From Tourist to Citizen Scientist?

Exploring the Feasibility of Applying Citizen Science at the Living Lodge

Thesis Report

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Abstract

Citizen science is an efficient tool for raising environmental awareness and education and can contribute significantly to conservation efforts. Citizen science is increasingly gaining attention in the scholarly world, however, in tourism related literature, the implementation of citizen science has not been given much attention. Also, the motivations of citizens to participate in citizen science have not yet been researched extensively. This thesis report employs a mixed-methods approach, using desk research, an interview, and a questionnaire to evaluate the feasibility of applying citizen science at the Living Lodge, which is to be built in the Biesbosch national park in the Netherlands. Requirements for sound implementation of citizen science, criteria for citizen science to be effective at the Living Lodge and the motivations of potential guests of the lodge to participate in citizen science are assessed in this report. The findings show, that the target group of the Living Lodge is interested in participating in citizen science. The desire to contribute to nature conservation has been found to be the main motivator to participate in citizen science. This report concludes, that citizen science can be incorporated well into the Living Lodge project, given that the identified requirements for sound implementation and criteria for citizen science at the Living Lodge are carefully considered.

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1. Introduction

> "Never doubt that a small group of thoughtful, committed citizens can change the world; indeed, it is the only thing that ever has."
>
> — Margaret Mead
>
> Attributed in Donald Keys, *Earth at omega: passage to planetization* (1982), p. 79

The Earth system and ecosystems are under extreme pressure, mainly caused by anthropogenic activity on this planet. Humans are highly dependent on the health and functioning of ecosystems and the services they provide (Costanza et al., 2016; De Groot et al., 2012). It is vital for mankind's survival to preserve biodiversity and the benefits it provides to society (Balmford et al., 2005). According to estimations, three of the nine planetary boundaries have been crossed already, posing an extreme challenge on humankind and its interaction with the planet (Rockström et al., 2009).
Tourism is a significant contributor to the global negative trend in environmental health and is a catalyst of the global increase in annual temperatures (Gössling & Hall, 2006; Hall & Saarinen, 2010). The use of land for tourist accommodations and the associated use of natural resources and land degradation are part of this issue, too (Gössling, 2002). Pritchard and Morgan (2013) argue that humankind needs to change the way it inhabits the planet and uses its resources.

To encourage the urgently needed social change and to improve socio-ecological relationships (Johnson et al., 2014; Shirk et al., 2012), citizen science can be an effective tool. The field of citizen science has grown considerably worldwide in recent years (Ellwood, Crimmins, & Miller-Rushing, 2016; McKinley et al., 2016), especially in the fields of ecology and environmental sciences (Silvertown, 2009). Citizen science can be defined as the engagement of members of the public in scientific projects that are managed by professional scientists (Dickinson, Zuckerberg, & Bonter, 2010; Palermo, Laut, Nov, Cappa, & Porfiri, 2017; Ruiz-Mallén et al., 2016; Silvertown, 2009). The participation of the public in scientific research is not new and has a centuries-long history (Carballo-Cárdenas & Tobi, 2016; McKinley et al., 2016; Miller-Rushing, Primack, & Bonney, 2012). It is worth noting, that until late into the nineteenth century almost all science was citizen science (Haklay, 2013). Science was mostly conducted by people with other ways of making a living, which allowed them to spend their leisure time on conducting scientific research. Famously, Charles Darwin, who joined the Beagle voyage in 1831, did so as a comrade to Captain Robert FitzRoy and not as a scientist (Silvertown, 2009).

The typical citizen scientist of today feels at home in nature, cares about the wild, wants to explore new places and simultaneously make a difference, solve environmental problems and learn new things about nature (Goffredo et al., 2010). Citizen scientists can be involved throughout several steps of the scientific process, including monitoring (McKinley et al., 2016), experimentation (Theobald et al., 2015), analysing data, proposing research questions and sharing results (Domroese & Johnson, 2016). Citizen science projects can be executed as bottom-up initiatives, where community members address local issues, or as top-down processes, led by scientists where members of the public are asked to participate in certain tasks to facilitate the process (Devictor, Whittaker, & Beltrame, 2010; Newman et al., 2012).

1.1. Research Objective & Research Questions

The objective of this research is to identify currently available citizen science approaches and to assess whether these are compatible with the aims of the Living Lodge project. To do so, existing citizen science projects have been analysed, the conservation goals of the Living Lodge projects have been identified and it has been explored how guests can actively contribute to monitoring or improving the quality of the ecosystem. Furthermore, the motivations of lay citizens to participate in citizen science projects have been examined.

The main research question (MRQ) this thesis answers is: “How can citizen science contribute to the objectives of the Living Lodge project?” A set of specific research questions (SRQs) has been formulated to support the main research question:

SRQ1: What are currently existing forms of citizen science and what are their requirements for sound implementation?

SRQ2: What are the objectives of the Living Lodge project and how do they translate into criteria to evaluate methods of citizen science?

SRQ3: How do the forms of citizen science identified in SRQ1 score on the criteria formulated in SRQ2?

SRQ4: What are the motivations of potential guests of the Living Lodge to participate in citizen science and how does the target group evaluate the identified forms of citizen science?

1.2. Scholarly Relevance

The broad topic that this report aims to address is the application of citizen science in a tourism setting. At this stage, there is almost no research about these two topics combined. This seems paradoxical, considering that increasingly tourists want to actively contribute something to the places they visit on holiday (Aljazeera, 2011; Horton, 2011). This research is unique in that it applies the issue of implementing citizen science in a tourism context to a specific example, namely the Living Lodge.

Several scholars have made attempts to generate overviews of some existing citizen science organisations and projects (see Lorenzo, Ilaria, Sergio, Stefano, & Giovanni, 2011; McKinley et al., 2016; Silvertown, 2009). But, what is currently missing is an extensive overview of existing citizen science projects including an overview of their requirements. These projects could be evaluated along a set of criteria to then evaluate their feasibility in a given context, such as tourism.

The benefits of involving citizens in science for conservation seem to have been researched well already, however this has happened at the neglect of the motivations of citizens to participate in such projects (Carballo-Cárdenas & Tobi, 2016; Johnson et al., 2014; Tinati, Luczak-Roesch, Simperl, & Hall, 2017). While the benefits of citizen science to conservation are widely acknowledged, the motivations of citizens remain little studied and poorly understood (Domroese & Johnson, 2016). There is a considerable amount of scholarly literature on motivations for volunteering, but motivation for voluntary participation in citizen science projects specifically has not been researched much (Nov, Arazy, & Anderson, 2011). Franzoni and Sauermann (2014) argue that increasing participants' motivations to contribute to citizen science is a crucial issue. Citizens can be motivated to participate in scientific projects for a variety of reasons, ranging from intrinsic to extrinsic drivers. To develop a successful citizen science project, it is vital to understand citizen science from the perspective of the volunteers. As Raddick et al. (2013) point out, "why do volunteers choose to contribute their time and energy to citizen science? What do they get out of it?" (p. 2) are key questions to be answered.

The remainder of this report is structured as follows: First, a literature review on citizen science in general, existing classifications and typologies of citizen science, online platforms and tools for citizen science projects is provided. This chapter also includes an overview of existing literature to date on motivation for participating in citizen science. Next, the research methods are explained, in which each specific research question has been assigned a different data collection method. The following four chapters present the findings of the SRQs. The final chapter of this paper discusses

and concludes the findings, critically assesses the limitations of this research and provides suggestions for future research.

2. Literature Review

2.1. Citizen Science

In recent years the field of citizen science has grown considerably worldwide (Ellwood et al., 2016; McKinley et al., 2016). Projects now deal with a variety of issues, ranging from population ecology to invasive species and climate change (Silvertown, 2009). Citizen science can increase public education and environmental awareness and engagement (Dickinson et al., 2010; Goffredo, Piccinetti, & Zaccanti, 2004; Johnson et al., 2014; Schmeller et al., 2009). Bonney et al. (2014) and Conrad and Hilchey (2011) acknowledge that one of the drivers behind the growth of citizen science is an increased awareness of the impacts of human activities on ecosystems. When done thoughtfully, citizen science can increase socio-ecological relationships and advocate for social change and environmental justice (Johnson et al., 2014; Shirk et al., 2012). Citizen science can address global issues, such as biodiversity loss, on a local level and make them locally relevant and meaningful (Tweddle, Robinson, Pocock, & Roy, 2012).

Citizen science is often used when the employment of experts is practically and economically unfeasible (Haklay, 2013). By recruiting large numbers of volunteers, citizen science allows for large datasets to be generated over a long period of time (Loss, Loss, Will, & Marra, 2015; Theobald et al., 2015). Small tasks can be divided among the many volunteers and the results can later be combined (van Etten et al., 2016). Moreover, with such projects, scientists can gather data from locations they could otherwise not reach, like private property (Cooper, Dickinson, Phillips, & Bonney, 2007). While tasks can also be more complex, citizens participating in citizen science are often asked to fulfil tasks such as image classification or engage in activities such as observations. Smart phones are often being used in such cases (van Etten et al., 2016).

While citizens get the opportunity to get insights into the practical world of science and increase their interest in science (Riesch & Potter, 2014), scientists receive help with conducting their research (Ruiz-Mallén et al., 2016; Silvertown, 2009). It has been argued, that due to this the remaining distance between laypeople and science can be reduced (S. A. Gray, Nicosia, & Jordan, 2012; Powell & Colin, 2008). In many citizen science projects volunteers have no specific training (Lorenzo et al., 2011). In some projects, however, especially in projects around marine and underwater conservation, training is required, along with certain skills, such as scuba diving (Branchini, Meschini, et al., 2015; Branchini, Pensa, et al., 2015; Carballo-Cárdenas & Tobi, 2016).

To achieve a transformative learning process in citizen science (Jenkins, 1999), Ruiz-Mallén et al. (2016) suggest three essential features that a citizen science project should have. First, relationships and interactions should be transparent and trust-building and all participants should be involved in the project on a voluntary basis; second, to achieve their empowerment and informed decision-making, all participants should become active agents (Dietz, 2013). In a continuous deliberative process, they are engaged to reflect on their decisions, actions and limitations while conducting research (Ruiz-Mallén et al., 2016); and third, Ruiz-Mallén et al. (2016) suggest that citizen science should occur on a long-term (3-10 years), flexible basis with task deadlines instead of performance targets. If executed properly, citizen science projects can generate objective and robust data that can contribute to long-term and large-scale monitoring and which is of the same quality as data collected by professional scientists (Branchini, Pensa, et al., 2015). Johnson et al. (2014) argue, that citizen science can contribute significantly to monitoring environmental change. However, often, funding for citizen science projects is not sufficient to ensure long-term conservation (Ellwood et al., 2016).

In the burgeoning field of conservation-related science (Catlin-Groves, 2012; Roy et al., 2012; Silvertown, 2009), citizen science holds a strong educational value, because it enhances the public's awareness of conservation issues (Goffredo et al., 2010) and it can stimulate new relationships between participants and nature conservation (Couvet & Prevot, 2015). Citizen science has already greatly contributed to conservation science and can achieve much more (Ellwood et al., 2016; McKinley et al., 2016). It has been argued, that major conservation challenges can be approached through citizen science (McKinley et al., 2016).

A citizen science project requires a primary investigator or an organisation that invests money and time into the project. Furthermore, volunteers and staff need to be recruited and tools and resources need to be provided (McKinley et al., 2016). Like any other scientific research project, citizen science projects need a robust scientific design (Domroese & Johnson, 2016).

2.1.1. Classifications

Several scholars have made classifications of citizen science projects according to the degree to which citizens are involved in the scientific process (Bonney et al., 2009; Cooper et al., 2007; Shirk et al., 2012). The following classification seems to be widely adopted by scholars:

(1) *Contributory* projects – projects designed by scientists where citizens mainly contribute to data collection;
(2) *collaborative* projects – projects structured by scientists that allow the public to collaborate on project design, data collection and analysis; and
(3) *co-created* projects – projects or partnerships where citizens contribute to the whole scientific process (S. Gray et al., 2016).

Most citizen science projects reflect the category of *contributory* projects (Bonney et al., 2009). While it is widely acknowledged that these projects have contributed significantly to many scientific disciplines, including the field of conservation science (Newman et al., 2012), the contributions of *collaborative* and *co-created* projects are not as clear (S. A. Gray et al., 2012). Nonetheless, there seems to be an increase in *collaborative* and *co-created* projects (S. Gray et al., 2016). These projects are often started by citizens that are concerned about a certain issue and that are motivated to contribute to improving environmental quality at the local-scale. This is because some volunteers feel dissatisfied with the contributions of *contributory* projects that are often not directly linked to the places at which they collect data (Wiggins & Crowston, 2012). In addition, in *contributory* projects, scientists might unintentionally develop a project that is not socially relevant to the group of volunteers, as citizens are solely the means to provide data to a project that is of relevance to the scientists (Tweddle et al., 2012).

Tapia, Crall, Cayot, Sterling, and Gibbs (2013) argue that by including tourists, as well as residents, citizen science could be used extensively on the Galapagos islands. The scholars made a framework which applies the above-mentioned classifications of citizen science projects to show to what extent tourists could be involved in citizen science (see Figure 1).

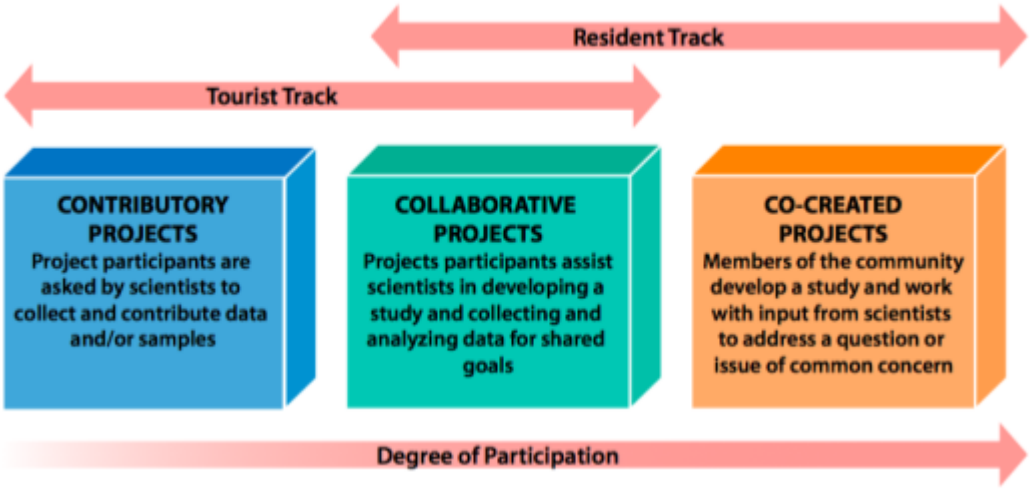

Figure 1. Classifications of citizen science projects and their respective degree of participation (Tapia et al., 2013).

Haklay (2013) distinguishes between a *first class of 'classic' citizen science* and a *second type of citizen science activity*. In the first class, lay citizens collect data and send their findings and observations to the organisations or scientists managing the research. Citizens involved in this type of citizen science usually do so as part of their leisure time. Modern technological developments have made these processes cheaper and easier. The *second type of citizen science activity* concerns 'community science' in which citizens take on a more active role and carry out scientific measurements and analysis and set action plans for environmental management in their area (Haklay, 2013).

In 2009, Francois Grey first brought up the term 'citizen cyberscience'. Nowadays, most citizen science projects make use of smart phones, personal computers and GPS receivers for data collection and analysis. Citizen cyberscience can be divided into three subcategories, namely *volunteered computing*, *volunteered thinking* and *participatory sensing* (Haklay, 2013). In *volunteered computing*, participants install software on their computers that distributes data. *Volunteered thinking* requires a more active and cognitive involvement of the volunteers. Participants are engaged in image or information classification on a website, for which they usually receive a short training. *Participatory sensing* is the most recent type of citizen cyberscience, in which smart phones are used to sense the environment, for example in sensing noise levels through the location of the smart phone and readings from the microphone (Haklay, 2013).

The collection of location information is a key part of geographical citizen science. To a large extent, the previously mentioned 'classic' citizen science, community science and citizen cyberscience projects fall within this field. In geographical citizen science, volunteers can take on an either active or passive role. An active participation would be, for example, taking photographs

of plants or animals and sending them to the project organisers. In passive participation, for example, participants volunteer to be tagged by GPS receivers to monitor daily walking activities (Haklay, 2013).

Haklay (2013) suggests a framework that classifies the level of participation and engagement of participants in citizen science activity (see Figure 2). The scholar makes an important remark saying that one project should not be classified in only one category, but always shows characteristics of multiple levels.

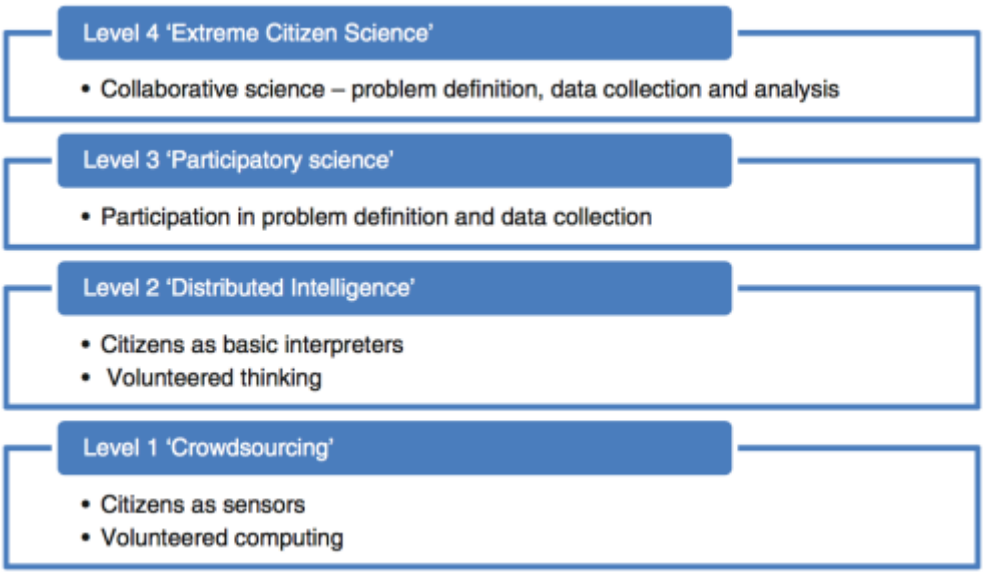

Figure 2. Levels of participation and engagement in citizen science projects (Haklay, 2013).

On the first level, citizens engage in volunteered computing and contribute to the project in a passive way. They do not fully understand the project, yet they can engage and contribute to the scientific study by providing resources without high cognitive engagement. A high number of participants is needed for this type of citizen science. Accordingly, this level of participation and engagement has been termed 'crowdsourcing' by Howe (2006). Participatory sensoring falls under this level, too. Participants carry around sensors which they later return to the organisers of the project. While this method can be controlled more easily, the cognitive ability of the participants is not used at all (Haklay, 2013).

The second level is termed 'distributed intelligence' in which the cognitive ability of the participants is being used as a resource. Many of the 'classic' citizen science projects in which participants undertake some basic training and collect or classify data belong to this category. Project organisers need to be aware that participants will ask questions during the project and know how to support their continuous learning (Haklay, 2013).

The next level in the framework reflects community science in which the participants set the problem definition and come up with a data collection method together with scientists and experts. Participants aid in data collection, but need the help of the experts in data analysis. This level has been termed 'participatory science'.

In collaborative science professional and non-professional scientists work closely together in deciding on the problem definition and data collection methods. Participants can also be involved in data analysis and the publication of results. This level has been termed 'extreme citizen science' by Haklay (2013) and can even be carried out by citizens without any help of professional scientists.

2.1.2. Online Platforms

A search of the Internet and scientific articles showed that there is a variety of platforms that host citizen science projects and provide information on the topic. Examples of such platforms are *SciScarter* (scistarter.com) and *iNaturalist* (www.inaturalist.org) which act as media to connect scientists with citizens. For this, scientists upload the projects that they would like to receive help on to the website. On *Project Noah* (www.projectnoah.org), which is supported by National Geographic, people can start their own citizen science mission, on either a global or local scale. The website *CitSci.org* (www.citsci.org) provides tools and resources to carry out a research project. These tools allow for customised projects and data sheets and the web page provides an online interface for each project. To date there have been more than 400 projects. Anyone can register as a citizen scientist with *CitSci.org*, but one needs to gain permission to post projects by requesting to be enrolled in a higher user level.

There are non-governmental and not-for-profit organisations that offer conservation tours in which tourists can participate in citizen science (Brosnan, Filep, & Rock, 2015). *Earthwatch* (eu.earthwatch.org) is one of such NGOs that matches interested citizens with environmental research projects. Volunteers have to pay to take part in the expeditions and scientists can apply for funding from *Earthwatch*. The research projects first undergo a peer-review process and/or are reviewed by academics to make sure the scientific quality of the research is appropriate. The data collected by these projects is used in management plans and policies concerning ecological conservation and peer-reviewed scientific publications.

Ornithology seems to be the most popular field addressed by citizen science. This observation is in line with the findings of B. L. Sullivan et al. (2009), Goffredo et al. (2010) and Worthington et al. (2012). Examples of such projects and platforms are *eBird* (ebird.org) and the annual *Christmas Bird Count* (www.audubon.org/conservation/science/christmas-bird-count). The *Christmas Bird Count* has been taking place in the U.S. every year from the 14th of December to the 5th of January.

The count takes place in several locations throughout the country. The data collected during the annual Christmas Bird Count has contributed to over 200 peer-reviewed articles and has contributed to decision-making about birds by U.S. federal agencies ("Christmas Bird Count Bibliography," n. d.).

2.1.3. Motivation for Participating in Citizen Science

Franzoni and Sauermann (2014) contend that enhancing participants' motivation to engage in citizen science projects is a critical issue. Cappa, Laut, Nov, Giustiniano, and Porfiri (2016) found that most motivations for participating in citizen science are intrinsic.

Citizens can be motivated to participate in scientific projects for a variety of reasons. These can be, for instance, because they find contributing to research exciting or because they have an individual interest in the project (Cappa et al., 2016; Nov, Arazy, & Anderson, 2014; Raddick et al., 2009) or science in general (Tinati et al., 2017). Often, non-scientists are motivated by a general interest in participating in authentic scientific projects (Wiggins & Crowston, 2012). The collaboration with researchers may give people the feeling of playing a central role, which increases their sense of commitment (Ryan, Kaplan, & Grese, 2001). Dickinson et al. (2012) argue, that if participants perceive the project as "easy and fun", their motivation to contribute is higher. Moreover, people may want to participate in citizen science projects because they want to give something back to their community (Toppe, Kirsch, & Michel, 2001) and because of a sense of belonging to a group of people with the same interests (Raddick et al., 2009; Tinati et al., 2017). When working together with a group of like-minded people, participants can develop a sense of collective ownership of data (Overdevest, Orr, & Stepenuck, 2004; Wilderman, Barron, & Imgrund, 2004). Volunteers may want to participate in citizen science to contribute to change, support their favourite organisations and for educational purposes (Ellwood et al., 2016). Cappa et al. (2016) found that motivations in technology-mediated citizen science increase after face-to-face interaction. Simply meeting new people and developing relationships can be motivators as well (Cappa et al., 2016). Other motivating factors can be the desire to learn about nature and wildlife conservation and the desire to contribute to saving nature (Johnson et al., 2014), and contributing to a honourable scientific cause (Tinati et al., 2017). Learning and acquiring new skills – such as identifying plants and using GPS units – and learning about invasive species proved to be significant drivers, too (Crall et al., 2013). Furthermore, people are interested in such projects because they provide a reason to get outside. Also, citizens can develop enhanced feelings of values and esteem (Bruyere & Rappe, 2007; Wright, Underhill, Keene, & Knight, 2015). Moreover, participants may be concerned about the reaction of their friends and family and personal reputation enhancement (Nov et al., 2014). After

having participated in a citizen science project, participants may feel motivated to apply what they have learned to address further conservation-related issues (Jordan, Gray, Howe, Brooks, & Ehrenfeld, 2011).

Nonetheless, many scientific enquiries do require specialised knowledge and can therefore only be executed by professional scientists. In other cases, citizen science may be impractical or inefficient as volunteers are often not trained or the required equipment and investment is not available (MacKenzie, Murray, Primack, & Weihrauch, 2016; Snäll, Kindvall, Nilsson, & Pärt, 2011).
To ensure uniform data collection many citizen science projects require strict protocols to be followed by their participants and sometimes require intensive training (Marshall, Kleine, & Dean, 2012). Marshall et al. (2012) argue that this can discourage volunteers and also disturb the accuracy of the data collected (Dickinson et al., 2012). Rather, as Parsons, Lukyanenko, and Wiersma (2011) state, the easier citizen science is, the better. Parsons et al. (2011) argue that the simpler the methods, the likelier it is that members of the public will be motivated to contribute to scientific research. Pre-participation extensive training or certification should be avoided (Parsons et al., 2011). According to Domroese and Johnson (2016), however, projects do need a strategy for training non-scientists.

Batson, Ahmad, and Tsang (2002) provide a framework of *Four Motives for Community Involvement.* Rotman et al. (2012) applied this framework to the motivations of participants in ecological citizen science. The four motives are:

(1) Egoism, where people participate to increase their own welfare;
(2) altruism, where people participate to increase the welfare of another individual or a group;
(3) collectivism, where people are motivated to increase the welfare of a group of which the participant is a part; and
(4) principlism, where people volunteer in order to uphold their personal principles. (Geoghegan, Dyke, Pateman, West, & Everett, 2016)

According to Ellwood et al. (2016), further studies could give new insights into how the design of citizen science projects can be improved and how they can be used by scientists, conservationists and policy makers. They also call for studies on how citizen science projects can generate higher quality data and on how citizen science projects can be evaluated effectively (Ellwood et al., 2016). Johnson et al. (2014) urge future scientists to concentrate on the social instruments that clarify the workings of citizen science and its effects. According to Theobald et al. (2015), increasing the rate

of citizen science related publications can strengthen the connection between lay researchers and professional researchers and translate into a better utilisation of data resources in the scientific research community.

3. Methods

3.1. Research Design

This research was designed to provide an overview of citizen science criteria and requirements and to evaluate these against the objectives of the Living Lodge, which is the case study used for this research. Furthermore, this research captures a sample of potential guests of the Living Lodge and assesses their motivation to participate in citizen science. The research has been conducted by using a mixed-methods approach. In the following the different kinds of methods are applied to the respective research questions.

3.2. Case Study: The Living Lodge

The Living Lodge is a project that is currently being developed by the social enterprise Nature Nomads which aims to provide luxury accommodation in a natural environment. The idea stems from the discourse on the ongoing environmental degradation and the growing alienation between humans and nature. While the lodge itself will provide a highly comfortable and luxurious stay for the guests, its outer wall will provide living and nesting space for local plants and animals. The Living Lodge will be environmentally sustainable and off-the-grid, meaning that it will be self-sufficient in terms of energy, water and waste (water) management. The goal of the Living Lodge project is to contribute to the recovery of the natural ecosystem. The first prototype of the Living Lodge will be located in the National Park De Biesbosch in the Netherlands. The Biesbosch national park, located in the delta of the lower Rhine and Meuse, was established in 1994 and covers an area of approximately 9,000 hectares. In the nineteenth century, most parts of the wetland were reclaimed for agricultural purposes and today, the area is completely regulated by humans (van der Deijl, van der Perk, & Middelkoop, 2017). The area is home to many plants and animals, with the beaver being the 'figure head' of the Biesbosch. The beaver was reintroduced in 1988, and now there are more than 200 beavers in the Biesbosch (Kanselaar, 2015). The area is characterised by willow bushes, creeks and islands (Hamers, Van den Berg, Van Gestel, Van Schooten, & Murk, 2006) and is easily accessible by boat (Kanselaar, 2015).

Once the goal of recovering the ecosystem will have been achieved, the lodge will be moved elsewhere. The outer wall, however, will be left at the original location of the lodge, as it will have become completely integrated with the natural environment. The Living Lodge and its guests should bring benefits to the ecosystem surrounding the lodge and the project aims to connect humans with nature and to provide tourists with profound nature experiences.

3.3. Data Collection & Data Analysis

To answer the first specific research question ("What are currently existing forms of citizen science and what are their requirements for sound implementation?") desk research has been conducted. An overview of currently existing citizen science projects and available tools and methods has been created. This question also addresses what output citizen science projects generate, what the required level of training is, what their requirements regarding the willingness of citizens are and what gadgets or tools are needed. Furthermore, the required level of expertise and involvement of citizen scientists was assessed. A detailed search of websites (using the search engine Google) provided a first insight into existing citizen science organisations and projects. The final sample of projects has been assembled by these first findings on Google and through websites such as zooniverse.com and projectnoah.org. Another fraction of projects was found in online scientific articles. In total, 13 projects were included in the analysis. These projects have been summarised in a table (see Appendix A). The projects have been described along a set of criteria, namely temporal scale, number of participants, geographical scale data collection, geographical scale data analysis, training, tools/methods and outcomes/goals/benefits. The citizen science projects summarised in the table have then been divided into two clusters of citizen science (see Table 2).

The second specific research question ("What are the objectives of the Living Lodge project and how do they translate into criteria to evaluate methods of citizen science?") has been answered by using qualitative methods. A semi-structured interview with one of the founders of Nature Nomads has been conducted via a Skype call. Semi-structured interviews allow the researcher to have an interview guide, but leave the freedom for probes and tailoring the interview to the participant (Adler & Clark, 2011). Prior to the interview, an interview schedule with a set of questions had been made (see Appendix B). The interview added valuable input as questions concerning the objectives and goals of the Living Lodge project have been answered. Furthermore, it has been made clear what conservation efforts and goals are expected in the project. To ensure credibility and trustworthiness (Lewis-Beck, Bryman, & Liao, 2003), the interview was recorded and a transcript has been made. To ensure good practice according to ethical guidelines, the interviewee was asked at the beginning of the interview if the interview could be recorded.

The third specific research question ("How do the forms of citizen science identified in SRQ1 score on the criteria formulated in SRQ2?") has been answered by combining the findings from SRQ1 and SRQ2, meaning that the identified forms and requirements of citizen science were evaluated along the criteria in the Living Lodge case.

To answer the fourth specific research question ("What are the motivations of potential guests of the Living Lodge to participate in citizen science and how does the target group evaluate the identified forms of citizen science?") a questionnaire has been distributed (see Appendix C). The questionnaire was translated from English to Dutch and German prior to distribution. The responses show what would motivate potential guests of the Living Lodge to participate in citizen science. Furthermore, the answers of the questionnaire show how the target group evaluates the citizen science methods that have found to be suitable in a tourism context.

Data collection for the questionnaire took place for 13 days. The target group consisted of Dutch and German people, who could potentially fall into the target group of the Living Lodge. However, no pre-participation assessment regarding income or other variables had been made. The questionnaire was not distributed on social media platforms, such as Facebook, as this would have reached mostly young people and students with low budgets, but the link to the questionnaire was sent out to acquaintances by email and snowball sampling was used.

The final sample downloaded from the online survey tool consisted of 144 responses, which included some empty responses. Only cases in which the respondents were either Dutch or German were included in the final analysis, which deleted almost all of the empty and partial responses. Text boxes have been left empty in many cases, but there was only one case left in the final analysis, in which the respondent did not respond to one item in one of the Likert-scales. The final sample consisted of 105 responses.

In the beginning of the questionnaire, the purpose and the objectives of the questionnaire were explained and ethical statements were provided. Following this, the Living Lodge was introduced. After a short, simplified explanation of what citizen science is, respondents were asked whether they would generally be interested to participate in citizen science. If they answered the question with "disagree", they were directed to a question that asked them to provide a reason for their disinterest in citizen science. However, this question was only added to the questionnaire at a later point, when a total of 57 responses had been reached already. If respondents replied with "agree", the next question asked them which kind of citizen science they would be interested in. Next, respondents were asked which steps of the scientific process they would be interested in.

The main part of the questionnaire consisted of 5-point Likert-scales ranging from *totally disagree* to *totally agree* or *not important at all* to *highly important*. The first block of these Likert-scale questions addressed the willingness of citizens to participate in citizen science, while the second block assessed the prerequisites for participation in citizen science. Some of the statements were inspired resulting from the literature review and some others were added after the interview with the founder of Nature Nomads. The statements were put into a table according to the respective category of Batson et al.'s (2002) framework (see Table 1).

Following from this, respondents were asked to state whether they would generally be interested in staying at the Living Lodge. If the respondent answered the question with "no", the next question asked them to state their reasons for this.

Respondents who answered with "yes" were asked how much they would be willing to pay for one night at the Living Lodge, and whether they would be willing to pay 150€ or more. This information was mostly of interest to Nature Nomads, but was also relevant in confirming that the target group had been reached.

The questionnaire concluded with some basic socio-demographic information about gender, age, nationality and country of permanent residence. At the end of the questionnaire, participants were thanked for their participation and, to increase the sample size, were asked to send the questionnaire to other people they know that might have been interested in filling out the questionnaire. For ethical reasons, the participants were not asked to provide names of other people, but rather to ask them to come forward themselves. The data of the questionnaires has been analysed using SPSS. Simple frequency statistics have been performed to assess the distribution of the scores.

The findings from the specific research questions jointly helped to answer the main research question ("How can citizen science contribute to the objectives of the Living Lodge project?") and consequently fulfil the aforementioned research objective.

Table 1. Motives for Community Involvement and Questionnaire Statements.

Motive for Community Involvement	Questionnaire Statements
Egoism	I want to learn more about the environment. I want to learn about wildlife and nature conservation. I want to learn and acquire new skills – for example identifying plants and using GPS units. My friends and family would think positively about my participation in an environmentally concerned project. It would give me a reason to spend more time outside. I find science and research exciting. Participation should be easy and fun. Participation should only cost very limited time. I want to continue my participation in the project, even after my stay at the Living Lodge.
Altruism	I want to contribute to the collection of scientifically useful data. I want to contribute to nature conservation. I want to give something back to nature.
Collectivism	It is important to me to socialise with other volunteers and with scientists. I want to be able to exchange ideas about the project with the scientists or organisers of the projects.
Principlism	The results of the project/research should be shared with me. I want to contribute to change. The project should take place globally (e.g. local projects combined in one research project on a website). (I could submit my data online instead of by mail.) (The project required me to use a/my smartphone or tablet.)

3.3.1. Sample

Out of the 105 respondents, 72 (68.6%) are German and 33 (31.4%) are Dutch. Out of the 31 respondents (29.5%) that live in the Netherlands, 29 are Dutch and two are German. Out of the 71 (67.6%) that live in Germany, 70 are German and one is Dutch. Two of the Dutch respondents live in Slovakia and one Dutch respondent did not tell their country of permanent residence (2.9%, N=3). 61 respondents (58.1%) are female and 44 (41.9%) are male. Most respondents are between 45 and 54 years old (36.6%, N= 38), followed by 55 to 64 years old (25.7%, N= 27), 35-44 years (17.1%, N= 18), 25-34 years (11.4%, N= 12), 18-24 years (6.7%, N= 7), 17 years or younger (1.9%, N= 2) and 65 years or older (1.0%, N= 1).

4. Citizen Science Clusters and Requirements

In the following four chapters, the results of the SRQs are presented. To answer SRQ1 ("What are currently existing forms of citizen science and what are their requirements for sound implementation?") extensive desk research was conducted. Following the desk research, I made two clusters of existing forms of citizen science. In Cluster A, citizen scientists are involved in data collection, usually through observations, and in Cluster B they are involved in data analysis, mostly through classifying data. The clusters, including examples of citizen science, are explained in the following section and summarised in Table 1.

4.1. Cluster A

In Cluster A, citizens are, to a certain degree, involved in data analysis. These projects represent the *volunteered thinking* subcategory of 'citizen cyberscience'. Data in this type of citizen science is usually collected by cameras or camera traps. Image classification seems to be a wide-spread tool for data analysis, in which photographs are classified online by volunteers from all over the world. In other cases, citizens make digital transcripts of old hand-written observations. This is an efficient way of data analysis in cases where computer algorithms simply cannot perform the same tasks as the human eye and brain or where data analysis would take far too long if the – usually small – group of scientists involved in the project was to do it alone. These types of projects manage to include high numbers of volunteers. There is no training required for citizens to participate in such projects, however some projects require background knowledge. Data analysis takes place online, which is why volunteers need a computer and an Internet connection. Extrinsic rewards for citizens involved in this type of projects include privileges based on task performance. *The Snapshot Serengeti*, *Galaxy Zoo*, *Brooklyn Atlantis* and *Jungle Rhythms* are examples for this type of citizen science.

In *The Snapshot Serengeti*, which is hosted by *Zooniverse*, volunteers identify animal species, count the number of taxa and characterise the behaviour of animals (Swanson, Kosmala, Lintott, & Packer, 2016). Camera traps have been set up in the Serengeti National Park in Tanzania and people can participate from all over the world. So far, more than 28,000 people have contributed to *The Snapshot Serengeti* (Swanson et al., 2016).

In *Galaxy Zoo*, also hosted by *Zooniverse*, citizens classify images of galaxies shot by telescopes and satellites. During the first year 150,000 people contributed to the project. Thanks to this, a process that would have taken far longer otherwise, could be sped up significantly. Like in *The*

Snapshot Serengeti, people can participate from all over the world as the image classification takes place on the website of the project. *Galaxy Zoo* claims to have generated the largest number of publications based on citizen science input ("The Story So Far," n. d.).

Another project hosted by *Zooniverse* is *Jungle Rhythms*. *Jungle Rhythms* was started in November 2015 and ended in 2017. Participants transcribed old observations of tree life cycle events that had been made between 1937 and 1958 at Yangambi research station in the Democratic Republic of the Congo. The project aimed to generate knowledge about droughts and their impacts on the structure and function of rainforests in Africa ("The rhythm of plant life," n. d.). Because these images could not be processed automatically, human help was necessary. Again, volunteers from all over the world could participate and perform their tasks online.

In *Brooklyn Atlantis*, citizen scientists classify objects on pictures as “threat” or “no threat” to wildlife and water quality on a web-based interface (Laut, Porfiri, & Nov, n. d.) in order to facilitate environmental monitoring and to map and study the canal environment. An aquatic surface vehicle has been installed on the heavily polluted Gowanus Canal in Brooklyn, NY (Cappa et al., 2016). Participants receive points and privileges based on their task performance. What distinguishes this project from the previous ones in this cluster, is that volunteers can participate both online and on-site. During special events, volunteers get the opportunity to control the aquatic robot (Laut et al., n. d.).

4.2. Cluster B

In Cluster B, citizens are involved in data collection. Methods for data collection include questionnaires, photographs or submission forms. For analysis, the data is passed on to scientists. Some of these projects require that participants have certain skills to perform data collection, such as diving skills, and usually cameras or smart phones are required. These projects are often embedded in a recreational context, and participants receive feedback in the form of reports that are mailed to them or specific information about individual animals. Examples of projects in Cluster B are *STE: Scuba Tourism for the Environment*, *The Mediterranean Hippocampus Mission*, *Divers for the Environment*, *Evolution MegaLab*, *Cheetah Watch Campaign & Wild Dog Watch Campaign*, *The Lost Ladybug Project* and *Project Squirrel*.

STE: Scuba Tourism for the Environment is a coral reef biodiversity monitoring programme based on volunteer work (Branchini, Meschini, et al., 2015). In this citizen science project, volunteers collected data during dives in three countries around the Red Sea, namely Egypt, Sudan and Saudi

Arabia. The divers filled out a multi-language questionnaire to gather information about the ecosystem health of the coral reef ("STE: Scuba Tourism for the Environment," 2015). Each participant was involved in the programme for several days. Volunteers were asked to fill in the questionnaire both before and after the project and questions concerned their level of knowledge on the biology and ecology of coral reefs and their awareness of human impacts on the environment ("STE: Scuba Tourism for the Environment," 2015). Data collection took place for seven years between 2007 and 2013. In total, 14,502 volunteers were involved in the project (Branchini, Meschini, et al., 2015). The project took on a recreational approach, which, apart from the long duration compared to other projects, can be assumed to be one of the reasons why the project attracted such a high number of volunteers. Familiar and easily recognisable species were included in the survey, as divers normally look for these ("STE: Scuba Tourism for the Environment," 2015). Furthermore, there were no strict survey protocols, which made participation more enjoyable (Branchini, Meschini, et al., 2015). Dive professionals had been trained during courses about the goals and methods of the project and they engaged volunteers to participate in the project. Dive masters and SCUBA instructors then provided the divers with information about the national environment and how they could minimise their impact on coral reefs ("STE: Scuba Tourism for the Environment," 2015). The completed questionnaires were sent to the University of Bologna where statistical analysis took place. Moreover, the aim of the project was to inform local authorities and to contribute to local environmental management and conservation. As indicated before, one of the key goals was to raise environmental awareness and education among participants and to develop a future of sustainable tourism. According to the project organisers, dissemination activities are vital to attract volunteers and enhance their loyalty to the project. While media exposure pulls in volunteers, media dissemination increases citizen awareness and participation. Sharing project results is vital to keep up the public interest in environment and biodiversity issues ("STE: Scuba Tourism for the Environment," 2015).

The *Mediterranean Hippocampus Mission* aimed to map the geographical and ecological distribution of sea horses in the Italian Mediterranean Sea by involving Italian recreational divers (Goffredo et al., 2010; Goffredo et al., 2004). The regions surveyed included parts of the Ligurian, Tyrrhenian, and Adriatic seas off 18 coastal regions in Italy and Croatia. (Goffredo et al., 2004). The study took place for three years between 1999 and 2001 and 2,536 divers were involved in the project. A scientist and a graduate student had been engaged by the Department of Evolutionary and Experimental Biology of the University of Bologna to sustain the project. Training took place in the form of workshops to educate on environmental issues. Prior to participation, volunteers had to meet certain requirements. Specifically, they had to show an interest in marine conservation, the willingness to raise project awareness and the willingness to be trained to meet the needs of the

project, as well as scuba qualifications. During data collection, the divers filled in questionnaires. For data analysis, the completed questionnaires were sent to the headquarters of Underwater Life Project. This database was then sent to the Department of Biology of the University of Bologna. The divers who had contributed the most questionnaires received direct feedback as the resulting reports were mailed to them. This is believed to have enhanced their commitment to the study (Goffredo et al., 2004).

The project *Divers for the Environment* was motivated by the success of the *Mediterranean Hippocampus Mission*. The project, which took place in the same area as the first one lasted for four years between 2002 and 2005 and 3,825 divers participated. The goal of the project was to assess the quality of the environment (Goffredo et al., 2010). Dive masters and trainers participated in training courses for professional divers. Recreational and tourist divers and snorkelers were asked to fill in questionnaires recording the presence of animals, plants and litter in the sea. The biodiversity status is key to drawing conclusions on the quality of the environment (Goffredo et al., 2010). The questionnaire consisted of two parts: the first part had photographs to identify the taxa and the second part was a form to record data. To ensure data quality, the questionnaires were completed shortly after each dive and data recording was assisted by trained professional divers. In this case, involving citizen scientists saved a lot of time and money. Goffredo et al. (2010) say that if an individual alone would have collected the same amount of data it would have taken them 45 years and cost more than US$4,758,000.

Evolution MegaLab was active in 2009. The project took place in 15 European countries and the website is still available in 14 languages. 6,461 users were registered with the site (Worthington et al., 2012). The project studied shell polymorphism of snails in Europe and aimed to compare new findings with historical ones in order to draw conclusions on evolutionary change responding to changes in climate and predation pressures. The study was designed as a hands-on study of evolution to enable participation of the general public throughout Europe. Participants had to register on the website of the project and print out a recording sheet on which they recorded the number of snails they saw. They then uploaded the collected data online. Instructions were available for download and an online quiz simultaneously trained users. The project resulted in scientific publications (Silvertown, 2009) and users received immediate feedback on their results (Worthington et al., 2012).

Data collection for the *Cheetah Watch Campaign* is taking place at Serengeti National Park in Tanzania. The project is ongoing, with the initial project having started in 1974 ("Serengeti Cheetah

Project ", n. d.). The project aims to monitor and conserve carnivores, especially cheetahs and to keep track of individual animals across the country. A similar project focuses on wild dogs. No training is required to participate in the project. While on safari, people take photos of cheetahs that they then submit by mail or email together with some basic information on the location and time. There is a recording sheet available for download on the website. The animals can then be matched with spot pattern records ("The Cheetah Watch Campaign," n. d.). If the information is available, the volunteers get information about the animal that they photographed and its history ("How you can help," n. d.).

The Lost Ladybug Project – hosted by *Project Noah* – is an ongoing project that started in 2000. 5,432 participants have since contributed to the data collection in North America. There is no training required and also children can participate in the project. Volunteers go outside and take photographs of ladybugs which they upload through a submission form online, together with information on time, date, location, and habitat. The findings lead to information on the number of ladybugs and the amount of still existing ladybug species. While the scientists involved can identify the different ladybug species, they rely on the help of citizens to find rare species ("The Lost Ladybug Project," n. d.).

Project Squirrel is another project hosted by *Project Noah* in North America. The project started in 1997 and is still ongoing. 5,702 volunteers have participated so far (Project Noah, n .d.). There is no further training required, however there is a citizen scientist research guide available online (S. Sullivan, n. d.). The aim of the project is to collect data about a large number of squirrels in a variety of places, as squirrels are central indicators of local ecology. There is a smartphone application and participants submit their observations through an online interface.

Table 2. Two Types of Citizen Science.

	Cluster A	**Cluster B**
Role of citizen	Data analysis	Data collection
Data collection methods	Camera (traps) and/or photographs	Questionnaire Photographs and/or submission form
Data analysis methods	Image classification Transcripts	By scientists
Level of training	None Background knowledge required	None to moderate
Prerequisites	Computer with Internet connection	Skills (e.g. diving skills) Cameras
Extrinsic rewards for citizens	Privileges based on task performance (Brooklyn Atlantis)	Recreational approach Reports mailed to volunteers Feedback
Examples	The Snapshot Serengeti Galaxy Zoo Brooklyn Atlantis Jungle Rhythms	STE: Scuba Tourism for the Environment Mediterranean Hippocampus Mission Divers for the Environment Evolution MegaLab Cheetah Watch Campaign & Wild Dog Watch Campaign The Lost Ladybug Project Project Squirrel

These findings show that citizen science is an effective way to speed up processes of data collection and analysis, to collect and analyse large amounts of data, and to effectively work through data that cannot be classified or read by computers. All of the above-mentioned citizen science projects fall into the category of *contributory* projects (see S. Gray et al., 2016) where the scientific process follows a top-down approach and citizens solely contribute data or aid in simple data analysis.

4.3. Requirements for Implementation

Resulting from the preceding findings some vital points for sound implementation of citizen science projects can be pointed out. *Contributory* citizen science projects, in which citizens usually contribute to data collection and simple analyses, require the least from the volunteers. These projects are usually designed by scientists in a top-down approach and participants collect or analyse data according to strict guidelines (Tweddle et al., 2012). In the following, an overview of requirements for sound implementation of citizen science projects is provided.

Scientific design: All citizen science projects need to adhere to the general international standards of science ("Standards for Citizen Science," 2015). A citizen science project needs to have a sound scientific design and be specific about its goals. The European Citizen Science Association (2015) published a guide on 'Ten principles of citizen science' which is freely available for download on their website. Many citizen science projects have the aim of contributing to environmental monitoring (e.g. *Brooklyn Atlantis*) and environmental management and conservation or to inform local authorities (e.g. *STE: Scuba Tourism for the Environment*).

Training: While most of the projects do not require participants to take part in training, some of them do. All of the projects require some form of instructions to be communicated to the volunteers. In some projects, like in *STE: Scuba Tourism for the Environment*, professionals have to take part in training courses and then brief the participants. Projects that fall into Cluster B often require citizens to take part in training in the form of workshop, which requires high motivation and commitment to the study.

Commitment and support of volunteers: The continuous motivation by the participants needs to be ensured and the participants need to be continuously supported by the organisers of the project. As stated in the guide by the European Citizen Science Association (2015) both scientists and citizens should benefit from their participation in the project. The findings of the desk research show, that a recreational approach engages high numbers of volunteers. Even though strict guidelines for data collection and analysis need to exist (Tweddle et al., 2012), if participants feel like the survey protocols are too strict or limiting, they will be less motivated to participate. If a citizen science project requires too much of the volunteers, it is likely to fail. For example, The British Trust for Ornithology's Nest Sanitation project engaged a very small number of participants because it required very intensive work and therefore did not come to a conclusion (Goffredo et al., 2010).

Staff: First and foremost, citizen science requires scientists that design and manage the research which adheres to the general standards for scientific research. The scientists need to be committed throughout the whole study and, as mentioned above, guide and support the participants whenever needed. The *Mediterranean Hippocampus Mission*, for example, engaged a scientist and a graduate student that were committed to the study throughout its duration. Other members of staff could be, for example, national park rangers, or volunteers that check on the equipment used, like camera traps.

Monetary investment: Any citizen science project needs to be paid for. Often, this comes in the form of funding by governments (e.g. Goffredo et al., 2010; "STE: Scuba Tourism for the Environment," 2015). The *Mediterranean Hippocampus Mission* received a grant of US$55,000 by the diving agency Scuba Schools International Italy, which covered the fellowship, computer hardware, software and workshops and participation at conservation conferences. Another US$25,000 were granted for printing costs and general publicity. *Brooklyn Atlantis* received US$560,000 by the National Science Foundation (National Science Foundation, n. d.).

Tools: Examples of tools can be a website or a web interface that need to be set up specifically for the project. In many projects, citizens are required to use their own smart phones or cameras. Moreover, for data analysis, questionnaires are a common tool. These need to be designed by the organisers of the project and be made available to the participants.

Equipment: Especially projects in Cluster A, where citizens contribute to data analysis, require equipment to be installed beforehand. Often, camera traps are being used, or, as in the case of *Brooklyn Atlantis*, special data collection tools, such as an aquatic surface vehicle/robot are installed.

Time: Citizens do not need to invest as much time into a *contributory* citizen science project as in *participatory* or *co-produced* ones, as they can contribute to the data collection only once and are not required to do so regularly (in most projects). Nonetheless, a citizen science project requires a certain amount of time. The shortest data collection of the projects included in this analysis lasted for one year (*Evolution MegaLab*), while all others lasted for at least several years.

5. Objectives of the Living Lodge Project

To answer the first part of SRQ2 ("What are the objectives of the Living Lodge project…?"), an interview with one of the founders of the Living Lodge was conducted.

According to the interviewee, the objective of the Living Lodge project is twofold. On one hand the project aims to connect humans with nature, "so that they understand nature better and the relevance of it, but are also touched by its . . . beauty and versatility and [the] genius ways its built and set up and functions". On the other hand, the project aims to "enhance nature through the built environment", through tangible but also intangible aspects. Citizen science is seen as one of many pillars to convey these objectives.

The target group of the Living Lodge is quite broad. It consists of people with "a bit of a higher income" who can afford to pay 150€ a night and "with a genuine interest in nature . . . [however] not necessarily [so]". Furthermore, the lodge targets holiday makers that are looking for a comfortable holiday and a romantic getaway. Moreover, according to the interviewee, the Biesbosch is a "birders' paradise", so naturally, the lodge will attract bird watchers, who apparently have a lot of budget. In addition, the Living Lodge accommodates the desires of families. The target group does not necessarily show an interest in sustainability prior to their stay, but rather it is something that Nature Nomads wants to "give to the people".

The interview also included questions about citizen science which asked if Nature Nomads already had any specific ideas about the implementation of citizen science at the Living Lodge. According to the interviewee, "ideally, citizen science also becomes an experience, a fun thing to do. I think that is important [and an] important prerequisite to involve people in citizen science". The interviewee would like to see the Living Lodge as a hub for volunteers or people that have a general interest in the Biesbosch. Like this, a broad array of people could be connected to the "Living Lodge ecosystem", including past guests and other volunteers that are not staying at the lodge.

5.1. Criteria to Evaluate Forms of Citizen Science

Following from the findings of the interview and the objectives of the Living Lodge, the second part of SRQ2 ("…and how do they translate into criteria to evaluate methods of citizen science?") was answered by creating a framework with criteria for citizen science at the Living Lodge (see Figure 3). The forms of citizen science can then be evaluated along these criteria.

Figure 3. Criteria for citizen science at the Living Lodge.

Citizen science at the Living Lodge should increase environmental understanding and awareness of the guests. They will get to understand nature better, learn about sustainability and be touched by the beauty and ingenuity of nature. Ideally, citizen science will connect humans with nature. The overall aim is nature conservation and the nature surrounding the lodge is to be enhanced through the built environment. Importantly, guests of the Living Lodge want to spend a comfort holiday and/or a romantic getaway, which is why one of the criteria for citizen science at the lodge is that recreation and luxury are accounted for. To motivate guests and other potential citizen scientists, science should be seen as an experience and a fun activity. Several groups of people shall be involved in the community of the Living Lodge, including current guests, past guests, scientists, other volunteers, potentially even future guests and others.

6. Citizen Science and Living Lodge Objectives

In the following section, SRQ3 ("How do the forms of citizen science identified in SRQ1 score on the criteria formulated in SRQ2?") is answered. To do so, the criteria shown in the framework in the previous section are illustrated with examples from SRQ1.

Increasing environmental awareness and understanding: One of the aims of the Living Lodge project is to decrease the estrangement between humans and nature and to make people spend more time in nature. A project in Cluster A, namely *STE: Scuba Tourism for the Environment*, tested the knowledge of participants on human impacts on the environment and their environmental awareness pre- and post-participation. Projects that fall in Cluster B, in which citizen scientists participate in data collection, require them to spend time in nature, for example to take photographs of specific species of plants and animals or to count taxa, such as birds.

Nature conservation: One of the goals of the Living Lodge is to improve the health of the ecosystem the lodge is located in. Many citizen science projects in both Cluster A and Cluster B address environmental monitoring and conservation challenges. For example, *The Snapshot Serengeti* aims to monitor wildlife and to contribute to nature conservation and management. *STE: Scuba Tourism for the Environment* is aimed at environmental management and conservation and hopes to achieve a future of sustainable tourism.

Recreation and luxury: The Living Lodge is designed to provide recreation and luxury to its guests. Many citizen science projects take on a recreational approach. Projects in Cluster A, in which citizen scientists usually sit behind a desktop and perform information or image classification do not seem to fall into this category. In Cluster B, some projects take place in a holiday setting, like in *STE: Scuba Tourism for the Environment* and *Divers for the Environment*, and/or people collect data when they are outside, like in *The Lost Ladybug Project* and *The Cheetah Watch Campaign*. However, the extent to which this can be called 'luxury' is debatable.

Science as fun: Nature Nomads would want citizen science to be a "fun thing to do". *The Snapshot Serengeti* in Cluster A, has been described as highly addictive and exciting and participants get to go on a virtual trip to the Serengeti National Park (Howard Saunders, 2017). In Cluster B, participants in *STE: Scuba Tourism for the Environment* were motivated to participate in the project, because there were no strict survey protocols (Branchini, Meschini, et al., 2015). *STE: Scuba Tourism for the Environment*, *The Mediterranean Hippocampus Mission* and *Divers for the*

Environment all took place in a recreational/tourism context. Participants got to do an activity they enjoy, in this case scuba diving or snorkelling, and they got to look for known and interesting species.

Community building: According to the Living Lodge criteria, ideally, not only the current guests of the Living Lodge will be involved in the project, but also past and future guests and other volunteers. In *contributory* projects participants are engaged in a lesser extent than in *collaborative* and *co-created* projects. Some projects in Cluster A, such as *Galaxy Zoo* and *The Snapshot Serengeti*, have forums in which citizen scientists can talk to other participants and in Cluster B, people can see the contributions of others, for example, in the form of photographs uploaded to the respective website. In *Brooklyn Atlantis*, people can both classify images online and participate in events on-site together with other volunteers.

7. Motivation for Participating in Citizen Science

To answer the fourth specific research question ("What are the motivations of potential guests of the Living Lodge to participate in citizen science and how does the target group evaluate the identified forms of citizen science?"), a multi-language questionnaire has been distributed.

The final data set consisted of 105 responses. 89 respondents (84.8%) are interested in staying at the Living Lodge, while 16 (15.2%) are not interested in staying there. Out of the 89 respondents that would be interested in staying at the lodge, 19 respondents (21.3%) would be willing to spend 150€ or more for one night at the Living Lodge, 48 respondents (53.9%) said that they would maybe be willing to spend 150€ or more and 22 respondents (24.7%) indicated that they are not willing to spend 150€ or more.

The 16 respondents that are not interested in staying at the Living Lodge gave various reasons for this. One respondent said that it does not "involve their hobby". Another respondent stated that they are not a nature-seeking holiday maker. Another person said that the project supports the disturbance of previously untouched nature and that through their interest in the Living Lodge – and that of others – a chain of commercialisation would emerge which in turn would support other projects of this kind. According to this respondent, there already are enough of such projects, "surely also in the Netherlands". Furthermore, the respondent said that their income is too low to be part of the target group. Another respondent asked: "a lodge in nature for one family… and what does the rest do?". According to the respondent this is the fault of the concept and in general, no humans should stay overnight in a national park with which another respondent seems to agree saying that they find a lodge placed in a natural area disturbing for animals and nature. One respondent said that they love cities and the sea and that they only like other types of nature in movies. One respondent said that they have no time, another one said the lodge is too isolated and another one said that it is far too much action and they just want their peace. According to one respondent, there are "other aims to achieve".

Out of the 105 respondents, 63 (60%) indicated that they would generally be interested to participate in citizen science, while 42 (40%) said that they are not interested to participate in citizen science. Respondents that said they are not interested to participate in citizen science, were not shown the questions about citizen science and were directed to the questions about socio-demographics. Four (25%) of the 16 respondents that are not interested in staying at the Living Lodge are interested to participate in citizen science and the remaining 12 respondents (75%) that are not interested in staying at the lodge are also not interested in participating in citizen science.

The respondents that said they are not interested in citizen science were given the opportunity to explain their choice. Two respondents said that participating in citizen science does not contribute to their relaxation and one person said that it does not count as "quality time" for them. Others said they do not have the time or that they are not interested because participation takes time (N= 5). Three respondents said they are generally not interested in the topic. One respondent also said that they think that such topics should be worked on professionally. One respondent said that it would take too much effort, another said "I like to enjoy nature without having cameras with me; I do not generally take pictures". Another person said that it would not be a holiday for them. One respondent said they may be interested in a citizen science project in the city, but they are not interested in the Living Lodge project.

The question "What kind of citizen science projects would you be interested in?" allowed for multiple answers to be chosen by each respondent. Most respondents would be interested in nature and/or environment related citizen science projects, followed by equally rated plant related and animal related, community related, and lastly, geography related citizen science (see Table 4). One person responded with "I don't know" and three respondents provided other reasons under "Other". These responses are "careful handling of natural resources", "zero waste, health" and "natural sciences topics (next to biology)".

Table 3. Types of citizen science projects.

	N		
	Valid	Missing	Percent
Nature/environment related	56	7	88.9
Plant related	36	27	57.1
Animal related	36	27	57.1
Community related	25	38	39.7
Geography related	24	39	38.1
Other	3	60	4.8
I don't know	1	62	1.6

Most respondents would be interested in doing experiments. This is closely followed by collecting data, followed by analysing data, sharing results and formulating and/or proposing research questions. Four respondents selected "I don't know" and one person selected "other", but did not fill anything in in the text box (see Table 5).

Table 4. Steps of the scientific process.

	N		
	Valid	Missing	Percent
Doing experiments	41	22	65.9
Collecting data	36	27	63.8
Analysing data	31	32	44.7
Sharing results	25	38	38.3
Formulating/proposing research questions	18	45	34.0
I don't know	4	59	8.5
Other	1	62	2.1

In the next section, the questionnaire assessed the respondents' willingness to participate in citizen science on a 5-point Likert-scale (see Table 6). The motivator that was on average valued the strongest by the respondents is the desire to contribute to nature conservation (N= 63, M= 4.47, SD= 0.618). Most respondents also agree with the statement "I would like to participate in citizen science, because I want to contribute to change" (N= 63, M=4.32, SD= 0.668). The desire to give something back to nature scored highly, too (N= 63, M= 4.27, SD= 0.827). The respondents would like to participate in citizen science, because they want to learn more about the environment (N= 63, M= 4.12, SD= 0.609). "I would like to participate in citizen science, because I want to learn more about wildlife and nature conservation" was rated with 'agree' on average (N= 63, M= 4.08, SD= 0.679) and on average people agreed that they find science and research exciting (N= 63, M= 3.94, SD= 0.914). Wanting to learn and acquire new skills, like identifying plants and using GPS units, was rated between neutral and agree on average (N= 63, m= 3.79, SD= 0.883). The respondents on average replied with neutral and agree concerning the statement that participation in citizen science would give them a reason the spend more time outside (N=63, M= 3.56, SD= 0.929). "I would like to participate in citizen science, because I want to contribute to the collection of scientifically useful data" was mostly answered with 'agree' (N= 62, M= 3.45, SD= 0.843). Socialising with other volunteers and with scientists is not a strong indicator for willingness to participate in citizen science (N= 63, M= 3.25, SD= 0.803). The vast majority of respondents did not find the reputation among family and friends to be a very strong motivator (N= 63, M= 2.86, SD= 1.060). All in all, it becomes apparent that, on average, none of the statements were rated very negatively by the respondents with the lowest one being centred around the 'neutral' score.

Table 5. Willingness to participate in citizen science.

I would like to participate in citizen science, because...	N		Mean	Mode	Std. Deviation
	Valid	Missing			
I want to contribute to nature conservation.	63	0	4.48	5	.618
I want to contribute to change.	63	0	4.32	4	.668
I want to give something back to nature.	63	0	4.27	5	.827
I want to learn more about the environment.	63	0	4.13	4	.609
I want to learn about wildlife and nature conservation.	63	0	4.08	4	.679
I find science and research exciting.	63	0	3.94	4	.914
I want to learn and acquire new skills – for example identifying plants and using GPS units.	63	0	3.79	4	.883
it would give me a reason to spend more time outside.	63	0	3.56	4	.929
I want to contribute to the collection of scientifically useful data.	62	1	3.45	4	.843
it is important to me to socialise with other volunteers and with scientists.	63	0	3.25	3	.803
my friends and family would think positively about my participation in an environmentally concerned project.	63	0	2.86	3	1.060

The second block of Likert-scale questions addresses the prerequisites for participating in citizen science (see Table 7). Respondents would be especially interested to participate in citizen science, if participation was easy and fun (N= 63, M= 4.21, SD= 0.600). Moreover, respondents would like if the results of the project or research were shared with them (N= 63, M= 3.89, SD= 0.785). Being able to exchange ideas with the scientists or organisers of the projects is relatively important to the respondents (N= 63, M= 3.67, SD= 0.880). The respondents do not necessarily find it to be important to be involved in citizen science after their stay at the Living Lodge (N= 63, M= 3.46, SD= 0.800) and time is not a major prerequisite for participation either (N= 63, M= 3.54, SD= 0.779). Being able to submit the data online instead of by mail (N= 63, M= 3.41, SD=1.072) and the project taking place globally (N= 63, M= 3.30, SD= 0.961) are not very important to the respondents. Using a smart phone or tablet in the citizen science project was ranked the lowest, with most respondents choosing ‘neutral’ (N= 47, M= 2.40, SD= 0.814).

Table 6. Prerequisites for participating in citizen science.

I would be more interested to participate in citizen science, if...	N		Mean	Mode	Std. Deviation
	Valid	Missing			
participation was easy and fun.	63	0	4.21	4	.600
the results of the project/research were shared with me.	63	0	3.89	4	.785
I would be able to exchange ideas about the project with the scientists or organisers of the projects.	63	0	3.67	4	.880
participation only cost very limited time.	63	0	3.54	4	.779
I could continue my participation in the project, even after my stay at the Living Lodge.	63	0	3.46	4	.800
I could submit my data online instead of by mail.	63	0	3.41	4	1.072
the project took place globally (e.g. local projects combined in one research project on a website).	63	0	3.30	4	.961
the project required me to use a/my smartphone or tablet.	63	0	2.40	3	.814

No significant differences in the rankings of statements in the different categories in Batson et al.'s (2002) framework of *Four Motives for Community Involvement* can be pointed out, as all statements scored relatively high.

8. Discussion & Conclusion

The broad topic addressed in this thesis report is the application of citizen science in a tourism setting. This has been done by using an example, namely the Living Lodge. There has been almost no research about the topics of citizen science and tourism combined, which seems paradoxical given that nowadays more and more tourists want to actively contribute something positive to the places they visit (Aljazeera, 2011; Horton, 2011). To contribute to minimising this knowledge gap, the objective of this study was to identify currently available citizen science approaches and to assess whether these are compatible with the aims of the Living Lodge project. This thesis reports provides an overview of existing citizen science projects and adds to the existing literature of frameworks and classifications by providing a set of clusters according to the involvement of citizens in citizen science projects. What is more, the objectives of the Living Lodge project have been assessed and the identified forms of citizen science have been evaluated along a set of criteria for the implementation of citizen science at the Living Lodge. Lastly, the motivations to participate in such citizen science projects have been studied by reaching the potential target group of the Living Lodge. Motivation to participate in citizen science is presented as an under-researched topic in the scholarly world, to which this report adds new knowledge. This study has shown, that the majority of participants would be interested to be involved in citizen science. The findings obtained in this study are broadly consistent with the major positive trend in the abundance of citizen science projects. The main research question that this report aimed to answer is "How can citizen science contribute to the objectives of the Living Lodge project?" It is concluded, that citizen science can be an efficient approach for the Living Lodge project to achieve its goals.

This report gives examples of citizen science projects which show, that citizen science can be incorporated well in a tourism context. A list of criteria for sound implementation of citizen science projects has been suggested. If citizen science is to be part of the Living Lodge project, these criteria need to be taken into account. From the perspective of the Living Lodge project, a set of criteria concerning the goals of the project is provided in this report.

As the article "Unite research with what citizens do for fun: "recreational monitoring" of marine biodiversity" by Goffredo et al. (2010) shows, citizen science certainly can take place in a recreational context, which supports the idea of the Living Lodge project. When projects take place in a recreational setting, like *STE: Scuba Tourism for the Environment* and *Divers for the Environment*, citizens are likely to enjoy their participation. Nonetheless, projects that take place in a holiday setting, like the Scuba diving ones included in the prior analysis, require a couple of days

of commitment, including training sessions, which might limit the feeling of luxury that the Living Lodge aims to offer.

This study supports the finding that citizens can be motivated to participate in citizen science for many different reasons. According to the interviewed founder of the Living Lodge, citizen science should be an experience and a fun thing to do. Successful citizen science projects confirm that if the project is perceived as "easy and fun" by the participants, they are more likely to participate (see Dickinson et al., 2012). While doing an activity that the participants would do either way, such as scuba diving, their commitment and interest is high. The target group of the Living Lodge also values the project being "easy and fun" highly. In addition, participation becomes more enjoyable when there are no strict survey protocols to be followed (Branchini, Meschini, et al., 2015).

The Living Lodge project has two objectives: to connect humans with nature and to contribute to nature conservation. Johnson et al. (2014) and Shirk et al. (2012) argue that, if executed properly, citizen science can increase socio-ecological relationships. Couvet and Prevot (2015) claim, that citizen science can stimulate new relationships between citizen scientists and nature conservation. Consequently, citizen science can be an efficient tool to teach the guests of the lodge about nature and sustainability.

Most members of the target group find science and research exciting, which, as argued by Tinati et al. (2017) is an important motivator to participate in citizen science. For apparent reasons, this is an essential prerequisite for citizen science to be effective at the Living Lodge.

One of the aims of the Living Lodge project is to increase environmental awareness and understanding. This fits well with several scholars previously having argued that citizen science can increase public education and environmental awareness as well as engagement (see Dickinson et al., 2010; Goffredo et al., 2004; Jansujwicz, Calhoun, & Lilieholm, 2013; Johnson et al., 2014; Schmeller et al., 2009). To minimise the estrangement between humans and nature, the Living Lodge project aims to connect humans with nature. Like Bruyere and Rappe (2007) and Wright et al. (2015) argued, most respondents agree that participating in citizen science would give them a reason to spend more time outside. Also, citizen science enhances the public's awareness of conservation issues (Goffredo et al., 2010). Raising awareness is a widely used reason to initiate a citizen science project (Jansujwicz et al., 2013), which provides another reason as to why citizen science can be an efficient tool to reach the goals of the Living Lodge project. Besides, citizen science is a useful way to educate citizens and to empower them to make more informed decisions (Liu, Kobernus, Broday, & Bartonova, 2014).

This study is in line with the findings by Ellwood et al. (2016) who argue that citizens want to participate in citizen science to contribute to change as well as for educational purposes.

Respondents rated the desire to contribute to change, to learn more about nature and to learn new skills highly. Wanting to learn about nature and wildlife conservation and to contribute to saving nature have been found to be motivating factors in previous research (Johnson et al., 2014). Likewise, in this study, almost all of the respondents interested in citizen science were most interested in projects related to nature and the environment. In addition, the desire to contribute to nature conservation scored the highest on the Likert-scales. Branchini, Pensa, et al. (2015) argue that citizen science can contribute to long-term and large-scale monitoring. Simultaneously, Johnson et al. (2014) argue, that citizen science can contribute to monitoring environmental change. Consequently, nature conservation, one of the goals of the Living Lodge, is an issue that can be addressed well by citizen science. Considering that the overall aim of the Living Lodge project lies in making a positive contribution to the ecosystem the lodge is located is, these are promising results.

Contradictorily to what Cappa et al. (2016) found, socialising with others (i.e. other volunteers and the scientists) is not of high importance to the respondents of this study. This may be explained by one of the appealing factors of the Living Lodge being the privacy and isolation that many holiday makers seek. Yet, one of the criteria of the Living Lodge project has been termed 'community-building'. This criterion would allow for a combination of both clusters of citizen science projects to be employed at the Living Lodge. Possibly, not only the current guests of the Living Lodge will take part in the citizen science project. With more people involved, like past guests and other volunteers, the participants get to enjoy the benefits of working together on a scientific issue with other citizens and scientists and they can communicate with each other and share ideas, recommendations etc. Nonetheless, it is debatable whether 'socialising with others' while staying at the lodge and 'community-building' while taking part in a citizen science project can be put on par.

Because individual guests of the Living Lodge will only be staying at the lodge for a short period of time, a top-down approach, which is led by scientists and in which participants aid in certain tasks (Devictor et al., 2010; Newman et al., 2012), would be the most feasible. Following the same line of reasoning, a *contributory* project is the best-fitting approach to be used at the Living Lodge. The risk with *contributory* projects, however, lies in developing a project that is not socially relevant to the group of volunteers. Nevertheless, one of the strengths of citizen science is that it can address global issues on a local level and make them locally relevant and meaningful (Tweddle et al., 2012). Accordingly, citizen science at the Living Lodge could teach guests about global environmental issues as well as sustainability. As mentioned before, the target group of the Living Lodge does not necessarily show an interest in sustainability prior to their stay (i.e. it is not meaningful to them) but

rather it is something that they learn about while staying at the lodge. Therefore, citizen science can help to achieve this goal. Tapia et al. (2013) suggest, that tourists can be involved well in *contributory* projects and collected data and/or samples. They call this the 'tourist track'.

There are various possibilities to involve the guests of the Living Lodge either actively or passively. Guests could, for example, walk around in the area surrounding the lodge and take photographs of certain plants and animals, or potentially they could volunteer to be tagged by GPS receivers to provide measurements without actively having to do something (Haklay, 2013). *Participatory sensing*, in which smart phones are used to sense the environment, for example sensing air quality through the location of the smart phone and readings from the microphone (Haklay, 2013), may be an efficient to use citizen science at the Living Lodge. However, as this is a very passive approach, this would diminish the learning effect and therefore would not exactly fulfil the aims of the Living Lodge project.

Potentially, the citizen science project at the Living Lodge could be a combination of Cluster A and Cluster B. Van Etten et al. (2016) argue, that small tasks can be divided among the many volunteers and the results can later be combined, which may be an interesting approach for the Living Lodge. The guests that are currently staying at the lodge could perform tasks such as taking photographs of animals and plants and other volunteers that want to participate in the project could participate online by classifying images or information.

Another approach could be to focus mainly on Cluster B and to set up camera traps and to design an online interface, so that people from all over the world can contribute to the project by performing image or information classification. In this case, the current guests and/or other staff, such as national park rangers, could check the equipment (e.g. the camera traps).

Nonetheless, citizen science projects usually engage a large number of volunteers over a long period of time, which at first does not seem applicable to the case of the Living Lodge, where tourists will stay only for a short period of time (e.g. one weekend). Nonetheless, while there will always be different people staying at the lodge, the lodge itself stays. This provides room for interesting future investigations into whether the continuous commitment from Nature Nomads rather than individual participants is sufficient to keep the citizen science project running in a sound and proper way, and whether this can generate robust data.

If citizen science is to be implemented at the Living Lodge, there are a number of points that need to be taken into account. Like any other scientific research project, citizen science projects need a robust scientific design (Domroese & Johnson, 2016). Also, a primary investigator or an organisation is required which invests money and time into the project. Staff, that runs the project, and tools and resources need to be provided (McKinley et al., 2016). This study shows that the

guests of the Living Lodge would want to be informed about the outcomes and results of the research. Consequently, it is essential for Nature Nomads and/or the organisers of the project to have a robust design and a continuous commitment to the study.

Luxury and recreation are a key part of the Living Lodge experience. Hence, citizen science must not limit these two aspects and, for apparent reasons, participation should always take place on a voluntary basis (Ruiz-Mallén et al., 2016). There should be no training required to participate in the project and the project should in no way interfere with the guests' sense of privacy and luxury. Also, as Raddick et al. (2013) argue, it is essential to understand citizen science from the perspective of the volunteers and to understand their motivation. Consequently, it is advisable for Nature Nomads to pay specific attention to the motivations of their (potential) guests, as they will be the main component for the citizen science project to keep running successfully. While this study provides a first insight into the motivations of the target group, a more detailed follow-up study could be of high value.

Nevertheless, resulting from the preceding findings and argumentation, it can be concluded, that citizen science can be an effective way for the Living Lodge project to reach its goals. What is more, the Living Lodge has the potential to be a leading example in holiday accommodation aimed at enhancing the awareness of the impacts of human activities on ecosystems, which, according to Bonney et al. (2014) and Conrad and Hilchey (2011) is one of the main drivers behind the recent growth of citizen science.

8.1. Limitations

Lack of time was a major limitation to the execution of this study. For instance, given the short amount of time, the interview was conducted almost simultaneously to the questionnaire design and before the desk research was completed. Preferably, the questionnaire would have been distributed after the first two data collection methods would have been finished, as the questionnaire was designed to include information found in both existing literature and the interview. Nonetheless, the questionnaire still covers the parts that were of most relevance for this study. Also, the time available for the response collection was very limited, with less than two weeks. The main drawback is the relatively small sample size, which is not representative of the whole Dutch and German market. More time for data collection would have resulted in a larger data set, which would have allowed for more robust and generalisable conclusions.

The questionnaire was translated from English to German and Dutch, which is why it is to be assumed that some things may have gotten lost in translation or simply were not translated in the

exact same meaning. However, to prevent this, the translated questionnaire was checked by both Dutch and German native speakers.

Some limitations arose during the response collection of the questionnaire. The sentence "Nature Nomads is considering using citizen science to improve the health of the ecosystem the lodge is located in" in the introductory part about citizen science might not have stressed enough, that the guests would consequently take part in citizen science activities during their stay at the lodge. Only few of the respondents that are not interested to participate in citizen science gave their reasons for this. However, the most-determining reason seemed to be a lack of time or that participation in citizen science does not fall under their idea of a holiday or a relaxing time. This raises doubt of whether the respective question was formulated clearly enough and, subsequently, whether these respondents were aware, that they could participate in citizen science during their stay at the lodge. This is because in most cases this would mean that they are on holiday and do not have any (work-related) appointments to follow.
Moreover, there is a considerable amount of missing values. This refers to the questions with text boxes, where respondents were asked to indicate the price they would be willing to pay for one night at the Living Lodge and their reasons why they are not interested in citizen science or staying at the lodge. Because no responses were forced in the questionnaire, respondents could skip these questions. The information about the price is not necessarily relevant for the study at hand, but the information about disinterest for participating certainly is. As mentioned before, this question was only added at a later point, which is why the data set is not complete regarding this variable nevertheless.

8.2. Suggestions for Future Research

This study provides insight into the feasibility of applying citizen science in a unique and specific case, namely the Living Lodge. Generally, as previous literature has argued as well, more studies on the implementation of citizen science in tourism are essential and can contribute greatly to the development of a future of sustainable tourism, and, as this study adds, to the development of more sustainable forms of tourist accommodation. In the following, some suggestions for future research resulting from this research are presented.
Because of the small sample size in this study, a follow-up study with a larger sample is suggested to be able to draw conclusions on the larger population. Having a larger sample size would also make a test of differences between age groups more feasible. It can be assumed, that some data collection methods are more appealing to children and parents than elderly people or couples looking for a romantic getaway. Moreover, the finding that most respondents would not prefer

using a smart phone or tablet is surprising given that nowadays most citizen science falls into the category of ‘citizen cyberscience’ (see Haklay, 2013). This could potentially be explained by the relatively high average age of the respondents in this sample. It can be expected, that if the target group was younger, using smart phones or tablets would be more popular.

Nonetheless, this study provides a good first insight into the motivations of potential guests of the Living Lodge, notably before the lodge has even been built. Integrating children and young families into the questionnaire would provide useful insight, as well.

The number of variables included in the questionnaire had to be very limited, as otherwise the questionnaire would have been too long, which quite likely would have decreased the willingness of respondents to take part in the study. In previous literature, however, many more (potential) motivators for participating in citizen science have been identified, which could be tested for in a future study.

Eventually, a follow up study after the (potential) citizen science plans of the Living Lodge project are concrete and the lodge will have been built, is suggested. Once citizen science will have been implemented, several factors could be tested for, such as the contribution of the project to the natural environment and the environmental awareness of participants pre- and post-participation.

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Appendices

Appendix A: Table Overview of Existing Citizen Science Projects

Project	The Snapshot Serengeti	Galaxy Zoo	Brooklyn Atlantis	Jungle Rhythms	STE: Scuba Tourism for the Environment	Mediterranean Hippocampus Mission	Divers for the Environment: Mediterranean Underwater Biodiversity Project	Evolution MegaLab	Cheetah Watch Campaign & Wild Dog Watch Campaign	The Lost Ladybug Project	Project Squirrel
Website/ Reference	www.snapshotserengeti.org	www.galaxyzoo.org	cb.engineering.nyu.edu/index	junglerhythms.org	www.steproject.org	Goffredo et al. (2004)	Goffredo et al. (2010)	www.evolutionmegalab.org	www.tanzaniacarnivores.org	www.lostladybug.org	www.projectsquirrel.org
Temporal scale	Long term	Long term	Ongoing	Short term	Medium term	Short term	Short term	Short term	Long term	Long term	Long term
Number of participants	>28,000	>150,000	–	≈2,900	>14,500	>2,500	>3,800	>6,400	–	>5,400	>5,700
Geographical scale data collection	Local	Space	Local	Local	Regional	Regional	Regional	Global	Local	Nation-wide	Nation-wide
Geographical scale data analysis	Global	Global	Global	Global	Local	Local	Local	Global	Local	Local	Local
Training	None	None	None	Moderate	Extensive	Extensive	Extensive	Moderate	None	None	Moderate
Tools/ Methods	Camera traps Web-based interface	Web-based interface	Robotic vehicle Web-based interface	Web-based interface	Questionnaire	Workshops Questionnaires	Questionnaire	Website Recording sheet	Cameras	Camera /smart phone Website with submission form	Submission form Smartphone application
Outcomes/ Goals/ Benefits	Monitoring of wildlife, conservation & management	Better understanding of how galaxies are formed	Environ-mental monitoring	Knowledge on how droughts affect the structure and function of African rainforests	Environmental management and conservation, environmental awareness and education Sustainable tourism development	Map distribution of seahorses in the Italian Mediterranean Sea	Information on quality of environment	Knowledge on evolution-nary changes, predator-prey relation-ships	Monitoring and conser-vation of carnivores	Detailed infor-mation on which ladybug species are still out there and how many individuals are around	Information on local ecology

Appendix B: Interview Schedule

1. What are the objectives of the Living Lodge?
2. What is your target group? (Probe: Do you also target families with children; Do you only target Dutch people?)
3. What kind of citizen science in mind? If any? (Probe: Watching birds, taking photos of plants, etc.; Only guests or also other people that would like to get involved (long-term)?)
4. What goal do you want to achieve with citizen science? (Probe: Scientific data or increased awareness?)
5. What kind of scientific projects? (Probe: Do you already have any specific ideas/things in mind; Which scientists involved; Who designs and manages the research; Who initiates the projects; Park ranger or someone else involved?)
6. Where exactly? (Probe: What is the geographical span?)
7. Do you specifically want to use citizen science as a selling point?
8. How long do you want the project to be running?
9. You already have cameras/camera traps set up at the future location of the Living Lodge. What for? (Probe: Could you imagine involving more people than only the guests staying at the lodge? E.g. by having camera traps and allowing people from all over the world to participate in classifications etc.)

Appendix C: Questionnaire

[Introduction to questionnaire and ethical statements]

The Living Lodge

The Living Lodge is a project that is currently being developed by the social enterprise Nature Nomads which aims to provide luxury accommodation in a natural environment. The first prototype of the Living Lodge will be located in the national park Biesbosch in the Netherlands. There will be only one lodge at this location meaning that guests get to spend an exclusive and private, relaxing and romantic holiday away from the masses. The lodge and its guests will help to recover the natural ecosystem. The project aims to connect humans with nature and provide tourists with profound nature experiences.

Citizen Science

Citizen science is the involvement of lay citizens in scientific projects. Citizen scientists usually participate in such projects on a voluntary basis, without financial compensation. Thanks to such projects, citizens get the opportunity to get insight into the practical world of science and scientists receive help in conducting their research.

For example, citizens can classify images on a website that have been taken by camera traps and identify different animals. In other projects, volunteers look for animals or plants and take photos of them, which they submit to the respective organisation or researchers. Nature Nomads is considering using citizen science to improve the health of the ecosystem the lodge is located in.

Nature Nomads is considering using citizen science to reach the goal of the lodge and its guests improving the health of the ecosystem the lodge is located in. However, for this they need to know whether their guests would be interested in participating in citizen science.

I would generally be interested to participate in citizen science.

- ❍ Agree
- ❍ Disagree

Display This Question:
If I would generally be interested to participate in citizen science. Disagree Is Selected

Why are you not interested to participate in citizen science? **text answer**

Condition: Why are you not interested ... Is Displayed. Skip To: End of Block

What kind of citizen science projects would you be interested in?

- ❑ Nature/environment related
- ❑ Plant related
- ❑ Animal related
- ❑ Community related
- ❑ Geography related
- ❑ I don't know
- ❑ None
- ❑ Other: _____

Which of the following steps of the scientific process would you be interested in? (Multiple answers possible)

- ❑ Formulating/proposing research questions
- ❑ Collecting data
- ❑ Doing experiments
- ❑ Analysing data
- ❑ Sharing results
- ❑ I don't know
- ❑ Other: _____

Please indicate the degree to which you agree with the following statements. I would like to participate in citizen science, because...

	Highly disagree	Disagree	Neutral	Agree	Highly agree
... I want to learn more about the environment.	❍	❍	❍	❍	❍
... I want to learn about wildlife and nature conservation.	❍	❍	❍	❍	❍
... I want to learn and acquire new skills – for example identifying plants and using GPS units.	❍	❍	❍	❍	❍
... I want to contribute to change.	❍	❍	❍	❍	❍
… I want to contribute to nature conservation.	❍	❍	❍	❍	❍
... I want to give something back to nature.	❍	❍	❍	❍	❍
... my friends and family would think positively about my participation in an environmentally concerned project.	❍	❍	❍	❍	❍
... it would give me a reason to spend more time outside.	❍	❍	❍	❍	❍
… it is important to me to socialise with other volunteers and with scientists.	❍	❍	❍	❍	❍
... I want to contribute to the collection of scientifically useful data.	❍	❍	❍	❍	❍
... I find science and research exciting.	❍	❍	❍	❍	❍

Please indicate how important the following statements are for you. I would be more interested to participate in citizen science, if...

	Not important at all	Not important	Neutral	Important	Highly important
... participation was easy and fun.	❍	❍	❍	❍	❍
... participation only cost very limited time.	❍	❍	❍	❍	❍
... the project required me to use a/my smartphone or tablet.	❍	❍	❍	❍	❍
... the results of the project/research were shared with me.	❍	❍	❍	❍	❍
... I would be able to exchange ideas about the project with the scientists or organisers of the projects.	❍	❍	❍	❍	❍
... the project took place globally (e.g. local projects combined in one research project on a website).	❍	❍	❍	❍	❍
... I could submit my data online instead of by mail.	❍	❍	❍	❍	❍
... I could continue my participation in the project, even after my stay at the Living Lodge.	❍	❍	❍	❍	❍

Regardless of location and price, would you generally be interested in staying at the Living Lodge?

❍ Yes

❍ No

Condition: Yes Is Selected. Skip To: The Living Lodge will have space for ....

Why are you not interested in staying at the Living Lodge? **text answer**

Display This Question:
If Regardless of location and price, would you generally be interested in staying at the Living Lodge? Yes Is Selected

The Living Lodge will have space for up to 6 people (4 adults and 2 children). The price doesn't depend on the number of people staying there. How much would you be willing to pay for one night at the Living Lodge? (Please indicate in Euro, without the €-sign)

Display This Question:
If Regardless of location and price, would you generally be interested in staying at the Living Lodge? Yes Is Selected

Would you be willing to pay 150€ or more?

❍ Yes

❍ Maybe

❍ No

Socio-demographic information

What is your gender?
- ❍ Male
- ❍ Female
- ❍ Gender neutral

How old are you?
- ❍ 17 years or younger
- ❍ 18-24 years
- ❍ 25-34 years
- ❍ 35-44 years
- ❍ 45-54 years
- ❍ 55-64 years
- ❍ 65 years or older

What is your nationality?
- ❍ Dutch
- ❍ German
- ❍ Other: _____

In which country is your permanent residence?
- ❍ The Netherlands
- ❍ Germany
- ❍ Other: _____

[Thank you and invitation to snowball sampling]