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# **Dark Nature: Exploring potential benefits of nocturnal nature-based interaction for human and environmental health**

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## **Abstract**

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This article considers 'Dark Nature', a term proposed to encompass both the nocturnal environment and the nature-interaction activities available therein. Current thoughts surrounding nature-interaction are briefly outlined and a more holistic view of nature-based interaction is suggested that includes the nocturnal environment. We report on a small pilot study focusing on stargazing as an example of a Dark Nature activity. The study utilized a short questionnaire incorporating open- and closed-ended questions coupled with the Connectedness to Nature Scale to explore to what extent stargazing could be considered a Dark Nature activity and what aspects of such an activity may benefit wellbeing. The results suggest that nature connectedness was higher for those with more years of stargazing experience and for those who indicated noticing wildlife while stargazing. Participants highlighted a range of benefits, including a sense of personal growth from developing skills to experiencing positive emotions and a variety of transcendent thoughts and experiences. Participants' responses suggest stargazing could be considered a Dark Nature activity in that it does not just take place in the dark but that those involved interact with the nocturnal environment. As such stargazing may offer benefits similar to those experienced by people taking part in daytime activities within natural environments. Using the study as a starting point for a wider discussion regarding Dark Nature activities and their potential benefits to both human quality of life and concern for nocturnal environments, we outline a range of beneficial features that the nocturnal environment may offer as a setting for nature-based activities.

**Keywords:** stargazing, Dark Nature, connectedness, wellbeing, nature-interaction

## **Introduction**

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Interactions with nature are considered important contributors to human health and wellbeing (for reviews see e.g., Hartig et al, 2014; Keniger et al, 2013). Such interaction can increase positive emotions (e.g., Hinds & Sparks, 2011; Irvine et al, 2013) and reduce stress levels (e.g., Roe et al, 2013), whilst nature-based activities such as gardening and outdoor walking have been found to benefit multiple dimensions of human health/wellbeing (e.g., Hawkins et al, 2011; Marselle et al, 2013, 2014; Okvat & Zautra, 2011). Much of the research into the benefits of nature-based activities has, to date, focused on daylight pursuits primarily based in green surroundings, with sunlight cited as an additionally important aspect in enhancing wellbeing (Beute & Kort, 2013). Recent research has begun to focus on benefits from different types of environments (e.g., Marselle et al, 2013), the level of biodiversity (e.g., Fuller et al, 2007) and ‘bluespace’ (e.g., Wheeler et al, 2012). This article is an exploration of the potential wellbeing benefits from activities that take place in nocturnal environments.

There are a small but noteworthy number of activities in which individuals take part that occur outdoors during the hours of darkness: activities such as stargazing, night fishing, moon gardening, camping, and wildlife watching of nocturnal species. As with activities that take place during the day many of these pursuits involve interaction with nature on a number of levels, from passively viewing nature through to active participation and engagement with the natural environment itself (Irvine & Warber, 2002; Pretty, 2004). There seems to be an increasing awareness of the importance of interaction with nocturnal environments outside of academic research. For example, the Royal Society for the Protection of Birds (RSPB) in the UK recently promoted a national ‘Big Wild Sleepout’ event as part of their ‘engaging with wildlife and nature’ campaign. The project incorporated a range of activities that can be characterized by the term ‘Dark Nature’ and sought to increase awareness of and engagement in nocturnal nature activities. The campaign’s description calls people to:

Discover the secret world on your doorstep ... sleep out in nature’s home, hear night sounds, feel the night air on your face and marvel at the night sky (RSPB, 2013).

The RSPB project suggests that nocturnal activities may reveal a secret side to nature, one that may appeal to many senses and encourage feelings of wonder and awe in individuals. Despite such awareness campaigns and an increase in dark sky parks across Europe (International Dark Sky Association, 2013; Globe at Night 2014), there is limited academic research into how the features of the nocturnal (and

daytime) environment might promote psychosocial and particularly spiritual wellbeing (Irvine & Warber, 2002). The small number of existing studies instead come from a variety of disciplines: within medicine, the effects of light pollution on human physical health are examined (Chepesiuk, 2009), the biological sciences often focus on the effects of artificial lighting on biodiversity (Rich & Longcore, 2006), and astronomy itself has largely been investigated solely as a leisure pursuit (Ferris, 2002).

There has been little research examining the relationship between human interactions with the natural environment during night-time hours. As such, a notable proportion of activities that could facilitate nature-interaction may be overlooked. Such interactions could be labelled 'Dark Nature', which the authors define as an activity that promotes interaction with nature and takes place in the nocturnal environment. Identifying such Dark Nature activities could help to consolidate the ways in which the nocturnal environment may enhance wellbeing for individuals and benefit from increased protection and stewardship. This complementary relationship could be utilized and Dark Nature activities identified as environmentally sustainable leisure pursuits. The article develops the concept of Dark Nature and explores the extent to which stargazers interact with and are aware of the natural environment around them. The article examines findings from a pilot study of stargazing to explore the extent to which it could be considered a Dark Nature activity and discusses the wider implications that this study introduces in terms of individual and environmental wellbeing.

### **Stargazing as a Dark Nature activity – A pilot study**

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A small scale pilot study was undertaken in April of 2013 to explore the idea of Dark Nature. Stargazing was selected as a leisure pursuit that took place in the nocturnal natural environment and as such may be an example of an intentional nature-interaction (Keniger et al, 2013). In some respects it may seem self-evident that stargazing is a nature-interaction activity as it is an activity based in nature which may offer a change in perception through "a mutual interaction between a subject and their environment" (Sewall, as cited in Totton, 2011). Yet stargazing appears to involve engaging with nature at a distance, with limited direct interaction i.e., it may not facilitate interaction with and awareness of the more 'nearby' natural environment. Thus, prior to this study, it was assumed that stargazers' focus would be away from ground level nature and as such may not necessarily be perceived as a nature-interaction activity. Consequently for this study we defined stargazing as an

activity that involved looking up at the night sky from an outdoor location only i.e., it did not include time spent in an observatory. To the authors' knowledge, this is the first study to conceptualise stargazing as a Dark Nature activity with a focus on exploring potential wellbeing benefits.

## **Methods**

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### ***Research design and participants***

The study was based around two central research questions. The first sought to understand to what extent stargazing could be considered a Dark Nature activity. The second focused on whether nature-based activities that take place during the night-time offered wellbeing benefits similar to those associated with nature-based activities that take place during daytime hours. The project took a cross-sectional study design and utilized a questionnaire with open- and closed-ended questions. This approach was taken in order to obtain participants' connection to nature through a quantitative measure and their personal experiences through qualitative data collection. Ethical approval was granted by the host university institution's Ethics Review Board. The questionnaire that was developed for the study was trialled with a small group of students from an astronomy society with subsequent minor revisions.

The study focused on astronomers who took part in stargazing as a leisure pursuit at both a novice and more experienced level. In total 29 participants were recruited by means of convenience sampling. These participants were drawn from a student astronomy group and individuals attending an astronomy outreach event. Three quarters of the participants were men (N=22); the majority (N=17) were over the age of 21.

### ***Measures and data collection procedure***

In addition to two demographic questions (age, gender), the questionnaire incorporated open- and closed-ended questions structured around three areas of interest: (i) the stargazing experience; (ii) stargazers' interaction with and experience of nature; and (iii) the potential wellbeing benefits from time spent stargazing. These areas were considered useful in identifying the practicalities of the pursuit itself – such as frequency, locality etc. – and also any potential relationships between the pursuit of stargazing, interaction with nature, and resultant wellbeing.

Five questions were constructed to explore the stargazing experience: Participants

answered questions about their stargazing activity, specifically where their stargazing took place (open-ended response to ‘Do you stargaze from your garden or somewhere else?’) and what made them decide to end a stargazing session (open-ended response to ‘What makes you decide to stop stargazing?’). Alongside this participants were asked how long they stargazed at any one period of time and on a weekly basis, and for how many years they had been stargazing. For the first of these questions (‘On average how long to you spend stargazing at any one period of time?’) response options were categorical in minutes (0-5, 5-10, 10-20, 20+). The other two time-related questions – ‘On average how much time do you spend per week stargazing’ and ‘Approximately how long have you been stargazing? (in years, months or weeks)’ – were open response. It was thought that these five questions would provide insight into the practical activity of stargazing and what it consists of in terms of commitment and engagement.

The stargazers’ interaction with and experience of nature was addressed through use of two data collection tools, these were the Connectedness to Nature Scale (CNS) and an open-ended question constructed by the authors. The CNS, a validated scale, measures trait levels to identify the extent of an individual’s feelings of being “emotionally connected to the natural world” (Mayer & Frantz, 2004: 1). The stem question asks individuals to consider fourteen statements (such as ‘I often feel a sense of oneness with the natural world around me’) and then rate to what extent they agree or disagree with each based on a scale of one (‘strongly disagree’) to five (‘strongly agree’). Using the CNS was considered useful in helping to understand any potential relationship between feeling a connection to nature and time spent stargazing. The open-ended question asked participants ‘Have you ever seen any wildlife whilst you were Stargazing? If so, what?’. This question sought to consider the extent to which stargazers were aware of the natural environment around them besides the skyscape, and whether being engaged in a deeply focused activity allowed for an awareness of the wider natural surroundings. Two open-ended questions were developed in order to consider stargazing and wellbeing. Participants were asked what they most enjoyed about stargazing (‘What do you enjoy most about Stargazing?’) and if (in their opinion) it enhanced their life (‘Does Stargazing enhance your life? If so, how?’). These questions were developed to not only distinguish which aspects of stargazing they considered to be enjoyable, but also to encourage participants to think about the role it played in their lives. The questions also helped establish whether participants consciously identified interaction with nature as a benefit of stargazing and if so whether they considered this to be life enhancing.

The data collection procedure involved approaching attendees at a stargazing event with a brief verbal description of the project. Those who indicated interest were provided with an information sheet and consent form. The information sheet detailed the aims of the study and provided specifics on data storage and confidentiality. Individuals willing to take part in the study were asked to sign the consent form and were handed a questionnaire to self-complete. The questionnaire was completed immediately prior to a stargazing event.

## ***Analysis***

The qualitative short answer data were analysed using open and axial coding (Saldana, 2013), to identify key themes and commonalities of experience. The biopsychosocial and spiritual dimensions of wellbeing (Irvine et al, 2013; Engel, 1977) were considered as an important template for understanding the themes present in the data and identifying potential wellbeing benefits that may be experienced through nocturnal nature-interaction. The quantitative data collected from the CNS were analysed using SPSS 22.0 and utilized Cronbach's alpha and independent samples t-tests. The CNS data showed moderate reliability (Cronbach's alpha = 0.75). Independent samples t-tests compared mean CNS scores of novice and experienced stargazers. These two groups were chosen to ascertain any difference in the effects of long term engagement in stargazing compared with those who had recently begun. CNS scores of individuals who did and did not notice wildlife while stargazing were also compared.

## **Results**

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### ***The stargazing experience***

Responses around the stargazing experience indicated that commitment to and engagement differed amongst participants. In terms of time spent per week this varied substantially with a small number of participants (N=2) taking part in the activity for the first time that evening. In contrast to this, one participant stated that they stargazed whenever they could, whilst the majority stargazed for between 10 minutes and 7 hours per week. Fourteen of the participants typically stargazed for less than 10 minutes, six stargazed for 10-20 minutes whilst nine stayed out for more than 20 minutes. The range of data in both of these questions suggests that even short periods a few times a week may also be considered 'stargazing' alongside more organized lengthy activity. Participants' reasons for ending a stargazing session

included, perhaps unsurprisingly, physical issues as a key factor such as a stiff neck or being cold/hungry. Additionally, some participants reported reasons such as feeling like they had met the evening's challenges or achieved their personal goals. When asked how many years they had been stargazing the responses were also widespread. Sixteen participants had been stargazing for 5 or fewer years with several of these individuals (N=5) having partaken in the activity for less than a year. Of the thirteen people who had been stargazing for more than 5 years, eight had been doing it for 25 years or more.

In terms of location, participants tended to stargaze either from their gardens (N=3) or another easily accessible and suitable location (N=10), with most utilizing numerous sites (N=16). It is interesting to note, however, that very few stargazed solely from their gardens suggesting that stargazing as an activity may encourage participants to venture out into the nocturnal environment to find appropriate locations.

### ***Stargazers' interaction with and experience of nature***

The quantitative data collated from the CNS suggests that overall, stargazers demonstrated a relatively neutral level of connection to nature (M = 3.16, SD = 0.54). An independent samples t-test was conducted to compare nature connectedness between groups with more or less years spent stargazing. There was a significant difference for individuals who had stargazed for many years (>5 years; M = 3.46, SD = 0.43) and those who had stargazed for less (5 or fewer years; M = 2.92; SD = 0.53);  $t(27) = -2.920$ ,  $p = 0.007$ . These results suggest that nature connectedness was higher for those with more years of stargazing experience. There was no significant difference in nature connectedness for those who were younger (under 21 years of age) and those who were older (21+ years);  $t(27) = -1.798$ ,  $p = 0.083$ .

Whilst outside, stargazers reported seeing a wide range of nocturnal species such as bats or birds. Of those who reported wildlife sightings, over half (N=17) stated they had also seen some form of ground dwelling wildlife. Stargazers reported seeing animals such as foxes, badgers, and hedgehogs suggesting that whilst looking up they were also aware of the natural world around them at ground level. An independent samples t-test was conducted to compare nature connectedness between those who reported seeing wildlife while stargazing and those who did not. A significant difference was found whereby individuals who saw wildlife (M = 3.42; SD = 0.54) scored more highly on nature connectedness than those who reported seeing no



wildlife ( $M = 2.80$ ,  $SD = 0.33$ );  $t(27) = 3.498$ ,  $p = 0.002$ ).

Based on the findings as discussed thus far, it would appear that stargazing could be conceptualized as a Dark Nature activity. This is apparent both directly through reports of wildlife sightings and indirectly with reported reasons for ending a stargazing session including the changing natural conditions around them. For example, many participants noticed changing aspects of their environment including the phases of the moon and shifting weather patterns such as the increase or decrease in cloud cover and changes in temperature whilst outside. Awareness of such features in the natural environment would suggest that stargazers often find that their focus is both broken by and drawn to the natural environment around them.

### *Stargazing and wellbeing*

The questionnaire included two questions developed to explore the wellbeing and life enhancing effects of a Dark Nature activity. A few participants considered these to be strange questions with some verbally commenting that they tended to think of stargazing as a science-based pursuit and as such had rarely considered it in terms of life enhancement and enjoyment.

On a physical level the qualitative data suggested that stargazing activity offered a possible link to wellbeing evident through an increase in a physical activity during a typically sedentary time period. As one individual stated, “It makes you go outside and stop watching TV” (Participant 4, male). Although stargazing may provide only minimal movements such as setting up equipment or walking to a suitable location, on a physical level, any increase in activity (particularly outdoors) is one of the factors which has been shown to improve wellbeing (Penedo & Dahn, 2005). Nevertheless, participants’ comments tended to focus more on the non-physical elements of the biopsychosocial-spiritual model of health such as the social benefits and sense of personal growth through developing skills and acquiring knowledge. In addition, some individuals highlighted a range of spiritual and transcendent emotions that they enjoyed whilst stargazing.

In terms of the social benefits of stargazing, one participant stated that they “feel a communal spirit with the Astro society” (Participant 15, male). This sense of social integration and acceptance within a group through the activity of stargazing suggests that the social side is a significant feature. A sense of social contribution through sharing knowledge was also important “I enjoy being able to point out constellations to friends” (Participant 29, male). Another participant stated she enjoyed stargazing

as it was something she had “in common” with her dad. Another participant stated that they tend to stop stargazing when their friends go home, indicating that even though the activity may still be possible it is less enjoyable without company. A sense of connection with friends and family alongside feelings of social integration, acceptance and contribution are often considered to be important aspects in social wellbeing (Ryff, 1989; Keyes, 1998), which is one of the dimensions of overall wellbeing.

In terms of personal growth and sense of achievement stargazing offered individuals an ongoing activity that allowed them to build on their knowledge. As such being able to “learn my way around the night sky” (Participant 2, female), “testing my knowledge of the sky” (Participant 19, male), and “finding objects” (Participant 14, male) were often reported as things participants enjoyed most about stargazing. Whilst wanting to develop knowledge was considered an important reason for stargazing, achieving their personal goals was often cited as a reason for stopping a stargazing session. Working towards and achieving goals is considered to be an important aspect in wellbeing (Emmons, 1996).

In addition to the social nature and goal focused components of stargazing, some individuals reported that they enjoyed the more transcendent and spiritual elements. A number of participants gave comments that could be interpreted as reflecting the spiritual or transcendent aspect of stargazing often focusing on one’s place in the universe. Two individuals reported particularly enjoying “The sense of crushing smallness compared to the universe one feels” (Participant 23, male) and “Realizing how small we are” (Participant 20, male), whilst others simply enjoyed “the peace and the intrigue” (Participant 17, male) and “the beauty” (Participant 8, male).

The study findings suggest that those who spend more time stargazing tended to be more likely to describe it as a life enhancing pursuit, often mentioning regular occurrence of positive and transcendent emotions such as awe and wonder whilst stargazing. One individual stated “I feel in awe of nature and the natural world... A sense of wonder at it all!” (Participant 14, male) whilst another reported “It relaxes me and reminds me of how precious life is...” (Participant 8, male).

Such positive emotions are important factors in quality of life as it has been demonstrated that the ratio of positive to negative emotions experienced by an individual has a direct effect on their subjective wellbeing (Pavot et al, 1991). Transcendent emotions which may be associated with peak experiences often incorporate feelings of awe and wonder. Such emotions are often related to feelings

of being “deeply happy” and feeling a “sense of unity and meaningfulness in life” (Boniwell, 2012: 35).

Fascination was also highlighted as a key feature of the activity, with participants reporting that they lost a “sense of time” when stargazing and often only came inside due to increased cloud cover. Comments regarding the interest and fascination that stargazing provided were some of the responses given by participants for taking part in the activity: “I find it fascinating” (Participant 5, female). Increase in fascination and a sense of loss of time are factors that define a state of ‘flow’ and regular engagement in flow-inducing activities are thought to also increase positive affect and happiness (Csikszentmihalyi, 1990).

Overall, the above pilot study seems to indicate that stargazing as a Dark Nature activity provides positive experiences often encountered in some daylight activities such as increased fascination and sense of flow. In addition, the study also highlights a link to and immersion in, an environment often neglected by daytime-based nature-interaction studies.

## **Discussion**

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In this study of stargazing – an activity that takes place in nocturnal environments – we have quantified the range of experiences in terms of time spent and locations where stargazing occurs. We have seen that people who have engaged in stargazing for a longer number of years were found to have a greater connection to nature on a validated scale; this was also found for those who saw wildlife while stargazing. It also appears from our qualitative findings that stargazers are aware of the breadth of nature around them and that they are not solely noticing the stars during a night out stargazing. Stargazing might cultivate wellbeing through increased physical and social activity in addition to developing personal growth through sense of achievement. A range of transcendent and spiritual elements which are seen as an integrative component in health and wellbeing (Heintzman 1999) were highlighted by participants. Results suggest that stargazing may promote an increased sense of flow through fascination and loss of time. Reported positive emotions suggest that stargazing may be perceived as a life enhancement activity.

These findings lend some support to the idea that stargazing promotes multiple aspects of wellbeing, a feature discussed by others who have looked at other nature-based activities such as gardening (Hawkins, 2011; Unruh, 2011), the use of urban parks (Irvine et al, 2013) and outdoor walking (Marselle et al, 2013, 2014). Being in

parks has also been associated with a higher connection to nature than other indoor public locations (Arbuthnott et al, 2014) and participant reports suggest that stargazing may encourage engagement with such outdoor spaces. Leisure activities in general play an important role in wellbeing as free time is often spent partaking in pursuits that give life meaning for individuals (McDonald & Schreyer, 1991). The findings reported here also provide some additional insight into our understanding of human relationships with the nocturnal environment, moving beyond previous literature which focused primarily on the effect of light pollution and human health (Chepesiuk, 2009) and biodiversity (Rich & Longcore, 2006).

We appreciate there are limitations associated with a small scale pilot study in terms of sample size and the subsequent limited amount of data available for quantitative analysis. The results of the study did however identify some interesting aspects of stargazing as a Dark Nature activity: one that takes place in a nocturnal environment and provides opportunity for nature-interaction. The study also suggests a potential role in promoting human wellbeing. Future research would benefit from obtaining a larger sample size and conducting in-depth interviews which may provide richer data.

## **Implications**

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The small scale pilot study reported raises some intriguing and interesting implications to consider for future study. Here we utilise elements of the stargazing study as a starting point for a deeper consideration of the aspects of Dark Nature activities that may enhance wellbeing for both the individual and for the environment.

### ***Enriching the experience of nature-interaction***

An important potential benefit of Dark Nature activities is that they may offer a deeper engagement with the environment due to limited visual perception. As daily life becomes more urbanized (UN, 2013), the natural environment is often a place with which many individuals have little more than visual contact, and engagement of other senses such as smell and touch whilst in the outdoors is considered to be surprisingly rare (Stilgoe, 2001). Nocturnal activities provide only a limited range of vision, thus encouraging individuals to utilize additional senses such as hearing and smell. Thus participating in Dark Nature activities may enrich the nature-based experience by appealing to a multitude of senses which is considered beneficial in enabling individuals to engage with the natural environment in its entirety (Louv,

2012).

The limited vision available during nocturnal activities may also increase feelings of mystery and wonder due to the fact that the immediate landscape cannot be easily understood. Consequently what little can be seen receives our full sharpened focus, whilst aspects that cannot be explained or remain hidden may help to build positive emotions such as awe and wonder of the natural world. Such transcendent emotions alongside feelings of mystery may lead individuals to encounter ‘peak experiences’ which are characterized as moments when individuals feel intensely happy (Bonniwell, 2012). The night sky, a primary feature of the nocturnal environment, also offers an opportunity to connect with feelings of “grandeur and overpowering elements of nature” and it is settings such as these that help to support beneficial spiritual experiences (McDonald & Schreyer, 1991: 188) The addition of nocturnal nature-interaction may allow for a more holistic individual experience of the natural environment and the benefits obtained therein.

### ***Potential role of dark nature activities***

Dark Nature activities may offer additional benefits beyond those experienced during daylight nature-based activities. By being out in the garden or outdoors during unfamiliar hours, individuals may be able to ‘recycle’ their landscape, giving it a dual purpose and a new identity during the hours of darkness. This could allow people to cognitively increase the perceived amount of natural space available to them, which may be an important consideration in an era of decreasing natural environments. This change in perception may inspire individuals to experience everyday settings such as their garden in a novel way. This broadened perspective may in turn lead to a greater awareness of that environment (Fredrickson, 2001). Engaging individuals in Dark Nature activities may also challenge the sense of threat often felt in the nocturnal environment by providing opportunities to engage with and develop confidence in and knowledge of the nocturnal environment. Increased human activity in green spaces during nighttime hours may additionally help to reduce the sense of human threat and enable communities to reclaim areas considered to be unsafe.

Dark Nature activities could increase our engagement with natural spaces by lengthening the time-frame that is available to spend in nature. In terms of accessibility, almost half of our lives are spent in hours of darkness and to ignore this is to discount almost half of the natural environment that we are able to come into contact with. For those who work during the week, the weekend may be the

only time able to be set aside for engaging in nature-based activities. Dark Nature activities however provide an additional range of pursuits for those with limited time-frames: for example, those working during the day may engage with the activities in the evening.

### ***Dark nature and environmental wellbeing***

Previous studies indicate that individuals who spend more time outdoors and report feelings of connection to nature tend to show pro-environmental behaviours (Mayer & Frantz, 2004; Nisbet, Zelenski & Murphy, 2009). These studies have focused on daytime activities in nature but this could also be the case for those involved in nocturnal nature-based activities. By spending time in nocturnal settings, individuals may also begin to value and subsequently engage in protective behavior. A familiarity with species not visible during daytime hours may encourage an increased consciousness of and concern for their conservation. For example, conservation projects addressing the impact of light pollution on biodiversity (IDA, 2013) are often being driven by participants taking part in Dark Nature activities. Dark Nature activities thus allow individuals to identify and interact with nocturnal flora and fauna which may be neglected in other studies.

### **Summary**

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This article has highlighted the importance of considering nocturnal environments and the benefits these settings may offer and provided some preliminary data to illustrate these. In summary, it is proposed that Dark Nature activities need to be researched in greater depth to better understand not only the wide range of activities available, but also the motivations, experiences and perceived benefits of the individuals who engage in these pursuits. Such work could provide a basis on which to begin to establish the relevance of Dark Nature activities to the literature and conversation concerning human-nature interaction and human wellbeing.

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