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Are Some Natural Environments More Psychologically Beneficial Than Others? The Importance of Type and Quality on Connectedness to Nature and Psychological Restoration

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1 **Are Some Natural Environments More Psychologically Beneficial Than Others? The Importance of Type**
2 **and Quality on Connectedness to Nature and Psychological Restoration**

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13
14 **Keywords:**

15 Restorative experiences, nature connectedness, monitoring engagement with the natural environment, terrestrial &
16 marine environments, psychological benefits

17
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23 [and-results](https://www.gov.uk/government/collections/monitor-of-engagement-with-the-natural-environment-survey-purpose-and-results)), for any enquiries, please contact Natural England statistician Haney King

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1 **Are Some Natural Environments More Psychologically Beneficial Than Others? The Importance of Type**
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3

4 **Abstract:**

5 Exposure to nature can strengthen an individual's sense of connectedness (i.e., emotional/cognitive bonds to the
6 natural world) and enhance psychological restoration (e.g., feeling relaxed/refreshed). To date there have been few
7 large studies looking at the role type and quality of natural environments may have on these outcomes. The present
8 study used data from a large survey in England (sample analyzed = 4,515), which asked participants to recall a
9 recent visit to nature. After controlling for covariates, respondents recalled greater connectedness to nature and
10 restoration following visits to rural and coastal locations compared to urban green-space, and to sites of higher
11 environmental quality (operationalized by protected/designated area status e.g., Nature Reserves). A series of
12 structural equation analyses provided evidence for a bidirectional association between connectedness and
13 restoration. Consideration of the psychological benefits associated with different types and quality of environment
14 has implications for human health, environmental management, and conservation.

15

16 **Keywords:**

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18

Introduction

Natural environments are increasingly threatened by anthropogenic pressures, including urbanization (European Union, 2014). Importantly, however, there is growing evidence that not only are natural environments important in their own right, they can also provide a valuable resource for human health (Centers for Disease Control and Prevention, 1996; Department of Health, 2004; Weinstein et al., 2015). Numerous studies have demonstrated that experiencing nature can reduce stress levels (Hansmann, Hug, & Seeland, 2007; Ulrich et al., 1991), elevate subjective well-being (Johansson, Hartig, & Staats, 2011; Luck, Davidson, Boxall, & Smallbone, 2011; White, Pahl, Wheeler, Depledge, & Fleming, 2017), improve cognitive functioning (Berman, Jonides, & Kaplan, 2008; Berto, 2005), and strengthen individuals' bonds with others and the natural environment (Mayer, Frantz, Bruehlman-Senecal, & Dolliver, 2009; Richardson, Cormack, McRobert, & Underhill, 2016; Weinstein et al., 2015). This evidence emphasizes the importance of preserving and increasing accessibility to natural environments. However, previous research has rarely distinguished different types and levels of quality of natural settings. This simplified approach risks masking key differences that may be associated with different levels of psychological benefits. Understanding these differences better would advance the field of people-environment interactions and help prioritize environmental management. Consequently, further research is needed to understand how psychological benefits of nature vary between environmental contexts (type and quality) and why such variation might exist (Pett, Schwartz, Irvine, Dallimer, & Davies, 2016; Wheeler et al., 2015).

Effects of Experiencing Nature: Connectedness to Nature and Restoration

One potentially important psychological benefit of experiencing natural environments (i.e., 'open spaces in the countryside and in and around towns and cities', Natural England, 2016) is connectedness to nature. This concept relates to an individual's emotional and cognitive bond to the natural world (Mayer & Frantz, 2004), which links to other concepts such as geopiety or topophilia (Tuan, 1974, 1977), commitment to nature (Davis, Green, & Reed, 2009), and emotional affinity towards nature (Kals, Schumacher, & Montada, 1999). Connectedness to nature has been conceptualized both as a relatively stable personality trait that develops over time (e.g., Mayer & Franz, 2004; Leary, Tipsord, & Tate, 2007; Nisbet, Zelenski, & Murphy, 2011), and as a state indicator, a situational emotional response that differs with the surrounding context (e.g., Mayer et al., 2009; Nisbet & Zelenski, 2011; Weinstein, Przybylski, & Ryan, 2009). Using a range of measures, previous correlational studies have found that people who experience nature more frequently report stronger connectedness to nature (Bragg, 1996; Hinds & Sparks, 2008; Holmes, 2003; see also Loughland, Reid, Walker, & Petocz, 2003). Moreover in

1 experimental studies, connectedness has been greater after experiencing natural than urban settings (Mayer &
2 Frantz, 2004; Nisbet & Zelenski, 2011). This construct is relevant for both the environment and individuals, as
3 greater connectedness to nature has been associated with more pro-environmental acts (Hinds & Sparks, 2008;
4 Mayer & Frantz, 2004) as well as better human health and subjective well-being (how individuals think and feel
5 about their lives) in the form of overall life satisfaction (Mayer et al., 2009; Tam, 2013), positive and negative
6 affect (Howell, Dopko, Passmore, & Buro, 2011; Nisbet & Zelenski, 2011), happiness (Tam, 2013; Zelenski &
7 Nisbet, 2014), and meaningfulness (Cervinka, Röderer, & Hefler, 2012). In a meta-analysis of 30 studies looking at
8 the relationship between well-being measures and connectedness to nature in isolation (independent of whether
9 individuals visit nature or not), Capaldi and colleagues (Capaldi, Dopko, & Zelenski, 2014) found that
10 connectedness was significantly correlated to well-being (with the strength of the associations varying slightly
11 depending on the measures used).

12 Considerably more research has demonstrated that experiencing nature strengthens well-being directly.
13 Although many aspects of cognitive and emotional well-being have been explored in prior work, we focus here on
14 ‘psychological restoration’. The concept of psychological restoration is based on the suggestion that the complex
15 world in which most humans now live places demands on their cognitive and emotional systems for which they are
16 not necessarily well adapted. Like all biological systems, it is believed that these systems have finite resources and
17 can be ‘depleted’, e.g., by busy, hectic, and complex urban environments (Kaplan & Berman, 2010). Crucially, for
18 the current work, theories such as Attention Restoration Theory (Kaplan & Kaplan, 1983) and Psychosocial Stress
19 Recovery Theory (Ulrich, 1983) argue that exposure to natural environments that put relatively few demands on
20 cognitive and emotional systems can help restore these depleted resources (hence the term ‘psychological
21 restoration’). Such restoration has the dual benefits of both reducing the negative emotions associated with stress
22 and enhancing positive emotions (Fredrickson, 1998). Indeed, in an important systematic review of 32
23 experimental studies, McMahan and Estes (2015) report that while exposure to natural environments, compared to
24 primarily urban control settings, was associated with reductions in negative emotions, the effects on positive
25 emotions were generally stronger and more consistent.

26 Importantly, theory and recent empirical work suggests that these two psychological benefits (i.e., feelings
27 of connectedness to nature and psychological restoration) are not independent, but rather people may derive
28 emotionally restorative effects from nature *because* of their connectedness. Within the biophilia hypothesis, Wilson
29 (1984) proposed that, as humans evolved in natural environments and have only recently in their evolutionary

1 history been isolated from nature by living in urban settlements, people have the need to connect with nature and
2 will consequently benefit when this need is satisfied. Further, Mayer and colleagues (2009) demonstrated the
3 interrelationship of psychological restoration and connectedness by comparing these attributes in students who
4 either walked in a nature reserve or in a town center. Walks in a nature reserve resulted in greater restoration
5 (measured via positive affect). However, when connectedness to nature was accounted for, this effect was rendered
6 statistically non-significant, indicating that connectedness to nature is a potential mechanism through which nature
7 can be beneficial for restoration. More recently, however, Nisbet and Zelenski (2011) have proposed that the
8 relationship may also work in the opposite direction with a person's experiences of connectedness being influenced
9 by the degree to which the individual found the experience restorative. This makes sense if one considers that a
10 very unpleasant experience in nature, such as an encounter with a feared animal such as a snake or spider, might
11 decrease one's feelings of connectedness (Knight, 2008).

12 **Type and Quality of Nature**

13 Although there are now several studies that have explored the restorative effects of different types of
14 natural environment, with aquatic environments seeming to be particularly restorative (Felsten, 2009; Laumann,
15 Gärling, & Stormark, 2001; White et al., 2010; Wyles, Pahl, Thomas, & Thompson, 2016), far less research has
16 looked at whether the quality of these environments matters or whether the type and quality affects connectedness
17 specifically. The connectedness to nature literature in particular has tended to look at nature somewhat holistically,
18 with those studies that have distinguished between settings so far mainly comparing nature to urban environments
19 in general (Mayer & Frantz, 2004; Nisbet & Zelenski, 2011). Thus, it is not known whether connectedness to
20 nature is similarly sensitive to the type of natural environment and whether the restorative effects for different
21 settings remain once connectedness to nature is accounted for (or vice versa). For instance, it is not known to what
22 extent Mayer and colleagues' (2009) explanation generalizes to other environments and whether all experiences of
23 nature (e.g., to urban parks, the countryside, or the coast) are associated equally with connectedness to nature.

24 In terms of environmental quality, the few studies available imply that psychological restoration is greater
25 for environments known to be of good quality. For example, as an indicator of environmental quality, biodiversity
26 can have positive effects on people, with visits to environments with greater (or perceived greater) species richness
27 and abundance resulting in greater restoration (Cracknell, White, Pahl, Nichols, & Depledge, 2015; Dallimer et al.,
28 2012; Fuller, Irvine, Devine-Wright, Warren, & Gaston, 2007; Lindemann-Matthies, Junge, & Matthies, 2010). The
29 pristineness and aesthetic value of the environment (e.g., absence of litter and degradation) has also been linked to

1 beneficial restorative effects (Maguire, Miller, Weston, & Young, 2011; Pretty, Peacock, Sellens, & Griffin, 2005;
2 Wyles et al., 2016). The current research builds on these earlier approaches by identifying whether nature visits
3 were made to locations with nationally recognized ‘protected or designated area’ (PDA) status, indicating high
4 ecological quality and/or aesthetic value. Within the UK, there are a number of statutory designations protecting the
5 natural environment under UK national, European, and international legislation. This includes Areas of
6 Outstanding Natural Beauty (AONBs, to protect landscapes of national importance), National Parks (to provide
7 access for the public to areas of beauty, wildlife and cultural heritage), Sites of Special Scientific Interest (SSSIs, to
8 conserve wildlife, geological, and physiographical heritage), and National and Local Nature Reserves (to preserve
9 wildlife and geological sites important to the country or of special interest locally; Joint Nature Conservation
10 Committee, 2014). The primary intention for all of these PDAs is to preserve environments that are scientifically
11 important and/or of known cultural value, and, moreover, they can occur in rural, urban green-space, and coastal
12 settings. To the best of our knowledge no previous research has explored visitor experiences to these designated,
13 versus non-designated sites, across a range of urban green-space, rural green-space, and coastal settings, and thus
14 the role that environmental quality may play.

15 Perhaps the closest research was conducted by Wheeler and colleagues (2015) who found a positive
16 relationship between how close individuals lived to one or more of these UK PDAs and their self-reported health.
17 However, due to its ecological focus, that research was unable to explore whether this was due to people actually
18 visiting these sites and deriving any direct benefits. This nonetheless seems feasible given that a) people are more
19 likely to visit natural environments closer to home (e.g., Schipperijn et al., 2010) and b) visiting such areas may
20 confer significant benefits if they have higher biodiversity or aesthetic value (e.g., Fuller et al., 2007; Wyles et al.,
21 2016). The current study addresses this second issue by investigating whether visits to PDAs in England are
22 associated with greater connectedness to nature and psychological restoration than visits to sites without designated
23 status, indicating poorer ecological/aesthetic quality. As these locations might be considered to be in some way
24 ‘more natural’ than non-designated sites, or at least of a certain environmental quality, people might feel a stronger
25 connection to nature when visiting them, which in turn may improve the restorative experience of the visit (or vice
26 versa).

27 **Other Factors that Influence the Benefits of Experiencing Nature**

28 To identify the unique role that environment type and quality has on these two psychological outcomes,
29 ideally research should control for other factors that might influence both the propensity to visit nature and the

1 psychological outcomes. Specifically, connectedness to nature and psychological restoration have been found to
2 vary according to demographic factors and visit characteristics. For example, connectedness to nature has been
3 shown to be greater in older age groups (Cervinka et al., 2012; Luck et al., 2011), and in females (Cervinka et al.,
4 2012; Haluza, Simic, Hölzge, Cervinka, & Moshhammer, 2014). Connectedness to nature can also be associated with
5 the specific activities people engage in. Wolsko and Lindberg (2013), for instance, considered the type of activities
6 undertaken by comparing three broad groups of activity conducted in Northwest USA: Appreciative outdoor
7 recreation (e.g., walking, cross-country skiing, and non-motorized boating), consumptive outdoor recreation (e.g.,
8 hunting and fishing), and motorized outdoor recreation (e.g., boating and snowmobiling). They found that
9 individuals who engaged in more appreciative outdoor recreation had the highest connectedness to nature scores,
10 whereas those who engaged in more motorized outdoor recreation had the lowest. Thus connectedness to nature
11 can be associated, to some extent, with some visit characteristics; however many other factors have yet to be
12 explored (e.g., whether connectedness is associated with the duration of the visit, companions, and distance
13 travelled).

14 In comparison, for the restorative effects of experiencing nature, a number of key influential visit
15 characteristics have been identified. Visiting nature by oneself has been found to be associated with greater
16 psychological restoration compared to being accompanied by a friend, as do short distances to the site. The longer
17 people spend in nature, the more restorative benefits they also tend to receive (Coombes & Jones, 2010; Hansmann
18 et al., 2007; Hinds & Sparks, 2008; Johansson et al., 2011). White and colleagues (White, Pahl, Ashbullby,
19 Herbert, & Depledge, 2013) examined the role of all of these factors on a retrospective measure of restoration
20 simultaneously, using 2009-2011 data from a large secondary dataset, the *Monitor of Engagement with the Natural*
21 *Environment* (MENE; Natural England, 2015). Visits to coastal environments were associated with greater recalled
22 restoration compared to urban green and rural green environments. They also identified influential demographic
23 factors (e.g., younger age groups reported less restoration than older groups), and highlighted additional visit
24 characteristics that were significant predictors of restoration (e.g., recalled restoration was lower for those visiting
25 with children, and higher for walking compared to other activities). However, while White and colleagues (2013)
26 concluded that type of nature was important after adjusting for these other influential factors, they did not consider
27 environmental quality or the role of connectedness to nature in their work.

1 Present Research

2 Here, we uniquely examine whether connectedness to nature differs according to the *type* and *quality* of a
3 natural environment visited, and in turn, how this relates to psychological restoration in the large English MENE
4 survey. Because the survey asks about visits in the past seven days, our measures are necessarily related to
5 recollections of an experience, as opposed to direct experiences in the moment. Thus we refer to recalled
6 connectedness to nature (RCN) and recalled restoration (RR) to make it clear that these descriptions are of
7 encounters that could have occurred several days ago, as opposed to minutes or hours ago. In sum, we carried out a
8 novel analysis of the recently updated national and large-scale MENE dataset (adding three years of data to the
9 earlier set used by White et al., 2013; Natural England, 2015). As illustrated in Figure 1, we examined three main
10 research questions: 1) are environment *type* and *quality* related to recalled connectedness to nature (Paths A₁ and A₂
11 of Figure 1), 2) are environment *type* and *quality* related to recalled psychological restoration (Path B₁ and B₂), and
12 finally 3) expanding on the biophilia hypothesis and empirical studies (Mayer et al., 2009; Nisbet & Zelenski,
13 2011; Wilson, 1984), what is the relationship between recalled connectedness to nature and recalled restoration
14 (Path C). All of these questions are explored while also controlling for the role of demographics and visit
15 characteristics.

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Method

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The MENE Survey Overview

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The MENE survey is part of the UK's national statistics and uses the same protocols, and many of the same
demographic questions, as other surveys collecting data to inform policy. It is conducted across the whole of
England and throughout the entire year (to reduce potential geographical and seasonal biases) as part of an in-home
omnibus survey using Computer Assisted Personal Interviewing (CAPI). It is funded by Natural England (the UK
government's advisory body for the natural environment) with support from both the UK government's Department
for Environment Food and Rural Affairs and the Forestry Commission (the government department responsible for
the protection of forests and woodlands). Between 2009 and 2014 there were approximately 240,000 interviews
where participants were asked to consider occasions in the last week when they spent time out of doors. Out of
doors was explicitly defined as 'open spaces in and around towns and cities, including parks, canals and nature
areas; the coast and beaches; and the countryside including farmland, woodland, hills and rivers. This could be
anything from a few minutes to all day. It may include time spent close to your home or workplace, further afield

1 or while on holiday in England. However, this does not include routine shopping trips or time spent in your own
2 garden' (Natural England, 2015).

3 Of this large national sample, 40% of respondents ($n = 93,770$) reported that they made at least one visit in
4 the last seven days, with the average number of visits being 1.22 ($SD = 2.54$). This sub-sample was no longer
5 representative of the full dataset ($N = 235,565$), as age and socio-economic status categories were no longer
6 proportionally represented. For example, while 46% of people in the 35-44 years range made a recent visit, only
7 32% of those over 65 years of age, and 39% in the 16-24 age range made a recent visit. Similarly for socio-
8 economic status, the lowest category made significantly fewer visits to the natural environment compared to the
9 other categories, with 31% of people in the lower category having made a recent visit in comparison to the highest
10 category where 53% had made a recent trip to nature in the past week. Given the large sample size, these
11 differences were statistically significant ($ps < .001$), thus any generalization of this sub-sample should be treated
12 with caution but it is nonetheless representative of the population of England who did visit nature in the previous
13 seven days.

14 Participants were then asked further questions about a single visit, randomly selected (via CAPI) from
15 those taken in the last week. Questions required respondents to provide details of their visit (e.g., distance from
16 starting point, travel mode, duration), reasons for making the visit, and to reflect on their experiences (see Natural
17 England, 2016, for the full question script). With respondent time as the primary constraint, some questions were
18 only asked to smaller sub-sets of the sample across the year. The measures of interest for this analysis (RCN and
19 RR) were thus only asked one week each quarter (reducing the potential sample size of our study to $n = 7,055$).

20 **Participants**

21 For the purpose of this analysis, strict sampling criteria were adopted. First, only day visits were selected,
22 as only a small portion of responses described overnight visits (6%). Second, only visits that involved one activity
23 were selected, as it would not have been possible to distinguish which responses were attributed to which activity
24 for the minority of participants (20%) that reported more than one. Third, entries where a lack of information
25 prevented the identification of the geographical location of the visit were omitted (14%). This resulted in a sample
26 of 4,515 people describing and evaluating a visit, see Table 1 for a detailed profile of the sample and their visits.

1 **Measures**

2 **Environment type**

3 The *type* of environment visited was based upon responses to a question asking whether the visit had taken
 4 place in one of the following four locations: ‘in a town or city; in a seaside resort or town; other seaside coastline
 5 (including beaches and cliffs); and in the countryside (including areas around towns and cities).’ Due to the
 6 substantially smaller sample sizes for the two coastal options, these were condensed into one category to strengthen
 7 statistical power (see also White et al., 2013), resulting in three main environmental types: Urban green, rural
 8 green, and coastal.

9 **Environment quality**

10 The *environmental quality* of the visit location was based upon whether the place visited had an official
 11 designated status recognizing it as being of particular scientific, ecological or aesthetic value. The five designations
 12 we included in the analysis were: National Parks, Sites of Special Scientific Interest, National or Local Nature
 13 Reserves and Areas of Outstanding Natural Beauty. Designation status of location visited was assigned by Natural
 14 England post-interview based upon the geolocation of the place reported by respondents and applying Lower-Layer
 15 Super Output Area (LSOA) (i.e., the respondents did not need to know whether the place they visited had a
 16 designated status). We followed Wheeler and colleagues (2015) in collapsing across all five designation types to
 17 produce a binary quality indicator, i.e., whether the visit location was, or was not, in a ‘protected/designated area’
 18 (PDA) as well as the interaction between these two variables (see Table 1). Figure 2 shows the locations of each of
 19 the six visit categories (i.e., type by quality).

20 **Demographic information**

21 Participants answered a number of questions about their demographic profile, including age, gender and
 22 socio-economic status. Following standard national classification guidelines, MENE interviewers rated each
 23 individual’s socio-economic status in terms of four categories: AB, C1, C2 and DE (Ipsos-Mori, 2009). This
 24 assignment was based on the individual’s work profile as follows: AB = high/intermediate managerial,
 25 administrative or professional; C1 = supervisory, clerical and junior managerial, administrative or professional; C2
 26 = skilled manual worker; D/E = semi and unskilled manual workers, state pensioners, casual or lowest grade
 27 workers, unemployed with state benefits only. Respondents were also asked about their ethnicity, marital and
 28 working status, but these were not included in our analysis to avoid over-parameterizing the models.

1 **Visit characteristics**

2 Participants also gave information regarding visit characteristics (Table 1). For activities undertaken during
 3 their visit, participants could choose from a list of 20. These activities were then aggregated into groups of related
 4 activities where possible (e.g., water activities consisted of swimming, paddling, and water sports) to form 11
 5 activity groups. Duration of the entire visit was estimated (from leaving and returning to the starting location –
 6 mostly from home), with 133.20 minutes ($SD = 136.72$) being the average time spent. Because the responses were
 7 positively skewed, they were grouped into five more meaningful categories (less than 30 minutes, 31-60 minutes, 1
 8 hour 1 minute-2 hours, 2 hour 1 minute-3 hours, or over 3 hour visits; Table 1). Distance to the site was also self-
 9 reported, with participants given 10 options ranging from less than 1 mile (1.6 km) to more than 100 miles (160.9
 10 km). These categories were reduced to four to, again, form more meaningful categories for analyses (see Table 1).
 11 The mode of transport used to get to the site was also reported. From the original 11 options given to participants,
 12 five categories were formed: Car / van / motorbike / scooter; public transport (including bus & coach); walking;
 13 cycling; and other (e.g., horseback, boat, taxi, and mobility scooter). Finally, the presence of companions was
 14 recorded. Participants were asked to state the number of adults and children (< 16 years) that accompanied them
 15 during the visit. For the purpose of the paper, this was categorized as visiting alone, with adults, with children, or
 16 with both adults and children.

17 **Assessing psychological benefits of a visit**

18 After describing the visit, participants evaluated their visit by rating the extent to which they agreed with
 19 the following six statements: ‘I enjoyed it’, ‘it made me feel calm & relaxed’, ‘it made me feel refreshed &
 20 revitalized’, ‘I took time to appreciate my surroundings’, ‘I learned something new about the natural world’, and ‘I
 21 felt close to nature’ rated on scales from 1 (‘strongly disagree’) to 5 (‘strongly agree’). For this paper, we focused
 22 on three of these items in particular.

23 ***Recalled connectedness to nature.*** ‘*Recalled connectedness to nature*’ (RCN), was operationalized as the
 24 final item of these six: ‘I felt close to nature’. Conceptually, RCN is related to other connectedness to nature
 25 measures that look at affective connections, such as the Connectedness to Nature Scale (CNS, Mayer & Frantz,
 26 2004, e.g., ‘feeling connected with the natural world’), Connectivity with Nature (Dutcher, Finley, Luloff, &
 27 Buttolph Johnson, 2007, e.g., ‘feeling a sense of oneness with nature’) and the Love and Care for Nature Scale
 28 (Perkins, 2010, e.g., ‘I often feel emotionally close to nature’) but it is specific to an actual recent visit rather than
 29 generic. While we had no control over the initial measurement design, we did conduct a pilot study for this paper,

1 with a UK sample ($n = 105$; age and gender were census representative) to test whether RCN was correlated with
 2 the state-version of CNS. The resulting correlation, $r = .58$, $p < .001$, was similar to other studies testing measures
 3 of connectedness to nature (e.g., Cervinka et al., 2012; Mayer & Frantz, 2004; Tam, 2013 with correlations
 4 between .39 and .62), thus, increasing confidence in using this item to measure connectedness to nature.

5 ***Recalled restoration.*** Replicating White and colleagues (2013), ‘*recalled restoration*’ (RR) was
 6 operationalized as the mean of ‘it made me feel calm and relaxed’ and ‘it made me feel refreshed and revitalized’
 7 (Spearman-Brown’s $r = .71$). ‘I enjoyed it’ was not included in part due to a ceiling effect and resulting lower
 8 reliability, and in part because ‘calm/relaxed’ and ‘refreshed/revitalized’ are a better conceptual match for
 9 restoration than enjoyment is.

10 **Analysis**

11 Following the approach of earlier studies using this dataset (e.g., White et al., 2013) we used two, two-step
 12 Ordinary Least Squared (OLS) regressions to explore whether: a) RCN; and b) RR were greater in some
 13 environments than others. Step 1 (unadjusted models) included the dummy-coded environment types with urban
 14 green as the reference category, the quality of the environment operationalized as Protected and Designated Areas
 15 (PDAs), dummy coded as ‘Yes’ or ‘No’ (reference), and the relevant interaction terms between type and quality.
 16 These latter terms were necessary to identify any moderating (antagonistic or synergistic) effects of location type
 17 and quality. To reduce the role of potential bias (e.g., certain types of people visit certain types of environment),
 18 Step 2 (adjusted models) added demographic variables and visit characteristics. Due to negative skews in both
 19 dependent variables, analyses were also performed using log transformations but as conclusions were highly
 20 similar, only the analyses using the original response scales are reported.

21 To explore the relationship between RCN and RR we conducted two structural equation models (SEMs).
 22 The first model (again controlling for demographic and visit characteristics) tested the hypothesis that the reason
 23 why RR would be higher in some environments than others was because RCN is greater in these environments.
 24 Evidence in support of this suggestion would be found if: a) there was good ‘model fit’ (e.g., non-significant chi
 25 square, plus $RMSEA < .06$, plus $CFI > .95$), and b) there was a significant ‘indirect’ path from environment type to
 26 RR via RCN. The second model tested the alternative hypothesis that the reason why people recall feeling more
 27 connected to nature was because they were in environments where they felt calmer and more relaxed; that is, RCN
 28 was now the outcome variable and RR was the mediating variable. If our predictions were correct and RCN was the
 29 mediating process, the second model should show poorer fit than the first, and there should be no significant

indirect path from environment type to RCN through RR. In both models, RR was modelled as a latent variable (constructed of the two observed variables) and a condensed set of demographic and visit covariates were included rather than the full regressions for simplicity. Specifically, and based on the significant outcomes of the OLS regressions described above, the SEM covariates were all dummy variables and included: Gender (Male *vs.* female); Age (<35 years *vs.* 35+); visit duration (<30 mins *vs.* >30 mins); activity type (walking with or without a dog *vs.* other); and companion type (alone with children *vs.* other). The models presented are the final models following stepwise removal of the least significant paths from the original model until only significant paths remained (and modification indices suggested no further significant paths).

Results

The Role of Type and Quality of an Environment for Recalled Connectedness to Nature (RCN) and Recalled Restoration (RR)

On average, participants rated their RCN and their RR following visits to nature spaces relatively high on the 5-point scale ($M = 3.81$, $SD = 0.97$; $M = 4.09$; $SD = 0.70$ respectively). Crucially, in both cases ratings varied depending on the type and/or quality of the environment they visited (see Table 1 & 2).

Regression analysis predicting Recalled Connectedness to Nature (RCN)

In the fully adjusted RCN model, RCN was 0.24 higher ($p < .001$) on the scale for a visit to a rural green space compared to an urban green-space (a 4.8% difference), whereas a visit to a coastal location was given a marginally significantly higher score (0.10, $p = .07$) than to urban green-space (a 2.0% difference, Table 2). Further, RCN was 0.31 higher ($p < .001$) on the scale for a visit to a location with PDA status compared to a location without PDA status (a 6.1% difference). When exploring how environment type and quality interact, there was a marginally significant interaction in the adjusted RCN model, reflecting that while visiting both urban green-space and coastal locations with PDA status was associated with similar higher ratings of RCN compared to non-PDA status locations, a similar effect was not found between rural PDA and non-PDA location visits. In other words, while RCN was greater for designated status in urban green-space and coastal settings, it did not appear to affect RCN in rural settings, in part because non-PDA status rural visits seemed to be higher than might be predicted from the other two locations (Figure 3).

In line with previous studies, demographics were also associated with connectedness: males and younger respondents recalled lower connectedness (Table 2). Socio-economic status was not, however, significantly

1 associated with RCN, suggesting that individuals from all social groups recalled similar connectedness to nature on
 2 nature visits. Some of the visit characteristics were also significant predictors. Compared to the activity ‘walking
 3 without a dog’, visiting an attraction, exercise, playing, and food related activities were all associated with lower
 4 RCN. Visits with children were also associated with lower RCN than visits alone and RCN was greater for visits
 5 that lasted longer than 30 minutes. Even with the inclusion and demonstration of previously untested individual and
 6 visit-related predictors for connectedness to nature, the predictive power of environment type (coasts and rural
 7 green compared to urban green) and quality (PDAs compared to non-PDAs) remained (although only marginally
 8 for coasts).

9 **Regression analysis predicting Recalled Restoration (RR)**

10 When predicting RR, a visit to a coastal location was associated with a 0.14 ($p < .001$) greater score in RR
 11 compared to a visit to an urban green-space (a 2.8% difference), whereas rural green-space was rated marginally
 12 different to urban green-space: a rural green-space was associated with a greater score on the scale of 0.05 ($p = .06$)
 13 in RR compared to a visit to an urban green-space (a 1.0% difference) in the fully adjusted model. The quality of
 14 the environment was a significant predictor of RR in the unadjusted model; however when adjusting for
 15 demographic variables and visit characteristics, it lost significance ($p = .14$); and unlike RCN, an interaction
 16 between type and quality was not found for RR (see Table 2 and Figure A in the Supplementary Materials). As
 17 found in White et al. (2013), RR was greater for females and older individuals, and was associated with longer
 18 duration visits and when visiting alone. Some activities, such as visiting an attraction and exercising, were
 19 associated with lower RR than merely walking (Table 2).

20 **Exploring the Overall Model with SEM**

21 As noted above, to explore the relationships between RCN and RR we ran two SEMs, one with RCN as the
 22 hypothesized mediator, and the reverse possibility with RR as the mediator. The final models can be seen in the
 23 Supplementary Materials. Supporting the hypothesis that RCN did mediate the relationship between environmental
 24 type and quality, and restoration, there was good model fit (Chi Square ($df = 10$) = 7.97, $p = .63$, RMSEA = .000
 25 CFI = 1.00) and significant indirect effects of both rural (.08, $p < .05$) and coastal (.03, $p < .05$) environments, PDA
 26 status (.07, $p < .05$), and the interaction between rural and PDA status (-.03, $p < .05$; this was marginally significant
 27 in the regression analysis above). Although the direct path from coastal location to RR was also significant (.06,
 28 $p < .05$), suggesting partial mediation, this was the only significant direct path, suggesting that all other relationships
 29 were fully mediated through RCN (Figure B). That is, it seemed that the reason why rural locations and those with

1 PDA status, in particular, was associated with greater RR was because these were associated with higher feelings of
2 connectedness to nature.

3 Despite this support for the RCN as mediator hypothesis, the alternative model with RR as the mediator
4 and RCN as the dependent variable also showed good fit (Chi Square ($df = 9$) = 4.12, $p = .90$; RMSEA = .000, CFI
5 = 1.00; Figure C). In this model there were also significant indirect effects of rural (.03, $p < .05$) and coastal (.04, p
6 $< .05$) locations and PDA status (.03, $p < .05$) on RCN via RR. In other words, it would be equally feasible to argue
7 that the reason why people felt more connected to nature in rural, coastal, and PDA status locations was because
8 they felt more relaxed and refreshed. Consequently, the most logical conclusion, from this cross-sectional data, is
9 that there is a bidirectional, mutually reinforcing effect.

10 Since we could not assume that one variable was the mediator and one the dependent variable, we
11 produced a third (unplanned) SEM where both variables were treated as outcome variables in the model (allowing
12 their error terms to co-vary, thus no direct path was included). This model also showed good fit (Chi Square ($df =$
13 8) = 4.12, $p = .90$; RMSEA = .000, CFI = 1.00). This final model is presented in Figure 4 and shows direct effects
14 of both environment types and PDA status on RCN and RR and the interaction between rural location and PDA
15 status (as explained above). This final model is perhaps the best representation of the data and can be summarized
16 as follows: even after controlling for a range of important demographic and visit characteristics, a) visiting a rural
17 or coastal location was associated with greater RCN and RR than was visiting an urban green location; b) visiting a
18 location with PDA status was associated with greater RCN and RR than was visiting similar environments without
19 PDA status; and c) visiting coastal and urban locations with PDA status was also associated with higher RCN than
20 non-PDA coastal and urban locations, but that PDA status was unimportant for the relationship between rural
21 locations and RCN (i.e., as reflected in the significant negative interaction term).

22

23

Discussion

24 Experiencing nature can have psychological benefits for visitors, including strengthening the sense of
25 connectedness to nature and enhancing psychological restoration (Mayer et al., 2009; Nisbet & Zelenski, 2011).
26 Using a large sample from a nationally representative survey in England, the current findings show that different
27 types of environment are associated with greater recalled restoration and connectedness to nature, extending
28 previous research (White et al., 2013). While the size of the effects may be relatively small compared to studies
29 contrasting two more extreme environments (nature vs. built settings; e.g., Mayer et al., 2009; McMahan & Estes,

1 2015), these findings are important especially in terms of the potential cumulative effects (e.g., from individual to
2 population level, and from one visit to multiple visits). More importantly, the present research also demonstrated,
3 for the first time, that the quality of these environments, in terms of designation status, was associated with the
4 amount of psychological restoration people experienced from these visits and how connected they felt to nature
5 during them. More specifically, urban and rural green-spaces and coastal locations with designated status were all
6 associated with greater recalled restoration than locations without designated status; and urban green-spaces and
7 coastal locations with designated status were also associated with greater connectedness to nature than locations
8 without designated status. Given that designation status is often associated with ecosystem richness, these findings
9 support claims that higher quality green and blue spaces may have direct benefits on psychological restoration
10 (Cracknell et al., 2015; Dallimer et al., 2012; Fuller et al., 2007; Lindemann-Matthies et al., 2010). Evolutionary
11 theories might help explain these findings. According to the biophilia hypothesis (Wilson, 1984), for instance,
12 natural environments of higher “quality” may signal a greater variety of food and a higher ecological resilience to
13 exogenous shocks (e.g., temperature changes). These environments would have been better for human survival in
14 that period of human evolutionary history where such things were of most immediate importance, the residual
15 being innate preferences for more ecologically rich settings.

16 Supporting earlier research (Cervinka et al., 2012; Haluza et al., 2014; Luck et al., 2011), females and older
17 adults reported greater restoration and connectedness to nature from nature visits than did males and younger
18 adults, and the most popular activity, walking, was associated with higher levels of connectedness than other
19 activities (in particular exercise, playing, food-related activities, and visiting attractions). Walking falls within
20 Wolsko and Lindberg’s (2013) category of appreciative outdoor recreation, thus supporting their earlier findings.
21 These activities could be seen to immerse the individual with the natural world and the animals that live within it to
22 a greater degree than other activities, hence the greater scores. Distraction from the surrounding environment (thus
23 lack of immersion) could be a reason why we found that recalled connectedness to nature was lower for other
24 activities (e.g., visiting an attraction, exercise, playing, and food related activities) and when visiting with children
25 compared to being alone. We also found that the level of recalled connectedness varied with the duration of a single
26 visit, with visits longer than 30 minutes associated with greater connectedness. This novel finding for
27 connectedness to nature reflects a similar trend for psychological restoration, where a dose-response effect has been
28 proposed (an optimum amount of time for an individual to receive the most benefit from the environment; Barton
29 & Pretty, 2010; Cox et al., 2016). We did not, however, find an effect of socio-economic status, suggesting that

1 individuals from all social groups experienced similar levels of connectedness on nature visits. This is an intriguing
2 finding that suggests providing access and preserving nature is important in light of increasing trends in socio-
3 economic inequality. However, while we were able to explore various individual and visit-related predictors for
4 connectedness to nature, this paper's primary contribution to understanding connectedness is its sensitivity to the
5 type and quality of the environment experienced, how this remains even when these individual and visit
6 characteristics are accounted for, and how this relates to psychological restoration.

7 In terms of the direction of association between recalled connectedness to nature and restoration, structural
8 equation modelling suggested a bidirectional relationship. People reported greater connectedness to nature for
9 environments that were more restorative, and recalled feeling more restored in environments where they felt more
10 connected. Although some previous theoretical and empirical literature had proposed that connectedness to nature
11 might mediate the relationship between natural environments and psychological restoration (e.g., Mayer et al.,
12 2009), the alternative direction had also been suggested by Nisbet and Zelenski (2011), and the general mutual
13 association between the two variables has been widely demonstrated (Capaldi et al., 2014; Cervinka et al., 2012;
14 Howell et al., 2011; Tam, 2013; Zelenski & Nisbet, 2014). There are a number of possible explanations why one
15 direction was not stronger than the other. First, the results may be due to an inherent limitation in the design of
16 cross-sectional studies such as these, where questions are asked together in blocks and causality is not directly
17 testable. This important issue notwithstanding, there are other factors that may also have played a role. For
18 instance, Mayer and colleagues (2009) and Nisbet and Zelenski (2011), found evidence for mediation using
19 experimental designs on relatively small samples of students measuring only the main variables of interest (namely
20 the mediator and the outcome in response to a visit to indoor *vs.* outdoor environments or the equivalent of a rural
21 green PDA *vs.* urban setting). While this gave them control and power over the environmental manipulation, they
22 did not consider the influence of other factors. One strength of our analysis is that we used a large heterogeneous
23 sample of the general population, accounted for other factors (e.g., demographic and visit characteristics), and
24 explicitly looked at the predictive value of recalled connectedness to nature on recalled restoration *and* the reverse.
25 Further, the current study explored different environmental contexts. Both Mayer et al. (2009) and Nisbet and
26 Zelenski (2011) contrasted two rather different and more extreme environments (indoor *vs.* outdoor environments
27 or the equivalent of a PDA *vs.* urban setting); whereas we compared types and quality of natural settings.
28 Consequently, by using more similar settings, the variances in responses were somewhat narrowed, and thus may
29 have resulted in the strength of any mediating effect to be too subtle to detect.

1 **Limitations, Future Work, and Implications**

2 In addition to the cross-sectional nature of our data, which limited our ability to fully investigate more
3 causal relationships between connectedness and restoration in the current research, we also recognize several other
4 limitations in our study that need to be noted. For example, constraints on the survey meant that single-item
5 measures were used to assess psychological constructs that are typically measured through multi-item scales. For
6 example, the single item RCN measure included by the survey designers meant that we were unable to distinguish
7 between sub-dimensions of connectedness (e.g., physically, emotionally, cognitively close to nature). Although
8 piloting suggested the single RCN item did correlate well with an established emotional state-level scale, we
9 appreciate the issue of mono-operational bias. Relating to this, it would be interesting to further examine the state-
10 trait distinction of connectedness to nature. While the focus of this paper was to explore the sensitivity of
11 momentary feelings of connectedness to nature in respect to an environment visited, it would be worthwhile for
12 future work to also consider the role a more stable trait-like connectedness to nature may have on these visits and
13 psychological outcomes (and vice versa). For instance, using correlational techniques, further research could
14 explore whether people who have a stronger trait-like connectedness to nature tend to visit certain types and/or
15 quality of environment; as well as exploring how this relates to the state-like measures of connectedness. However,
16 as the majority of the existing literature is correlational, a crucial line of study would be to examine the more causal
17 relationships: does visiting nature lead to increased connectedness to nature, or does this connectedness make
18 people have a need to experience nature? And in turn, how does this relate to state-level connectedness, and other
19 psychological benefits experienced by spending time outdoors? For example, a mixed experimental design could
20 examine two conditions (comparing people who already have high vs. low trait connectedness) who would ideally
21 experience a range of environments (e.g., coastal vs. urban green vs. rural green), examining a change in
22 psychological outcomes such as state connectedness (before vs. after the different experiences).

23 We also appreciate that, although the PDA measure of *environmental quality* was similar to past research
24 (e.g., Wheeler et al., 2015), it was nonetheless relatively simplistic. Due to an issue of power, we were only able
25 use a designation status that spanned several possible indicators of quality (including biodiversity richness,
26 aesthetic appeal and cultural importance), thus, PDA designation indicates that these areas have some value to
27 society that reflects some aspect of quality that is worthy of protection, but we were unable to break this down into
28 individual categories (e.g., SSSIs or AONBs) or aspects (e.g., historical vs. ecological value). Although there is
29 considerable interest in the best ways to define and measure environmental quality, this is an area where there has

1 been little agreement on a single index to date. Although our PDA measure was found to be a valuable proxy of
2 acknowledged quality and might be an important aspect of the environment to be considered in future, we also
3 recognize that finer grained analyses of quality will be beneficial. It is also notable that designated status was not
4 made salient to survey respondents. Rather, this was only mapped and analyzed afterwards, reducing the potential
5 of response bias.

6 Another limitation was that responses were collected retrospectively rather than *in situ*. Fortunately, the
7 time frame for surveying was fairly short, so the potential for memory bias was smaller than it might have been if
8 asking about visits more than a few days ago (cf. Mackerron & Mourato, 2013). Future work would ideally monitor
9 a change in these psychological outcomes by collecting data *in situ* before and after the visit using an experimental
10 approach. For example, rural green visits were associated with stronger feelings of connectedness to nature, but an
11 experimental approach would be more equipped to examine whether these visits produce these stronger feelings or
12 whether people who have a stronger need to connect to nature tend to go to these environments (see Shanahan, Lin,
13 Gaston, Bush, & Fuller, 2014 for further discussion). Nevertheless, by controlling for demographic and visit
14 characteristics, we took into account a range of the potential confounds not often explored in this literature. Overall,
15 by demonstrating the importance of type and quality of an environment (and other personal and visit
16 characteristics), we hope that future work adopting complementary, including experimental and longitudinal,
17 methods will extend this investigation.

18 Despite these limitations, our findings are potentially relevant for the management of natural environments.
19 The different effects of particular types of nature, for example coastal environments, coupled with the finding that
20 PDAs are associated with greater psychological benefits (RCN and RR), emphasizes the importance of not
21 oversimplifying natural environments. The findings also reinforce that psychological benefits are associated with
22 visiting different types of natural settings irrespective of socioeconomic status and this highlights the importance of
23 making nature widely accessible. Such understanding could support the prioritization of access to and protection of
24 different environments or aspects of them, now and in the future, to maintain these additional psychological
25 benefits for visitors.

26 **Conclusions**

27 The current study used data from a large national survey of nature visits in England to explore whether
28 recalled connectedness to nature differs according to the *type* and *quality* of a natural environment visited, and in
29 turn, how this relates to recalled psychological restoration. We found that both connectedness to nature and

1 psychological restoration were sensitive to the natural environment visited. Specifically, rural green and coastal
2 environments (compared to urban green) and sites of known better quality (protected/designated areas) were
3 associated with greater recalled connectedness to nature and restoration. Overall, our findings contribute to the
4 burgeoning literature on psychological benefits of nature visits and could be useful to policy and management by
5 helping to prioritize protection of and accessibility to environmental sites that confer these benefits.

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21 **Tables**
22

1 Table 1.

2 *Summary of Key Variables: Frequency and Percentages of Responses, and Their Associated Mean (and Standard Deviations) Recalled Connectedness to Nature*
 3 *(RCN) and Recalled Restoration (RR) Scores*

	<i>N</i>	<i>%</i>	<i>RCN</i>		<i>RR</i>			<i>N</i>	<i>%</i>	<i>RCN</i>		<i>RR</i>	
Environment Visited													
Environment Type													
Environment Type							Visit Characteristics						
Urban Green	2046	45.3	3.62	(1.03)	4.02	(0.70)	Sole Activity engaged in						
Rural Green	1973	43.7	3.98	(0.86)	4.13	(0.70)	Walking (without dog)	1543	34.2	3.88	(0.91)	4.16	(0.61)
Coastal	496	11.0	3.88	(0.96)	4.23	(0.67)	Walking (with dog)	1487	32.9	3.95	(0.88)	4.13	(0.69)
Environmental Quality													
Non-PDAs	3802	84.2	3.75	(0.98)	4.07	(0.70)	Food related	198	4.4	3.29	(1.12)	3.96	(0.75)
PDAs	713	13.6	4.09	(0.83)	4.22	(0.68)	Water activities	84	1.9	3.80	(1.12)	4.23	(0.72)
Environment Type & Quality													
Urban Green – Non-PDAs	1888	41.8	3.59	(1.04)	4.01	(0.71)	Visiting an attraction	160	3.5	3.49	(1.14)	3.82	(0.91)
Rural Green – Non-PDAs	1524	33.8	3.94	(0.87)	4.11	(0.70)	Exercise	405	9.0	3.67	(1.02)	4.09	(0.73)
Coastal – Non-PDAs	390	8.6	3.79	(0.99)	4.21	(0.66)	Playing	389	8.6	3.47	(1.02)	3.83	(0.78)
Urban Green – PDAs	158	3.5	3.99	(0.81)	4.15	(0.60)	Scenery from the car	35	0.8	3.97	(0.92)	4.24	(0.70)
Rural Green – PDAs	449	9.9	4.11	(0.84)	4.22	(0.70)	Wildlife watching	30	0.7	4.27	(0.69)	4.40	(0.55)
Coastal – PDAs	106	2.3	4.18	(0.78)	4.30	(0.70)	Hunting sports	60	1.3	3.93	(0.90)	4.13	(0.86)
Demographics													
Gender													
Male	2156	47.8	3.74	(0.96)	4.09	(0.67)	Other	124	2.7	3.67	(1.14)	4.00	(0.97)
Female	2359	52.2	3.87	(0.96)	4.10	(0.73)	Duration of visit						
Age													
16-24	608	13.5	3.45	(1.04)	3.95	(0.69)	< 30 min	628	13.9	3.65	(1.02)	3.97	(0.73)
25-34	693	15.3	3.66	(0.99)	4.03	(0.72)	31-60 min	1389	30.8	3.88	(0.89)	4.12	(0.65)
35-44	760	16.8	3.83	(0.92)	4.10	(0.69)	1hr 1 min -2 hr	1186	26.3	3.84	(0.95)	4.12	(0.67)
45-54	758	16.8	3.88	(0.92)	4.12	(0.72)	2hr 1 min -3 hr	491	10.9	3.76	(1.02)	4.07	(0.74)
55-64	728	16.1	3.96	(0.93)	4.17	(0.70)	3+ hr	821	18.2	3.78	(1.03)	4.10	(0.78)
65+	968	21.4	3.95	(0.92)	4.14	(0.68)	Distance travelled						
Socio-economic status													
AB	1050	23.3	3.87	(0.95)	4.10	(0.74)	< 1 mile	1714	38.0	3.78	(0.98)	4.08	(0.69)
C1	1292	28.6	3.81	(0.98)	4.11	(0.67)	1-5 miles	1821	40.3	3.82	(0.94)	4.10	(0.68)
C2	924	20.5	3.80	(0.95)	4.10	(0.68)	6-20 miles	633	14.0	3.79	(1.00)	4.11	(0.74)
DE	1249	27.7	3.75	(0.98)	4.06	(0.72)	21+ miles	347	7.7	3.86	(0.99)	4.12	(0.78)
Mode of transport													
car / van / motorbike													
public transport													
walking													
cycling													
other													
Companion													
alone													
with adults only													
with children only													
with both adults & children													

4 ^a AB = high/intermediate managerial, administrative or professional; C1 = supervisory, clerical and junior managerial, administrative or professional, C2 = skilled manual worker,

5 DE = semi and unskilled manual workers, state pensioners, casual or lowest grade workers, unemployed with state benefits only.

1 *Table 2.*2 *Unadjusted and Adjusted Regression Analyses Looking at the Role of Environment Type and Quality on Recalled*
3 *Connectedness to Nature (RCN) and Recalled Restoration (RR; n = 4,515)*

4

	RCN (unadjusted)			RCN (adjusted)			RR (unadjusted)			RR (adjusted)		
	<i>B</i>	<i>SE</i>	<i>Beta</i>	<i>B</i>	<i>SE</i>	<i>Beta</i>	<i>B</i>	<i>SE</i>	<i>Beta</i>	<i>B</i>	<i>SE</i>	<i>Beta</i>
Environment type												
Coastal	.21	.05	.07***	.10	.05	.03 ⁺	.20	.04	.09***	.14	.04	.06***
Urban green (ref)	-	-	-	-	-	-	-	-	-	-	-	-
Rural green	.35	.03	.18***	.24	.03	.12***	.10	.02	.07***	.05	.03	.03 ⁺
Environmental quality												
PDA's	.40	.08	.15***	.31	.08	.12***	.14	.06	.07*	.08	.06	.04
Type & Quality Interaction												
Coastal vs. urban green X PDA vs. non-PDA	-.02	.13	-.00	.03	.13	.01	-.05	.10	-.01	-.01	.09	.00
Rural green vs. urban green X PDA vs. non-PDA	-.24	.09	-.07**	-.17	.09	-.05 ⁺	-.03	.07	-.01	.02	.07	.01
Demographics												
Male	/	/	/	-.16	.03	-.08***	/	/	/	-.04	.02	-.03 ⁺
16-24 yrs.	/	/	/	-.38	.05	-.13***	/	/	/	-.14	.04	-.07***
25-34 yrs.	/	/	/	-.15	.05	-.06***	/	/	/	-.02	.04	-.01
35-44 yrs.	/	/	/	-.04	.05	-.01	/	/	/	.04	.04	.02
45-54 yrs.	/	/	/	-.07	.05	-.03	/	/	/	.01	.03	.00
55-64 yrs.	/	/	/	-.01	.05	.00	/	/	/	.03	.03	.01
65+ (ref)	/	/	/	-	-	-	/	/	/	-	-	-
AB socio-economic status (ref)	/	/	/	-	-	-	/	/	/	-	-	-
C1 socio-economic status	/	/	/	-.01	.04	.00	/	/	/	.04	.03	.02
C2 socio-economic status	/	/	/	.00	.04	.00	/	/	/	.04	.03	.02
DE socio-economic status	/	/	/	-.04	.04	-.02	/	/	/	.00	.03	.00
Visit characteristics												
Activities												
Walking without dog (ref)	-	-	-	-	-	-	-	-	-	-	-	-
Walking with dog	/	/	/	.07	.04	.03 ⁺	/	/	/	-.02	.03	-.01
Food related	/	/	/	-.48	.07	-.10***	/	/	/	-.18	.05	-.05***
Water activities	/	/	/	-.09	.11	-.01	/	/	/	.01	.08	.00
Visiting an attraction	/	/	/	-.40	.08	-.08***	/	/	/	-.33	.06	-.09***
Exercise	/	/	/	-.17	.06	-.05**	/	/	/	-.07	.04	-.03
Playing	/	/	/	-.29	.06	-.08***	/	/	/	-.24	.05	-.10***
Scenery from the car	/	/	/	.05	.16	.00	/	/	/	.05	.12	.01
Wildlife watching	/	/	/	.29	.17	.02	/	/	/	.22	.13	.03***
Hunting sports	/	/	/	.11	.12	.01	/	/	/	-.01	.09	.00
Other	/	/	/	-.22	.09	-.04**	/	/	/	-.16	.07	-.04*
Duration												
< 30 min (ref)	-	-	-	-	-	-	-	-	-	-	-	-
31-60 min	/	/	/	.26	.04	.12***	/	/	/	.17	.03	.11***
1hr 1 min -2 hr	/	/	/	.30	.05	.14***	/	/	/	.21	.04	.13***
2hr 1 min -3 hr	/	/	/	.28	.06	.09***	/	/	/	.18	.05	.08***
3+ hr	/	/	/	.32	.06	.13***	/	/	/	.21	.05	.12***
Distance travelled												
< 1 mile	/	/	/	.03	.04	.02	/	/	/	.02	.03	.01
1-5 miles (ref)	-	-	-	-	-	-	-	-	-	-	-	-
6-20 miles	/	/	/	-.04	.05	-.01	/	/	/	.02	.04	.01
21+ miles	/	/	/	.04	.06	.01	/	/	/	.02	.05	.01
Transport												
car / van / motorbike	/	/	/	.01	.04	.00	/	/	/	-.05	.03	-.03
public transport	/	/	/	-.08	.08	-.02	/	/	/	.03	.06	.01
Walking (ref)	-	-	-	-	-	-	-	-	-	-	-	-
cycling	/	/	/	.06	.09	.01	/	/	/	.06	.07	.01
Other	/	/	/	.01	.15	.00	/	/	/	.11	.11	.01

5

6

1 *Table 2 cont.*

2

	RCN (unadjusted)			RCN (adjusted)			RR (unadjusted)			RR (adjusted)		
	<i>B</i>	<i>SE</i>	<i>Beta</i>	<i>B</i>	<i>SE</i>	<i>Beta</i>	<i>B</i>	<i>SE</i>	<i>Beta</i>	<i>B</i>	<i>SE</i>	<i>Beta</i>
Companion												
Alone (ref)	-	-	-	-	-	-	-	-	-	-	-	-
with adults only	/	/	/	-.07	.04	-.03 [†]	/	/	/	-.01	.03	-.01
with children only	/	/	/	-.15	.06	-.05**	/	/	/	-.11	.04	-.05**
with both adults & children	/	/	/	-.04	.05	-.01	/	/	/	-.10	.04	-.05**
Constant			3.59			3.68			4.01			3.97
R²			0.04			0.10			0.01			0.05
adjusted R²			0.04			0.09			0.01			0.04
sig model			< .001			< .001			< .001			< .001

3 (ref) denotes the reference category (i.e., the largest group); *B* = unstandardized coefficient, *SE* = standard error, *Beta* =
 4 standardized coefficients; [†] = marginal (.05-.08); * *p* < .05; ** *p* < .01; *** *p* < .001

5

6

Figure Captions

7

8 **Figure 1. The conceptual model examining the role of environment type and quality on recalled**
 9 **connectedness to nature and recalled psychological restoration.**

10

11 **Figure 2. The geographical distribution of recalled visits to nature (*n* = 4,515)**

12 *Note:* Environment type was self-categorized by the respondents, whereas environmental quality (PDAs vs. non-
 13 PDAs) was determined post-data collection using LSOAs (Lower-Layer Super Output Areas). Image prepared by
 14 Natural England.

15

16 **Figure 3. RCN according to the environment type and quality.**

17

18 **Figure 4. The SEM model highlighting significant predictors of both recalled connectedness to nature (RCN)**
 19 **and recalled restoration (RR).**

20 *Note.* This model shows direct standardized effects while controlling for the previously found significant covariates
 21 (namely gender, age, duration, activity, and companion). There was a good model fit, Chi Square (*df* = 8) = 4.12, *p*
 22 = .85, RMSEA = .000, CFI = 1.00). PDA = Protected Designated Area; ref = reference category.

23

Supplementary materials

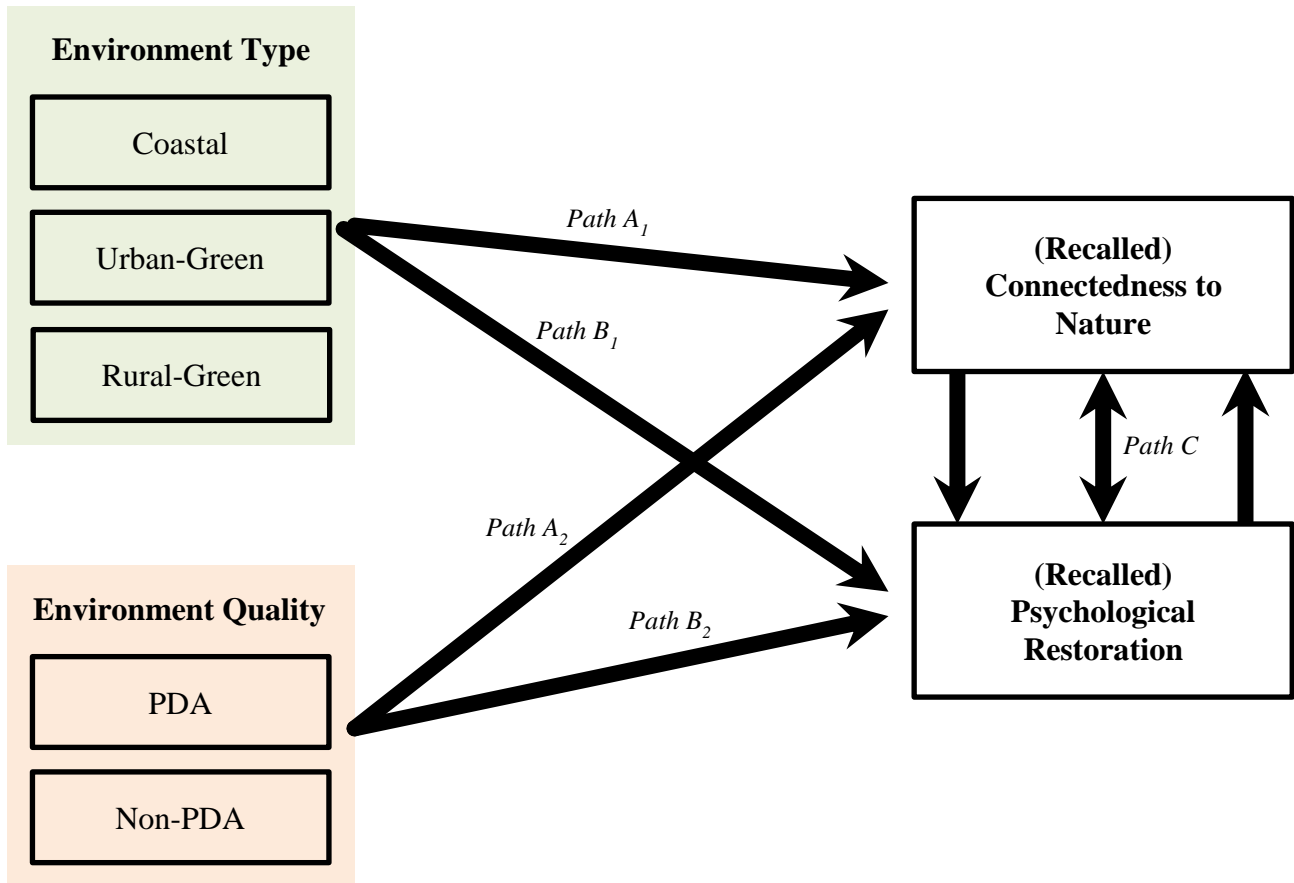
Figure A. Recalled restoration according to the environment type and quality.

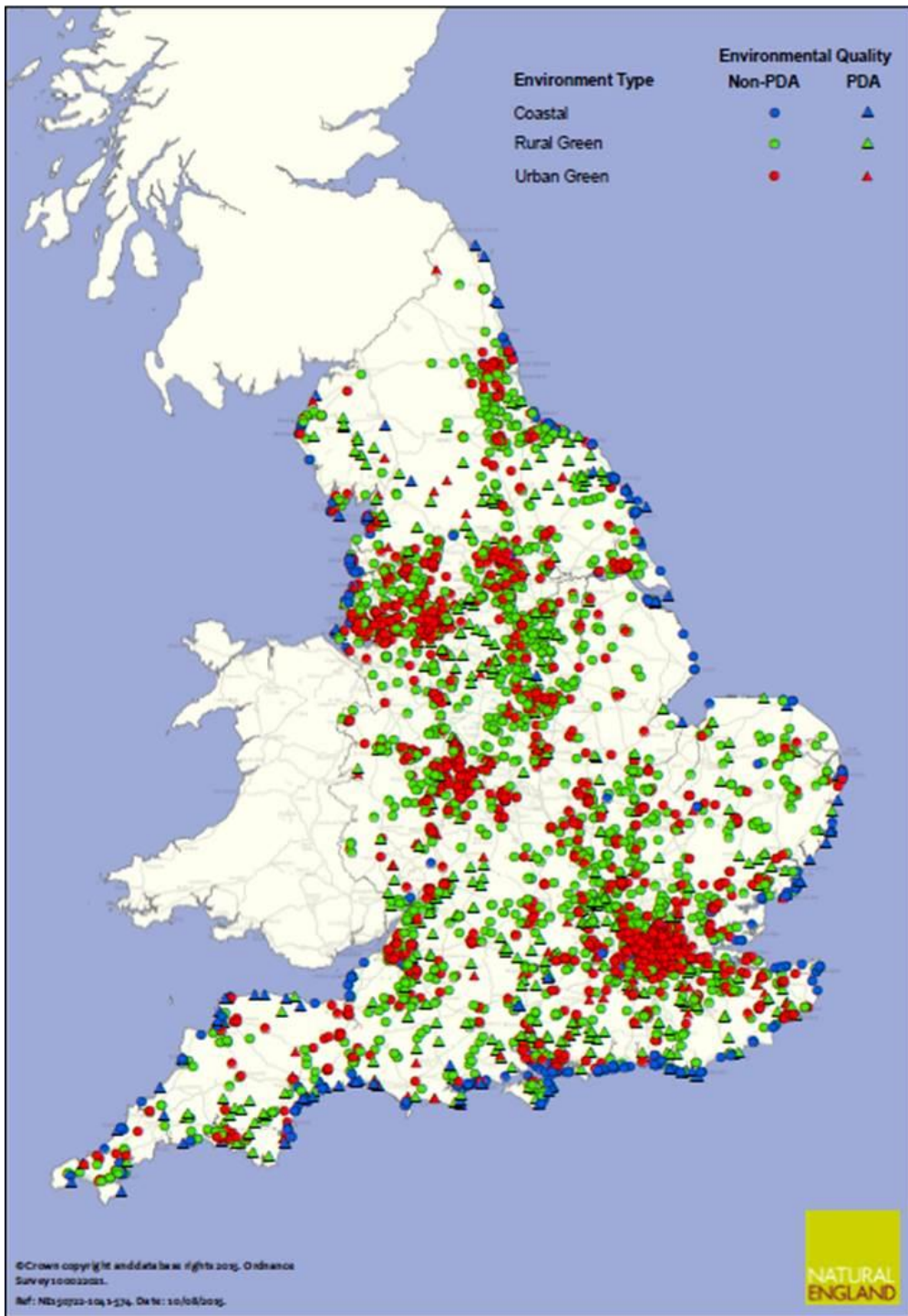
Figure B. SEM model to test the mediating role of recalled restoration (RR) on recalled connectedness to nature (RCN).

Note. This model shows direct standardized effects while controlling for the previous found significant covariates (namely gender, age, duration, activity, and companion). There was a good model fit, Chi Square ($df = 10$) = 7.97, $p = .63$, RMSEA = .000, CFI = 1.00).

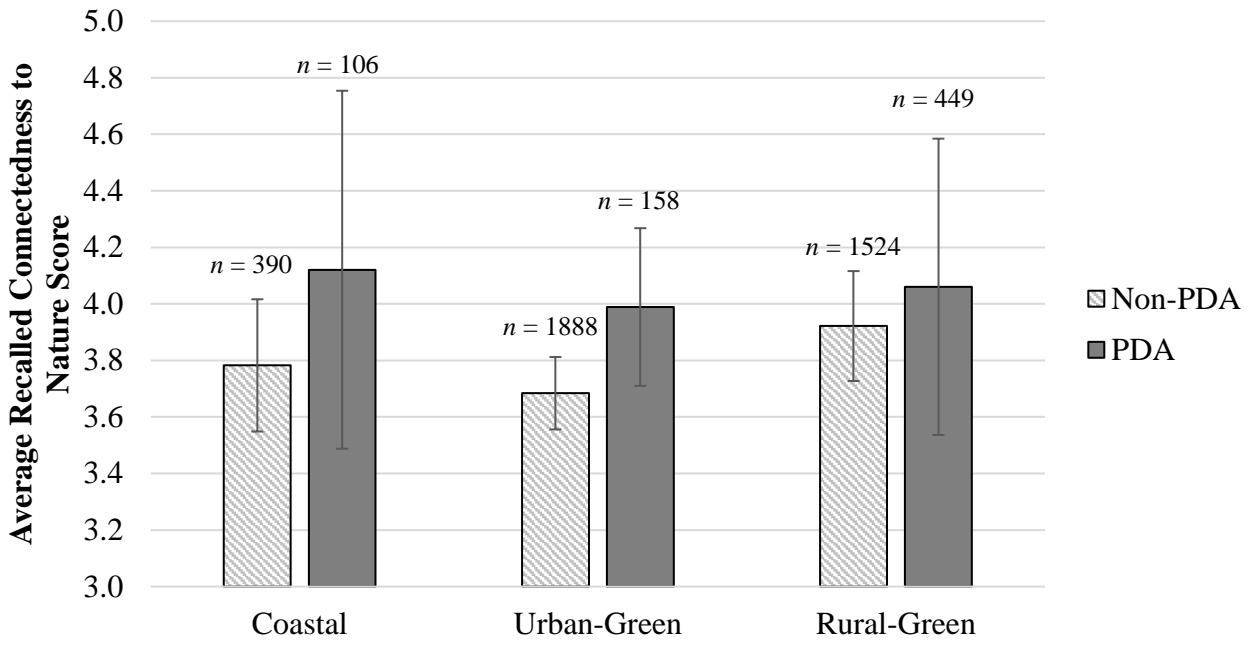
Figure C. SEM model to test the alternative direction, with recalled connectedness to nature (RCN) playing a mediating role on recalled restoration (RR).

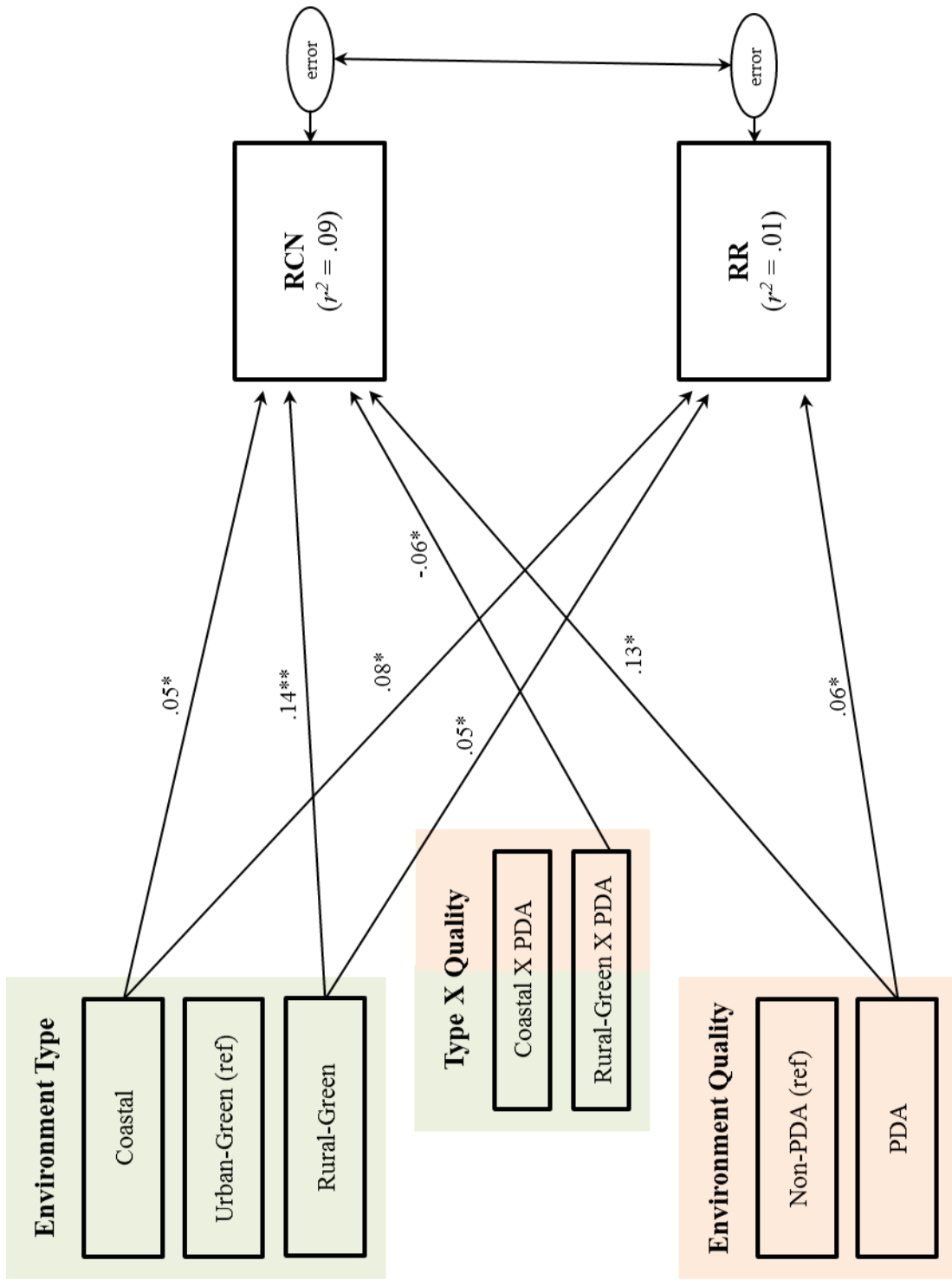
Note. This model shows direct standardized effects while controlling for the previous found significant covariates (namely gender, age, duration, activity, and companion). There was a good model fit, Chi Square ($df = 9$) = 4.12, $p = .90$, RMSEA = .000, CFI = 1.00



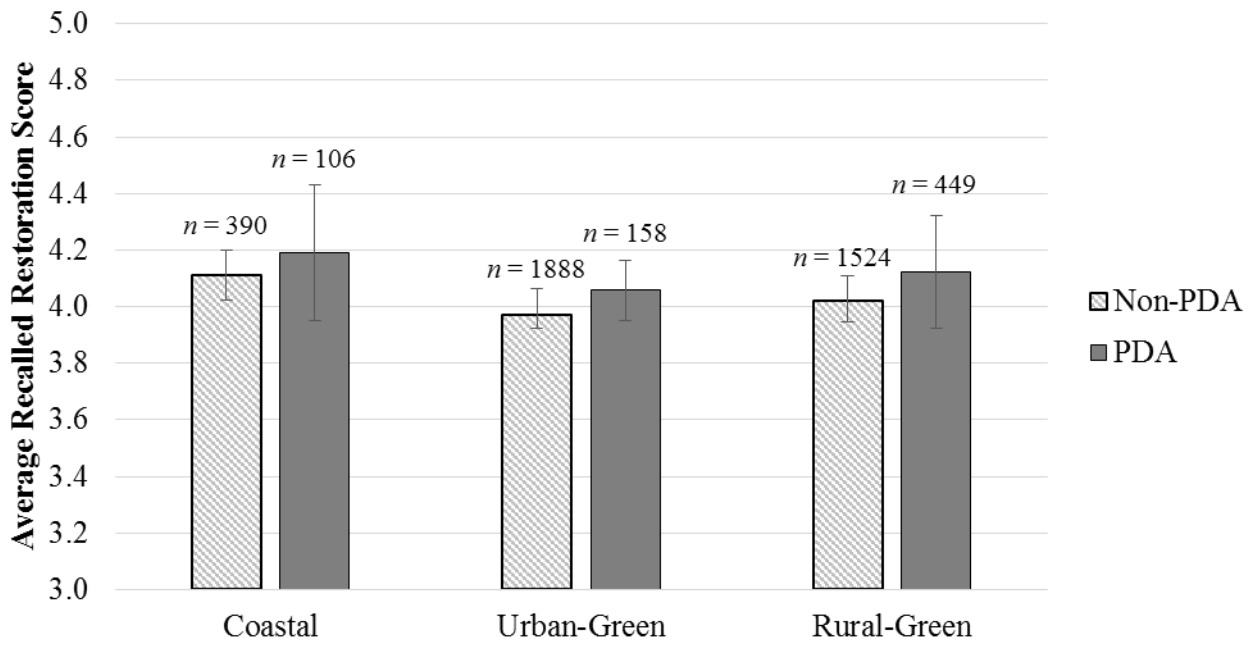


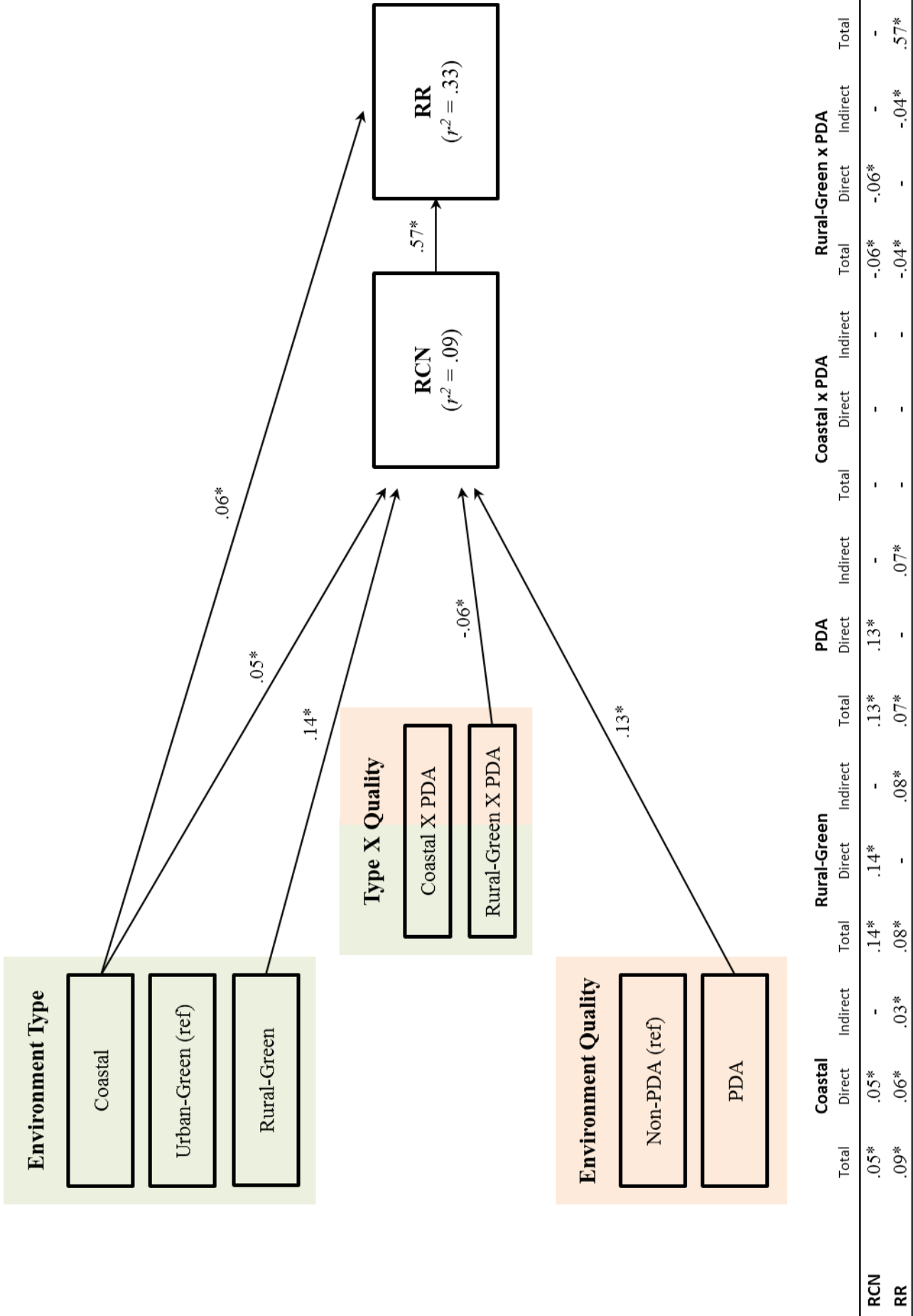
1





	Coastal			Rural-Green			Coastal x PDA			Rural-Green x PDA		
	Total	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect
RCN	.05*	.05*	-	.14**	.14**	-	.13*	.13*	-	-	-.06*	-
RR	.08*	.08*	-	.05*	.05*	-	.06*	.06*	-	-	-	-





	Coastal		Rural-Green		PDA		Coastal x PDA		Rural-Green x PDA		RCN	
	Total	Direct	Total	Direct	Total	Direct	Total	Direct	Total	Direct	Total	Indirect
RCN	.05*	.05*	.14*	.14*	.13*	.13*	-	-	-	-	-	-
RR	.09*	.06*	.08*	.08*	.07*	.07*	-	-	-.04*	-.04*	.57*	.57*

