a way of being founded on humility and thereby shedding the terrible hubris of our belief that we can engineer solutions based exclusively on new human technologies and in particular the spread of artificial intelligence. Indeed, as Crawford (2021) puts it, artificial intelligence is neither artificial nor intelligent and is often based on environmental degradation. It is produced from natural resources, involving, for example, the labour exploitation of lithium mining, and requires people to perform the data extraction tasks that render the systems apparently autonomous.

Our dialogue with nature depends on how we construe our relationship to nature. Artificial intelligence is not the basis of a different relationship, nor is it the answer to how we can be a part of (not the sole player in) a new ecological transition, since it is essentially built perpetuating the same kinds of human and resource exploitation. We must understand how nature has all that is necessary to promote a process of dynamic equilibrium of which we are a more or less significant part and develop ways of re-entering into harmony with that process. Since the term ecological is descriptive and not prescriptive, we need to question how we conceptualize ecological processes in terms of predicting, interpreting, decision-making, coordinating and organizing based on interaction and information processing, and understand how our human languaging can guide our action on the basis of this awareness.

Humility and marvel

An important point of departure for such an ecological transition could perhaps be that of developing greater concern for concepts such as *ecoliteracy* and *ecojustice*. Both are relatively recent developments within human languaging and can in no way be adequately treated here. If, however, we take a basic principle of ecoliteracy to be awareness of our interconnectedness and kinship with all life (Young Brown, 2021), then all our languaging should be based on the humility that such a recognition engenders and consequent marvel (*mirari* = "look intensely, with attention, with surprise, with wonder, with admiration"). From this point of view, what is normally the object of our perception and subsequent action becomes a subject in the interaction between the observer and the observed and renders the dialogue a two-way flow of information. The observed becomes the source and the initiator of perception and acts upon the observer.

This way of construing ourselves as part of nature could feed directly into the concept of ecojustice, whereby we recuperate the idea of justice as a harmonious relationship that is common to many and various philosophical traditions. Justice is a human concept we have tended to apply exclusively to ourselves but which we would be well advised to extend to nature, seen as what gives rise to our biosphere, an inhabitable environment in which life can emerge and reside. Nature itself is not concerned with justice, but rather with dynamic equilibrium and adaptability, but, since we are able to conceptualize such an idea and consider it a pillar of democracy, we should apply it to the entire biosphere, simply because this would be *just*, or harmonious. Otherwise, our dialogue with nature will always be hypocritical and we will remain unable to understand that the value of non-human life cannot be judged on the basis of its usefulness for human purposes.

Perspectives on human beings and nature

Each of the papers published in this issue consider the relationship between human beings and nature from different perspectives.

Kopnina et al. examine various aspects of ecodemocracy and ask how capable democratic societies are of addressing environmental challenges. They are concerned with what ecodemocracy could look like in practice, and in particular with what is needed to secure democratic legitimacy for policy measures to benefit nonhuman species. In this respect, they investigate a possible approach in the form of a mandate for proxy eco-representation similar to civil rights through continuous affirmative action, while considering other approaches and what are the limitations and possibilities of each approach for nature representation.

Di Carmine and Berto offer an environmental psychology perspective on the benefits of contact with nature with particular reference to *atypical* children with Attention deficit hyperactivity disorder (ADHD). They examine how environments can be capable of restoring depleted resources such as attention and consider the scientific evidence that exposure to nature offers attentional recovery as explained by Attention Restoration Theory.

Colombo et al. present a study of wildflowers in Italian urban settings and people's preferences as regards the rich diversity of wildflowers. They look at how preference for wildflowers may be affected by the way the issue is presented, and also whether an individual's connection to nature affects preference for wildflowers.

Asim et al. look at how working and living environments may be restorative and mitigate psychological problems at the source. Their main focus in this paper is on the strategies and developments of Biophilic design with respect to therapy and restoration, in order to achieve sustainability in terms of quality of life within the immediate built environment.

Paukku argues that sustainability is most often defined through three dimensions: environmental, economic, and social. Looking a Finnish legislation, he considers how environmental sustainability is often pursued directly, whereas the other two are pursued indirectly or not at all, depending on the way in which sustainability itself is defined. He concludes that it is better to pursue separate policy goals that promote individual aspects of sustainability within specific laws.

Dodman's review of *The Disappearance of Butterflies*, by Josef Reichholf, shows how the author offers a series of fascinating insights into the biology, the physics and the chemistry of

Lepidoptera, including their remarkable adaptive capacities in the face of eco-systemic transformations. At the same time, he also considers how Reichholf poses a range of provoking questions concerning the multiple, interwoven facets of living organism and human trajectories and the question of assuming responsibility for taking action when those trajectories become either threatening or threatened.

Next year's words

Clearly, if our dialogue is with nature, then a key aspect of any process of re-languaging concerns the way or ways in which we define nature and ourselves as part of it, how we understand it and our role within it, how we interact with it and all the abiotic and biotic elements that compose it. As Ducarme & Cuvet (2020) put it:

> "nature" is not such an easy word, and it actually fits the definition of an abstract concept, hence a mental construction rather than a concrete notion, which is situated both historically and geographically, and needs definition in context […]. [Moreover], the word "nature" does not always have a translation in other languages or can embody different meanings within a language (pp. 1-2).

This editorial has been an attempt to examine some features of the current historical context and contribute to a new mental construction based on re-languaging our dialogue with nature. If languaging is our way of being and our current way of being is largely unsustainable, then we must at least consider the extent to which our current way of languaging is therefore unsustainable. Perhaps we will really be able to talk about a year that changed the world if a different and more sustainable voice emerges for our dialogue. As Eliot (1942) puts it:

> For last year's words belong to last year's language
>
> And next year's words await another voice.
>
> And to make an end is to make a beginning.

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Ecodemocracy in Practice: Exploration of Debates on Limits and Possibilities of Addressing Environmental Challenges within Democratic Systems

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Abstract

This article examines the practical implications of ecological democracy or ecodemocracy, inquiring how capable democratic societies are of addressing environmental challenges. It asks: What is needed to secure democratic legitimacy for policy measures to benefit nonhuman species? What would ecodemocracy look like in practice? Different types of existing and possible types of representation are discussed, including the expansion of the precautionary principle, the Council of All Beings or Parliament of Things, and representation through the Parties for Animals. A possible approach in the form of a mandate for proxy eco- representation similar to civil rights through continuous affirmative action is investigated. Limitations and possibilities of each approach for nature representation are weighed.

Key words. anthropocentrism, democracy, ecocentrism, ecological democracy, ecodemocracy, ecological justice, environmental justice, multispecies justice, rights of nature

Introduction: Democracy and environmental problems

Several social and political scientists question the capacity of current democratic systems to address environmental challenges and/or the interconnected concepts of the interests and rights of animals and Nature, of which we are part (Midgley, 1994; Mathews, 1996; Eckersley, 2004; Dryzek, 2005; Lidskog & Elander, 2010). In this article, we argue that conventional democracy based on one-species representation falls short of decision-making that benefits Nature. It is argued that anthropocentric motivation is unlikely to protect all life on the planet, especially

instrumentally “useless" species (Katz, 1999). Despite the evidence of mass extinctions and the inability to address climate crises, the pathological attachment to the idea of “progress” in our democracies remains (Foster, 2015). This belief underpins environmental politics within advanced modern consumer societies that foster denial (Blühdorn, 2007) and limit our understandings of extinctions and human and nonhuman world relationships.

Since nonhumans are not represented in parliamentary systems, their interests are often ignored (Lidskog & Elander, 2010) and our society and politics remain exclusively anthropocentric (Baxter, 2005; Washington et al., 2017; Piccolo et al., 2018; Gray & Curry, 2020). Therefore, following Eckersley (2004), in an anthropocentrically-minded democracy that values biodiversity only in economic terms, there will be no institutional guarantees that respect nonhuman interests. Recognizing the legal rights of Nature is one way, but in many jurisdictions, this remains difficult to implement or operationalize (Taylor et al., 2020). Rethinking “progress” has become increasingly critical.

As a solution, this article proposes uniting animal rights with Rights of Nature (Naess, 1973; Kopnina et al., 2018a) approaches, which are both critical of human exceptionalism and anthropocentrism. This research discusses how existing forms of democracy can form a basis for eco-representation (Baxter, 2005; Eckersley & Gagnon, 2014; Gray & Curry, 2016), inclusive pluralism (Kopnina & Cherniak, 2016), and “Earth Jurisprudence” (Cullinan, 2003; Burdon, 2011) both through existing and still possible democratic means. This article uses existing forms as a base to advance ecodemocracy, including the application of the precautionary principle, the Council of All Beings (Seed et al., 1988; Macy 2005), the Parliament of Things (Latour 1993), and Parties for Animals.

By adopting an environmental philosophy that stresses the intrinsic values of nonhuman species and biological diversity, this article argues for eco- representation at individuals, populations, species, communities, and governance levels. Ecocentric (ecology or ecosystem)-centered democracy or ecodemocracy is a legal and political system in which nonhumans and their habitats are represented and nonhuman beings’ right to survive and flourish can be accounted for in human society’s decision-making processes (Stone, 2010; Gray & Curry, 2016; 2020). But can existing democratic governments effectively solve the most pressing environmental problems of our time?

This paper critically examines steps to ensure existing democratic systems are more inclusive and ecocentric. Some of the emerging questions include: What is needed to secure democratic legitimacy for policy measures for the benefit of nonhuman species that may impose added responsibility on their present electorates? What are the best strategies for swaying current electorates to accept these burdens? Will representatives agree on what the "good" is regarding millions of species, climate change, and biodiversity loss? These are questions worthy of analysis in environmental politics.

Before we turn to practicalities and the assignation of rights, we address the larger requirements of ecodemocracy. To begin, we ask under which conditions will almost 8 billion (potential) voters speak up on behalf of the Earth system, composed of interactive and reciprocal relationships that connect every organism on Earth into one planetary and complex interdependent ecosystem. Firstly, we argue for the recognition of the grave injustice that innumerable nonhuman beings have no legally recognized voice in human democratic decision-making. This exposes current democracies as vastly inadequate to address the planet-wide subordination of places and beings to a single dominant species. To quote Crist (2012, p. 148):

Our conceit has made us so imagination-poor that we cannot fathom that future people, disabused of our species-small-mindedness, will desire to live in a world rich in kinds of beings and kinds of places. Hope lies in humanity’s coming to realize the immensity of what we are irretrievably losing, which is not resources. Hope lies in the fact that we are native to the Earth: we have the potential of understanding that we are losing our own family.

This realization of injustice recognizes limits in the human capacity to meet projected future farmed animals' product demand, while also “achieving animal welfare and environmental goals, limits that signal the need for urgent action to also reduce overconsumption and escalating demands" (Garnett et al., 2013, p. 34). Resolving such tensions must constitute part of the resolution process. What is proposed here is neither acceptance of a conventional democratic

model nor a conspiracy theory of environmentalists imposing a totalitarian state – but an expansion of democracy to include greater-than-humans.

Relevant definitions

These definitions are key to the discussion we offer, with the cognizance that the making of ecodemocracy is beset with complex challenges, aimed at combating overt or covert forms of speciesism (Singer, 2009) and anthropocentrism. “Anthropocentrism” is defined as: “the privileging of that class of beings who best fulfill a conception of what is considered to be quintessentially human over and against all nonhuman others” (Calarco, 2014). “Democracy” here refers to a system of government by (parts of or whole) population of a nation through chosen representatives. “Ecodemocracy” is intertwined with “earth democracy”,“ eco- justice" or “Earth justice”, and refers to political processes that recognize the intrinsic value of non-human beings through “inclusive pluralism” (Cullinan, 2003; Baxter, 2005; Kopnina & Cherniak, 2016; Gray & Curry, 2011). “Environmental justice” is social justice focused on equalizing relationships and access to so-called “natural resources” among different social groups (Bird Rose 2007; Schlosberg 2004). By contrast, proponents of ecological justice emphasize that we should also consider non-human species as morally significant agents (Baxter, 2005; Cafaro & Primack, 2014; Mathews, 2016).

“Ecocide” is a crime against elemental Earth itself, the damage caused to the land and water, the flora, and fauna within one or several affected ecosystems (Higgins, 2010). “Earth jurisprudence” refers to a philosophy of human law and governance based on the idea that the welfare of each member of the community of beings, including humans, is dependent on the welfare of the Earth as a whole (Cullinan, 2003; Burdon, 2011). The term “nonhumans” (or “greater-than-humans”, or “animals") includes vertebrates such as mammals, birds, marsupials, and reptilians; and invertebrates such as sea urchins, earthworms, sponges, jellyfish, insects, and snails, but also plants, fungus, algae, etc. “Nonhuman nature” refers to environment, ecosystems, or habitats that might have been altered by human anthropogenic change. “Wilderness” refers to minimally human-altered “Nature” (Sitka-Sage et al., 2017). The term “interests" refers here to well-being, with concepts and theories of interests, rights, virtues, etc. being different lenses by which to understand and act on what well-being means. The term “rights" refers to a set of legal, political, and/or moral understanding or recognition of certain kinds of (ethical) considerations of what is in the best interest of a species, based on the recognition of “intrinsic value” (Naess, 1973; Midgley, 1994; Singer, 2009).

While “animal rights" might protect the animal from human use, “animal welfare” might permit animal use as long as they are used “humanely” (Garner, 2015). Similarly, “Rights of Nature” refer to ecology-centered (“ecocentric”, or “deep ecology") protection of the environment, ecosystems, or habitats (Naess, 1973; Kopnina et al., 2018a; Piccolo et al., 2018; Washington et al., 2017; 2018). In “shallow ecology”, a usually healthy environment is protected for the sake of human welfare, not because of recognition of its intrinsic value (Naess, 1973; Mathews, 2016). “Intrinsic value” refers to the non-instrumental value, independent of human benefits, of living beings, and ecological systems (Nelson et al., 2016). For Mathews (2016:143), “To possess intrinsic value is to be valuable in one’s own right, and inherently worthy of moral consideration”, and further that “Biocentrism … attributes intrinsic value, and hence moral considerability, to non-human entities in their own right”. The terms “eco-representatives” and “proxies” are legal advocates for future generations of people, animals, and Nature (Treves et al. 2019). Human proxies represent “nonhumans” or “Nature” through “ecodemocracy” (Eckersley, 1995; 2004; Lundmark, 1998; Baxter, 2005; Dobson, 2010).

Can existing democratic governments solve pressing environmental problems?

Whether democratic governments can move toward ecological justice depends on many factors including prevailing worldviews and beliefs in society, the power of the industry, and other social institutions such as the education system, the role of political parties, and grassroots movements. On the level of civil society, experimental and experiential groups emerge that play with alternative perspectives on human nature and human-animal relations.

The belief that democracy can protect nonhumans is based on the “convergence thesis" which assumes that a healthy environment is beneficial to human welfare (Norton, 1986). Since the protection of the natural world is in the interests of humans, anthropocentric and nonhuman-centered policies are assumed to converge in the long run (Norton, 1986; Light, 1996). This process is supposed to be supported by the twin processes of democracy and the advancement of “postmaterial values”, the transformation from economic to more “enlightened” ones such as environmental protection (Inglehart & Flanagan, 1987). This transformation is believed to take place through economic development, technology, and education (Inglehart & Flanagan, 1987; Light, 1996). In Africa, for example, it has been noted that even the issue of community conservation and participatory approaches to biodiversity protection is complicated by economic factors (Fitzgerald, 2015; Habu & Muhammad, 2017). Human-wildlife conflict has taken its toll on wildlife conservation because of crop damage and the levels of (illegal) killing wildlife (Osborn & Parker, 2002; Plotnik & de Waal, 2014). It was suggested that unless governments take drastic measures in solving their people’s economic problems when it comes to the issue of allocation of natural resources, ecodemocracy will hardly be supported.

The environmental crisis has been attributed to the increasing human population and growing material demands stimulating production and consumption (Crist et al., 2017). Thus, one key action is foregrounding ecocentrism and ecojustice in political, legal, and economic decision-making (Stone, 2010). This includes promoting volunteer non-coercive family planning (Crist et al., 2017) and striving towards degrowth or steady-state-economy approaches (Kallis, 2011; Washington & Maloney, 2020). Re-pacing development may be easier to implement where environmental deprivation is already making itself felt (Tremblay & Dunlap, 1977), simultaneously protecting developing countries’ economies. Otherwise, growing demands on natural resources will continue to jeopardize ecological integrity. In turn, long-term prosperity and alleviation of poverty become all but impossible, rendering the Sustainable Development Goals unachievable (Kopnina, 2020). Economic development, which critics have identified as a form of a neo-colonial vision of progress, leads to short-term thinking. Earning quick money through poaching and logging gives way to long-term security through eco-tourism. However, some political and economic barriers need to be overcome (Habu & Muhammad, 2017).

It can be hypothesized that any politician wanting to start subtracting environmental costs from the national economy accepts funding from established allies and industrial lobby groups (Rancière, 2007). What is perhaps most disturbing, is not just the fact that democracies are influenced by powerful industrial lobbies, but that even environmentally-conscious politicians, may fail to push through reforms that are unpopular with the voters and lobbies. After all, the relationship between the democratic system and the capitalist market economy (Rancière, 2007) is stronger than it seems at first sight and affects the ways Nature is treated (Goldman, 1998)

Even in an “enlightened democracy”, Warwick (1998) warns that the assumption that the twin processes of education and democracy are globally transforming values “needs to be treated with some degree of caution” (p. 604). Despite more than half a century of environmental education, environmental problems have worsened (Bonnett, 2013; Sitka-Sage et al., 2017). While “diversity”, “pluralism" and “equality” are embraced in democratic societies (Goodman, 2019), these virtues have little bearing upon rights or well-being improvements in other species (Eckersley, 1995; 2004; Kopnina & Cherniak, 2016). The great moral wrong of extinction (Cafaro & Primack, 2014), or the “silent killer” of habitat destruction (Fitzgerald, 2015), or the miserable conditions of farm animals (Crist, 2012) are still largely not recognized as ethically abhorrent in current democracies as these are not concerned with the rights of nonhumans.

It has been argued that without recognition of the intrinsic value of nonhuman Nature, no institutional guarantees, legally or politically, can be given that nonhuman well-being will be considered (Katz, 1999; Washington et al., 2017; Kopnina et al., 2018a; Piccolo et al., 2018). Perspectives foregrounding ecocentrism supporting nonhuman Nature: individually, in parts, or as a whole, needs integration into the functioning of political and legal institutions (Eckersley, 1995; 2004; Peterson, 2013; Lynn, 2015; Kopnina & Cherniak, 2016).

While Western “enlightened" societies recently became alert to safeguarding the rights of people of different gender, sexual orientations, and especially racism (Williams, 2020), this moral consideration applies only to humans (Bisgould, 2008). For example, the use of millions of

laboratory animals to develop the COVID-19 vaccine is justified by the idea of the "common [human] good" (Toliver, 2020). Following postmaterial values theory (Inglehart & Flanagan 1987), the choice of "common good" in people of less privileged backgrounds might be determined not as much by the images of billions of dead lab animals but of affordable products. Industrial-scale farming operations, slaughterhouses, factories, and enormous quantities of food waste suggest that the way one species turns all other species into "fictitious commodities" (Polanyi, 2001) is by no means competitive with the idea of democracy.

A key question regarding including nonhuman beings in the sphere of moral concern is whether national governments can secure lasting electoral support for imposing major responsibilities on electorates for the benefit of nonhuman species (Lidskog & Elander 2010). Empirically speaking, it appears they struggle to do so, even for the sake of electorate health. Nevertheless, the majority support of the electorate and society need to deliberate on what is "good" regarding millions of species, climate change, and biodiversity loss. The question of what is "good" is of course ethical and relative, while some of the issues discussed here are practical (Midgely, 1998).

Pragmatically, existing Green parties primarily focus on the environment when it affects human welfare (Kopnina, 2019a). In mainstream politics, words like ecology and sustainability are increasingly used in rhetorical rather than meaningful ways, with anthropocentric economic policies (Washington & Maloney, 2020). Meanwhile, grass-roots environmental movements impact the political agenda beyond green parties. Fridays For Future (FFF), the global activist movement calling for 'climate justice' inspired by the Swedish youth activist Greta Thunberg, brought millions to the streets, issuing a call for both environmental and 'democratic renovation'. FFF protests affected the EU elections in Germany and Austria by boosting results for the Green parties (Spannring, 2020). Yet, aside from Parties for Animals, the political representation of nonhuman beings is rare, and social movements that defend Nature often compete with a myriad of human-centered interest groups, with mutually exclusive interests (Kopnina, 2019b).

For example, in 2018, in Paris, the Gilets Jaunes, protesters in yellow vests, blocked roads opposing the decision of the French government to raise taxes on fossil fuels. When interviewed many protestors identified as "common citizens" demanding the government not interfere with their livelihoods. Simultaneously, in 2018, Extinction Rebellion, a group of activists that originated in London, engaged in civil disobedience and roadblocks to pressure their government into action on climate change and species extinction, which demonstrates an ecocentric viewpoint. Extinction Rebellion modeled their non-violent direct action and strategies on the civil rights, suffragettes, and social liberation movements of centuries prior. Because of the shifting membership and lack of coherency in goals and practicable policy reforms in both cases, the value of these protests is yet to yield tangible results, hence, the role of government remains central.

What is needed to secure democratic legitimacy for non-anthropocentric policy?

To accept complex trade-offs of eco-representation, ecocentric or animal ethics must be widely shared in society. If this does not occur, nonhumans' interests are likely to be underrepresented (Werzansky-Orland, 2019; Wilson, 2019). To achieve this representation, Lundmark (1998) and Dobson (2010) both suggest a form of proxy representation in parliament. Lundmark reflected that "a random sample of people from the 'ordinary 'electorate act on behalf of non-humans" (p. 52).

Given that nonhuman stakeholders cannot formally authorize their representation in political discussion or deliberation, direct representation is impossible (Gray & Curry, 2020). According to O'Neill (2006), the legitimacy of representation can instead arise through the possession of knowledge concerning the interests of non-human stakeholders. Existing deliberative democracy allows for "virtual representation" through the internalization of the interests of nonhuman stakeholders (O'Neill, 2006). The practicalities of this proxy representation are not yet fixed, yet some could complement Parties of Animals by expanding focus on a spectrum between domestic animals and wild species and habitats.

The most drastic plan would reserve places for nonhuman representatives, based on existing electorates, and as mandated requirements or quotas. This can be seen as compensation for the fact that nonhuman beings cannot appoint themselves as candidates, cannot speak in human assemblies. Proxy representation raises questions about how individuals will be elected, whom they will represent, and how representation will be balanced with existing anthropocentric politics. To ensure democratic legitimacy for ecocentric policies, proportionate representation (number of individuals within a species, or the significance of species for the flourishing of other species) might be possible. However, as a global census of species is impossible, marginal geographies and their species may remain unknown. Mathews (2016) proposes the "bio-proportionality principle", seeking not merely viable but optimal populations of all species. Allowing all species to flourish has specific policy implications and strengthens the case for increasing the extent of protected areas (Mathews, 2016) with minimal intervention, while also considering the ethical reduction of human populations (Crist et al., 2017).

How to make the existing democratic systems more inclusive and ecocentric?

To address the shortcomings of current democratic systems, a typology of existing and possible ecodemocratic initiatives is emerging. Some steps have already been taken, such as the constitutional entrenchment of the precautionary principle (Eckersley & Gagnon, 2014), which is already widely applied in the context of climate change and pollution. Related to the precautionary principle, the Vorsorgeprinzip helps to foresee, forewarn, and forestall harm in the form of care ethics in public policy which has relevance in scientific disputes about certainty (Bernard, 2016; Lynn, 2018). It applies to harm-causing actions when scientific knowledge of the consequences of this action is lacking or uncertain (O'Riordan, 2013). For example, some governments have taken the precautionary principle regarding wildlife trade based on emerging evidence that the consumption of wildlife caused the spread of COVID-19 (UNEP, 2020).

The restraint to limitless expansion, in terms of population and consumption, will also bear multiple benefits to humans, such as a healthy and abundant planet for future generations, and deeper understanding and affection for what it means to co-inhabit the Earth (Crist, 2012). This could lead to a meaningful change in human society. Another possibility of giving a legally recognized voice to nature in human decision-making processes does not necessarily involve proxy representation, but political engagement emanating from civil group activities, like The Council of All Beings (Seed et al., 1988). The activities of the Council involve deep ecology-inspired "despair and empowerment" workshops, targeted at deeper political engagement for the community of all life. The workshops involve a communal ritual in which participants speak on behalf of another being or entity (for example, a wolf or a river). After each has spoken about their species' concerns, participants talk as humans about their responsibilities to remove the threats or correct the injustices identified. More latterly, the concept of "water literacy" and "environmental literacy" (Hawke, 2012; Hawke & Palsson, 2017) encourages 'listening in to the river' and recognize "a living presence", as "its own self" (Bird Rose 2007, p. 18) and inviting nature to the policy table (Muecke, 2007).

These workshops are useful in helping individuals to experience the beauty and power of our interconnectedness with all life. The Council of All Beings method is normally not applied in a political context but intended for audiences keen to "better understand both their place in the ecosphere as humans and how they should behave" (Gray and Curry, 2020). Similar to the Council is the Parliament of Things, based on Bruno Latour's (1993; 2005) theory of subject-object "entanglements". This idea has recently been developed into a creative collective in the Netherlands, consisting of "designers, policymakers, biologists, artists, lawyers, philosophers and writers" (Parliament of Things, 2021). This collective does "speculative research into the emancipation of animals, plants, and things". It also established the Embassy of the North Sea, from the starting point that the sea owns itself and researching how the sea "can become full-fledged members of society" (Embassy of the North Sea, 2018).

Latour's work has been criticized by Whiteside (2013) as it turns attention from environmental problems to technology and "things". Whiteside (2013) argues that the Parliament of Things refuses to support or create clear norms capable of solving environmental problems, easily dissolving debates in politically disengaged postmodern philosophy. Potentially,

however, these types of informal “Embassies”, “Councils” or “Parliaments” can help empower different socio-economic segments of society through activities such as role-play, moral education, and political visioning (Muecke, 2007).

Another example of political representation encouraging broad participation is the Parties for Animals, based on the EU’s existing agricultural, animal and wildlife platforms across all sectors of society – civil, corporate, and governmental (Morini, 2018; Kopnina, 2019a; 2019b). The parties are normally focused on farming or domesticated animals, and not on (wild) collectives, or broader issues of sustainability (Kopnina 2019a, 2019b). Animal Parties are stronger in Europe, but also in North and South America, Asia, and Oceania (Party for the Animals, 2021).

As part of the search for a more inclusive and ecocentric democratic system, it is worth considering the degrowth movement (Kallis, 2011), as well as the economy for the common good (Felber, 2015). These movements support the robust protection of ecosystems and the broadening of democratic values, allowing for alternative ethic-political spaces (Calarco, 2014; Wadiwel, 2015), such as eco-democracy.

What would ecodemocracy look like in operation?

Lundmark (1998) cautions that “our ability to understand nonhumans is primarily restricted to species that are similar to us”. The proxy representation, in this case, may cause difficulties in deciding who will represent which nonhumans and whether all species will weigh equally. Some might be less subjectively “likable” but scientifically – from the ecosystem functioning point of view - more important than others. Because it is not possible to count the numbers of all species populations on earth, the proxy idea must evolve differently and the allocation of votes and inclusions must be ethically considered in the interests of fair representation.

Making room for nonhuman others implies entitlement to the possession of their own lives. Support for nonhuman rights implies that the most basic interests of animals - such as avoidance of death or suffering - should be considered (Wallach et al., 2020). This realization is rooted in many transdisciplinary positions that have been named post-humanism or non-anthropocentrism, inspired by deep ecology (Naess, 1973), animal rights, and animal law literature (Sunstein and Nussbaum, 2004; Borràs, 2016; Shyam, 2019). Stone’s (2010) work “Should Trees Have Standing” argues for the legal standing of trees through legislative measures, advocating the legal personage of nonhuman life.

However, the movement to integrate animal (or broader nonhuman) rights or nature law with ecocentric ethics has not been easy. Efforts to establish legal rights for nature are mired in discussions about which animals should be accorded rights, and whether individual animals should have less ethical standing than species or habitats (Garner, 2015). Species ranking or hierarchy in terms of which species deserve more rights, has indeed been a subject of a long debate in both deep ecology and animal rights literature (Sunstein & Nussbaum, 2004; Garner, 2015). The discussion about whether invasive (but rare or endangered) versus native (but abundant) species or individuals within the species should be included in the sphere of moral consideration has been ongoing (Sunstein & Nussbaum, 2004; Garner, 2015; Wallach et al., 2020).

As an example, the mention of animal rights in the Facebook group “Conservation, Biodiversity, and Biogeography” in May 2020 evoked a variety of comments. One commentator thinks it is insensitive to speak of animal rights before human inequalities are addressed. Another commentator suspects that recognizing the rights of individual animals will negatively affect conservation as a whole by protecting invasive species. Midgley’s (1994) distinction between absolute and relative dismissals of animal concerns is apparent from these reactions. Both commentators seem to be taking a position of relative dismissal based on what they believe are more important issues or goals.

Following this illustration, the idea of “rights” may bring controversies even within “sympathetic” biological conservation. Indeed, nonhuman rights are not likely to be easily accepted unless established political, legal, and broad cultural recognition of these rights exists, as Stone (2010) proposes. This needs a major change requiring care for both nonhuman and human, sidestepping the common confusion between ecocentrism and ecocentric holism

(Peterson, 2013; Lynn, 2015). The change also requires recognition of objectification and commodification of nonhumans and nature and expanding the possibility of care within a multi-species community (Spannring, 2019). Advocates for Earth jurisprudence argue that Earth-centred governance – including representation – does not (and should not) privilege one species over another, but instead emphasize the key priority as overall ecological integrity and the ability of broader ecosystems to support and regenerate life.

Perhaps the largest global organization addressing ecodemocracy is the United Nations Harmony with Nature Programme (United Nations Harmony with Nature, 2021). It states:

> Rights of Nature are grounded in the recognition that humankind and Nature share a fundamental, non-anthropocentric relationship given our shared existence on this planet... Legal provisions recognizing the Rights of Nature are sometimes referred to as Earth Jurisprudence, including constitutions, national statutes, and local laws. Also, new policies, guidelines, and resolutions are increasingly pointing to the need for a legal approach that recognizes the rights of the Earth to well-being.

Wide-ranging actors are incorporating ecocentric and animal-ethics perspectives and revolutionizing the way Earth-centered perspectives can be applied. The Global Alliance for the Rights of Nature (GARN, 2021), the Nonhuman Rights Project (2021), as well as the Ecological Law and Governance Association (ELGA, 2021), all work with the rights of nature in different ways. Some of the youth organizations are Global Youth Biodiversity Network, Youth4Nature, Youth for our Planet, and Earth Advocacy Youth.

In some countries, including the USA, New Zealand, and Bangladesh, some rivers and lakes have been given legal rights (Ruru, 2018; Strang, 2020). In June 2020, the Supreme Court of Justice of Colombia declared the Isla de Salamanca National Park a subject of rights to protect it from rampant deforestation, and in Aotearoa/New Zealand, the Whanganui River/Te Awa Tupua was granted legal personhood rights in 2014 (Ruru, 2018). Indigenous political movements and demands crucially impacted these reforms. In the case of the Whanganui River, the river's interests were represented by Maori Iwi, and local and national government representatives.

Discussion: Strategies for action between idealism and pragmatism

Individual lifestyle change is part of the story but, on its own, is possibly too small to impact meaningful differences. Issues of resource overconsumption and population growth also require effective transnational multi-level governance. At the moment, as Lidskog and Elander (2010) observe in the case of democracy and climate change, this type of transnational governance still needs to be developed through a truly global optic, not just a western gaze.

This does not mean, of course, that some form of the eco-dictatorial elite will impose on people how to live their lives (Ophuls, 1977; Dryzek, 2005). It does imply, however, that several assumptions and values need to be re-examined. Sometimes a win-win scenario of convergence theory (Norton, 1986) might prevail. For example, as United Nations Environment Program (UNEP, 2020) has communicated, the (il)legal trade of wildlife affects both biodiversity and human health, and presently there are serious efforts to regulate this trade. By implication, human-centered policies espoused by current democratic societies can have a positive effect on the environment if they are strongly reinforced.

Bolder initiatives like proxy representation, offer much hope. Values have changed and new institutions have emerged that secure human rights, abolish slavery, and protect individuals and groups from other forms of discrimination. These institutions and mechanisms are not perfect, but they do exist in democratic systems without the use of force or dictatorship and could be replicated in the rights of nature.

Once the basic institutions and mechanisms protecting nonhuman beings are established, specific conundrums need to be discussed. Given climate change, for example, human proxies need to ponder several (limited) choices. If a threatened species cannot move fast enough to keep up with climate change (given the massive fragmentation of landscape caused by highways, cities, agriculture across global landscapes), are we justified in introducing that species to a similar environment elsewhere? Are we justified in taking an interventionist (active

management) approach, as it is, arguably, the management and "pragmatism" that has served mass extermination of invasive species in practice and anthropocentrism in ethics?

We may not reach a consensus on what the "good for the greatest number" is. For some, it is having personal freedom to drive a car, for others, it is a commitment to future generations of humans and nonhumans. While we speak about the "will of the people" in the age of the Anthropocene, when humanity "controls" the entire planet (Johns 2019), some will choose according to reason, and some according to heart.

We recognize that the optimistic story of conventional democratic environmental reform is widely appealing as making claims against the radiant hope of easy salvation is never a popular position (Sitka-Sage et al., 2017). Yet, act we must. This action should be broadly based, and not shouldered by a minority group of committed individuals (although, like all social movements, it is likely that the broad base will be reached only by the efforts of those committed individuals). The broad base is necessary if only to avoid defensive fantasies of "ecofascism" (Zimmerman, 1995), a term commonly applied to the concern that environmentalists strive to impose totalitarian regimes to achieve their objectives. The term might better apply to a situation in which one single species destroys others – what Crist (2012) referred to as genocide of nonhumans, as well as situations where environmental activists (most of them in developing countries) are murdered defending the rights of nature. Simply put, no known environmentalists or environmental groups support totalitarian, authoritarian, or murderous regimes. Violent ideologies and oppression are not compatible with ecocentrism as a worldview. Ecocentrism in its many varieties embraces and defends the entire community of life (Kopnina et al., 2018b; Piccolo et al., 2018; Washington et al., 2017; 2018; Taylor et al., 2020).

Ways forward: Keeping the wealth of global non-human nature

Both animal rights and environmental ethics share a rejection of anthropocentrism and economy-centered ideology that seeks to exploit the natural world for short- term human profit (Garner, 2015; Wallach et al., 2020). Once the basic non-anthropocentric principles are established, the interests of various stakeholders can be further discussed, weighed, and negotiated. A new epistemology is needed to establish new goals, as is the non-anthropocentric ontology that underpins it. It is, therefore, a fundamental paradigm shift and this must necessarily involve doubt and resistance.

The realization of global species injustice should lead to action. However, urgent action does not presently dominate the political agenda. Current democratic systems are made in a way that they refute biological kinship and exclude humans from any obligations to other planetary inhabitants. Similar to the civil liberation movements of the past, another key to progress is foregrounding ecocentrism and ecojustice in social, economic, political, legal, and cultural institutions. Another action is developing animal well-being combined with nature/habitat protection agencies that push beyond the boundaries and blinkers of instrumental stakeholder meetings to further develop moral, scientific, political, and cultural deliberations to aid non-anthropocentric agendas. These actions are necessary if our privileged access to anything living on earth is to be truly sustainable, both for our future generations and for innumerable planetary inhabitants.

Examples of possible ecodemocratic strategies

Aside from initiatives that already support the "Rights of Nature", there are many emerging and developing instruments and initiatives, such as the platform that promotes "ecocide law", which argues for the criminalization of ecocide and debates the elements required for such an international crime (Ecocide Law, 2021). One way to advocate for an international law of ecocide to be introduced is by reforming the Rome Statute by adding ecocide to the list of crimes against humanity (Mwanza, 2018).

Finally, to achieve a democratic system that can deal with environmental challenges in both pragmatic and ethical terms, eco-representation through "eco-advocates" was proposed (Lundmark, 1998; Baxter, 2005; Dobson, 2010; Gray & Curry, 2016; Gray & Curry, 2020). While details of the process of representation need ongoing adjustment, the overall purpose of

ecodemocracy would be to recognize the entitlement rights of nonhumans to exercise their forms of agency and to flourish in their ways. Building on this shift an ecological democracy must make room for nonhuman others. However, this cannot take the form of simply extending the franchise, since nonhuman others cannot represent themselves in the public sphere in the same way as humans, as we have discussed (Eckersley & Gagnon, 2014).

Following this, "you could, therefore, claim that this rule can serve as a form of proxy representation for future generations of humans and nonhuman others, and broader ecosystems as well" (Eckersley and Gagnon 2014, p. 101). This may need to involve "some type of advocacy mandate, i.e., representatives being appointed for the specific task" (Lidskog & Elander 2010, p. 37). These representatives, like ourselves, can come from a mixed group of biophilic, biocentric, ecocentric, and zoocentric individuals from different countries, cultures, existing inter-, intra-, and supra-government organizations, private sector, NGOs, or green parties that may together form a Global Party for Nature.

Conclusion

In answering the question of whether current democratic governments can solve various environmental problems, this article has delivered both negative and positive answers. This relates to the limitations of growth-centered industrial systems and societies. Both pragmatically and ethically, the needs of nonhuman beings and their habitats independent of their utilitarian value (a complete revaluation of the anthropocentric paradigm) must be considered.

Existing democratic systems must become more inclusive and ecocentric and involve learning from both existing mechanisms or organizations and pushing for a more ambitious system of eco-representation or mandate proxies. What is needed to secure democratic legitimacy for policy measures for the benefit of nonhuman species, is the realization that while some measures may impose limitations on electorates, if these electorates are expanded to nonhumans, the benefits would by far outweigh the burdens.

Simply put, future generations of humans will profit from a planet that is biologically abundant, and sensitive in an inter-species sense. Articulating this mutual benefit is likely to help sway current electorates to accept wider eco-representations of oppressed nonhuman beings while concomitantly recognizing them as intelligent beings in their own right. Not all present voters might agree on what the "good" for nonhuman species is; eco-representatives are likely to be in the majority but we surmise that they are likely to support mutually beneficial measures. Ecodemocracy in operation will most likely look like regular democracy, only it will be fairer and more inclusive, although perhaps imperfect and in need of constant negotiation and interlocution. Churchill said: "Democracy is the worst form of government, except for all the others that have been tried before". Maybe we should try again - and keep on trying.

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Contact with Nature can help ADHD children to cope with their symptoms. The state of the evidence and future directions for research.

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Abstract

Research within the environmental psychology area shows the benefits that Nature contact offers to *typical* children in terms of better mood, better social relations and on improved cognitive functioning. Although many psychological benefits in childhood have been highlighted by researchers from different backgrounds, *atypical* children have scarcely been included in such studies. We refer to children affected by Attention Deficit Hyperactivity Disorder (ADHD). Environments capable of restoring depleted resources such as attention might be of specific help, especially for those who struggle for attention as ADHD children do. Considering the scientific evidence that exposure to Nature offers attentional recovery, as explained by Attention Restoration Theory (ART), we believe that special consideration needs to be given to ADHD children, whose core issue is attention depletion. ART presupposes that psychological restoration occurs while the person feels mentally fatigued. Therefore, ART might constitute the theoretical basis for the clinical aspects of attention in the ADHD frame. The purpose of this mini-review is to offer an overview on what has been done until now on restorative research among ADHD children and indicate new directions for future research by a description of new areas of enquiry and final proposals for policy makers, parents and teachers in order to implement Nature-based interventions in the ADHD field.

Keywords: attention deficit hyperactivity disorder; ADHD; attention restoration; Nature-based treatment; children; symptoms severity; restorative environments.

1. Introduction

ADHD is a childhood-onset disease of neurodevelopment characterised by inhibition and self-regulation impairments that are mainly manifested through chronic inattentiveness and impulsive behaviour (hyperactivity). Such disease can persist across adulthood and the entire lifespan (Barkley, 1997; 1998; 2014; Brodeur & Pond, 2001; Vallesi et al, 2013). Although most researchers agree that the causes of the disease are mainly of neurobiological origin, psychological and

environmental factors seem to have a key role in the maintenance of the disease. More specifically, a multi-factored approach takes into consideration cognitive, motivational, behavioural and genetic components as well as self-regulation deficits (Fabio, 2001; Frigerio & Montali, 2018). Interventions are constituted by pharmacological treatments (Maschietto et al., 2012) that often ameliorate the symptoms but, as has been acknowledged, may also lead to side effects such as facial tics, hypertension, and anorexia (Searight et al., 2009), affecting in different forms the daily life of the ADHD child and family. Finally, approximately 30% of medicated children do not respond to pharmacological therapy (Catalá-López et al., 2017; Goldman et al., 1998). In addition to medical therapies, cognitive-behavioural treatments are also implemented. In many cases, the treatment offered is multimodal and includes a combination of pharmacological, psychoeducational and psychotherapeutic interventions. Considering that a growing number of children worldwide has been affected by ADHD (the incidence is around 5-7%; Polanczyk et al., 2014) and the economic impact that it may have (Mazzotta et al., 2008), there is a clear public interest into finding new ADHD complementary and alternative treatments that can both alleviate ADHD symptoms and improve the quality of life of children and families (Searight et al., 2012). Thus, it is necessary to include other perspectives in the current treatments. The perspective that we aim to propose in this article derives from environmental psychology since it recognizes that the complexity of human behaviour, health and well-being are also a result of the physical environment (Gifford, 2014; Glanz, Rimer, & Viswanath, 2008). Such aspects have not been considered yet but deserve a special emphasis on evaluating alternative and complementary treatments for ADHD.

Nature[1] is considered an effective and cost-free way of recovering from daily stress in general (Berto, 2014; Berto et al., 2018) and mental/attentional fatigue in particular (Kaplan, 1995). *Mental fatigue* refers to lack of attention, becoming easily distracted, having difficulty in staying focused on and completing unappealing tasks, as well as in listening to and following directions, feeling exhausted, irritable and leading to a greater inclination to be impulsive, similar to the ADHD symptoms described in the Diagnostic and Statistical Manual of Mental Disorders - Fifth Edition (APA, 2013). The activation of mechanisms able to restore attentional capacity is therefore fundamental and one such way is via exposure to natural environments. Contact with Nature mainly activates bottom-up involuntary attention[2], and since people are not required to focus on specific 'less interesting' stimuli in natural environments, no effort needs to be directed towards suppressing such 'distracting' stimuli (for a more in-depth discussion see: Berto, 2005; Berto, Massaccesi & Pasini, 2008; Berto et al., 2010). Though we are aware of the differences between mental fatigue effects (on an average person) and ADHD symptoms (in a formally diagnosed with ADHD child) this mini-review aims to suggest exposure to natural environments as an alternative and/or complementary treatment for ADHD children.

2. Studies on ADHD symptoms

2.1. Studies on ADHD symptoms among typical children

Studies assessing the benefits of greenness on cognitive functioning among typical school children have considered both residential and educational setting (Bakir-Demir et al., 2019). Considering the greenness of *residential areas*, Faber Taylor, Kuo and Sullivan (2002) showed that green views from apartment windows potentially reduce both symptoms of Attention Deficit Disorder (ADD) and Attention Deficit Hyperactivity Disorder (ADHD) and, as such, they offer evidence that green views constitute a protective factor among children living in inner cities or in urban areas in general. Similarly, in a sample of children in Germany, Markevych et al. (2014) showed that, as the distance from home to green areas decreased, so did the probabilities of the child presenting symptoms of inattention and hyperactivity. Wells (2000) conducted a study in the USA and had

[1] In this minireview we refer to Nature (and greenness) to indicate a wider concept of natural environment, i.e. "an environment with little or no apparent evidence of human presence or intervention, and the two terms [Nature and natural environment] been used interchangeably" (Hartig, Mitchell, De Vries, & Frumkin, 2014, p. 208).

[2] Attention can be categorized into two distinct functions: "bottom-up" attention, also known as stimulus-driven or exogenous, and "top-down" attention, also known as goal-driven or endogenous. In natural environments, mostly bottom-up involuntary attention is captured and individuals do not spend energy suppressing distracting stimuli.

similar results. Thus, in ADD (Attention Deficit Disorder) children, symptoms are reduced after moving to a greener area independently of factors such as low income. In addition, in line with previous findings, Amoly et al. (2014), considering parents' and teachers' assessment of children's ADHD symptoms, found that in Spain greenness around residential areas was related to less inattention and hyperactivity and also that this result was not dependent on family income. Similar results were obtained by Lee, Kim, and Ha (2019) who conducted a study investigating the relation between community greenness and neurodevelopment health among children in South Korea. In brief, findings revealed that the greenness of residential neighbourhood was associated with lower problematic behaviour in children, in particular aggressive behaviours and attention problems.

Considering the *educational settings*, Martensson et al. (2009) wondered whether the greenness around the school area could have a positive effect on preschool children's cognitive functioning. Authors conducted a study by assessing the quality of the outdoor environment and the fraction of visible sky from play structures used by children. Then, teachers rated attention level and impulsive behaviour of children during play time in the assessed green areas. Outcomes showed that children spending their recreation in large and integrated outdoor areas which include hilly terrain, shrubbery and trees significantly displayed fewer behaviours characterized by inattention. Similarly, a longitudinal study among Norwegian pre-schoolers spending time outdoors during day-care time revealed that attention skills were supported by outdoor time in preschool (Ulset et al., 2017). The study had also predictive value since authors stated that spending time outdoor during preschool protects against developing attention deficit hyperactivity disorder in the future.

Dadvand et al. (2015) conducted a longitudinal study in Spain that merged both *educational and residential settings*. Authors showed that school-aged children improved their attention and working memory during the year as levels of vegetation around home, routes to school and school area increased. Accordingly, Donovan et al. (2019) conducted a study in New Zealand on 49.923 children born in 1998. Their findings revealed that a lower risk of ADHD was associated with increased minimum greenness and rurality (see also Markevych et al., 2018). Other findings that reinforce and extend previous research on ADHD symptoms conducted among typical children are those revealed by Yang et al. (2019). Authors evaluated the association between greenness surrounding schools or day-care centres and ADHD symptoms reported by parents or guardians through a population-based cross-sectional study based on a total number of 59.754 children aged between 2 and 17 years. Results suggest the existence of a beneficial association between greenness and ADHD symptoms.

2.2. Studies on ADHD symptoms among ADHD children

A few studies in restorative research included children affected by ADHD, some of them are correlational, while two are quasi-experimental field studies. Regarding the correlational studies, an example is the one conducted by Faber Taylor, Kuo and Sullivan (2001), who showed that ADHD children who usually play in green settings are more likely to experience less severe attention deficits and, the greener the child's play area is, the stronger is the correlation. A few years later, the same authors conducted an online survey involving children affected by ADHD. From parents' reports, it resulted that "children who regularly play in green outdoor settings experience milder ADHD symptoms than their counterparts playing indoors or in built outdoor settings" (Faber Taylor and Kuo, 2011, p. 296). Moreover, authors tried to differentiate environments between ADD (attention deficit only) and ADHD (attention deficit with hyperactivity) groups. Findings demonstrated that children diagnosed with attention deficits only improved after playing both in grassy areas with big trees and grass open lawns whereas hyperactive children improved only after playing on open grass areas.

To the best of our knowledge, only two quasi-experimental field studies have been conducted in the environmental psychology framework among children affected by ADHD. One took place in the USA by Faber Taylor and Kuo (2008), who conducted single blind controlled trials in a within-subjects crossover design study. The authors exposed the ADHD children to three different outdoor environments: a city-park, an urban residential area and a downtown area. Their aim was to evaluate the effects of a slow paced twenty minute individually guided walking in such environments during different sessions on attention and impulse control. Participants (N = 17)

aged seven to twelve, were pharmacologically treated. Attention and impulsivity were measured after walking in each environmental condition by administering four objective tests. Findings revealed that children concentrated better after walking in the natural condition (an urban park) compared to the two built conditions, suggesting that the amelioration might be compared to medication effect (e.g. methylphenidate peak effect of extended release). The authors stated that Nature "might serve as a safe, inexpensive, widely accessible new tool in the tool kit for managing ADHD symptoms" (Faber Taylor & Kuo, 2008, p. 402).

The second quasi-experimental field study (Van den Berg & Van den Berg, 2010) conducted among children affected by ADHD took place in the Netherlands and was aimed at testing and observing the participants in a natural (a wooded area) and an urban setting. Authors assessed emotions, cognitive functioning and behavior. Participants were medicated and their age ranged between nine and seventeen years of age. Outcomes showed that woods were perceived as more restorative as compared to the town and that children could better concentrate in the woods than in the town. Their behaviour was less impulsive and inattentive in the woods. Moreover, more positive feelings were reported by the children in the woods than in the town.

3. Four gaps to fill in literature on ADHD children

Although studies on ADHD children offer some evidence that Nature contact ameliorates symptoms severity, much more rigorous evidence through experimental studies (e.g. pre and post treatment assessment, within subject design, longitudinal study) is needed to fill some gaps in literature.

The *first gap.* Special attention to the natural settings needs to be given in order to choose different natural scenarios (e.g. "blue" settings such as rivers, lakes and sea or different types of "green" settings) that are objectively differentiated (Martensson et al., 2009). In fact, the natural settings implemented in previous quasi-experimental studies relate to examples of urban nature or wooded areas while, for instance, no experimental evidence exists on the effects of being exposed to a large open field that may be likely to offer a deep vision of field characterized by high prospect (Appleton, 1975; Di Carmine, 2019; Gatersleben & Andrews, 2013). This aspect needs to be addressed by future research since correlational studies suggest that hyperactive children seem to benefit from the presence of open grassy lawns (Faber Taylor & Kuo, 2011), as recently shown also by Di Carmine (2019), who suggests that big trees in grassy lawns may probably constitute an obstacle and an unnecessary refuge for children, probably because trees limit children's need to be in constant movement. Such an outcome deserves more scientific attention since it seems in accordance with the factor *compatibility*, part of the ART framework, which explains the restorative potential of an environment on the basis of the correspondence between the child's purposes and the support or opportunities offered by the environment to fulfil them (Kaplan, 1995).

Researchers should implement different types of Nature categorized through objective data of the physical environment to examine which specific characteristics lead to recovery (Collado, Staats & Sorrel, 2016; Martensonn et al., 2009). Moreover, as suggested by Collado and Staats (2016), the Nature tag used in environmental psychology needs to be broadened, not only in terms of types of natural environments but also in terms of which senses are assessed to evaluate the restorative potential of that environment. In fact, current literature is mainly focused on the sense of sight while the human-Nature transactions are more complex since humans are multisensory. "The multi-sensory aspect of nature experiences is crucial because monotony of stimulation can be a source of stress and multimodal sensory input itself can drive positive mental states such as tranquillity. Indeed, it has been shown that stimulating multiple senses at the same time may possibly lead to additive beneficial effects of nature experiences" (Franco, Shanahan & Fuller, 2017, p. 2). Further investigation among ADHD children is needed in order to evaluate and measure whether Nature exposure can be even more effective and intense through other senses such as the sense of hearing and the sense of touch.

Future research should investigate the difference between *nearby or everyday* Nature (Cox et al., 2017; Wells & Evans, 2003) and *extraordinary* Nature (Joye & Bolderdijk, 2015) among ADHD children. We argue that, because ADHD children struggle for attention, they might need a more intense dose of Nature to replenish, maybe for a longer beneficial effect (Collado et al., 2015; Cox

et al., 2017; Shanahan et al., 2016). It is worth examining whether extraordinary Nature is awe-evoking (Collado & Manrique, 2019) also for this clinical population and, as such, its relation with symptoms alleviation.

Another line of research including the natural environment and ADHD makes reference to the possibility to be restored by exposure to Virtual Nature. In challenging times, such as during Covid-19 emergency, access to public green areas may be restricted, thus becoming an important limitation for hyperactive children and this limitation is further exacerbated by the many hours spent at a computer screen for online teaching. At this purpose, future research could address whether the implementation of virtual extraordinary Nature is effective in reducing stress and anxiety and promoting cognitive functioning among ADHD, although screens need to be used with caution due to possible side effects (Berto, 2014; Hutton et al., 2019; Liszio, Graf & Masuch, 2018; Valtchanov, Barton & Ellard, 2010).

Another field that deserves investigation among ADHD children is the concept of Nature as a containing and holding space, or the theory of Nature Nurtures (Hordyk, Dulude & Shem, 2015). In this case, ADHD is seen as "patterns of disruptive childhood behaviour emanate from interactive dynamics within the family and a lack of psychological well-being in children" (Rafalovich, 2015, p. 79) rather than a disorder of neurobiological and genetic origin. However, what is of interest in this article, is that Nature can become a caregiver substitute, a source of relational attachment when caregiver's holding (Winnicott, 1965) and containment (Bion, 1963) is absent or weak. Nature promotes cognitive functioning (Attention Restoration Theory; Kaplan, 1995) and stress-reduction (Stress Recovery Theory; SRT, Ulrich, 1983) simply establishing an affiliation with Nature (Barbiero & Berto, 2018; Cheng & Monroe, 2012; Hinds & Sparks, 2008). In this way we argue that adopting a Nature-based treatment aiming at nurturing the child as in the mother-child relationship, as demonstrated by Hordyk et al. (2015), could be an effective intervention for improving the quality of life and the well-being of ADHD children in a psychodynamic frame, that at the same time does not exclude the recognized advantages in terms of cognitive functioning (Korpela, Kyttä & Hartig, 2002).

Another future line of research might address the educational settings (Carrus et al., 2015). Researchers could evaluate whether the benefits of spending the recreation outdoors, the so called "green breaks" (Amicone et al., 2018; Chawla et al., 2014; see also Weeland et al., 2019) and outdoor pedagogies might be effective also for ADHD children (Kuo, Browning & Penner, 2018; Otte et al., 2019).

The second gap. Future studies on restorative research should address the importance of the (built) outdoor and indoor environment. Regarding the built outdoor, that is the urban environment, researchers should take a closer look at historical environments. There is some evidence that exposure to urban settings rich in high levels of architectural variation (Lindal & Hartig, 2013), among other details that belong to some historical architectural styles, promotes restoration, more than exposure to urban settings (Bornioli, Parkhurst & Morgan 2018a; Bornioli, Parkhurst & Morgan, 2018b; Fornara, 2011; San Juan, Subiza-Pérez & Vozmediano, 2017; Scopelliti et al., 2019; Van den Berg, Joye, & Koole, 2016; Xu, Zhao & Ye, 2018). Although the benefit of Nature contact is widely recognized in literature, we have to admit that urban children spend their time in the inner city, and therefore emerges the importance to choose on daily basis in which areas their attention is sustained. Furthermore, this seems an important aspect that deserves the attention of policy makers and those who aim to design sustainable cities.

Next, regarding the indoor spaces, future research should address how to promote attention functioning in those settings that ADHD children attend on daily basis, in which they spend most of their time and that constitute an essential promoter of learning and academic achievements, such as day-care centres and schools as well as home environments. Although being affiliated with Nature cannot be reduced to taking Nature indoors (Browning, Ryan & Clancy, 2014), a practical form of taking advantages of Nature for ADHD children in indoor school settings (and not only) is through green walls with living plants in classrooms, since there is some evidence of their restorative potential (Van den Berg et al., 2017). We have to recognize that children spend most of their time indoors rather than outdoors. Therefore, a research question to be addressed would be whether indoor environments foster or deplete attention among ADHD children. In this respect, it is worth considering Biophilic Design (Kellert et al., 2008): "an applied science, aimed at

planning artificial spaces that reflect biophilia, the innate tendency of human beings to seek connections with Nature. It is well known that the application of Biophilic Design reduces stress, stimulates creativity and clear thinking, improves physical and psychological well-being and accelerates healing" (Bolten & Barbiero, 2020, p. 12). In other words, biophilia is an innate tendency that is inherently part of our equilibrium and functioning, since as a species we spent most of our existence in natural, rather than urban, environments. This aspect opens up a new perspective for researchers to examine, through a rigorous methodology, to see if being exposed to restorative indoor environments which recall our biophilia ensures psychological restoration (Berto, 2019; Berto, Maculan & Barbiero, 2020) also among ADHD children, with a possible impact on academic achievements, if considering school settings.

The third gap. More studies are needed to better explore, on a longitudinal design, the relation between the frequency of contact with Nature in daily and afterschool activities and cognitive functioning as well as how the frequency of contact with Nature is influenced by the family's composition, family's Nature connectedness and frequency of contact with Nature (Carrus et al., 2017; Collado et al., 2015; Di Carmine, 2019; Faber Taylor & Kuo, 2011). While there is evidence of cognitive benefits deriving from Nature exposure among ADHD children, research needs to determine the amount of a minimum effective dose of contact with Nature (Cox et al., 2017; Shanahan et al., 2016). In other words, we refer to the minimum length of exposure able to ensure psychological restoration among ADHD children and the frequency of exposure essential to guarantee a long-lasting effect and able to improve the daily quality of life of children and families affected by ADHD. In this respect, an insight that can drive future investigations derives from previous studies which implemented a twenty minute intervention that resulted in a statistically significant improvement of attention (Di Carmine, 2019; Faber Taylor & Kuo, 2008). However, more rigorous research through experimental studies is needed to address this aspect, also in relation to its frequency (Shanahan et al., 2016).

The fourth gap. It is important to consider the social context of children's restoration (Collado & Staats, 2016). Children affected by ADHD are often impaired in terms of social relations since they are affected by a malfunction of joint attention, which is vital to social competence during childhood and the entire lifespan (Marotta et al., 2013). Considering that exposure to Nature has proved to be effective for pro-social behaviour (Carrus et al., 2015; Chawla et al., 2014; Hordyk et al., 2015; Myers, 2012), this aspect needs to be addressed in future research within the ADHD population (often in comorbidity with opponent-defiant disorder) since improvements in social relations may constitute an improvement in the quality of life and a reduction of public costs (Mazzotta et al., 2008).

4. Conclusions

This mini-review aims to relate and extend the attention restoration construct to attention clinical issues, such as those regarding ADHD. Based on Attention Restoration Theory (Kaplan, 1995), attentional recovery is possible when individuals are exposed to natural restorative environments. Such theoretical framework seems fitting within ADHD clinical manifestations (APA, 2013). As suggested by the literature considered in this article, there is already some scientific evidence that being exposed to Nature leads to recovery among ADHD children (Di Carmine, 2019; Faber Taylor et al., 2008; Van den Berg & Van den Berg, 2010; Weeland et al., 2019). An integrative framework, based on a holistic perspective between clinical and non-clinical aspects of attention, could be conceptualized to explore the impact of Nature contact on attention depletion within the ADHD framework. Accordingly we suggest: 1) to examine attention through a continuum from *attentional fatigue* to *attention restoration* obtainable through the psycho-physiological restorative process (Barbiero & Berto, 2016; Herzog et al., 1997), 2) to let Nature be a buffer from daily demands amongst ADHD children (Wells & Evans, 2003).

We address this mini-review not only to researchers, but also to those "surrounding" ADHD children, i.e. teachers, school directors and practitioners, and, in particular, parents, to inform them of the benefits that Nature contact offers to alleviate their children's symptoms and consider that Nature "might serve as a safe, inexpensive, widely accessible new tool in the tool kit for managing ADHD symptoms" (Faber Taylor & Kuo, 2008, p. 402). However, at this point, a social and cultural consideration of ADHD is worth mentioning (Bergey et al., 2018; Lange et al., 2010).

In modern society, alienated from Nature (Louv, 2005; 2009) and dehumanized as part of that alienation's implications (e.g. the videophilia; Zaradic & Pergarms, 2007), as well as sedentary activities conducted indoors more than outdoors, the abuse of medications, the unnatural raising of babies with low-contact, the reduction of breast-feeding, unnatural-modified food etc., we are no longer used to think of Nature neither in terms of health (in a holistic sense) nor in terms of physiological needs. This unsustainable vision of life may affect also ADHD children, since paying attention (i.e. to focus and sustain) is something learnable in early stages in which both the social and physical environment play a key role. Attention needs to be promoted and fostered when its physiological development occurs, during early and later infancy. Hence the importance of encouraging Nature contact from early infancy, as it constitutes a prevention tool and a protective factor against ADHD and other clinical issues (Ulset et al., 2017) as well as constituting part of a physiological developmental milestone able to prepare the child for a healthy developmental trajectory, a concept in accordance with the topical bio-psycho-social concept of health (WHO, 2014). This aspect also reminds us that, because the aetiology of ADHD is still unclear, and environmental factors associated with ADHD (prenatal included) are estimated between 10 and 40% of variance (Beydoun & Saftlas, 2008; Sciberras et al., 2017), we do not know to what extent being alienated by Nature (both mother and offspring) leads to the development or to the persistence and the severity of the disease (Van den Berg & Van den Berg, 2010). However, because no side effects are expectable through Nature contact (apart from biophobia; Ulrich, 1993) and, on the other hand, the planet might also benefit from pro-environmental behaviour (Collado et al., 2015), researchers should investigate how to promote Nature contact to children and families affected by ADHD. Moreover, we hope that practitioners may include Nature contact in their prescriptions and extend them to ADHD children, as recently and successfully done in the "Park prescription program" by a group of paediatricians and practitioners in the USA (Seltenrich, 2015).

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Wildflowers in urban design: an exploratory research of preference in Italian adults.

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Abstract

Wildflowers are plants rich in diversity that can be used in many different ways. Nevertheless they are not widely used in Italian urban settings. This exploratory study aims to investigate preference for wildflowers. To this end, seventy-six adults answered a questionnaire developed to assess a series of wildflower pictures for preference (pictures depicted wildflowers in natural and urban environments, showing pro and cons of this cultivation), and a series of questions concerning wildflowers and their use (questions served as a control of preference ratings). To investigate a secondary area - how preference for wildflowers may be affected by the way the issue is presented - the questionnaire was presented with or without the title explaining the nature of the study, and each question presented with or without a picture. Finally, we considered whether an individual's connection to Nature affects preference for wildflowers. Results showed our participants liked wildflowers (no differences between genders and ages emerged) and this correlated with participants' connection to Nature. However, questions concerning the actual use of wildflowers in urban settings still remain, e.g. concerning the fauna that comes with them, and people being more used to ornamental vegetation that challenges preference and use of wildflowers.

Keywords: Connection to Nature, Preference, Public Perception, Urban Settings, Wildflowers.

1. Introduction

The use of wildflowers in parks and gardens has been well known for centuries all over Europe but the concept of 'wild gardening' or 'flowery med' or 'meadow gardening', i.e. of assembling plants and flowers that grow wild in a specific region, has emerged only in the last few decades (Woudstra & Hitchmough, 2000). Nevertheless it has been gaining more and more popularity in planning theory, policy and landscape design of such communities as sustainable vegetation (Hitchmough, 2004; Ponte-e-Sousa et al., 2016). What are wildflowers? A good explanation is: 'flowering herbaceous perennials and annuals, best suited to be sown in a mixture for the creation of wild meadows managed in a sustainable way' (ISPRA, 2010). Indeed, the main advantages of

wildflowers are ecological, economic and aesthetic in the management scenario and can be used for different purposes, e.g. from recovering and renaturalizing derelict urban or anthropized soils to ornamental purposes (Bretzel, 2009). In economic terms, the benefits can be seen in the reduction in mowing regimes compared to turf grasses, or in water regimes unlike flowerbeds which need watering on a regular base during summer periods, which can be quite costly. From an aesthetic benefits point of view, wildflowers are often seen as having increased colour, more interesting texture and exceptional seasonal change. Meadows also have a more diverse plant community compare to other habitat types and can provide shelter for a great number of wildlife and insects (Ahern et al., 1992). This biodiversity is seen as a very valuable aspect of a natural environment (Lindemann-Matthies et al., 2010; Voigt & Wurster, 2015), but, most importantly, it is able to increment the aesthetic interest of urban green spaces (Lindemann-Matthies & Brieger, 2016).

In addition to being sustainable, wildflower meadows in anthropogenic areas represent a link between urban environments and rural areas (Bretzel et al., 2016). Literature shows that people greatly appreciate rich and more diverse plant communities, which add attractiveness and biodiversity to urban green spaces (Folmer et al., 2016). Urban green spaces that contain high number of flower species, typical of wildflowers, are the keys for provision of ecosystem services (Fuller, 2007; Mitchell, 2008), which in turn, are known to have positive impacts on human health and quality of life (Baur et al., 2013; Kabish et al., 2014). Accessible Nature has been proven to reduce stress, promote mental restoration and emotional self-regulation from just visiting it (Kaplan & Kaplan, 1989; Ulrich et al., 1991; Hartig, 2003; Berto, 2014; Collado et al., 2016; Cox et al., 2017). Moreover, the presence of wildflower meadows in city environments would allow residents to observe and enjoy Nature in the first place (Bretzel et al., 2016), thereby fostering and enhancing the individual sense of connection to Nature, i.e. the extent to which people feel to be a part of the natural world, feel a sense of oneness with Nature, of kinship with animals and plants and of equality between self and Nature (Mayer & McPherson Frantz, 2004). Research demonstrates that the more time people spend in Nature, the more they feel a sense of connection to it (Schultz, 2000). Not only people who feel very much connected to Nature experience a higher sense of well-being, but connectedness to Nature is also an important predictor of ecological behaviour (Berto & Barbiero, 2017), and has also an important role in predicting intentions to engage with the natural environment. Generally speaking, people who have a greater experience of the natural environment express greater affective connections with it than those with less experience. In this perspective, to stimulate one's affective sense of connection to Nature through exposure to wildflower beds and urban green in general could be seen an important step because it would simultaneously affect Nature perceived restorativeness (Berto et al., 2018) and environmental concern (Berto & Barbiero, 2017). In fact, people are not all aware of the psycho-physiological benefits deriving from exposure to natural elements and this 'lack', due to a weak sense of connection to Nature, affects the perception of Nature restorative power and preference for natural environments. In this regard (Berto et al., 2018) recently identified people's connection to Nature as an antecedent of positive perceptual experiences of natural settings that was able to predict preference and people's ability to perceive how Nature (in Its different aspects) can be restorative. In order to stimulate and/or enhance connection to Nature, people need to be exposed more and more frequently to Nature. Flower beds serve perfectly the aim to connect people to Nature (Younis et al., 2010; Shoemaker et al., 1991). Indeed, Nature relatedness predicts environmental sustainable attitudes and behaviours and happiness. Happiness affects subjective well-being and both can easily be increased by spending more time enjoying Nature. This in turn, contributes to act environmentally sustainable behaviours (Zelenski & Nisbet, 2014). In this regard, Shwartz (2014) found that people express high interest in flower diversity. If people are more aware of biodiversity and species diversity, typical of wildflowers, they would be more likely to accept and support in conservation acts and take on pro-environmental behaviours (Cilliers, 2010; Barbaro & Pickett, 2016).

Naturalistic planting and different habitats could better stimulate individuals' interest in the natural world and could provide better educational activities (Özgüner et al., 2007) because of their ecological, economic and aesthetic values. When horticultural and conservation activities are organized to teach in depth about wildflowers, i.e. seed dormancy, propagation methods and plant identification, they become greatly appreciated by the local community (Younis et al., 2010).

Since many studies suggest and demonstrate that Nature can have impacts on the well-being of people, and that educational activities could help them reconnect to the natural world (Shwartz et al., 2014), the need to involve residents in planning decisions and giving them a role in planning their own public spaces, becomes more and more important (Faehnle et al., 2011). Social values and attitudes towards green areas are key factors to integrate citizens in the planning process (see co-design, Gobster et al., 2000; Tyrväinen et al., 2007; Santz et al., 2015) and the public can provide excellent input for improving urban environments (Weber et al., 2014).

This research study is part of a broader project aimed to investigate whether people really like wildflowers for urban uses and if the eventual realization of wildflower meadows is suitable for urban environments. To our knowledge, this exploratory study is the first of its kind, therefore an ad-hoc questionnaire was developed to consider preference for wildflowers. The main aim of the study was to find out whether a group of adults liked wildflowers in general and for different urban uses, and then if differences between genders and ages existed. To this end, the questionnaire was made up of different sections. In a section of the questionnaire participants will be requested to assess a series of pictures for preference, and in another one they will be asked a series of questions concerning wildflowers and their use. Pictures will depict wildflowers in natural and urban environments, showing pro and cons of this cultivation, while questions will serve as a control of preference ratings. In fact, a secondary hypothesis of this study concerns how people's preference for wildflowers may be affected by the way the issue is presented. To this aim the same questionnaire will be presented with or without the title explaining the Nature of the study, and each question of the questionnaire presented with or without a picture. Finally, in order to discover whether an individual inclination towards Nature may affect preference for this natural element, subjects' connection to Nature will be assessed as well.

2. Method

2.1 Participants

Seventy-six volunteers (33 males and 43 females) from 21 to 75 years of age (M = 35.68, SD = 14.87) were randomly chosen from the metropolitan area of Torino, Italy. The participants were chosen using a convenience sampling procedure and were recruited in streets, residential and urban areas. Participants were asked if they wanted to participate in an anonymous environmental psychology survey of the duration of approximately 10/15 minutes.

2.2 Instruments

To accomplish the study's aim two instruments were administered, an ad-hoc devised questionnaire and the Connectedness to Nature Scale.

The questionnaire

A questionnaire was designed to assess the preference for wildflowers composed of 27 items and made up of three parts. In the first part respondents were requested to provide socio-demographic information (gender, age, level of education, occupation and, if a student, course of study). The second part aimed to evaluate the level of preference of 12 pictures chosen to show urban landscapes with and without wildflowers. These pictures were selected from a large number of pictures, where wildflowers were differently represented, systematically collected from magazines and existing stimulus materials. The goal was to provide as wide as a variety of pictures as possible showing settings with and without wildflowers, showing wildflowers in different moments of their blooming, how they appear in winter, their different uses in urban areas (e.g. to hide tram tracks, as traffic islands, in flower beds, etc.) and the fauna related to this type of flower. The pictures assessed by four independent judges were finally sorted into 6 environmental categories: Wild Natural (WN: wildflowers in natural environment), Wild Urban (WU: wildflowers in urban environment), Safety Natural (SN: presence of insects, small reptiles, mammals around wildflowers in natural environment), Safety Urban (SU: presence of insects, small reptiles, mammals around wildflowers in urban environment), Wild Urban Winter (WUW: wildflower bed in winter when flowers are not present and the bed looks dry) and Pre-Post (PP: wildflowers in summer and in winter, i.e. flower beds shown with and without flowers). Each category was represented by two examples in order to diminish the likelihood of the so-called 'place effect' in

which the respondents' answer is bound to that particular image, e.g. presence of a disturbing element to the subjects, pictures perspective, etc. With two pictures per category it is possible to evaluate the environmental category average answer (see Purcell et al., 2001). In the third part of the questionnaire participants were asked to assess 15 items without images used as control or 'liar detector' for the first part, i.e. for the answers to the pictures.

All items were rated on a Likert scale from 1 to 5 where: 1= not at all, 2 = very little, 3 = rather much, 4 = much, 5 = completely. Only two items required the binary response 'Yes-No'.

Figure 1 shows three examples of pictures (a, b, c) to be assessed for preference and the equivalent control items, without pictures.

Figure 1. From left to right: (**a**) a pathway created amongst wildflowers; (**b**) two bees sucking nectar from a wildflower; (**c**) wildflowers in an urban environment during winter months. Participants were asked this question for each picture: 'How much do you like this picture?'
Control items. For picture **1a**: 'Do you get concerned from the presence of insects (e.g. grasshoppers), small mammals (e.g. hares, mice) or reptile (e.g. lizards) in an urban park?' For picture **1b**: 'Are you comfortable when walking in a park notice bees and other insects?' For picture **1c**: 'Do you like seeing wildflowers in the city?'

In order to eliminate the so-called 'sequence or order effects' three different versions of the questionnaire were created, where the order of the 27 items was randomised (McBurney & White, 2008). Moreover, to evaluate if preference for wildflowers can be influenced by the way the issue is presented, the so-called *framing effect* (Tversky & Kahneman, 1981; Tversky et al., 1988), half of the participants were administered the questionnaire with the presence of the following title in the heading: 'Questionnaire on the aesthetic and visual quality of the landscape'. The version of the questionnaire with the title will be called 'title', whereas the version without 'no title'.

The connectedness to Nature Scale

The Connectedness to Nature Scale (CNS; Mayer & McPherson Frantz, 2004) evaluates the individual's bond with Nature. The CNS is made up of 14 items which evaluate how much an individual feels to be part of the natural world (alpha = .84; Mayer & McPherson Frantz, 2004). Each item is assessed on a Likert scale from 1 to 5 where 1 is equivalent to 'never' and 5 to 'always'.

2.3 Procedure

In order to minimise external distractions, the individual administration of the questionnaire took place in a peaceful and quiet environment at the Department of Agricultural and Environmental Sciences of the University of Torino. Each participant was given one of the three versions of the questionnaire and asked to carefully read the instructions. It was emphasized they should carefully think before answering and, if some questions were hard to understand, it was possible to ask for further clarification. Once they had completed the questionnaire, the participants were asked to fill out the CNS. The same procedure was used for each participant. Participants' data consent was obtained, and confidentiality guaranteed.

3. Results

Two of the 27 items of the questionnaire required the binary response Yes-No. The first 'binary' item assessed how participants liked wildflowers and the second if they were members of any association concerned with environmental issues (e.g. Greenpeace, WWF, Legambiente, etc.). Since almost the totality of the sample responded positively to the preference for wildflowers

(96%), and only 4% of the participants were involved in associations that fight to protect the environment, it was decided to not include these two items in the future analysis. Our sample was homogeneous as far as the preference for wildflowers was concerned.

A reliability analysis performed on the remaining 25 items showed the devised questionnaire was reliable: alpha = .75.

The 12 pictures were grouped in 6 different environmental categories: WU (wild-urban), WN (wild-natural), SN (safety-natural), SU (safety-urban), WUW (wild-urban-winter) and PP (pre-post), where preference for each category was assessed by two pictures. The highest preference score belongs to WN, with an average score of 4.22 out of 5, whereas the lowest average score was given by the participants to the environmental category WUW, with a value of 2.26 (see **Table 1**).

	WU	**WN**	**SU**	**SN**	**WUW**	**PP**
Preference score	3.40	4.22	3.76	2.80	2.26	3.83
	(.65)	(.63)	(.72)	(.55)	(.71)	(.75)

Table 1: Mean preference score and SD in parenthesis for the 6 environmental categories. WU = Wild Urban, WN = Wild Natural, SN = Safety Natural, SU = Safety Urban, WUW = Wild Urban Winter and PP = Pre Post.

A univariate ANOVA was performed to evaluate if there was an effect of the category (fixed factor) on the subjects' preference score. A significant effect of the category emerged, $F(5, 375) = 101.36$, $p < .001$, showing that variations in subjects' preference were due to the category to which the picture belongs to.

The next step was to analyse the sample's characteristics: social-demographic information, level of education, occupation or course of study of the participants (see **Figure 2**).

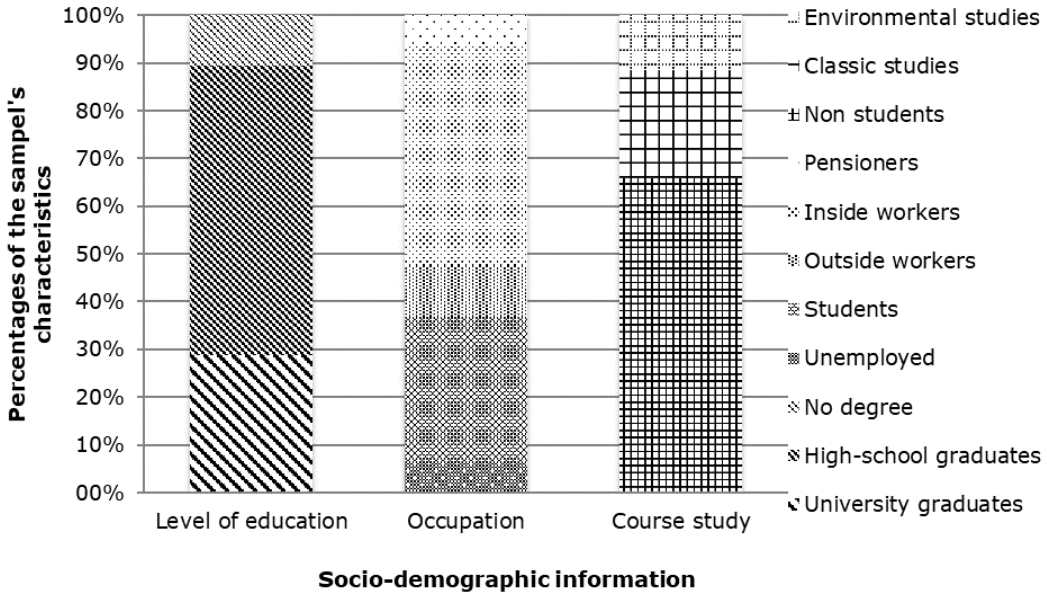

Figure 2: Graphical representation of the socio demographic characteristics of the sample.

Since students (30.3%) and office workers (46.1) were the most frequent categories within the 'occupational status', it was established whether any difference existed between these two groups on the preference scores for wildflowers. To this end, the mean score for the 6 categories (grouped items) and for each single item of the questionnaire was obtained for workers and students respectively, and independent samples T-test were run on these means. Concerning categories, one significant difference emerged for WUW: t(71) = 2.39, p = .01 (see **Table 2**). Considering single items, no signifi-cant differences emerged for preference except for picture shown in **Figure 3**, t(56) = 2.75, p=0.01, where students' preference score was 2.96 (SD = .86), while workers' score was 2.31 (SD = .90).

	Occupation	Mean	St. Deviation
WU	Students	3.44	.51
	Office workers	3.40	.75
WN	Students	4.28	.63
	Office workers	4.22	.64
SN	Students	3.68	.80
	Office workers	3.71	.80
SU	Students	3.00	.55
	Office workers	2.77	.62
WUW	Students	2.35	.59
	Office workers	2.00	.67
PP	Students	3.85	.86
	Office workers	3.95	.59

Table 2: Mean preference score and SD for the 6 environmental categories (WU = Wild Urban, WN = Wild Natural, SN = Safety Natural, SU = Safety Urban, WUW = Wild Urban Winter, PP = Pre-Post) across Students and Office workers.

Figure 3: This picture depicts how wildflowers transform during summer and winter. Subjects were asked the following question: 'This is an example of how wildflowers present themselves in winter after summer blooming. Do you like it?'

At this point we wanted to investigate whether differences between males and females existed. To this end, T-tests for independent samples were run on the preference scores of males and females for each category and for each single item. No significant results were found for the 6 categories (see **Table 3**), while only one significant difference emerged between genders for the preference of picture shown in **Figure 4**, t(74)=2.28, p=0.03 (males = 3.85, SD = .67; females = 3.37, SD = 1.05).

	Gender	Mean	Standard Deviation
WU	Male	3.41	.61
	Female	3.40	.61
WN	Male	4.19	.56
	Female	4.24	.63
SN	Male	3.79	.72
	Female	3.75	.76
SU	Male	2.84	.56
	Female	2.94	.56
WUW	Male	2.32	.72
	Female	2.28	.71
PP	Male	3.65	.83
	Female	3.90	.73

Table 3: Mean preference score and SD for the 6 environmental categories across genders. WU = Wild Urban, WN = Wild Natural, SN = Safety Natural, SU = Safety Urban, WUW = Wild Urban Winter, PP = Pre-Post.

Figure 4: This picture shows a lizard amongst wildflowers. Subjects were asked the following question: 'How much do you like this picture?'

This study aimed also to ascertain whether the presence/absence of a title on the questionnaire heading might influence participants' judgements. To assess the so-called 'context effect' nearly half of the participants were given a version of the questionnaire with a title ('title' group), whereas for the other half no title was present ('no title' group). Independent samples T-tests run on the scores of the two groups for the 6 categories showed one significant difference only for WUW: t(98) = 2.16, p = .03. The same analysis run on each single item showed significant differences for 6 out of 25 items, as shown in **Figure 5**: Item_06: t(74) = 2.61, p =.01; item_11: t(74) = -2.28, p = .03; Item_17: t(74) = 2.30, p = .03; Item_20: t(74) = -2.21, p = .03; Item_21: t(74) = -2.26, p =.03; Item_26: t(74) = -3.04, p = .00. In the 'no title' group the item mean scores were significantly higher than the 'title' group (see **Table 4** and **Figure 5**).

These results suggest that the two versions are not totally equivalent.

	Typology	Mean	Standard Deviation
WU	Title	3.41	.55
	No title	3.40	.68
WN	Title	4.21	.64
	No title	4.24	.56
SN	Title	3.81	.70
	No title	3.72	.79
SU	Title	2.90	.51
	No title	2.90	.61
WUW *	Title	2.44	.71
	No title	2.13	.68
PP	Title	3.68	.87
	No title	3.93	.64

Table 4: Mean preference score and SD for the 6 environmental categories (WU = Wild Urban, WN = Wild Natural, SN = Safety Natural, SU = Safety Urban, WUW = Wild Urban Winter, PP = Pre-Post) across the two versions of the questionnaire: 'title' vs. 'no title'. * = Significant difference

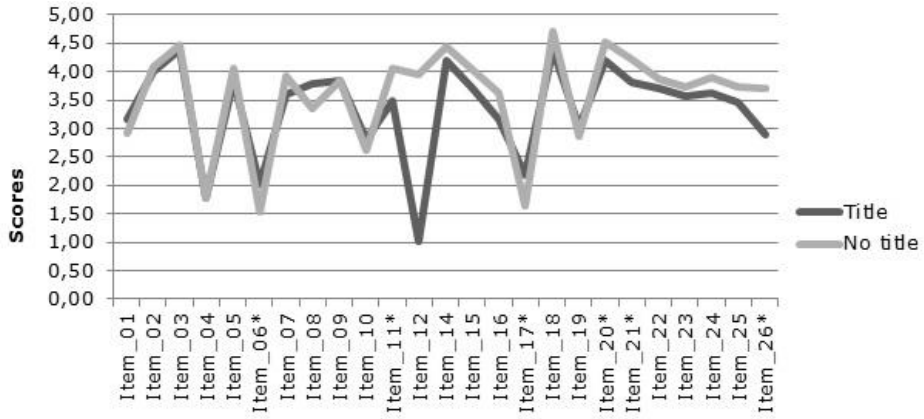

Figure 5: Mean preference score of each item (from 1 to 26 on x-axis) for the two versions of the questionnaire: 'title' vs. 'no title'. * = Significant difference

The questionnaire was composed of items that evaluate preferences for a series of questions on wildflowers where a picture was shown and a series of control items on the same issue without picture, i.e. control items. The control items were added to verify if the subject's preference judgments for such natural element may vary in relation to the presentation of the visual stimulus. From the paired sample T-tests the majority of the comparisons between pictures vs. items (no pictures) proved significant (see **Figure 6**).

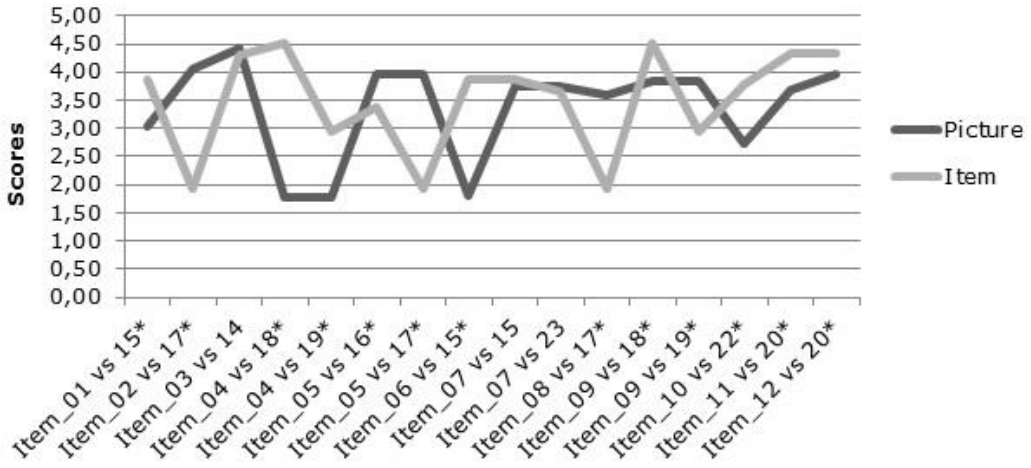

Figure 6: Mean preference score of each picture vs. the respective control item (without picture).
* = Significant difference

On the contrary, no significant differences emerged for the picture shown in **Figure 7**, in comparison to the related control items ($p > .05$).

Figure 7: From left to right: picture on the left depicts wildflowers in a natural environment; in picture on the right wildflowers are cleverly used to mask railway tracks. Control item for picture on the left was: 'Do you like seeing wildflowers when walking in a field or in the countryside?' Control item for picture on the right was: 'Would you like wildflowers to be used also in different contexts other from flowers beds, e.g. to mask the trams railway tracks'

Overall, results showed that participants' preference judgements for an item were affected by the presence/absence of a picture. Next paired sample T-tests, comparing the picture scores vs. the item control scores, were performed within the sub-samples males and females, and within the two typologies of the questionnaire, 'title' vs. 'no title'. Results showed no significant differences within any sub-sample ($p > .05$).

Our sample was made of subjects with an age ranging from 21 to 75, subdivided into 3 groups in order to verify if differences existed among age groups. The division was from 21 to 35, 36 to 50, 51 to 75, so to have enough subjects in each group. For each age group mean preference scores were calculated for each category (see **Table 5**).

	Age_group	Mean	Standard dev.	N
WU	21-35	3.36	.55	45
	36-50	3.36	.74	19
	51-75	3.54	.86	12
WN	21-35	4.14	.67	45
	36-50	4.47	.45	19
	51-75	4.12	.64	12
SN	21-35	3.64	.75	45
	36-50	3.92	.73	19
	51-75	3.95	.49	12
SU	21-35	2.74	.56	45
	36-50	3.00	.52	19
	51-75	2.70	.54	12
WUW	21-35	2.35	.67	45
	36-50	2.39	.67	19
	51-75	1.70	.68	12
PP	21-35	4.01	.68	45
	36-50	3.65	.72	19
	51-75	3.41	.84	12

Table 5: Preference scores and SD of the 6 environmental categories across the 3 age groups. WU = Wild Urban, WN = Wild Natural, SN = Safety Natural, SU = Safety Urban, WUW = Wild Urban Winter, PP = Pre-Post)

A MANOVA was performed to see if age groups (fixed factor) affected the preference scores of the 6 categories. There emerged a significant effect of age on the category WUW, $F(2,76) = 4.50$, $p = .01$, and on PP, $F(2,76) = 3.90$, $p = .02$.

At this point, the Connectedness to Nature Scale (CNS) was considered. The CNS score, which comes from the average score of the 14 items, was calculated first for each subject and then for the entire sample. With a mean score of 3.27 (SD= 0.52) our subjects felt connected to Nature more than the average. An independent sample T-test was calculated to establish if there was any difference on the CNS scores of males and females. The males scored respectively 3.22 (SD = 0.58) while females 3.31 (SD = 0.48). There were no significant differences between the two genders, $p > .05$.

In order to see if significant differences existed among the 3 age groups, the CNS average score (and SD) was calculated for each age group (see **Table 6**).

age_group	Mean	Standard dev.	N
21-35	3.10	.49	45
36-50	3.41	.43	19
51-75	3.68	.48	12

Table 6: Connectedness to Nature scores and SD across the 3 age groups.

A univariate ANOVA with age as fixed factor showed a significant effect of age on the CNS scores, $F(2, 76) = 7.86$, $p < .001$.

At this point a mean preference score for wildflowers in general was obtained from the mean scores of the 21 items of the questionnaire (socio-demographic questions and binary items excluded). For the entire sample mean preference for wildflowers was 3.51 (SD = .31). Wildflowers preference was then calculated for genders and age groups separately. The independent sample T-test run on the mean score of males (M = 3.51, SD = .30) and females (M = 3.51, SD = .33) showed no significant difference. Likewise, from the univariate ANOVA (dependent variable: wildflower preference, fixed factor: age, 3 levels) emerged no significant effect of age on preference scores (see **Table 7**), showing (once again) the sample's homogeneity concerning preference for wildflowers.

age_group	Mean	Standard dev.	N
21-35	3.49	.32	45
36-50	3.60	.34	19
51-75	3.44	.25	12

Table 7: Wildflower preference scores and SD across the 3 age groups.

The last analysis concerned the relation between the preference for wildflowers in general and the feeling of being connected to Nature. To this end Pearson's bivariate correlation was used to evaluate the strength and direction of the relation between preference for wildflowers and connectedness to Nature. The correlation proved significant: $r = 0.35$ ($p < .05$). The same correlation was calculated for males and females separately. The correlation was significant only for males, $r = 0.59$ ($p < .05$). Concerning age groups, the correlation between preference for wildflowers and connection to Nature resulted significant only for the 21-35 years group: $r = .44$ ($p < .01$), the most numerous age group.

4. Discussion

The objective of this explorative study was to investigate the preference given to wildflowers in natural and anthropic environments. This research is part of a broader project aimed to evaluate if wildflower meadows are generally liked and if they could be good elements to add in urban areas. Overall, 96% of participants in our study liked wildflowers, they liked seeing flowers growing naturally in fields and in urban environments. Though in this study preference for wildflowers was addressed in a general way, a co-design perspective and the participation of the local community in a project of requalification of urban green has been taken into account. In this regard, it was hypothesised that the way an issue is presented to the citizens may affect how the issue is conceptualised, therefore affecting attitudes and preferences: *framing effect* (Tversky & Kahneman, 1981; Tversky et al., 1988). One of the most interesting results of our study refers to the differences in preference expressed for an item accompanied by a picture, which was generally higher than for the item that assesses the preference for the same construct without the photograph. This difference emerged for both males and females and for the two versions of the questionnaire 'Title' and 'No title'. It clearly emerged also that participants' responses were influenced by the presence of the title concerning the 'landscape aesthetic assessment'. The title surely gave an important insight of the nature of the study defining in the subject's mind a sort of 'reference framework' (Tversky & Kahneman, 1981). Though our results showed the two versions of the questionnaire were not totally equivalent, we decided to consider results from both versions together because they differed significantly only for 1 category out of 6, for a total of 6 items out of 25, actually ¼ of the items. However, except for the category Wild Urban Wild -WUW, the two versions are consistent.

Environmental preference assessments should be immediate. They are evaluations driven by positive or negative emotions coming directly from the environment rather than from what we know about it (Russell & Snodgrass, 1987). As stated by Zajonc (1968) 'preferences need no inferences'. In this study the pictures served as a stimulus for a more spontaneous answer about wildflowers in the subjects. This result is very important to keep in consideration when involving the public in participated projects, because the methodology (project presented orally, showing images, calling participants to the study area, analysing their habitats/movements, interviewing them, etc.) chosen to present for example the redevelopment of an abandoned site can actually influence the citizens' attitude, evaluation and preference as regards the final design (McBurney & White, 2008).

As we know, wildflowers attract all sorts of wildlife, like small mammals, reptiles and birds. Although in an urban park the presence of these species might be of a concern for park users, the subjects interviewed gave very different answers on this matter. When asked if small animals could be a problem, responses were mostly all negative, but when shown actual pictures of bees and reptiles, they showed greater preoccupation. Nevertheless, no difference between genders emerged in the Connectedness to Nature Scale, the series of questions we submitted to measure how much an individual identifies with the natural world, i.e. feels to be part of it. On the other hand, in assessing the relationship between the preference for wildflowers in general and the sentiment of being part of Nature results showed this relation is significant only for males. In other words, wildflowers are appreciated by males only if they have a strong connection to the natural world. This result suggests it would be appropriate to set programs and activities in order to 'educate' and 'raise awareness' in males with the goal of bringing them closer to these typologies of plants, which are still not widely used as an urban feature.

One of the more curious result in this explorative research study was that, analysing males and females' answers, the hypothesis where the preference for wildflowers might be higher for females has not been satisfied at all. In fact, there wasn't an appreciable difference between the two genders when the entire questionnaire is considered. Only one significant difference has emerged for the preference given to the picture where a lizard was present. If we analyse the control item for the lizard picture, females did not differ in preference score to males, meaning that females do not like 'to see' that kind of animal but they know small mammals, insects, rodents and reptiles may be present in wildflower meadows. This allows us to speculate concerning the different preference score given to an item with the picture and it's control item, which concerns 'social desirability', i.e. the tendency to answer in a certain way in order to please the interviewer

while hiding real opinions (McBurney & White, 2008). More often than not, subjects are convinced that a series of questions (opinions/generic evaluations) are a masked way to measure one's intelligence, social and/or emotional competence, or specific cognitive abilities. To become more socially desirable, they give false answers to seem more 'normal'.

The environmental category that registered the highest preference was Wild Natural – WN – because natural environments are preferred to urban environments (Purcell et al., 2001) and as a result of the tight relationship existing between environmental preference and perceived restorativeness (for a review see Berto, 2014), which means that we prefer those places that we immediately perceive as restorative, i.e. places that positively affect physical and mental health. A number of studies confirm that natural environments are perceived as more restorative than urban/artificial environments and that exposure to Nature is particularly effective in restoring from psychophysiological stress and mental fatigue (Berto, 2005; Berto, 2007; Berto, 2014) and for recreation, socialisation and environmental education (Kaplan, 1995; Bretzel et al., 2016). This is the reason for which urban design should reproduce more natural environments, combining natural elements (e.g. quantity, typology and disposition of vegetation, presence of water) and artificial (e.g. rocks, pebbles, sand), and be sufficiently extensive and consistent in order to engage and capture the involuntary attention for a relatively long period of time and promote exploration without any cognitive effort (Berto et al., 2008; Berto, 2011; Berto et al., 2015). In the category Wild Natural, no 'built' urban elements were present to remind the subject of environmental stressors like traffic, noise, air pollution, congestion, etc. In addition to that, natural scenes are usually more comprehensible and legible, i.e. they are easier to recognize and when necessary to acquire further information about them in comparison to urban scenes that on the contrary show high levels of complexity (Kaplan & Kaplan, 1989). In brief, preference that people manifest for green areas are due to a series of regenerative benefits, psychological and/or physical, resulting from a direct and frequent experience with Nature. In terms of preference for natural elements and restorative benefits strictly related, wildflower beds could serve the need for psychological restoration typical of urban dwellers.

In contrast, the environmental category with the lowest preference score was Wild Urban Winter – WUW –, in particular a picture depicting an urban area where natural elements were arranged in such a way to make the flowerbeds look scruffy and bare, indeed unpleasant (Figure 3). People expect to see Nature in an orderly fashion but ecological rich environments, such as wildflowers, tend to become disorderly during the winter period (Nassauer, 2002).

The most numerous participants in our study were students and office workers. Their answers differed significantly only for one photograph (**Figure 3**) where a wildflower bed is shown in winter when flowers are not really present and the bed looks dry. This difference might be because office workers are usually 'forced' to spend long hours in closed spaces, and at the end of the day might find greater pleasure in lush and orderly green flower beds. On the other hand, students are probably less concerned if flower beds are bare or dry, or with urban aesthetics in general, moreover they have more opportunities to surround themselves with natural elements by spending their time in parks and gardens during lunch time or in between lessons.

Preference for wildflowers seems to vary in relation to age. Significant effects emerged in the age group 51-65, specifically for the environmental category Wild Urban Winter – WUW – and the age group 66-75 for the category Pre-Post – PP – , where wildflowers are shown in summer and in winter, where flower beds are shown without and with flowers. In the first age group, the difference can be based on cultural factors. In the 1960s and 1970s, at the onset of adolescence where we form our personal identity, there was little talk about green spaces or on Nature and the benefits deriving from them, but rather on industrialisation and the economic boom that characterised that period (Daniele & Malanima, 2011). This led to less awareness of the topic of Nature, today very common, probably resulting in low preference scores. For the 66-75 age range, we can imagine that subjects involved understand the implications needed in a project, e.g. the enormous investments needed for its realisation or the risk of abandonment of the areas once completed by local authorities and/or by citizens, but they might also prefer to spend public funding in other alternative more beneficial ways like in public health or in road safety. The younger generation might give less importance to the factors cited above and prefer to see degraded areas turned into aesthetically pleasing 'green' areas, with the chance to spend time with family or in different sport activities i.e. basketball, football, running.

Also for the Connectedness to Nature Scale, we wanted to ascertain if there were any differences between the 3 age groups on the average score. We found that the connection to Nature within the subjects increases with ageing. Around the age of 20, we feel slightly connected and develop a strong connection towards 65. For the participants with ages between 21 and 50, the connection is not very high. The relation with Nature might become secondary because of being more attracted by other interests (e.g. finishing school, working, starting a family, etc.). For example, when we are close to adolescence, although interest for aesthetics appears, everything rotates around the formation of personal identity and building relations with peers and there is less interest in the surrounding environment (Barbiero & Berto, 2016). Towards the end of the working life (age group 51-65), the connection with Nature reaches high scores probably because the regenerative, psychological and physical benefits deriving from direct contact with Nature becomes more important as a result of fatigue and exhaustion generated in people after long years working and the difficulty of keeping up with the new working rhythms (Angeli, 2014). During retirement, the connection may slightly decrease, probably because, having more free time, people tend to stay for longer periods of time surrounding themselves with what Nature has to offer, getting used to it, a tendency acquired through the frequent repetition of that same thing (Aloisi, 2014).

In general, any type of achievement (in economic, environmental and ease of cultivation terms) is preferred compared to costly installation. In this regard participants were asked also to answer questions on transferring the up-keep of flowerbeds and parks/gardens from local authorities to the public with the goal to reduce maintenance costs. Results show that subjects are favourable but not as much as we might have thought. It is possible that transferring complete control to people with 'poor' knowledge is not one of the best ways to reduce costs: there may be eventually a loss of interest and abandonment, or alteration of the sites' original function for personal gain. Participants gave, however, higher scores to the idea of involving citizens in the realisation of city flowerbeds. Local authorities should consider implementing more activities that involve the public, one of the most efficient ways to reduce vandalism and urban degrade is to let people take part in the decision processes but most importantly to create their own urban spaces. This participation brings people together, informs them about their surroundings and how they could change, creates links between citizens, the environment and local authorities because it's an intervention that they contributed to create (Toccolini & Fumagalli, 2009).

5. Conclusion

Literature shows that wildflowers represent a valid instrument to improve the biodiversity and the landscape of the Mediterranean urban ecosystem and can constitute models in terms of landscape management , e.g. hide railway tracks, cover embankments, traffic islands, in cemeteries, for school projects, in industrial and waste disposal areas heavily modified by man (Köppler et al., 2014). Wildflowers are versatile plants which can be successfully duplicated in anthropized areas to mitigate the negative effects of human activities in the city and enhance the biotic component with low management cost (for a review see Bretzel et al, 2016). However, in our study focused on people's preference for these flowers, we found that the different use of wildflowers from the usual flower beds may be challenging because people are more used to and accordingly prefer the ornamental vegetation, e.g. well-kept mown grass and tidy flowerbeds (Tyrvainen et al., 2007; Qiu et al., 2013). Indeed, people see wildflower meadows in areas that differ from the usual flowerbeds as too demanding and complicated to create, and for the same reason there might be less will on the part of local authorities to truly commit themselves to studies and projects that require dedication, time and effort. Actually, cultivation techniques and maintenance of wildflower meadows/beds are not as economical as we might think in the short period but become sustainable from the second year of installation. The use of a proper species mixture with grass and leguminous plants, able to guarantee the soil fertility and a balance in species during time, is needed. Native species must be preferred. Wildflowers are costly when it's time to seed as a result of the work needed to prepare the soil and the care needed in its first year of growth due to the soil seed bank (weeds that stay dormant in the first few layers of soil which might become dominant) (Scotton et al., 2012; Lloyd, 2014). In addition to that, wildflowers are pretty to look at from spring to autumn but once the life cycle of the plant ends, the flowerbeds quickly turn into a sprawl of dead grass that could make the area look untidy and uninviting. Only knowledge of the

characteristics of wildflowers can help people understand and accept that for short periods the beauty associated to these flowers vanishes and is substituted by dead and shriveled plants. People should also be helped to accept the presence of small mammals, reptiles, and pollinators, which comes with wildflower meadows.

In conclusion, there are two main limitations of this study: the small sample involved and the fact that familiarity for wildflowers was not assessed. At the same time, it is important to ascertain whether a relationship between familiarity and preference for these natural elements exists.

Further research is needed in order to inform more precisely decision-makers, urban green space designers and managers about citizens' preferences for wildflowers. In the meantime, if local authorities informed citizens about the ecological benefits arising from wildflowers, educating them on the natural cycles of the plants, on the perception of time in Nature, there would be more comprehension towards wildflowers and a greater will to utilize them in urban projects and ideas. Within this framework, recently, several projects of citizen sciences have been developed, also involving disadvantaged people, with a positive effect on their psycho-physical health (see, for example, www.farfalleintour.it). Although exploratory, results from this research study are encouraging, showing that people like seeing wildflowers in different urban settings and that they can be considered a good example of a Nature-based solution in the case of low maintenance strategy of urban greening.

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Biophilic Architecture for restoration and therapy within the built environment

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Abstract

Can *'restoration and therapy in design'* signify something more than the places like hospitals and healing gardens? Can those restorative environments be brought inside the working and living environments to mitigate the psychological problem at the source? The main objective of this paper is to look at the strategies and developments of Biophilic design with respect to therapy and restoration in order to achieve sustainability in terms of quality of life within the immediate built environment. The paper explores the mental health issues under the domains of built environment and indoor environment with respect to their connection with nature. Biophilic design has gained a favourable momentum within the last four decades and is now visualised as a medium that bridges the gap between humans and the nature. Out of a variety of measures of sustainable environmental design, biophilic design focuses on the end-results of naturally nurtured or inspired habitats and workplaces. It embodies strategies of Green and Intelligent buildings, works as a mitigation strategy for foul indoor environment and establishes the vision that veristic sustainability can only be achieved if there is qualitative control over human physiological prosperity and psychological health. In the context of work efficiency, preference and productivity within the indoor environment, it is seen as a promoter of constructive thoughts and enhancer of creativity. The paper aims to enlist biophilic design and retrofitting strategies, which can improve cognitive function, reduce stress and provide mental peace within the built environment.

Key words. Biophilia; biophilic design; built environment; restorative environment; sustainability; sustainable architecture; well-being.

Introduction

The Agenda 2030 of the U.N. has given priority to health and well-being under its 'Goal 3' for targeted sustainable development, which has to be ensured for all. According to a majority of researchers, health and social prosperity are important aspects of the 21st century human

population, where they are packed closely with each other in dense urban environments with very little scope for nature to pierce through their technologically advanced lifestyles (Freudenberg, Galea, & Vlahov, 2006; World Health Organization, 2007; Wolch, Byrne & Newell, 2014). A significant segment of previous research in this field suggests that these urban environments create more concerns for humans regarding their health than they can solve (Sclar, Garau & Carolini, 2005; Rydin et al., 2012; Hardoy, Mitlin & Satterthwaite, 1992; McMichael, 2000). The inadequate spaces, which lack contact with nature, burden the psychological well-being of the human mind and lead to development of a variety of ailments (Evans, 2003; Spencer & Baum, 1997; Stigsdotter, 2005; Martin et al., 2015).

Human health has a causal relationship with the indoor environment, which has been evident since the mid-nineteenth century outbreak of diseases and epidemics in cities of third world countries. Poorly designed buildings have remained a major health concern where there is partial or insufficient availability of sunlight and ventilation that resulted in alarming indoor air quality. A combination of insufficiencies in aspects of physical comfort and poor acoustics leads to the contributing factors of Sick Building Syndrome (SBS) (Boubekri, 2008; Burge, 2004). The United States Environmental Protection Agency (US EPA) described 'Sick Building Syndrome (SBS)' as "situations in which building occupants experience acute health and comfort effects that appear to be linked to time spent in a building, but no specific illness or cause can be identified. The complaints may be localized in a particular room or zone or may be widespread throughout the building. In contrast, the term "building related illness" (BRI) is used when symptoms of diagnosable illness are identified and can be attributed directly to airborne building contaminants" (US EPA, 1991). Lindheim (1983) argued that the connection between the environmental aspects and health aspects might not always be obvious or straightforward. The early assumption put forward in most cases claimed that diseases are a result of direct exposure to virus-carrying pathogens or unaccountable microbes until this scientific notion was challenged by new researchers, who suggested that diseases are indeed the symposium of a three-sided relationship between the host, the pathogenic virus and the environment (Dubos & Pines, 1965; Nash, 2006).

Boubekri (2008) suggests that for humans to be optimally functional, they must be in continuous and rigorous connection with nature because that is their native environment and the indoor environments are comparatively new to them. Sunlight keeps humans linked to their native environment when they are functional indoors; it keeps them aware of their biological clock and maintains their circadian rhythm. Similarly, buildings are designed to act as a filter between humans and their native environment and they should not act as a separator or as a blockade, which resists one's access to another.

At this stage, the built environment shares a major responsibility with other ecologically conscious disciplines to intervene in the process of design and shift the direction more towards a healthy and sustainable model, which involves nature and its systems as the core principles of design, resulting in the associative aspects of Biophilic Architecture. Biophilic Architecture, although in continuous practice for millennia, has recently rejuvenated itself as architects and designers have begun to show interest into the possibilities of natural modifications and adaptations of built environment. The degree of application varies from retrofitting to fresh designs. Biophilic architecture involves ecology along with environmental psychology to justify the use of design elements.

This paper lists the mental health issues caused by the built environment along with suggesting the mitigation strategies to deal with them through design. It includes the compilation of the emerging design parameters developed by several designers and researchers on an experimental basis to reduce the possibility of a built environment with poor connection with nature.

Methodology

The literature including biophilic patterns of design, behaviours and environment were identified by web searches, research papers' reference list and from articles of prominent, peer reviewed and scientifically indexed journals of environment, psychology, health and architecture.

Literature Search

Psychology, health, environment and architecture databases of SCOPUS, Web of Science, ProQuest and Google Scholar were searched between June – August 2020 using words and synonyms of 1) Biophilia, 2) Sustainable architecture, 3) Built environment, 4) Well-being, 5) Restorative environment. The quantity of available literature was limited to article titles and abstracts for appropriateness of database searches. Approximately 6430 results were enlisted for further extension of the research.

Article Selection

Articles and literature were screened in two stages: The first stage includes examination of titles and abstracts if they mentioned biophilia and whether they were published in peer-reviewed and scientific indexed journals in order to regulate the quality of research. 314 relevant articles, books and documentations were shortlisted based upon the above criteria. The second stage screening included a strict analysis of full text if: 1) The text mentioned E.O. Wilson's Biophilia hypothesis in relation to design adaptations 2) The text had systematic analysis of behaviour and psychology around biophilic built environments.

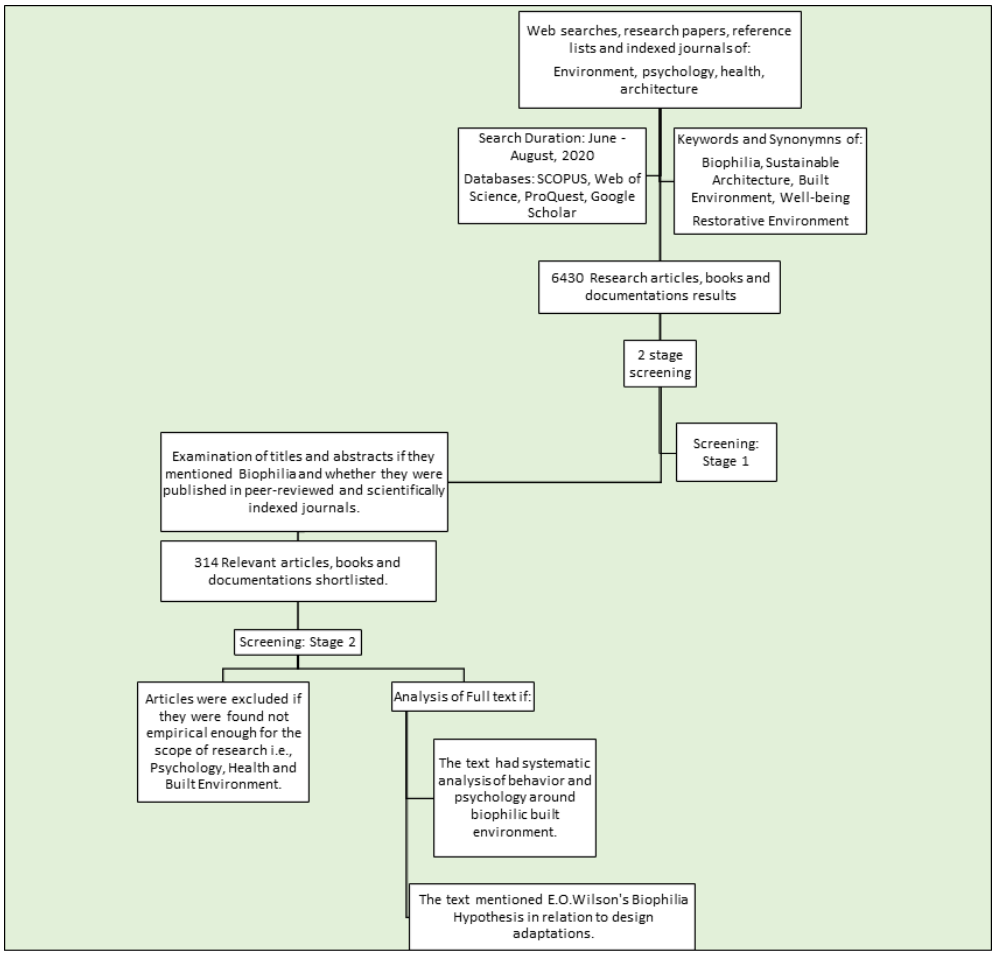

Figure 1. Graphical Methodology: Literature search and article selection.

Biophilia and Biophilic Design

The term 'Biophilia' was first mentioned in the works of German psychologist Fromm (1973), as "the passionate love of life and of all that is alive". The term has ancient Greek origins (bios: life, philia: love) and was later popularized by American biologist Wilson (1984). In the hypothesis, biophilia is defined as "the urge to affiliate with other forms of life" (Kellert and Wilson, 1993).

Human evolution has demonstrated that 99% living species had an adaptive response towards natural environment and its subsequent forces (Kellert and Calabrese, 2015).

These adaptive responses led to prolonged human reliance on nature and its resources. Biophilic design is the multidisciplinary transformation of biophilia into the design prospects of built environment (Kellert et al., 2011).

Reference	Definition
Fromm (1973)	The passionate love of life and of all that is alive.
Wilson (1984)	Our innate tendency to focus upon life and life-like forms and, in some instances, to affiliate with them emotionally.
Kahn (1997)	A fundamental, genetically based, human need and propensity to affiliate with life and lifelike processes

Table 1. Biophilia definitions and adaptations

The evolution of Humans as a species from *Homo sapiens*' migration out of Africa until the invention of electricity has been seen as a bio-centric development of physique, mind and senses (Kellert and Calabrese, 2015; Kellert, 2018). Architect and design theorist Christopher Alexander (1977) has expressed in his book 'The Pattern Language' that a number of natural patterns here are quintessential for humans, they are deeply inbuilt within the human nature now and they are going to be there within them for the next 500 years as well. Sturgeon (2017) in her book on 'Creating Biophilic Buildings' mentions that we have used our buildings since the industrial revolution to claim superiority over nature and to illustrate our alienation from it. The consequences of global climate change have forced us to turn to urgent solutions, and now our buildings and their 40% share of energy usage are key influencers in this regard. According to a study conducted in Sweden by psychologists Ohman and Mineka (2001), humans as a species have hereditary behavioural inclination towards natural forces, while their stimuli responses swing between constructive and destructive in terms of emotions. The available research in this domain considers four aspects of the natural world (Fig.1): animals, plants, landscapes, and wilderness (Frumkin, 2001). The concept of Biophilia strengthens the premise that the built environments need to be equipped with both biotic and abiotic features for psychological well-being as well as for preservation of natural environment (Downtown et al., 2017).

Biophilic design is based on the conceptualization of the theory of biophilia within the perspectives of architecture, urban design, landscape design and sustainability. Kellert (2018) recently affirmed, "Buildings and living spaces with biophilic design bring people closer to nature".

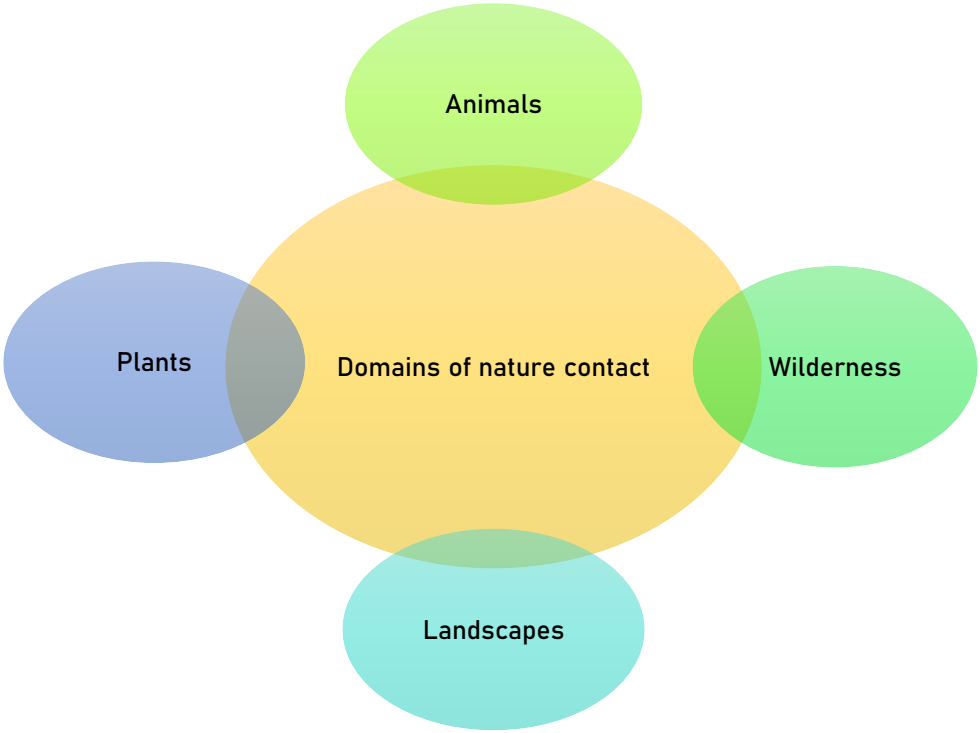

Figure 2. Domains of Nature Contact adapted from Frumkin, 2001 (Source: Authors).

Biophilic Design depends upon the following basic elements (Fig. 2): natural ventilation, natural lighting and organic forms (which exist naturally), and natural landscapes. These features strengthen the bond between humans and their immediate environment (Duzenli et al., 2017). Research conducted in this field shows that upcoming residences, schools, townships, hospitals and corporate offices have embarked on a process of acknowledging the beneficiary aspects of Biophilic design. This particular aspect of Biophilia and Biophilic Design has led to development of curated and human-centric building design rating systems and guidelines which are voluntary in nature like International Living Future Institute (ILFI)'s 'Living Building Challenge (LBC, 2012)' and 'Biophilic Design Guidebook' respectively. The Health + Happiness Petal's mission of ILFI is to build safe environments that allow all organisms to flourish by linking people to nature and ensuring that healthy air and natural daylight are in our indoor spaces.

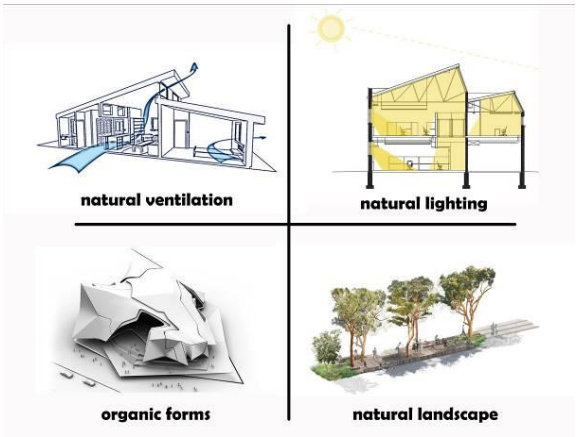

Figure 2. Basic Elements of Biophilic Design adapted from Duzenli et al., 2015. (Source: Author)

The Living Building Challenge aims to create a developed setting that is nourishing, highly efficient and safe where everybody has fresh air, sunshine, scenic views outside and can be related to the weather, seasons and time of day.

Wellbeing, Stress and Restoration

Humans spend an average of 90% of their total time in the vicinity of built environment. Mental health is affected by built environment in two ways (Fig. 3), direct and indirect. Housing situations, crowded spaces, noise, indoor air quality, and ambient light are among the features of environments which have direct mental health consequences. Mental health is indirectly affected by interferences in psychosocial processes by built environments (Evans, 2003). Psychosocial processes are related to human psychological aspects such as wellbeing, commitment, engagement, self-efficacy, self-esteem, belongingness, motivation and satisfaction. Altering the psychosocial processes often leads to mental disorders of varying degrees in which built environment may or may not be the cause of disorder and is rather seen as an enhancer (Carlson et al., 2012). Mental illness is considered a major psychological issue for the prisons of 21st century, and a variety of research has concluded that around 89% of prisoners face traits of depressive persona and 74% have experienced stress related issues (Söderlund and Newman, 2017).

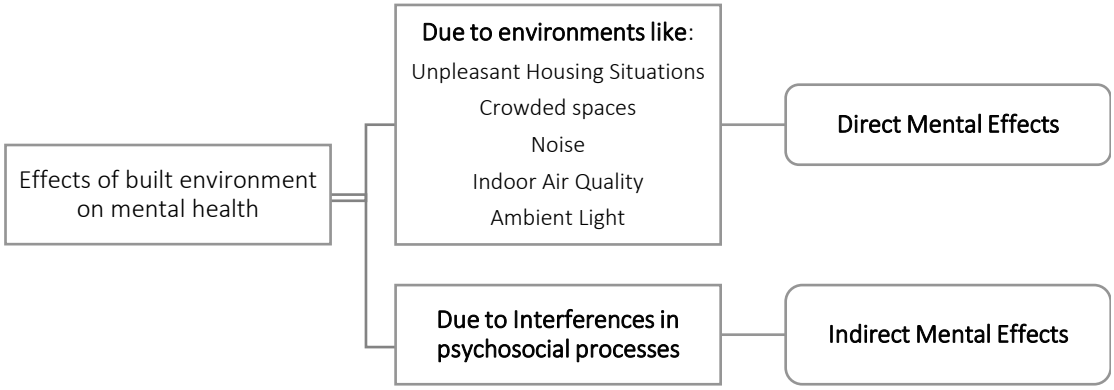

Figure 3. Effects of built environment on mental health adapted from Evans, 2003. (Source: Authors)

Deviation contributors	*Direct mental effects*
Temperature *(Chua et al., 2006; Fang et al., 2004; Kamaruzzaman and Sabrani, 2011; Seppanen, Fisk and Lei, 2006; Wargocki et al., 2006).*	***Lowering the rate of performance and productivity.*** ***Distraction***
Ventilation *(Bakó-Biró et al., 2012; Seppanen, Fisk and lei, 2006; Fisk, Black & Brunner, 2012).*	***Lowering the rate of performance and productivity.*** ***Negative effect on memory and concentration.***
Illuminance *(Glen et al., 2016; Mills, Tomkins & Schlangen, 2007; Osterhaus, 2005).*	***Disturbed circadian rhythm.*** ***Lowering the rate of performance and productivity.***
Noise *(Takki et al. 2011; Seidman and Standring 2010).* ***Air quality*** *(Pegas et al. 2011; Seppanen, Fisk and Lei, 2006; Wyon, 2004).*	***Distraction*** ***Behavioral and physiological effects.*** ***Decision-making.*** ***Lowering the rate of performance and productivity.*** ***Tiredness.***

Table 2. Direct Mental effects of built environment on human well-being (Source: Authors).

According to a study conducted on 'Built environment and mental health', attractive internal environments which are based on the use of plants lead to lower perception of stress and helps in creating a restorative environment (Renalds et al., 2010). Multiple studies have proposed that confrontation with nature reduces the chances of heart related diseases and abnormal pulse rates, maintains a healthy blood pressure, diminishes the production of cortisol and enhances

parasympathetic nervous system functions, which directly relates to internal organs and glands (Song et al., 2016).

Humans react positively not only towards direct exposure to natural environment, but they have also responded with certainty to artificial imitation of nature and its forms in fractal patterns, and also to cases of organic and conceptual mimicry of natural entities (Appleton, 1996). For example, Kulper and Roy (2005) attempted to link architecture with biophilia through the design of an 'Institute for Nano Biomedical Technology and Membrane Biology' in China. They imitated the design of a cell for the exterior of the building and the interior mimics molecular biology (El-Zeiny, 2012). Another example of this are the Treepods installed for Shift Boston's 'Urban Intervention Contest'. The Treepods mimic the concept of trees and utilize it as an air cleaning system that traps CO_2. Since it is based on the design of Dragon tree, it has wider foliage and is preferred by locals for shade (Rao, 2014).

Rai et al. (2019) and Rai et al. (2020) in two separate studies investigated the role of Biophilic Environment Variables (BEVs) in terms of Perceived Restorativeness Quality for a religious and historic environment of churches. They concluded that although both the churches under study were designed in the same architectural style and within the same era, they slightly vary in their perceived restorativeness quality due to richness of BEVs and site context of their built environment.

In his study on effects of natural elements such as sound and sight on the people with Flexible Bronchoscopya, Diette (2003) concluded that use of murals inspired by nature and natural sounds help in minimizing the degree of pain they experience. A study conducted by Lohr and Pearson Mims (2006) reinforced the hypothesis that the presence of indoor plants in an uncomfortable or stressful environment raises the pain tolerance of the occupants. Lohr and Pearson had previously conducted a similar study for a window-less work environment and found that occupants exhibited less stress, had more productive thoughts, and had more presence of mind when natural plants were used in the room interior in comparison to the data collected for the same room without the indoor plants (Lohr et al., 1996).

A further analysis of the selected available literature was conducted and the data was categorised accordingly based on impact on the associated and relevant patterns of biophilic design. Certain benefits of biophilic design have been listed in Table 3. along with the applied strategies used to attain them. The degree of benefits includes mood enhancement, sense of defence against outdoor environment, satisfactions of thermo receptors of the body, cognitive improvement, stress management, constructive problem-solving skills, improvement of short-term memory and enhanced creativity.

Authors	Strategy	Benefits
Herzog (1985)	Use of paintings and photographs of Rivers, ponds, lakes, mountain waterscapes and large bodies of water.	Positive impact on mood.
Ruddell and Hammitt (1987)	Shaded and semi-covered spaces for outdoor environment to create refuge.	Provides sense of defence and surveillance against outdoor environment.
Orians and Heerwagen (1992)	Use of clean water, which has reflection possibility.	Evaporative cooling: satisfies the thermoreceptors of body.
Appleton (1996)	Artificial imitation of nature and fractal patterns. Organic and conceptual mimicry of natural entities.	Positive psychological response towards immediate environment.
Lohr et al. (1996) Lohr and Pearson Mims (2006)	Use of plants in windowless indoor environment.	Pain tolerance and stress management. Increased productivity and enhanced presence of mind.
Rapee (1997)	Introducing levels of risk and control in design.	Enhances problem solving and decision making skills.
Edwards and Torcellini (2002)	Modified daylight mechanism, which can adjust throughout the day.	Artificially generated mood and creativity enhancer for workplaces and habitats.

Van den berg et al. (2003)	Natural movement of water.	Stress reduction.
Diette (2003)	Use of natural sounds and murals inspired by nature.	Reduction in degree of pain experienced by patients of flexible bronchoscopya.
Ikemi (2005)	Creation of mystery through arrangement of tress and objects.	Enhanced preference of space or facade in case of housing.
Leslie (2008) Friedman (2017)	Design of open and unrestricted spaces to represent prospect.	Provides sense of security to the occupants.
Renalds et al. (2010)	Use of plants in internal environments.	Lower perception of stress.
White et al. (2010)	Increasing proportion of visible aquatic space.	Increases preference of the space.
Alvarsson et al. (2010)	Small or momentary interventions with non-visual senses.	Positive health impacts. Physiological and psychological relief.
Almusaed (2010)	Presence of natural or transparent light.	Positive psychological effect, flow of positive emotions and enhances creativity.
Mehta el al. (2012)	Natural sounds of birds, winds and gushing of leaves.	Enhanced creativity.
Tsunetsugu et al. (2013)	Visual connection with nature for 5 – 20 minutes.	Stress reduction.
Van Wieren and Kellert (2013)	Elements with unprecedented organic growth like planters and shrubs.	Acts as natural modulators of fear and surprise for the pedestrian.
Benfield et al. (2014)	Natural sounds	Recovery from stress, wounds and sickness.
Browning et al. (2014)	Good connection with ongoing natural processes and systems. Biomorphic designs and patterns	Relaxation, nostalgia, enlightenment and repeated anticipation. Minimises stress and creates visually preferred environments.
Ryan (2015)	Clouds, shadows, natural sounds and water reflections.	Generates interest and acts as natural energiser.
Song et al. (2016)	Confronting natural environments.	Reduces chance of heart diseases, balances pulse rate and blood pressure, reduces secretion of cortisol and enhances parasympathetic nervous system.
Sharifi and Sabernejad (2016)	Appropriate task specific lux levels of light.	Improves the accuracy of senses and induces the power of vision.
Lee and Park (2018)	Including accessible hideout spaces in library design, which can provide a view of natural systems.	Psychological stability: tranquillity and safety in an unfamiliar environment.
Yin et al. (2018)	Short exposure to biophilic indoor environment.	Lower systolic and diastolic blood pressure and skin conductance. 14 % improvement in short term memory.

Figure 3. Benefits of Biophilic Design for Human well-being (Source: Authors)

Biophilic design has constructive impacts on the human psychology, physiology and immediate surrounding environment. The benefits enlisted in Table 3 strengthen the postulates of Wilson's Biophilia hypothesis. The studies conducted by Ryan et al. (2014) and Cramer & Browning (2008) have strengthened the premise of biophilic design and argued that biophilia in design helps in improving the overall health of the occupants and works positively for their levels of satisfaction, quality of performance and productivity.

Patterns of Biophilic Design

There have been a number of significant attempts to categorize and relate various variables and attributes of biophilic design to have a confined idea of an actual hypothesis for biophilia in architecture and in its associated disciplines. The most acknowledged versions of this are by Kellert and Wilson (1995), Soderlund and Newman (2017), Browning (2014) and Bolten and Barbiero (2020) and which discuss the major classification of biophilic patterns. A detailed 62 variable classifications were developed by Asim and Shree (2019) where they evaluated a biophilic environment of a student hostel in an academic campus in lower Himalayas.

Common Features of Biophilic Design (Kellert, 2004)	14 Patterns (Browning et al., 2014)	
1. Natural lighting 2. Natural Ventilation 3. Natural Materials 4. Natural and Indigenous Vegetation 5. Ecological Landscape Design 6. Open Space 7. Water views and Vistas of Nature 8. Shapes and forms that mimic organic forms 9. Vistas characterized by refuge and prospect 10. Natural features that evoke mystery 11. Exploration and Enticement 12. Natural features characterized by order and complexity 13. Natural Rhythms 14. Natural processes and change 15. Aesthetic and recreational values of nature 16. Informational and intellectual values of nature 17. Emotional and Spiritual values of nature	Nature in the Space	1. Visual Connection with Nature 2. Non-Visual Connection with Nature 3. Non-Rhythmic Sensory Stimuli 4. Thermal and Airflow Variability 5. Presence of Water 6. Dynamic and Diffuse Light 7. Connection with Natural Systems
	Natural Analogues	8. Biomorphic forms and patterns 9. Material connection with Nature 10. Complexity and Order
	Nature of the Space	11. Prospect 12. Refuge 13. Mystery 14. Risk / Peril

Table 4. 'Evolution of 14 Patterns of Biophilic Design' (Source: Authors)

Ryan and Browning (2014), in a nascent effort to gather evidence for different aspects of biophilic design, proposed '14 patterns' and justified the use of term 'pattern' for three reasons:

1. To propose a clear and standardized terminology for biophilic design.
2. To avoid confusion with multiple terms already in use like metric, attribute, condition, characteristic, typology, etc.
3. To maximize accessibility for designers and planners by upholding familiar terminology.

The Biophilic Environment Variables (BEVs)

Visual connection with nature

Visual connection with nature is observed as an important aspect of biophilia as it deals with several elements of visual comfort and relaxation. An example of this can be found at *Myst (Fig. 5)*, which is initially designed as a biophilic housing project in hilly region of Kasauli, India. Each residential unit has unobstructed views of nature in order to regulate and maximise the functioning of occupants and to enhance their creativity.

Figure 4. Visual Connection with Nature at Myst, Kasauli by Tata Housing (Source: Myst Brochure)

It is also one of the most evident examples when it comes to identifying emerging design parameters:

- Stress reduction through visual connections with natural elements (Ryan et al., 2014; Van den berg et al., 2003). It also alleviates mood and enhances self-esteem (Biederman and Vessel, 2006; Fuller et al., 2007).
- Give priority to real natural elements instead of artificially produced or acquired aspects of nature (Kahn et al., 2008).
- Prioritizing the promotion of biodiversity over expansion of land (Fuller et al., 2007).
- Giving priority to spaces for exercise and recreation, which have visual connection with green spaces (Barton and Pretty, 2010).
- Minimum exposure to nature for 5-20 minutes/day (Tsunetsugu et al., 2013).

Non-visual connection with nature

Non-visual connection with nature can be distinguished in the form of sensory receivers other than visual (eyes), such as auditory (sense of hearing), haptic (touch or kinaesthetic communication), olfactory (sense of smell), or gustatory (taste) that create a positive response to natural elements. F.L. Wright's organic architecture marvel 'The Fallingwater' (Fig. 6) depicts non-visual connection with nature where the sound created by the movement of water acts as a comforting and restorative element for the occupants.

From the activity and responses of above-mentioned sensory receivers, we can identify emerging design parameters as:

- Small or momentary interventions with non-visual sensory stimuli can have a positive health impact (Alvarsson et al., 2010).
- Giving priority to natural sounds over unpleasant urban sounds to generate physiological and psychological relief (Alvarsson et al., 2010).
- Utilizing the natural sounds of birds, winds and rustling of leaves to enhance the creativity of the people (Mehta et al., 2012).

Figure 6. The Fallingwater by Architect F.L. Wright in Pennsylvania (Source: Wikimedia Commons)

Non-rhythmic sensory stimuli

According to Ryan, non-rhythmic sensory stimuli are random and transient connections with nature that can reduce stress and improve productivity. The non-rhythmic sensory stimuli can be listed as clouds, shadows, nature sounds, and water reflections. A space that has good non-rhythmic sensory stimuli acts as a refreshing environment, centralizes human interest and functions as a natural energizer (Ryan, 2015). Fig. 7 depicts the implementation of elements of non-rhythmic sensory stimuli in active designs of Shimla Wildflower Hall and The Oberoi Amarvillas, Agra.

Emerging design parameters for non-rhythmic sensory stimuli can be identified as follows:

- A cast shadow can be utilised to reveal features of the 3-dimensional form that are not usually apparent in a direct view of the object hence emphasising the space (Tregenza & Loe, 2013).
- The clouds can be treated as restorative mediums due to their non-rhythmic nature and can be utilised through horizontal or diagonal openings in the roof or wall to make creative use of their view from interior spaces (DeKay & Brown, 2013).

Figure 5. Non-rhythmic sensory stimuli: Clouds, shadows and reflections as part of built environment at Shimla Wildflower Hall (left) and The Oberoi Amavillas, Agra (right). (Source: Wikimedia Commons)

Thermal and Airflow variability

The role of ventilation and thermal comfort is very crucial in the satisfaction index of human habitats. Airflow, thermal diversity and natural ventilation are some key factors that provide thermal comfort to the occupants of buildings. Fig. 8 features the thermal comfort zones within the bioclimatic charts as put forward by Olgay et al. (1963) and Givoni (1992). Olgay's chart uses 21º C (dry bulb temperature) as the threshold for sunlight, moisture and winds required in order to obtain thermal comfort, whereas Givoni's version of bioclimatic chart advocated for a thermal comfort range of 20ºC - 28.5ºC along with a 10%-90% range for relative humidity. According to ASHRAE (2013), for human thermal comfort the average humidity should range between 30% to

65% and the average temperature should range between 22.8º C to 26.1º C in summer and 20º C to 23.6º C in winter.

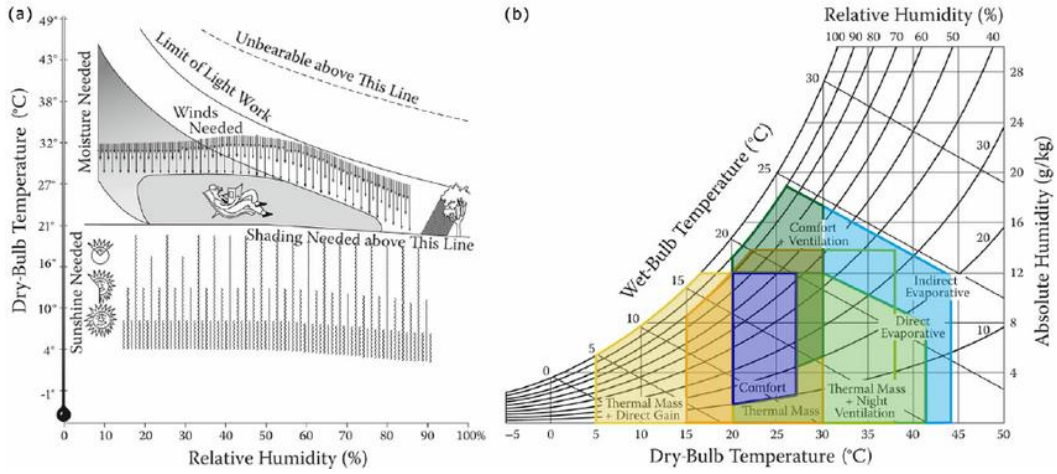

Figure 6. Thermal comfort zones a) Bioclimatic chart (Olgyay et al, 1963). b) Building bioclimatic chart (Givoni, 1992).

The current population growth has put a significant pressure on the resources of renewable energies as well as on the ones provided by fossil fuels. To minimize the impacts of this on the energy, adequate ventilation and regulation of heat sources is recommended for buildings (Sharifi and Sabernejad, 2016).

Emerging design parameters for a balanced thermal environment and airflow are as follows:

- Maintaining low and dense vegetation between the buildings especially where high temperatures are measured (Gaitani, Mihalakakou & Santamouris, 2007).
- Maintaining a small water body to induce evaporative cooling for the surroundings (Givoni, 1992).
- Pergolas used with deciduous plants and trees provide solar control and provide a shade induced cooling in summers (Sandifer, 2009; Alexandri & Jones, 2006).
- Employing green roofs and green walls for reduction in heat gain and for maintaining a fresh air flow (Alexandri & Jones, 2006).
- Construction materials of high emissivity and reflectivity values to be used in order to avoid excessive heating in summers (Gaitani, Mihalakakou & Santamouris, 2007; Santamouris, Synnefa & Karlessi, 2011).

Presence of water

The presence of water in biophilic architecture is considered a restorative environment both in visual as well as auditory aspects (Ulrich et al., 1991; Alvarsson et al., 2010). The quality of water decides the degree of human preference towards it for restorative environments, i.e., dirty water will be less restorative than clean water (White et al., 2010). Other than its psychological benefits, water has climate responsive capabilities as it helps in bringing down rising temperatures through evaporative cooling and induces comfort through satisfying the thermoreceptors. St. Fiachra's garden in Ireland (Fig.9), designed by landscape architect Martin Hallinan, carries restorative and recreational properties as it depicts water in its positive aspects.

Figure 7. St. Fiachra's Garden, Ireland by Architect Martin Hallinan (Source: Irish National Stud and Gardens).

Emerging parameters for water in biophilic design are as follows:

- The perception of water should be as a clean element (Orians and Heerwagen, 1992).
- Priority should be given to an experience that involves use of multiple senses for water (Alvarsson et al., 2010).
- Priority should be given to natural movements of water which are unpredictable (Van den Berg et al., 2003).

Dynamic and Diffuse Light

Light is associated with human psychology for visual comfort and has different results for a variety of exposures to it. Research suggests that the presence of natural and transparent light induces a positive psychological effect on the senses of occupant and if the source of light is sun then it enhances a vital locomotion movement, further promoteing flow of positive emotions and enhancing creativity (Almusaed, 2010). Appropriate lighting of a space promotes the accuracy of senses and induces the power of the vision (Sharifi and Sabernejad, 2016).

Emerging design parameters for balanced dynamic and diffused lighting are as follows:

- Transitional balance between indoor and outdoor spaces in terms of separation, privacy and zoning can just be induced through dynamic lighting conditions without the presence of any physical medium to act as a separator (Kelly, 1952).
- A modified daylight lighting mechanism, which has the capability to change throughout the day to mimic the features of natural light, such as circadian rhythm-based lighting system, can pave a way for artificially generated mood and creativity enhancer systems for workplaces and habitats (Brawley, 2009).
- Indirect exposure to ambient light through perforations can be ensured, which enhances the preference of the space and makes the space appear larger. It also improves the brain's cognitive function and gives positive psychological feedback (Ozdemir, 2010).

Figure 8. a) Suryagarh (left) at Jaisalmer, India uses perforation (locally called Jali work) to aesthetically minimise the impact of direct light (Source: Wikimedia Commons). b) Church of Light, Japan (right) by Architect Tadao Ando uses light to amplify emotions for spiritual environment (Source: Tadao Ando Architect and Associates).

Connection with Natural Systems

In their book '14 Patterns of Biophilic Design', Browning, Ryan and Clancy have described connection with natural systems as "the awareness of natural processes, especially seasonal and temporal changes characteristics of a healthy ecosystem". Any space with a good connection with natural systems creates a bond to a greater whole that in turn improves the experience to provide relaxation, nostalgia, enlightenment and repeated anticipation (Browning et al., 2014).

Figure 9. Viceregal Lodge (Rashtrapati Niwas) in Shimla designed by Architect Henry Irwin. a) West Elevation (left) b) East Elevation (right) (Source: IIAS Archives)

The Viceregal Lodge was built in Jacobethan style by the architect Henry Irwin in 1888 as a summer retreat for the then Governor of British India - Lord Dufferin in Shimla. The entire complex was designed in accordance with the natural systems of the hilly region. In order to utilise the heavy rainfall that the region receives, underground reservoirs were built below the landscaped gardens to accommodate rainwater for all the activities of the compound. Post-independence, the volume of water and capacity of tanks were extended to supply water to the neighbouring localities of Tilak Nagar, Ghora Chowk and Hanuman Temple. New overhead tanks below the elevation line of the main building were constructed. According to Detailed Project Report (2009), the complex, with all the overhead tanks and underground reservoirs, has a capacity of 0.23ML (Singh and Kandari, 2012). The way the Lodge (Fig. 11 & Fig. 12) was set up against the slope of the hill gave it the ability to channelize and store water on lower levels and to interact with a variety of natural systems occurring around it.

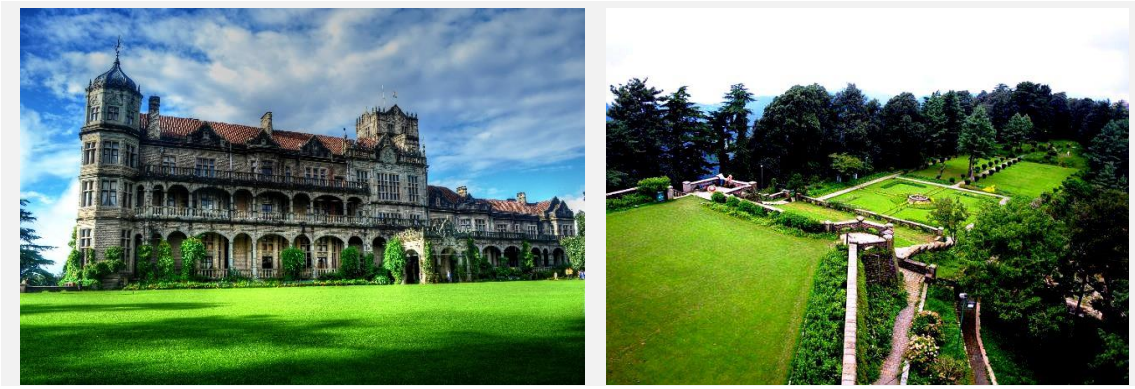

Figure 10. The gardens and recreation courts of Viceregal Lodge, which are built above the underground reservoirs. (Source: Author)

Emerging design parameters to create quality connections with natural systems include:

- Collection, treatment and use of rainwater into the design of landscapes that is responsive to monsoon and channelizes surface run-off of water (Kinkade-Levario, 2007).
- The provision of visual access to naturally occurring systems is considered the easiest and smartest cost-effective approach. In other cases, the inclusion of design that has responsive tactics, robust structures, and adaptable land formations helps in achieving the desired levels of mobility for the design (Lin, de Dear & Hwang, 2011).

Biomorphic forms and patterns

"Biomorphic forms and patterns are symbolic references to contoured, patterned, textured or numerical arrangements that persists in nature" (Browning et al., 2014). Biomorphic forms have been evident in a variety of artistic expressions, designs and structures throughout the evolution of civilization. Their presence can be seen in the ancient temples of Egypt, India and Rome and even in most modern designs of the Spanish architect Santiago Calatrava (Hu et al., 2013). There has been an exponential reliance of architecture and design on biomorphic forms due to its mathematical relevance in the construction of various forms of buildings and the utilization of sanctum spaces as seen in temples of India, Greek and Rome through mimicking natural elements with respect to the human body (Feuerstein, 2002).

In his paper on 'Applications of the Golden Mean to Architecture' Salingaros (2012) affirms: "A crucial lesson that comes from understanding natural structure is to realize that scales in a natural hierarchy are skewed towards the smallest sizes. Natural growth begins at the infinitesimal scale and develops through an ordered hierarchy up to the largest size".

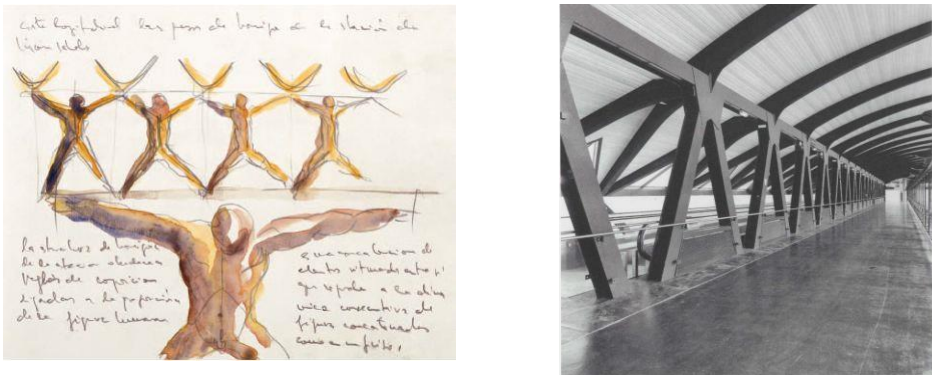

Figure 11. Lyons Airport Railroad Station by the architect Santiago Calatrava. Concept design (left) and final output (right) (Source: McQuaid, 1993).

Biomorphic patterns help in creation of more visually preferred environments that are capable of enhancing cognitive performance of occupants through assistance in minimizing the stress (Browning et al., 2014).

Emerging design parameters to create qualitative biomorphic condition are as follows:

- The biomorphic attributes should be applied on 2 or 3 planes or dimensions (e.g., floor plane and wall; furniture windows and soffits) for greater diversity and frequency of exposure (Salingaros, 2012).
- As a design measure, try to avoid the overuse of forms and patterns that may lead to visual toxicity (Michl, 1995).
- More interventions that are comprehensive will be cost effective if they are introduced early in the design process (Browning et al., 2014).

Material connection with Nature

'Material Connection with Nature' pattern involves various physiological responses to a variety of elements of natural materials, and the influence of a nature-based colour spectrum, of which the green colour exhibits features of improved cognitive conduct. Building materials that are derived from original natural materials are analogous to their 'natural' state (Browning et al., 2014). The

architect Cesar Pelli recalled that as a student of architecture he learned that verite modern architecture should depict no colour other than the colours of natural materials (Caivano, 2006). Architects and designers who belong to the purist regime of the profession consider whites, greys or anything else as superficial or unprincipled if they are not natural (Pelli, 1996).

USGBC's LEED gives extra weightage to the buildings, which efficiently adopt the sustainable and green materials with minimum or negligible impact on the environment. The materials affect the cognitive user performance as well as reducing the energy consumption in some cases (Meisel, 2010). Pacheco-Torgal and Jalali (2011), in their research on use of vegetable fibres in cementing materials, concluded that long bamboo fibres provide extended durability when used with cementing liquid. Apart from ecological and economic benefits, since bamboo is capable of representing the plant kingdom for a very much longer duration of time due to its colour, it is preferred by designers to imitate a natural environment.

Figure 12. Sustainable House, Romania uses natural materials for facades (Source: Tecto Architecture).

Figure 13. Residence in Vahrn, Italy by Architect Norbert Dalsass using natural materials in order to merge with the surrounding environment. (Source: Norbert Dalsass Architekt)

Emerging design parameters for creating a qualitative material connection with nature are as follows:

- The frequency of use of a material in a space should be based upon its function (Addington & Schodek, 2012)
- There should be a preference for natural materials over synthetically fabricated materials as human sensory receptors can identify and sense the difference between them (Ritter, 2007).

- The use of colours in a space should be done on an experimental basis. However, the green colour is favoured by designers due to its ability to enhance the mood of creativity in spaces (O'Connor, 2011; Minah, 2012; Dalke et al., 2006).

Complexity and Order

A space that exhibits information in the form of complexity is considered engaging for human mind. It creates intrigue and is often considered as a regulator of balance between visually generated feelings of boredom and profusion. The main objective of this pattern is to create a visually productive environment that provokes a constructive cognitive response. Salingaros (2012) claimed that design bears a connection with natural growth through a structured hierarchy at various levels that can be found in a variety of natural structures. This structured establishment can however be complex and may appear to be ambiguous to users. This sense of complex nature relates to another biophilic pattern, i.e., mystery.

In his paper on 'Chaos and geometric order in architecture and design', Rubinowicz (2000) explained that these two elements are the basic components that constitute the structures of urban and architectural significance. They co-exist naturally and are interdependent. Geometric order is created through meticulous design and organised planning whereas chaos is generated when processes are self-organised. The architect Daniel Libeskind is known for creating a balance between geometrical order and chaos in his buildings while justifying intriguing feelings and emotions. Libeskind's renowned Royal Ontario Museum in Canada as well as his Military History Museum (Fig. 16) in Germany are examples of organised complexity and order.

Figure 14. Military History Museum, Germany by Architect Daniel Libeskind. (Source: Wikimedia Commons)

Fractal geometric patterns are a discrete result of repetition and a case of definite origins around which the entire evolution of form takes place (Kellert et al., 2011; Hagerhall et al., 2008). Understanding an already existing design is difficult and challenging but creating a complex fractal pattern from origin is easy and repetitive in nature.

Emerging design parameters that can help in evolving a qualitative Complexity and Order based pattern are as follows:

- To give priority to fractal geometries while dealing with aspects of urban planning, architecture façades, landscape design, etc. (Browning et al., 2014).
- To have greater impact of form in design, the fractal patterns with 3 iterations must be preferred over fractal patterns with 2 iterations (Kellert et al., 2011; Browning et al., 2014).
- The overuse of fractal patterns should be avoided to maintain a balance between stress reduction and restoration. The underuse of fractal patterns may lead to disinterest in design and offer predictability (Kellert and Calabrese, 2015; Browning et al., 2014).

- Buildings with fractal patterns as design elements in façades must consider the context and the impact on the city skyline (Browning et al., 2014; Joye, 2007).

Prospect

Prospect is defined as a pattern which provides an undisturbed, unrestricted, open and clear view over a large area or space for the purpose of monitoring, planning and surveillance. The idea of this is to provide the occupant with a sense of freedom as well as an inherent sense of safety, security and control over their immediate environment that is not native to them (Browning et al., 2014). In his book 'The Wright space: pattern and meaning in Frank Lloyd Wright's houses', Hildebrand (1991) explained that for spaces in building interiors or for spaces of high urban density, prospect is considered as the ability to observe one space through another. It builds up when there is certain divergence with the option to see through an alignment of multiple spaces. One of the best examples of prospect is Kahn's Salk Institute in California. Its central courtyard establishes the idea of prospect within the premise of built environment through the deliverance of open and unrestricted spaces in it, while it strengthens the sense of security for the occupant (Friedman, 2017; Leslie, 2008).

Figure 15. Salk Institute for Biological Studies by Architect Louis Isadore Kahn in Sandiego, California employs open space for the purpose of prospect. (Source: Sandiego Magazine)

Emerging design parameters that may help in creating a qualitative Prospect are as follows:

- Design interventions like placing stairwells at building edges with glass façade and internal glass walls can form a stable Prospect feature.
- Fenestrations that allow visual transparency along the corridors can make feature rich arrangements opportunities for workstations in office spaces (Ozdemir, 2010).
- A focal length range between 6 meters and 30 meters is preferred when there is adequate depth available for enhancing the experience of the user for walking, bicycling and similar exploratory in campus activities. This gives the user a control over their subconscious range of vision and enhances the preference of the space (Browning et al., 2014).
- Preference should be given to the quality of the symbiosis of Prospect and Refuge rather than the size or the repetition of the same feature (Joye, 2007).
- Visual Connection with Nature has the capability to optimize the Prospect experience with a quality view (Beatley, 2011).

Refuge

According to Browning, Ryan and Clancy (2014), "Refuge is a place for withdrawal, from environmental conditions or the main flow of activity, in which the individual is protected from behind and overhead". A space which offers a good Refuge pattern should enhance the feelings of safety, offer a sense of 'katabasis' i.e., retreat or recoil, for stress relief, restoration and inducement of a work efficient environment for individuals or groups. Dosen and Ostwald (2013) explained that the theory of prospect and refuge is about being able to observe all your

surroundings while being hidden and secure. This trait of human psychology is the reason why certain environments are preferable while in isolation like lighthouses, lake-houses and ranches.

A qualitative Refuge space has the ability to appear unique and stand out from its native environment. It offers a meditative, protective and welcoming environment without creating any unnecessary disengagement for the occupant (Appleton, 1996). Hildebrand (1991) argues "the edge of a wood is one of the most prevalent of natural prospect-refuge conjunctions" because it offers defence against hostile forces like weather and predators, while enableing the occupant to have extended outward surveillance.

According to Grahn and Stigsdotter (2010), the feedback for health in the case of refuge is better than that of prospect. In addition, the symposium of both the patterns (prospect and refuge) delivers an elevated and enhanced result and establishes hope for further collaboration between these two for improvement of biophilic design.

Figure 16. Villa Kogelhof, Netherlands by Paul de Ruiter Architects exhibits the features of both prospect and refuge. (Source: Jeroen Musch, Dezeen Magazine)

Villa Kogelhof (Fig. 18) is an example of both prospect and refuge as the building sits in a desert landscape with open and unobstructed views on all ends. It is built in two sections: one is built underground giving the assurance of refuge in the isolated environment and the other is uplifted with minimalistic and obscuring supports separating it from the ground and whatever remains normal.

A study aimed at identifying the components of restoration in small urban parks concluded that the restoration capabilities of a park does not depend only on the size rather it includes the design and its components as well (Nordh, 2009). For large urban parks, users prefer refuge areas under large trees that offer shade and spaces around the vegetation surrounding a meadow (Ruddell and Hammitt, 1987).

Emerging design parameters to attain qualitative Refuge are as follows:

- Lower ceiling levels induce an effect of refuge within usual environments. Some architectural adaptations for refuge inside the built space are soffit, false-ceiling and suspended fabric (Browning et al, 2014; Dee, 2004).
- A combination of refuge spaces should be used instead of a single one for buildings where a higher frequency of users is involved (Day, 2017).
- The refuge spaces and their adjacent spaces should use different lighting systems and there should be a separation based on the functionality of the space (Dawes & Ostwald, 2014).

Mystery

Mystery is a spatial state indicated by the assurance of more information made evident by the existence of relatively concealed views or other sensory impetus that intrigues and stimulates the individual to explore further into the native surroundings (Herzog and Bryce, 2007; Ikemi, 2005; Kaplan et al., 1989). The basic understanding of this pattern comes from psychologists R. Kaplan and S. Kaplan's (1989) claim that people need only 2 basic things from an environment: 'to

understand' and 'to explore'. Mystery is a useful pattern that can be utilized to modify spaces in indoor and outdoor including walkways, entrances, plazas and buffer spaces.

Robie House, designed by Organic Architecture pioneer Frank Lloyd Wright in prairie style, has several aspects of mystery and biophilia as it hides the information from the visitor and there is a sense of control with the occupant. The long overhangs of shading devices and indirect entrance are two distinct ways to enhance the characteristics of mystery in a building.

Figure 17. Robie House by F.L. Wright in Illinois (Chicago), built in Prairie style, is still considered one of the best examples of mystery as it does not reveal the main entry in any of its elevations and creates an intriguing interest for visitors. The long overhanging shading creates dark shadows and adds to the mystery of the design. (Source: Wikimedia Commons)

Emerging design parameters to attain quality in Mystery pattern are as follows:

- Use of curved edges is recommended as they play a more significant role in comparison to pointed edges, while guiding people's movement along them (Browning et al., 2014).
- Speed of movement of people through the space is a considerable factor for mystery as it enhances the small or large nature of the space in fractions of time. Design should control speed of movement through offering distractions and mild obstructions in the pathway (Fayazi, 2014).
- Dramatic use of shade and shadow can add to the mystery of the space (Stewart-Pollack and ASID, 2006).
- Elements with unprecedented organic growth like planters and shrub rails serve as the natural modulators of fear and surprise for the pedestrian (Van Wieren and Kellert, 2013).

Risk/Peril

Risk or Peril can be stipulated as a combination of threat and associated safety (Ryan et al., 2014). Environment has a way of revealing itself through creation of certain border parameters such as a limit line. This occurs in an environment that is capable of running multiple activities altogether (Fisher and Pedersen, 1996). For example, the first glance creates fear or a feeling of risk while looking at a façade, which does not have a supporting wall, or a guiding handrail. However, the design makes people feel safe and forget this fear when they walk along the same space (Movahed, 2015).

Risk can be a result of a response situation triggered through the reflexes as a learned mitigation and defence mechanism against an alleged danger. When the same risk is ruled out as a reason of causing harm, it ensures safety and becomes a trust element. The levels of danger and the level of control addresses whether it is risk or actual fear (Rapee, 1997). Risk / Peril has the task of intriguing people with curiosity, gaining attention and refreshing the memory so as to enhance their problem-solving skills.

Emerging design parameters that can be used to attain quality in Risk / Peril pattern are as follows:

- Risk/Peril should be approached with precision, as it is a sensitive element for human psychology. Its user base must be well defined and precisely targeted (Honga et al., 2017).
- The element of safeguarding the user must not create an overwhelming environment, which kills the possibility of risk. Risk should be kept as the end limit for the user, certain yet undefined (Zari, 2017).

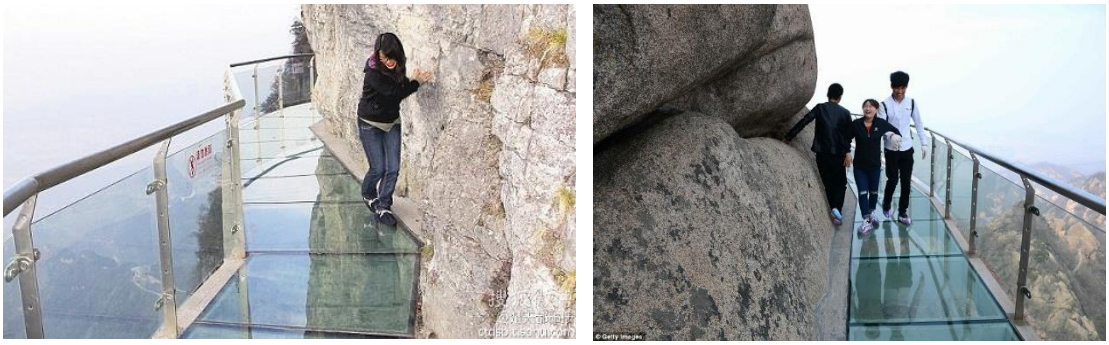

Figure 18. Glass Skywalk at Tianmen Mountain in Zhangjiajie National Forest Park, China. The initial reaction of the tourists is to stay away from the floorglass and be close to the rock-side.. Once the brain eliminates the risk then the walk becomes usual and adventure seeking. (Source: Wikimedia Commons)

One of the best examples of risk/peril can be seen in the glass skywalks where the users face acrophobia through walking on a safeguarding walkway experiencing groundlessness (Deriu, 2017). In that case, their safety is certain, yet they are subjected to a sense of taking risk. Skywalks are built as safe and highly controlled environments; they are expected to provoke the user's acrophobia by subjecting them to the view below their feet. The structure built out of multi-layered tempered glass ensures a sense of safety. This experience surpasses the visual senses to such an extent that it may call upon the brain to create a sensation of dizziness (Yardley and Redfern, 2001). Furthermore, sensory situation activates the sixth sense of the body traditionally called 'kinaesthesia' i.e., muscle sense (Stillman, 2002).

Conclusion

Biophilia has been a part of human habitats for some twelve millennia and has really only experienced a setback during the rise of the machine-oriented world in the last 250 years. Biophilic architecture acts as a symposium of technology, applied sciences and architecture by aptly following nature and its processes. The Biophilia hypothesis by Kellert, as well as the 14 patterns by Browning, Clancy and Ryan, have laid down the groundwork for the further development and research in this field. Biophilic design has arguably been an important influence in favour of sustainability and human well-being. The available research literature amply bears witness to its importance and emphasizes the idea that biophilia is both a part of human life and also a sustainable and healthy approach for its future. The future belongs to cities and when dealing with those highly densified built environments the scope for nature has to be discussed in the context of human health and well-being.

At the frontiers of architecture, biophilia should not be seen as merely a kind of luxury aesthetic adaptation in design. It has existed throughout the history of humanity and must be given relevant space in architecture so that there can be a positive impact on the mental health of the population and its immediate surroundings in the most suitable way possible. A multidisciplinary approach has to be adopted in order to conduct further research within the directives of biophilic design on a case-to-case basis to find out the preference, productivity and efficiency in terms of certain sets of criteria. It can include the relative weightage of each of the 14 patterns of biophilic design or the development of a more comprehensive and analytic tool like the Biophilic Quality Index (BQI) proposed by the Malaysian architect K. Yeang. Detailed research with respect to the different aspects like economics, use of energy and health in biophilic design must be undertaken in accordance with issues like absenteeism and presenteeism for work environments. If humans do not evolve to a point where they can live without nature, then

biophilia has a long journey on which to thrive. There is an optimistic possibility that with the guidelines of LEED and environmental sustainability directives, a great deal more can be targeted for expanding the scope of sustainability through biophilic design.

Glossary

Restoration	'Restoration' is improvement of cerebral functions and mental stress through exposure to nature (Asim & Shree, 2019).
Restorative Environment	Restorative environment is positive nature-rich environment such as scenic views, natural water bodies, flora and fauna that enhances the restoration of humans (Asim & Shree, 2019).
Built Environment	Man-made surroundings that provide the setting for human activity, ranging from the large-scale civic surroundings to the personal places" (Hollnagel, 2014).
Veristic Sustainability	Veristic Sustainability refers to the notion of achieving sustainability through naturalistic means (authors).
Therapy	The attempted remediation of a psychological health problem, usually following a diagnosis.

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Sustainability as a basic principle for legislation: a case study of drafting laws in Finland.

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Abstract

Sustainability is most often defined in terms of three dimensions: environmental, economic, and social. In legislative acts, environmental sustainability is often pursued directly, whereas the other two are pursued indirectly or not at all, depending on which definition of sustainability is used as a point of departure. This study includes a literature review about "sustainability" as a concept and in particular a case study about the use of this concept in Finnish legislation and preparatory materials. The aim is to establish what type of conceptualization of sustainability is used in Finnish law drafting and what types of roles the different sustainability dimensions have in the preparatory materials that are employed. What emerges is that sustainability seems to be too unclear a goal to be directly pursued in all its dimensions through legislation. Instead of incorporating sustainability, in general terms, as the object of every legislative act, it is recommended that separate policy goals that promote particular aspects of sustainability should be pursued with specific individual laws.

Key words: Economic sustainability; Environmental sustainability; Social sustainability; Sustainability.

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1. Introduction

Discussion about issues related to sustainability dates back to many centuries ago and the word "sustainability" has been present in European languages since the early middle ages (de Vries, 2013). An example from 1713 documents a debate about using forests in such a way that wood would remain to be used in the future (Zorpas, 2014). The need to always keep the future in mind when acting today has been a key component in the development of sustainability discourse in the second half of the twentieth century – as in the Brundtland Report *Our Common Future* (UN, 1987). A further component has been questioning the consequences of the growth imperative underlying the dominant socio-economic paradigm, as in *The Limits to Growth* (Meadows et al., 1972). By the 1980s the term "sustainability" had begun to recur within academic discourse (Portney, 2015, p. 1). Today sustainability can arguably be called one of humankind's highest aspirations in the twenty-first century (de Vries, 2013), a part of everyday vocabulary, but in many ways the concept remains elusive and is hard to define (Zorpas, 2014). According to Washington (2015) there are over 300 different definitions of sustainability. As they are proposed, new definitions cover more and more dimensions and are broader in scope (Amini & Bienstock, 2014, p. 12). Chelan (2018) argues that the idea of sustainable development's most significant attraction is indeed its broad-ranging scope. Ben-Eli (2018) also suggests that the word has partly become a general idea of a desired continuity.

It is even hard to define sustainability science in general, since it is a vibrant area bringing together different fields and practices (de Vries, 2013). However, it has become increasingly clear that sustainability is something that goes well beyond the idea of environmental protection and preventing environmental damage (Portney, 2015). In the words of what is probably still the best known and most widely used definition, proposed in the 1992 Rio declaration, achieving sustainability requires achieving "economic, social, and environmental goals" (Zorpas, 2014, p. 3).

Several laws and policies aim to promote environmental protection or achieve other sustainability goals (Schmeichel, 2014). Regulation is often seen as necessary in order to bring about change in different actors' actions so as they become more sustainable (Schwarz & van Basten-Boddin, 2013, p. 80-81). Placing sustainability at the heart of government action is a huge challenge for law- and policymakers worldwide in several different areas (Witbooi, 2011). In this respect, one major obstacle to promoting sustainability through law and policies is that endeavouring to address problems regarding one sustainability issue can trigger other sustainability issues that require balancing or more regulation (Schmeichel, 2014). The role of sustainability in law and policymaking is thus as difficult to define as is the concept itself.

The goal of this study is to discuss how sustainability is seen in terms of law drafting in Finland and to investigate how the multiple dimensions of sustainability can be taken into account in law drafting. The principal research question posed concerns what type of conceptualization of "sustainability" is present in Finnish laws on the basis of the preparatory work done in formulating them. This research question initially focuses on how sustainability appears in the process of drafting legislation. Answering this question necessarily requires a literature review concerning the definition of sustainability, not only in legal studies but also in other fields such as social studies, economics, and environmental sciences. The way the concept is presented in the literature is then compared to how it is used in law drafting.

The initial literature review will be followed by an introductory description of the legislative drafting process in Finland. After this, I will present a case study where several preparatory stages of law drafting are analysed to determine how the concept of sustainability is used as a goal for legislation and how it is discussed. I will then offer a discussion of my findings and propose some conclusions.

2. Three dimensions of sustainability

The first principle of the 1992 Rio Declaration states: "Human beings are at the center of concerns for sustainable development. They are entitled to a healthy and productive life in harmony with nature" (UN, 1992). Principles 4, 5, and 12 then identify three goals for sustainable development -

environmental, social and economic – and subsequently the focus in policies aiming to achieve sustainability has been achieving goals in these three dimensions (Zorpas 2014). The 1987 Brundtland Report defines these as follows: environmental sustainability is based on not living beyond world's ecological capacity; economic sustainability is based on economic growth which has the goal of being sufficient to meet the most essential needs of people; social sustainability is based on dividing this economic development equitably so as to fulfil the most essential needs for all (UN, 1987).

These dimensions are widely analysed in the sustainability literature. However, the environmental dimension gains the most attention in academic research, while the social dimension is often treated as a part environmental dimension, and the economic dimension is often left out (Papoutsi & ManMohan 2020). However, it is often noted that these dimensions are overlapping, and that for each of them there is the need to reach a desirable level of sustainability in order to achieve overall sustainable development (Ciegis & Martinkus 2009).

The environmental aspect of sustainability is generally treated as the one with the most significant challenges for legislators, involving climate change, pollution, and natural resource usage (Tortell, 2020). Environmental sustainability can be defined in a narrow way as using resources not to compromise future generations' use of resources (Moritz et al., 2018) and significant challenges in this respect arise from population growth and increasing consumption (Washington, 2015). Some authors state that continuous and long-term or even indefinite economic growth is necessary for sustainable development, since stagnation would endanger the fulfilment of some people's essential needs (Spangenberg, 2005). However, it has also been emphasized that growth endangers environmental sustainability due to increased consumption and usage of resources. At the same time, some state that de-growth endangers social sustainability due to increasing technology, which increases productivity, which generates unemployment if the economy is not growing (Jackson & Senker, 2011). It has even been argued that renouncing the goal of economic growth might be impossible due to how it increases people's well-being (Coyle, 2012). Others assert that with the current economic system, it is not possible to sustain economic growth for an increasing population without such growth being environmentally unsustainable (Jackson & Senker, 2011). Economic growth measured with current metrics, like GDP, cannot continue to grow without diminishing the well-being of future generations. (Coyle, 2012).

Economic sustainability has been defined as an economy that allows everyone to "have adequate food, shelter, clothing, and the other essentials to meet his or her basic needs for physical and mental development and well-being without diminishing the same opportunities in the future" (Ikerd, 2012, p. 1). Sustainability permits economic growth as long as beneficial effects offset harmful effects. (Lin & Zheng, 2017). Such economic growth must be based on human-made capital and less on other capital, like environmental capital, because this would lead to overuse of resources and therefore endangering environmental sustainability (Spangenberg, 2005). Creating income and stability without overusing capital resources is often considered central to the economic dimension of sustainability (Chelan, 2018). However, these include both natural and human resources and are therefore linked to the environmental and social dimensions (Spangenberg, 2005). In this sense, it is arguable that economic sustainability cannot exist without environmental and social sustainability.

It has been argued that overall sustainability is impossible to achieve without addressing people's and organizations' income needs (Bayramoglu *et al*., 2018). Income needs can cover people's most basic biological needs, or, in broader definitions, the income required so that organizations and people can continue their lifestyle or trade (Su & Cook, 2015). Some definitions of economic sustainability also cover, for example, fairness and equity of benefits distribution, employment and income-earning opportunities, and poverty alleviation in addition to most basic human needs (Qiu, 2019).

Economic sustainability can clearly be seen as incompatible with environmental sustainability. Policies that are adopted to address economic sustainability issues are often in conflict with environmental sustainability. Especially harmful is aiming to solve economic problems with increasing consumption (Washington, 2015). It is argued that people put themselves above the environment, even if they cannot prosper without its support (Crist 2019). Some authors state that developing technology can uncouple economic growth and environmental pressure, allowing both a growing economy and sustainable use of the environment without changing consumption patterns (Smith,

Hargroves & Desha, 2010). This argument has been based on observations that some environmental impacts follow the *Environmental Kuznets-curve*, which means that when the economy grows, environmental impacts grow, but when the economy reaches a certain growth level, the environmental impacts start to diminish (Ekins, 2000). However, this position is criticized by other authors who argue that this cannot be the only solution since previous experience demonstrates how developing technology inevitably increases consumption (Kopnina & Blewitt, 2014).

Only some studies treat social sustainability as a separate concept (Papoutsi & ManMohan, 2020). The social aspect of sustainability is often linked to the impact of globalization on economic development, and more specifically in terms of poverty, income inequality, education, gender equality, and healthcare (Haugh & Talwar, 2010). In some definitions, social sustainability also covers workplace safety and employee satisfaction (Khan, Yu, Golpîra & Sharif, 2019). Some literature suggests that social sustainability should be divided into *basic* and *advanced*, where basic is defined as covering essential human needs and advanced deals with more detailed aspects (Mani, Gunasekaran & Delgado, 2018). Social sustainability is also often associated with developing economies and how companies act there due to their internationalized operations (Mani, Gunasekaran & Delgado, 2018). Some definitions of social sustainability have been criticized for being too economy-oriented instead of focusing on people's welfare (Aseeva, 2018). In its broadest sense, social sustainability is used to describe people's harmonic and conflict-free coexistence in a community (Leshinsky & Mouat, 2015).

From the perspective of companies as economic operators, the main factors in achieving social sustainability for organizations are those concerning human rights, salaries, safety, and health (Zorpas, 2014, p. 279). Social sustainability policies when operating in different countries are often conditioned by the desire to maintain good relations with stakeholders, including governments (Mani, Gunasekaran & Delgado, 2018). Another reason for adopting practices seen as socially sustainable is customer pressure, which forces companies to act in such a way as to avoid scandals and widespread negative publicity (Mani, Gunasekaran & Delgado, 2018). Legislation is often concerned with social sustainability, since protection of people’s rights and welfare is often one main reason for legislative acts worldwide (Burns, 2012).

Clearly the different stakeholders of businesses and other organizations are becoming more aware of the significance of social sustainability and its relationship to both environmental and economic dimensions (Mani, Gunasekaran & Delgado, 2018). Sustainability and corporate social responsibility are positively correlated with economic performance, encouraging organizations to adopt sustainable policies (Tomšič, Bojnec & Simčič, 2015). However, other studies show that this correlation only exists when companies advertise their sustainability efforts enough (Wagner, 2010). Environmental sustainability has the most vital positive links to the economic performance of a firm. Adopting environmental standards has increased labour productivity in several firms (Sánchez & Benito-Hernández, 2015). Risk reduction, increased efficiency, and other environmental sustainability factors also increase economic performance (Wagner, 2010). Environmental-friendly actions of private companies also reduce the cost of equity in several countries as a. significant part of investors are following sustainable investment strategies (Gupta, 2018). Moreover, some authors add the dimension of institutional sustainability, which is achieved when long-term financial, administrative, and organizational capacity is obtained (Witbooi 2011, p. 49). This perspective is common in areas where sustainability is closely linked to corporate social responsibility (Schwarz & van Basten-Boddin, 2013, p. 4).

3. Linking policy and laws making to sustainability dimensions

While the three dimensions of sustainability that are generally identified and characterize much of sustainability literature are clearly intersecting, the following table summarizes how they are presented in terms of the different perspectives proposed. The differences can then be used to analyse policy and law-making processes.

Dimension	Narrow	Broader	Broadest
Environmental	Using resources in a way that does not compromise the use of resources for future generations	Preventing climate change prevention and mitigating pollution	Protecting the environment, giving the environment its own value, improving and developing the environment
Economic	Generating income that is enough for fulfilling essential needs without diminishing the same opportunities in the future	Income and stability generation without overusing capital resources. Providing income required so that organizations and people can continue their lifestyle or trade.	Creating income and stability without overusing environmental and human resources. Providing fairness and equity of benefits distribution, employment and income-earning opportunities. Alleviation of poverty
Social	Fulfilling the most basic human needs for all.	Providing fulfilling salaries, safety, health, education, gender equality, and healthcare. Preventing poverty and income inequality.	Promoting harmonic and conflict-free coexistence of people in a community and good relations with stakeholders

Table 1. The different dimensions of sustainability and the perspectives proposed

As they are presented in the majority of sustainability literature, most of these definitions do not offer any operational guidelines for policy design or organizational policies (Ben-Eli, 2018). However, governmental actions, as well as private actions, are required to reach environmental sustainability (van Rijswick, 2012). Policies can promote firms' environmental sustainability if they create economic incentives to increase environmental protection (Nishitani, Kaneko, Fujii & Komatsu, 2012). The economic benefits of adopting environmental-friendly policies are also strongly dependant on the political and legislative climate. Laws are needed to create incentives and create a context where private actors reward each other for a sustainable *business* (Gupta, 2018). Regulation can be seen as a necessity in order to achieve, for example, in ensuring sustainable use through common pool resources (Moritz et al., 2018).

Adopting single, all-encompassing sustainability laws is problematic since they would need to be adaptive, dynamic, and changing as our information about the earth and global ecosystem changes (Kim, 2016) and current legal systems do not easily permit this. Sustainability as a principle is most likely to affect legislation if narrow goals are set so that they can be changed by the political process and how our views of sustainability change. The Rio declaration was divided for several principles which were more or less specific as to how sustainability should be achieved. For example, principle 13 states that national law should make it possible to apply compensation for environmental damages and pollution.

Different dimensions of sustainability have for some time by now been impacting policymaking and practises in several countries (Heinrichs & Laws, 2014). There are several indicators which can be used in order to analyse the sustainability of current policies and situation (Ollivier & Giraud, 2010), and achieving sustainability goals clearly requires policy impact assessment (Czaika & Selin, 2017). Sustainability is measured using the methods of natural and social sciences, and therefore policy creation requires close science-policy interactions (Turnheim, Asquith & Geels 2020). This means that science can help create indicators of how policy affects many different dimensions measured on a short- and long-term basis, but policymakers still have to make targets and choices on how the policy will be implemented and how it will balance a number of diverse interests (Borgnäs 2016).

Sustainability impact of policy must clearly be based on a range of indicators (Ollivier & Giraud, 2010). Even where sustainability as a policy goal and specific sustainable policies are amply discussed,

they can still have a limited impact in term of policy implementation and administrative practises (Heinrichs & Laws, 2014). Increasing sustainability requires an overall understanding of complex problems during decision making processes (Heinrichs & Laws, 2014). Uninformed policymakers can implement policies that have quite different effects on sustainability from those they desired (Czaika & Selin, 2017). Without proper use of scientific information in policymaking, policymakers may well not be even aware of some sustainability issues (Turnheim, Asquith & Geels, 2020).

Difficulties in measuring sustainability have led to a situation whereby a limited number of key indicators are chosen and pursued through policies (Borgnäs, 2016). Identifying indicators, gathering data and carrying out impact assessment greatly increase the workload of administrative processes, and this reduces the focus to specific aspects of a given policy (Stritch et al., 2020).

4. Drafting laws in Finland

According to the Finnish Constitution (1999), legislative power belongs to parliament. The same article includes the threefold division of power. However, as parliament does not have institutions capable of drafting laws itself, its actual legislative powers are quite restricted (Jyränki & Husa, 2012). The constitution does not regulate the law drafting process itself. Rights for initiating legislation are given to the Council of State, practically meaning the governing parties and members of parliament. Actual law drafting takes place within a ministry responsible for a given administrative branch, or a committee established for law drafting.

After the draft of the bill has been finished, the relevant ministry asks for opinions concerning the bill from different stakeholders (Hautamäki, 2014). The bill is then modified on the basis of these opinions. After this, the draft of the law is passed to the relevant parliamentary committee as a governmental bill (Jyränki & Husa, 2012). In a parliamentary committee, all parliamentary parties are represented, and the Committee's task is to formulate parliament's opinion about the bill. (Jyränki & Husa, 2012). It is common for the committee to gather opinions from different stakeholders and experts (Keinänen & Lehtoviita, 2014). After receiving the committee’s opinion, the ministry can make changes to the bill to ensure that pass through the parliamentary voting process.

The governmental bill sent to the parliamentary committee should already include an impact assessment of the law when implemented (Slant, Rantala & Kautto, 2014). Recent developments have increased the significance of legislation's impact assessment (Slant, Rantala & Kautto, 2014). Law drafting has become a professionally organized action that is based on information, expertise, and knowledge-based decision making (Jyränki & Husa, 2012). Impact assessment is done in the ministries, and the parliamentary committee and hearings of different stakeholders and experts have a significant role in this process (Ahtonen & Keinänen, 2012). On some occasions, impact assessment has covered the legislation's social, economic, and environmental impact (Määttä & Tala, 2015), thereby dealing with the dimensions most often associated with sustainability. However, some argue that impact assessment should be broader and cover a wider range of issues (Keinänen, 2010).

Economic impact assessment is most often carried out and is considered to be the highest in quality, although also the hardest to assess (Keinänen & Vuorela, 2015). The economic impact is assessed in more than half of governmental bills, while environmental impact is assessed in one-tenth of bills, and the social impact even less (Pakarinen, 2012). This is indeed similar to the overall situation in the European Union (Määttä & Tala, 2015). At the same time, a fundamental legal draft principle is that laws are prepared so as to not conflict with the constitution, which makes clear reference to responsibility for the environment:

> Nature and its biodiversity, the environment and the national heritage are the responsibility of everyone. […] The public authorities shall endeavour to guarantee for everyone the right to a healthy environment and for everyone the possibility to influence the decisions that concern their own living environment (Chapter 2, Section 20).

On several occasions, this has been interpreted as an obligation to assess sustainability issues while drafting laws and ensure sustainable development, at least in its environmental dimension, while legislating (Ministry of Justice, 2013), even though the constitution does not make direct reference to

sustainability. In the following case study, the focus will be on environmental sustainability, although economic and social sustainability issues are also addressed in laws relevant to those dimensions.

5. Case study

The following case study analyses seven laws in Finland to examine how they discuss sustainability and how broadly the concept is used. The laws are related to each sustainability dimension: economic, environmental, and social. Looking at the preparatory work we can see whether and how sustainability was discussed and used as a goal or reasoning for the law, although we cannot always be sure what the lawmakers' real intentions were. The aim is to consider how the word "sustainability" is used during preparatory work and look at the goals and estimated impacts of the law and how they relate to different sustainability definitions in Table 1.

In Finland, national guidelines on how to assess the impacts of the legislation (Oikeusministeriö, 2008) identify four impact types that should be assessed while drafting laws: 1) Economic impact, 2) Impact on public administration, 3) Environmental impact, and 4) Social impact. Economic impacts cover, for example, income issues, costs for businesses, the functionality of the market, resource allocation, competition, and economic development. These fall mostly under the broader and broadest definition of sustainability as the current state of the economy seems to enable income that allows fulfilling the most basic human needs. Environmental impacts cover the use of natural resources, emissions, traffic, human health, and impact on nature and the built environment. These fall under all levels of the breadth of sustainability definitions as the use of natural resources is one of the most fundamental parts of sustainability, impact on the built environment and traffic fall under the broadest definitions, and others fall somewhere in between. Social impacts cover fundamental rights, due legal process, political participation, well-being, equality, labour market, crime, security, regional development, and the information society. These all also cover all levels of the broadness of sustainability. Impact on public administration is mostly related to resources used by public administration and is difficult to link to any sustainability category.

Since the term was first coined, environmental sustainability has been linked to resolving conflicts related to using natural resources. Due to this, laws related to the environmental dimension of sustainability were partly chosen based on purpose to address this conflict. Although, for example, the goal of the Mining Act and The Fishing Act is promoting the use of natural resources (Forss, 2011), they do also aim at resolving conflicts related to how these resources are used, including the perspective of sustainable use (Similä, 2016). The seven laws examined below were analysed in terms of their significant intended impact on a specific sustainability dimension and also their significant overall impact. The laws were also chosen on the basis of the impact assessment required for them. All these laws come after Finland joined the European Union in 1995 and EU regulation has affected some significantly. The laws examined are:

- Economic dimension: The Competition Act (948/2011), The Limited Liability Companies Act (624/2006)
- Environmental dimension: The Fishing Act (379/2015), The Mining Act (621/2011), The Waste Act (646/2011)
- Social dimension: The Legal Aid Act (257/2002), The Social Assistance Act (1412/1997)

The documents analysed varied in length. The longest, the Mining Act, was some 270 pages. However, the relevant part for the study was shorter, as significant parts of the government proposals were detailed explanations of single paragraphs, international comparison and reference to current legislation. Therefore, the relevant parts were the introduction, the stated goals, and the impact assessment. The introduction often included general goals of the legislation. For example, the beginning of the Mining Act states that "the proposal aims to secure possibilities for mining operations in a socially, economically and environmentally sustainable way" (Introduction).

The texts chosen were analysed to identify mentions of sustainability or issues related to sustainability and the relevant dimensions. These were then examined in terms of their specific contexts, their relationship to the literature, and how closely they were linked to sustainability.

The Competition Act

The primary material for analysis was the government bill for a Competition Act (HE 88/2010 vp) and the Economic Affairs Committee's statement (Talousvaliokunnan mietintö 50/2010 vp Hallituksen esitys kilpailulaiksi). Only the economic impacts of the act were assessed. Sustainability itself was not assessed explicitly. However, the act's stated goals are similar to aspects related to the broad definition of economic sustainability. Preparatory materials mention several goals that are closely linked with broader definitions of economic sustainability. However, in the economic impact assessment Chapter 4.1, it was stated that the law would improve the functioning of the market. In Chapter 4.2, it was stated that the law would directly or indirectly affect all undertakings in Finland. In Chapter 4.2, it was also mentioned several times that law would improve undertakings' rights for due process, which was a point highlighted in the committee opinion (p. 4). It was also stated that the law would enhance competition, increase productivity, and market effectiveness, and all obstacles to competition should be removed if there is no valid reason for them to exist (p.3).

The market's functioning is considered as part of economic sustainability, understood broadly as sustainable income in order to continue operations long-term. This requires the assumption that free competition and functional markets are better for undertakings and people, a market-economy-oriented policy. The functioning of the market is indeed a vague concept, as effectiveness can be defined in several ways (Määttä, 2009). If economic sustainability is understood narrowly to be merely sustainable income to satisfy the most basic biological needs, history shows that that can be achieved without particularly efficient markets, and improvement for Finland's current situation was probably not necessary in that sense. In any case, the Competition Act deals with issues related to broad definitions of economic sustainability.

The Limited Liability Companies Act

The analysis was based on the government bill for a Limited Liability Companies Act (HE 109/2005 vp) and the opinion expressed by the Economic Affairs Committee (talousvaliokunnan mietintö 7/2006 vp Hallituksen esitys uudeksi osakeyhtiölainsäädännöksi). This act does not directly mention sustainability or social and environmental impacts. However, issues related to broader definitions of economic sustainability were discussed in the preparatory materials.

The main reason given for the law was to increase alternatives for LLC:s to give as good as possible opportunity for honest business by increasing market effectiveness and competitiveness and reducing uncertainty derived from regulation (p.16-17). In the impact assessment chapter 3.1 of the bill, it was stated that giving more alternatives to companies would increase the effectiveness in companies and, therefore, in the whole economy as well as increasing international competitiveness. In the same chapter, it was stated that the law also aims not to increase creditors' uncertainty as it would be harmful to the economy when financial costs would rise. It was also stated that small LLCs' conditions for continuing operations are vital for society (p.4).

The Fishing Act

The primary material for analysis were the government bill for a Fishing Act (HE 192/2014 vp), the opinion of the Committee for Agriculture and Forestry (CAF) (Maa- ja metsätalousvaliokunnan mietintö 31/2014 vp Hallituksen esitys eduskunnalle kalastuslaiksi ja eräiksi siihen liittyviksi laeiksi) and the opinion of the Environmental Committee (Ympäristövaliokunnan lausunto 26/2014 vp Hallituksen esitys eduskunnalle kalastuslaiksi ja eräiksi siihen liittyviksi laeiksi). This Act does differ from the previous ones, as in the bill (p. 1), CAF opinion (p. 3)and the EC opinion (p. 2) it is directly stated that the law aims to set usage of fish stocks in a way that is environmentally, economically and socially sustainable. Sustainability is indicated directly as a goal and a reason for the law.

Environmental sustainability is stated to mean using fish stocks in a way that will not diminish them in the long run, as in the narrow environmental sustainability definition (p.16). The EC opinion defines environmental sustainability in the same way (p. 2) and adds that ecological sustainability is the most problematic aspect. This is probably why the narrowest definition was used when stating the

law's goal, since this is already difficult enough to achieve. The CAM states that, although the bill balances different interests related to fishing, it gives most weight to improving the environmental sustainability of fish stocks and fishing activity (p.4). The social and economic dimensions of sustainability were not significantly dealt with. One goal of the bill was to benefit commercial fishing and recreational fishing (p. 17). The law's economic impacts were analysed (p. 20-21), and they were principally concerned with improving operating conditions of commercial fishing. However, the CAM sees these changes as necessary for commercial fishing to continue the existing sustainable way (p. 7). This is also part of the broad definition of economic sustainability. Social impacts were analysed (p. 23-24), principally in terms of making recreational fishing slightly easier to practice, something which is difficult to link to sustainability even in broader definitions. The CAM sees some changes necessary to improve employment in rural areas with high unemployment (p. 9). This can be seen to include some elements of a broader definitions of social sustainability.

Although the Fishing Act claims to consider all the sustainability dimensions, it mostly focuses on environmental sustainability and other sustainability dimensions are concerned with enabling fish resource use. It even seems that economic and social sustainability could entirely derive from environmental sustainability, a perspective supported by some literature. Economic sustainability is taken into account to some extent if understood broadly, as with previous laws, but social sustainability issues are quite hard to find even in terms of a flexible definition.

The Mining Act

The primary material for analysis were government bill (HE 273/2009 vp), opinion of the economic affairs committee (Talousvaliokunnan mietintö 49/2010 vp Hallituksen esitys kaivoslaiksi ja eräiksi siihen liittyviksi laeiksi) and the opinion of environmental committee (Ympäristövaliokunnan lausunto 7/2010 vp Hallituksen esitys kaivoslaiksi ja eräiksi siihen liittyviksi laeiksi). In the government bill (p. 1), the EAC opinion (p. 2) and the EC opinion (p. 2) it is stated that “The objective of the Act is to promote mining and organise the use of areas required for it, and exploration, in a socially, economically, and ecologically sustainable manner”. This became article 1 of the law.

Social sustainability was used mostly when understood broadly enough. It was indirectly mentioned through indigenous peoples' rights to the traditional cultural environment (p. 27). In EAC opinion, part of the committee objected to the law (p.35). They saw that the law would lead to consuming non-renewable natural resources without compensating it to locals and improving social and economic conditions in rural areas, mostly unemployment. This can be seen as a concern of economic and social sustainability while using natural resources. These opinions do also cover some aspects related to broader definitions of social sustainability.

In the bill, sustainable development is referred to mostly as environmental sustainability, covering things related to narrow and broad definitions of environmental sustainability (p. 44). The bill also states how it aims to take account of economic and social sustainability (p. 47-48). The EC noted only environmental sustainability (p.2). The EAC also notes how the law would improve mining operations' national utility, which could be seen in the broad definition of economic sustainability.

The Mining Act does take sustainability issues into account more often and from more dimensions than other acts analysed. Environmental issues were analysed most. However, economic and social sustainability impacts were noted and documented, although social sustainability effects were somewhat unclear and indirect. Economic sustainability impacts were analysed in terms of the national utility of operations. In addition to this, employment issues were considered, although these are in fact more related to sustainability's social dimension. The act does take different sustainability dimensions into account, much more than other laws and is the one where the social and economic dimensions of sustainability were discussed the most.

The Waste Act

Primary materials for analysis were the government bill (HE 199/2010) and opinions of the EC (Ympäristövaliokunnan mietintö 23/2010 vp YmVM 23/2010 vp - HE 199/2010 vp) and the EAC (Talousvaliokunnan lausunto 30/2010 vp TaVL 30/2010 vp - HE 199/2010 vp). The governmental bill

(p. 6) mentions that act aims to promote sustainable development by promoting natural resources' smart use and preventing harm caused by the waste. However, this act does mostly cover issues related to the broad definition of environmental sustainability. In the EC opinion (p. 4), a sustainable development strategy is related to several environmental impacts of the act. The bill that sustainable use of resources is one main goal of the act (p. 53) and this subsequently became article 1. The same goal was also referred to several times by the EAC and the EC. This is part of the narrow and core definition of environmental sustainability. Social impacts were not assessed at all. Economic impact assessment is dealt with (p. 48), leading to the conclusion that the act does not have any impact on companies' operating conditions.

Although there are some references to sustainability in the bill, these mostly focus on environmental issues, which is constantly used more narrowly than other sustainability dimensions. Economic issues are assessed to some extent and understood more broadly. The social dimension of sustainability can be linked to the fact that using resources so that future generations can enjoy them can be considered part of social sustainability, as with the Mining Act. However, this is not specifically referred to.

The Legal Aid Act

Primary material for analysis was the government bill (HE 82/2001 vp) and the opinion of the judiciary committee (Lakivaliokunnan mietintö 22/2001 vp LaVM 22/2001 vp - HE 82/2001 vp). Although the bill mentions more practical points as the law's goal (p. 48-49), more fundamental social issues are addressed concerning international treaties and fundamental rights requirements (pp. 24-25). The right to a fair trial requires free judicial assistance where necessary. How the law would affect several groups' fundamental rights by significantly widening the group entitled to legal aid is assessed (pp. 74-75), making it more a general civil right than a right entitled to financially disadvantaged people.

Sustainability itself is not mentioned in the bill or the opinion. However, fundamental rights are mentioned several times, and these are part of social sustainability according to narrow and broad sustainability definitions. Although the law does not directly pursue social sustainability, it is likely to increase social sustainability if social sustainability is understood to cover endorsing fundamental human rights. As with a number of other laws, linking social sustainability to the goals of the law requires a broad definition of sustainability.

The Social Assistance Act

The Primary material for analysis was the government bill (HE 217/1997 vp) and the opinion of the Social and Health Affairs Committee (Sosiaali- ja terveysvaliokunnan mietintö 33/1997 vp StVM 33/1997 vp- HE 217/1997 vp). In the bill, it is stated that social assistance is based on the fundamental right to a basic livelihood and that its lack is unsustainable (pp. 11-12) and the HA Committee agreed with this (p. 2-3). The bill briefly assessed how changes in the law would affect how the right to a basic livelihood (p. 15).

The Social Assistance Act is linked to sustainability in similar way to the Legal Aid Act. Both aim to endorse fundamental human rights, which are core parts of social sustainability. The Social Assistance Act focuses even more on basic needs, mostly the need for a basic livelihood. This can be seen to be part of economic sustainability, in that it is related to a necessary income. At the same time, a basic livelihood includes satisfying both physiological and social needs. This can be understood as part of both economic and social sustainability if broad enough definitions are used. As in other cases, social sustainability is not introduced in itself, but rather as related to environmental sustainability, which only includes social sustainability if understood broadly enough.

Summary

Analysis shows that sustainability is most discussed in the context of laws that have an environmental focus. At the same time, preparatory work often includes several mentions of environmental, economic, and social sustainability dimensions, especially as regards laws that regulate using natural

resources. On these occasions, sustainability's environmental aspect is defined quite narrowly and used as in its core meaning. The economic and social dimensions of sustainability are, however, used more broadly. It seems that economic sustainability is overally considered more broadly, as narrow definitions were not used in any preparatory work analysed. This was consistent with laws that had environmental focus as well as with laws that have economic focus. However, laws with economic focus did not implicitly use the term "sustainability". Some issues related to the narrow definition of social sustainability were dealt with in the laws related to social security and other fundamental human rights. However, the term "sustainability" was not implicitly mentioned here. It is necessary to note that laws with most impact assessment were all laws from years 2011-2015, as awareness emerges of sustainability as an increasingly key issue. However, as these laws with environmental impacts typically have the highest quality impact assessment, the period in which they are passed should not make that much difference compared to other laws analysed (Keinänen & Vuorela, 2015, p. 189).

Dimension	Narrow	Broader	Even broader
Environmental	Mining act, Fishing act	Waste act	
Economic	-	Competition act, Limited liability companies act, Fishing act	Competition act, Limited liability companies act, Mining act, Waste act
Social	Social assistance act	Legal aid act	Fishing act, Mining act

Table 2. How different dimensions of sustainability were mentioned in preparatory works of different laws

6. Conclusions

There are several definitions of sustainability. The concept itself has a long history, and it has played a significant role in several declarations and policy documents. However, as time passes, the concept risks becoming blurred as more definitions appear and older ones are challenged. Most definitions of sustainability include three dimensions: environmental, economic, and social sustainability. There are also several definitions of these three dimensions, which differ significantly. When discussing these dimensions, it must be noted that some definitions are significantly broader than others. For example, some narrow definitions of economic sustainability only include income that provides the most basic physiological needs like food and shelter. Broader definitions of economic sustainability can mean that income is enough to continue operations or trading in the long term.

The environmental dimension of sustainability is the one used most often. Other dimensions are often defined by their relation to environmental sustainability. The role of environmental sustainability has been most significant in several policies. Especially in natural resource use, environmental sustainability has played a significant role in previous literature. Even in quite new legislation, environmental sustainability still has a significant role when regulating the use of natural resources. Although sustainability has its role in reducing the environmental impact of several functions, i.e., waste handling, it still plays a significant role in use of natural resources, even if trends like circular economy are emerging and becoming increasingly important.

Policies, like legislative acts, have a significant role in achieving sustainability. Policies are a tool that can direct the behaviour of individuals and organizations towards a more sustainable trajectory. Most literature is focused on companies and how their actions affect sustainability and how policies affect those companies. Several market incentives are aimed at altering companies' operations with a view to promoting sustainability.

Although sustainability can be considered a base requirement for societies' and human beings' existence in the long term, the extent to which as a concept it can be the basis for policy is an open question. When analysing several laws, it seems that this is also apparent in the process of law drafting. As sustainability is a broad concept without exact definitions, it is difficult to incorporate it into legislation because an impact assessment for a law should be more exact. In this respect, it might be

better to derive single and specific policy goals rather than aim for overall sustainability. These policy goals could, for example, best promote a single dimension of sustainability like environmental sustainability, such as pursuing reductions in pollution and waste or better protection of nature.

In some cases, linking policy goals to sustainability can be problematic. In economic sustainability, most narrow definitions are linked to income enough to satisfy the most basic physiological needs. In Finland, this was achieved more than a hundred years ago. Going beyond this means regulating markets and businesses in order to improve operating conditions and improve people's welfare. This is included in broader definitions of sustainability, but not in more narrow ones. Similar issues are involved with social sustainability as some definitions are based only on most fundamental human rights like freedom, health, and life. However, broader definitions do even include workplace satisfaction and other aspects of wellbeing much higher in the needs hierarchy.

The results of the case study are in line with one outcome of the literature review in that environmental sustainability is discussed the most, and other dimensions are either linked to it or not discussed at all. Where sustainability is referred to, it is normally not clearly defined and is used differently depending on the context. As regards questions of economic and social sustainability, the word "sustainability" itself is not used, although the rationale for the laws includes several policy goals related to economic or social sustainability if these are defined broadly.

For example, enabling operations in the long term can be seen as promoting economic sustainability, even if there is no explicit reference to this. In economic sustainability, the goal is often to improve firms' operating conditions and significant competition in the market, often mentioned as base requirements for welfare generation in market economies. In social sustainability, laws have goals that might not be related to the most fundamental human rights, but to specific rights like the right for a fair trial or right for socially acceptable living.

In environmental law, the word "sustainability" often refers only to the environmental dimension of sustainability. The other two dimensions are often mentioned as regards the use of natural resources, but the contents are left unclear. The environmental dimension of sustainability is often dealt with more deeply, and environmental impact assessment addresses sustainability issues. In some cases, social and economic sustainability are linked to this, but not dealt with separately. The overall economic dimension of sustainability is not directly discussed in preparatory works, but smaller goals in line with achieving economic sustainability can be present.

When comparing how broad a definition of sustainability is used in different laws, a clear pattern emerges. When discussing environmental sustainability, a narrow definition is often used. In the case of economic sustainability, only broader definitions are used. In cases where laws have social goals, the goals are in the core area of social sustainability, but broader definitions are used when laws include some other goals. Economic and social sustainability are often implicitly present when the law has an environmental goal.

Sustainability is clearly a base requirement for humanity and its continuing existence on the planet we inhabit. At the same time, it is not an easy overall goal for legislation, due to a common lack of clarity in defining it as a concept. An analysis of Finnish legislation shows how awareness of the importance of sustainability acts as a basic principle, affecting how the laws were formulated. At the same time, laws need to have exact goals so that their impact can be assessed in terms of specific dimensions and examples of sustainability.

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Vision and action in scientific discourse. *The Disappearance of Butterflies*. Josef H. Reichholf. (2021). Polity Press.

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Scientific study has always combined, in different ways and to varying degrees, research designed to increase understanding and build knowledge, together with making forecasts, warnings or proposals on the basis of that knowledge. Moreover, in recent decades many phenomena related to accelerating global change have tended to increase the need to unite vision and action within scientific discourse. The fact that the world is now facing a sixth mass extinction, involving one million plant and animal species that are at risk, largely attributable to human impacts, is but one example of such a development.

Within this context, in *The Disappearance of Butterflies*, Josef Reichholf offers a series of fascinating insights into the biology, the physics and the chemistry of Lepidoptera, including their remarkable adaptive capacities in the face of eco-systemic transformations. At the same time, he also poses a range of questions that act as provocations for all those who study the multiple, interwoven facets of living organism and human trajectories, within life sciences in general and sustainability science and ecology in particular, and ultimately those, including politicians, who should assume the responsibility for taking action when those trajectories become either threatening or threatened. The majority of the data he uses is related to Germany, the country in which he has carried out a lifetime of research, but the analysis he proposes and the issues he deals with are largely relevant on a global scale.

Reichholf is constantly at pains to emphasize the complexity of ecological processes and warn against distortions due to overgeneralization or simplistic explanations and solutions:

> […] it is crucial to distinguish ordinary fluctuations from the general trend. This is critical not only for understanding the natural cycles but also for identifying the correct measures required to reverse the downward trend. It will not be achieved, for example, by simply reducing the application of poisons, as worthwhile as this might be (p.3).

At times, he is scathing in his criticism of what he sees as unscientific positions and facile policy prescriptions. He also assumes a clear position as regards the widespread diffusion of current antiscientific trends:

> Whatever we commonly associate with 'green' or 'eco' holds its own problems with respect to the conservation of species. […] The ecology movement lost its claim to scientific integrity in my opinion when it was converted into a 'nature religion' through crises that lent themselves to political manipulation. […] Scientific discourse differentiates itself from the exchange of publicly entrenched opinions by accepting better findings. This makes natural science stronger but also increasingly unpopular. It remains qualified and flexible while today people seemed to delight in dogmatically countering one principle with another. Scepticism does not disqualify you from being a natural scientist. Instead, it is the praiseworthy habit of someone who does not submit to dogmas, even if they are currently supposed to be in fashion (p.3).

He also underlines the need to be clear about the relationship between scientific enquiry and the natural world and how this awareness should be employed as regards his own research, in order to not jump to hasty conclusions:

> Nature is dynamic. Changes can and will always occur. My initial claim that we have lost 80% of the butterflies in the last 50 years refers to the overall frequency and requires much more concrete evidence (p.9).

Indeed, 50 years of study, for example of ermine moths, have led him to summarize his conclusions in two "key statements":

> First: many years of investigation are insufficient for understanding the population dynamics of moths or butterflies; often, even a decade is too short. Second: the interactions between insect and plant are much more profound and complex than we like to imagine, particularly in the area of pest control (p.94).

The dynamics of biodiversity: variation, variability and adaptive capacities

New ways of estimating global species richness are constantly being developed and existing ones modified as new data emerge and statistical tools are refined. As a result, we have clearly become increasingly aware of the range of biodiversity, both in terms of the richness and distribution of species in the world and those that are at risk as a result of global change. At the same time, Reichholf stresses the importance of recognizing a particular aspect of these changes in techniques of estimation:

> Modern molecular genetics [have led to classifications] based on an arbitrary determination of genetic distances for a justification of species differentiation. Currently the "splitters" dominate the field and have done so for about 100 years so that many species are becoming subdivided into two or more species. Numbers therefore grow whenever new species are recognized as such. However, they are not newly formed, but have simply been discovered using a new method (pp. 150-151).

His principal aim is, however, to underline that the true significance of biodiversity lies in its relationship to variety and the ecological significance of this. "Species are not so easy to pigeonhole, however desirable this might be. Their fundamental principle and the reason for their success is variation and variability" (p.151).

The Disappearance of Butterflies provides numerous and detailed examples of such variety in Lepidoptera. This involves illustrating the multiple ways in which the complex interactions between biology, physics and chemistry are interwoven in a range of different species and how these interactions determine their particular behavioural characteristics within the ecosystems in which they thrive, together with the extraordinary ways in which they manifest their adaptive capacities in the face of perturbations that lead to eco-systemic transformations.

At times, Reichholf focuses on genetic peculiarities and their relationship to particular features of the evolutionary history of butterflies and moths.

> With butterflies and moths, the female sex is genetically marked XY and the male XX; that is, the exact opposite from us. For this reason, it is much easier for females to develop two different forms than it is for males. This characteristic manifests itself with particular clarity in forms of 'mimicry', that is, through the imitation of poisonous or foul-tasting examples by non-poisonous imitators that are not protected by unpleasant flavours. In short, in moth and butterfly circles it is worthwhile for the females to be

more highly diversified (p.29).

He frequently describes in great detail the adaptive capacities of particular species, such as the brown china-mark aquatic moth, through an examination of their physiological characteristics and how these are shaped by their interactions with their physical environment during each of their developmental stages. For example, since the metamorphosis of a pupa into a butterfly:

> […] requires a great deal of energy, the pupa must breathe. In contrast to the caterpillar, which floats on the water surface in its air-filled vessel and can replenish its air directly, the pupa is dependent on the plant for its air supply. It is even possible that the leaves that remain green in the water carry out photosynthesis for longer, just to provide oxygen to the air bubble of the pupa. The highly complex problem of how an air-based animal can breathe underwater is therefore solved in different ways: an adaptive achievement that one can only wonder at (pp.22-23).

The brown china-mark aquatic moth also provides an example of the challenges posed by the establishment of ecological niches and the struggle to survive in the face of modification or destruction of biotopes.

> The female brown china-mark will leave the pool from which she emerged if the floating leaves of the water plants have been overconsumed. She will examine the edges of the floating leaves quite thoroughly before laying her eggs, and for good reason. If there is extensive feeding damage, she will leave and search for other waters with better conditions. A tendency to disperse would already be expected since such small bodies of water are normally only temporary under natural conditions. They arise through inundation of the floodplains. New ponds will last a couple of years or a few decades, depending on how large or small they are when they form and gradually disappear again through sedimentation and plant succession. Species that colonise an environment that is by its nature unstable must seek alternatives in good time (p.26).

The relationship between the biology of Lepidoptera and the physics of both light and sound offers many examples of behaviours that go well beyond the most frequently studied phenomena of positive and negative phototaxis, as well as often taking us well beyond the current limits of human understanding.

> Certain species of moth have developed the quite extraordinary capacity to detect the ultrasonic pulses emitted by bats without having 'heard' them. Then, if they are struck by them, they let themselves fall into the grass or the bush is as quick as lightning. This is quite hard for us to grasp (p.33).

Navigating the dark requires a seemingly precarious balance between processing chemical and physical stimuli.

> Night-flying moths are above all concerned with finding a flight path through the darkness without crashing into obstacles if somewhere, perhaps several hundred metres away, a newly emerged female is exuding her own kind of sexual lure. The travelling males remain unscathed, which is surprising considering that they are practically flying blind with only their scent-sensors in their antennae to steer with. How they manage this never ceases to amaze me, since it is light that steers them off their course and causes them to bump into obstacles. 'More light, worse sight' is hard for us to comprehend, since we depend so much on vision. […] The moths and night-flying butterflies evidently […] need […] residual light. But based on the current level of knowledge we can barely even begin to speculate how they process this and how they use it to manage their often quite rapid flights, since, in terms of structure and function, their eyes are not significantly different from those of the butterflies and day-flying moths (p.34).

The relationship between Lepidoptera, light and sound is therefore highly complex and recognizing how partial our understanding of this complexity is should help us avoid making overgeneralizations based on inadequate timescales.

> Many nocturnal insects fly towards UV-rich light … What is so beautiful and appealing in individual butterflies lies in the eye of the beholder, that is, in our eyes. They do not see each other like this at all and birds also recognise them in other ways. On their night-

> time hunts, bats estimate where they are using sonar imaging, which is different again. Yet over the thousands and millions of years of their existence butterflies and moths must have learned to deal continually with the visual ability of birds and the echoes produced by the ultrasound of bats. The challenges presented by humans, on the other hand, are still relatively new. A century of nights illuminated by electric light is not enough. Or so one might think.
>
> But perhaps we should not take such a pessimistic view. There is actually a rich diversity of species in nocturnal moths living in those big bright cities. Light pollution in general cannot therefore be the main factor in determining their occurrence and abundance (p.37).

Once again, for Reichholf it is of fundamental importance both to consider the relativity of different timescales and to avoid overgeneralization in reaching conclusions. Cities are one of the most salient examples of the Anthropocene and the ever-increasing human impacts on the biosphere. At the same time, as the author stresses, the relationship between cities and biodiversity is much more complex than might appear. This emerges as a development of the author's analysis of what is certainly the most disrupting human impact for Lepidoptera, that caused by industrial agricultural, and a comparison between the very different human impacts in two places: the countryside and the city.

The resourcesphere and industrial agriculture

The *oikos* studied by eco-logy is both life itself and a place in which to live, since without somewhere in which to do so life simply could not "take place". In the same way, the biosphere is both all life and the place (*sphaira* = terrestrial globe), the physical environment, or particular biotope, that hosts all life. The interactions between biotic and abiotic elements that take place within the biosphere give rise to constant reciprocal impacts which derive from the continuous interplay between the characteristics of the elements, the relations between them that are determined by these characteristics, and the transformations these relations give rise to. These in turn determine new characteristics, relations and transformations in an ongoing series of interlinked cycles.

In recent decades, we have come to be increasingly aware of how human actions and interactions within the biosphere have led to all-pervasive transformations and devastating outcomes such as global warming and a massive loss of biodiversity and the disastrous ramifications that follow. The COVID-19 pandemic has perhaps raised the awareness of such effects to a much higher level, particularly as regards how the destruction of ecosystems and the consequent loss of biodiversity is a powerful driver of emerging infectious diseases, although this is but one example of the overall ecological effects of the destruction of the diversity of living organisms. Many of these destructive human interactions are the result of our way of conceiving the entire biosphere as a gigantic *resourcesphere* (Dodman et al., 2020) in which any form of natural capital is considered "ours" to dispose of as we wish, without any regard for how that impacts on the biosphere as a whole. In this way, our attitude to the resourcesphere continues to compromise it for all life, including ourselves, in terms of all the provisioning, regulating, supporting and cultural ecosystem services it furnishes.

Among the numerous examples of such impacts, the development of agriculture – and in particular industrial agriculture and its concomitant international agribusiness – has been among the most devastating. The advent of agriculture transformed the biosphere in terms of impacts related to changes in human food supply and diet, health, population, social structure, mobility and resource use. The interaction between each of these factors has determined the many outcomes of our resource use and Reichholf offers a series of examples of how this use has been characterized by a dramatic acceleration in the ever-increasing scale of blind exploitation and profit seeking and the multiple consequences that ensue, for nature, for biodiversity and for farmers themselves:

> Over the past half century, nature has changed to an extent and at a speed that are simply unprecedented in such a short period. The findings are staggering and the prospects that they imply are exceptionally grim. This is because we cannot expect the main agent of this loss of species diversity – agriculture – to undergo any substantial change. Anyone who delves into the agricultural problem in any depth will find that it has less to do with the farmers themselves than with agricultural politics. The billions of

> subsidies they have received over the past 50 years have resulted in a highly competitive displacement of the small-scale farms by the large ones. Traditional farmers more or less disappeared, until only a tenth of their former numbers now remain, and yet the victor in this situation, international agribusiness – in particular the producers of crop protection products – managed to keep a low public profile while the decline of insects and birds proceeded in shocking parallel to the death of small-scale farm-based agriculture (p.12).

Particularly devastating aspects of industrial agriculture among those examined are competition, monocultures, fertilization and pesticide use. Competition and monocultures are often linked in terms of the effects produced:

> […] as a result of the concentration by agricultural businesses on a few, and increasingly just one, field crop, and the enlargement of production units, costs were lowered, but at the same time competition between farmers was enhanced. More and more farmers had to give up because the areas that they managed were too small to withstand the pressure from competition and to carry the enormous costs of the machinery and the monocultures required. In just 30 years prior to the turn of the century, approximately 90% of farmers in Germany gave up farming. The remaining 10% survived as businesses because they received area-related subsidies from the state or from the EU agricultural budget. This is a state-controlled command economy. In practice the public has already bought off the farmer's land several times over with the subsidies (p.201).

Reichholf repeatedly emphasizes the complexity of analysing ecological processes related to reasons why insect biomass has decreased by over 70% since the 1990s, a calculation based on "numbers recorded either in nature reserves or in other areas not used for agriculture" which clearly demonstrates how the effects of the crop enhancing and protecting products employed by industrial agriculture go far beyond the areas directly treated:

> This decline can only have been caused by the combined effect of fertilizers and pesticides. The application of fertilizer, which in this case came above all from exposure through the air, strengthened plant growth and caused the principal effect of colder and damper living conditions in the zone close to the ground. This expelled those species that need warmth and sunlight. Others that could cope with the increased density of plants and should thus have become more abundant did not compensate for the losses. The study was concerned with the mass of insects more precisely their biomass, or live weight. This, not the mere number of insects, had decreased by almost three-quarters (p.202-203).

Both the paradoxical, often absurd, consequences and the pernicious nature of the massive pesticide use that characterizes industrial agriculture are also clearly illustrated:

> Conventional agriculture is carrying out by far the largest weed and insect annihilation program that has ever taken place. In comparison, the burning of stubble, field margins and drifts that used to be practiced after the harvest, with a virtually harmless interference living things could cope with, that since it is visible and conspicuous stubble burning has been prescribed for decades but it has been replaced by poisoning which is invisible and inconspicuous (p. 178).

Moreover, there are many examples of what is known as the pesticide paradox, in terms both of the range of environmental impacts caused by their manufacture and use and how this can have effects that are opposite to those desired, and also of its relationship to the negative ecological consequences of monoculture:

> […] the fact that the (agro)chemical fight against pests seems to aspire to the total destruction of the pest species that it targets should give us food for thought. The speed at which the opposite is achieved, that is, resistance by pests to pesticides and new mass proliferations of the pest species in question, has led to an abstruse race: between the pests, which are constantly getting faster and better, and the chemical insecticides which are constantly being redesigned. This problem is aggravated by the extreme genetic standardization of crop plants, since it has long been known that mass proliferation and the development of resistance in pests is best controlled by genetic

diversity in the relevant crop (p.91).

The role played by livestock farming and the huge quantity of sewage this produces is also highlighted, particularly as regards the insane consequences of the blind pursuit of profit:

> […] hundreds of billions of litres of slurry end up directly on the fields, with huge consequences for nature, not only for plants and animals but also for the quality of air and groundwater these vast quantities of animals must be looked after if they are to produce corresponding profits sometimes this includes the use of medicines and other additives that inevitably place a burden on nature and our environment all of this has been reported frequently and in vain the agribusiness seems to be immune to its significance (p. 184).

The far-reaching consequences of the move towards obtaining biogas from biomass, based on a massive increase in maize monoculture, is also clearly illustrated in order to demonstrate the link between ecological and socio-economic impacts:

> In 1960 maize production covered only a couple of 1000 hectares in Germany. Now, in 2018, it covers 2.5 million hectares. That is 1000 times more land, thanks to the use of maize as a biofuel. The area of maize cultivation had already risen to 1.5 million hectares by the late 1990s. Maize cultivation was heavily subsidized by the state. With the arrival of biogas from biomass, farmers rapidly changed their crop portfolio. They became energy farmers while still maintaining all the privileges and public subsidies of land farmers (p.183).

All these examples regard ways in which industrial agriculture is based interventions designed to maximise monocultural plant growth and "protect" agro-ecosystems and crops from pests. The impacts have been not only on the land to be cultivated, but also all the surrounding areas which make up what we commonly call the countryside, with multiple paradoxical consequences. In this respect, Reichholf constantly returns to the comparison between "nature-friendly cities" and the "inhospitable countryside" and how this manifests itself in the different levels of loss of biodiversity with:

> […] largely stable populations in the city, smaller populations in smaller towns and villages, high losses outside these, even in protected areas, and only minimal residual populations of insects in the conventionally used agrarian landscape. As bizarre as it may seem, it is not the metropolis that spells the end of nature but the maize field […]. Nobody should be astonished, least of all those involved in industrial agriculture, whose objective was and is to maximize profit. Society has sanctioned these developments with its financial support. Whoever is willing to pay money so that pesticides and slurry can be applied *en masse* will inevitably be confronted with this outcome. (p.204).

Biodiversity in the city is conditioned by a multiplicity of factors and manifest in many different ways, whereby:

> […] woods have a quite different, truly public function […] trees are generally left to grow old and hollow. They do not have to deliver a good yield of timber they can be calculated as a profit to set against costs. Recreational value and beauty take priority over utility and monotony. The contrast is massive. One sees it as soon as one looks a little closer. In the cities whatever arrives and can cope with the inner-city living conditions is allowed to grow and live. Control and defence measures are limited to what is strictly necessary and even this is the subject of public discussion. […] This means that cities are (1) much richer in structure; (2) offer better living conditions; (3) warmer than their surroundings; and (4) subjected to far less fertilizer and pesticide than the countryside; also (5) the urban population is much more prepared to take into account the living requirements of animals and plants. Visible expressions of this are the fact that birds in the city are not shy, mammals show themselves by day and do not need to remain hidden in the dark of the night. Moths and butterflies also benefit from the advantages of the city, as the findings clearly demonstrate. […] It is not the cities that are bad but rather the countryside that is become inhospitable, and to quite a large extent (pp. 179-80).

If we look at the Anthropocene in all its complexity, we can see that urban nature is indeed more diverse than that of cultivated rural areas. Their diversity of micro-ecosystems, due to the diversified structure of cities, has led to those cities becoming islands of biodiversity.

Towards a biotope for each community

In *The Disappearance of Butterflies*, Reichholf pursues two principal aims. The first is to describe and explain the marvels of Lepidoptera in order to help us understand "what makes these creatures so distinct" (p.233). This understanding should lead us to a full appreciation of their beauty if we have the opportunity to observe them in a park or garden:

> Wings as fine as tissue paper with patterns and colours that an artist could barely imagine without the living model; antennae that pick up signals from the environment and convey them to the butterfly; eyes made up of many tiny ommatidia that register movement much more quickly than our own far larger eyes; and legs with a tactile sensitivity far more acute than our fingertips – yet all this only produces a rough superficial impression of the essence of a butterfly (or moth) (p.233).

Even if superficial, this impression must surely be an example of something that induces in us *biophilia*, "the love of nature", and its two fundamental constituents – *fascination* and *affiliation* (Barbiero & Berto, 2018). Each of these must unquestionably be at the heart of the kind of engagement necessary in uniting vision and action in promoting biodiversity.

Reichholf is equally concerned to warn against the pitfalls inherent in interpreting data on the basis of categorical, overgeneralizing thought patterns. This means differentiating "continuing trends from natural fluctuations" and recognizing that "the time periods used for investigations must be long enough" (p.133). Such investigation shows how "not all species have been affected equally" (p.119) by disturbances and consequent impacts. The mass of data he has collected during 50 years of scientific enquiry leads him to stress that "comparative trends must be independent of one another, in the same way that weather and climate trends are independent from butterfly populations" (p.134). In the search for causes, it is extremely important to differentiate between general effects, such as climate change, and special ones which are independent of this (p.156).

> This is not the first time that the climate is changed, and it is not changed only because of human activity. We use the term climate change to refer to long term lasting changes in the weather. Since nature has never been stable, these weather changes form part of the normal events that lead to the development of lifestyles. This is exactly why nature is so species rich (p.116-117).

At times, he expresses his position with biting irony, both in terms of unscientific positions regarding cause and effect and how this deviates attention from what has true responsibility for the loss of biodiversity – industrial agriculture.

> It was a stroke of luck for those who caused these various problems that climate change was discovered and exposed as the alleged cause of all change. Since this discovery there are no longer any guilty parties as everything can be attributed to the climate […]. The evasion of real soluble problems by labelling them as climate change reduces our sense of obligation to demonstrate the true causes and find effective measures here and now (p.205).

In many respects, this is a question of agricultural politics. If "today farmlands dominate 38% of the global land surface, almost 30% of global net primary production is appropriated for human use […] and the demand for agricultural commodities is projected to increase inexorably (Zabel et al., 2019), then much depends on the determination and the willingness of politicians and of the international agribusiness industrialists to bring about radical change. At this level, Reichholf is sceptical, since:

> […] a great many people have been commenting on industrial agriculture for several decades, but they are still too few to achieve the political pressure that would be required to bring about a change for the better (p.4).
>
> […] Making industrialized agriculture environmentally compatible in the foreseeable future is an objective that must be pursued, but not an option that is likely to be successful in the short term. It will continue to hold its course like an overloaded super

> tanker […] (p.228).

At the same time, he believes that community awareness and action must be the essential drivers of change:

> I am convinced that the path must be from the bottom upwards from the foundations to the top of the organizations, authorities and political committees. The objective must be for the critical public to become more interested in the species. We should concentrate on the beauty, individuality and unique characteristics of butterflies, moths, beetles, wild bees and other insects as well as our wildflowers (p.230).

In this respect, what is essential is to focus on the role of biodiversity in terms of its importance for cultural, in particular spiritual, ecosystem services that promote wellbeing and the desire to create "a biotope for each community" in which that very diversity can thrive.

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