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ORIGINAL ARTICLE

The role of emotions in human–nature connectedness within Mediterranean landscapes in Spain

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Abstract

Landscapes can lead to different emotions towards nature that in turn shape people's environmental behavior and decision processes. This study explores the role of emotions that Mediterranean landscapes foster in people and to what extent these emotions are associated with human–nature connectedness (HNC). We conducted 176 face-to-face surveys to explore HNC and the diversity of emotions associated with a suite of landscapes in Southeast Spain. Results revealed that Marine and Coastal Protected Areas received the highest number of positive emotions, whereas Greenhouses and Non-Protected Littoral were linked to negative emotions. We propose a framework for classifying emotional landscapes according to four groups: emotionally positive, negative, polarized or neutral. Results showed that emotions might play a key role in shaping HNC in Spanish Mediterranean landscapes and may be used as a common ground for understanding roots underpinning human decisions and actions that lead to sustainable management or landscape degradation.

Keywords Emotional landscape · Landscape management · Leverage points · Social preferences · Conservation · Sustainability

Introduction

People's disconnection from nature has been proposed as one of the roots underpinning landscape degradation (Soga and Gaston 2016). People and nature have always coexisted, leading to distinct types of human–nature relationships that change and coevolve (Liu et al. 2007). This people and nature co-evolution is particularly relevant to understand cultural landscapes such as those traditional farming landscapes of Europe and the Mediterranean Basin (Bürgi et al. 2017; Plieninger et al. 2015). According to the biophilia theory, there is a natural and innate bond between humans and nature that leads to an empathy feeling and interest for living beings (Wilson 1984). Yet our ability to connect with

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nature depends on the ability to experience nature (Soga and Gaston 2016; Zylstra et al. 2014). People who have little contact with nature or live and work in nature-deprived venues would be dispossessed of the emotional benefits that contact with nature entails, experience disaffection towards nature and could even experience a decline in their environmental attitudes and behaviors (Gaston and Soga 2020; Nadkarni et al. 2017; Soga and Gaston 2016, 2018). The loss of human–nature interactions, a phenomenon known as 'extinction of experience' (Miller 2005), has been amplified by processes of rapid economic growth, urbanization and industrialization, coupled with increased areas of nature-deprived venues and level of indoor sedentary behaviors characteristic of urban lifestyles (Colléony et al. 2020; Soga and Gaston 2020). The extinction of experience is particularly relevant in the context of cultural landscapes, where rapid urbanization and agricultural intensification are negatively influencing the way people connect and interact with nature, possibly leading to a spiral of disconnectedness from it (Riechers et al. 2020, 2021, 2022).

The conceptual framework of human–nature connectedness (HNC) (Ives et al. 2018) can serve as a key tool for reframing how people interact with nature and how they can reconnect with it. Ives et al. (2018) and Riechers et al. (2021) distinguished five HNC dimensions: (1) material, comprehending the extraction and consumption of natural resources; (2) experiential, associated with activities carried out in contact with nature; (3) cognitive, related to values and attitudes towards nature and to the knowledge about the environment; (4) emotional, considering feelings or affective bonds with nature; and (5) philosophical, concerning the deepest ideas of what nature is and why it matters. Despite the importance of an in-depth understanding of all these HNC dimensions to facilitate transformational changes at individual and societal levels towards sustainability (Abson et al. 2017; Ives et al. 2018; Richardson et al. 2020), most scientific literature has focused on the material and experiential dimensions (Abson et al. 2017). Although the material and experiential dimensions are easier to research, they are less likely to produce significant changes on the system that lead to sustainable management of landscapes (Riechers et al. 2021). On this basis, it is urgent to assess the multiple dimensions of HNC, including the cognitive, emotional and philosophical dimensions (Abson et al. 2017). For instance, building a better understanding of how landscapes can lead to a specific emotional connection might be a crucial step for sustainable management of landscapes because these emotions play a key role in people's behavior towards landscapes and environmental support (Batavia et al. 2021; Riechers et al. 2019). Nevertheless, research on emotional responses connected to the Natural Sciences subject field is still missing, in part because emotions have been often considered not clearly connected with these disciplines and 'irrational' (Buijs and Lawrence 2013). However, some major advances in the study of emotions towards nature and HNC have come from other disciplines such as Psychology (Kals et al. 1999; Marczak and Sorokowski 2018; Perkins 2010; Petersen et al. 2019, Petersen and Martin 2021) and Geography (Davidson and Milligan 2004; Wood and Smith 2004) and, more recently, Sustainability Science (Riechers et al. 2021, 2022) and Landscape Ecology (Riechers et al. 2019).

Former literature coming from the Natural Sciences research field has explored the tolerance, attitudes and emotions towards wildlife in general (Jacobs 2009) and towards particular carnivore species (Marino et al. 2021; Vaske et al. 2021) and the issues of landscape changes and people's emotional responses towards those changes (Riechers et al. 2019). Despite these relatively recent studies, there is not yet a sufficient engagement with research coming from the Natural Sciences on how emotional experiences of and in nature can be important for fostering HNC (Pramova et al. 2021) and sustainable management of landscapes (Zylstra et al. 2014).

A possible starting point for covering this knowledge gap could be the study of the HNC articulated by unique landscapes, such as those landscapes of the Mediterranean region which have been shaped over centuries by human activities and that have been leading to a wide variety of emotional experiences derived from human–nature interactions. Landscapes reflect this social–ecological co-evolution and can be used to capture a gradient of human interactions with nature, from activities and attitudes with minor impact and barely changing the natural 'pristine' state of landscapes to others causing major impacts and rapid anthropization of landscapes (Riechers et al. 2020).

Spain, like most of the Mediterranean region, has a long history of sustainable management of ecosystems and connection with nature through the development of traditional cultural practices (i.e., pastoralism, lopping, beekeeping and controlled burns) that contributed into growing a great diversity of landscapes (Martín-López et al. 2016). Nevertheless, in the last 50 years, Mediterranean landscapes in Spain, especially arid and semi-arid landscapes, have suffered rapid land-use changes and landscape simplification processes (Quintas-Soriano et al. 2019). This is the case of Almería's landscapes, which are part of one of the most transformed regions of the world (e.g., in less than 40 years Almería's coastal plain subsistence agriculture has turned into an intensive greenhouse horticulture anthropized landscape occupying large areas) (Quintas-Soriano et al. 2016). Despite that Almería's landscapes host unique biodiversity (Armas et al. 2011) and provide a diverse set of ecosystem services (Quintas-Soriano et al. 2019), these landscapes are often perceived as unproductive lands where people feel disconnected from nature (Castro et al. 2011, 2018). According to Balázsi et al. (2019), certain changes in the natural

environment may lead to changes in HNC dimensions: the intensity of changes in land use seems to promote alterations in the material, experiential, and emotional dimensions, while changes in political and economic paradigms can drive transformations in the cognitive and philosophical dimensions. Consequently, it is reasonable to think that the intense land-use and economic changes in Almería during the last decades might have influenced all the different dimensions of HNC.

The intensity of these land-use and economic changes can also lead to emotional responses that, in turn, might shape HNC through time (Riechers et al. 2019). Since emotional experiences of and in nature seem to be important for fostering HNC (Pramova et al. 2021), this study aims to explore the role of emotions in shaping HNC occurring in arid and semi-arid Mediterranean landscapes with different land-use intensity levels.

To do so, we specifically aimed to (1) identify the level and dimensions of HNC associated with a suite of representative arid and semi-arid Mediterranean landscapes; (2) explore social preferences towards these landscapes; and (3) determine the diversity of positive and negative emotions associated with these landscapes. In addition, we proposed a novel landscape classification to unravel relationships between social preferences of landscapes, diversity of emotions and HNC. Finally, we discuss the role of emotions in shaping HNC and how associations between emotions and HNC can offer insights for regional and global transformations towards sustainability.

Materials and methods

Defining the study area

The case study was conducted in landscapes of the province of Almería (Southeast of Spain) (Fig. 1). Subdesertic-Mediterranean subclimate is dominant in most of the territory where mean annual precipitation does not exceed 300 mm (occasionally less than 200 mm) with winter mean temperatures between 12 and 15 °C and maximum summer temperatures of 40 °C (Armas et al. 2011). Nevertheless, some areas present a Continental-Mediterranean subclimate with cooler winters (6–12 °C) and mean annual precipitation between 300–600 mm; even reaching 1000 mm and temperatures below zero during winter in high mountain areas (Gómez-Zotano et al. 2015). Both Mediterranean subclimates are characterized by hot dry summers and a seasonally restricted rainfall mostly occurring during the mild and wet winters.

We selected 10 landscapes from the province's varied set of landscapes based on two ecological and social criteria: (1) representativeness of the ecological heterogeneity of

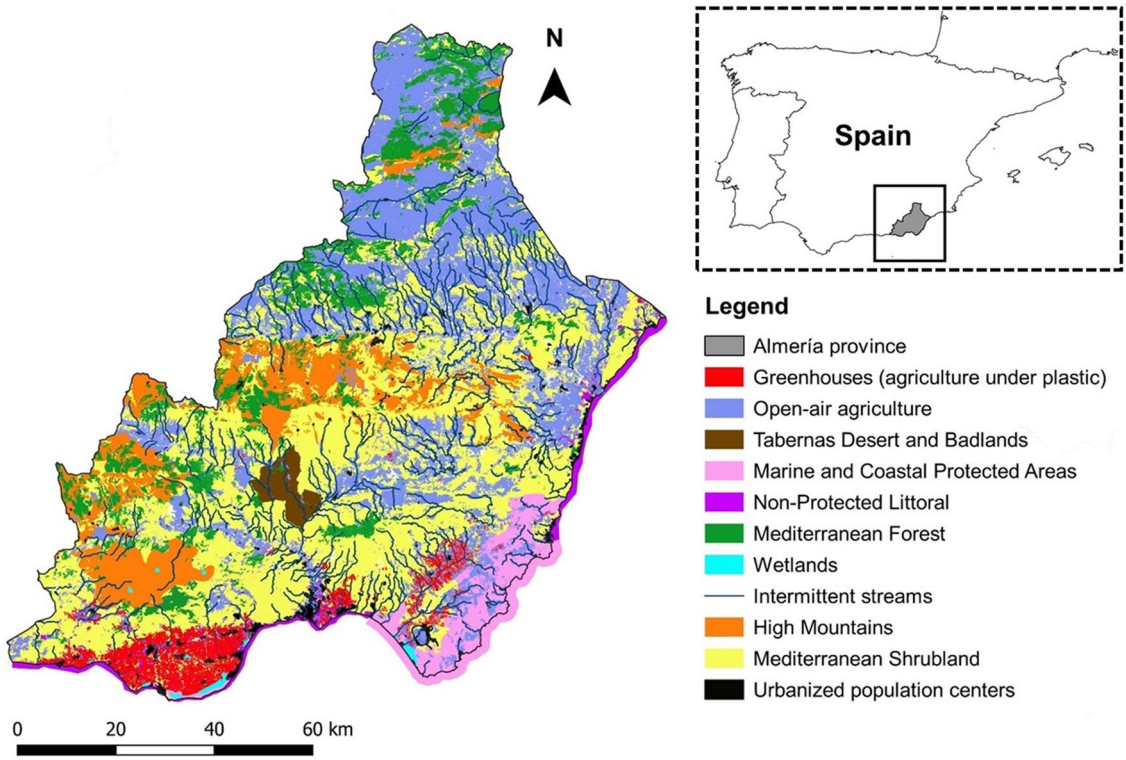


Fig. 1 Geographical location of studied landscape types in Almería province, Southeast Spain

Almería according to the Andalusian landscape classification (Moniz et al. 2005) and (2) being well-known landscapes that could be easily recognized and understood by the local population based on previous research in the region (Castro et al. 2014; Quintas-Soriano et al. 2016). Selected landscapes included: (1) Greenhouses, (2) Open-air agriculture, (3) Tabernas Desert and Badlands, (4) Marine and Coastal Protected Areas, (5) Non-Protected Littoral, (6) Mediterranean Forest, (7) Wetlands, (8) Intermittent streams (or 'Ramblas'), (9) High Mountains and (10) Mediterranean Shrubland. We related these 10 representative landscapes with ten landscape images (García-Llorente et al. 2012) and provided a description for each landscape type (Table 1). Landscape images were extracted from the available set of color photographs in Google Images. To make these landscape images as representative as possible, we chose panoramic color pictures with similar lighting and color saturation containing the main characteristic landscape features. We then used the QGIS 3.16.3 tool to spatially represent the location of the ten studied landscapes (Fig. 1). The area occupied by each of the ten studied landscape types was determined using spatial information obtained from various data sources (Table 1).

Almería province includes a total of 103 municipalities, with a total population of 727,945 inhabitants (Table 2). The economy is driven by two main activities and industries: (1) intensive agriculture (320.48 km^2 of the province occupied by greenhouses) (Regional Government of Andalusia 2019) and its associated industry (e.g., production of fertilizers, pesticides, plastics and machinery), and (2) tourism and services sector. During the last decades, policy decisions regarding land use management in Almería have reflected a dichotomy between economic development and conservation (Sánchez-Picón et al. 2011).While some decisions have favored migration to cities, rural abandonment, resources exploitation and urban intensification in some areas of the Almería province, others have been declared as protected areas and contributed to biodiversity conservation in other parts of the province (Quintas-Soriano et al. 2016).

Social sampling strategy

We conducted a semi-random social sampling based on individual face-to-face structured surveys during April 2019. Respondents were randomly selected among the people who met at the University of Almería's Biodiversity Marathon (AmBioBlitz), a major event that brings inhabitants from most of Almería's municipalities to the university campus. This event was used to capture a wide range of the local population (e.g., students and teachers from different educational levels, environmental experts and university workers) and visitors. We asked respondents to voluntarily participate in the survey. No compensation was offered for participation. We informed respondents that all responses were anonymous and that there were no right or wrong answers.

Survey design

The survey included sections with multiple-choice questions, open-ended questions, and freelisting technique to collect information regarding: (1) human–nature connectedness (HNC), (2) social preferences of the 10 representative landscapes, (3) diversity of emotions that people have towards these landscapes, and (4) socio-demographic characteristics (i.e., age, gender, place of birth/residency and educational level) (see Appendix S1 in Supplementary Material for a full description of the survey). Furthermore, to improve respondents' understanding of the survey and to make the emotions' section more appealing (Quintas-Soriano et al. 2014); we used a panel with 10 photos, one for each studied landscape (see Appendix S2 in Supplementary Material). To create this panel, we matched the 10 selected landscapes with 10 landscape images (Table 1). Selected images were first tested to probe their utility and then used to capture the diversity of emotions people identify as being associated with each landscape. This panel aimed to induce respondents to reflect on landscapes based on their own positive and detrimental experiences. Respondents were not forced to identify emotions for each landscape.

Data analysis

Analyses were organized into three sections: (1) human–nature connectedness (HNC), (2) landscape preferences, and (3) abundance and diversity of emotions associated with landscapes.

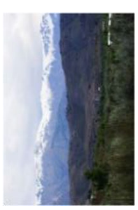
Human–nature connectedness (HNC)

To explore HNC we used the 'inclusion of nature in self' (INS) graphical scale proposed by Schultz (2002). This INS represents 'nature' and 'self' within two circles with various levels of overlap, representing a respondent's connection with nature. We asked respondents to select the level that better described their connection with Almería's nature (Pérez-Ramírez et al. 2021). Circle associations were presented on a scale from 1 to 5, where 1 = Strongly disconnected, 2 = Somehow disconnected, 3 = Neutral, 4 = Somehow connected, and 5 = Strongly connected. The INS scale does not provide a pre-imposed definition of what can be considered as 'nature', so it allows respondents to answer based on what they individually understand as nature avoiding bias towards a specific cosmovision. Thus, respondents could freely answer based on what they individually understood as Almería's nature. Then, we explored the reasons underpinning respondents' choices on a specific level of

Table 1 Landscape views and descriptions of the ten studied landscape types and data sources of spatial information used to determine their geographical location in Almería

Landscape types	Landscape views	Description	Sources of spatial data
Greenhouses		Intensive agriculture in greenhouses	Spanish Land Cover/Land Use Information System (SIOSE) for Andalusia[a]
Open-air agriculture		Land dedicated to agricultural practices other than intensive agriculture in greenhouses (e.g., herbaceous rainfed crops, vineyards, almond trees and olive trees)	Map of land use and vegetal covers of Andalusia (MUCVA)[a]
Tabernas desert and badlands		Tabernas Desert Natural Reserve characterized by semi-arid badlands (i.e., landforms developed on soft or poorly consolidated bedrock with limited plant cover displaying a component of explicit aridity)	Map of Andalusia's Natural Protected Areas (EENNPP)[a]
Marine and coastal protected areas		Defined protected areas of Cabo de Gata-Níjar Natural Park, Punta Entinas-Sabinar Natural Reserve and Adra's Albufera Natural Reserve	Map of Andalusia's Natural Protected Areas (EENNPP)[a]
Non-protected littoral		Marine areas (from the coastline up to 2 km offshore) and coastal areas (municipalities containing littoral zones) that are not under protection figures	Map of Andalusian regions and municipalities[a]
Mediterranean forest		Areas occupied by *Quercus* sp. forests, conifer forests and/or mixed forests (no matter if they are natural or a result of previous reforestations or plantations)	Map of land use and vegetal covers of Andalusia (MUCVA and CORINE Land Cover)[a]
Wetlands		Wet ecosystem permanently or seasonally flooded by water (e.g., marshes, swamps or lagoons)	Map of wetlands[a]
Intermittent streams (or Ramblas)		Temporary or seasonal watercourses that cease to flow at some point in time and space	Hydrographic network map[a]

Table 1 (continued)

Landscape types	Landscape views	Description	Sources of spatial data
High mountains		High altitude mountains including Sierra Nevada National Park, Sierra María-Los Vélez Natural Park and Sierra de los Filabres	Digital elevation model (90 m)[b] and map of Andalusian landscape regions[a]
Mediterranean shrubland		Mediterranean Scrub and Grassland biome. It includes sclerophyllous shrubs (from low to arborescent) and herbaceous vegetation (mixed annual and perennial growth forms)	Map of land use and vegetal covers of Andalusia (MUCVA)[a]

[a]Data obtained from the Environmental Information Network of Andalusia (REDIAM) from https://descargasrediam.cica.es/repo/s/RUR

[b]Shuttle Radar Topography from https://www2.jpl.nasa.gov/srtm/

connection to nature (Pérez-Ramírez et al. 2021). We asked, 'Why have you chosen this association of circles?' and reclassified answers afterwards according to the five dimensions of HNC proposed by Ives et al. (2018): material, experiential, cognitive, emotional and philosophical. Finally, we calculated the relative frequencies of each connectedness level and HNC dimension in order to detect which are the dominant ones in Almería province.

Preferences for landscapes

To assess social preferences towards landscapes, we asked for the respondents' favorite and least favorite landscapes of Almería province. To explore these preferences, we used the freelisting technique by which respondents could openly express any of their most and least preferred landscapes (García-Llorente et al. 2020). We then reclassified responses according to our ten landscape types. For this reclassification, we considered 'City' as a new landscape as it was often mentioned by respondents as the landscape where they lived in. This highlighted the urban landscape as one of the landscapes people have more contact with during their daily lives. Finally, we calculated the percentage of respondents that identified each landscape as their favorite or least favorite to establish a ranking of preferred and less preferred landscapes reflecting which landscapes are considered more important for HNC by Almería's inhabitants.

Abundance and diversity of emotions towards landscapes

We explored the diversity of positive and negative emotions by asking respondents to identify a set of emotions and associate those to any of the ten representative landscapes presented on a panel (see Appendix S2 in Supplementary Material). Interviewers asked, 'Which emotions does this landscape inspire in you?' towards each of the ten landscapes, and respondents marked their emotions on the panel. Based on the diversity of positive and negative emotional states described by Quoidbach et al. (2014), respondents could freely choose between 18 types of emotional states: nine positive (alertness, amusement, awe, contentment, joy, gratitude, hope, love, and pride) and nine negative (anger, sadness, embarrassment, fear, disgust, guilt, shame, contempt, and anxiety), without establishing minimums or maximums of chosen emotions for each of the 10 previously defined landscapes. Responses were codified with 0 and 1; with 0 = not associated, and 1 = emotional states associated with a particular landscape.

We used Nightingale's diagrams (using Kutools™ tool for Excel) to represent the relative frequencies (Ribecca 2021) of each of the eighteen emotions present on each landscape and bar plots to depict frequencies of emotions grouped as positive or negative in order to show the

Table 2 Socio-demographic characterization of Almería province

Variables	Data in Almería
Area [b]	8774 km^2
Constructed area (housing and infrastructures)[b]	240.14 km^2
Protected area[c]	2763 km^2
Population[a]	727 945 inhabitants
Population density[a]	83.0 inhabitants per km^2
Population loss[a]	35.0% of Almería's municipalities lost population in 2020
Population living in rural areas[b]	24.7%
Population living in urban settlements[b]	42.3%
Population living in large urban centers[b]	33.0%

[a]Statistics National Institute (2020)

[b]Institute of Statistics and Cartography of Andalusia (2019)

[c]Environmental Portal of Andalusia (2021)

dominance and prevalence of some emotions over others. Finally, to compare similarity in the relative frequencies of emotions between the 10 studied landscapes, we performed a Non-Metric Multidimensional Scaling (NMDS) based on a Bray–Curtis dissimilarity matrix with two dimensions and a maximum of 100 random starts. In this ordination method, the closer two landscapes (square points) are, the more similar they are with respect to the emotions (arrows). The analysis was conducted using the 'metaMDS' function implemented in 'vegan' package for R. The main purpose of this analysis was to establish the similarity and dissimilarity between landscapes regarding the emotions that respondents associated to each of them. These similarity/dissimilarity results will allow us to discuss the reasons why some landscapes inspire the same or completely different emotions.

Finally, we calculated the diversity of emotions associated with each landscape. To do so, we used an Emodiversity Index (Quoidbach et al. 2014), which is adapted from the Shannon Index (Eq. 1).

$$\text{Emodiversity} = \sum_{i=1}^{s} \left(p_i \times \ln p_i\right) \quad (1)$$

where s is the total number of emotions assigned to each landscape and p_i equals the proportion of s made up of the ith emotions. To obtain p_i, we divided the number of times each emotion was expressed for each landscape by the total number of emotions for that landscape. In addition, we multiplied all the products of $p_i \times \ln p_i$ by -1 to obtain positive values (Quoidbach et al. 2014).

We calculated the Emodiversity Index for both positive and negative emotions with the goal of identifying the landscapes that were reinforcing HNC and the ones boosting disconnection from nature. Once we obtained the positive and negative emodiversity indexes for each landscape, we used a scatter plot to represent them: negative emodiversity index on the *X*-axis and positive on the *Y*-axis. Subsequently, we calculated the median of each of the emodiversity indexes as cut values in order to construct a matrix of diversity of emotions. This allowed us to divide this matrix into four sections and classify landscapes by their position in the matrix as landscapes inspiring higher or lower varieties of positive or negative emotions (Fig. 6).

Methodological limitations of the study

Our findings must be considered with some limitations. First, the convenient sampling strategy performed may be not fully representative of Almería's population. We acknowledge some limitations regarding the sampling strategy since face-to-face surveys were conducted during the University of Almería's Biodiversity Marathon (AmBioBlitz) which took place at the facilities of this institution, very close to the city of Almería. Therefore, some biases may emerge towards sampling people with higher levels of education, younger adults, university students and people living in Almería's metropolitan area. Future data collection efforts must focus on trying to capture a more representative sample of Almería's population by conducting more surveys in rural areas. A second drawback was the use of a single image for representing each landscape. Although it is a commonly used technique (García-Llorente et al. 2012; Quintas-Soriano et al. 2016), respondents could have based their answers on that particular image rather than on the general idea of the landscape type represented. To reduce this bias as much as possible, we chose panoramic color pictures with similar color saturation and containing the main characteristic features of each landscape. Nevertheless, there were some differences between images' characteristics. Here we

suggest that future landscape panel designs must choose multiple images for each landscape, consider images with similar lighting conditions and distance perspectives, and avoid particular features (e.g. blue skies, flowering trees, and sunsets) that could induce some other bias in responses. Finally, another limitation of this study was the use of a dummy variable for measuring the association of emotions (0 = not associated and, 1 = emotional states associated with a particular landscape). This decision was taken in order not to excessively lengthen the survey time. Although respondents were not forced to associate emotions with landscapes, this binary characteristic may have influenced them to make judgements about the thresholds where the emotion became associated with the landscape or not. To reduce this bias, we asked respondents for the reason why they associated each emotion with each landscape. However, to overcome this limitation, new efforts in landscape elicitation exercises could be based on a 5-point Likert-scale ranging from 0 (not associated) to 5 (strongly associated).

Results

From the 191 compiled questionnaires, 176 were completed and valid for further analyses. Fifteen questionnaires were not included since they were incomplete or because of respondent's low understanding of the survey.

Social sample characterization

Regarding respondents' sociodemographic characteristics, the social sampling captured a similar number of women and men (52.3% and 47.7% of respondents, respectively). Most respondents were 18–30 years old (47.7%), followed by 31–55 years-olds (34.1%). In addition, the majority of the people surveyed had a university degree (64.8%). Most respondents now live in large urban centers (77.3%), followed by urban settlements (11.4%) and a minority living in rural areas (10.2%) (Table 3).

Table 3 Socio-demographic characterization of respondents

Sociodemographic variables	Categories	Number of respondents	% of respondents
Gender	Female	92	52.3%
	Male	84	47.7%
Age	15–18 years	9	5.1%
	18–30 years	84	47.7%
	31–55 years	60	34.1%
	> 55 years	23	13.1%
Place of birth	Rural [a]	15	8.5%
	Urban settlement[a]	18	10.2%
	Urban center[a]	119	67.6%
	Non specified	24	13.6%
Place of residence	Rural[a]	18	10.2%
	Urban settlement[a]	20	11.4%
	Urban center[a]	136	77.3%
	Non specified	2	1.1%
Educational level	No university	62	35.2%
	University	114	64.8%
Total of respondents	$N = 176$		

[a]Based on Dijkstra and Poelman (2014) and data from the Institute of Statistics and Cartography of Andalusia (2019). The Urbanization Degree Classification seeks to characterize the intensity of human settlements through a statistical grid of 1 km^2 cells where the population resides. According to the methodology presented by EUROSTAT, based on population density, different categories are defined using geographic contiguity criteria, population density and population thresholds. The three existing cell categories are: urban centers (density of at least 1500 inhabitants/km^2 and a minimum population of 50,000 inhabitants), Urban settlements (density of at least 300 inhabitants/km^2 and a minimum population of 5000 inhabitants) and rural areas (those not classified as urban centers or settlements). For a population center to be considered as a "city", at least 50% of the population living in the area must live in "urban center" cells. To obtain the consideration of "urban settlement" it is required that less than 50% of the population resides in rural cells and urban center cells. Finally, rural areas are those in which at least 50% of the population lives in rural cells

Human–nature connectedness

The analysis of HNC revealed different levels and dimensions (Fig. 2). The highest levels of connectedness ("strongly connected" and "somehow connected") grouped 59.1% of the total responses. However, we identified the neutral level as the most selected option (35.2% of responses). Finally, the categories for the lowest levels of connectedness ("somehow disconnected" and "strongly disconnected") captured only 5.7% of total responses.

According to the dimensions of HNC proposed by Ives et al. (2018), we found that the experiential (39.3%) and emotional (30.4%) dimensions were identified as the most influential. Overall, 15.0% and 13.0% of responses corresponded to philosophical and cognitive dimensions, respectively. Finally, the least mentioned dimension was the material (2.4%).

Most respondents associated with a neutral level of HNC identified arguments within the experiential dimension, while those who expressed the strongest level of connection mostly offered arguments related to the emotional dimension. Higher levels of connection presented a higher variety of HNC dimensions with responses more distributed all over the five dimensions (Fig. 2).

Preferences for landscapes

Marine and Coastal Protected Areas clearly stood out as the most preferred landscape (45.7% of respondents) (Fig. 3). The next preferred landscapes were High Mountains, Tabernas Desert and Badlands, Non-Protected Littoral and Mediterranean Forest.

Regarding least preferred landscapes, Greenhouses were the least preferred (49.1% of respondents) (Fig. 3), followed by Tabernas Desert and Badlands, Non-Protected Littoral, City, Intermittent streams and Marine and Coastal Protected Areas. Open-air agriculture, Mediterranean Forest and Wetlands were never considered as 'least favorite'.

Tabernas Desert and Badlands and Non-Protected Littoral were simultaneously chosen as most and least preferred landscapes. In both cases, percentages of responses considering them as their favorite or least favorite landscape were remarkably similar (Fig. 3).

Diversity of emotions towards landscapes

The 176 questionnaires captured a total of 3568 emotions. Grouping all responses of each landscape into positive and negative emotions (Fig. 4), results identified two different rankings. The ranking for positive emotions (from the maximum to the minimum of emotions) was ordered as follows: (1) Marine and Coastal Protected Areas, (2) Mediterranean Forest, (3) High Mountains, (4) Open-air agriculture, (5) Wetlands, (6) Mediterranean Shrubland, (7) Tabernas Desert and Badlands, (8) Intermittent streams, (9) Greenhouses, and (10) Non-Protected Littoral. Likewise, the ranking of negative emotions was ordered as follows: (1) Greenhouses, (2) Non-Protected Littoral, (3) Intermittent streams, (4) Tabernas Desert and Badlands, (5) Mediterranean Shrubland, (6) Wetlands, (7) Open-air agriculture, (8) Mediterranean

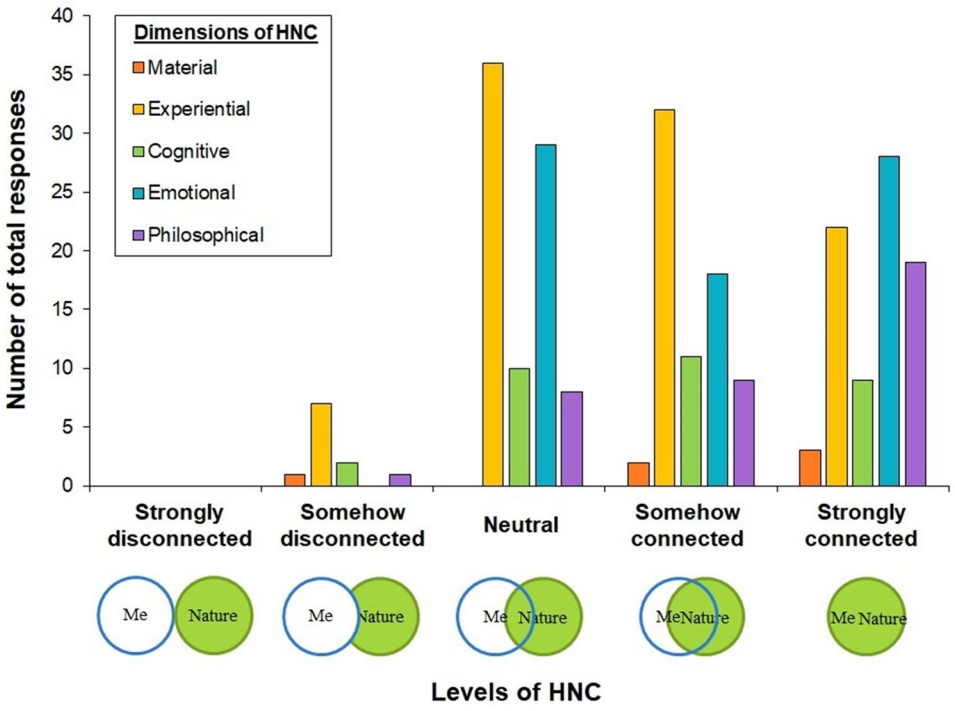


Fig. 2 Levels of HNC (circles for inclusion of nature in self (INS) based on Pérez-Ramírez et al. 2021) expressed as the five dimensions of HNC (i.e., material, experiential, cognitive, emotional, and philosophical) proposed by Ives et al. (2018)

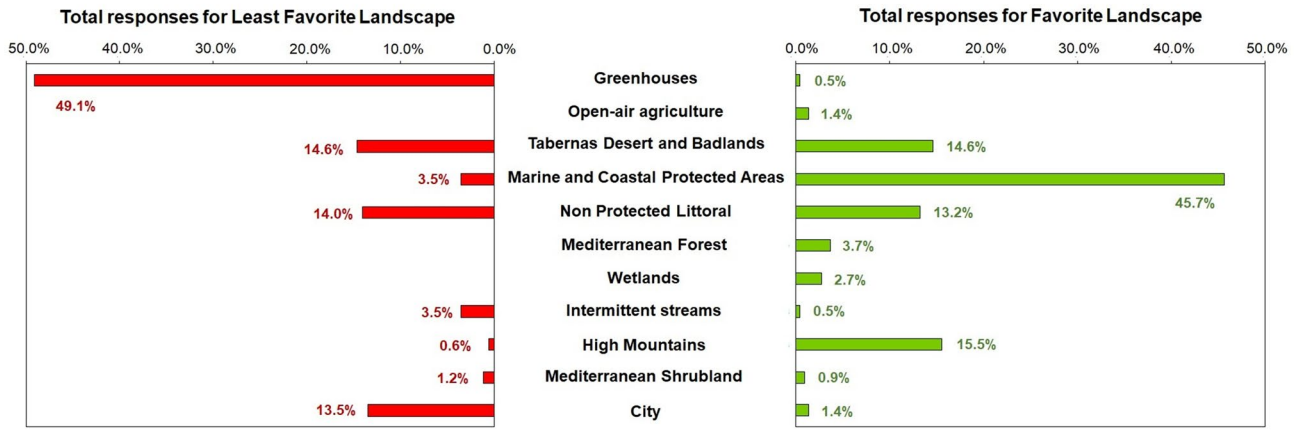


Fig. 3 Least favorite and most favorite landscapes selected by respondents (% of total responses to each question)

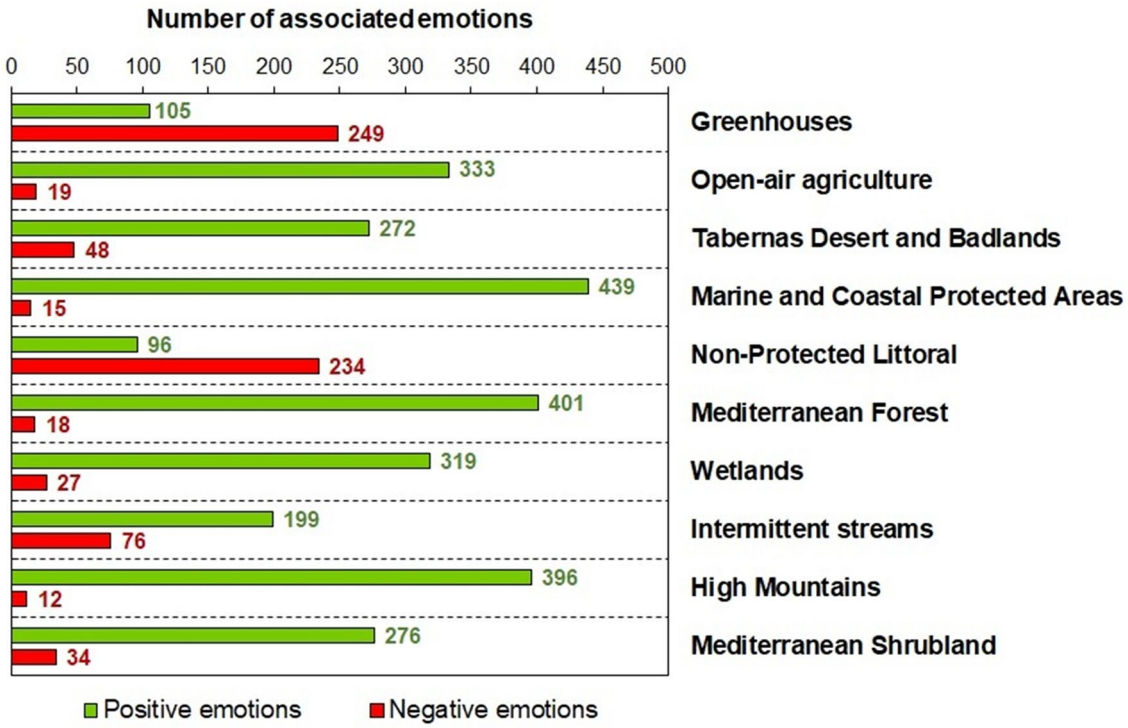


Fig. 4 Number of positive and/or negative emotions associated with each of the 10 studied landscapes

Forest, (9) Marine and Coastal Protected Areas, and (10) High Mountains.

The NMDS ordination of the frequency of emotions among landscapes reveals a clear gradient of increasing positive emotions and decreasing negative emotions from the left to the right side of the *X*-axis (Fig. 5a). Greenhouses and Non-Protected Littoral landscapes dominated by the highest frequency of negative emotions, are located on the left side of the *X*-axis whereas the Mediterranean Forest, High Mountains, and Marine and Coastal Protected Areas occupy the contrast position presenting the highest frequencies of positive emotions. Tabernas Desert and Intermittent streams are in an intermediate situation with some respondents describing positive emotions and other negative (Fig. 5a). Nightingale diagrams performed for each landscape further corroborated these results. As observed in Fig. 5a, there is a wide variety of negative emotions correlated with Greenhouses and Non-Protected Littoral, whereas positive emotions were mainly related with the rest of landscapes. Tabernas Desert and, especially, Intermittent streams were

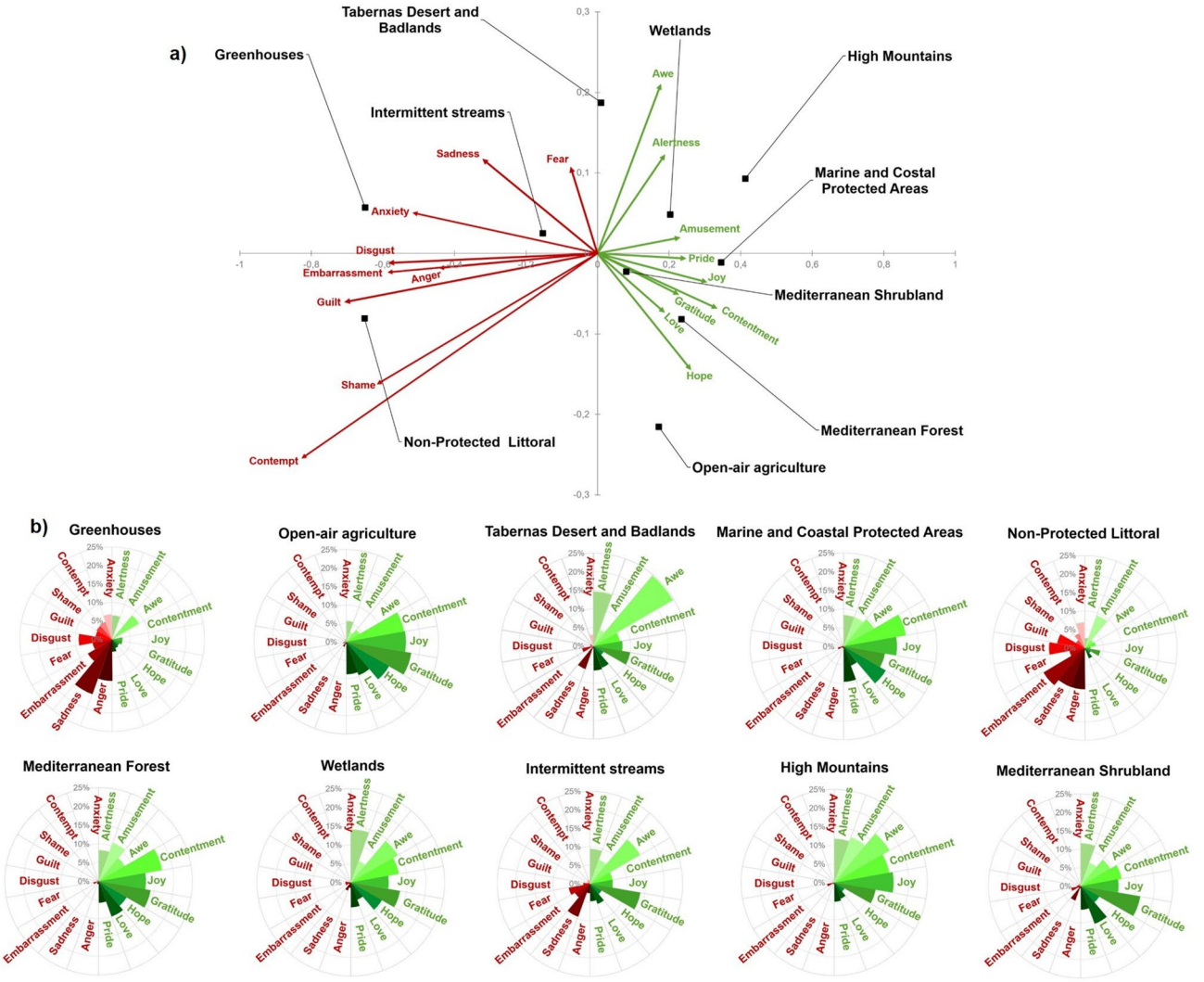


Fig. 5 **a** NMDS plot showing similarity/dissimilarity between landscapes. The closer two landscapes (square points) are, the more similar they are with respect to the emotions (arrows pointing towards those landscapes). The direction of the arrow indicates the direction of the gradient of increasing frequency of each emotion; the length indicates the correlation between it and the NMDS axis. **b** Nightingale diagrams showing the distribution of the 18 types of emotions in each landscape

related with positive emotions, mainly "awe", "alertness" and "gratitude", but some respondents also expressed a set of negative emotions, mainly "fear" and "sadness" (Fig. 5b).

Figure 6 represents the diversity of emotions estimated through the Emodiversity Index. Four groups of landscapes were identified in the matrix: (1) emotionally positive landscapes with high diversity of positive emotions and low diversity of negative emotions; (2) emotionally negative landscapes with low diversity of positive emotions and high diversity of negative emotions; (3) polarized landscapes with high diversity of positive and negative emotions simultaneously; and (4) emotionally neutral landscapes with low diversity of both positive and negative emotions.

According to their positions in this matrix of diversity of emotions (Fig. 6), Marine and Coastal Protected Areas, Mediterranean Forest, Wetlands and High Mountains were considered emotionally positive landscapes. Non-Protected Littoral, Greenhouses, Intermittent streams and Tabernas Desert and Badlands were mainly considered emotionally negative landscapes. Mediterranean Shrubland was grouped as a polarized landscape and Open-air agriculture was categorized as an emotionally neutral landscape.

Discussion

How do human–nature connectedness and landscape preferences relate?

The HNC analyses identified that most respondents were somehow or strongly connected with nature (Fig. 2). However, it should be noted that the most represented HNC

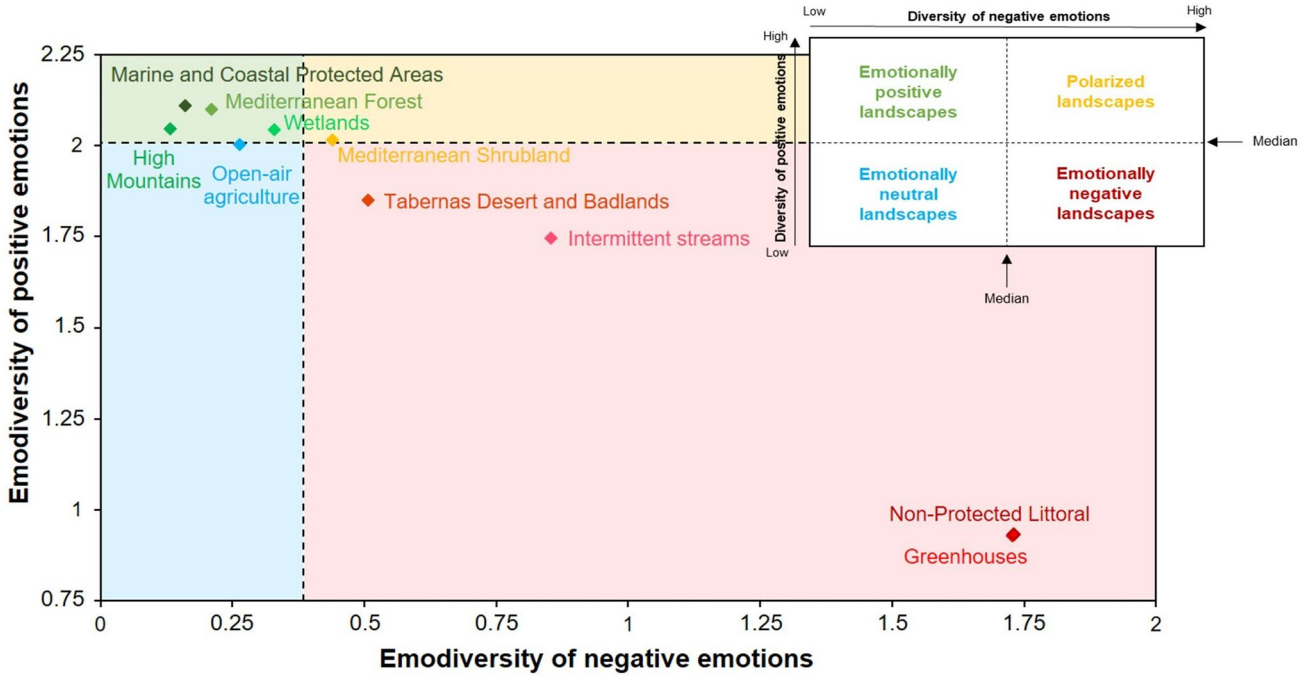


Fig. 6 Scatter-plot diagram representing the Emodiversity Index of negative emotions (*X* axis) and positive emotions (*Y* axis) for the ten studied landscape types

level was the neutral one, suggesting that some portion of Almería's population does not feel a strong connection with nature. Among the reasons explaining this trend we found the stress caused by daily responsibilities and lack of free time, which suggests that Almeria's urban lifestyle (predominant as the majority of respondents were born and live in urban centers) is underpinning this lack of experience in nature. These findings are consistent with similar studies that show stronger levels of HNC in rural areas than in urban settlements since it is in rural areas where people spend more meaningful time in contact with nature (Elwell et al. 2020; Pérez-Ramírez et al. 2021). These results reinforce the idea that (re)introducing nature into people's daily lives can increase HNC (Riechers et al. 2021). Yet, more research is needed in Mediterranean rural landscapes in order to gain better understanding of HNC.

Respondents identified the lack of appealing landscape features of Almería's most abundant landscapes (i.e., Mediterranean Shrubland and Intermittent streams) as the cause of their lack of interest for them and the main reason for lower HNC levels. This brings up an interesting discussion around the common understanding of socially acceptable landscapes, often related to green landscapes (Bidegain et al. 2020) or beautiful landscapes (Gobster et al. 2007). For instance, Kaltenborn and Bjerke (2002) and Howley (2011) showed that the general public manifests stronger preferences for landscapes with a constant abundance of water. This may explain the results found around the lack of HNC observed for Intermittent streams, as it seems that landscape preferences in Almería are influenced by the presence or absence of water (García-Llorente et al. 2012). Furthermore, according to Kaplan and Kaplan (1989) natural landscapes are more preferred than landscapes with visible signs of built infrastructure. Thus, less anthropized landscapes where water is present (i.e., Marine and Coastal Protected Areas, Mediterranean Forest and High Mountains) seem to be the most preferred landscapes, which in turn, can reinforce the respondents' HNC in Almería.

Our results identified Greenhouses as the least preferred landscapes. The respondents' rejection of greenhouses seems to be mainly related to their anthropic nature (Kaltenborn and Bjerke 2002), the presence of built infrastructures (Kaplan and Kaplan 1989), their intensive component (García-Llorente et al. 2012), their huge extension and the large impact they cause in coastal areas (Castro et al. 2019). Finally, rejection towards the landscape representing Tabernas Desert and Badlands can be explained by the general repulsion for brownish and yellowish landscapes with bare soils and dry or sparse vegetation that people associate with sterile and unproductive places (García-Llorente et al. 2012; Bidegain et al. 2020). However, we found that some respondents selected Tabernas Desert as one of their favorite landscapes (Fig. 3), a result that might show that part of Almería's population appreciates the unique biodiversity hosted in this area (Rodríguez-Caballero et al. 2018). In addition, respondents perceived this landscape as something of their

own, related to a strong feeling of belonging and sense of place (i.e., emotional bonds with the surrounding landscape and nature based on personal roots and identity, community membership and a utilitarian connection between people and the environment) (Pérez-Ramírez et al. 2021). Both reasons, strong levels of sense of belonging and the perceived importance of biodiversity, can also explain the fact that the emotional and philosophical dimensions were the most relevant to those respondents reporting strong HNC (Fig. 2). This may indicate that the emotional connection and the ability to recognize the importance of biodiversity (Quintas-Soriano et al. 2018) might entail stronger levels of connection with nature than the material and experiential HNC dimensions, which are considered more tangible, but have less transformational potential towards sustainable management (Riechers et al. 2021).

Can emotions help to understand human–nature connectedness?

We found that the experiential and emotional dimensions are the most frequent reasons explaining stronger HNC (Fig. 2). Experiential dimension's role has been associated to the increasing interest for recreational and leisure activities that occur in nature (Giusti 2019; Riechers et al. 2020). On the other hand, our results for the emotional dimension resonates with Riechers et al. (2020)'s findings: more diverse and unique landscapes lead to a higher diversity of emotions and to higher levels of HNC. The diversity of unique landscapes present in the province of Almería can explain the diversity of positive emotions expressed by respondents leading to stronger HNC (Fig. 4). In fact, we found that emotionally positive landscapes (i.e., Marine and Coastal Protected Areas, High Mountains, Mediterranean Forest and Wetlands) (Fig. 5) are those mostly preferred by respondents (Fig. 3) and those that spatially overlap with the province's protected areas. This is consistent with studies that evidence how positive emotions are often more intensely generated in outstanding natural places associated with beautiful, surprising and interesting experiences (Joye and Bolderdijk 2015). The protection of these areas reflects how emotions underpin conservation actions (Tapia-Fonllem et al. 2010; Zelenski and Desrochers 2021). This protection of the outstanding nature that generates positive emotions does not only occur in Almería but also in Spain (Martín-López et al. 2011) and in many other parts of the world (Batavia et al. 2021). In contrast, some emotionally negative landscapes (i.e., Greenhouses, Non-Protected Littoral and Intermittent streams) represent the most widely distributed and transformed landscapes (Vanderheyden et al. 2014) in Almería province. This can be explained by the rapid and dramatic transformation of Almería's land use suffered in the last decades, which has been rejected by a large part of the local population (Quintas-Soriano et al. 2016). This rejection for very anthropized landscapes based on negative emotions can also foster pro-environmental behavior (Tapia-Fonllem et al. 2010). In Almería province, some initiatives of ecological and regenerative agriculture have emerged in response to these negative emotions as the basis for a paradigm shift from a high-impact intensive agriculture to a more sustainable agriculture. Thus, current negative emotions could also be 'seeds' for the sustainable management of the territory in the future (Bennett et al. 2016).

Emotional experiences of and in nature are important for fostering HNC (Pramova et al. 2021). Emotions are internal affective mental states that often are formed by feelings towards a specific location (Batavia et al. 2021). Being in direct contact with a landscape and the nature embedded in it brings up stronger emotions than other indirect experiences and generates an emotional attachment to place that can reinforce a deeper HNC (Pramova et al. 2021). In this sense, we suggest that this emotional attachment to specific landscapes in Almería needs to be considered for landscape management and for dealing with those conflicts associated to landscape changes (i.e., expansion of greenhouse horticulture or urban expansion) (Buijs and Lawrence 2013). Landscapes can lead to different emotions towards nature that in turn shape people's behavior and landscape management decisions. Thus, engaging with the entire spectrum of lived emotions can lead to a greater understanding of people–place and people–nature relationships and guide a more effective design of landscape interventions that satisfy both people's and nature's needs (Pramova et al. 2021) and that restore people's experience with nature, reinforcing HNC. The engagement with emotions at a local and regional scale for creating sustainable landscape management policies could be the first step leading to a final consideration of HNC as a key leverage point when designing global policies.

Towards a classification of emotional landscapes

Landscape regionalization and classification is a crucial tool for informing territorial planning and management. However, in most cases these processes only integrate variables that reflect on structural or functional attributes of ecosystems, leaving out crucial information to understand the drivers that produce landscape changes. Here, we propose a new classification approach based on the diversity of emotions evoked by landscapes and the importance that people place on them. We argue this classification may serve as an indicator of people's emotions towards nature and as a practical metric for assessing the 'weight' of the emotional dimension on the diverse HNC types occurring in different landscapes.

By using positive and negative emodiversity indexes (Quoidbach et al. 2014) our results identified four groups of emotional landscapes (Fig. 6) that provide complementary

information to guide landscape management. On the one hand, by understanding and recognizing the diversity of emotions that people experience towards a particular landscape, we can better understand factors underpinning this positive and/or negative relationship with nature and design land use policies to reinforce HNC and landscape conservation. In Almería, these land use policies should focus on: (1) limiting or at least controlling the expansion of emotionally negative landscapes hindering HNC that emerge from human activities intensively occupying land (i.e., Greenhouses and Non-Protected Littoral) and (2) fostering the conservation of emotionally positive landscapes reinforcing HNC (i.e., Marine and Coastal Protected Areas, High Mountains, Mediterranean Forest and Wetlands). On the other hand, drawing on locals' emotional expressions of HNC can be a powerful way to boost underlying motivation to foster transformative changes towards sustainability in degraded landscapes (e.g., Mediterranean Shrubland) and to identify places that strengthen local identity and sense of place (Pérez-Ramírez et al. 2019). Therefore, it would be crucial to increase public support for conservation of these landscapes through the application of new protection policies. Furthermore, commitment is needed to support environmental education at all levels giving opportunities for positive emotions reinforcement by direct contact with landscapes, building sense of place and highlighting the important features and Nature's Contributions to People (NCPs) provided by landscapes. This would be especially important in order to makeover the image of polarized landscapes (i.e., Mediterranean Shrubland) and emotionally negative landscapes associated with sterile, unproductive and low-valued places (i.e., Tabernas Desert and Intermittent Streams) and to increase their appreciation and the HNC towards them. This HNC reinforcement could lead to more pro-environmental behaviors (Zelenski and Desrochers 2021) demanding for more effective land management policies.

Our classification of emotional landscapes has some limitations in its application. The main weaknesses would be: (1) difficulties for measuring emotions, (2) variation of emotions when changing the scale (emotions towards a determined landscape can be very different when measured at local, regional or national scale) and, (3) prejudices (i.e., emotions being irrational and subjective) coming from governmental and scientific institutions when using emotions as a practical metric for informing decision-making and management. Nevertheless, the strengths of the emotional landscapes classification are understood to overcome these weaknesses. Action should be taken now to inform decision-making using the best available inter and transdisciplinary knowledge and to start walking towards landscape sustainable management. This emotional classification of landscapes contributes to both these key steps for transformation towards sustainability.

Conclusions

This research provides empirical evidence on landscapes leading to diverse emotions towards nature that in turn help to comprehend a greater or lesser HNC. The study of emotions is thus a crucial line of research to understand and boost the establishment of belongingness, land stewardship and care connections that may influence the human decisions and actions that compromise or foster sustainability. The landscape classification method through the emotional lens conducted in this study opens space for new research that delves deeper into the motivations that shape emotions towards landscapes or integrates, in a spatially explicit way, the diversity of emotions as variables to be included in land decision-making processes. In this sense, Mediterranean landscapes will require: (1) new land policies that protect them from uncontrolled extractivism, degradation and excessive anthropization, (2) economic and social policies that promote sustainable human activities and build a sense of community, (3) restoration projects that foster landscapes' socio-ecological resilience and, (4) environmental education initiatives to encourage contact with and interest for nature at all ages and reorient population preferences towards characteristic Mediterranean landscapes traditionally ignored or undervalued.

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Data availability The data used in this study are available for public access. Interested parties can request the data associated with this article by contacting the corresponding author or the leading author.

References

Abson DJ, Fischer J, Leventon J, Newig J, Schomerus T, Vilsmaier U, von Wehrden H, Abernethy P et al (2017) Leverage points for sustainability transformation. Ambio 46(1):30–39. https://doi.org/10.1007/s13280-016-0800-y

Armas C, Miranda JD, Padilla FM, Pugnaire FI (2011) Special issue: the Iberian Southeast. J Arid Environ 75:1241–1243. https://doi.org/10.1016/j.jaridenv.2011.08.002

Balázsi Á, Riechers M, Hartel T, Leventon J, Fischer J (2019) The impacts of social–ecological system change on human–nature connectedness: a case study from Transylvania, Romania. Land Use Policy 89:104232. https://doi.org/10.1016/j.landusepol.2019.104232

Batavia C, Nelson MP, Bruskotter JT, Jones MS, Yanco E, Ramp D, Bekoff M, Wallach AD (2021) Emotion as a source of moral understanding in conservation. Conser Biol. https://doi.org/10.1111/cobi.13689

Bennett EM, Solan M, Biggs R, McPhearson T, Norström AV, Olsson P, Pereira L, Peterson GD et al (2016) Bright spots: seeds of a good Anthropocene. Front Ecol Environ 14(8):441–448. https://doi.org/10.1002/fee.1309

Bidegain Í, López-Santiago CA, González JA, Martínez-Sastre R, Ravera F, Cerda C (2020) Social valuation of Mediterranean cultural landscapes: exploring landscape preferences and ecosystem services perceptions through a visual approach. Land 9(10):390. https://doi.org/10.3390/land9100390

Buijs A, Lawrence A (2013) Emotional conflicts in rational forestry: towards a research agenda for understanding emotions in environmental conflicts. Forest Policy Econ 33:104–111. https://doi.org/10.1016/j.forpol.2012.09.002

Bürgi M, Bieling C, von Hackwitz K, Kizos T, Lieskovský J, Martín MG, McCarthy S, Müller M et al (2017) Processes and driving forces in changing cultural landscapes across Europe. Landsc Ecol 32(11):2097–2112. https://doi.org/10.1007/s10980-017-0513-z

Castro AJ, Martín-López B, García-Llorente M, Aguilera PA, López E, Cabello J (2011) Social preferences regarding the delivery of ecosystem services in a semiarid Mediterranean region. J Arid Environ 75(11):1201–1208. https://doi.org/10.1016/j.jaridenv.2011.05.013

Castro AJ, Verburg PH, Martín-López B, García-Llorente M, Cabello J, Vaughn CC, López E (2014) Ecosystem service trade-offs from supply to social demand: a landscape-scale spatial analysis. Landsc Urban Plan 132:102–110. https://doi.org/10.1016/j.landurbplan.2014.08.009

Castro AJ, Quintas-Soriano C, Egoh BN (2018) Ecosystem services in dryland systems of the world. J Arid Environ 159:1–3. https://doi.org/10.1016/j.jaridenv.2018.09.006

Castro AJ, López-Rodríguez MD, Giagnocavo C, Gimenez M, Céspedes L, La Calle A, Gallardo M, Pumares P et al (2019) Six collective challenges for sustainability of Almería greenhouse horticulture. Int J Environ Res Public Health 16(21):4097. https://doi.org/10.3390/ijerph16214097

Colléony A, Cohen-Seffer R, Shwartz A (2020) Unpacking the causes and consequences of the extinction of experience. Biol Conserv 251:108788. https://doi.org/10.1016/j.biocon.2020.108788

Davidson J, Milligan C (2004) Embodying emotion sensing space: introducing emotional geographies. Soc Cult Geogr 5(4):523–532. https://doi.org/10.1080/1464936042000317677

Dijkstra L, Poelman H (2014) Regional working paper 2014: a harmonized definition of cities and rural areas: the new degree of urbanization. Regional and Urban Policy. European Commission. https://ec.europa.eu/regional_policy/sources/docgener/work/2014_01_new_urban.pdf. Accessed 24 March 2022

Elwell TL, López-Carr D, Gelcich S, Gaines SD (2020) The importance of cultural ecosystem services in natural resource-dependent communities: Implications for management. Ecosyst Serv 44:101123. https://doi.org/10.1016/j.ecoser.2020.101123

Environmental Portal of Andalusia (2021) Surface report: Andalusian network of protected areas (RENPA). Regional Government of Andalusia, report 2021, Seville, Spain (in Spanish). https://www.juntadeandalucia.es/medioambiente/portal/documents/20142/0/informe_superficie_renpa_2021.pdf/68a4f874-f89e-2696-23d0-d4342cc50a3a?t=1624961187021. Accessed 24 March 2022

García-Llorente M, Martín-López B, Iniesta-Arandia I, López-Santiago CA, Aguilera PA, Montes C (2012) The role of multi-functionality in social preferences toward semi-arid rural landscapes: an ecosystem service approach. Environ Sci Policy 19:136–146. https://doi.org/10.1016/j.envsci.2012.01.006

García-Llorente M, Castro AJ, Quintas-Soriano C, Oteros-Rozas E, Iniesta-Arandia I, González JA, García del Amo D, Hernández-Arroyo M et al (2020) Local perceptions of ecosystem services across multiple ecosystem types in Spain. Land 9(9):330. https://doi.org/10.3390/land9090330

Gaston KJ, Soga M (2020) Extinction of experience: the need to be more specific. People Nat 2(3):575–581. https://doi.org/10.1002/pan3.10118

Giusti M (2019) Human–nature relationships in context. Experiential, psychological, and contextual dimensions that shape children's desire to protect nature. PloS ONE 14(12):e0225951. https://doi.org/10.1371/journal.pone.0225951

Gobster PH, Nassauer JI, Daniel TC, Fry G (2007) The shared landscape: what does aesthetics have to do with ecology? Landsc Ecol 22:959–972. https://doi.org/10.1007/s10980-007-9110-x

Gómez-Zotano J, Alcántara-Manzanares J, Olmedo-Cobo JA, Martínez-Ibarra E (2015) The systematization of the Mediterranean climate: identification, classification and climatic characterization of Andalusia (Spain) (in Spanish, English abstract). Rev Geogr Norte Gd 61:161–180. https://doi.org/10.4067/S0718-34022015000200009

Howley P (2011) Landscape aesthetics: Assessing the general publics' preferences towards rural landscapes. Ecol Econ 72:161–169. https://doi.org/10.1016/j.ecolecon.2011.09.026

Institute of Statistics and Cartography of Andalusia (2019) Methodology for classifying the degree of urbanization in Andalusia. Ministry of Economy, Knowledge, Enterprises and University (in Spanish). Regional Government of Andalusia. URL http://www.juntadeandalucia.es/institutodeestadisticaycartografia/gradourbanizacion/metodologia/Notas_Metodologicas.pdf. Accessed 24 March 2022

Ives CD, Abson DJ, von Wehrden H, Dorninger C, Klaniecki K, Fischer J (2018) Reconnecting with nature for sustainability. Sustain Sci 13(5):1389–1397. https://doi.org/10.1007/s11625-018-0542-9

Jacobs MH (2009) Why do we like or dislike animals? Hum Dimens Wildl 14(1):1–11. https://doi.org/10.1080/10871200802545765

Joye Y, Bolderdijk JW (2015) An exploratory study into the effects of extraordinary nature on emotions, mood, and prosociality. Front Psychol 5:1577. https://doi.org/10.3389/fpsyg.2014.01577

Kals E, Schumacher D, Montada L (1999) Emotional affinity toward nature as a motivational basis to protect nature. Environ Behav 31(2):178–202. https://doi.org/10.1177/00139169921972056

Kaltenborn BP, Bjerke T (2002) Associations between environmental value orientations and landscape preferences. Landsc Urban Plan 59(1):1–11. https://doi.org/10.1016/S0169-2046(01)00243-2

Kaplan R, Kaplan S (1989) The experience of nature: a psychological perspective. Cambridge University Press, Cambridge

Liu J, Dietz T, Carpenter SR, Alberti M, Folke C, Moran E, Pell AN, Deadman P et al (2007) Complexity of coupled human and natural systems. Science 317(5844):1513–1516. https://doi.org/10.1126/science.1144004

Marczak M, Sorokowski P (2018) Emotional connectedness to nature is meaningfully related to modernization. Evidence from the Meru of Kenya. Front Psychol 9:1789. https://doi.org/10.3389/fpsyg.2018.01789

Marino F, Kansky R, Shivji I, Di Croce A, Ciucci P, Knight AT (2021) Understanding drivers of human tolerance to gray wolves and

brown bears as a strategy to improve landholder–carnivore coexistence. Conserv Sci Pract 3(3):e265. https://doi.org/10.1111/csp2.265
Martín-López B, Martín-Forés I, González JA, Montes C (2011) La conservación de la biodiversidad en España: atención científica, construcción social e interés político. Ecosistemas 20(1):104–113
Martín-López B, Oteros-Rozas E, Cohen-Shacham E, Santos-Martín F, Nieto-Romero M, Carvalho-Santos C, Cramer W et al (2016) Ecosystem services supplied by Mediterranean basin ecosystems. In: Haines-Young R, Fish R, Turner RK (eds) Routledge handbook of ecosystem services. Routledge, New York, pp 405–414
Miller JR (2005) Biodiversity conservation and the extinction of experience. Trends Ecol Evol 20(8):430–434. https://doi.org/10.1016/j.tree.2005.05.013
Moniz C, Moreira JM, Ojeda JF, Rodríguez M, Venegas C, Zoido F (2005) Mapa de paisajes. In: Consejería de Medio Ambiente y Obras Públicas y Transportes de la Junta de Andalucía (eds) Atlas de Andalucía, Spain
Nadkarni NM, Hasbach PH, Thys T, Crockett EG, Schnacker L (2017) Impacts of nature imagery on people in severely nature-deprived environments. Front Ecol Environ 15(7):395–403. https://doi.org/10.1002/fee.1518
Pérez-Ramírez I, García-Llorente M, Benito A, Castro AJ (2019) Exploring sense of place across cultivated lands through public participatory mapping. Landsc Ecol 34(7):1675–1692. https://doi.org/10.1007/s10980-019-00816-9
Pérez-Ramírez I, García-Llorente M, Saban de la Portilla C, Benito A, Castro AJ (2021) Participatory collective farming as a leverage point for fostering human-nature connectedness. Ecosyst People 17(1):222–234. https://doi.org/10.1080/26395916.2021.1912185
Perkins HE (2010) Measuring love and care for nature. J Environ Psychol 30(4):455–463. https://doi.org/10.1016/j.jenvp.2010.05.004
Petersen E, Martin AJ (2021) Kama Muta (≈ being moved) helps connect people in and to nature: a photo elicitation approach. Ecopsychology 13(1):37–47. https://doi.org/10.1089/eco.2020.0032
Petersen E, Fiske AP, Schubert TW (2019) The role of social relational emotions for human–nature connectedness. Front Psychol 10:2759. https://doi.org/10.3389/fpsyg.2019.02759
Plieninger T, Hartel T, Martín-López B, Beaufoy G, Bergmeier E, Kirby K, Montero MJ, Moreno G et al (2015) Wood-pastures of Europe: geographic coverage, social–ecological values, conservation management, and policy implications. Biol Conserv 190:70–79. https://doi.org/10.1016/j.biocon.2015.05.014
Pramova E, Locatelli B, Valdivia-Díaz M, Vallet A, Quispe Condé Y, Djoudi H, Colloff MJ, Bousquet F et al (2021) Sensing, feeling, thinking: relating to nature with the body, heart and mind. People Nat. https://doi.org/10.1002/pan3.10286
Quintas-Soriano C, Castro AJ, García-Llorente M, Cabello J, Castro H (2014) From supply to social demand: a landscape-scale analysis of the water regulation service. Lands Ecol 29(6):1069–1082. https://doi.org/10.1007/s10980-014-0032-0
Quintas-Soriano C, Castro AJ, Castro H, García-Llorente M (2016) Impacts of land use change on ecosystem services and implications for human well-being in Spanish drylands. Land Use Policy 54:534–548. https://doi.org/10.1016/j.landusepol.2016.03.011
Quintas-Soriano C, Brandt JS, Running K, Baxter CV, Gibson DM, Narducci J, Castro AJ (2018) Social–ecological systems influence ecosystem service perception. Ecol Soc 23(3):3
Quintas-Soriano C, García-Llorente M, Norström A, Meacham M, Peterson G, Castro AJ (2019) Integrating supply and demand in ecosystem service bundles characterization across Mediterranean transformed landscapes. Landsc Ecol 34(7):1619–1633. https://doi.org/10.1007/s10980-019-00826-7
Quoidbach J, Gruber J, Mikolajczak M, Kogan A, Kotsou I, Norton MI (2014) Emodiversity and the emotional ecosystem. J Exp Psychol 143(6):2057–2066. https://doi.org/10.1037/a0038025
Regional Government of Andalusia (2019) Cartography of greenhouses in Almería, Granada and Málaga. Ministry of Agriculture, Fisheries and Rural Development, Seville (in Spanish). https://www.juntadeandalucia.es/export/drupaljda/producto_estadistica/19/06/Cartografia%20_inv_AL_GR_MA_190926.pdf. Accessed 24 March 2022
Ribecca S (2021) Nightingale rose graph. The data visualization catalogue. https://datavizcatalogue.com/ES/index.html. Accessed 24 March 2022
Richardson M, Dobson J, Abson DJ, Lumber R, Hunt A, Young R, Moorhouse B (2020) Applying the pathways to nature connectedness at a societal scale: a leverage points perspective. Ecosyst People 16(1):387–401. https://doi.org/10.1080/26395916.2020.1844296
Riechers M, Henkel W, Engbers M, Fischer J (2019) Stories of favourite places in public spaces: emotional responses to landscape change. Sustainability 11(14):3851. https://doi.org/10.3390/su11143851
Riechers M, Balázsi Á, Abson DJ, Fischer J (2020) The influence of landscape change on multiple dimensions of human–nature connectedness. Ecol Soc 25(3):3. https://doi.org/10.5751/ES-11651-250303
Riechers M, Pătru-Due IA, Balázsi Á (2021) Leverage points to foster human–nature connectedness in cultural landscapes. Ambio 50:1670–1680. https://doi.org/10.1007/s13280-021-01504-2
Riechers M, Martín-López B, Fischer J (2022) Human–nature connectedness and other relational values are negatively affected by landscape simplification: insights from Lower Saxony, Germany. Sustain Sci 17(3):865–877. https://doi.org/10.1007/s11625-021-00928-9
Rodríguez-Caballero E, Castro AJ, Chamizo S, Quintas-Soriano C, García-Llorente M, Cantón Y, Weber B (2018) Ecosystem services provided by biocrusts: From ecosystem functions to social values. J Arid Environ 159:45–53. https://doi.org/10.1016/j.jaridenv.2017.09.005
Sánchez-Picón A, Aznar-Sánchez JA, García-Latorre J (2011) Economic cycles and environmental crisis in arid southeastern Spain. A historical perspective. J Arid Environ 75(12):1360–1367. https://doi.org/10.1016/j.jaridenv.2010.12.014
Schultz WP (2002) Inclusion with nature: the psychology of human–nature relations. In: Schmuck P, Schultz WP (eds) Psychology of sustainable development. Springer, Boston, pp 61–78
Soga M, Gaston KJ (2016) Extinction of experience: the loss of human–nature interactions. Front Ecol Environ 14(2):94–101. https://doi.org/10.1002/fee.1225
Soga M, Gaston KJ (2018) Shifting baseline syndrome: causes, consequences, and implications. Front Ecol Environ 16(4):222–230. https://doi.org/10.1002/fee.1794
Soga M, Gaston KJ (2020) The ecology of human–nature interactions. Proc Royal Soc B 287(1918):20191882. https://doi.org/10.1098/rspb.2019.1882
Statistics National Institute (2020) Demographics and population. Spanish Government. https://www.ine.es/dyngs/INEbase/es/categoria.htm?c=Estadistica_P&cid=1254734710984. Accessed 24 March 2022
Tapia-Fonllem C, Corral-Verdugo V, Gutiérrez-Sida C, Mireles-Acosta J, Tirado-Medina H (2010) Emotions and pro-environmental behavior. In: Corral-Verdugo V, García CH, Frías-Armenta M (eds) Psychological approaches to sustainability: current trends in theory, research and applications. Nova Science Publishers, México, pp 247–266
Vanderheyden V, Van der Horst D, Van Rompaey A, Schmitz S (2014) Perceiving the ordinary: a study of everyday landscapes in Belgium. Tijdschr Econ Soc Geogr 105(5):591–603. https://doi.org/10.1111/tesg.12066

Vaske J, Pallazza S, Miller CA, Williams B (2021) Attitudes, emotions, and acceptance of wolf management in Illinois. Hum Dimens Wildl. https://doi.org/10.1080/10871209.2021.1967526

Wilson EO (1984) Biophilia. Harvard University Press, Massachusetts

Wood N, Smith SJ (2004) Instrumental routes to emotional geographies. Soc Cult Geogr 5(4):533–548. https://doi.org/10.1080/1464936042000317686

Zelenski JM, Desrochers JE (2021) Can positive and self-transcendent emotions promote pro-environmental behavior? Curr Opin Psychol 42:31–35. https://doi.org/10.1016/j.copsyc.2021.02.009

Zylstra MJ, Knight AT, Esler KJ, Le Grange LL (2014) Connectedness as a core conservation concern: an interdisciplinary review of theory and a call for practice. Springer Sci Rev 2(1):119–143. https://doi.org/10.1007/s40362-014-0021-3