Non-material nature's contributions to people from a marine protected area support multiple dimensions of human well-being

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Abstract

The non-material aspects of nature are frequently the most socially valued and demanded nature's contributions to people (NCP). This is because non-material NCP often lay the foundations of key human well-being dimensions such as identities, experiences, and capabilities. Yet, while research on material NCP such as food and water abound, studies of non-material NCP are relatively scarce. This research gap results in a limited understanding of the relationships between non-material NCP and human well-being, especially in the marine and coastal environment. To understand the relationships between non-material NCP and subjective human well-being, we surveyed 453 users of Litoral Norte—a multiple-use marine protected area in Portugal. Our survey included 16 statement indicators reflecting theoretical constructs of subjective well-being. Using factor analysis, we found that subjective well-being derived from relating to, interacting with, and experiencing marine and coastal sites can be grouped into four interpretable cultural dimensions of well-being. These dimensions are 'engagement with nature & health', 'sense of place', 'solitude in nature', and 'spirituality'. We also found statistically significant differences in reported levels of the four dimensions of well-being. Reported levels of well-being varied with interviewees' socio-economic characteristics and environmental behaviour. Our findings offer interesting insights for marine conservation practice and policy that aims to foster both biodiversity and human well-being.

Keywords Nature's contributions to people · Human well-being · Marine protected areas · Ecosystem services · Social-ecological systems · Factor analysis

Introduction

Cultural dimensions of human well-being related to nature are supported by what can be conceptualised as non-material nature's contributions to people (NCP), such as identities, experiences, and capabilities (Fish et al. 2016; Díaz et al. 2018). Interacting with nature develops people's identities through sense of place (Ainsworth et al. 2019), connectedness (Mayer et al. 2009), and spirituality (Heintzman 2009). Being in nature enables experiences through aesthetic

appreciation (Fletcher et al. 2014), inspiration (Oliveira and Berkes 2014), and opportunities for solitude (Borrie and Roggenbuck 2001). It can also enhance capabilities such as knowledge about nature (Plieninger et al. 2013), cognitive functioning (Berman et al. 2008), and physical and mental health (Hartig et al. 2014). While there is ample evidence that interactions between people and nature positively affect constituents of well-being (Ban et al. 2019), only a few studies have integrated systematically multiple elements of well-being in NCP or ecosystem services assessments (Bryce et al. 2016).

Assessing subjective well-being—a self-reported assessment of a person's overall well-being—can shed light on the motivations that lead people to interact and value nature. For example, recreational sea anglers and divers seek a wide variety of UK marine sites due to perceived values associated with engagement with nature, place identity, and health (Bryce et al. 2016). Stakeholders of marine protected areas (MPA) might value these areas as places of care, spirituality,

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freedom, and refuge (Pike et al. 2015). Coastal residents derive aesthetic pleasure, sense of place, and cultural identity as elements of a ‘fulfilled human life’ associated with living by the coast and relating to charismatic marine life and biodiversity (Ainsworth et al. 2019).

Examining relationships between people and the natural environment reveals limitations in the ‘instrumental vs. intrinsic values’ dichotomy that has been guiding environmental ethics and biodiversity conservation (Muraca 2011). People are not limited to choices and behaviour guided solely by the inherent worth (intrinsic value) or utility of nature (instrumental value), but also by how they relate to nature—emphasising the relevance of relational values (Himes and Muraca 2018). Relational values encompass a wide range of values about nature such as identity, care, stewardship, and reciprocity (Chan et al. 2016). They emphasise the importance of the bidirectional character of the people–nature relationship and the need for expanding the perspective about the values of nature to achieve sustainability goals and improve human well-being (IPBES 2015; Pereira et al. 2020). This relational notion of well-being reflects a eudaimonic approach to life—a good, meaningful, and worthwhile life—that can be explored to understand what fosters subjective well-being (Ryan and Deci 2001).

Multiple-use MPAs can contribute to human well-being in complex and numerous ways (Lester et al. 2009; Jentoft et al. 2012), although assessments on human well-being derived from MPAs are limited and empirical studies quantifying these relationships are rare (Rasheed 2020). Besides their material contributions such as seafood, seaweeds, or renewable energy, MPAs often encompass important sites for people’s non-material connections to nature (Potts et al. 2014). These connections arise through interactions between environmental spaces and cultural practices (Fish et al. 2016). Spaces of marine and coastal environments may include beaches, seascapes, and coastal waters, while cultural practices may comprise playing, gathering, and caring. Non-material NCP lay the foundations of the cultural dimensions of human well-being associated with the interactions between people and non-human nature (Russell et al. 2013). Yet research on NCP has been missing assessments of subjective and intangible NCP, resulting in a limited understanding of the relationships between non-material NCP and human well-being, especially in the marine and coastal environment (Garcia Rodrigues et al. 2017).

To shed light on the relationships between non-material NCP and human well-being, we explore the role of Litoral Norte MPA—a multiple-use MPA—in supporting cultural dimensions of subjective well-being. To this end, we ask the following research questions:

- What cultural dimensions of subjective well-being underlie the non-material connections between people and Litoral Norte MPA sites?
- How do people’s socio-economic characteristics and environmental behaviour affect cultural dimensions of subjective well-being?
- What insights of subjective well-being assessments can be drawn for MPA practice and policy?

Methods

Study area

Litoral Norte encompasses a dynamic marine social–ecological system located inside the municipality of Esposende in northern Portugal (Fig. 1). Since 2005, the MPA is an IUCN category V multiple use protected area. The MPA includes a Natura 2000 site—a site of Community Importance under the Habitats Directive of the European Union—designated to protect important habitats such as reefs, mudflats, dunes, coastal dunes, salt meadows, and estuaries. Litoral Norte MPA covers 8887 ha of which 14% are terrestrial and 86% marine.

The Portuguese government created the MPA in 2005, changing the legal status of the area which was classified as a protected seascape since 1987 (Regulatory decree 2005). Two governance institutions run the MPA: a steering committee—with executive power—and an advisory council. The steering committee is presided by a representative of the national institute of nature conservation—the institution that manages the MPA. The advisory council has representatives of the local municipality, non-governmental organisations, research institutes, local associations, and other civil organisations that advise the steering committee.

The objectives set by the government for the MPA include not only conserving biodiversity and seascape heritage, but also ensuring sustainable use of natural resources, and recovering depleted or overexploited resources (Resolution of the Council of Ministers 2008). Scientific studies in the area and environmental education are to be promoted. As are economic activities: (mainly) tourism and recreation that should be compatible with local ecological, aesthetic, and cultural values. Another goal of Litoral Norte is to promote sustainable development and the well-being of local populations.

The ecosystems of Litoral Norte MPA support the livelihoods of two fishing communities—Apúlia and Esposende—that rely on local fishery resources. MPA ecosystems are also important for gleaners who harvest sea urchins, octopus, gooseneck barnacles, limpets, mussels, and other marine organisms in the intertidal zone.

Fig. 1 Location of Litoral Norte Marine Protected Area. Map shows the main land-use types in the coastal fringe of the MPA

Litoral Norte beaches, estuaries, and seascapes are attractions for national and international tourists. Since decades ago, beach tourism has been one of the most important sources of revenue for the local economy. Owners of housing and hotel companies, restaurants, bars, and shops profit from seasonal revenues brought by tourists. Adding to beach tourism, the importance of nautical sports has been growing. The Cávado estuary and other Litoral Norte coastal areas have been increasingly sought after by

locals and tourists for surf, kitesurf, kayaking, and diving. Hiking and bird watching are also increasingly popular and contribute to the growing importance of nature tourism in the MPA.

Data collection

We did 453 face-to-face structured interviews between October and December of 2018 in Esposende—the Portuguese municipality where Litoral Norte MPA is located. We used

two sampling strategies: one for residents of the municipality, and other for non-residents (hereafter, visitors). Visitors are the people who visit the Litoral Norte area mainly for cultural or recreational purposes. Since we knew the number and distribution of residents in the municipality (INE 2018), we applied a stratified random sampling per municipality parish (351 interviews, 95% confidence interval, $\pm 5\%$ margin of error). For visitors, we only had estimates of the annual number of MPA visits. That is why we applied a convenience random sampling in places known to be frequently visited by non-residents (102 interviews, 95% confidence interval, $\pm 10\%$ margin error). In both sampling groups, we chose to interview people over 18 years. We pre-tested interview questions before implementing the survey to assess the suitability of the survey design.

To measure the cultural dimensions of well-being supported by the MPA, we asked survey respondents to report their degree of agreement with a set of indicator statements (Table 1). Survey respondents had to choose an option from a 5-point Likert scale for each indicator statement. The scale ranged from ‘strongly disagree’ to ‘strongly agree’. Indicator statements were intended to represent cultural well-being constructs relevant for users of the marine environment. The constructs we used reflect a eudaimonic conception of well-being (Ryan and Deci 2001). Constructs were selected based on human well-being frameworks (Max-Neef et al. 1990; Cruz et al. 2009) and on previous studies about the relationship between people and nature (Fuller et al. 2007; Chan et al. 2012a, 2012b; Tengberg et al. 2012; Dallimer et al. 2012). To measure subjective well-being, we relied on the same 15 indicator statements used by Bryce et al. (2016). Based on our literature review about the theoretical

constructs behind the indicator statements, we believe these statements are broad enough to encompass similar aspects in different geographies. In this sense, we applied them in our research in Litoral Norte MPA in northern Portugal to study the relationships between non-material NCP and subjective human well-being. We added one indicator statement reflecting ‘solitude’, because positive experiences of solitude in nature suggest that being alone in nature contributes to peace, tranquillity, self-reflection, and sense of freedom (Borrie and Roggenbuck 2001; Long and Averill 2003; Heintzman 2009). We pre-tested interview questions—including all indicator statements—before implementing the survey, to assess its suitability. Our preliminary results suggested that interviewees recognised the various non-material NCP represented in the survey, and hence we considered them valid for our study of Litoral Norte MPA.

The survey was structured into five sections (S1). In the first section, we asked participants about their recreational activities and behaviour in Litoral Norte MPA. The following section included questions about the contribution of MPA sites to human well-being. Here we included the 16 indicator statements to measure self-reported well-being. For this, we asked participants to identify one MPA site they knew and considered important, unique, or special. Indicator statements were contingent on the chosen MPA site. To avoid potential response order effects (Krosnick 1999), we used two survey versions that differed in the ordering of the indicator statements. The third section comprised questions about knowledge and opinions about the MPA. We asked questions about environmental behaviour in the fourth section. In the last section, we collected participants’ socio-economic characteristics. Throughout

Table 1 Indicator statements used in the survey to assess non-material NCP from sites of Litoral Norte MPA (adapted from Bryce et al. 2016)

Indicator statement	Theoretical constructs
Visiting this site clears my head	Reflection and sense of wholeness
I gain perspective on life during my visits to this site	Reflection and sense of wholeness
Visiting this site makes me feel more connected to nature	Reflection and sense of wholeness; connection to nature
At this site I feel part of something that is greater than myself	Reflection and sense of wholeness; spiritual value
This site feels almost like a part of me	Place identity and continuity with the past
I feel a sense of belonging in this site	Place identity and continuity with the past
I’ve had a lot of memorable experiences in this site	Place identity and continuity with the past; transformative values
I miss this site when I have been away from it for a long time	Place identity and continuity with the past
Visiting this site has made me learn more about nature	Knowledge about nature
I have made or strengthened bonds with others through visiting this site	Social bonds
I feel like I can contribute to taking care of this site	Participation
I have felt touched by the beauty of this site	Aesthetics
This site inspires me	Inspiration
Visiting this site leaves me feeling healthier	Health
Visiting this site gives me a sense of freedom	Freedom
I can be alone and appreciate solitude when I visit this site	Solitude value

the interviews, questions about NCP were framed around the well-being benefits that people derive from marine and coastal sites, the relationships that people have with those sites, and the importance of marine and coastal sites in people's lives.

Data analysis

The data analysis process entailed three stages. First, we did a categorical principal component analysis (PCA) to transform the raw data of the survey. Second, after transforming the data, we did an exploratory factor analysis (EFA) (Mair 2018) to reveal latent constructs reflected by the indicator statements used to assess well-being. Third, we ran statistical tests to compare the effect of respondent's environmental behaviour, opinions, and socio-economic characteristics on the EFA latent construct scores. We did all data analysis procedures in the R version 3.5.1 (R Core Team 2018).

To run the EFA, we first transformed the raw data through 'optimal transformation' by doing a categorical PCA (Linting et al. 2007). We applied this data transformation because data were ordinal (5-point Likert scale), non-normally distributed (positively skewed), and susceptible to strong effects of outliers in the computation of correlations and covariances. We used the function 'princals' of the R package 'Gifi' (Mair et al. 2019) to run the categorical PCA (S2). Then we analysed categorical PCA models with a varying number of components and chose the model that best fitted the data, based on the Kaiser-criterion (eigenvalues > 1) and scree plot inspection (S3) (Kaiser 1960; Mair 2018). We selected the first three components of the categorical PCA and then computed the optimally transformed scores, which we used to run the EFA.

We did an EFA because the latent constructs of the 16 indicator statements used to assess well-being provided by marine non-material NCP are not yet theoretically established (Bryce et al. 2016). Factor analysis can reveal the underlying structure of the indicator statement data without imposing a priori conceptions of well-being. That is why we used factor analysis—to identify interpretable dimensions of self-reported well-being associated with the marine environment. To run the EFA, we used the function 'fa' of the R package 'psych' (Revelle 2018). Our protocol for EFA consisted of using 'maximum likelihood', as a factor extracting method, and to rotate the matrix of factor loadings with 'varimax' rotation to obtain orthogonal factors.

After identifying the factor structure describing interviewees' self-reported well-being, we tested whether the composite factor scores varied significantly according to socio-economic characteristics, reported environmental behaviour, and knowledge and opinions about Litoral Norte MPA. We computed the composite scores for each factor that emerged from the EFA. Composite scores were based on

the mean values of the indicator statements that loaded onto each factor. To analyse differences between two-group data, we applied Wilcoxon rank-sum tests (Wilcoxon 1945; Mann and Whitney 1947). For three or more group data, we used Kruskal–Wallis tests (Kruskal and Wallis 1952) followed by post-hoc Dunn tests for inter-group comparisons (Dunn 1964). For the Dunn tests, we adjusted the *p* values with the Benjamini–Hochberg method (Benjamini and Hochberg 1995). We did the statistical tests with the functions 'wilcox.test', 'kruskal.test', and 'dunnTest' of the R package 'FSA' (Ogle et al. 2019). All survey variables and statistical tests are shown in the supporting information of this paper (S4).

Results

Survey sample

We interviewed 453 people, lasting each interview 23 min on average. After removing incomplete interviews, we ended up with 367 valid interviews (S5). Of those 367 surveyed people, 48.8% were female and 51.2% male. All interviewees were adults with ages ranging from 19 to 91 years and a mean age of 43. Most interviewees (32.4%) had a high school education, followed by those with a university degree (25.3%), middle school (21.5%), and those who only attended elementary school (3.8%). About three quarters (75.2%) were residents of Esposende—the municipality where Litoral Norte MPA is located—and nearly one quarter (24.8%) were national visitors. The mean time living in the municipality of surveyed Esposende residents was 30 years. Most interviewees (62.4%) identified the setting where they lived as 'urban', while the remainder (37.6%) reported living in a rural environment. On average, households were composed of 2.9 people. Although 25.6% of interviewees did not disclose their monthly household income, about half (51.5%) reported having less than 1700 euros of available household income per month. Most of the interviewees (76.0%) were employed.

Although Litoral Norte MPA was created in 2008, 35.1% of interviewees were not aware of the protected area. Among those who did not know the MPA, 69.8% were residents of the municipality of Esposende, and 30.2% were visitors. When asked about their agreement with the existence of the protected area in the municipality, most residents (71.4%) believed the MPA should exist. A similar proportion of visitors (69.2%) agreed. Although the proportion of interviewees who were against the existence of the MPA was low (5.1% of residents and 2.3% of visitors), 23.6% of residents and 28.6% of visitors did not have an opinion at the time of the interview.

Cultural dimensions of subjective well-being

All 16 indicator statements (hereafter, items) representing non-material NCP had positive responses, suggesting that interviewees experienced the variety of benefits asked in the interview (S4). Four factors emerged from the EFA, cumulatively explaining 82% of the variance of the survey data (Table 2). All 16 items of non-material NCP loaded strongly (factor loadings > 0.45) onto four interpretable cultural dimensions of subjective well-being related to marine and coastal sites. We interpreted and labelled the factors consistently with well-being constructs described in the scientific literature.

The EFA resulted in eight items loading onto the first factor. Items were closely related to experiences, connections, and learning about nature such as ‘to have an aesthetic experience’, ‘to feel connected to nature’, and ‘to learn about nature’. Some items were associated with perceived therapeutic benefits of marine and coastal sites, such as ‘to feel healthier’, ‘to gain perspective on life’, and ‘to clear one’s head’. To highlight the links between people, the natural environment, and health, we labelled this factor *engagement*

with nature & health. This factor explained the highest proportion of variance of survey data, that is, 35% of variance.

Four items loaded onto a second factor related to interviewees’ place attachment, place identity, and place dependence towards local marine and coastal sites. These items were ‘to have a sense of belonging’, ‘to strengthen bonds with others’, ‘to feel that the site is part of oneself’, and ‘to miss the site’. To emphasise the relationships between people and local marine and coastal sites, we labelled this factor *sense of place*. This factor explained 25% of variance in the data set.

The items ‘to find solitude’ and ‘to have a sense of freedom’ loaded onto a third factor. As the item related to solitude had the strongest factor loading of the two (0.92), we labelled this factor *solitude in nature*. This factor reflects the well-being that people derive from being alone in nature while experiencing a sense of freedom. Twelve percent of data variance was explained by this factor.

Equally, two items loaded onto a fourth factor. These items were related to spirituality—‘to feel part of something greater than oneself’; and associated with caring—‘to take

Table 2 Factor loadings along four interpretable cultural dimensions of human well-being

Abbreviated indicator statements	Engagement with nature & health	Sense of place	Solitude in nature	Spirituality
To feel healthier	0.95	0.19	0.22	0.13
To have an aesthetic experience	0.95	0.19	0.22	0.13
To feel inspired	0.95	0.19	0.22	0.13
To feel connected to nature	0.95	0.19	0.22	0.13
To clear one’s head	0.67	0.13	0.15	0.09
To gain perspective on life	0.65	0.16	0.15	0.13
To learn about nature	0.57	0.37	0.20	0.39
To have memorable experiences	0.47	0.30	0.16	0.32
To have a sense of belonging	0.19	0.95	0.06	0.25
To feel that the site is part of oneself	0.17	0.89	0.09	0.22
To strengthen bonds with others	0.26	0.87	0.09	0.08
To miss the site	0.15	0.69	0.06	0.18
To find solitude	0.33	0.12	0.92	0.13
To have a sense of freedom	0.44	0.09	0.82	0.06
To feel part of something greater than oneself	0.23	0.54	0.12	0.75
To take care of the site	0.28	0.59	0.09	0.75
Proportion variance	0.35	0.25	0.12	0.10
Cumulative variance	0.35	0.60	0.72	0.82

The four dimensions of non-material NCP are ‘engagement with nature & health’, ‘sense of place’, ‘solitude in nature’, and ‘spirituality’. Factors were extracted from optimally transformed (categorical PCA scores) survey data with maximum likelihood and varimax rotation. Grey shading indicates strong loading (> 0.45) of a non-material NCP onto a specific factor

care of the site'. We labelled this factor *spirituality*. This factor explained 10% of the survey data variance.

Effects of socio-economic characteristics on cultural dimensions of well-being

Reported levels of well-being derived from marine and coastal sites varied significantly according to some socio-economic characteristics of interviewees (Fig. 2). We found significant differences in composite scores of the four factors. Composite scores of engagement with nature and health, sense of place, solitude in nature, and spirituality, varied depending on interviewees' place of residence (that is, resident of the municipality of Esposende vs. visitor; and rural vs. urban), level of formal education, household size, gender, and number of years living in the municipality of Esposende. All composite scores and corresponding statistical tests are shown in the supporting information of this chapter (S4).

Residents of Esposende rated higher than visitors the non-material NCP associated with engagement with nature and health ($W=887,966$, $df=1$, $p<0.001$), sense of place ($W=247,672$, $df=1$, $p<0.001$), and spirituality ($W=247,672$, $df=1$, $p<0.001$) (Fig. 2A). Compared with urban interviewees, those living in a rural setting reported higher benefits from the four cultural dimensions of well-being (Fig. 2B): engagement with nature and health ($W=1,104,309$, $df=1$, $p<0.001$), sense of place ($W=283,403$, $df=1$, $p<0.001$), solitude in nature ($W=69,548$, $df=1$, $p<0.05$), and spirituality ($W=59,037$, $df=1$, $p<0.01$).

We also found significant differences in reported well-being according to the level of formal education (Fig. 2C; S4). Those who had lower levels of formal education tended to report higher levels of non-material NCP provided by interactions with the marine environment. Comparing with interviewees with a university degree, those who attended high school reported significantly higher levels of benefits about engagement with nature and health ($Z=2.53$, $df=3$, p . adj <0.05), and sense of place ($Z=4.33$, $df=3$, p . adj <0.001). Similarly, comparing with university graduates, those who had an elementary or middle level of formal education reported higher levels of benefits about sense of place ($Z=3.31$, $df=3$, p . adj <0.01 ; $Z=4.63$, $df=3$, p . adj <0.001 ; respectively).

Interviewees living in households with more than four people rated significantly higher those benefits related with engagement with nature and health ($Z=2.64$, $df=2$, p . adj <0.05), and with sense of place ($Z=3.10$, $df=2$, p . adj <0.01), when comparing with households with two to four people. We also found significant differences in smaller households. Interviewees living alone attributed higher importance to the spiritual connections with the marine

environment than those from bigger households ($Z=2.45$, $df=2$, p . adj <0.05).

Other socio-economic variables such as gender and number of years living in the municipality of Esposende also revealed significant differences in composite scores (S4). Yet they differed only in one of the four cultural dimensions of subjective well-being. For example, interviewed women rated higher the spirituality interactions with marine and coastal sites ($W=74,024$, $df=1$, $p<0.05$). In addition, compared to residents of Esposende living for a long time in the municipality (that is, more than 20 years), residents more recently established in Esposende reported higher levels of benefits from solitude in marine and coastal environment ($W=26,120$, $df=1$, $p<0.05$). Other socio-economic variables such as household income, employment, and age did not significantly affect the reported levels of well-being derived from marine settings.

Effects of environmental behaviour on cultural dimensions of well-being

We found significant differences in interviewees' self-assessed levels of non-material NCP according to reported environmental behaviour (Fig. 3). Variables of environmental behaviour with significant differences include the type of interactions between people and marine and coastal sites (that is, cognitive, physical, or both); interviewees' visit frequency to local beach and sea; amount of perceived benefits to human well-being provided by local marine and coastal sites; whether the interviewee had visited a protected area over the past year; and whether the interviewee read environmentally themed books/magazines. All composite scores and related statistical test results are shown in the supporting information of this paper (S4).

We asked people which activities they enjoyed doing the most when they were at the local beach or sea. There were cognitive and physical activities. We classified as cognitive activities those involving contemplation, reflection, and thinking such as 'observing nature', 'reading', and 'enjoying the seascape'. In contrast, we classified as physical activities 'diving', 'hiking', and 'playing beach football'. Those activities that combined cognitive and physical elements, we classified as 'both'. We recognise that arguably any human activity can be considered solely cognitive or physical, but for the sake of analysis, we intended to stress the *main* elements of recreational activities in the marine environment. Results shown in Fig. 3A reveal that, comparing to those who do mainly physical activities, people who do mostly cognitive activities in the marine environment reported significantly higher levels of well-being from engagement with nature and health ($Z=3.82$, $df=2$, p . adj <0.001), and sense of place ($Z=3.51$, $df=2$, p . adj <0.01). For the same well-being dimensions, those who engage in both cognitive

Fig. 2 Composite scores of cultural dimensions of subjective well-being by socio-economic characteristics. Cultural dimensions are engagement with nature & health, sense of place, solitude in nature, and spirituality. Socio-economic variables include: **A** if is a resident or visitor of the municipality of Esposende; **B** if lives in a rural or urban setting; **C** formal education level; **D** household size. Only variables with more than one significantly different dimension are shown. Boxes range from the first (25th percentile) to the third (75th percentile) quartiles, and whiskers extend to the highest value that is within 1.5 times the first and third inter-quartile range. Data beyond the end of whiskers are outliers (grey dots). Median score is indicated by the horizontal line in the boxes. Black dots represent the mean score. Box widths are proportional to the square-roots of the number of observations in the groups. Non-statistically significant results are represented by 'n.s'

and physical activities reported significantly higher levels of well-being than those who do mainly physical activities ($Z=3.10$, $df=2$, p . adj <0.01).

Interviewees' visiting frequency to local beaches also revealed differences in reported levels of well-being derived from the marine and coastal environment (Fig. 3B). Those interviewees who admitted going frequently to local beaches reported significantly higher levels of well-being associated with sense of place than those who reported not going as often ($Z=3.85$, $df=2$, p . adj <0.001). Similarly, people who recently had visited protected areas reported significantly higher levels of benefits associated with engagement with nature and health ($W=555,219$, $df=1$, $p <0.01$). On the other hand, for benefits related with sense of place and spirituality, those who had not visited protected areas over the past year had significantly higher scores ($W=173,452$, $df=1$, $p <0.001$; $W=41,447$, $df=1$, $p <0.05$; respectively). Finally, interviewees who frequently read environmentally themed books and/or magazines revealed significantly higher benefits derived from engagement with nature and health than those who do not read them as frequently ($Z=3.10$, $df=3$, p . adj <0.05). Other variables of environmental behaviour did not reveal statistically significant differences in responses. These variables include habits of buying environmentally certified food; recycling; whether the interviewee does outdoor activities; and the type of preferred marine and coastal site (natural vs. with human-built elements). Likewise, knowledge and opinion about the existence of Litoral Norte MPA did not reveal significant differences in interviewees' cultural dimension scores of subjective well-being.

Discussion

Systematic subjective well-being assessments are rarely applied in NCP studies. Yet these assessments can be useful to shed light on the underlying reasons that lead people to engage with and care for the marine and coastal environment (Bryce et al. 2016). A deeper understanding of how

people relate to non-human nature can help improve conservation outcomes (De Vos et al. 2018). Here, we show that self-reported well-being derived from relating to, interacting with, and experiencing marine and coastal sites can be grouped into four cultural dimensions of well-being. Based on EFA results, we interpreted cultural dimensions as *engagement with nature and health*, *sense of place*, *solitude in nature*, and *spirituality*. We do not claim that these cultural dimensions are mutually exclusive or separate. In fact, they may reflect intertwined elements of human well-being. An interesting finding was the significant differences in reported levels of non-material NCP among the four cultural dimensions of well-being. These differences depended on interviewees' socio-economic characteristics and environmental behaviour. We discuss these findings below.

Cultural dimensions of well-being derived from the marine environment

People answered positively to all indicator statements of cultural well-being dimensions. Positive answers suggest that respondents experienced the non-material NCP tested in the survey. A study reports a similar finding for UK marine sites, although with slightly different well-being dimensions emerging from factor analysis (Bryce et al. 2016). Other empirical findings support the relevance of the cultural well-being dimensions that emerged from our data. First, the dimension *engagement with nature and health* is corroborated by medical studies that demonstrate the contributions of seas and coasts to self-reported general (Wheeler et al. 2012; White et al. 2013), physical (Bauman et al. 1999; Papathanasopoulou et al. 2016), and mental health (Barton and Pretty 2010; Nutsford et al. 2016). Engaging with seas and coasts is also positively associated with self-reported overall well-being (Busch et al. 2011; Koss and Kingsley 2010).

Second, *sense of place*—the emotional bonds that people establish with places (van Putten et al. 2018)—is a key dimension of well-being for many communities of the world (Wynveen et al. 2012; Lin and Lockwood 2014; Klain et al. 2014). Sense of place reflects people's attachment, rootedness, dependence, and sense of belonging to a physical space. It can contribute to the formation of people's identity, resulting in deep connections to marine and coastal sites (Urquhart and Acott 2014).

Third, factor analysis revealed that the enjoyment of *solitude in nature* was closely related to sense of freedom experienced by being alone in the marine and coastal environment. Finding solitude in nature can be important for people to escape from everyday life (Wynveen et al. 2012). Solitude is also sought after by people to find peace, tranquillity, privacy, time for self-reflection, and spiritual development (Heintzman 2009).

Fig. 3 Composite scores of cultural dimensions of subjective well-being by reported environmental behaviour. Cultural dimensions are engagement with nature & health, sense of place, solitude in nature, and spirituality. Reported environmental behaviour variables include: **A** type of interaction with MPA sites (cognitive, physical, both); **B** visit frequency to sea/beach (rarely, sometimes, frequently); **C** amount of perceived benefits provided by sea/beach; **D** if visited a protected area over the past year (yes, no/don't know); **E** if reads environmentally themed books/magazines (never, rarely, sometimes, frequently). Boxes range from the first (25th percentile) to the third (75th percentile) quartiles, and whiskers extend to the highest value that is within 1.5 times the first and third inter-quartile range. Data beyond the end of whiskers are outliers (grey dots). Median score is indicated by the horizontal line in the boxes. Black dots represent the mean score. Box widths are proportional to the square-roots of the number of observations in the groups. Non-statistically significant results are represented by 'n.s'

Finally, *spirituality* emerged from items of perceived connections to metaphysical elements that exist beyond humans, and from the need of caring for sea and coastal sites. Studies often have focused on the spiritual connections between indigenous communities and nature (Oviedo and Jeanrenaud 2007; Russell et al. 2013). However, it has been shown that people of diverse backgrounds can feel deeply connected to ecosystems (Gould et al. 2014; Klain et al. 2014). Spiritual attachment to marine and coastal sites can be critical to the well-being of coastal communities (Klain et al. 2014).

Relational values underlie the cultural dimensions of well-being

The four cultural well-being dimensions that emerged from factor analysis support the notion of people valuing non-human nature relationally (Chan et al. 2016). Although ecosystem services frameworks have depicted mainly the benefit flows that humans receive from nature (MA 2005; Haines-Young and Potschin 2010), this study's results suggest a bidirectional human–nature relationship. This means that the interactions between people and nature are not merely based on instrumental values, that is nature's utility. As Himes and Muraca (2018) put it, “such [non-instrumental] relationships are not reducible to mere means to some humans' end, but constitute who we are as humans”—that is, people–nature relationships are embedded in people's identities, as people are an integral part of nature. This study illustrates this point. For example, the dimension *sense of place* includes highly rated items associated with identities and feelings of belonging to local coastal sites. People also reported seeking the marine and coastal environment to feel healthier, connected, and inspired by nature, as suggested by the positive responses of *engagement with nature and health*. Moreover, interviewees reported a need for caring for their preferred sites in a survey item associated with *spirituality*. These results show that the importance, significance, and worth

of non-human nature is intimately connected with people's relations, identities, and interactions with nature.

The notion of relational values about nature challenges the pervasive dichotomy between instrumental (nature's utility) and intrinsic values (nature's inherent worth) that has been guiding environmental ethics and biodiversity conservation (Justus et al. 2009; Muraca 2011). Relational values broaden the outlook of environmental valuation enabling more pluralistic assessments of values (Arias-Arévalo et al. 2018). Broadening environmental valuation assessments by including relational values can provide stronger arguments to conserve or further protect areas that are important beyond their intrinsic or instrumental worth (Arias-Arévalo et al. 2017), such as Litoral Norte MPA. These arguments can help extend protection to those unprotected areas with deep human–nature connections that combine high relational and ecological values.

Though, top-down designation and management of MPAs, as is the case in Litoral Norte, deserves careful attention. MPAs can be sources of social injustice when social dynamics are neglected (Mascia 2004). MPAs are often established near coastal communities whose well-being depends on locally provided resources (Jentoft et al. 2012; Mahajan and Daw 2016). After designation, MPAs can enhance or decrease resource provision by restricting or allowing human activities (Pascual et al. 2016). For example, MPAs can entail trade-offs such as opportunities for tourism instead of fishing (Jentoft et al. 2012). MPAs can also give rise to synergies such as maintenance of habitats and species, and harvestable fish through 'spill-over' (Lester et al. 2009). In this context, it is necessary to understand local communities' perspectives and expectations on ecosystem services and related well-being benefits, as changes in resource provision after the establishment of MPAs may determine approval or disapproval for marine conservation initiatives. Collaborative assessments of multiple values, including relational values, can provide the space for constructive dialogues on conservation and management initiatives (Skubel et al. 2019). Participatory processes prior to MPA creation, and local communities' meaningful participation in management after MPA designation are essential pre-requisites for successful MPAs able to support both biodiversity and livelihoods.

Socio-economic characteristics and environmental behaviour affect cultural dimensions of well-being

The cultural importance of Litoral Norte MPA sites varied significantly depending on people's socio-economic characteristics. Compared to visitors, nearby residents of the MPA reported significantly higher levels of non-material NCP related to three of the four cultural dimensions of

well-being. This could be so, because these are place-based benefits which are strongly related to people's connections and identities to local sites. By living near the MPA, residents have had more time and opportunities than visitors to establish deeper relationships with local sites. These deeper relationships might have resulted in increasing place-meaning, providing context for a deeper place attachment, and hence higher levels of well-being derived from those relationships (Wynveen et al. 2012).

We have found significant differences in the responses of rural and urban people. Interviewees living in a rural setting reported higher levels of cultural benefits related to MPA sites. Similarly, compared to interviewees with university degrees, those with lower levels of formal education (that is, elementary, middle, and high school) reported higher levels of benefits obtained from engagement with nature and health, and sense of place. These differences could be inter-related, because, in our survey, interviewees living in rural areas tended to have lower levels of formal education. Urban and rural differences in reported levels of non-material NCP might be explained by the fact that people living in rural areas usually have greater exposure to natural environments than urban people. Research shows that fewer opportunities to directly experience nature undermine health and well-being, changing people's affections, values, beliefs, and interest towards nature (Soga and Gaston 2016). As an increasing number of people live in urban areas, human–nature interactions tend to decline, leading to further alienation and indifference towards nature. This indifference can undermine both biodiversity conservation and human well-being (Turner et al. 2004). In an urbanised world, the importance of human–nature interactions—especially in childhood (Zhang et al. 2014)—needs to reach vaster audiences.

Interviewees' environmental behaviour significantly affected responses about non-material NCP. People who perceived Litoral Norte MPA sites as providing many benefits to human well-being reported significantly higher levels of benefits from engagement with nature and health. This is not surprising because people who derive more well-being from being in nature are usually those who better recognise nature's benefits (Soga and Gaston 2016). Policies aiming at reconnecting people and nature, such as educational and outreach programs, can help increase people's awareness of nature's benefits and help improve human well-being (Soga and Gaston 2016).

Our results showed differences between cognitive and physical outdoor activities. People who engage mainly in cognitive outdoor activities such as observing nature or enjoying seascapes reported higher levels of benefits than those who do mainly physical activities such as diving or hiking. These differences were related to engagement

with nature and health, and sense of place. These could be random differences because physical activities require cognitive interaction and the opposite may also be true. Yet, we need further research about the role of cognitive and physical activities in the outdoors to better understand their contributions to the cultural dimensions of well-being.

Insights for conservation practice and policy

Our study offers several insights for conservation practice and policy. First, subjective well-being assessments can provide useful information for MPA managers and practitioners. These assessments can make explicit the reasons underlying the cultural importance of MPAs to people by eliciting relational values about nature. As shown by this study, relational values might include therapeutic, care, solitude, and spiritual values. This information is valuable, because it can help prioritise conservation initiatives based on the underlying reasons why people relate, connect, and interact with the marine environment. Prioritising conservation initiatives based on relational and ecological values can also help to strategically allocate limited resources to areas that combine both types of values. It can be a practical way of finding synergies between biodiversity conservation and human well-being (Bennett et al. 2015). In addition, assessing the diversity of values beyond intrinsic and instrumental values, with pluralistic value assessments as advanced by the Intergovernmental Platform on Biodiversity and Ecosystem Services approach (IPBES 2015), can help achieving effective and socially just decisions about nature and its contributions to people (Pascual et al. 2017).

Second, conservation initiatives supported by subjective well-being assessments and relational values could receive stronger support by local communities. This is because these assessments incorporate local people's values and highlight the societal relevance of protected areas (De Vos et al. 2018). A relational values approach to conservation can be more legitimate and appealing to local people, enabling extensive participation in conservation designation, planning, and management. Local support and participation are often necessary conditions for positive conservation outcomes (Bennett and Dearden 2014; Bennett et al. 2019).

Third, a relational values approach to conservation can strengthen the connections between people and non-human nature, increasing human well-being. By emphasising the relevance of MPAs to health, inspiration, identity, place attachment, freedom, and spirituality, conservation initiatives may attract more people to experience nature. It can contribute to reconnect people and the biosphere (Folke et al. 2011). Recognizing the diversity of values of NCP provided by MPAs implies considering the ways through which people ascribe meaning and importance to the marine

environment which can ultimately result in a more equitable way to manage protected areas (Pascual et al. 2017). Given that decision making processes are usually themselves value-laden, the inclusion of relational values can also help to reduce asymmetric social power relationships within a given socio-economic and institutional context.

Decision-makers require a different approach in those geographies where conservation interventions create ethical and social justice issues by hindering people's access to places important for their identity and cultural practices (Outeiro et al. 2019). In these situations, decision-makers should engage local communities in open and transparent deliberative processes to avoid loss of legitimacy, social conflicts, and negative effects on biodiversity they intend to protect in the first place (Lele et al. 2010). Strengthening experiential, cognitive, emotional, and even philosophical connections between people and non-human nature can play an important role in addressing current ecological and sustainability challenges (Ives et al. 2018).

Limitations

The method we applied here needs to be further tested in other scales and geographies, with different social and cultural contexts. Our results suggest that the indicators we used are suitable to subjective well-being assessments in similar contexts as the one of our study. We showed that self-reported well-being derived from relating to, interacting with, and experiencing marine and coastal sites can be grouped into four cultural dimensions of well-being. However, this could be case study dependent given the specific social–ecological characteristics of Litoral Norte MPA. Future research should further test the set of indicator statements we used to measure self-reported well-being.

Our study focused only on cultural dimensions of subjective well-being that underlie the non-material connections between people and Litoral Norte MPA sites. We acknowledge that human well-being is shaped by other dimensions, such as instrumental dimensions, and that local ecological knowledge may also underlie non-material dimensions of well-being. The ecosystems of Litoral Norte MPA support the livelihoods of people that rely on local fishery resources, and the livelihoods of those who rely on revenues from tourism. We applied a random sampling approach to capture the perceptions of the general population, i.e., residents and visitors, and not specifically from those whose livelihoods depend on local natural resources. In this sense, our study may not reflect local ecological knowledge in terms of natural resources and people's livelihoods. In addition, it does not assess how instrumental dimensions shape human well-being. To have a broader perspective on human relationships with nature, and how well-being is affected, other dimensions beyond cultural dimensions should be considered.

Another important aspect worth exploring in the future, but out of the scope of our study, is understanding how biophysical attributes are associated with well-being domains, and what are the reasons behind those associations. Knowing if and how specific biophysical attributes of marine and coastal sites affect human well-being would provide important insights for conservation practice and policy that could help to identify conservation initiatives that promote both marine and coastal biodiversity and human well-being.

Conclusion

Our subjective well-being assessment has expanded the application of a new set of indicators of non-material NCP developed by Bryce et al. (2016) to a different geography. Indicators were selected based on human well-being frameworks (Max-Neef et al. 1990; Cruz et al. 2009) and on previous assessments about the relationship between people and nature (Fuller et al. 2007; Chan et al. 2012a, 2012b; Tengberg et al. 2012; Dallimer et al. 2012). We have shown that both applications share similarities but have also important differences. To generalise the application of this set of indicators to different social and cultural contexts, researchers should broaden, refine, and test further this set of indicators, by adding, for example, a 'solitude' indicator. Applying a subjective well-being assessment to before–after, control–impact studies of conservation initiatives may offer promising insights. Here we have shown the importance of a multiple-use MPA in supporting four cultural dimensions of human well-being—engagement with nature and health, sense of place, solitude in nature, and spirituality—and what promoting those cultural well-being dimensions imply for MPA practice and policy that aims to foster both biodiversity conservation and human well-being.

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