



Research

# The influence of landscape change on multiple dimensions of human–nature connectedness

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**ABSTRACT.** Human–nature connectedness is hailed as a potential remedy for the current sustainability crisis, yet it is also deeply affected by it. Here, we perform a comprehensive assessment of human–nature connectedness that includes material, experiential, cognitive, emotional, and philosophical dimensions. We show that these dimensions of human–nature connectedness are strongly interlinked, especially via emotional and experiential connectedness. Our findings showcase a cross-country comparison of four focal landscapes in Transylvania, Romania and Lower Saxony, Germany, which represent gradients from minor and gradual to relatively major and rapid landscape change. Based on content analysis of 73 in-depth interviews, we show that landscape change was seen by the interviewees to have a strong, and often negative, influence on multiple dimensions of human–nature connectedness. Focusing only on isolated dimensions of human–nature connectedness could inadvertently exacerbate the sustainability crisis because unawareness about relationships between dimensions of connectedness may lead to false predictions regarding policy implications.

**Key Words:** *agricultural intensification; landscape sustainability science; smallholder farming; social-ecological systems*

## INTRODUCTION

Humanity has already passed planetary boundaries (Rockström et al. 2009), and status quo trajectories of human behavior continue to exacerbate the threats to our planet (Steffen et al. 2015, IPCC 2018). For terrestrial systems, unsustainable trajectories can be readily observed by studying landscape change expressed through the sociocultural consequences of land-use and land-cover changes (Bürgi et al. 2004). The structural simplification of landscapes through abandonment or intensification has long been recognized as a key threat to terrestrial ecosystems, negatively influencing wild and farmland biodiversity (Green et al. 2005, Tschamtko et al. 2005), the stability of farm incomes (Di Falco and Perrings 2003, Abson et al. 2013), and the diversity of crop varieties (FAO 2011). Moreover, recent studies highlight negative effects of landscape simplification on rural communities (Riechers et al. 2020). Landscape change, in turn, is closely interlinked with other unsustainable social-ecological trends such as anthropogenic climate change (IPCC 2014) and rising demand for energy-rich foods (Khoury et al. 2014).

Although the ecological consequences caused by landscape change are well documented (e.g., Foley et al. 2011), landscape change can also have detrimental effects on human–nature connectedness (Chan et al. 2016). These effects could lead to a downward spiral of ever increasing disconnection of people and societies from nature, which may further exacerbate the global environmental crisis by enhancing unsustainable behavior patterns (Pyle 2003, Nisbet et al. 2009, Kahn et al. 2010). In contrast, the beneficial effects of connections between humans and nature include positive outcomes for health (Maller et al. 2006, Shanahan et al. 2016), the cognitive development of children (Taniguchi et al. 2005), and overall happiness and well-being (Capaldi et al. 2014). Based on these outcomes, scholars state a need for strengthening human connections with nature (Folke et al. 2011, Zylstra et al. 2014). However, many calls for

such “reconnection” lack concrete insights about what human–nature connection means and how it might be fostered.

Literature on this topic is fragmented among disciplines and encompasses a wide range of concepts and means to operationalize notions of human–nature interactions (Ives et al. 2017). Within this field, prominent literature includes notions of a “connectedness to nature scale” (Mayer and Frantz 2004), “nature relatedness” (Nisbet et al. 2009), and “connectivity with nature” (Dutcher et al. 2007, Restall and Conrad 2015; for a more comprehensive overview, see Ives et al. 2017). What is missing to date is work that recognizes multiple dimensions of human–nature connectedness and systematically links these dimensions to important features of social-ecological change such as landscape change.

To address this gap, we use a multidimensional conceptualization of human–nature connectedness and apply it to four contrasting landscapes undergoing change. Drawing on Ives et al. (2017, 2018), we recognize five dimensions. (1) The material dimension includes food, fuel, or other goods; research on this dimension has focused largely on biophysical flows (Wackernagel et al. 1999, Haberl et al. 2004, Dorninger et al. 2017), including teleconnections (Yu et al. 2013). (2) The experiential dimension relates to activities in nature and is based on decades of work, e.g., works by Miller (2005), Soga and Gaston (2016), and Keniger et al. (2013). (3) The emotional dimension spans aspects such as spirituality, aesthetics, and place attachment (Kals et al. 1999, Stedman 2003, Brown and Raymond 2007). (4) The cognitive dimension captures awareness and knowledge about natural systems (e.g., Bradley et al. 1999, Schultz 2001, 2002). (5) The philosophical dimension relates to conceptions of humanity’s place in nature (e.g., van den Born 2008, Raymond et al. 2013). These five dimensions cover a multitude of disciplines and conceptual framings that together span decades of research in their respective fields. Here, we do not aim to provide a literature review or an in-depth analysis of these categories (for

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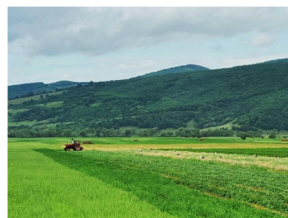
that, refer to Ives et al. 2017, 2018); rather, we aim to give a balanced and, therefore, simplified overarching empirical assessment of these dimensions. To reach this aim, we studied each of these five dimensions in four contrasting cultural landscapes in two countries (Romania and Germany), which represent a gradient from minor and gradual to relatively major and rapid landscape change. Drawing on data from all four landscapes, we sought to identify local perceptions of human–nature connectedness, to characterize relationships among different dimensions of human–nature connectedness, and to elicit the interplay between landscape change and human–nature connectedness.

## METHODS

### Focal landscapes

We focused on four landscapes: two in Transylvania, Romania, namely Erdővidék (Covasna county) and Aranyosszék (Cluj and Alba counties; Fig. 1); and two in Lower Saxony, Germany, namely Bispingen (district Heidekreis) and Dötlingen (district Oldenburg). The focal areas capture a gradient of minor and gradual (Erdővidék, Romania and Bispingen, Germany) and more rapid and major (Aranyosszék, Romania and Dötlingen, Germany) landscape change in their respective countries. Further, in all four focal areas, prior research was undertaken that facilitated the contextualization of our empirical study and the data collection process. Although both countries, and all four focal landscapes, have differing political, economic, and social place-specific differences, we compiled results from the four focal areas to show overall trends and differences in human–nature connectedness between the countries (for details, see Balázs et al. 2019, Riechers et al. 2019). Our qualitative empirical work with large sample sizes allowed us to combine detailed place-based knowledge with a cross-country comparison.

**Fig. 1.** Example landscape photographs and descriptions of the four focal landscapes.



(a) Erdővidék, Covasna County  
Smallholder dominated cultural landscape;  
minor and gradual landscape change



(b) Aranyosszék, Cluj County  
Adjacent to urban & industrial areas;  
moderate rate of landscape change



(c) Bispingen, district Heidekreis  
Agriculture and infrastructure development  
limited; moderate rate of landscape change



(d) Dötlingen, district Oldenburg  
Intensive agriculture; rapid & major  
landscape change

Erdővidék is a smallholder-dominated cultural landscape, with large patches of forest and grassland and abundant wildlife. The landscape has changed only very slowly over the centuries, including during Romania's transition periods from a presocialist to socialist and now democratic society. Driven by socioeconomic and institutional change, increases in both land abandonment and intensification are considered possible in the foreseeable future (Hartel et al. 2016). Although changes have been slow in Erdővidék to date, ongoing governance challenges and socioeconomic changes could pose a risk to the landscape and its social structures in the long run (e.g., Horcea-Milcu et al. 2018). Local industry declined in the period of socialism, and Erdővidék struggles with poor socioeconomic viability and emigration of its youth. However, infrastructure development has increased in the last decade because of access to European Union (EU) funds.

The landscape in Aranyosszék is flat, crop-dominated, and subject to strong urban influences because of its proximity to the cities of Cluj-Napoca and Turda. Following Romania's accession to the EU in 2007, land-use intensity has increased, and smallholder vegetable cultivation has been increasingly replaced by industrial croplands. Family farming is declining because of an ageing population and strong competition with supermarkets. However, industrial development and small businesses have increased due to improvements in infrastructure.

The landscape in Bispingen (district Heidekreis) lies in eastern Lower Saxony and partly inside the Lueneburger heath nature park (protected under Germany's federal nature conservation act), which was established in 1907. Environmental protection laws have slowed landscape change because of restrictions to agricultural intensification and large-scale infrastructure projects. Especially for the agricultural sector, these limitations have posed economic challenges, making small-scale farming increasingly unviable and causing conflicts between farmers and nature park authorities. Tourism is an important income source for people within the landscape.

The landscape in Dötlingen (district Oldenburg), located in mid-west Lower Saxony, has changed substantially over the last 20 years because of agricultural intensification, including the expansion of maize cultivation, mass animal husbandry, and biogas production. Associated drivers have included EU agricultural subsidies, as well as national subsidies for renewable energy production. In the district of Oldenburg, the proportion of agricultural land under maize production increased from 18% in 1995 to 33% in 2016 (Landesamt für Statistik Niedersachsen 2018a,b) while decreases have been observed in water and air quality (Velthof et al. 2014).

### Data collection

To understand different dimensions of human–nature connectedness, the relation between these dimensions, and how they are influenced by landscape change, we used problem-centred interviews (Flick 2006). Interviews were held in Romanian, Hungarian, and German using a semistructured interview guideline, which was partly adjusted to the interviewees' profession (Atteslander 2006; see Appendix 1 for full interview guidelines). The guideline included sections on interviewees' material, experiential, cognitive, emotional, and philosophical connectedness, which were assessed through questions on the use of local natural products, habits and frequency of nature visits,

knowledge of nature and the landscape, perception of beauty, favorite places, and the feeling of and attachment to their homes. Regarding landscape change, we asked specifically for perceived changes in the recent decades, how these changes influenced interviewees' lives, and how interviewees perceived the trajectory of changes for the decades to come. The interview guidelines were adjusted to fit the local context in the respective countries (Appendix 1). Because of different historical events in Romania and Germany, the discussion around landscape change and its drivers led to the capture of different time spans. Whereas most interviewees in Romania felt a need to explain the drastic political, social, and economic changes in the country starting in the socialist area from 1947 onward, German interviewees typically focused on changes in the last 20 to 40 years.

For the interviews, we addressed informed laypersons and experts who we expected to be connected to a given landscape based on prior information about actors and actor groups or organizations in the focal areas. Those areas were mainly related to agriculture, forestry, policy-making regarding environmental issues, priests, and long-term inhabitants, usually with a high level of civil engagement. Based on these initial interviews, we used snowball sampling to reach other potential interviewees (Flick 2006). The interviewee age ranged from participants in their 30s to 90s. Although we aimed for gender balance, more men than women were interviewed because of the social structure in agriculture and politics. This sampling approach resulted in a total of 73 interviews with an average length of 71 min (Erdővidék:  $N = 20$ , Aranyosszék:  $N = 19$ , Bispingen:  $N = 17$ , Dötlingen:  $N = 17$ ).

#### Data analysis

Interviews were transcribed verbatim and analyzed using MaxQDR Plus 12 (VERBI Software, Berlin, Germany) and NVivo 10 (QSR International, Doncaster, Australia). Data were analyzed using summarizing qualitative content analysis (Mayring 2008). Based on the five dimensions of human–nature connectedness as described by Ives et al. (2017, 2018), we created a deductive coding tree that was iteratively adjusted inductively, driven by the narratives and topics raised by the interviewees. The deductive approach helped to focus existing theories and allowed comparability between the focal areas; it focused primarily on the five predefined categories of human–nature connectedness and known aspects of landscape change. The inductive approach ensured that all relevant specificities and topics not covered in the coding tree were able to be captured and unexpected statements made by interviewees were sufficiently incorporated. Codes were successively grouped together to form categories of an increasing level of abstraction (Mayring 2008). Table 1 shows the resulting final categories and their subdivision (subcategories) within the five dimensions of human–nature connectedness. For example, one type of emotional connection is captured by the category “spiritual and religious feelings”. This category, in turn, is divided into two subcategories: “Christian-based” and “mystical” connections.

To assess relationships between different dimensions of human–nature connectedness, we extracted stated relationships. For example, we may have coded an interviewee's statement into the category of emotional connectedness such as sense of place, which was related by the interviewee to experiential connectedness such as social activities in nature (e.g., “I feel like home here so I spend

a lot of time outside”). Another interviewee might have spoken of material connections such as provision of food, and linked this connection to experiential activities such as a high frequency of nature visits (e.g., “I collect mushrooms in the forest every week”). Such relations were captured and used to illustrate relations between the different dimensions of human–nature connectedness. The direction of the relationships and their strength were not coded because they typically could not be identified clearly from the qualitative statements made by the interviewees. The same procedure was used to combine information on landscape change and categories of human–nature connectedness. To guarantee anonymity, we do not give the age, gender, or profession of the interviewees here.

#### RESULTS

We first identify perceptions of human–nature connectedness (Table 1) and highlight their interrelations (Fig. 2). We then illustrate the interplay between landscape change and human–nature connections.

#### Dimensions of human–nature connectedness and their relationships

Interviewees stated that their material connections to nature stemmed from the use of fuel (biogas, wood), food (collected, self-grown), building material, collection of artisan goods, owning land, agriculture and forestry, and the use of regional products. In Transylvania, strong material connections stemmed from traditional smallholder farms because using materials from nature for subsistence (firewood, food, etc.) was very common. Interviewees related material connectedness to experiential and emotional connectedness (Fig. 2): experiential connectedness through extraction of goods and time spent on working the land; emotional connectedness through a sense of responsibility and sense of belonging to particular places (e.g., where inhabitants produced food, hay, or collected water).

Experiential connections were identified as frequent nature visits, especially close to home. They included recreation and social activities in nature. The stimulation of the senses and motoric development, and especially interviewees' own childhood experiences, were seen as constituents of experiential nature connectedness. Experiential connectedness, in addition to its aforementioned relation to material connectedness, was linked by the interviewees to emotional connectedness (Fig. 2). In particular, social activities in natural settings (experiential) were related to inhabitants perceiving a sense of place (emotional). When discussing their love for nature (emotional), interviewees often referred back to childhood experiences in nature (experiential).

Cognitive connections were defined as learning by doing and observing in nature, especially through an active awareness of daily encounters with nature. Self-identification with the landscape, knowledge about the environment and farming practices, and especially the knowledge and visibility of specific historical events and cultural sites were perceived as key components of cognitive connectedness to nature. In addition, raising awareness for nature through education (formal and informal), active communication about environmental topics in peer-groups, and general environmental education were deemed as another pillar for cognitive connectedness. Cognitive

**Table 1.** Results of the cross-country, summarizing content analysis, grouped into five dimensions of human–nature connectedness. Categories and subcategories are themes that emerged from the interview data.

Dimension	Category	Subcategory
Material	Fuel (biogas, gas, wood)	Subsistence, industrial
	Food (collected, self-grown)	
	Agriculture and forestry	Subsistence, small scale, large scale, collective
	Decorative or artisan goods	
	Owning land	Private, community, state, collective or cooperative
Experiential	Mining or building materials	
	Regional products	Symbolic, not appreciated enough, too expensive, trust
	Frequency of visiting nature	Work, leisure
	Passive recreation	Solitude, silence, contemplation
	Active recreation	Sports, hiking
	Social activities in nature	Family and friends, festivals, traditions
	Encountering nature	Using senses, motoric development
Cognitive	Visits close to home or on own land	
	Own childhood	
	Learning by doing or observing	
	Identification with region or landscape	
	Active communication on nature topics	
Emotional	Environmental education	
	Knowledge of local history, culture, and nature	Informal, formal
	Awareness	Increased awareness in daily encounters with nature
	Sense of beauty	Natural nature, wide view, landscape diversity
	Strong regional identity or sense of place	Social structure, attachment to cultural landscape and home land
	Agency, responsibility, ownership	
	Spiritual and religious feelings	Christian-based, mystical
	Love of nature	Especially trees, animals, being a farmer from the heart
	Arts or inspiration	
	Curiosity or looking for special features	Discovering something new, extraordinary, special experiences
Philosophical	Sadness	Loss of biodiversity, knowledge, awareness, traditional farming
	Fear	Of unstoppable intensification, loss of regional identity, brown bear ( <i>Ursus arctos</i> )
	Distaste of industrialized livestock production	
	Sustainability, fit for the future	Economic stability, all is connected, more important than aesthetics
	Consumerism negative	Constant need to grow
	Preservation of traditions	
	Importance for environmental protection	Exchanged for economic gain, has to be done right
	Agriculture comes with high responsibility	For own family, heritage, consumers
	What is nature and what is it for	Ideological fronts hardened, role of humans in nature

connectedness was related to philosophical, experiential, and emotional connectedness (Fig. 2). For example, through the discussion of sustainability (philosophical), interviewees linked their knowledge (cognitive) with a normative perspective of human–nature relationships, and in that context, they often expressed sadness regarding the current landscape change (emotional). Cognitive connectedness was further related to emotional connectedness because the knowledge and awareness of a given landscape’s specific history and culture fed into a strong sense of place.

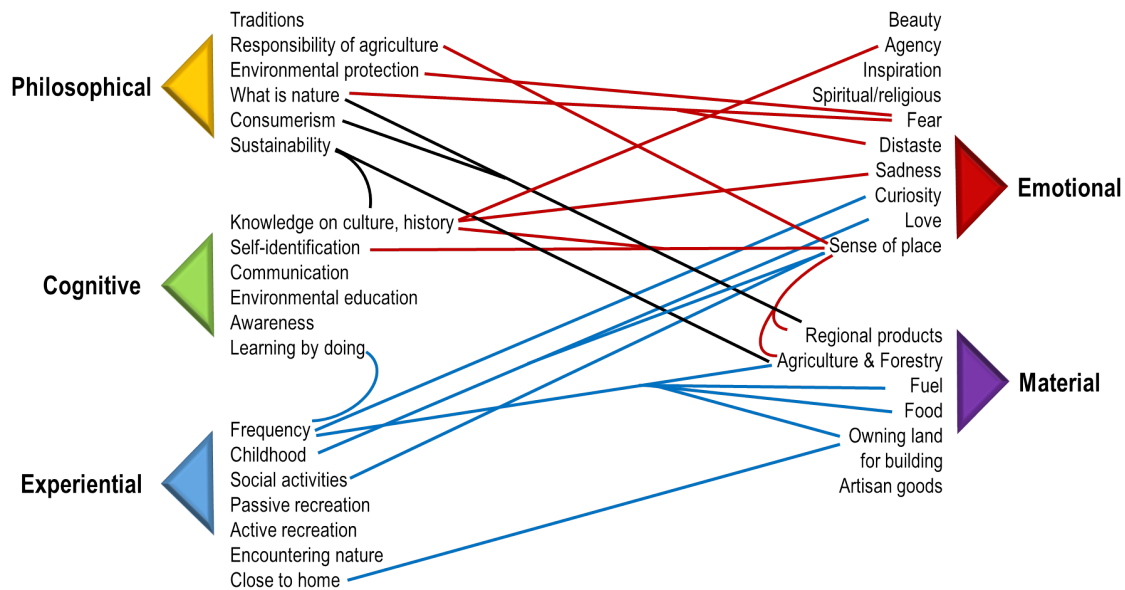
Emotional connections were partly positive, stemming from love for nature, spiritual and religious connections to it, aesthetics, and, moreover, feeling inspired and creative by being in nature. Feelings that fostered emotional connectedness were further related to agency, responsibility and ownership, a strong sense of place, and curiosity to look for new and special encounters or experiences in nature. Emotional connections also came from negative emotions such as fear and sadness regarding the state of the landscape and a dislike of industrialized livestock production. Emotional connectedness, in addition to the aforementioned relations, was linked by the interviewees with philosophical

connectedness (Fig. 2). As an example, the normative notion of the need to preserve the landscape (philosophical) and the discussion of what nature is and who owns it (philosophical) was related to a fear regarding current landscape changes (emotional).

Philosophical connections were identified from discussions around differing notions of sustainability or the need to be fit for the future (from the German: *zukunftsfähig*). A critical view of consumerism and the constant need for growth (e.g., more products or more farmland) increased philosophical nature connectedness. Moreover, the perceived importance of environmental protection, preservation of traditions, the highlighted responsibilities of agriculture and forestry, and the discussion of the definition of nature (and for whom it exists) were pillars for philosophical connections. For philosophical connectedness, in addition to its aforementioned relations, interviewees also saw a link with material connectedness (Fig. 2). The discussion of the use of regionally produced goods (material) was linked to negative opinions of consumerism in general (philosophical). For example, some interviewees stated a lack of trust in commercialized production and critically questioned



**Fig. 2.** Graphical representation of relationships among the five dimension of human–nature connectedness (material, experiential, cognitive, emotional, and philosophical; from Ives et al. 2018) based on the content analysis of four focal areas (see details in Table 1). Lines indicate relationships between the categories of human–nature connectedness as highlighted by the interviewees. For ease of interpretation, lines from experiential and emotional connections are shown in blue and red, respectively.



modern consumption patterns such as high rates of processed meat consumption.

#### Interplay between landscape change and human–nature connectedness

In all four landscapes, material connectedness was perceived to be declining due to the decoupling of consumers from local production processes and the increased consumption of nonlocal goods. In both landscapes in Transylvania, landscape change was related to changes in state governance, which resulted in shifts in land ownership. Nationalization and collectivization of private property by the state during communism led to a loss of material connectedness because the goods produced were often allocated to other localities. However, when connections to inhabitants' own land were reestablished following the collapse of communism, socioeconomic conditions changed as well, preventing a durable reconnection of material connectedness:

*[...] the land was given back after the 90s. Everyone turned back to the practices used before the collectives [were established]. Everyone did their share, as they could, with horses, oxen, and cows. They were struggling with it for about 10 years. [...] now they want to get rid of it. Now we don't know how to convince farmers to rent our land. (Aranyosszék, teacher).*

In Lower Saxony, smaller agricultural farms and local products declined because of global and national political and economic drivers. Many goods that still provide a material connection to nature have changed from being livelihood necessities to becoming symbols of regional identity (e.g., specific regional varieties of potatoes or honey). Because of the increase in biogas

plants and wind parks, some villages, especially in Dötlingen, have become energy self-sufficient. Although this self-sufficiency provides a new type of material connection to nature, it has come at the cost of a large proportion of land being used for maize production, which is viable largely in combination with mass animal husbandry.

Whereas experiential connectedness in Lower Saxony was perceived as stable, in Transylvania, it transformed with a change in rural lifestyles. Recreation and leisure increased while farming experiences decreased. Moreover, high rates of emigration weakened the experiential connections with “home”:

*In Erdővidék, more than 60% of young people leave their home landscape because of a lack of jobs. Some turn back after making some money, some commute between home and abroad, [some] never look back. The last two are the worst because the majority remains [abroad]. Those who come back build their homeland at the beginning, but then are trapped again when their finances run out. (Erdővidék, teacher).*

Further, in Transylvania, cognitive connectedness to nature was shaped by shifts in knowledge systems and political ideologies (presocialist, socialist, democratic). The shifts affected individuals and the community's collective cognition regarding the management of the landscape and its resources. Most notably, inherited and experience-based knowledge became increasingly supplanted by formal and disciplinary knowledge. Shifts in political ideologies (e.g., socialism, communism, capitalism, environmentalism) appear to influence cognitive connectedness. Interviewees stated that the traditional knowledge of the

community might get lost because of a lack of interest in it by the younger generation.

*The knowledge about nature, of what nature is, I think, they don't get that now, [...] the relation [to nature] which is inherited. Obviously, inherited knowledge includes the names of trees and things. [...] In other words, there is an emotional bond, whereas in learned knowledge, we just know a lot of things. (Aranyosszék, priest).*

Cognitive connections in the two Lower Saxony focal areas were often generated through stimulating and exciting experiences such as visiting new places, rare sightings of particular plants or animals, or special atmospheres (Table 1):

*[The view] has something mystical. The wide plains and the juniper [Juniperus communis], and, when the fog lies upon it and the sun comes through. That... that is wonderful. (Bispingen, Tourism).*

Such cognitive stimulating experiences were often connected to a structurally diverse landscape, which, in turn, was connected to emotional connectedness.

In fact, in all four landscapes, emotional connectedness was linked by the interviewees to a structurally diverse landscape. The most highlighted themes related to emotional connectedness were special landscape features, seasons, animals, and a wide view of the landscape (Table 1). In Transylvania, emotional connections came from stories about social relationships that existed in the past, for example, working the land gathered the community in nature. Interviewees talked nostalgically about lost traditions (e.g., cleaning pastures in spring, community work for hay making) and social relationships that had become weakened because of changing lifestyles. In Lower Saxony, and Dötlingen specifically, interviewees expressed sadness, especially with regard to the topic of environmental protection and the current landscape trajectory. This sadness was linked to a feeling of loss of agency and ownership of nature, while still feeling a sense of responsibility for it, as exemplified by a story in which a tree was cut illegally due to agricultural expansion:

*My favourite tree has been cut down. I thought: This cannot be true. [...]and even though I tried to find the responsible persons] the big beautiful tree, which I loved, was of course gone. (Dötlingen, employee in an environmental protection authority).*

Most interviewees showed negative feelings regarding landscape changes. In Dötlingen, where landscape change had been most rapid, anger and sadness for the perceived destruction of the landscape, as well as for the resulting conflicts affecting the communities' social relationships, were particularly pronounced. However, in all focal areas, sense of place, love for nature, and spiritual expressions remain important.

Themes related to philosophical connectedness in Transylvania included meanings of nature, heritage values, and the role and place of human beings in the natural world, revealing sustainability issues (although this term was rarely used). The most common associations with sustainability were respect for nature and family heritage. The family's land and traditions regarding its management occupied a central role, especially in Erdővidék. Philosophical connectedness in the Lower Saxony focal areas was

defined by the influence of landscape change. Differing understandings of who owns land and the landscape, as well as contrasting definitions of what constitutes nature, showed differing paradigms among the local people. The current trajectory of agriculture, perceived to be driven by a paradigm of growth, was often seen to be contradictory to environmental protection:

*They always say - you have to do more, you have to get bigger [agriculture but also in general...] or is this just a dream of some (economic) growth? I don't know. Is there an end somewhere? (Dötlingen, young farmer).*

## DISCUSSION

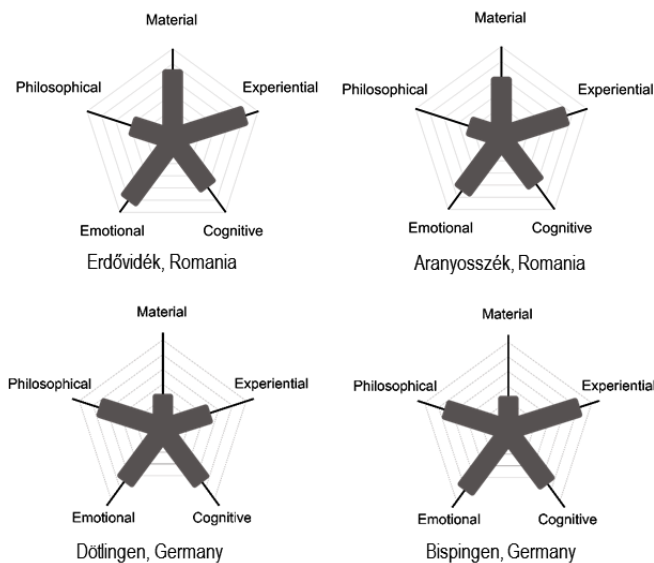
Drawing on four different landscapes in two countries, we elicited the following four ideas. First, the experiential and emotional dimensions of human–nature connectedness seemed to play a key role for our interviewees and had links to many other dimensions. This interpretation might show that those two dimensions could foster, through ripple effects, a multitude of connections when strengthened. Second, in general, many human–nature connections were linked to each other, and reinforcing and balancing relationships seem likely to influence ambitions to strengthen overall human–nature connectedness. Third, landscape change was stated to be eroding and changing human–nature connectedness in the focal areas. Lastly, there are a multitude of human–nature connections, and hence, research should not be solely compartmentalized into disciplines. Although in-depth specific studies are of utmost importance, overarching synthesizing studies should not be left aside. Knowledge about the heterogeneous and context-specific character of human–nature connectedness is therefore crucial.

Emotional and experiential connectedness had the most connections to the other dimensions and seem to act as key connectors (Fig. 2). In particular, emotional connections such as love (Wilson 1984, Schultz 2001) and place attachment (Stedman et al. 2004) had multiple connections to other dimensions. Likewise, the experiential connection of frequent visits to nature (Soga and Gaston 2016) was linked to other dimensions of connectedness (Fig. 2). Because disconnection from nature is likely to exacerbate the global sustainability crisis, it is important to find concrete ways to foster and strengthen human–nature connectedness. However, most calls for reconnection have remained vague and abstract and lack concrete insights about a comprehensive notion of what this connection means and how to foster it. Our findings point to a multidimensional notion of human–nature connectedness with many interlinkages among those dimensions. Our results showed that the experiential and emotional dimensions of human–nature connectedness could be particularly important entry points when trying to enhance and strengthen human–nature connectedness because these two dimensions were linked to many other connections. A possible focus on emotional connections could be done via art (Riechers et al. 2019) or through a focus on personal sustainability (Ives et al. 2020).

Apart from the key role of experiential and emotional connectedness (Fig. 3), we found a high degree of interconnectedness among these dimensions. As an example, in our results, a strong sense of place (an emotional connection) was related to philosophical (e.g., preservation of traditions), material

(e.g., regional products), cognitive (e.g., knowledge of regional history and culture), and experiential (e.g., social activities) dimensions of connectedness to nature. Although we do not know the causal relationships among these links, these findings suggest that there will likely be ripple effects when there is a change in any dimension of human–nature connectedness, positive or otherwise. Our findings thus emphasize the heterogeneous character of human–nature connectedness and the attention to dynamic interlinkages needed to study this phenomenon comprehensively. Reinforcing the relationships between different types of connections, for example, could foster useful ripple effects (or even reinforcing feedbacks) across multiple dimensions of connectedness.

**Fig. 3.** Schematic depiction of the current strength of material, experiential, cognitive, emotional, and philosophical connectedness in the four focal areas of Erdővidék, Aranyosszék, Dötlingen, and Bispingen. Bars are a subjective interpretation based on the collective interview statements from each focal area and depicted here schematically to allow comparison among the focal areas.



Across the four focal areas, we found the trend that rapid landscape change appeared to decrease the overall levels of connectedness. This trend could continue due to continued simplification of landscapes, and also as values might change slower than the landscapes, creating a situation in which values are linked more to memories of landscapes than to the currently existing ones (Horcea-Milcu et al. 2018). Even though we found vastly differing political contexts in which the landscapes changed over the last 20 years (Balázsi et al. 2019, Riechers et al. 2019), the trajectory of changing human–nature connectedness was similar. The five dimensions of human–nature connectedness appeared to be relevant for all four focal areas, and discussions around landscape change touched upon comparable issues in both Romania and Germany. We thus consider it plausible that similarities can also be observed in other rural landscapes elsewhere in the world. Indeed, a recent comparison considering

additional study systems suggests there were generalizable links between landscape change and the erosion of cultural and individual identity, human–nature connectedness, and sense of agency (Riechers et al. 2020). However, despite the potential value for human–nature connectedness, structural landscape diversity is deteriorating in many parts of the world (Foley et al. 2005), as is small scale agriculture (e.g., Mikulcak et al. 2013). In areas of rapid landscape change, sense of place and biocultural values are at risk (Hartel et al. 2018). Finally, trajectories favoring economic growth over social equity not only lead to landscape simplification but can also lead to an increase in conflicts (Scoones et al. 2019). Quantitative analyses of such interlinkages could show insights into complex patterns between landscape change and human–nature connections in their various forms (Jansson and Polasky 2010, Dobbs et al. 2014) and could potentially help to inform decision makers about large-scale management processes.

Our empirical study is the first to apply the interdisciplinary framework proposing five dimensions of human–nature connectedness by Ives et al. (2017, 2018). The conceptual framework was broad enough to cover all important aspects of human–nature connectedness that we identified through the deductive and inductive coding process. It allowed us to capture a wide variety of relationships between different types of connections and to include a focus on how these relationships were perceived to alter through landscape change. Assessing material, experiential, cognitive, emotional, and philosophical perceptions of connectedness seemed to capture heterogeneity successfully, both in concepts and people’s experienced realities, and opens the possibility for integrating different disciplinary perspectives on human–nature connectedness, including biophysical flows between societies and nature (Wackernagel et al. 1999, Haberl et al. 2007, Dorninger et al. 2017), behavioural approaches (Capaldi et al. 2014, Soga and Gaston 2016), and approaches that focus more strongly on philosophical aspects (Dutcher et al. 2007, Nisbet et al. 2009).

## CONCLUSION

The empirical work from four different landscapes in Romania and Germany highlight four major results. We found multiple links among material, experiential, cognitive, emotional, and philosophical dimensions of human–nature connectedness in the lived experiences of our interviewees. Landscape change, in all four landscapes, showed a change and a decrease in human–nature connectedness, and hence, we hypothesize that a similar trend might be observable in other landscapes. Improved human–nature connectedness has been hailed as a possible remedy to the global sustainability crisis. However, the relationship between human–nature connectedness appears to be mutually reinforcing such that there is a two-way link; that is, human–nature connectedness can also be eroded quickly through unsustainable landscape trajectories. To combat a spiral of disconnectedness and landscape change, we suggest focusing on the importance of strong emotional and experiential connectedness as pivotal points in overarching human–nature connectedness and reinforcing and balancing relationships among the dimensions. We acknowledge that societal changes (economic, cultural, etc.) are likely to influence human–nature connectedness. However, such societal changes drive landscape change; therefore, we believe that landscape change acts as a useful phenomenon through which such complex societal changes are played out and can be explored.

Whether landscape change is a proximate or ultimate driver of changing human–nature connectedness is a question deserving further research.

We also suggest that more firmly establishing the causal links between human–nature connectedness and sustainability could be an important research focus. Human–nature connectedness is not something that can be readily manipulated across entire social-ecological systems or landscapes, and sustainability is also a highly complex and multidimensional concept. These factors pose challenges for disentangling the relationship between changes in human–nature connectedness and sustainability outcomes. Finally, applying the conceptual framework used here to other contrasting landscapes would be useful to assess whether there are indeed broadly applicable interventions that could foster human–nature connectedness and thereby benefit sustainability.

Responses to this article can be read online at:  
<http://www.ecologyandsociety.org/issues/responses.php/11651>

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#### Data Availability Statement:

The data are not publicly available due to restrictions; they contain information that could compromise the privacy of our interviewees. For questions please contact M. R.

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1. Do you do trips in nature after work? Which places do you prefer to visit?
  - a When do you visit these places?
  - b How often do you visit these places?
  - c Why do you visit these places, what do you appreciate about them?
  - d What do you do there usually?
2. Considering these places we have just talked about, what is important for you when it comes to nature?
3. How important is nature for you to relax?
4. Are there any places in the area that you find particularly pleasant or beautiful?
  - a Where are these?
  - b Can you describe what it is, that makes it beautiful or pleasant?
5. Are there places that you find unpleasant?
  - a Where are these?
  - b Can you describe what it is, that makes it unpleasant?
6. What is your most memorable experience of nature?
  - a Can you describe it?
  - b What made that experience special?
7. For some, their feeling of home and landscape are connected. How is that for you?
8. Did you always live in this area?
  - a Could you imagine moving away from here?
  - b If you would move to a city, what would you miss?
  - c Could you find the landscape that would mean home for you again?
9. Were there any visible changes in the village/town and the surrounding landscape in recent decades (e.g. during socialism, after socialism, after EU accession)?
  - a What did change and when?
  - b How you perceived those changes?
  - c What did cause those changes in the landscape?
  - d Can you point out places on the map that changed the most?
  - e Can you tell me about changes in agriculture?
  - f Can you tell me about changes in forestry?
  - g How did landownership change?
  - h How did public administration, bureaucracy change?
  - i How did the social and economic conditions change?
  - j Show me those areas where cultural events took place. Did these areas change over the last decades?
  - k How could you describe the connection/respect of old generations toward nature (e.g. grand-grandparents, grandparents, parents, interviewee's generation, and children)?
10. What do you think, in which directions will your village and the landscape change in the coming decades?
  - a What kind of impact might the changes have you on?

- b What changes would you like to see? Why?
11. I have here some pictures. Could you order these pictures by what you most want to see in the future in your area?
  12. In some places, solar panels, micro hydropower plants or wind energy turbines have been built to capture energy from nature. What is your opinion about those?
    - a Do you know such here in the area?
    - b Did these influence the landscape?
  13. Currently, local products tend to be highly marketed in Europe, yet sometimes these are more expensive. What do you think of this in your village?
    - a Do you pay attention if your food comes from this region?
    - b Do you think the region could be a self-sustainable?
    - c Which kind of products could the community assure to the market?
  14. What do you think about nature conservation?
    - a Do you know about nature conservation initiatives here in the area? Could you describe them?
    - b In many places there are problems with nature conservation. Do those exist here in the area? What are those problems?
    - c Are you aware of plants and animals that only exist here in the area? Is this of importance for you?
  15. Where do you get information on subjects related to nature? (e.g. nature conservation, places to visit, guidelines and policies)?
  16. In how far do you share and discuss your impressions, experiences, knowledge related to nature within your family and friends?