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How deep is your love – Of nature? A psychological and spatial analysis of the depth of feelings towards Dutch nature areas

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ABSTRACT

The most binding nature protection policy in the Netherlands and the EU primarily designates areas based on ecological value, ensuring their sustained protection. Of less concern to these policies are the current and future needs of the average citizen, who is experiencing increases in education, income, and health. This paper argues that although existing policies protect biodiversity needs, the spatioemotional needs of the public are of similarly high importance. We analyze the spatial and emotional characteristics of favorite natural places in the Netherlands selected on the Hotspotsmonitor survey. Content analysis of the open question, "Why is this place important to you?" identified three categories: peace & quiet, explore, and peak. These were mapped using GIS to identify predominant hotspots and compared against the most binding nature protection policy - Natura 2000. The important societal benefits of augmenting ecologically based nature protection policies with emotional valuation are discussed.

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1. Introduction

What nature is protected now and in the future are critical questions in land-use policy (Foley et al., 2005; Wu, 2013). Of equal importance is *why* nature is protected – the purpose behind the policy (Coeterier, 1996). However, currently, measures that support protecting nature for biodiversity value are far more developed than those for psychological appreciation (European Environmental Assessment (EEA), 2009; 2012; Milcu, Hanspach, Abson, & Fischer, 2013).

In the aim to deepen our understanding of nature protection and public appreciation, the present paper investigates the relationship between biodiversity protection and the psychological appreciation of natural areas. Our study combines macro scale mapping of attractive nature areas and policy boundaries (Sijtsma, Daams, Farjon, & Buijs, 2012) with a micro scale study of individual psychological nature experiences. The paper seeks to assess whether and to what extent highly attractive natural areas overlap

with areas that are officially 'protected' for their biodiversity value. A key part of our assessment is to explore more deeply how nature areas differ in the extent to which they reflect distinct categories of emotion. Focusing on the Netherlands, we contribute to what Alessa, Kliskey & Brown call 'socio-ecological hotspot mapping,' known as the investigation of areas of spatial representations of social and ecological convergence (2008, p. 27).

1.1. Nature protection and public appreciation

Biodiversity is declining at the global and the European level (Chapin et al., 1998; Dobson, 2005; Millennium Ecosystem Assessment (MEA), 2005; Smith et al., 2000; Swift et al., 1998). To prevent further losses, the European Union (EU) has created an ecological network of nature conservation areas, entitled Natura 2000, which was established under the Habitats Directive (92/43/EEG) and Birds Directive (2009/147/EG). The purpose of this policy is to assure the long-term survival of Europe's most valuable and threatened species and habitats (EU Council Directive, 1992). Protected habitats include mostly natural, but also some areas with human impact, such as traditional farmland (Evans, 2006; Martinez, Ramil & Chuvieco, 2010). Although 17% of Europe has been designated as a Natura 2000 area, 60% of protected species

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and 77% of protected habitats have an unfavorable conservation status (EEA, 2015), in large part due to environmental pressures such as habitat fragmentation, climate change, intensive land use and inappropriate management (Balmford et al., 2005; Chapin et al., 2000; Mack et al., 2000; Thomas et al., 2004). In the Netherlands, only 23% of species and 4% of habitats have a favorable status (EEA, 2009).

The restoration of favorable conservation status requires action in various sectors by different parties. To gain public acceptance and involvement, information on how much and why the public appreciates nature areas is important and worthy of serious consideration (Smith, Davenport, Anderson, & Leahy, 2011). The current Netherlands Natura 2000 policy has been criticized as too technocratic as it focuses only on ecological protection (BIO Intelligence Service, 2011). Recent research finds that some successful Natura 2000 sites have nationally mandated local management and engagement (Petrosillo, Zaccarelli, Semeraro, & Zurlini, 2009). However, words like 'biodiversity' and 'Natura 2000' are still not commonly known to the wider public (European Commission (EC), 2013). To increase citizen knowledge of the value of biodiversity for human well-being, policy efforts have been taken to promote the identification, mapping, and valuation of ecosystem services (Maes et al., 2012). The Millennium Ecosystem Assessment (MEA) identifies four ecosystem services – provisioning, regulating, supporting, and cultural (2005). Cultural ecosystem services are most relevant to this study as a proximate measurement of nature appreciation and 'well-being.'

Cultural ecosystem services are defined as the "nonmaterial benefits people obtain from ecosystems," such as aesthetic and spiritual appreciation, or, reflection and recreation (MEA, 2005, p. 40). Although these services are most directly related to the current needs of the wider public, they are reportedly in decline and are often not properly considered in real decision contexts (Gee & Burkhard, 2010; Schaich, Bieling, & Plieninger, 2010; MEA, 2005). While the Natura 2000 policy does not turn a blind eye to human needs (i.e., some sites allow recreation), site designations do not consider cultural services such as aesthetic and spiritual emotions in nature. As such, the extent to which public appreciation of nature areas overlaps with Natura 2000 areas, and what that appreciation looks like, remains an open question.

When viewed from a long-term planning perspective, this question is further amplified considering that, on average, European citizens are experiencing greater life expectancy, education attainments, and health outcomes (EC, 2010; Malik, 2013). In particular, the Netherlands Human Development Index score ranks among the top in the EU in maintaining a healthy, high-income, and well-educated population (Malik, 2013). In this paper we build conceptually on the human development idea, which asserts that when basic physical and social needs are met, non-materialistic values and growth needs such as self-actualization and transcendence may become more important (Inglehart, 1995; Maslow, 1970). The ecosystem services of nature and landscape may therefore have 'shifting roles' in human development over time. In the early stages, when basic needs are of primary importance, provisioning services (e.g. food from agricultural production) may dominate development and nature appreciation; whereas later, cultural services such as nature experiences may also become prominent. The implication is that, over time, shifts in development may lead to shifts in why we appreciate nature – i.e., first for food and then later for food as well as aesthetic appreciation and emotional nature experiences.

1.2. Understanding nature experiences

Previous research has identified and/or grouped nature

experiences in various ways.¹ One commonly adopted framework measures our immediate response to nature on a grid of two bipolar dimensions: pleasant to unpleasant and low-to-high arousal. Here, a pleasant high arousal response could be excitement (Russell, Weiss, & Mendelsohn, 1989) and a pleasant and low arousal nature experience could be relaxation, or, peace and quiet – emotional experiences commonly reported in nature (Davis & Gatersleben, 2013; Korpela & Hartig, 1996; Pearce, 2005; Tyrvaäinen, Mäkinen & Schipperijn, 2007). Other frameworks suggest nature experiences may exist on a continuum where one experience allows for another such as clearing away thoughts, or being away (escaping physically or psychologically daily routines) allowing for deeper contemplation (Hartig, Mang, & Evans, 1991; Kaplan, 1995; Korpela, Ylén, Tyrvaäinen, & Silvennoinen, 2008). Being away is a feature of Attention Restoration Theory (ART), a theory which posits that exposure to four restorative components of nature can recover depleted cognitive resources and increase positive emotions. These components are: being away, compatibility between the environment and the visitor's goals, a sense of fascination, and extent, defined as the realization that one's immediate environment is connected and has scope, allowing for exploration (Hartig et al., 1991; Kaplan & Kaplan, 1989; Kaplan, 1995; Staats & Hartig, 2004; Van den Berg, Jorgensen & Wilson, 2014; Ward-Thompson, 2011).

Along these same lines, time in nature can increase a sense of freedom through exploration and vitality (Hartig et al., 1991; Ryan et al., 2010). Research has found that confronting challenges in nature can lead to a sense of mastery and competence (Herzog & Strevey, 2008; Kaplan & Kaplan, 1989). These more physical nature experiences can induce higher levels of arousal.

Finally, people also report transcendent or spiritual experiences in nature (Kler, 2009; Maslow, 1970; Williams & Harvey, 2001), representing 'higher' nature values (Sijtsma, van der Heide, & van Hinsberg, 2013). These experiences tend to be infrequent (James, 1902; Maslow, 1970) and can include a sense of unity, timelessness, and harmony (Csikszentmihalyi, 1992; Williams & Harvey, 2001). These experiences also tend to occur in more varied, wild, or remote natural environments (Davis & Gatersleben, 2013; Williams & Harvey, 2001), and can inspire environmental perspectives (Fredrickson & Anderson, 1999; Kaplan & Kaplan, 1989).

Building on the suggestion of Sijtsma et al. (2012) that there appear to be large nature areas in the Netherlands that inspire 'deeper feelings,' this paper aims to specify and map distinct emotional nature experiences and compare them against Natura 2000 sites which are protected for their biodiversity. Building on the theoretical work discussed above, we categorize the open ended micro data of respondents' statements of why they find a nature area attractive and combine it with macro level mapping techniques (see Method section).

Mapping cultural ecosystem services in a scalable manner is a challenging task that requires working across disciplines and scales. Researchers have mapped attractive natural places (Bijker, Mehnen, Sijtsma, & Daams, 2014; De Vries et al., 2013; Sijtsma et al., 2012), well-being (Brereton, Clinch & Ferreira, 2008; Pellenbarg & Van Steen, 2011), nature values and preferences (Ribiero, Migliozi, Incerti, & Correia, 2013; Tyrvaäinen et al., 2007). Still, more work needs to be done connecting macro and micro scale measures. On the one hand, the majority of nature experience research relies on established quantitative scales and analyses are

¹ We use the term 'nature experiences' broadly in reference to research on experiences in nature, including work on the health and psychological benefits of nature, such as increased positive emotion (e.g. Berto, 2005; Hartig, Evans, Jamner, Davis, & Garling, 2003).

Fig. 1. A conceptual model of higher needs demands on land use across time.

typically conducted at the micro level of the individual (e.g. Hartig, Korpela, Evans, & Garling, 1997; Mayer & Frantz, 2004; Schultz & Tabanico, 2007). On the other hand, as Bieling, Plieninger, Pirker & Vogl (2014) note, the majority of mapping research on cultural services asks participants to pinpoint where nature values – pre-identified by experts (e.g. resource managers) – occur (Alessa, Kliskey, & Brown, 2008; Brown, Raymond, & Corcoran, 2007; Plieninger, Dijks, Oteros-Rozas, & Bieling, 2013; Rolston & Coufal, 1991).

In this paper, through an online participatory GIS survey (PGIS), we ask participants to mark the natural place they find most attractive and describe, in their own words, why this is so. We use these ‘double-open’ data, open in the geographical marking as well as open in the reasons for marking, to first map which nature areas the Dutch visitor finds attractive compared to the ecologically-rich Natura 2000 sites, and then, to identify the distinct emotions reported by visitors, and whether they differ for different nature areas.

1.3. Aims and hypotheses

Since nature conservation requires long-term policy action and public support, our central argument is that policymakers need an in-depth look into particular cultural ecosystem services such as aesthetic and emotional appreciation of nature. Recent research has found that now and in the near dependence on provisioning ecosystem services is declining and dependence on cultural services is rising (Guo, Zhang, & Li, 2010).² While we cannot observe the future value of nature areas directly from current emotions and appreciation, if a specific nature area generates a strong emotional experience, this could indicate long-term value. Indeed, theorists have suggested that our aesthetic responses to nature are an expression of underlying human needs (Kaplan & Kaplan, 1989).

Fig. 1 presents this idea conceptually, where ‘higher’ nature-related needs (self-actualization) emerge as basic needs (provisioning services) are met over time and shows how this may have

implications on appreciation for different natural areas. When interpreting Fig. 1, two points are noteworthy. First, although basic needs could be seen as becoming less prominent over time, they have to be met continuously and simultaneous to support other needs. Second, the land use surfaces depicted are meant to convey the idea of increasing importance in appreciation over time and are not meant to be interpreted as realistic projections.

Building on this conceptual framework, we have three goals and associated hypotheses:

- (1) To determine whether and how attractive nature areas, as perceived by the average Dutch citizen, overlap with Natura 2000, including what nature types this overlap represents. We hypothesize that there may be substantial differences between Natura 2000 areas and appreciated areas.
- (2) To categorize the emotional responses of a sample of citizens by analyzing their statements about appreciation of specific natural areas. We hypothesize that it is possible to indicate the importance of areas in relation to different emotional experiences.
- (3) To assess if goals 1 and 2 are connected by exploring whether nature areas differ in terms of what needs they serve and to which extent. We hypothesize that different nature areas will generate different emotional profiles.

1.4. Method

1.4.1. Sample data

The Hotspotmonitor (HSM) is a recently developed online survey tool, see De Vries et al. 2013, with the broad purpose of determining what natural areas people find attractive in order to better inform land use policy (www.hotspotsmonitor.eu). The data used in this paper were derived from the survey database as per December 2014. The survey respondents were asked to mark – using a XY-point location marker – which nature area they find most ‘attractive, valuable or important’ on a national map of the Netherlands in a Google Maps-based environment and then to answer several questions regarding that place. While the designation of a nature area as particularly attractive or important supports

² Guo et al. used “roundwood production, hydroelectricity generation and tourism investment as the indicators of human well-being yielded from provisioning, regulating and cultural services, respectively” (2010, p. 2).

the systematic assessment of non-monetary values in landscape impact evaluations (Sijtsma et al., 2013), the open-ended responses about why this area was chosen might identify people's emotional experiences in these areas. However, only certain hotspotmonitor surveys contain open-ended responses. Thus, for analysis two datasets from December 2014 were used. One dataset, representative of the Dutch population, was used for our main spatial analysis of highly attractive areas. The other dataset contains the open-ended text responses of participants.

The first dataset contains all data for respondents sampled from the GfK internet panel – the internet panel with the highest spatial coverage of the population throughout the Netherlands (De Vries et al., 2013; Sijtsma et al., 2012). In terms of its socio-economic profile, these data are representative of the Dutch population, because the data is acquired with the prerequisite that respondents be representative. The average age of respondents is 48 years and 46% have a university or higher vocational degree. This combined set contains 8908 individual responses (markers). We use this set because its large sample size provides the largest spatial precision for the delineation and analysis of hotspot areas – areas that are appreciated by the general Dutch public.

The second dataset contains data from members of Natuurmonumenten, the largest private nature conservation organization of the Netherlands (~750,000 members). The data are drawn from a HSM survey of Natuurmonumenten members (Sijtsma et al., 2012). Most distinctive about this dataset is that it contains open-ended responses about why the selected nature area is attractive to respondents, allowing for textual analysis. The sample in this dataset differs from the more representative GfK set in three respects: they are members of a nature organization, which indicates their support for nature protection; they are older with an average age of 56 years; and they have attained higher education levels (67% have a university or higher vocational degree). The Natuurmonumenten set contains 1728 individual responses (markers), 14 of which were excluded from spatial analysis because they were plotted outside Dutch municipal borders, leaving $n = 1714$ markers (Statistics Netherlands & Netherlands Cadastre, Land Registry and Mapping Agency, 2013).

1.5. Delineation of attractive hotspot nature areas

Using the XY-point location of attractive natural places identified by respondents in the representative GfK panel dataset, we cluster the markers to spatially delineate wider hotspot areas of attractive nature areas and landscapes.³ This allows us to later on assess bounded areas for overlap with Natura 2000 areas, and to analyze variation in the frequency of emotions associated with HSM point-designations within each hotspot area.

To designate hotspot areas based on the 8908 national markers (Fig. 2), we use a measurement approach based on point density that is similar to the approaches in De Vries et al. (2013) and Daams, Sijtsma, and van der Vlist (2016); the latter also provide a visual scheme of the measurement approach. De Vries et al. (2013) delineates hotspot areas at the scale of regional landscapes, as we aim to do as well, rather than to delineate hotspot areas at the scale of smaller – lesser appreciated – areas; therefore, in our point density analysis we apply the same parameters. More specific, first a raster grid of 250×250 m cells is constructed and covers the Netherlands entirely. Then, for each grid cell the density of HSM markers within

a 5 km radius from the cell's centroid is measured. Thereafter all grid cells with densities that exceed 0.4 markers/km² (within the radius around the grid cell) are merged. This merging of contiguous grid cells that are surrounded by high densities of markers creates our measure of hotspot nature areas that are highly appreciated for their attractiveness.

1.6. Natural land use and protection data

Data on Natura 2000 areas are obtained from the European Environment Agency. These data delineate 201 Natura 2000 areas within the Netherlands. In this paper we also use descriptive analysis as well as basic regression analysis to explore the extent to which different natural land uses are included within Natura 2000 areas and hotspot areas of appreciated nature.⁴ The nature types data were derived from the Nature Basemap 2013, which measures land use on a 25×25 m grid across the Netherlands.⁵ In this dataset, land uses are categorized in thirteen classes, of which we remove two, 'infrastructure' and 'built area', so that only 'natural' land uses (including agricultural land use) remain. A wide definition of natural land use is used since this does not influence our definition of nature areas, as it refers to natural land uses within Natura 2000 areas or hotspot areas that people perceive as attractive nature. In terms of land-based area, 11.9% of all observed natural land use is located within Natura 2000 areas.

1.7. Content analysis

To investigate why respondents found a particular area attractive, we performed a content analysis; a method whereby in-text patterns and themes are identified for the purpose of creating and coding categories with specified criteria (Krippendorff, 1980; Stemler, 2001). Spatially-explicit data have been derived from the following question: "Please indicate, in your own words, what makes this exact spot attractive to you." Ranging in length from 1 to 250 characters, responses were inductively analyzed through the following coding process. First, responses were read independently by three coders. Second, codes were recommended, discussed, and finalized collectively. Third, all three coders met in the same location, where, after each had privately re-read and coded a response, decisions were shared aloud and discrepancies were resolved through discussion.

Through this process thirteen emotion codes were identified, many of which reflect different aspects of the nature experience theories and research outlined above, including affective appraisals and attention restoration theory. Some codes emerged that were not as clearly a part of past research, such as nostalgia. Because only 27% of all markers contained explicit emotional content, we categorized them into three groups as a necessary means of reaching critical mass for the spatial analysis. The first and third groups, '1-Peace & Quiet' and '3-Peak,' align most clearly with previous research. A second group '2-Explore' reflects research on a sense of vitality and freedom when exploring in nature (Ryan et al., 2010),

⁴ We analyzed spatial overlap between land uses and hotspot areas rather than the underlying Hotspotmonitor point-markers because the latter would likely lead to over-precision. The point-markers typically designate wider attractive areas, at a national scale, and as such may not pinpoint the specific local land uses that HSM respondents perceive as attractive. Attractive nature areas also include a mix of land use types (Daams et al., 2016), further motivating our choice to analyze overlap with land uses types at the scale of nature areas rather than point-locations.

⁵ This dataset in turn is based on data on land use from the Netherlands Cadastre, Land Registry, and Mapping Agency, Statistics Netherlands, and Staatsbosbeheer – the Dutch national forestry service that is commissioned by the central government to manage nature areas (Kramer & Clement, 2015).

³ It is possible that clusters may be slightly over-identified in regions where relatively high numbers of respondents are sampled; as such, we checked this following Daams et al. (2016) and found that it has a minimal impact on our national-scale analysis.

Fig. 2. (Left) Markers from stratified Hotspotmonitor (HSM) surveys representing the perceptions of favorite nature areas by individuals; (Center) hotspot areas identified from clustering of HSM markers, thus representing nature preferences of the larger public; (Right) overlap between Hotspot areas and Natura 2000 areas, on natural land; circled are 'misfit' areas.

but which, to the best of our knowledge, has not been previously 'grouped' as a nature experience.

2. Results

2.1. Appreciated hotspots and protected areas

Fig. 2 addresses the first goal of the paper – to identify the extent of overlap between appreciated hotspots and Natura 2000 areas. The three maps show the appreciated areas chosen by individual respondents (left), the hotspot clusters indicating intensely appreciated areas (middle) and the overlay and misfits of those clusters with Natura 2000 protected areas (right). The analysis shown in the right map indicates an overlap of 63%. Results show great overlap in some areas and limited overlap in others. The larger Natura 2000 areas are all mostly identified as appreciated hotspots. The areas of greatest overlap are near the northern and western coast (e.g. Meyendel, Coepleduynen, Kennemerland, the North-Holland dune reserve, and the dunes of the Wadden Islands); the same situation applies for inland Natura 2000 sites: the forest area of the Veluwe, the heathlands of Dwingelderveld, Sallandse Heuvelrug and Loonse, Drunense Duinen, and the swamps of Oostvaardersplassen, Biesbosch, Wieden and Weerribben, and Lauwersmeer (see more on the map online under 'additional materials').

Three large areas were identified where the attractive nature area markers did not overlap with Natura 2000 areas. The largest misfit is the vast space in the middle of the Netherlands known as the Utrechtse Heuvelrug (a in Fig. 2), a hilly, forested area not designated as a Natura 2000 site. The second largest misfit is Zuid-Limburg (b in Fig. 2), situated in the south-east, which can be characterized as a hilly, mosaic landscape with small patchy nature areas (some are Natura 2000 sites) along with extensive agriculture. In this landscape the cluster of markers – of average Dutch citizens – differs from the small patches of the protected nature areas. The third largest misfit between Natura 2000 and appreciated areas occurs in Walcheren (c in Fig. 2) in the south-western part of the Netherlands on the North Sea coastline. This area includes both the sand dunes designated as Natura 2000 sites as well as the non-designated agricultural grasslands situated behind the dunes. In sum, although the collective hotspot areas show considerable overlap with Natura 2000 area, 39% of the 8908 individually placed markers considered here do not fall within Natura 2000.

Fig. 3 demonstrates that the overlap between protection and appreciation varies across nature types. The black bars show how much different types of nature are protected by Natura 2000. Using

the areas from the cluster analysis, the dashed bars show how much this nature type is appreciated in our data and is a part of Natura 2000. The most overlap is visible for dunes and coastline followed by heath and shifting sands, reed swamp, and forest. A regression analyses indicated a similar variation among the different nature types inside and outside Natura 2000 areas ($r^2 = 0.83$; $y = 0.80x + 19.16$; $p < 0.05$ with x and y as the proportion of a nature type in hotspot clusters within- and outside Natura 2000 areas). The regression line lies above the $y = x$ line, indicating that the level of appreciation per nature type is in general higher inside rather than outside Natura 2000 areas.

In addition, the proportion of the various nature types in hotspot areas is positively correlated with the proportion of these nature types in Natura 2000 sites ($r^2 = 0.66$ $y = 0.78x + 1.84$, $p < 0.05$), which suggests that designation of Natura 2000 areas is, in general, positively related to the appreciation of the nature types by the general public. Exceptions are agricultural pastures and ordinary fields, which are sometimes highly appreciated (e.g. in the hilly south), but have not been designated as Natura 2000 areas.

2.2. Classifying distinct nature-related emotions

In order to address the second goal of the paper to categorize the emotional responses of a sample of citizens, we analyzed open-text answers of members of the Dutch nature organization Natuurmonumenten. Of the 1714 responses, 3654 individual codes were identified (i.e., many responses contained several codes). These included nature features⁶ (e.g. bog, animals) (51%) as well as 'activities engaged in' (9%) and 'other characteristics' (12%), such as economic value (3%), or accessibility (2%). Of the 3654 individual codes, emotions were identified in approximately 27% of the content (982/3654; see Table 1) and represented the various 'cognitive, motivational and somatic' components of emotions (Moors, Ellsworth, Scherer, & Frijda, 2013, p. 123).

Table 1 presents the frequency and percentage of sub-emotions in each emotion category and gives textual examples. 'Peace and Quiet-1' experiences include a sense of being away (e.g. from the everyday or city life), cognitive relaxation, rest, and peace. 'Explore-2' experiences entail feeling alive, invigorated, and free to explore. 'Peak-3' experiences include a sense of awe, timelessness, feeling overwhelmed, and a general or personal connection to nature. One

⁶ Consistent with the majority of appreciated attractive areas identified in the first analysis by the representative sample, forests (13%), dunes, and beaches (10%) were mentioned most often.

Fig. 3. Amount of each nature type's total area that is designated as Natura 2000 and within a hotspot area per nature type. In parenthesis, the total area of each nature type within the Netherlands is provided.

Table 1
Sub-emotions in each category^a.

Group and sub-categories of emotions	Frequency Sample quote		Sample quotes
	abs	%	
Peace & Quiet – 1			
1. Rest	97	9.9%	'The sea, rest; you will come to rest.'
2. Being Away	230	23.4%	'It's a whole different world than the world of everyday life'
3. Peace; Calm	239	24.3%	'tranquility in nature'
Explore – 2			
4. Alive; Invigorated	24	2.4%	'Inviting nature!' 'the roaring surf, stormy weather!' 'feel alive – the power of nature!'
5. Freedom; Wandering	140	14.3%	'carefree wandering,' 'I must go as far as possible'
Peak – 3			
6. Connectedness all nature	62	6.3%	'Dear and intense moments ... so dynamic, autonomous, strong presence, but also vulnerable'
7. Overwhelmed	55	5.6%	'the immensity of nature in which man seems a tiny crumb'
8. Connected self with nature	50	5.1%	'was here as a child for the first time and was over-whelmed by the shifting sands'
9. Timelessness	48	4.9%	'The endless vastness and emptiness of these beaches,' 'The sea is the end for me'
10. Sense of divine	10	1.0%	'Lovely sanctuary' 'exactly, salvation'
11. Fascination, Awe	27	2.7%	'Awesome!'
Total sub-emotion codes	982	100.0%	

^a More than one sub-emotion category was coded for several responses, thus the N of sub-emotions (982 in Table 1) is higher than the N of emotion categories (795 in Table 2 below).

to three percent of the responses contained sub-emotions in more than one category (e.g. Peace & Quiet and Explore).

Table 2 presents the prevalence of the three each emotion categories out of all responses and all emotion codes. Of the initial 13 emotion codes identified, 11 were grouped into categories. Two codes - 'nostalgia' and 'beautiful' - were not categorized. 'Nostalgia' was mentioned in 2.85% of responses, but analysis revealed it was not spatially-dependent (i.e., located where respondents were born and/or raised). 'Beautiful' arose in 8.37% of responses but was difficult to categorize because it was unclear whether the term referred to an emotion or objective description (see this issue in *Natural England, 2009* and *Zube, Sell, & Taylor, 1982*).⁷ Nevertheless, responses that included the word 'beautiful' as well as other emotional terms were included in the analysis.

If a respondent reported at least one of the sub-emotions in a

given category, they were recorded as having experienced that category. As mentioned before, because several sub-emotions were reported in single responses, the number of sub-emotions (982 in Table 1) is higher than the total emotion categories codes (795 in Table 2).

2.3. Spatial differentiation in emotions

The third goal of this paper was to determine whether nature areas differ based on emotions reported and if so to what extent.⁸ Fig. 4 shows the results of all three emotion categories together on a

⁷ In *Russell et al. (1989)* grid of affective descriptors, 'beautiful' falls clearly on the 'pleasant dimension' but indistinguishably on the line between high and low arousal, indicating the difficulty in cleanly categorizing it as an 'emotion'.

⁸ A comparative analysis of the two (GfK and Natuurmonumenten based) samples of HSM markers revealed that these have a nearly identical coverage over the hotspot cluster areas, indicating proximal representativeness of the hotspot cluster areas for both samples of markers: of the GfK hotspot markers, which represent the general Dutch public and from which the hotspot cluster areas are delineated, 63.1% fall within the cluster areas; and for the Natuurmonumenten sample (on which no cluster analysis is performed) these same hotspot cluster areas enclose 60.9% of the markers.

Table 2
Emotion categories.

	All emotions categorized		All emotions categorized as % of all responses (N = 1728)
	abs	%	
Peace & Quiet- 1	461	58.0%	26.7%
Explore - 2	157	19.7%	9.1%
Peak - 3	177	22.3%	10.2%
Total	795	100%	46.6%

Note: The totals for each emotion category were determined by giving that category a '1' if any of the sub-emotions within that category were present in a response.

Fig. 4. Overall emotion category density.

continuum - the darker the area, the more emotions reported. The clusters containing the highest percent of emotions, i.e., the areas that evoke the most emotional appreciation, represent the highest level of cultural ecosystem service delivery.

These include in the Wadden Islands, specifically, Terschelling, Vlieland, and Schiermonnikoog, as well as the rural, forested, landscape of Borger, the Vechtdal river valley near Ommen, and the Winterwijk area, characterized by rural landscapes with streams. The clusters show the highest recorded emotions per category – this suggests that while all hotspot areas are highly appreciated, some may evoke (certain) emotions much more than others.

To explore whether different nature areas are linked to the experiences of different emotion categories, we looked at the dominance (percentage share) of the different categories in the overall responses for an area. This combined spatial cluster and psychological experience analysis revealed differences between the spatial distributions of distinct emotion categories across hotspot areas (see Fig. 5). Peace & Quiet-1 showed the highest percentages in the Wadden and Borger areas, which are predominantly coastal and rural landscapes. Explore-2 showed the highest percentages in Oisterwijkse bossen, a forest in the southern part of the Netherlands, in Oostvaardersplassen, a swamp in the central part,

and in the Wieden and Weerribben, a national park known for its wet semi-natural grassland and swamps (Fig. 5; see #14 on center map), amongst other nature reserves. Peak-3 emotions showed the highest percentages in nature areas in the eastern part of the Netherlands, e.g. the countryside river valley of Vechtdal (the Valley of the River Vecht) and the forest of Groesbeekse bos. Some emotion categories overlapped with Natura 2000 areas more than others, although differences are small. Explore-2 overlapped the most with Natura 2000 (67.0%), followed by Peak-3 (65.0%), and Peace & Quiet (58.4%).

3. Discussion

Overall the results highlight the possibilities and importance of measuring and mapping cultural ecosystem services to support decisions on which natural environments are protected. These decisions can now be based on measurements of both ecological and emotional value. There has long been a heated debate as to whether natural landscapes should be protected for their ecological or aesthetic value (Gobster, Nassauer, & Daniel, 2007; Nelson & Callicott, 2008). This paper has added new insights to this debate by focusing on measurement of the emotional responses in protected and non-protected nature areas.

Our study explored three specific avenues of inquiry. First, we examined whether appreciated nature areas, as perceived by the average Dutch citizen, overlap with protected Natura 2000 sites. We found a significant amount of overlap in the discovery that many Natura 2000 areas are highly appreciated, but also found several non-Natura 2000 areas similarly valued. Second, we were also able to identify and categorize the reasons why a sample of citizens appreciated a particular natural area. Some of our results reflect previous research, and some reflect new avenues of inquiry. Third, we inquired into whether and how different nature areas serve different emotional needs (e.g. attractive vs. peace and quiet vs. peak experiences). Each of these avenues will be discussed in turn below, before we turn to policy implications.

4. Appreciation and Natura 2000

Our hypothesis that there are substantial differences between Natura 2000 areas and attractive nature areas was partially supported. By and large there was a significant overlap between attractive nature areas and Natura 2000 areas, lending some support to the idea that the ecologically healthy nature is seen as attractive (Gobster, 1999; Tveit, Ode & Fry, 2006). Challenging the European biodiversity monitor's conclusion that the wider public is not familiar with Natura 2000, our results show that Natura 2000 areas are highly appreciated by the general public and nature conservation supporters.

However, there were also several areas of misfit between appreciated and protected nature. Most of these areas are diverse landscapes situated at the boundaries of Natura 2000 sites. Specifically, the misfits on the north-western and south-western

Fig. 5. The share of markers associated with any of the three classified emotions (level 1, 2, and 3) within each cluster, relative to the number of all markers from the Natuurmonumenten sample. While the given absolute shares are comparable across the three sub-maps, the coloring of hotspot areas allows for a visual assessment of the spatial distribution of each of the three emotions individually, through using a Jenks natural breaks classification.

islands contain some protected areas (i.e., Natura 2000 or the Dutch National Ecological Network) and surrounding non-protected areas, such as grasslands around the islands that are often rich in agricultural birdlife. The misfit in these areas could be due to several factors – these sites could be favored for their varied natural or agricultural landscapes, or, for their different species and habitats, all of which policymakers might consider worthy of national or international protection. These misfits may also be the result of individuals who do not formally perceive the legal boundaries of a protected nature areas, or the imprecise nature of the point selected, a limitation in the new field of participatory PGIS (Alessa et al., 2008). Our method of clustering markers only by their locations may have led to clusters that were wider than the designated nature areas and as a result, encompass developed land in-between or beside, natural land.

In addition, similar to commonly designated as Natura 2000 nature types – forests (32.3%), coastal saline habitats (16%) and inland sand dunes (1.6%) (Mucher, Hennekens, Bunch, & Schaminee, 2009) – our results revealed that dunes, coastline and forests represented much of the overlap between appreciated nature and Natura 2000 areas. This result suggests that creating nature policies that protect these types of nature for ecological value could be further legitimized by the emotional value the Dutch public attributes to these nature types. This attachment however could be due to respondent's explicit knowledge that the area is protected or the unique role of particular ecological features (i.e. perceived clear air, limited pollution) or emotions (sense of peace or unity). To investigate this question further, we explored whether we could identify, categorize and then map why respondents selected a particular nature area as attractive.

5. Identifying and mapping emotions

Three categories of emotional nature experiences were identified using content analysis: Peace & Quiet-1, Explore-2, and Peak-3.

Across all categories the highest densities were evident in large nature areas along the coastline and scattered in the central part of the country. Peace & Quiet-1 was reported most often and represents the majority emotion in almost every high marker density region, echoing the suggestion that this type of experience (being away, sense of rest) may be more easily accessed psychologically than others (Hartig et al., 1991). However, specific emotion categories emerged in some areas more than others.

The Wadden and Borger areas, with coastal and rural landscapes, showed relatively high levels of Peace & Quiet-1 markers. Explore-2 markers exhibited unique regional representations in several national parks and nature reserves, e.g. the new wilderness area the Oostvaardersplassen. Peak-3 emotions predominantly occurred in remote central and eastern countryside and forested areas, confirming previous research that 'intangible' nature experiences are infrequent and tend to occur in sometimes distant and varied nature (Alessa et al., 2008; Davis & Gatersleben, 2013; Williams & Harvey, 2001).

By merging micro level psychological experiences with macro level mapping techniques, insights have emerged, but we believe further work in three areas will clarify these insights. First, the use of an open-ended question to determine why participants chose a particular natural area uncovered a relatively understudied nature experience, nostalgia, which manifested in different ways – nostalgia for childhood natural areas, historic sites and old growth nature (i.e., old forests). While work in cultural heritage preservation represents nostalgia for historic sites, nostalgia for childhood nature and old growth nature are important areas to explore in future work. To improve the scalability of this method, future iterations of the hostpotsmonitor will integrate a validated emotional nature experience scale that considers existing work and the experiences uncovered in this qualitative analysis.

Second, researchers should expand hotspot mapping to more fully merge micro and macro scale measurements (Brown and Kyttä, 2014), by creating Google 'Street view' for nature areas or

linking photo-oriented landscape atlases (e.g. European LUCAS database at <http://ec.europa.eu/eurostat/web/lucas/lucas-photo-viewer>) to ratings of attractiveness. This could also lead to a sample of local hotspot areas that is, unlike the sample in the current study, sufficiently large to correlate hotspot areas' features with emotions in future research. As a scalable method for policy analysis, this information would greatly inform what land to protect in long-term nature conservation policy – a need highlighted by the European Commission (2014). Third, this paper drew to some extent on Maslow's hierarchy of needs framework to show its parallel in shifting land use needs (see Fig. 1 and Guo et al., 2010). While no measure of this was explicitly assessed in the study, research should continue to explore parallels between psychological motivations, human development, land use and nature experiences (see Kler, 2009) to determine if nature experiences occur on a continuum where one experience opens the door to another (Korpela et al., 2008).⁹

6. Differences in nature areas profiles

The third goal of this paper was to explore whether nature areas differ in their emotional importance. The hypothesis that nature areas would show different emotional profiles was supported. However, we found that across highly appreciated/emotional clusters, different emotional experiences were reported in different areas. For instance, particular areas – such as the Wadden Islands, and central and eastern forests – represent areas with a high emotion marker density but, Peace & Quiet-1 experiences were most pronounced in the former, and Peak-3 experiences in the latter. This work suggests that existing and/or new nature protection policies can be augmented with information on public appreciation, allowing policy-making to integrate socio-ecological trends and public sentiment.

7. Policy implications

Whereas spatial planning in the Netherlands and nature protection planning, in particular, is considered an intensive process that balances the needs of the people and the environment (Faludi, 1991; van Schaick & Klassen, 2011), current nature protection policy in the Netherlands and EU overwhelmingly refers to ecological motives rather than aesthetic or emotional appreciation of nature (Groote, Haartsen, & Van Soest, 2006; Willis & Birks, 2006). This paper shows that emotional nature experiences can be monitored and assessed in terms of policy-relevant indicators. Across samples the same nature areas and nature types within these were appreciated, and different nature areas were found to satisfy distinct emotional needs.

These results not only support protecting areas rich in biodiversity, but also open the door to protecting areas which are highly appreciated but are declining in ecological value, such as existing Natura 2000 sites with low conservation status. By continuing to monitor whether the overlap between appreciated hotspots and Natura 2000 remains the same or evolves over time, future work will be able to track trends in policy prioritizations and gauge public sentiment towards new site designations.

Our analysis – consistent with the Dutch policy goal of including the public in nature conservation (Economische Zaken (EZ), 2014) – revealed that much of the current policy prioritization is well-aligned with the public's emotional nature appreciation. However, expanding the survey to underrepresented groups as well as

residents in the proximity of Natura 2000 sites and visiting tourists, would be useful for local planning. Knowing which areas trigger an emotional response would benefit site managers in determining which areas need to be strengthened, particularly if tourists prefer to visit and pay for protected nature destinations. For the ~40% of hotspot markers that were outside of the Natura 2000 areas, areas with a high density of markers might be prioritized for national funding, whereas targeted or regional funding could support areas with less-pronounced densities.

Finally, we propose that the integration of emotional nature experiences into nature protection policy can have a wide variety of societal implications, particularly given increases in wealth, health, education and increasing dependence on cultural services (EC, 2010; Guo et al., 2010). Research has found that nature experiences (peak-or-otherwise), can lead to psychological expansion and inspire concern for issues beyond the self, such as pro-social and environmental behavior (Heylighen, 1992; Zhang, Piff, Iyer, Kolvela, Keltner, 2014; Zelenski, Dopko, & Capaldi, 2015). A failure to provide opportunities for psychological growth to an increasingly 'satisfied' citizen leaves few options, one of which is the so-called 'hedonic wheel,' where no matter the money or resources gained, happiness levels plateau (Diener, 2000).

8. Conclusion

In this paper we have examined appreciated nature areas and emotions about nature and how these two factors correspond to nature protection policy goals. We have demonstrated the use of a method to measure the emotional significance that different nature areas hold for visitors or fans. Although more research is needed to confirm our results, we have verified that the nature areas appreciated by respondents do indeed overlap significantly with Natura 2000 sites, thereby indicating a strong link between ecology and appreciation. We also found that measuring emotions in different categories reveals variations in public experiences of these areas. In this paper we have highlighted how the identification and mapping of 'spatial-emotional needs' provides added justification for the stringent protection of ecologically-valuable nature areas. In addition, we have confirmed through our methodological approach that legally-binding European nature policy does not automatically protect all of the highest-valued nature areas. Explicitly adopting emotional value as a reason for protection may be a logical next step for spatial planning strategies for the long-term 'well-being' of both nature and citizens.

Appendix A. Supplementary data

Supplementary data related to this article can be found at <http://dx.doi.org/10.1016/j.apgeog.2016.09.012>.

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⁹ As a caveat, Maslow acknowledges that the needs hierarchy is not rigidly linear (Maslow, 1969; 1993, p. 270).

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