

Promoting Sustainability through the Integration of Citizen Science and Ecotourism

Sarah Lamb

Jennifer Martel

Jos Sienknecht

Daniel Villafranca



Blekinge Institute of Technology
Karlskrona, Sweden
2018

Examiner: Henrik Ny Ph.D.
Supervisor: Professor Karl-Henrik Robèrt
Primary advisor: César Levy França
Secondary advisor: James Ayers

Promoting Sustainability through the Integration of Citizen Science and Ecotourism

Sarah Lamb, Jennifer Martel, Jos Sienknecht,
Daniel Villafranca

Blekinge Institute of Technology
Karlskrona, Sweden
2018

Thesis submitted for completion of Master of Strategic Leadership towards Sustainability,
Blekinge Institute of Technology, Karlskrona, Sweden.

Abstract:

This study aims to draw attention to a new concept within the tourism industry that integrates citizen science into an ecotourism product. The merge of citizen science and ecotourism shows potential to play a role in strategic sustainable development and to give ecotourism providers a competitive advantage in the market. However, the environmental and social benefits of this concept can only be realized if it is applied correctly. The framework for strategic for strategic sustainable development (FSSD) was used to address the complexity surrounding ecotourism and the use of citizen science. The study used a mixed method research design by conducting exploratory interviews, and then distributing a questionnaire to validate the qualitative findings. Results demonstrate that the merge of citizen science and ecotourism could contribute to sustainability through education, conservation, local community engagement, and the increased environmental awareness of the travellers. Additionally, it demonstrates that the integration of citizen science in an ecotourism product might create business benefits for the ecotourism providers in conjunction with a dynamic learning experience for the consumer. This study makes adaptations to a widely used citizen science toolkit and recommends appropriate changes to the process in order to ensure that it is effective for ecotourism providers while incorporating sustainability throughout the product design phase.

Keywords: Ecotourism, Citizen Science, Sustainability, Strategic Sustainable Development, Toolkit, Guidelines

Statement of Contribution

This thesis has been written in a group consisting of 4 members coming from different cultures and with a different set of values. The team was committed to creating a final product that provides value to the reader and can be used to inform the tourism industry about the sustainable potential of the topic. This thesis represents a group effort. Although individual work was sometimes needed to accomplish the goal, each level during the process involved the contribution of the four of us. When individual work was performed, we aligned on the process before each of us worked on their individual parts.

We have been open and attentive to our group dynamics and especially our ways of communication. As we went through the process, we discovered differences in the way each of us likes to communicate and to work. In order to enhance the understanding for each other and set the base for a good process, we scheduled regular feedback sessions, which was the base for common trust and a good working atmosphere.

Individually, in terms of contribution, Daniel's passion for sustainable tourism and his experience in the field was invaluable. Daniel's most essential contributions to the team were his positive attitude, supportive behaviour, and communication skills. His passion and energy are contagious and make him irreplaceable. Jen's analytical skills as well as her desire for a clear end-result contributed to the success of this project. She helped the group overcome strategic challenges with novel and practical solutions that gave direction and clarity to the overall process. Both Jen and Daniel were also a great asset in acquiring interview partners around the globe making this project such a diverse one. Sarah's ability to mitigate different interests in the group, her critical eye, capacity to edit text, as well as her practical mindset were crucial for the group's performance. Her unwavering patience with the other team members was invaluable. Jos's strategic mindset and overall vision of the process was the lighthouse that guided the research, not to mention he is the formatting *guru*. His leadership capacity and proactive work attitude were vital strengths to overcoming the challenges presented in this investigation.



Sarah Lamb



Jennifer Martel



Jos Sienknecht



Daniel Villafranca

Acknowledgements

The team formed over a common goal of creating something useful and practical, a tangible tool for ecotourism providers, that creates a positive future for the tourism sector which its future cannot be neglected by society at large. Without the vision, knowledge, and understanding of substantial persons and organizations this would not have been possible. We would like to thank the following individuals for the time invested and the shared knowledge. We deeply appreciated the effort and time, the hearts and minds, that have supported us during this learning experience.

To our advisors, Cesar and James. Thank you for your guidance, your direction and patience. Your openness, experience, and support were vital in this process. We want to thank you, not only for your time, energy, and understanding, but also for the approach you used in this journey. Your patience and support are greatly appreciated.

We are deeply grateful to the time and knowledge shared by the representatives of the interviewed organisations: Sierra Gadaire, Bob Janes, Renee McKeon, Morgan Luker, Daniel Couceiro, Susan Adie, Allison Lee, Lauren Farmer, and Suzie Teerlink. Thanks to your collaboration, this investigation will be a stepping stone to strengthen the combination of citizen science into ecotourism products to contribute to strategic sustainable development. This thesis would not have been possible without your contributions.

To Hans Pfister, Brooke Mitchell, Juan José Jimenez, and Carter Hunt. Our warmest thanks for giving us the space to asses our initial ideas and proposal. Your interviews were crucial in determining the base and foundations of our research. At times of low clarity, your point of view gave us great insights to converge in concepts and determinate our research's direction.

A special thanks to Travis Bays. We have immense gratitude for your inspiration and selfless heart. We want to thank you for the numerous calls, interviews, and feedback given in our learning journey.

To Johana Arguello and the board of directors of the Costa Rican National Chamber of Ecotourism. We are deeply thankful for your assistance and support, it was crucial for the results of this investigation.

The knowledge, feedback, and experience from Rachel Gould, Edith Callaghan, Pierre Johnson, Elaine Daley, Yannick Wassmer, and Jessica Conrad are greatly appreciated. Thanks to them, the group was able to enhance its investigation abilities.

To our fellow MSLS colleagues and specially to our cluster groups. Your feedback and advices were highly relevant to improve our investigation. The support of Iris Nekeman was key to developing our group dynamic that allowed us to achieve our full potential. Your assistance at the beginning of our process was highly relevant to understanding our personality types and choosing our most effective ways of communicating between each other.

Executive Summary

Introduction

The tourism industry is infamous for its contribution to environmental and social unsustainability. However, it continues to be one of the strongest global economic growth drivers. With the number of annual international tourists expected to grow to 1.8 billion by 2030, the tourism industry is in a unique position to either positively influence sustainability issues faced in society or risk aggravating the situation. The impacts of tourism can be felt in the environmental, social, and economic systems; therefore, a systematic approach is necessary for the tourism industry to become a key change agent towards a sustainable future.

While the tourism industry can have significant impacts on the systems in which it's embedded, it is also dependent on the sustainability of these systems. Firstly, the tourism industry depends on the support of the local communities; therefore, eliminating negative impacts on the social system is essential to its continued operations in those areas. Secondly, the tourism sector is reliant on the natural environment and it is particularly susceptible to the negative impacts of unsustainability, especially climate change. The effects of climate change have been shown to have negative impacts on tourism markets that rely on a healthy environment in all different climates globally. The tourism industry's vulnerability to the impacts of climate change as well as its dependence on a thriving social system clearly demonstrates the importance for the industry to take actions towards a more sustainable society.

One of the fastest growing segments within the tourism industry is nature-based tourism with an expected representation of 25% of the global tourism industry by 2020. Within nature-based tourism exists a well-known sub-type called ecotourism. Ecotourism has three general criteria: it is nature-based, it is environmentally and socially educational, and it is sustainably managed. These criteria along with its market share make ecotourism an ideal avenue for driving sustainability initiatives in the tourism industry.

After examining the stakeholders within ecotourism, the ecotourism providers were established as a crucial leverage point for strategic sustainable development in the tourism sector; this was due in part to the fact that the ecotourism providers are responsible for designing their products, and they have the potential to greatly influence the tourists as they have strong interactions with the customers. Furthermore, in tourism there has been an increased demand by consumers for more sustainable options. Ecotourism providers must incorporate these changes in order to stay relevant in the market. To gain a competitive advantage, providers must go one-step further and include sustainable innovations in their product portfolio. This is another leverage point for strategic sustainable development, because innovations might have the potential to reach a critical mass in the tourism market.

One possible option that has the potential to address both the need of ecotourism providers to innovate and the need to address sustainability is products that incorporate citizen science. While several definitions of citizen science exist, the Oxford Dictionary released the following definition in 2014: "scientific work undertaken by members of the general public, often in collaboration with or under the direction of professional scientists and scientific institutions." There has often been trepidation around utilizing data collected through citizen science; however, the validity and reliability of the data has been increasingly accepted after extensive

research on the issue confirmed that the quality of the data can be comparable to that collected by professional researchers.

Citizen science has proven extremely beneficial to scientific research with large spatial or temporal scales as it can accelerate the data collection process and generate far larger volumes of data than traditional methods. In regards to sustainability, citizen science projects have also demonstrated the ability to address both social and environmental issues. Social contributions range from increasing scientific literacy to democratizing the scientific process and removing barriers of influence for citizens. These projects have also influenced the pro-environmental attitudes and behaviours of the participants, and some have played important roles in conservation, legal, and policy initiatives that impact the ecosystems they examined. Research involving citizen scientists has helped in species protection, habitat restoration, infectious disease monitoring, and many other initiatives aimed at preventing the degradation of the environment.

Recognizing the potential of citizen science, some ecotourism providers have recently taken the initiative to incorporate citizen science into their products. However, since this is on the cutting edge of product innovation, there is a significant gap in the literature. Since ecotourism and citizen science each individually have the potential to contribute to sustainability initiatives, the combination of these concepts could further benefit the sustainability movement. Several guidelines and frameworks for implementing citizen science projects exist already in the literature; however, there is a lack of literature on how citizen science projects can be integrated into ecotourism. Understanding the possible contributions to sustainability, the potential added value of these products to ecotourism providers, and the process for designing and implementing are key areas that must be examined in order to further promote and develop these sorts of products within the ecotourism industry.

Ecotourism and citizen science are both complex concepts with multiple elements interacting within and between them in a chaotic way, which makes it impossible to predict their behaviour. Many efforts of analyzing complex systems and its interconnections using linear thinking result in errors or short-term solutions that often create long-term problems. Consequently, there is a need for structure and a strategic approach. A framework, which fulfill this need is the Framework for Strategic Sustainable Development (FSSD). The framework was developed as a strategic planning methodology designed to study and plan complex issues with a systematic and coordinated approach using a principled definition of sustainability.

Research Question

The purpose of our research is to demonstrate how the merge of citizen science and ecotourism might contribute to strategic sustainable development. Furthermore, this study aims to provide insights about how the incorporation of citizen science might create a competitive advantage for the ecotourism providers within the tourism market. Finally, a description of how the ecotourism providers can effectively integrate citizen science into their ecotourism products and what the components are of these products.

The overall research question is therefore:

“How might ecotourism providers integrate citizen science into their products, and what might be the benefits of these products for the business and for strategic sustainable development?”

Methods

The research involved an exploratory approach to the research providing the flexibility needed to approach this relatively new field within the tourism market. A sequential exploratory research design is a mixed method, which creates a qualitative strand followed by a quantitative strand. The FSSD as a framework for strategic sustainable development incorporates a 5 level framework (5LF), which helped to create interview question according to the level of the framework: System, Success, Strategic guidelines, Actions, and Tools. The FSSD and its principled definition of sustainability also helped to assess the potential contribution of ecotourism and citizen science for strategic sustainable development. The research design involved four steps. Step 1 of the chosen exploratory sequential design approach consisted of the preparation of research, literature review and expert interviews, semi-structured exploratory interviews, and finally the analysis and synthesis of the qualitative data. In total, nine semi-structured interviews were conducted with ecotourism providers, scientists and non-profit organisations from around the globe. Step 2 incorporated the planning for the survey in order to verify the hypothesis, which derived from the findings during the qualitative research. Step 3 included the actual design of the questionnaire. In step 4 we connected both qualitative and quantitative findings, concluded and interpreted our results. Primary data collection was represented in the study by conducting exploratory interviews and surveys. Secondary data collection occurred in the literature review.

Results and Discussion

This study explored how citizen science might be integrated into ecotourism products and what might be the benefits of these products for the business and strategic sustainable development. We addressed three research aims related to our primary research question.

Research Aim 1: How might the incorporation of citizen science into ecotourism products contribute to strategic sustainable development?

We examined the literature related to citizen science and ecotourism through the lens of the FSSD, specifically using the principled definition of sustainability within the framework to understand how each concept might play a role in the transition to an environmentally and socially sustainable future. Our research indicated that citizen science and ecotourism applied separately had potential to positively impact the transition towards a sustainable society; however, there was a gap in the literature about how the combination of these concepts could enhance one another and their contributions to sustainability. Based on the literature, we predicted that the merge of citizen science and ecotourism could play a role in strategic sustainable development because the activities of citizen science do not conflict with or negate the contributions of ecotourism.

During the semi-structured interviews, we examined whether the current projects were making any of the predicted contributions. While many of the projects had conservation goals in mind, very few took social sustainability contributions into account in their design. Overall, there seemed to be a lack of systems thinking in the design and implementation of the projects. While not every project has the potential to address the negative impacts of tourism, each project should have a vision of their product that incorporates sustainability. A more holistic approach is needed in the design and implementation phases of to ensure that sustainability is incorporated into the overall aim and outcomes of the projects rather than being an afterthought. Despite this, our findings indicate that these projects are supporting the transition towards a

sustainable society through environmental awareness, education, local community engagement, increase acceptance of citizen science, policy development and conservation.

Research Aim 2: How the incorporation of citizen science might provide a competitive advantage for the ecotourism providers in the tourism market?

The ability of ecotourism providers to remain competitive in this growing market depends on their ability to innovate and adapt to changing trends. There is an increasing demand from consumers for more sustainable options and for novel experiences. In the questionnaire that we conducted with tourism experts in Costa Rica, nearly 97% of respondents agreed or strongly agreed that there was a need for innovation in ecotourism products. Incorporating citizen science into ecotourism products could help fulfill that need and assist ecotourism providers in deliver a unique experience. Evidence from the literature as well as the interviews we conducted reported that there was an increasing number of travellers looking for ways to give back to the areas they were travelling to. Ecotourism products incorporating citizen science could be a leverage point for attracting these consumers and provide a competitive advantage over other tourism providers. Interviewees and questionnaire respondents also expressed that these products offer an added-value experience that entices consumers. Results from our interviews reported benefits of image enhancement as well as reputation. Offering sustainability-driven products also has the potential to attract a more talented hiring base. Sustainably-minded businesses have a higher retention rate and less turnover which has been shown to decrease operational costs in both the literature and from the providers we interviewed.

Research Aim 3: How might ecotourism providers incorporate citizen science into their products?

The concept of integrating citizen science into ecotourism products is a relatively new concept with very little literature available on these projects or their potential impacts. In fact, in the questionnaire that we conducted, "lack of information and knowledge on how to structure these activities effectively" was listed as the most significant challenge affecting the potential implementation of these products. In order to answer our first research aim, based on our literature review we chose to work with the CLO Citizen Science Toolkit because it provided the most exhaustive and well-researched framework for the implementation of citizen science projects. To our knowledge, there are no open source guidelines for how to integrate citizen science into an ecotourism product. Therefore, we conducted semi-structured interviews with ecotourism providers and scientists involved with citizen science projects that are incorporated into ecotourism products as well as non-profit organizations who had experience developing similar projects. Through these interviews, we were able to gain insights into the process that was used to design and implement these projects. By comparing the interview responses to the existing CLO Citizen Science Toolkit and by integrating some aspects of the FSSD, we were able to provide recommendations for adaptations to some of the steps and considerations of the model to make it more relevant and effective for ecotourism providers. Some of the recommendations and highlighted considerations were also provided to increase the likelihood that these projects could contribute more directly to sustainability efforts. An overview of the adaptations and highlighted considerations is described in the following table:

Conclusion

The integration of citizen science within ecotourism presents an innovative opportunity to transform the ecotourism industry towards a more transparent, authentic and sustainable

industry. We created a series of recommendations for ecotourism companies to apply in order to support this transition. Effective conservation policies can reduce major environmental negative impacts caused by society and the integration of citizen science into ecotourism has proven to facilitate and multiply data collection. This is crucial for creating more environmental policies and to increase their level of efficiency and accuracy. The integration has also proven to support an increase of environmental awareness of travellers. However, further research needs to be done in order to verify if and how behavior change is created and if this is sustained through time. Although the transition towards sustainability is the focus of this research, we have also found that the integration citizen science has an additional value for the success of ecotourism providers. The integrations of ecotourism and citizen science can deliver a more profound and unique experience for travellers and vast possibilities for the differentiation of the organizations in highly competitive market while contributing to strategic sustainable development.

Summary of the Recommended Adaptations to the CLO Toolkit:

CLO Steps	Recommended Adaptations and Highlights
Choosing a Question	<ul style="list-style-type: none"> • Incorporate a principled strategic sustainable development lens into the objectives/product vision • Engage with local community to determine what is needed in the system
Forming a Team	<ul style="list-style-type: none"> • Bring in partners early on, particularly scientific partners • Engage, get input, and build relationships with other stakeholders
Refining Protocols	<ul style="list-style-type: none"> • Emphasis on incorporating hands-on activities; best done by using citizen science for the data collection phase of a project • Simplify methods and equipment used • Include an educational component that uses a systems approach • Analysis of needs and desires of the consumer; communication strategy
Recruiting Participants	<ul style="list-style-type: none"> • Leverage on the opportunity to give back to the area • Adapt lingo regarding citizen science
Training Participants	<ul style="list-style-type: none"> • Focus primarily on training ecotourism staff • Design projects that require minimal training of participants • Take advantage of transport time to provide instruction
Accepting Data	<ul style="list-style-type: none"> • Utilize the trained staff to oversee and be responsible for the data • Have backup methods for collected data
Analyzing Data	<ul style="list-style-type: none"> • Ecotourism providers should have a good understanding of what happens at this step even if they don't directly partake
Disseminating Results and Measuring Effects	<ul style="list-style-type: none"> • Incorporate both aspects into the project design • Make use of tools such as post-trip surveys, websites, email blasts, digital applications, and data catalogue and posters.

Glossary

Added Value: an element added to a product that makes it more attractive to consumers.

Below-the-line Advertising: denoting expenditure on advertising by other means than the traditional media, such as the provision of free gifts, special displays, direct mailshots.

Built Capital: physical infrastructure, access to resources, and security.

Citizen Science: the collection and analysis of data relating to the natural world by members of the general public, typically as part of a collaborative project with professional scientists.

Capital: a resource capable of producing additional resources

Complex Systems: consisting of many diverse and autonomous but interrelated and interdependent components or parts linked through many (dense) interconnections. Complex systems cannot be described by a single rule and their characteristics are not reducible to one level of description. They exhibit properties that emerge from the interaction of their parts and which cannot be predicted from the properties of the parts.

Cultural Capital: the customs, heritage, stories, identity, values, history and attachment to local place.

Data Collection: systematic process of gathering data for official statistics.

Ecotourism: responsible travel to natural areas that conserves the environment, sustains the well-being of the local people, and involves interpretation and education.

Ecotourism Product: well planned and interactive learning experiences, that introduce small quantities of travellers to new environments and cultures, while minimizing negative environmental impacts and supporting conservation efforts.

Ecotourism Provider: owner/operator of a company that offers ecotourism products.

Engagement: participation, involvement and interaction of individuals in decision-making, activities and leadership.

Environmental Conservation: efforts and activities to maintain and sustain those attributes in natural environments which are essential both to human physical and mental health and to enjoyment of life. Includes topics such as conservation of biodiversity, species, landscape, natural resources, wildlife, water, soil, and forest.

Financial Capital: strength of local economy, access to funding, personal and organisational wealth.

Framework for Strategic Sustainable Development (FSSD): a 5-level conceptual framework used in planning and analysing in complex systems with sustainability as the desired outcome.

Human Capital: skills, abilities and knowledge of individuals. Also, personal and community well-being and health.

Innovation in Tourism: the introduction of a new or improved component which intends to bring tangible and intangible benefits to tourism stakeholders and the local community, improve the value of the tourism experience and the core competencies of the tourism sector and hence enhance tourism competitiveness and /or sustainability. Innovation in tourism may cover potential areas, such as tourism destinations, tourism products, technology, processes, organizations and business models, skills, architecture, services, tools and/or practices for management, marketing, communication, operation, quality assurance and pricing.

Local Community: the collective of community members in the geographic location and surrounding area where the relevant project is located.

Likert Scale: a method of ascribing quantitative value to qualitative data, to make it amenable to statistical analysis. A numerical value is assigned to each potential choice and a mean figure for all the responses is computed at the end of the evaluation or survey.

Natural Capital: ecological stocks and flows; natural beauty; access to natural resources; and reduced waste.

Participatory Approach: process in which methods allow people to share their perspective and result in a greater sense of ownership in process outcomes.

Political Capital: ability to influence and participate in decision making.

Researcher: someone whose job is to study a subject carefully, especially in order to discover new information or understand the subject better.

Scientist: a person who studies or practises any of the sciences or who uses scientific methods.

Social Capital: relationships, trust, networks, and a sense of belonging to a community.

Socio-ecological system: the combined system that is made up of the biosphere, human society, and their complex interactions.

Stakeholders: individuals or organisations who can affect and are affected by an organisation's activities.

Strategic Guidelines: guidelines used in decision making as part of a strategy to achieve desired goals.

Strategic Sustainable Development: approach for conceptualizing and planning for sustainability that is designed to deal with the complexity of the global system. Comprised of the funnel metaphor, systems thinking, a definition of sustainability based on eight Sustainability Principles (SPs), backcasting, and a five-level planning framework for sustainability called the Framework for Strategic Sustainable Development (FSSD).

Systems Tools: take direct measurements in the system to monitor damage or improvement resulting from societal actions.

Systems Thinking: practice of thinking that takes a holistic view of complex events or phenomenon and on how they influence one another within a complex entity or larger system. The study of systems and their behaviours and feedbacks.

Tourism Destination: physical space with or without administrative and/or analytical boundaries in which a visitor can spend an overnight. It is the cluster (co-location) of products and services, and of activities and experiences along the tourism value chain and a basic unit of analysis of tourism. A destination incorporates various stakeholders and can network to form larger destinations. It is also intangible with its image and identity which may influence its market competitiveness.

Tourism Industries: comprise all establishments for which the principal activity is a tourism characteristic activity. Tourism industries (also referred to as tourism activities) are the activities that typically produce tourism characteristic products.

Tourism Product: combination of tangible and intangible elements, such as natural, cultural and man-made resources, attractions, facilities, services and activities around a specific center of interest which represents the core of the destination marketing mix and creates an overall visitor experience including emotional aspects for the potential consumers. A tourism product is priced and sold through distribution channels and it has a life-cycle.

Tourism Provider: organization or individual providing direct services to the traveller.

Tourism Value Chain: sequence of primary and support activities which are strategically fundamental for the performance of the tourism sector. Linked processes such as policy making and integrated planning, product development and packaging, promotion and marketing, distribution and sales and destination operations and services are the key primary activities of the tourism value chain. Support activities involve transport and infrastructure, human resource development, technology and systems development and other complementary goods and services which may not be related to core tourism businesses but have a high impact on the value of tourism.

Tour Operator: intermediary between consumer, tourism provider and travel agency. They are in charge of arranging and assembling tours that are sold through travel agencies or directly by tour operators.

Traveller: someone who moves between different geographic locations for any purpose and any duration.

Travel Agency: stakeholder in the tourism value chain whose activities primarily are engaged in selling travel, tour, transportation and accommodation services to the general public and commercial clients.

Acronyms

CS: Citizen science

CLO: Cornell Laboratory for Ornithology

CRM: Customer Relationship Management

IAATO: International Association of Antarctica Tour Operators

NBT: Nature-Based Tourism

TIES: The International Ecotourism Society

UNTWO: United Nations World Tourism Organization

Table of Contents

Statement of Contribution	ii
Acknowledgements	iii
Executive Summary	iv
Glossary	ix
Acronyms	xii
List of Figures and Tables	xvi
1 Introduction	1
1.1 The Impacts of Tourism	1
1.1.1 Environmental Impacts.....	1
1.1.2 Socio-cultural Impacts.....	2
1.1.3 Economic impacts	2
1.2 Climate Change Impacts on Tourism.....	3
1.3 Ecotourism	3
1.4 Ecotourism as a Tool for Sustainability	4
1.5 The Role of Tourism Products and Tourism Providers in Supporting Sustainable Development	5
1.6 The Role of Citizen Science	7
1.6.1 Citizen Science as a Tool for Sustainability	8
1.6.2 Design of Citizen Science Projects.....	10
1.7 Combining Ecotourism and Citizen Science as a Response.....	11
1.8 Strategic Sustainable Development.....	12
1.9 Research Aim & Scope.....	14
1.9.1 Research Aim.....	14
1.9.2 Exploratory Research.....	14
1.9.3 Scope.....	14
1.9.4 Research Question	15
2 Research Methods	16
2.1 Mixed Method Research.....	16
2.2 Using the FSSD.....	17
2.3 Step 1: Design and Implement the Qualitative Strand	18
2.3.1 Preparation of the Research	18
2.3.2 Literature Review and Expert interviews	19
2.3.3 Exploratory Interviews	19

2.3.4	Data Analysis	20
2.4	Step 2 –Building on the Qualitative Results	21
2.5	Step 3 – Design of the Questionnaire.....	21
2.6	Step 4 – Analyse the Connected Results	22
3	Results	23
3.1	Understanding of Sustainability.....	23
3.2	Perceived Competitive Advantage	24
3.3	Product and Process Design of Citizen Science Products	25
3.3.1	Initiation Phase – Identifying Research Topic or Business Opportunity	26
3.3.2	Initiation Phase – Initiating Contact.....	27
3.3.3	Initiation Phase - Identifying Internal and External Stakeholders	27
3.3.4	Planning Phase	28
3.3.5	Planning Phase - Creating a Vision.....	28
3.3.6	Planning Phase - Creating Strategic Guidelines.....	29
3.3.7	Planning Phase - Product Design	30
3.3.8	Implementation Phase.....	33
3.4	Quantitative Results	34
4	Discussion	35
4.1	Recommendations on how to incorporate citizen science effectively into ecotourism products.....	35
4.1.1	Choosing a Question.....	35
4.1.2	Forming a Team	36
4.1.3	Refining protocols	37
4.1.4	Recruiting Participants.....	38
4.1.5	Training Participants.....	39
4.1.6	Accepting Data.....	40
4.1.7	Analyzing Data.....	40
4.1.8	Disseminating Results and Measuring Effects.....	40
4.2	Key Findings for Creating Competitive Advantage.....	42
4.3	Possible implications for Strategic Sustainable Development.....	44
4.4	Validity and Limitations of the Research	47
4.5	Future research.....	48
5	Conclusion.....	50
	References.....	52
	Appendix A.....	59

Appendix B.....60
Appendix C.....61
Appendix D.....62
Appendix E.....63
Appendix F.....65
Appendix G.....69
Appendix H.....74

List of Figures and Tables

List of Figures

Figure 1.1. The Complex Tourism system (Jere Jakulin 2017).....6
Figure 1.2. Nested Product-Provider System..... 13
Figure 3.1. Stakeholder Map from the Perspective of Ecotourism Provider.....27

List of Tables

Table 1.1. Description of the Steps within the CLO Citizen Science Toolkit..... 11
Table 2.1. The Five Level Model of the FSSD adapted from Broman and Robèrt (2017)..... 18
Table 3.1. Steps Used to integrate Citizen Science and Ecotourism Products26
Table 4.1. Summary of the Recommended Adaptations to the CLO Toolkit41

Introduction

The goal of this research is to understand how the use of citizen science in ecotourism products can support the global transition towards sustainability. In order to accomplish this, this study explores 1) the design and implementation of current ecotourism products that give travellers the opportunity to participate in scientific research 2) the sustainability advantages of doing so and 3) the resulting competitive advantage for the ecotourism business.

The Impacts of Tourism

The tourism industry is one of the largest contributors to global GDP, it creates jobs in destination communities and is often responsible for a large portion of global exports (World Economic Forum 2017a). As wealth increases and the middle class grows and increasing number of individuals are able to spend a portion of their income on non-essential activities such as travel (Gössling 2002). For this reason, the number of international tourists is expected to grow to 1.8 billion in 2030 (World Economic Forum 2017a). Due to the size and influence of the tourism industry, the direction it takes provides a unique opportunity to influence the path towards sustainability for a large number of businesses, travellers and the communities that they visit (Buckley 2012). However, because of the natural resource consumption required to accommodate this growing industry, the tourism sector is notorious for being environmentally unsustainable (Stronza and Gordillo 2008).

The environmental, socio-cultural, and economic impacts of tourism overlap in many ways and vary depending on the perspective through which the industry is viewed (Mason 2008). For example, tourism activities often create trade-offs where the execution of an action might benefit one stakeholder in the short-term but negatively impact another in the long-term (Mason 2008). Tourism operates in a realm of trade-offs, where social benefits from increased tourism and economic activity may occur at the detriment of the natural environment, traditional culture and other long-term outcomes. Nevertheless, the tourism industry does have the potential to have a positive impact on travellers and the communities that they visit. The following sections discuss the impacts of the tourism industry.

Environmental Impacts

The global environmental impacts of tourism can be separated into five categories, 1) change in land cover and land use 2) biotic exchange and the extinction of wild species 3) green house gas emissions 4) the dispersion of disease and 5) change in perception and understanding of the environment (Gössling 2002). These categories are mentioned here because they have been used by many authors to explore the environmental impacts of tourism in different contexts (Kariminia et al. 2013, Juvan and Dolnicar 2017).

Land alteration is seen as the single most important component of global environmental change affecting ecological systems (Vitousek 1994, Vitousek et al. 1997). Changes in land cover are necessary for the tourism industry to build infrastructure such as new facilities, amenities and accommodations. This also includes airports, marinas, areas for food production, and other infrastructure necessary to create a pleasant experience for travellers. These changes in land cover also result in habitat fragmentation which can aggravate the situation for endangered species. In addition, the interaction between travellers and wildlife is a source of environmental impacts since human beings may alter animal's natural patterns and behaviours by trying to

feed them, photograph them, or interact with wild fauna in other ways. Due to the increase of international travellers worldwide, the green house gas emissions from transportation are also of concern for the health of the biosphere (Gössling 2002). Gössling (2002) found that transportation was responsible for 94% of the total contribution of the tourism industry to climate warming. There are currently no alternative fuel sources for air travel and current practices are deeply embedded and unlikely to change (Higham, Cohen and Cavaliere 2013). This ability to move from one region of the world to another also results in the spread of disease and the transfer of exotic species from one region to another which often has negative consequences for the effected ecosystem (Anderson et la. 2015). Lastly, tourism often leads to changes in environmental consciousness (Mitchel 2017) which also has implications for the socio-cultural changes in a region.

Socio-cultural Impacts

The tourism industry relies on the support of the local communities in order to be able to operate and ensure its long-term success. Therefore, understanding, monitoring, and managing the impacts that the tourists have on the local community is crucial to earning their ongoing consent. High peaks in visitation often have negative effects on local communities. As Choi and Sirakaya (2005) discuss, the number of people in shops, businesses, and other establishments may add vibrancy to the community but cause frustration and withdrawal of local residents. Overall crime rates are also often perceived to increase due to tourists in the region (Andereck 2005, Park and Sotokowski 2009).

Additional social-cultural impacts are related to the difference in values, religions, and spiritual preferences between tourists and local communities. The social and moral value systems of tourists may differ quite substantially from local residents which can then cause change or conflict in the local region. (Choi and Murray 2010) also highlight that because different individuals living in a community can have different engagement with, and attitudes towards tourists, there can be frictions between local community members. Further social impacts are related to the culture and heritage of a destination. As Ryan and Gu (2010) state, tourism facilities that are developed within a region may not be active in incorporating the current trends and cultural heritage of an area. Tourists often wish to engage with local residents as part of the tourist experience and if the tourists come from different cultures, this will promote intercultural interaction (Andereck 2005), which can evolve into changes in cultural identities and values.

The success of tourism in many regions is dependent upon the support of the local community. It is therefore essential that tourism's impact on the host community is understood, monitored and managed. Greater understanding of how certain behaviours and outcomes of tourism impact members of the local community is needed so that appropriate management strategies can be put in place (Deery, Jago and, Fredline 2012).

Economic impacts

As Socci et al. (2017) explain, it is challenging to measure the economic impact of the tourism industry because it represents a cluster of other industries. This normally includes accommodation, food and transportation but often impacts additional goods and services such as the medical system. Due the economic benefits, most countries are supportive of tourism development and many developing countries have selected it as part of their approach to sustainable development (Mason 2008). The tourism industry is generally considered to enhance the economic strength of the region by stimulating the local economy and creating

employment opportunities for locals (Choi and Sirakaya 2005, Haley, Snaith and Miller 2005). Tourism also generates increased revenue that local governments can later reinvest in the region. The presence of tourists can lead to an increase in the number of public service providers, but can also result in longer queues, waiting times and extended procedures (Andereck et al. 2005). In regions where there are many tourists, there is often strong demand for real estate to service the tourism industry and house seasonal workers. This can lead to increased property prices, which is good for property owners but problematic for locals seeking to purchase or rent affordable property (Frauman and Banks 2011). Despite the negative impacts of tourism, it is very common that the development of a tourism project in a remote region brings wealth and prosperity to that region.

Climate Change Impacts on Tourism

While the tourism industry has significant impacts on the social and environmental systems, it is also completely dependent on the health of these systems. Particularly for tourism sectors whose success relies on the natural environment, the negative impacts of an unsustainable society could be detrimental to their business and ways of life. Specifically, the effects of climate change as a result of unsustainable human activities pose a major risk to the tourism industry worldwide. As Gössling (2012, 59) explains “climate variability has been found to influence travel patterns (proportion of domestic and international holidays), activities and tourism expenditures.” There are a range examples of climate change impacts affecting tourism from various climates: warmer temperatures causing altered seasonality and wildlife damage, increased storm frequency and intensity, rising sea temperature causing coral bleaching and other marine life degradation, more frequent and larger forest fires, etc. (UNEP & UNWTO 2008). Appendix A provides a table summarizing the implications of the major climate change impacts on tourism. This list is not exhaustive, but it demonstrates how tourism in different climates can be affected by climate change.

The tourism industry’s vulnerability to the impacts of climate change clearly demonstrates the importance for the industry to take actions towards a more sustainable society. Although the negative impacts of the tourism industry are numerous, it is important to encourage responsible tourism in order to limit the damage and encourage and enhance the positive outcomes.

Ecotourism

The effects of climate change will have the biggest impact on the tourism providers who depend on the natural environment for their success. One such susceptible type is nature-based tourism (NBT) which is a prominent and growing type of tourism. While there exist many different definitions, one encompassing definition of NBT is leisure travel to natural areas (Ardoin et al. 2015). NBT is one of the fastest growing tourism sectors – and is expected to represent 25% of the global tourism industry by 2020 (Honey 2008). Its growth can be attributed to ecotourism which is a type of NBT that prioritizes environmental conservation and the well-being of the local community (Stronza and Gordillo 2008). Travellers are expected to behave responsibly towards the natural landscapes that they visit (Handriana and Ambara 2016). Due to the expected growth in this industry and the impacts attached to it, it is important for society that there are stringent guidelines in place mitigating the impacts and promoting conservational efforts. If implemented true to its definition, ecotourism has the potential to have positive effects on the environmental and social well-being of the areas where it is applied.

The first formal definition of ecotourism was written by Hector Ceballos-Lascuráin who defined it as travel “to relatively undisturbed natural areas with the specific objective of studying, admiring and enjoying the scenery and its wild plants and animals, as well as any existing cultural aspects (both past and present) found in these areas” (Ceballos-Lascuráin 1987). More recently, the International Ecotourism Society has defined ecotourism as “responsible travel to natural areas that conserves the environment, sustains the well-being of the local people, and involves interpretation and education” (TIES 2015). It is this definition of ecotourism that we will use in this research, however there is an extensive discussion on each aspect of an authentic ecotourism project in the literature. One of the most common themes that exists in the literature is ecological sustainability, meaning that the presence of tourists does not damage or degrade the local environment. Ecotourism also relies on undisturbed natural areas and should contribute to the protection and management of these areas (Valentine 1993). In addition, Ecotourism should respect the cultural integrity of the local community it operates in (Wight 1993).

There is now a near consensus in the literature that ecotourism should satisfy three core criteria 1) nature-based attractions 2) education and learning should be the priority at those attractions and 3) project and product management should follow the principles of economic, socio-culture, and ecological sustainability (Weaver and Lawton 2007, Blamey 1997). Although this consensus in the literature is ideal, the interpretation of these criteria continues to differ. This is increasingly problematic when the ecotourism providers being compared are offering completely different products, such is the case between ‘soft’ ecotourism and ‘hard’ ecotourism (Johnson 2006). Soft ecotourism refers to those activities that integrate nature in a subtle way, in comparison to those whose entire product is designed around exposure to the natural environment. The challenge is that these definitions are not operational, and although authentic ecotourism sounds promising for the sustainability agenda, in reality, the term ecotourism is used to brand a wide range of tourism activities that vary in legitimacy (Slocum, Kline, and Holden 2015). In order to avoid these discrepancies, it is essential to carefully plan the development of an ecotourism product. If this planning is successful, regardless of whether the activities are described as “soft” or “hard” ecotourism, they can have positive impacts on the ecological and social systems if they adhere to the guidelines and definitions described here. In order to understand what these positive impacts may be, we need to explore how ecotourism can support strategic sustainable development.

Ecotourism as a Tool for Sustainability

While the tourism industry as a whole is known for having negative environmental and social impacts, ecotourism has the potential to drive sustainable development within the tourism sector. The overall potential of ecotourism to generate revenues for and from conservation is enormous (Davis and Tisdell 1998). This makes ecotourism an excellent tool for the implementation of sustainability initiatives. It also encourages economic development that benefits diverse stakeholders, for instance, reinvesting resources in the ecosystems in order to support further conservation and restoration efforts. It can also benefit local communities by fostering employment or entrepreneurial skills and competence. According to Wearing and Neil (1999), this market segment also presents an ethics-minded approach towards natural capital and a willingness to preserve it. Ecotourism’s value proposition arises from a direct relationship with biodiversity and with protected areas. These efforts may incentivise the protection of new areas or result in more effective conservation efforts for existing protected areas. Another important effect of ecotourism projects are an increase in revenue creation for local

communities, which subsequently leads to changes in land-use patterns from consumptive use to non-consumptive use (Krüger 2005). Krüger (2005) also states that the possible transformation of the mindset and attitude of local communities towards the protected area around them can diminish activities that degrade the biosphere such as poaching, timber extraction and other consumptive land uses. Krüger (2005) highlights the importance of ecotourism in the empowerment of local populations, since they often organize themselves to plan, design, and make decisions on conservation programs and their own development. This, in turn, enhances their capacity to influence their own lives and their wellbeing.

The challenge for ecotourism is to go beyond its conceptual problems, overcome the lack of an agreed definition and prevent greenwashing (Almeyda, Broadbent, and Durham 2010). Ecotourism providers and experts must proactively pay special consideration to the design of their project or product in order to anticipate and mitigate the environmental and social impacts that may arise. Although ecotourism has been able to reduce some of the negative impacts of regular tourism such as prostitution and drug use (Almeyda et al. 2010), it is clear that it will not be able to dissolve them all. However, what has been proven is that the correct application of ecotourism principles results in a philanthropic platform for the local destination and also attracts a type of consumer, who is more focussed on nature-based activities and preservation. If the concept of ecotourism enhances community participation and prioritises the conservation of natural areas while contributing to the economic development in the region, it has the potential to support sustainable development.

The Role of Tourism Products and Tourism Providers in Supporting Sustainable Development

In order to take a strategic approach to the sustainable development of tourism, it is crucial to identify leverage points within the tourism system. This section discusses two of them: tourism products and tourism providers. Tourism can be described as an open complex system as demonstrated in figure 1.1. (Jere Jakulin 2017). The internal elements of the system are the tourism market area, supporting institutions, the tourism supply or providers, intermediaries, and the tourism demand or consumer. It needs to be noted that the tourism system is dependent on and influenced by the environment, which represents the external part. However, the tourism system also influences the environment and this has massive implications for sustainable development as pointed out in section 1.1.

Tourism Providers as a Leverage Point for Sustainable Development

The academic discourse in the field of tourism research focuses mainly on four stakeholder groups: residents, visitors, regional or local governments, and businesses belonging to the tourism service sector (Luštický and Musil 2016). Although there is no consensus in academia concerning who has the *biggest* influence on the other stakeholders, the UNWTO (2017) has pointed out that private businesses are key players in the tourism value chain and therefore for the sustainability of the industry. Private businesses and especially large tourism companies are using sustainability to increase their competitive advantage in terms of increased profits (UNWTO 2017). Depending on the company, these increased profits are achieved by decreased energy consumption, water consumption, waste production, etc. (Willard 2012; UNWTO 2017). However, sustainability is no longer only an economical surplus factor; it is also becoming increasingly important for traveller's choices. It has become a selection criterion for a lot of travellers and is therefore gaining momentum in the business of tour operators, who can

be defined as intermediaries between tourism providers (tourism supply) and consumers (tourism demand) (see figure 1.1.; UNWTO 2017; TOI 2003).

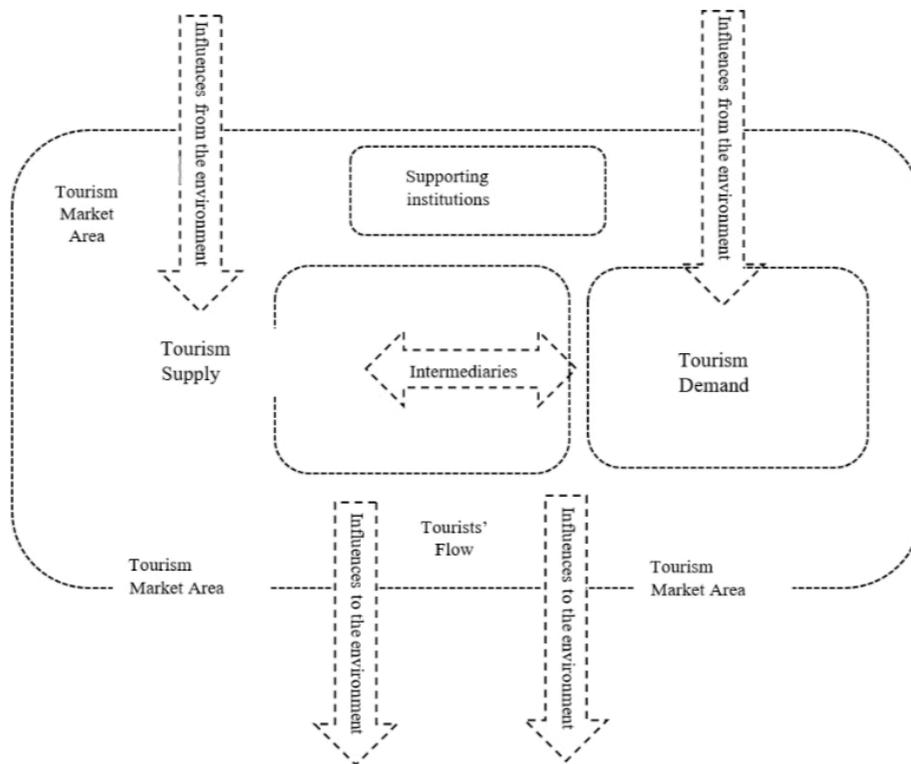


Figure 0.1. The Complex Tourism system (Jere Jakulin 2017)

As seen in figure 1.1., the tour operators (the intermediaries) are able to influence consumer choices as well as the tourism providers. A tourism provider is a business who is offering services and experiences to travellers, and is in *direct control* of setting-up and running the product (Budeanu 2005; Lozano, Arbulú, and Rey-Maqueira 2016; UNWTO 2017). Figure 1.1 makes it clear that the elements of the inner system are interrelated and dependent on the environment and society. Therefore, because the tourism provider is responsible for creating the product they are an essential leverage point for strategic sustainable development.

Furthermore, by targeting tourism *providers*, this study addresses a gap in current knowledge, because the majority of the literature focuses on tour operators, their influence on the supply chain, and how they can make use of sustainable practices to move towards sustainability (Luštický and Musil 2016; Budeanu 2005).

Tourism Products as a Leverage Point for SSD

It is essential for tourism providers to incorporate unique or engaging experiences because it results in differentiation and enhances the chance of repeat visits (Flint and Golicic 2009). Differentiation is a key strategy to create a competitive advantage (Porter 1985), which is described by Hunt and Morgan as the moment when an organization has one or more competencies that allows it to create superior value, relative to its competitors (1995). Porter

states that "a firm that can achieve and sustain differentiation will be an above-average performer in its industry if its premium price exceeds the extra costs incurred in being unique" (Michael E. Porter, cited in *Competitive Advantage* 1985, 14).

Differentiation is only one aspect of remaining competitive. Additionally, the tourism providers are increasingly obligated to act according to the market demand created by consumers and tour operators for sustainable experiences, accommodations, and transportation (UNWTO 2017, Budeanu 2005). This is the reason for tourism providers to include sustainable innovation in their product portfolio. As Willard (2012) points out, these sustainable innovations have in general the potential to also create a competitive advantage for businesses. Therefore, there is a substantial need for the tourism providers to explore what these sustainable innovations offering unique or engaging experiences could be.

Consequently, creating unique experiences embedded in a sustainable product might have the potential to be an above-average performer and might encourage other providers to adapt their products accordingly. This adoption of innovative products can be referred to as diffusion of innovation and might reach a critical mass in the market segment if the innovation offers advantages to the consumer (Rogers 2003). If this is considered, then it is of strategic importance to create sustainable products because they might have the potential to spread throughout the entire market.

Closing the gaps in research about the role of tourism providers and elaborating on which sustainable innovations have the potential to create a competitive advantage for tourism providers influencing the whole market segment, is necessary to progress strategically towards sustainability. As Amina Mohammed points out, this progress "will only be achieved through genuine and meaningful partnerships" (Amina J. Mohammed cited in UNWTO 2017, 40). One of the collaboration partners enabling innovation and creating unique experiences might be academia and more specifically the use of citizen science.

The Role of Citizen Science

Citizen science is commonly defined as "scientific work undertaken by members of the general public, often in collaboration with or under the direction of professional scientists and scientific institutions" (Citizen Science Center 2015). Citizen science can take several forms and can involve a large variety of participants. Efforts can be on local, national, and international scales, and it typically involves volunteers from the general public working with scientists to answer scientific questions by gathering data (Bonney et al. 2009). Citizen science has been used for several decades as a method to crowdsource data to enable research that may otherwise be too costly due to the required volume of data or due to difficulties in accessing more remote locations (Kullenberg and Kasperowski 2016). It can help accelerate research by generating more data in a shorter time frame than a researcher or group of researchers could collect on their own; this, in turn, can lower the costs of research overall; citizen science is best suited for projects that have a vast spatial and/or temporal scope, and it is more appropriate for research questions for which the data that is collected only require basic skills and minimal training, if any (Bonney et al. 2009). Citizen Science is generally regarded as complementary to more hypothesis-driven, localized research as it is not typically aimed at uncovering the underlying structures and mechanisms of ecological patterns (Dickinson, Zuckerberg, and Bonter 2010).

While citizen science is most commonly used for research in biology, conservation, and ecology, it can be used to advance research in a multitude of research areas (Kullenberg and Kasperowski 2016). A brief from the Stockholm Environmental Institute demonstrates how citizen science could be used in a multitude of areas and contribute to both environmental and social sustainability, specifically, the United Nations Strategic Development Goals (UN SDGs) (West and Pateman 2017). The UN SDGs are targets that, if achieved, support sustainable development, so contributing to them also contributes towards the sustainability principles that are defined in section 1.8. To understand the potential role of citizen science as part of the solution to the challenges faced by the tourism industry, we must examine its possible benefits for sustainability.

Citizen Science as a Tool for Sustainability

Citizen science projects have the potential to contribute to sustainability in a range of ways depending on the type of research and how the resulting information is used. In fact, impacts of citizen science project have included increasing scientific literacy and awareness, informing policy, increasing the influence of community members, influencing the participants' behaviours, and improving conservation efforts. Within the FSSD, citizen science can be used as a Systems Tool as it can take direct measurements in the system to monitor damage or improvement. This section provides examples related to the impacts of citizen science projects and how they relate to sustainability. This section provides examples related to the impacts of citizen science projects and how they relate to sustainability.

The data generated through citizen science has been increasingly valued and accepted as valid, benefiting scientific advancement, and it has also been shown to play a role in promoting scientific literacy and awareness (Bonney et al. 2009). The National Science Education Standards define scientific literacy as "the knowledge and understanding of scientific concepts and processes required for personal decision making, participation in civic and cultural affairs, and economic productivity" (National Research Council 1996). Therefore, improving scientific literacy among the general population is important for supporting social sustainability as it enhances critical thinking skills; furthermore, societies with higher scientific literacy are less susceptible to being manipulated or misled by individuals or groups attempting to distort or misrepresent information for personal gain (McNamee 2014). As Hunsberger (2004) explains, citizen science projects that enable participants to acquire knowledge can lead to shifts in the distribution of power. This is important for the sustainability agenda because it encourages civil engagement and help gathers multiple perspective on a problem. Furthermore, if applied correctly citizen science can also help to pursue the goal of gender equality and inclusiveness. The involvement of local communities and especially women in citizen science is helpful to pursue the sustainability agenda (UNTWO 2016).

Citizen science projects vary in their desired outcomes. Many projects focus on identifying local problems and empowering and educating participants; other projects aim their efforts on applying the results of their monitoring to legal, regulatory, policy, or conservation initiatives (Savan, Morgan, and Gore 2003). As Heiman (1997) explains, citizen science has the potential to "democratize" scientific processes, particularly when the local community is included in the problem identification and the data gathering. Democratizing science can help break down structural obstacles to influence that local community members may face. This may give the local community the opportunity to influence policy decisions that could impact them that they would not normally be consulted on. Heiman (1997) further explains that by integrating scientific methods with knowledge from locals, citizen science projects have the potential to

enhance decision making both at the community and government level; the projects allow for a broader spectrum of contributors who can inform and improve the decision-making process (Heiman 1997). Citizen science projects are also specifically important in adaptive decision-making cycles, also known as adaptive management (Bliss et al. 2001). This process is designed to inform and facilitate actions when facing environmental, social, or economic uncertainties, and it relies on continual collection and re-evaluation of data to inform and implement actions (Bliss et al. 2001). These methods can be useful in conservation efforts and in developing standards to protect species or ecosystems.

Recent research has looked at the possibility for citizen science to go beyond developing scientific literacy and awareness to examine whether citizen science can foster positive conservation attitudes and behaviours with promising results (Toomey and Domroese 2013). Citizen science in combination with ecotourism has demonstrated potential to nurture pro-environmental behaviours in tourists, among other benefits (Mitchell 2017). Furthermore, these projects have the potential to raise awareness and enhance ownership of certain issues which can further promote behaviour change to more sustainable lifestyles, and it can foster a better understanding and trust in the scientific process (West and Patement 2017). Evans et al. (2005) reported that many participants in The Neighbourhood Nestwatch citizen science project changed their behaviours and focused on accommodating the local species when making decisions. For example, some residents decided not to cut down trees or bushes on their properties after learning about the birds that lived and nested in their yards and planted shrubs and trees specifically to enhance the habitats for the birds (Evans et al. 2005). These attitude and behaviour changes can potentially have a positive impact on environmental sustainability.

Conservation initiatives and policies that utilize citizen science can help contribute to sustainability related issues such as addressing the systematic degradation of the environment (Bliss et al. 2001). One example of citizen science's positive applications relates to Coho salmon in the Pacific Northwest. The actions by the participants played a part of a larger initiative to protect Coho salmon from becoming endangered. The citizen scientists collected data related to salmon spawning, stream temperatures, maps of stream crossings and obstructions affecting fish passing, amongst other aspects. The information was imperative to the habitat restoration efforts and the eventual rise in the salmon populations. The project also involved designing voluntary measures that supplemented the de facto regulations to prevent the plucking of salmon (Bliss et al. 2001). Other examples often involve citizen science being used to monitor and track invasive species to provide evidence supporting counteractive responses.

The Stockholm Environment Institute has listed a number of ways that citizen science projects could contribute to both social and environmental sustainable development. The authors describe how citizen science monitoring projects could help ensure the conservation, restoration, and sustainable use of terrestrial and inland freshwater ecosystems; ensure the conservation of mountain ecosystems, including their biodiversity; protect and restore water-related ecosystems, including mountains, forests, wetlands, rivers, aquifers, and lakes; and introduce measures to prevent the introduction and significantly reduce the impact of invasive alien species (West and Pateman 2017). These are just some of the UN SDG targets that they predict citizen science could play a role in achieving by 2020.

Overall, citizen science projects have demonstrated their potential to influence positive change, particularly in terms of sustainability, when designed effectively. While it cannot be expected that every project contributes to each sustainability issue, proper planning and designing can facilitate the project team's ability to make an impact on their area of focus.

Design of Citizen Science Projects

Designing citizen science projects can be challenging and requires careful planning and consideration to ensure that the projects are beneficial to the scientific research (Bonney et al. 2009). Before a project can begin, Yoccoz, Nichols, and Boulinier (2001) ascertain that there are three essential questions that require answers: (1) Why monitor? (2) what should be monitored? and (3) how should monitoring be carried out? The answers to the first question are often either to understand the system or to inform the management decisions that impact that system.

The Cornell Laboratory of Ornithology (CLO) has been developing and implementing citizen science projects since the 1980's (Bonney et al. 2009). They have described a model they use for creating citizen science projects that can help project designers answer the three questions proposed by Yoccoz, Nichols, and Boulinier (2001). The initial planning stages outlined by CLO are crucial to ensuring the success of the project and its implementation. These stages include (1) selection of research questions involving a large spatial and/or temporal scope that require only basic skills for data collection, (2) formation of a team of scientists, educators, technologists, and evaluators, and (3) development, testing, and refinement of protocols, data forms, and educational support materials (Bonney et al. 2009). Participants are most commonly involved in the collection or processing of data, but more local initiatives may also utilize participants in the development and later stages of the scientific process (West and Pateman 2017). The authors have also released an online toolkit that provides step-by-step guidance for developing and running citizen science projects. Each step in the Toolkit contains the following categories: Overview, Reality Check, How To, Resources, Tools, Questions, and Cases. The descriptions of each step in table 1.1 were adapted from the respective “overview” and “how to” sections in the online Toolkit (CLO 2018)

The model from the Cornell Lab of Ornithology (CLO) was developed by experts from a variety of fields including education, population biology, conservation biology, information science, computational statistics, and program evaluation (Bonney et al. 2009). Toolkit is commonly found in literature regarding citizen science and is used by a large number of research projects involving citizen science. Citizen science data collected by projects run by the Cornell Lab itself have been used in at least 150 scientific papers since 1997 (CLO 2018). The number of papers utilizing data coming from projects that are not directly associated with the Cornell Lab but that utilize their framework is suspected to be even higher. In fact, as of 2010, CLO had over 600 extant citizen science projects on their roster (Dickinson, Zuckerberg, and Bonter 2010). The reputation and accessibility of the CLO Citizen Science Toolkit make it the ideal model to examine and recommend adaptations to the initial design guide.

The validity and reliability of the data collected through citizen science has often been called into question; however, there exists a large amount of scientific literature demonstrating that when studies are designed properly, the quality of the data gathered by citizens is comparable to the data collected by professional scientists (West and Patemen 2017, Kosmala et al. 2016). Designing a citizen science project properly is essential to ensuring that it is both effective for the research and can be used to support sustainable development.

Table 0.1. Description of the Steps within the CLO Citizen Science Toolkit

Step	Description
Choose a Question	Addressing common details that must be considered at the outset of a project. Involves choosing a topic and scientific question of interest and establishing focused goals and outcomes for both the science and the participants. It can involve working with the local community to find out what they need.
Form a Team	Establishing a team comprised of the major stakeholders and variety of experts. Bring in partners early in the design process.
Refine Protocols	Designing the project and process plan. Includes developing, testing, and refining protocols/methods and equipment such as data forms and educational support materials. Consider ways to facilitate accurate data collection and ensure positive experiences for participants.
Recruit Participants	Determining the target group and utilizing different venues to reach them. Take advantage of technology and marketing techniques.
Train Participants	Developing and providing training for participants in the protocols/methods and any equipment/technology they will use. This step is important for balance between research precision and a reward experience with science for participants.
Accept Data	Establishing data infrastructure based on technological needs for the collection, analysis, visualization, archiving, and delivery of data. Consider minimizing steps and whether technology may help or hinder.
Analyze Data	Resources for analyzing and interpreting including sophisticated data reduction techniques, tools to make data analysis accessible to volunteers, and other methods for dealing with data sets.
Disseminate Results	Recommendations and resources for sharing results with participants and project partners. Also addresses topics regarding using the results to inform policy or a community and to publish a peer-reviewed article.
Measure Effects	Establishing specific goals for the project at the outset and determining methods for measuring and monitoring the project effects.

Combining Ecotourism and Citizen Science as a Response

The integration citizen science into existing ecotourism products is a relatively new concept; however, some ecotourism providers have recognized the potential of doing so and have begun

to offer these activities to their customers. The novelty of these products means that there is a significant gap in the literature relating to them and their potential. While there exist several frameworks and guidelines for implementing citizen science projects, there is a lack of literature related to how citizen science can be incorporated into ecotourism and how this could benefit sustainable development. Although there is clearly potential, the volume of literature on how to create transformational experiences that result in long term environmental consciousness using ecotourism is also very small (Ardoin et al. 2015 and Wheaton et al. 2016). However, Ardoin et al. (2015) found three key elements that may result in pro-environmental behavioural change; they include high equality interpretive experiences, direct contact with wildlife and the opportunity to engage in environmentally related behaviour on site. Although this connection has not yet been explored, each of these key elements can be incorporated into an ecotourism product using citizen science. This concept is already being explored by researchers in Tanzania with positive preliminary results (Mitchell 2017). In addition, there is evidence that participation in citizen science alone is an excellent way to foster pro-environmental behaviour and attitudes (Toomey and Domroese 2013).

Furthermore, citizen science may be able to help address some of the challenges faced by ecotourism in regards to sustainability. The integration of these two activities could benefit ecotourism providers who are looking to innovate and gain a competitive edge in the markets. While pro-environmental behaviour change of travellers is one part of potential contribution to strategic sustainable development (Ardoin et al. 2015), there are other areas that need to be explored such as how these products can minimize the negative impacts of tourism or which best practices could be adopted by tourism providers. There is evidence demonstrating that ecotourism and citizen science on their own each have the potential to contribute to sustainability; therefore, it is expected that merging the two activities could yield positive effects for sustainability because the activities of citizen science do not conflict with or negate the contributions of ecotourism and vice versa. Understanding the possible contributions to sustainability, the potential added value of these products to ecotourism providers, and the process for designing and implementing are key areas that must be examined in order to further promote and develop these products within the ecotourism industry.

Strategic Sustainable Development

Considering the expected increase in travellers, tourism products that foster and promote strategic sustainable development are essential to address the negative impacts of tourism described in the above sections. This is especially evident for the ecotourism providers who rely on the health of the biosphere to sell their tourism products. To illustrate the interaction between the tourism providers and the systems they rely on, (Figure 1.2.) depicts the nested systems that are at play. The tourism providers and their products are nested within the social system which is nested in the environmental system. These systems all interact with and impact one another. However, these systems and the interactions amongst them are considered complex. The systems are more than just the sum of their components; the interrelations and interconnections between the parts cause behaviours and feedback loops that must be considered in the equation. The resulting complexity means that actions in one part of the system can have unpredictable and unforeseen consequences in other parts. The non-linearity and complexity of these systems necessitates a systems thinking approach, especially when planning for sustainability, to alleviate potential blind-spots and to address root causes of problems within the system by accounting for upstream causes to downstream effects.

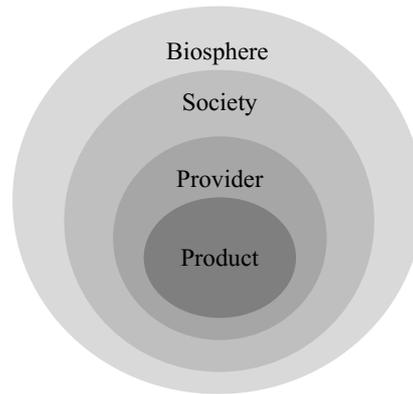


Figure 0.2. Nested Product-Provider System

A systems thinking approach is the study of systems in which the dynamics of the whole are used to understand the properties of and the relationships between the individual parts (Broman and Robèrt 2017). A system perspective provides us an overarching view and ability to see how things work together to create something bigger than the parts; it allows us to comprehend complexity and begin to make sense of it. This is particularly useful when analyzing a complex system, such as the tourism industry, which is non-linear and characterized by many interconnected components whose behaviour is counterintuitive and unpredictable (Broman and Robèrt 2017). Complex systems such as the ecotourism industry are emergent, meaning a small change in one area of the system can have major and unexpected repercussions in another part of the system. Complex systems also have a variety of unknown thresholds, at which major irreversible changes may occur.

The Earth itself is a complex, closed system that is open to energy and closed to matter. However, matter cannot be created or destroyed. This scientific law explains why the linear processing of matter on Earth is leading humanity on an ecologically unsustainable course. In addition, political, economic, and cultural obstacles continue to aggravate social issues across the globe. The tourism industry is currently responsible for many of these ecological and social issues. This systematic degradation of the social and ecological systems' ability to support the tourism industry can be represented using a funnel metaphor (see Appendix B). The funnel metaphor illustrates that society's unsustainable activities are degrading our socio-ecological system resulting in less room in which to maneuver in the attempt to overcome the challenge. The walls of the funnel are steadily closing, which undermines the adaptive capacity of the tourism industry to address the sustainability challenge (Broman and Robèrt 2017).

To help us navigate these concepts within their complex systems and to understand how the merge of citizen science and ecotourism can support sustainable development, we require an overall planning process. The Framework for Strategic Sustainable Development (FSSD) is an overarching conceptual framework that is adapted specifically to sustainability. The FSSD relies on scientific foundations of ecological and social sustainability and uses a systems approach to address the complexity of the sustainability challenge (Broman and Robèrt 2017). A major strength of the FSSD is that it uses a principle-based, scientifically reinforced definition of a socially and environmentally sustainable system that can work across most value and cultural systems (see Section 2.2). Its grounding in scientific knowledge and the generality of the sustainability definition allow them to be applied universally to any type or size of organization as a shared mental model (Broman and Robèrt 2017). We will use the FSSD and

its principled definition of sustainability to explore how the integration of citizen science within ecotourism can play a role in strategic sustainable development.

Research Aim & Scope

Research Aim

Ecotourism has been proven to enhance the environmental conservation of an area (Wearing and Neil 1999) and citizen science has the potential to contribute to the United Nations Sustainable Development Goals (West and Pateman 2017). Although the UN SDGs do not have the same principled base definition of sustainability as the FSSD, these findings demonstrate that the combination of citizen science and ecotourism may help accelerate the transition towards sustainability. If we consider the fact that both citizen science and ecotourism support the development of pro-environmental behaviour change, ecotourism and citizen science might have the potential to support strategic sustainable development on a global level as well as on an individual basis. Since they have only been researched independently from each other, the potential benefits and impacts of integrating citizen science into an ecotourism product are yet to be explored. In addition, there has been no research into how the use of a framework such as the FSSD could add to the role that the merge of citizen science and ecotourism plays in strategic sustainable development. Furthermore, whether or not citizen science provides a unique experience to the consumer and therefore to the ecotourism providers has yet to be explored. As discussed in the introduction, we chose to focus on tourism providers, instead of tour operators, because the providers have a direct connection to the travellers and the communities that they visit. Thus, the overall research aim is to:

- 1) Demonstrate how the merge of citizen science and ecotourism might contribute to strategic sustainable development.
- 2) Provide insights about how the incorporation of citizen science might create a competitive advantage for the ecotourism providers within the tourism market.
- 3) Describe how the ecotourism providers can effectively integrate citizen science into their ecotourism products and what the components are of these products.

Exploratory Research

The purpose of the study is to gain insights into how citizen science can be integrated into ecotourism and how it might contribute to strategic sustainable development. Also, there is a need to understand the situations in which the use of citizen science has created a competitive advantage for ecotourism providers. It is therefore necessary to use an exploratory research design that has fewer methodological restrictions and more flexibility. Furthermore, this new ecotourism concept made it necessary to adapt our research methods whenever new insights emerged. Most exploratory studies have in common an ambition to gain new insights into phenomena, a drive to go beyond regular mathematical tools and try to gather innovative information (McDaniel and Gates 2013).

Scope

The target audience for this study is ecotourism providers who currently have citizen science projects in their portfolio as well as ecotourism providers who are interested in integrating citizen science projects. The study focuses on selected actors within the tourism value chain: ecotourism providers, scientists, and non-profit organisations connecting researchers and the

tourism industry. Other actors in the tourism value chain such as airports, airlines or vacation rentals were not included in this research. There were no travellers interviewed during this study.

Ecotourism providers

The research included ecotourism providers in remote, biodiverse areas of the world including the Arctic, Antarctica, Costa Rica, Peru, and Turks and Caicos, and The United States. The ecotourism providers we selected are undertaking responsible travel to natural areas, following guidelines to conserve the environment, have sustainability efforts that could benefit the local communities where applicable, and give some sort of interpretation or educational aspects to the travellers. They all had several tourism products in their portfolio and among these were some citizen science products.

Scientists

The scientists associated with this study were involved in citizen science activities for some years and were also experienced working with travellers to collect data. The scientists were mainly located remotely from the data collection point but had also participated in the citizen science tours.

Non-Profit Organizations

The non-profit organizations we interviewed were responsible for connecting ecotourism providers with scientists or scientific projects. They were born out of the need for a centralized effort to manage citizen science activities within the tourism industry.

Research Question

Our main research question is:

“How might ecotourism providers integrate citizen science into their products, and what might be the benefits of these products for the business and for strategic sustainable development?”

Research Methods

This chapter provides an overview about the selected research methods and the justification for them. The research methods were helpful in exploring the gap in research around the new field of ecotourism and citizen science and their relevance in moving society towards sustainability. Step 1 of the chosen exploratory sequential design approach consisted of the research preparation, literature review and expert interviews, exploratory interviews, and finally the analysis and synthesis of the qualitative data. Step 2 incorporated the planning for the survey in order to verify the hypothesis, which was derived from the findings during the qualitative research. Step 3 included the actual design of the survey. In Step 4 we connected both qualitative and quantitative findings, concluded and interpreted our results. Primary data collection was represented in the study by conducting exploratory interviews and surveys. Secondary data collection occurred in the literature review.

Mixed Method Research

“Mixed methods research is the type of research in which a researcher or team of researchers combines elements of qualitative and quantitative research approaches (e.g., use of qualitative and quantitative viewpoints, data collection, analysis, inference techniques) for the broad purposes of breadth and depth of understanding and corroboration.” (Johnson, Onwuegbuzie, and Turner 2007, 123-24)

Creswell and Plano Clark (2011) describe that mixed method designs can be emergent or fixed. In order to successfully answer the research aim and question, we made use of the exploratory character of the study and decided to incorporate quantitative data collection and analysis to further enhance our qualitative findings. That is the reason why our approach has two stages and falls under the realm of emergent mixed methods designs. Additional reasons for choosing a mixed method approach included triangulation (refers to the combination of quantitative and qualitative research to triangulate their findings in order to find corroborations), offsetting the weaknesses of quantitative as well as qualitative research and enhanced credibility since we employed both approaches (Bryman 2006).

The mixed method design used in this research is one of six proposed by Creswell and Plano Clark (2011). This method is called exploratory sequential design and consists of following phases:

- 1) Design and implement the qualitative strand
- 2) Use strategies to build on the qualitative results
- 3) Design and implement the quantitative strand
- 4) Interpret the connected results

The benefits of choosing the exploratory sequential design were that we were able to verify the findings from our qualitative analysis and it was easy to implement the design into our running research project. The following section describes in detail how we performed our research.

Using the FSSD

As stated in Section 1.8, one major strength of the FSSD is its principle-based, scientifically reinforced definition of a socially and environmentally sustainable system. This definition can work across different value and cultural systems. It can be applied universally to various types and sizes of organizations as a shared mental model thanks to its grounding in scientific knowledge and the generality of the sustainability definition (Broman and Robèrt 2017). This applicability was particularly important when examining sustainability within tourism which is a global concept.

The FSSD's principled definition of sustainability defines success using sustainability principles (SPs) as boundary conditions for a sustainable society (Broman and Robèrt 2017). Broman and Robèrt (2017) explain that the ecological principles state that in a sustainable society nature is not subject to systematically increasing...

- SP 1) ...concentrations of substances extracted from the Earth's crust,
- SP 2) ...concentrations of substances produced by society,
- SP 3) ...degradation by physical means

and Missimer (2015) explains that in a socially sustainable society people are not subject to structural obstacles to...

- SP 4) ...health
- SP 5) ...influence
- SP 6) ...competence
- SP 7) ...impartiality
- SP 8) ...meaning making

We used this principled definition of sustainability to explore how the integration of citizen science within ecotourism can play a role in strategic sustainable development. We applied this definition during the literature review and the interviews to examine what violations to the sustainability principles (SPs) the tourism industry caused directly and indirectly and to explore what sort of contributions could be made towards social and ecological sustainability by ecotourism and citizen science both separately and through their integration.

The FSSD applies The Five Level Framework for Planning in Complex Systems (5LF) and can be used when planning for sustainability; the 5LF organizes information into five levels: System, Success, Strategic Guidelines, Actions, and Tools (see table 2.1.; Broman and Robèrt 2017). the FSSD assists in categorising complex information of a systems for analysis, planning, and decision making (Broman and Robèrt 2017). This categorization technique was used in this research to better understand and make sense of the complexity of the concepts. The levels were also used to guide the design of the interview questions to ensure all aspects of the projects were being examined.

In addition to the 5LF, the FSSD can also make us of a planning process for sustainability called the ABCD process (Broman and Robèrt 2017). The ABCD process has four individual steps. Step A is to create a shared vision of what the organization might look like in the future. The created vision of the organization should also be aligned with the company's core purpose and values. Thus, all the needed strategic actions leading towards the vision need to be aligned with

them as well (Broman and Robèrt 2017). The B step involves an analysis of the baseline of an organization in relation to the sustainable vision. Next, the C steps involves brainstorming potential solutions to address the challenges identified in the B step. The fourth and final step, the D step runs these ideas through a prioritization process. During this prioritization process there are three questions asked. They are (1) Is it a stepping stone in the right direction, (2) Does it provide a return on investment (ROI) and (3) does it lead the organization towards the vision created in step A (Broman and Robèrt 2017). Strategic guidelines are principles for decision making within an organization, which enhance the process of prioritizing between multiple actions. It answers the underlying questions of how an organization is making decisions during a planning process (Broman and Robèrt 2017). Components of the ABCD process, such as the shared vision and strategic guidelines, were examined in the existing products and guided some of the resulting recommendations for future projects.

Lastly, the FSSD was used in our recommended adaptations to the CLO Framework to provide a strategic process for integrating citizen science and ecotourism products that would enhance the potential of these projects to contribute towards sustainable development.

Table 0.1. The Five Level Model of the FSSD adapted from Broman and Robèrt (2017)

Level	Description
Systems	The global socio-ecological system and an overview of the sustainability challenge
Success	A society that complies with the sustainability principles
Strategic Guidelines	Backcasting from success: the three prioritization questions
Actions	The actions that help move the global socio-ecological system towards success
Tools	The tools that support efforts to reach global sustainability.

Step 1: Design and Implement the Qualitative Strand

Preparation of the Research

In order to draw a coherent picture of the related research it is important to approach the literature review in a structured way that encompasses all of the relevant aspects in the research aim. The reason for this is that when you are “aware of all the interrelationships involved in a problem, you’re in a much better position to address the problem” (Kim 1999, 6). Because of this, we mapped the relevant aspects in relation to the topic of tourism and its role in the sustainability challenge. This system’s view of the problem also helped highlighting all relevant contributions and interconnection to the problem and prioritize among the aspects which are the most relevant to our study.

Literature Review and Expert interviews

In order to organize the expected volume of information, we followed the recommendation of Savin-Baden and Major (2013) and focused during our literature review on three main themes deriving from the preparation of research: tourism, citizen science and sustainable development. In order to further support our literature review, we also conducted five expert interviews, one with a government representative who works with tourism, two others with operators who were interested in citizen science but had yet to integrate it into their product, and two with researchers who had explored the potential for transformational ecotourism experiences to result in pro-environmental behaviour change.

We acquired an understanding of the literature on how tourism is having an impact on local destinations, on how ecotourism products can contribute to sustainable development as well as many examples of successful citizen science projects. We primarily used the databases Scopus and Science Direct and paid specific attention to relevant journals, including the Journal of Sustainable Tourism, the Journal of Cleaner Production, and Tourism Management. Another important method we used was the Snowballing method. As Wohlin (2014) pointed out snowballing is a tool to identify additional papers by using the list of references of a paper. Snowballing was important to enhance the literature review, because there was no consensus in academia about the definition of citizen science and ecotourism and the research field we looked it at is relatively. Once a fitting paper was found, snowballing helped to further reveal additional papers and more precise keywords. A full list of keywords can be found in Appendix C.

Exploratory Interviews

As discussed in the introduction, we chose to focus our interviews on ecotourism providers because they have the closest connection to the development of the actual tourism product experience. In order to select our interview subjects, we did an online search for ecotourism providers who were integrating citizen science plus we contacted former colleagues who work as ecotourism providers. It is important to note here that because this type of product is still relatively new to the market there are a limited number of providers offering it, and it was difficult to identify them depending on how the products are marketed. We contacted 11 providers and five of them agreed to participate in a 1.5 to 2 hour interview. The interviews with the ecotourism providers helped us gather the necessary data in order to answer each of our three research questions, how can ecotourism providers integrate citizen science into their products, how do their products contribute to strategic sustainable development and what is the added value for their organizations. After interviewing each provider, we asked them to connect us with the scientists responsible for the citizen science project they were running. This is referred to as snowball sampling and is an efficient method of gathering interview subjects who are unusual in the population (Weiss 1994).

We were able to connect with two of these scientists and they did provide us with valuable insights from the research perspective. The purpose of these interviews was to help us understand how to set up a research design given the complexity of an ecotourism project and the requirements of rigorous, peer reviewed scientific research. Our conversations with the providers also informed us about the existence of two non-profit organizations whose purpose and mission were directly related to our research question. Both of these non-profits also agreed to participate in our research. These non-profits coordinate the dialogue between scientists and individuals or ecotourism operators who would like to participate as citizen scientists. In

summary, we interviewed individuals representing three groups of stakeholders involved in integrating citizen science into ecotourism; ecotourism providers, scientists and non-profit organizations. An overview of the interview partners including their role and location can be found in Appendix D.

In total, we conducted nine semi-structured interviews between March 8th, 2018 and April 13th, 2018, with different sets of questions for each stakeholder group. Semi-structured interviews were selected because they are useful when you only have one opportunity to interview the subject and the conversation must be focused yet also leave room for further questions (Savin-Baden and Howell Major 2013). Each interview was conducted over skype and recorded on a smartphone as well as on OneNote. Each participant was given a consent form, which they each signed and returned to us prior to the interview. We had two research team members participate in each interview, one who was responsible for asking the questions and another who was responsible for having an overview of the responses. Each interview subject is listed in Appendix D and a summary of the organizations we interviewed can be found in Appendix E. The questions we asked each stakeholder group can be found in Appendix F. These interview questions were structured by using the 5 Level framework (5LF) as discussed in section 2.2. We used the 5LF to organize our questions around the elements of an ecotourism product that integrates citizen science by structuring them into the five levels – (1) system, (2) success, (3) strategic, (4) actions, and (5) tools (Broman and Robèrt 2017). We wanted to understand (1) the system of stakeholders involved in the process, (2) what the success of such an ecotourism product looks like (3) the strategic guidelines tourism providers should follow (4) the actions they must take and (5) the tools they use.

Data Analysis

Transcription

Each of the nine recorded interviews were transcribed verbatim. In order to guarantee that each team member was familiar with the content of each interview, a team member who did not participate in the interview was responsible for the transcription of that interview.

Coding

The next step in our analysis was to code these transcriptions. A code is a word or a short phrase that captures the data's primary content and purpose (Saldana 2009). In order to initiate the coding process, each interview question was assigned a 1-2 word code such as decision-making or product design. In addition to the codes assigned to each question, we created new codes as they were identified in the text. The full list of codes can be found in Appendix F and included codes like decision-making, competitive advantage, components, etc.. This type of coding can be referred to as classical content analysis which allowed us to identify specific characteristics within the answers to each of our interview questions (Savin-Badin and Major 2013). For each interview, coding was undertaken by the fourth team member who had not participated in the interview or transcribed it.

Synthesis

In order to identify overarching themes and draw conclusions from the data we collected, the codes were then used to separate the transcribed responses into shorter excerpts. These excerpts were then copied into an Excel file that allowed for a visual comparison between the responses

from different interview subjects to the same question. Each row contained the coded responses to an individual interview question and each column contained the responses to all questions from one interview subject. As suggested by Saldana (2009) each cell contained the raw data and a short summary of the significance of that information. Our next step was to divide up the questions and have each team member compare and contrast the learnings for a specific set of questions across all of the interviews.

There are several guidelines available on how and when citizen science should be used. After our literature review, we chose to utilize the Cornell Lab of Ornithology Citizen Science Toolkit as a framework for designing projects (see section 1.6.2.), which is a well established citizen science guide. We examined the steps of the CLO Toolkit and compared them to the answers interviewees gave regarding the process they used to set up their citizen science projects within ecotourism products. We then examined these steps in relation to the FSSD.

Step 2 –Building on the Qualitative Results

The qualitative findings showed that the ecotourism providers we interviewed saw an added value experience for the consumers, whenever citizen science was integrated into their products. Therefore, the ecotourism providers were able to differentiate themselves and created a competitive advantage in their market. In order to verify their statement that a dynamic space where consumers participate in practical and stimulating activities that contribute to the research is an added value for the consumer, we saw the need to create a quantitative data collection tool.

Another reason why we created a quantitative tool was to support the relevance behind the third research aim, which was about how ecotourism provider might incorporate citizen science effectively into their products. The qualitative findings revealed there were certain barriers preventing citizen science from being incorporated into ecotourism products That was the reason to test quantitatively which barriers are most relevant for ecotourism providers. The answers to this should inform a tailored approach to overcome these barriers and to help the incorporation of citizen science.

When we selected the audience, we wanted to collect data from ecotourism providers, who have not incorporated ecotourism and citizen science products. By doing so, we intended to verify the value of citizen science experiences and the barriers by unbiased ecotourism providers. As Creswell and Plano Clark (2011) also confirm, it is common among exploratory sequential designs to ask different actors compared to the qualitative data collection. We intended to acquire a greater sample size, but the only participants we had access to were from from Costa Rica. However, despite not being representative for the whole tourism industry, Costa Rica is one of the most important ecotourism hubs in the world, and the country was ranked #3 in the world in the category of Natural Resources (World Economic Forum 2017b).

Step 3 – Design of the Questionnaire

The method we used was a self-administered questionnaire, because we were able to obtain information from a larger sample group in a relatively short amount of time. The questionnaire contained eight questions, seven of them were closed questions, and five of those seven contained a ranking style using the Likert-scale (for example “strongly agree” to “strongly disagree”) in order to perceive the maturity level of understanding and applying the concepts

of ecotourism and citizen science. There was one filter question to verify whether the respondents were actually incorporating ecotourism activities. The participants were asked if their current operations are aligned with the definition of ecotourism stated by TIES. All questions can be found in Appendix D.

The survey was sent to a member of the board of the National Chamber of Ecotourism of Costa Rica, and subsequently was sent to the affiliates of the organization. The survey was created using the platform Survey Monkey, was open for 10 days (April 4th 2018 to April 14th 2018) and gathered 32 responses. The quantitative analysis was performed by the online survey tool. The questionnaire was then exported from the online survey tool to excel to be analysed with the qualitative results.

Step 4 – Analyse the Connected Results

As mentioned above and as Creswell and Plano Clark (2011) suggested for exploratory sequential research, we first collected qualitative data by conducting interviews and literature research. The results were analyzed (see section 2.2.4) and the themes around added value and challenges informed the creation of the quantitative phase. After obtaining information from the questionnaire we connected the results in order to generalize the findings. The strategy we chose to compare the results is called a side-by-side comparison for merged data analysis (Creswell and Plano Clark 2011). That means we took the selected theme (e.g. “added value”) from our qualitative findings and compared it with the respective question from the questionnaire (e.g. “does this activity provide an added value to the ecotourism consumer?”). This comparison showed the significance of our findings.

Results

The results of this research are separated into each of the three research aims; sustainability, competitive advantage and the integration of citizen science and ecotourism. They include evidence obtained from the responses to our interview questions and emphasize any responses that were common between interviewees. It is important to note that although a respondent did not include specific information in the response to our questions, it does not indicate that they do not have this information, they simply did not include it in their response. These results are also supported by the findings from the questionnaire, as described in the methods section.

Understanding of Sustainability

All nine interviewees acknowledged the environmental aspect of sustainability, and there were three who acknowledged social sustainability in their definition. ETP 2 was the only provider that had social sustainability incorporated into one of their citizen science projects. Although each of our interview subjects had environmentally driven priorities, the majority of our respondents had not considered how they could integrate sustainability into the operation of their citizen science projects. One provider stated that this was potentially related to a lack of understanding of sustainability in their organization. Although all of the respondents were personally motivated by sustainability, they often recognized that it was not directly embedded in the organizations they worked for. For example:

“I definitely leverage my background in sustainability as I go through the process of building projects, and we’ve instituted a number of strategies to make that happen, but it’s super indirect. It’s not deliberate. It’s not something that’s at the front of the organization’s mind” (NPO 1).

Environmental contribution

The majority of respondents described aspects of tourism that are not directly related to the inclusion of citizen science in ecotourism products. However, respondents described positive environmental impacts in their organization’s role as a barrier to natural resource extraction. ETP 2 added that “education needs to be one of the pillars, one of the basic principles in which an ecotourism company should be based”. They also perceived a positive role in encouraging pro environmental awareness through their organizations. It was also mentioned by NPO 1 that these projects support the open access to large amounts of data. All nine interviewees had biodiversity monitoring as a consistent output of these citizen science projects, and this appears to be the most influential environmental benefit of these projects. For example:

“We offer them [the participants] the opportunity to learn the theory of the programs, what we do and why, then they have the option to accompany the coordinators on the sea turtle patrol in the evening or morning or in the hatchery, taking temperatures and measurements and then releasing the baby sea turtles” (ETP 3 2018).

This type of monitoring was used by ETP 4 and Scientist 2 to support policy decisions about the protection of species at risk. Scientist 2 mentioned that if the citizen science data gathered demonstrated a concerning ecological implication, then it would be addressed from a regulatory perspective. For ETP 4 the citizen science data they collect *“provides information for the*

researchers to better understand the populations of sea turtles...it's determining if the laws that are in place are actually effective or if they are not" (ETP 4 2018).

Social contribution

In terms of social sustainability impact, all nine respondents mentioned the value of education, and for ETP 2 *"the most important aspect of citizen science projects [was] education"* (2018). In the projects we researched, this education was primarily related to conservation and ecology; however, the importance of the increase in scientific literacy was also mentioned by two respondents as a benefit of the integration of citizen science and ecotourism. The scientists we interviewed both emphasized that *"it is critical that we teach people how not to shy away from science"* (Scientist 2 2018). Furthermore, one ecotourism provider stated that the work they do is raising the sustainability awareness of the consumer: *"the time and money were spending to bring this tour really does give back, even with the smallest lasting change or raised awareness"* (ETP 1 2018). Two of our interview subjects (ETP 5 and ETP 1) also mentioned that the inclusion of citizen science in ecotourism has enabled them to influence the development of citizen science for the other ecotourism providers operating in their region. This influence also extends to the staff who work for these ecotourism providers. ETP 1 and ETP 4 mentioned that their staff members have reported finding their work more fulfilling because they were part of a team that was contributing to science.

Perceived Competitive Advantage

Six of the interviewees mentioned that there is a growing number of travellers who are looking for ways to give back during their experiences. They elaborated by assuring that ecotourism is a rising segment which has the drive to actively engage in conservation efforts and that the ecotourists enjoy knowing that they are contributing to something greater and meaningful. Scientist 2 stated, *"it can add value to the tour itself, but I also think it adds value to the company, inherently people are going to be more interested in giving money to a company that they believe is helping in conservation efforts, helping to collect data, or otherwise having a greater and lasting impact, even if they are not part of that tour, just knowing that that company goes the extra mile has value to them"*. Six interviewees reported that a citizen science component, strategically inserted in an ecotourism product, delivers a more profound, diverse, and positive experience for the travellers: *"People are looking for much more authentic and unique experiences now and instead of just being a consumer while you are travelling, people are conscientious of being an educated and mindful consumer who is also doing good"* (ETP 3 2018). Another ecotourism provider reported that historically, ecotourism's concept and definition have been argued and contested, especially because many of providers use the term without having a deep analysis of its operations and outputs of their processes with the fragility of their surrounding eco-systems. *"Ecotourism is quite saturated and its becoming really diluted. Its definition is contested, what is it? There is a lot of greenwashing and superficial analysis of responsible tourism operations"* (ETP 3 2018).

The organization asserted that citizen science was an opportunity to validate themselves as a true ecotourism provider. ETP 5 stated that, *"something that sells itself as providing ecotourism services is greenwashing very often, and everybody has to get away from greenwashing, it's just disgusting, so you want to buy a trip to the coast of Thailand, and you're being told 'oh this is the best ecotourism destination there is, because we're doing X, Y, Z.' However, that hotel you're at, do they have sewage treatment, chances are good they don't, and you call that eco*

something, that's not at all. Not only do they have to embrace CS if they want to call themselves eco, they need to embrace environmentally responsible operations that also educate, if they don't do that than they are just bullshit". All of the ecotourism providers interviewed agreed that citizen science presents vast opportunities to improve their image and to differentiate themselves in the market.

Three of the ecotourism providers expressed that their employees are deeply engaged with their work because of the citizen science initiatives and that the employees are proud of the efforts that the organizations are doing to contribute to conservation practices. One of the interviewees explained how it has brought benefits to the organization when recruiting personnel. *"This citizen science project has directly filled my hiring base. I mean, I do not have to look for employees anymore. They come to us"* (ETP 1 2018).

One of the organizations highlighted the importance of the interaction with local people and for the travellers to be involved with the social, ecological, and economical contexts of the area and its surroundings. Four interviewees stated that by working with citizen science their consumers are interacting with nature in a different way and gaining knowledge about the ecosystems with a hands-on approach. They perceived that this evolves in very diverse activities which result in high level experiences that stimulates the travellers. *"The experience that they receive is richer, more intense, deeper. The knowledge the travellers get, they are interacting with nature at many different levels..."* (ETP 2 2018).

While three of the interviewed organizations reported an increase in their revenues - *"Now it is the fastest growing part of our business..."* (ETP 1 2018) - they expressed that they are reaching additional market segments with additional products that are different from what the market is offering. One of them expressed that their consumers want to do multiple activities in the same tour, not just the classic and regular activities.

Product and Process Design of Citizen Science Products

In order to encourage the integration of citizen science in ecotourism, the following section summarizes the methods ecotourism providers have used to integrate citizen science activities into an ecotourism product, based on the exploratory interviews. It provides an overview of the components of these products, including the product's vision and strategic guidelines.

The answers from the interviewees about the integration process of citizen science showed similarities. The three main stages of the process were the initiation, the planning/design, and the implementation. These stages along with the steps of each are summarized in the following sections and are visualized in table 3.1..

Table 0.1. Steps Used to integrate Citizen Science and Ecotourism Products

Phase	Steps
Initiation	<ul style="list-style-type: none"> • Identifying Research Topic or Business Opportunity • Initiating Contact • Identifying Internal and External Stakeholders
Planning	<ul style="list-style-type: none"> • Creating a Shared Vision • Creating Strategic Guidelines <ul style="list-style-type: none"> - Consumer Focus - Return on Investment - Data Quality • Product Design <ul style="list-style-type: none"> - Design of the Components - Setting up Training for the Practitioners - Choice of Equipment - Resolving Data Logistics - Promoting the Product
Implementation	<ul style="list-style-type: none"> • Feedback Loop and Post-Trip Follow-Up with the Traveller

Initiation Phase – Identifying Research Topic or Business Opportunity

In the cases we examined, the project was initiated by either a scientist who identified a gap in research and an opportunity to collect large volumes of data or by the tourism provider sensing an opportunity for creating an interesting experience for travellers while contributing to research as well as doing business.

“So the way it worked for us was that [the ecotourism provider] approached me and they wanted to collect data, they wanted their time to be useful, they wanted to have a commercially available option on tours to collect data, and in order to do that they needed a bona fide study ... we designed the study and we created data sheets that would drive the right type of data collection and came up with the flow that we needed and moved forward from there”(Scientist 2 2018).

One organisation (NPO 1) had a three-question process leading to determine the suitability of a project and therefore, whether or not they would move forward with the project. Those questions were:

- 1) Do we address an environmental issue where there is a current data gap or where it has currently been data limited?
- 2) Is there a direct line between data collection and conservational outcome?
- 3) Is an outdoor activity requiring special skills included?

Initiation Phase – Initiating Contact

Both ecotourism providers and researchers agreed that setting up a proper collaboration between scientific partners and the ecotourism providers is beneficial for both sides as they believed it enhances the trust between the parties and enables an open communication. When asked about the key to success, Scientist 2 felt it was for ecotourism providers to *"work with the research entity from the very beginning, to not work alone, because it is a partnership"* (Scientist 2 2018). Interviewees in all different roles also expressed the importance of working with a scientist on these projects to ensure that the data would be used and that the methods were appropriate. One ecotourism provider also stated that working with a scientist *"adds credibility to the program"* (ETP 1 2018).

When asked about how initial contact between the collaborators happened, respondents expressed that they relied on their existing networks and word of mouth, and some respondents felt that it took a considerable amount of time and effort to do. One interviewee explained that they did *"... some research and made several dozen calls to different science agencies, and we were finally able to partner with three of them"* (ETP 1 2018). Respondents were not aware of any existing platforms for identifying interested partners and initiating contact. One interviewee stated, *"there is no way, no clear path for us as a business to put out the word that we were looking for scientific partners"* (ETP 1 2018).

Initiation Phase - Identifying Internal and External Stakeholders

The most important stakeholder involved in the process of creating the product from the perspective of ecotourism providers were grouped into a stakeholder map (see figure 3.1).

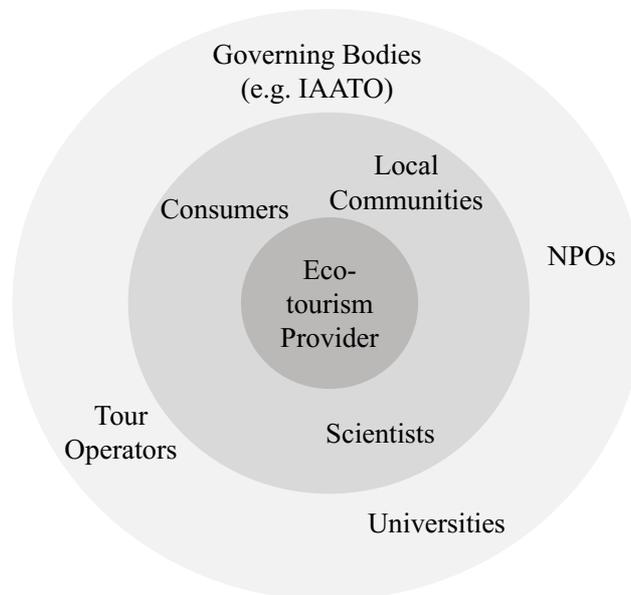


Figure 0.1. Stakeholder Map from the Perspective of Ecotourism Provider

The stakeholders mentioned by the interview subjects were consumers, local communities, and scientists. The other stakeholders mentioned were specific to the ecotourism provider and their area of operation. These were governing bodies (e.g. IAATO) - which were needed for operation permits- universities, and non-profit organisations. Depending on the project, some stakeholders were brought in at the earliest stages while others, such as the local communities, were never contacted but were considered in the decisions made regarding the projects. For the majority of the projects examined, the stakeholders in the outer circle of figure 3.1. were incorporated in the later phases of the process.

Planning Phase

As the next step, the interviewees described creating the overall design of the project and determining the logistics. In all of the projects we examined, this phase was a collaborative effort with both the ecotourism providers and scientists. All of the ecotourism providers and scientists interviewed emphasized proper planning and open communication in the beginning in order to manage the expectations and deliverables on both ends. *“We had a really open conversation with the scientists, and they gave us all the things that might be valuable for them, and we could then pick and choose what we could provide for them”* (NPO 2 2018).

The interviewees stressed the importance during the planning to have clear list of deliverables, product components, training, equipment, and the logistics needed to collect, record, and analyze the data.

Planning Phase - Creating a Vision

The answers from the ecotourism providers revealed that the *product* visions were mainly focussing on the traveller’s experience, the learning outcome for travellers, contribution to scientific research, and a post-trip influence on their behaviour:

“Well now with us taking on citizen science not only are we educating about the birds we see, we are documenting that information to provide it back to a university; so what I see citizen science has to give to our client is hands-on education opportunities . . . in expedition cruising, while of course the experience is important, the education is also important, the guest wants to learn as much as they can about a particular place that were going to, so that’s what I do, what my job is, I help them understand” (ETP 5 2018).

“We want them to understand that, maybe I’m not going to live in the jungle and plant trees for the rest of my life, but there are a few things I can do back home, and we want them to take that information back home and be stewards for the environment...” (ETP 3 2018).

The scientists and non-profit organizations gave answers related to a further contribution to conservational efforts, educational value for the travellers, tangible outcome for the community, or a democratization of information through shared responsibility among stakeholders in data collecting, recording, and analyzing. Lastly, one scientist mentioned that the vision of success is in *“...what I would call scientific literacy. Helping to show people what the process looks like so that they understand science a little bit better and consider themselves more literate”* (Scientist 2 2018).

Planning Phase - Creating Strategic Guidelines

As stated in section 1.8., strategic guidelines are principles for decision-making within an organization. The interview subjects gave a great diverse range of answers and can be grouped into three larger themes: consumer focus, data quality, and return on investment.

Consumer first

Almost all tourism providers had a consumer focus as a guideline for decision-making to reach the vision of their product and organization. One provider described that *"the bottleneck was for sure the guests"* (ETP 2 2018). Other factors such as a well-functioning process and facilities were described as not as important as the consumer itself.

Consumer focus meant for the ecotourism providers to put the consumer first making decisions during the product creation. For instance, this resulted in taking the decision to create lively learning experiences, offering hands-on activities, or tailoring the product offer to the consumers' demographics and interests: *"If the primary product you're interested in is to have engaged the people who were citizen scientist, then what you actually need is an interesting topic"* (Scientist 2 2018). One respondent stated that consumer focus includes to create mechanism to check upon consumers' satisfaction about the citizen science tour such as during and post- trip surveys.

Return on investment

For the ecotourism providers interviewed, it was important to take decisions which would lead to a simplification of the process and an enhancement of the operational efficiency, and therefore a better return on investment: *"We are probably turning down projects that require a lot of heavy equipment that might be complicated to logistically bring on a ship"* (NPO 2 2018). One of the reason for this was that the current prices for the tours were not different to their normal tours as one provider mentioned: *"We just try to keep the prices despite inflation. It is just part of the cost of doing that [the citizen science tours]"* (ETP 1 2018).

One scientist mentioned that complicated data collection processes might not be well perceived by the consumer, which would then result in less bookings. For one scientist, the opposite was the case and people got more interested when the equipment was simpler: *"... I would say that all of the equipment kind of has to be user friendly and easy to operate, so that's sort of where I love people get interested in engineering and making useful equipment that doesn't take a week to calibrate"* (Scientist 1 2018). Furthermore, more complicated scientific measures might influence the operational efficiency for the tour guides (e.g. too much equipment, samples to be taken care of). Although the cost for scientific equipment used during citizen science projects might not be high, the logistics of getting the samples and training to the tour guides requires a lot of working hours of training and logistics. More specifics can be found below the points *Choice of Equipment* and *Resolving Data Logistics* in section 3.3.7.

Focus on Data Quality

"We focus on data quality, that's number one for us... that's constantly something that we're describing and elaborating on" (ETP 3 2018). Some ecotourism providers were particularly interested in data quality and took decisions guided by the need for high data quality.

Also, the non-profit organisations were emphasizing “*that there has to be a clear line from the data collecting to some sort of conservation outcome*” (NPO 1 2018). For this it was needed to focus on data quality during the operation in order to make the scientific studies as accurate as possible. For both ends, data quality was needed to determine the right equipment, training and a clear process outline from “how to collect the data” to “how to process the data”.

One scientist emphasized the importance of keeping the projects simple even though it may be tempting to add on extra elements and activities that would further the research: “*What I have found is that the simpler the better, I would rather have less detail that is highly accurate vs trying to get a lot of detail and having a lot of gaps in the data and a lot of variability in the way it was collected and a lot of biases in the way it was collected*” (Scientist 2 2018). The scientist also felt that adding too many things could take away from the overall experience.

Planning Phase - Product Design

The following section presents the results of the product design as stated by the interviewees. Within the planning phase of an ecotourism product incorporating citizen science, it was important for the interviewees to include following states: Designing the components of the tours, setting up training for the practitioners, choosing the equipment for the tours, resolve the logistics around data processing, and create appropriate promotion around the product.

Product Components

The following section summarizes the responses from the interviewees about the components of the citizen-science-ecotourism products. The two main components of the products that were consistently suggested by the interviewees were hands-on activities and an educational or informative component.

The interviewees varied in the delivery of the educational component, yet it was consistently present. The delivery methods used were (1) pre-trip presentations by the staff, (2) video presentations during transit, and (3) information blended throughout the experience.

The content of the educational components generally included the following topics:

- What the participants can expect and instructions regarding methods
- How the data collected will be used and information about the research project
- Why this research is important and its potential impacts
- Information about the local ecosystem and how the research can help the area

“We, as a group of people, as educators on the ship, recognize that if you are just giving people a lecture, it is kind of pretty dull, its great for getting facts out, getting information out, sharing information in a lecture is a fabulous tool, however it's just one tool, and what we have always strived to do is to have multiple tools available to help us educate our clients, one of the tools is for instance pretty simple, go out on deck and do some bird watching and while you are bird watching you are educating the guests about the birds you are seeing, well now with us taking on citizen science not only are we educating about the birds we see, we are documenting that information to provide it back to a university”(ETP 5 2018).

“We do a pre-trip workshop with the guests that involves describing what we’re going to do, how we’re going to do it, and why we do what we’re going to do, who were partnered with, and a little bit about the local laws here and what they are, and how they came about, and then that’s about a 30-45 minute experience” (ETP 4 2018).

While the educational component provided the consumers with the opportunity to learn about the area and the research, the interviewees stressed the importance of the participants being able to do hands-on activities related to the data collection. Examples hands-on activities described included taking measurements of turtles, collecting water samples, and taking photos of whale tails for identification. The interviewees felt that the consumers were more engaged and had an overall more enjoyable and impactful experience when they were able to contribute directly to the research project and to feel like their actions were influential and valuable. The interviewees expressed that active learning was preferred over passive learning by the consumer. They explained that it was important for the consumers to feel like they are an integral part to the research.

“What we have taught them in that process, all we did was just go out on deck and whale watch, is light years past what we would do if we just had a lecture, so the enhancement to our guests’ understanding and the enhancement to our guests’ experience, they are so excited . . . people under 18 years old, and guess what, people over 18 years old love [citizen science] just as much; so it's a really great way to incorporate some old fashion simple techniques called hands-on understanding, or hands-on learning, and the guests love it” (ETP 5 2018).

“I think it’s [citizen science] the difference between a passive learning experience and an active participative experience where you feel like you were an integral part of something bigger than yourself and something that’s making the world a better place . . . Citizen science is a way for people who really enjoy nature-based tourism to really have an impact and to really get their hands dirty, so not just hike through the forest but actually catalogue what they see as they go and know that that list that they’re leaving behind is being put to good use and is going to be part of a growing scientific body of scientific research and information and can help us to our jobs better to protect the [project location] and in term have broader environmental impacts” (ETP 3 2018).

While citizen science can be used in different stages of a research project, the projects that were examined all used citizen science for the data collection phase. The data collection phase provided the best opportunity for the participants to participate in hands-on activities that contribute directly to the research.

Training for Staff Members

All of the interview subjects emphasized the importance of proper training for the tour guides, respectively the ones collecting the data, because they felt that it was in everyone's interest to focus on the good quality of the data. In all of the projects that were examined, the scientists were responsible for training the staff members on the procedures, methods, and information. This training was primarily done in person, and several of the projects would provide updated training at least once per year to refresh their skills and knowledge. In instances when it was not feasible for the scientist to regularly provide training to the staff (e.g. due to geographical and monetary demands), the scientist was able to provide the training through either pre-prepared videos or through video calls. One scientist was also able to train some staff members

to a level where they were then able to train other staff. This was done out of necessity to adapt to a high staff turnover rate.

Furthermore, whenever scientists were responsible for guiding travellers through the data collection process, the interviewees suggested that the scientists should be properly trained in hospitality and guiding. The reason stated was to enhance the consumer satisfaction as one interview subject stated. One business even installed a full-time employee, whose “*role has been exclusively over the past year to map out what that interaction between the two teams[...science and hospitality teams...], how do they come to agreements, how do they negotiate their needs which are quite different*” (ETP 3 2018). Another company hired an employee to be fully responsible for the citizen science projects.

Choice of Equipment

Equipment that the interviewees used generally had a dual role aimed at the participants and enhancing their experience while still practically and effectively contributing to the project. This was done by making sure the research equipment being used was easy to operate and user-friendly. Some equipment that would normally be required for specific research methods were re-engineered for the projects so that they were practical for the participants and still able to generate the results/data. The products were designed specifically for the participants, so in the pre-planning stages, equipment that was too large, too heavy, or had other barriers were eliminated from the design to avoid potential dis-satisfaction.

Equipment that was used for the data collection included digital data collection platforms (e.g. Zooniverse) and physical data sheets that were designed specifically for the products to be manageable for the participants while being functional for the research. Other general equipment used for the projects included cameras and camera traps, maps of the locations, GPS trackers, and measuring devices.

Some projects had also established or were developing materials that could be used during the excursions that would further enhance the experience. For example, one project was designing both a catalogue and posters with the most commonly sighted whales on the excursions. Another had strategically placed signage that promoted sustainable actions and behaviours.

Also, the equipment for monitoring or recording data (cameras, drones, binoculars, etc.) created one-time costs. The equipment for collecting data was mainly provided by the scientific partners which was most of the time financed by a grant the researchers were provided with.

Resolving Data Logistics

Some equipment used for data collection and recording was mentioned in the previous section. However, interviewees expressed that other steps need to be taken to ensure good quality data is collected and that the scientist is able to access the data for analysis. Some actions taken by interviewees to accomplish these objectives are described below.

To ensure the validity and quality of the data, four of the projects stated that they utilized the trained staff to oversee the data collection. The staff did so by writing the data down themselves, telling the participants what to record, or by checking the data after it was recorded by the participants. “*With the tourists, they’re generally accompanied by the coordinator. But usually*

the coordinator of that project owns the data, so they're responsible for making sure that it's clean and appropriately collected with the right methodology and so on" (ETP 3 2018).

Another aspect of data logistic was data analysis. ETP2 had a system in place that required an image to be confirmed by 15 other independent participants before the data was reviewed by a staff member to confirm the data. This was required due to the large volume of data and limited staff available to process it. Although this project was overseen by an ecotourism provider who has incorporated citizen science into some of its products, this particular project did not involve ecotourism.

As one scientist stated, the logistics of keeping the sample quality at a high level can become quite challenging when the distance between the collection location and analyzing location is large (e.g. the samples were collected in Antarctica and were analyzed in San Diego). *"From a scientific side, sampling, that's a huge challenge. Some of these samples I would love I can only use if they're frozen and if they stay frozen until they get to me [in San Diego]"* (Scientist 1 2018).

Promotion of the Products

The methods selected by the tour providers in order to promote their products were mainly focusing on their presence in the booklets of bigger tourism providers such as cruise liners. Furthermore, most of the ecotourism providers interviewed relied on their online presence and their engagement via social media or their websites. *"You can see on our website there's some cool videos of drone of the Amazon camera project"* (ETP 2 2018).

However, in terms of how to market the products that involve citizen science, each of the ecotourism providers had difficulties promoting them. Their perceived challenges revolved around the wording and framing of the term "citizen science" as their consumers generally had not heard of the concept and developed misconceptions at times. Some felt that rewording the name of the tour without using "citizen science" or even using synonymous terms served them well, yet there were still some issues at times of consumers not understanding what they had signed up for who were upset by the experience as a result. Two providers integrated the information into their normal marketing without making significant changes. Several providers relied on in-person presentations or discussions with consumers to expose their products once the consumers had already arrived at the destination. One of the providers preferred using short videos on their website that specifically promoted their citizen science products and believed that these were more effective than using text alone.

Implementation Phase

The implementation phase was described as the time when the product was implemented into the running business operation. During the first days after implementation one interview subjects did a constant feedback round with the visitors to ensure the consumer's satisfaction: *"So, at the beginning [...], we had this trial period, it was almost a couple of months in which I asked every different night a different group of guests, to come with me [...]. [...] after the activity we did an interview with them to understand what they thought about it"* (ETP 2 2018). This feedback round both with scientist and travellers were the foundation of iteration as one ecotourism provider explained: *"The average [the respondent to the interview] said it was a success, and as it was a success we decided to build the product of the discover new species project"* (ETP 2 2018).

During the implementation there was also a feedback round with the involved scientists who were not always located at the data collection point, which was challenging for them as Scientist 2 described: *“I do a lot of one on one training with the guides, but then the guides go on and work with the passengers, so I don't often get that feedback directly”* (Scientist 2 2018).

After the implementation of the product, one ecotourism provider stated that they would like to know more about the effects of the educational piece on the consumer, which is why they *“... participated in that project twice this year by giving a questionnaire at the beginning of the trip and a questionnaire at the end of the trip...”* (ETP 5 2018).

After the product was successfully implemented, Scientist 2 suggests that *“...it would be interesting to try to think about action items for those people who are inspired, who want to do more, who want to give back...”* (Scientist 2 2018). However, this has not been done so far, but would be a way of *“contributing to research efforts or ways that they can reduce their environmental impact ... “* (ETP 2 2018).

Quantitative Results

32 questionnaires were completed and were gathered remotely using the digital platform Survey Monkey (see Appendix H) for questions and for the summary of results). Of the 32 that were completed, 17 were answered by tourism providers, eight by other stakeholders involved at the tourism value network, such as tour operators and travel agencies. Six were answered by experts in the tourism field such as consultants and tourism professors.

The participants were asked if their current operations are aligned with the definition of ecotourism stated by The International Ecotourism Society. 25 of them strongly agreed that their operations are aligned with the ecotourism definition, 5 of them agreed and 2 of them neither agreed nor disagreed. Question 6 asked if the participants would be interested in offering an ecotourism product with includes dynamic activities that contribute to research and other forms of data gathering. 23 participants responded they strongly agreed and 5 of them agreed. 3 of the respondents stated that they neither agreed or disagreed and only one participant responded that he or she disagreed. None of the participants manifested that they strongly disagreed.

The participants were asked if they believed that this type of practical activities created an added value for ecotourism consumers. 24 of the respondents stated that they strongly agreed with it, and seven reported that they agreed. Only one participant expressed that he disagreed with the statement.

Participants were given a list of five choices and were asked to rank them according to their significance. They had to assign a three if the choice was a major obstacle, a two if it was significant, a one if it was minor obstacle or a zero if it was not an obstacle at all. From this item, the most relevant finding was that the choice *“Lack of information and knowledge on how to structure these activities effectively”* was elected by six-teen participants as a major obstacle, by twelve respondents a significant one, and only one participant stated that it does not represent a challenge at all.

Discussion

This chapter discusses the results from chapter 3. It gives recommendations about how to integrate citizen science into ecotourism products, the competitive advantage attached to it, and finally the potential of this concept for strategic sustainable development.

Recommendations on how to incorporate citizen science effectively into ecotourism products

This section will provide a proposal for how to design a citizen science project within the ecotourism industry. In the questionnaire that we conducted, "lack of information and knowledge on how to structure these activities effectively" was listed as the most significant challenge affecting the potential implementation of these products. This section will provide an overview about the process steps which should be followed in order to create a plan that incorporates citizen science effectively.

The steps of the CLO Citizen Science Toolkit were compared with the results from the interviews and discussed. The steps of the CLO Citizen Science Toolkit require some adjustments in order to be relevant for ecotourism providers and for the success of the product. For example, in traditional citizen science projects, the participants generally partake multiple times and over a long period of time; however, with citizen science projects within ecotourism products, the participants (i.e. the consumers) will generally only partake once and for a short amount of time (e.g. 4 hours).

Based on the information collected in the interviews, many of the actions taken by the ecotourism providers and scientists in the process of developing ecotourism products involving citizen science were similar to the CLO citizen science framework. The concept of integrating citizen science into ecotourism products is a relatively new concept with very little literature available on these projects or their potential impacts. In fact, in the questionnaire that we conducted, "lack of information and knowledge on how to structure these activities effectively" was listed as the most significant challenge affecting the potential implementation of these products. To further the potential of these products to contribute to strategic sustainable development, we have also added an FSSD perspective within the existing CLO Citizen Science Toolkit and make recommendations for how to do so. For ecotourism providers looking to incorporate citizen science into their products and to contribute towards a more sustainable society, we recommend following the CLO guidelines with the adaptations described below and summarized in table 4.1.. We will also highlight some of the considerations we feel are most relevant from all steps of the CLO Citizen Science Toolkit. Lastly, the use of the CLO Toolkit as well as our recommendations should be an iterative process as opposed to chronological.

Choosing a Question

The considerations in the "Choose a Question" step of the CLO Toolkit are applicable for the ecotourism providers looking to integrate citizen science into their products.

This step revolves around the initial stages of a project and determining its suitability. We would recommend introducing an initial three-question-phase – adapted from the process of one

interviewee - to assess the fit of a citizen science project. This could help eliminate unsuitable projects early in the development phase. The three questions are:

- 1) Do we address an environmental or social issue where there is a current data gap or where data collection has been limited?
- 2) Is there a direct line between the data collection and conservation or other sustainability-related outcomes?
- 3) Is a nature-based and engaging experience for the consumer possible?

Answering “yes” to the three questions can be a good indicator that a project has potential and should move forward.

In addition to the considerations in this step of the CLO Toolkit, we strongly recommend creating a shared vision in consideration of sustainability for the project. This process should include key stakeholders, and we recommend making use of the first step of the ABCD process included within the FSSD. The visions described by the interviewees differed slightly between the ecotourism providers and the scientists, even when they worked with the same project; while none of the interviewees reported any significant conflicts between the parties, creating a shared vision could avoid potential misunderstandings or misalignments and disputes regarding the direction of the project. We strongly recommend including certain themes in the shared vision to best facilitate all parties and encourage successful outcomes for the business, for science, and for the environmental and social systems (as described in the FSSD): positive experience and educational value for the traveller, contribution to scientific research, tangible outcomes to local communities, conservation, or other sustainability-related efforts, and increased scientific literacy.

Deriving from the nested system’s perspective as seen in figure 1.1. as well as the proposed procedure of the ABCD-process, we would recommend that ecotourism providers make a stronger effort to involve the local community at this stage as this consideration was lacking from the projects that we examined. Engaging the local community early enough is important for social and environmental sustainability and for the overall success of ecotourism providers who need the support from the local communities in order to operate. This can be done by creating a channel of communication with the major local stakeholders and community leaders. This channel could involve periodic meetings with the local communities. The initial purpose would be to inquire about their perspective of the social and environmental threats that could affect their quality of lives and about how citizen science in combination with travellers can become a tool in the communities' development process. In addition, this step could include discovering potential engagement or employment opportunities for the local communities. Furthermore, the ecotourism provider could also integrate their market research about their consumer to identify their needs and desires.

Forming a Team

The guidelines in the step “forming a team” are relevant for ecotourism providers aiming to incorporate citizen science into their products. One consideration that we would like to highlight is to bring the partners in early on in the process. This is especially important for the scientific partners. This recommendation was also emphasized by some of the interviewees who felt that this was crucial to the success of the product and the project. A sample of common stakeholders based on the interviews can be found in section 3.3.3, and every project will have to take time to establish who the relevant stakeholders are and to build relationships with them. Also, the

input from internal stakeholders, such as staff members, should not be neglected since they play an essential role in setting up a successful product.

There are many ways of involving stakeholders according to the literature, but we urge the ecotourism provider to make use of participatory processes. The reason for this is that participatory processes can help create a shared understanding about the vision and purpose behind the product. Also, the collaboration during a participatory process with local communities might also help enable innovation by incorporating diverse perspectives.

Based on the interviews, a platform facilitating the identification and contact with potential interested partners (either scientists or ecotourism providers) does not currently exist, and the existing projects relied on their existing networks and word of mouth to find each other. An online platform that allows interested parties to find one another may accelerate the development of future projects.

Refining protocols

The considerations in the CLO toolkit for this stage are generally applicable for ecotourism providers trying to integrate citizen science into their products; however, there are several aspects that we would like to emphasize in this stage that are crucial for ecotourism providers to take into account and improve the overall product. We would also suggest creating strategic guidelines which can serve during the process as guidance for decision-making.

Strategic Guidelines

By utilising an SSD approach, we would encourage the ecotourism providers to make use of the strategic level of the 5LF (see section 1.8.) and utilise this to create the right strategic guidelines for their product. As stated in section 3.3.6, the ecotourism providers mentioned three strategic guidelines for decision-making during the product design and for iterating the product: consumer first, focus on data quality, and return on investment. These should be considered for an optimal outcome. However, we would also propose to add another strategic guideline asking the question, whether the chosen actions lead to a sustainable outcome and to the shared vision. This guideline can also be referred to as backcasting from success as suggested by the FSSD (Broman and Robert 2017).

Engagement through Hands-On Activities

In general, citizen science can be incorporated in different stages of research such as research design, data collection, data entry, and data analysis. For citizen science projects within ecotourism products, the most common stage used by the interviewees and the stage we recommend using is data collection. This phase provides the best opportunity for participants to engage in hands-on activities that contribute directly to the research as well as being in direct contact with nature. The ecotourism providers stressed the importance of the participants being able to do hands-on activities related to the data collection for the enjoyment and satisfaction of the participants. Hands-on activities can help create deep connection between the travellers and the biosphere. As the travellers interact with and understand communities and nature in a different way, their perceptions of nature change and magnify the value and importance of the environment. People who engage with the world treasure it. Consumers had an overall more enjoyable and impactful experience when they were able to contribute directly to the research project and to felt that their actions were influential and valuable. It is important for the

consumers to feel like they are an integral part to the research and they weren't simply spectators watching the staff collect data. The participants' satisfaction is vital for the ecotourism providers who rely on the income from these participants.

Simplified Methods

An overall theme that emerged both from the literature and the interviews was to keep the projects simple, especially in regards to the methods and the equipment. As it is discussed in the section regarding "training participants", the citizen science projects incorporated into ecotourism products should be designed in a way that requires minimal training for the participants. Utilizing methods that require minimal equipment is one way to simplify the process. If equipment is necessary, we recommend using either simple equipment that participants may already know how to use or can learn to use on the spot or redesigning traditional scientific equipment to make it more user-friendly. Many of the citizen science projects we examined within ecotourism were in remote areas, and the scientists generally were not geographically accessible. That meant that the ecotourism provider and their staff were responsible for maintaining any equipment required for the research. If the equipment were to breakdown, it could be challenging to repair it unless significant time and effort went into training the ecotourism staff. This generally was not feasible and could provide a barrier to encouraging future ecotourism providers from taking on citizen science projects within their products. Therefore, designing projects that require minimal and simplified equipment are crucial to the success of the project.

Incorporating Educational Components

While the CLO Toolkit only briefly mentions educational components as an option if the research has educational objectives, we recommend that each project involving citizen science within ecotourism incorporate some form of educational aspects and objectives. These education components were used by all of the projects we examined. Besides providing information related to the methods used during the tour, they provided insight into how the data and research will be used, why it is important, and its potential impacts. Educational components provide the participants with a unique opportunity to better understand the community and the environment they are visiting. The majority of the participants in the projects we examined were travellers from outside of the area where the projects were taking place. Therefore, the educational components can inform the consumers about the challenges faced in the area and how they as consumers can make an impact both during their travels and when they return to their place of origin. The educational components should use a systems perspective of both the local and global systems to maximize their impact.

Recruiting Participants

A major difference between general citizen science participants and the participants from the ecotourism projects is that the latter are consumers. Furthermore, the consumers are, more often than not, tourists from outside of the local community. This difference requires building on the CLO approach to develop an effective communication strategy to acquire travellers.

The current communication strategies in use showed that there is hesitance towards promoting the term citizen science in the communication to the consumer via websites, social media, and other below-the-line marketing tools like brochures due to the ambiguity and potential misinterpretations of the term. In order to acquire more travellers to participate in their tours,

the ecotourism providers need to communicate effectively to their audience. One substantial need is as stated in “Choosing a Question” is to have a thorough analysis of the consumer to tailor the communication strategy around it.

Several interviewees confirmed what was discussed in the literature regarding an increased number of tourists looking for ways to give back to the areas where they are travelling. Tourism providers therefore could leverage this aspect in their communication strategy. Nevertheless, there is still uncertainty in the sector regarding the best methods for promoting citizen science and what vocabulary to use in order to attract consumers. Ecotourism providers must find a way to make these products equally or more appealing than their ecotourism products that don't incorporate citizen science. This requires further investigation and prototyping to determine a best practice for promoting ecotourism products integrated with citizen science.

Training Participants

The considerations of this step of the process will look different and are more complex for ecotourism providers incorporating citizen science into their products. Since the participants are generally only involved once for a short amount of time, projects should be designed with methods and equipment that require the least amount of training and that can be done by participants of all ages. This must be taken into consideration during the protocol refinement phase. Interviewees emphasized the importance of keeping the instructions and training required of consumers to a minimum so that it does not take away from the experience. They recommended short instructional presentations or videos, often while en route to the activities or to use methods that only required the tour guide to give the directions as needed. However, there are further steps that can be taken regarding training to provide a valuable experience to the consumers while still contributing to the research. The major adjustment would be to focus primarily on training the guides who will be delivering the ecotours involving citizen science. The guides should be provided with thorough training on all of the methods and equipment as well as the background and rationale for the research and the methods. Creating a level of expertise in the guides allows them to be comfortable and competent enough to ensure that proper protocols are being used, that they can give effective instructions to the consumers, and that they can answer questions or concerns the consumers may have.

While in-person training seems to be the preferred delivery method, adaptations may be required since the scientists involved with the project may not be located in the same area as where the project takes place, such as with several of the projects we examined. Some recommended methods by the interviewees included video calls, pre-recorded videos, and training some staff members to a high enough level to then be able to train other staff members. Lastly, we recommend doing what was common for the ecotourism providers we interviewed and provide training at least once per year for the staff to update their skills and knowledge.

It is highly relevant that the ecotourism providers have employees who are prepared and developed not only in ecotourism and hospitality, but who also deeply understand and prioritize the importance of scientific approaches and methods. In order to empower the employees, it is important to consider asking for their advice in the design of the product, which tools to use, and their insights on good practices to implement the activities. Subsequently, the staff will approve of the initiative and will constantly be looking for ways to enhance and improve the product and experience. It is very important that the employees continue their training and prioritize both elements of the product, the tourism experience, and the data responsibility.

Accepting Data

The data collected by citizen scientists has been highly scrutinized in the past; however, thanks to frameworks such as the CLO Toolkit that provide guidance on how to properly design citizen science projects, scientific literature is increasingly recognizing the validity of the data. The concerns regarding the data often centres around the fact that the participants are not trained scientists. If precautions are not taken, citizen science within ecotourism products run the risk of generating data that cannot be used by the scientists, especially considering the fact that most participants will only receive minimal training. The existing projects that we interviewed had come up with a few ways to address this issue that we recommend other ecotourism providers wishing to incorporate citizen science utilize. The main adaptation is to utilize the trained staff and have them oversee the data collection and take responsibility for the data. This can be accomplished by having the staff record the data themselves, dictating to the participants what to record, and by reviewing the data after it was recorded by the participants. Other recommendations included working directly with the scientific partners from the outset to co-create the project design. For this phase, the design team should also take into account how the data will be transferred to the scientific partners as this can prove challenging in remote locations.

In regards to the data collection methods, the considerations in the CLO Toolkit cover the majority of the recommendations that came out of the interviews. One additional consideration that we suggest would be to have multiple options for collection methods, particularly if the primary method relies on technology such as tablets, cellular devices, or laptops. For example, having printed copy of the data collection sheets on hand in case the technology does not work during a tour could be an easy way to ensure a positive experience for the participants. Since many of the tours were in remote areas or in marine settings, returning to the departure point for equipment in the middle of a tour would not be possible and could leave the participants with a negative experience.

Analyzing Data

This step will be less relevant to ecotourism providers, especially if the citizen science activities incorporated into their products will focus on the data collection phase of the projects. The actions within this phase will likely be the responsibility of the scientific partners involved with the project. Nevertheless, the development of this step will have to be considered in the overall project design during the protocol refinement phase, and ecotourism providers should have a general comprehension of this step to ensure they have a holistic understanding of the process and can relay that knowledge to the consumers.

Disseminating Results and Measuring Effects

The guidelines for these steps featured in the CLO Toolkit are acceptable and recommendable for ecotourism providers to use. However, these two steps were rarely taken into consideration by the projects we examined.

While a few projects had taken some initiative or incorporated plans to disseminate results in their design, several projects had not considered this phase in their project design even if they saw the value of doing so. This step is crucial to ensuring the research arising from these products leads to some sort of sustainable action or initiative and requires considerable planning in the early stages of the project design. Some of this can be accomplished through the

recommendations given in the section 4.1.1.. We further recommend working closely with the scientific partners to develop tools that facilitate follow-up with participants as well as disseminating results to them. This could be in the form of email newsletter, digital applications, websites, and catalogs and posters highlighting previous data. Post-trip surveys should also be included in the project design to better understand the consumers’ experience. These tools may also be useful for measuring some of the projects’ effects.

In terms of measuring the effects of the projects, there was little to no consideration in the design processes we examined. In fact, few interviewees could articulate what the long-term objectives of their projects were. As we will discuss in the following sections, having a clear vision for the project is essential to acting strategically.

Table 0.1. Summary of the Recommended Adaptations to the CLO Toolkit

CLO Steps	Recommended Adaptations and Highlights
Choosing a Question	<ul style="list-style-type: none"> • Incorporate a principled strategic sustainable development lens into the objectives/product vision • Engage with local community to determine what is needed in the system
Forming a Team	<ul style="list-style-type: none"> • Bring in partners early on, particularly scientific partners • Engage, get input, and build relationships with other stakeholders
Refining Protocols	<ul style="list-style-type: none"> • Emphasis on incorporating hands-on activities; best done by using citizen science for the data collection phase of a project • Simplify methods and equipment used • Include an educational component that uses a systems approach • Analysis of needs and desires of the consumer; communication strategy
Recruiting Participants	<ul style="list-style-type: none"> • Leverage on the opportunity to give back to the area • Adapt lingo regarding citizen science
Training Participants	<ul style="list-style-type: none"> • Focus primarily on training ecotourism staff • Design projects that require minimal training of participants • Take advantage of transport time to provide instruction
Accepting Data	<ul style="list-style-type: none"> • Utilize the trained staff to oversee and be responsible for the data • Have backup methods for collected data
Analyzing Data	<ul style="list-style-type: none"> • Ecotourism providers should have a good understanding of what happens at this step even if they don't directly partake
Disseminating Results and Measuring Effects	<ul style="list-style-type: none"> • Incorporate both aspects into the project design • Make use of tools such as post-trip surveys, websites, email blasts, digital applications, and data catalogue and posters.

Key Findings for Creating Competitive Advantage

This section presents the discussion about the key findings for creating competitive advantage for ecotourism providers. It is split up in the rise of ecotourism, innovation, communication and added value, social capital and engagement, and healthy destination and lower costs.

The Rise of Ecotourism

Considering the rise of ecotourism and nature-based tourism sector explained in our introduction, specifically in section 1.3, organizations who are committed to supporting the natural capital and who design products that incorporate an additional purpose into the tourism experience will likely reap many business benefits. Taking this into consideration, ecotourism providers who collect data aiming to create long-lasting positive impact and have a direct influence in conservation will pull the attention of this emerging niche of ecotourism travellers who are looking for ways of giving back while they travel. Citizen Science presents an opportunity for ecotourism providers to step beyond the regular and contested concept of ecotourism, providing a more authentic image, and enhanced reputation to this rising sector of tourism. Furthermore, as we found in both the literature review and in our interviews, ecotourism travellers are recognized for having a high level of education and therefore are looking for ways of absorbing knowledge (Wearing and Neil 1999). Therefore, ecotourism providers could capitalize on this desire by offering products that incorporate learning opportunities such as citizen science.

Innovation, Communication and Added Value

Ecotourism is becoming a saturated market where many providers present an equal value proposition to their segments. This was verified in our questionnaire, where almost 97% of the respondents agreed or strongly agreed that current ecotourism products are in need of innovation. This is possibly the reason why 81% of the participants stated that they invest different kinds of capital to find more novel practices that deliver different experiences for their clients. One benefit of citizen science is that it creates an opportunity for innovation where the tourism organizations can prototype new ways of interacting with nature by learning about the ecosystems with a hands-on and novel approach. This could result in more possibilities for new products to emerge, delivering unique dynamic experiences that result in original ways of deeper connection with their clients. With a proper communication strategy, this scenario presents itself as an optimum opportunity for the ecotourism provider to be positioned and distinguished in a very competitive market.

As we found in our interviews, even though the ecotourism segment is growing, the combination of citizen science into ecotourism products is still highly novel. Many providers and travellers might not comprehend the significance of the concept depending on how it is presented. This was also supported in our questionnaire, where only 7 of the 32 respondents strongly agreed to the statement that they knew and were aware of the concept of citizen science. Considering this, many ecotourists and regular travellers might not be initially interested in promoting the idea of “working” to collect data while on vacation. This presents a challenge for tourism providers when they introduce and communicate the activities to the travellers as explained in section 3.3.7.. The incorporation of citizen science into ecotourism products is still new to many ecotourism providers. Although, when the concept was described in the questionnaire, almost 97% felt that these kinds of activities create an added value experience

for ecotourism consumers. Having found that main issues towards the integration of citizen science into ecotourism products are based on the lack of understanding of what is citizen science and how to design the products effectively, we expect that the recommended adaptations to the CLO Toolkit in combination with communication strategies can help in strategically overcome these challenges.

Social Capital and Engagement

As described in section 3.3.3. the success of tourism in many regions is dependent upon the support of local communities and other stakeholders. The integration of citizen science and ecotourism products – in conjunction with a communication strategy aimed at stakeholders such as employees, surrounding communities, and local institutions - can strengthen the social capital within the value network of the ecotourism provider. By understanding the higher purpose of the organization and the importance of scientific research in sustaining the health of the surrounding ecosystems, employees and local residents may create a common meaning. When employees internalize this higher purpose, ecotourism providers can diminish recruitment costs; ecotourism providers are better able to retain talented employees who understand the long-term positive benefits of research that translates into conservation actions or policies. Another result of this shared meaning is an increase in employee productivity. The communication of this higher purpose should describe the services provided by the organization to society at large, resulting in a positive image that can engage employees and local communities in more meaningful ways.

Healthy Destination and Lower Costs

Citizen science multiplies the amount of resources available for monitoring and analyzing data for many conservation initiatives. Conservation areas that are effectively managed, in combination with the presence of flagship species, provide intriguing information for potential visitors. This can be used in a communication strategy to attract more travellers to a specific region. In the long term, the application of efficient development policies could create an economic spillover into the production value chain creating benefits for other businesses such as transportation services, guides, and other non-tourism related businesses. In remote ecotourism destinations, the development of small and strong businesses can help lower operational costs to an ecotourism provider, since transporting the goods and services required to operate from distant places can be cost-intensive. These strategies will enable a specific region to be more prepared to compete with other tourism destinations in an increasingly globalized industry.

In order to achieve this competitive advantage, providers must emphasize an effective design of the product to maintain a stable cost structure while providing interactive opportunities for travellers to give back to nature. The recommendations described in section 4.1 with special attention in a multi-stakeholder communication strategy are crucial to produce an advantage among its competitors. In our research, we also found the cost of integrating citizen science into an ecotourism product is relatively low in comparison to the benefits associated with the projects, especially the influential role they can play in strategic sustainable development. These two main aspects with the potential of creating competitive advantage are directly benefiting the business.

Possible implications for Strategic Sustainable Development

This discussion focuses on the implications of the addition of citizen science to an existing ecotourism product have in terms of sustainability. Each of the tourism products discussed in our results have negative environmental and social impacts unrelated to the addition of citizen science. However, these ecotourism products would exist with or without citizen science and therefore our aim is only to understand how the merge of citizen science and ecotourism can support strategic sustainable development. This chapter focuses on our sustainability results section; however, it also comments on the implications for sustainability of all of our findings.

Creating a Vision using a Systems Perspective

Overall, we found that projects integrating citizen science into ecotourism products showed a lot of potential to contribute to strategic sustainable development. However, sustainability objectives must be incorporated at the onset of the project to ensure that these outcomes are realized. While researching projects online, we found that several projects that we examined had clear sustainability related goals/initiatives, including policy development. Some of the projects had already begun using the data from the projects to make changes or implement new policies in their regions. However, the majority of the ecotourism providers that we interviewed struggled to explain exactly how the data they were collecting could be used for conservation initiatives and policy reform. We believe that it is crucial for all of the major stakeholders, especially those implementing the projects, to have a thorough understanding of the project, its vision and its goals. Having a shared mental model of the project can help avoid confusion and conflict in the future. The ecotourism providers should have a strong understanding of the potential impacts of the projects so that this information can be passed along to the participants to enhance their understanding of the experience.

In addition, the respondents struggled to outline how the projects could positively influence the global social and environmental systems, even when, in our opinion, there was a strong potential for positive impacts. These products are part of a larger social and ecological system, and we recommend that ecotourism providers adopt a systems perspective of the impacts their products are creating. The vision for their products should incorporate the systems perspective demonstrated by figure 1.1. The product is nested within the ecotourism industry, which depends on the environment for its success. This systems perspective will help ensure that the projects they invest in can contribute to a sustainable society.

The Importance of a Principled and Operational Definition of Sustainability

The incorporation of citizen science into ecotourism operations is in line with the core purpose of ecotourism which is to provide responsible travel options as well as an educational experience. However, the ecotourism providers we interviewed did not have an operational definition of sustainability that would allow them to ensure that the citizen science projects they support are actually moving society towards a sustainable future. An operational and principled definition of sustainability (such as the definition provided by the FSSD) would not only help them create a vision for their citizen science projects, it would also provide them with a mechanism to assess the sustainability of their operations. Although this research did not attempt to assess the sustainability of the ecotourism providers' business operations, it is

important for them to consider this to ensure that their business activities do not become obsolete by hitting the walls of the funnel as mentioned in section 1.8 of our Introduction. Additionally, the majority of citizen science projects have outcomes related to environmental sustainability, but we would also encourage ecotourism providers to explore how these projects can have implications for social sustainability through the data collection or through other means. Projects with environmental sustainability outcomes will advance the understanding of the fragility of the local biodiversity; however, there is a possibility to expand these implications beyond the environmental benefits. Although only one of the providers we interviewed had explored the possibility of addressing social sustainability challenges using a citizen science we believe that these projects could play an important role in addressing social sustainability.

Implications for Local Communities

As stated in the results, our interview subjects have observed that the support of the local communities is very important for the success of the tourism products. The literature also supports this conclusion; Luštický and Musil (2016) found that the local community has the ability to influence the sustainability and success of the majority of surrounding tourism developments. In isolated ecotourism destinations, the livelihood of the community and the health of their economy depends on the balance of the ecosystem and the health of its natural capital. This emphasis on the role of local communities found in our research has two implications. The first is that we would therefore suggest including the local communities in the development phase of the citizen science project to ensure that it takes into account local challenges with sustainability-related issues. The second is that these citizen science projects should be in some way accessible for the local community. The challenge here is that ecotourism products are either unaffordable or inaccessible for local communities or they are unattractive because tourism activities are often perceived negatively by local residents. Our recommendation to overcome this would be to integrate the participation of locals for free or for a reduced rate on a regular basis. The support from the local communities could result in a better relationship with local governments which may garner support for these and other tourism products. This has important implications for social sustainability in the destination because it provides local citizens with increased knowledge about their community and the surrounding ecosystem. It also gives these local residents the opportunity to influence policy that will impact the long-term health of the ecosystem in the region they depend on.

Education as a Tool for SSD

As mentioned in our guidelines for ecotourism providers, education is an important component of the products discussed in this research. In our research, we have found that citizen science may increase scientific literacy. This is crucial for the sustainability agenda because there is currently a lack of trust in the scientific process from the general public. This is potentially because average citizens are rarely exposed to the academic research process. The merge of citizen science and ecotourism provides exposure to science that the travellers may not seek out or have access to in their home community. The ecotourism providers we interviewed reported an increased consumer appreciation for a vacation experience that also involved education; this is a good indication that the inclusion of citizen science will enhance the general public's perception and understanding of science. This has implications for sustainability because it develops the critical thinking skills necessary to understand the complexity of the sustainability challenge we are facing today and to challenge the status quo.

Acceptance of Citizen Science

Throughout our literature review and our interviews, we have found that the increase in citizen science will likely have positive impacts for the sustainability agenda. Scientific research that plays a role in the transition towards a sustainable society can benefit from the access to a wide variety of remote environments and a faster and more efficient data collection process. Although citizen science has been used in a variety of settings, our interview subjects have experienced that there are still many researchers who regard it as an ineffective method of gathering data. The access that ecotourism provides to scientists for low cost, easily accessible, and high quality data will likely increase the appeal of citizen science across many academic fields, especially if they consider the proposed strategic guideline of data quality (see section 4.1.3.). One of the ecotourism providers we interviewed presented their work with citizen science at an academic conference and her experience was that none of the scientists in the room had even considered that it was possible but were more eager to explore the option following the presentation. It is also likely that the more travellers who have a positive experience with citizen science, the more likely they are to promote it after the end of their vacation. These opportunities of disseminating information demonstrate that ecotourism can help increase the uptake of citizen science in the field and therefore support long term sustainability outcomes.

Potential for Conservation, Restoration and Regeneration

Each of the citizen science projects discussed in this research were initiated due to an interest in environmental conservation. If applied correctly, these projects can go beyond conservation and contribute to the restoration and regeneration of the environment. Instead of only mitigating the impacts of the tourism industry, the merge of citizen science and ecotourism has the potential to provide information that can help reverse historical trends of environmental degradation. This is possible because the integration of citizen science into ecotourism brings together a wide variety of stakeholders who would not normally interact with each other. This diversity of perspective and collective motivation to promote ecosystem regeneration are necessary in order to combat the industries who threaten environmental sustainability objectives.

Awareness of the Travellers

In our literature review we found that applied separately, ecotourism and citizen science both have the possibility to result in pro-environmental behavioural change of the travellers even after they return home. Although there is very little empirical evidence of this, our exploratory interviews confirmed that travellers are returning home with a renewed appreciation for environmental conservation. In addition, each of the products reviewed in this research contain high quality interpretive experiences, direct contact with flora and fauna, and the opportunity to engage in environmentally related behaviours during the tour - the combination of which results in pro-environmental behaviour change (Ardoin et al. 2017). This may indicate that if applied correctly, these products have the potential to influence the global transition towards sustainability through the individuals who experience them. Citizen science projects often rely on volunteers from the local area on an ongoing basis. In contrast, ecotourism providers are in a unique position to promote sustainability as they interact with a diverse group of individuals from around the world. Combining their products with citizen science projects could extend the reach of the benefits of the projects to wider audiences. In an ordinary setting, there may not be an opportunity to explore the relationship these individuals have with the environment and this

conversation may even conflict with their existing belief system. These products should therefore help target individuals who are not already sustainability-conscious.

Policy Development

Although our literature review revealed that there are likely multiple benefits from an immersive natural experience, we want to go beyond this and ensure that the citizen science projects that are being carried out by paying travellers actually have implications for the global transition towards sustainability. It is easy to have travellers collect data that does not offer any tangible outcomes in terms of the sustainability agenda, but these projects will not contribute to the health of our ecological and social systems. Data collected by travellers can provide crucial evidence needed to make strategic decisions about the local environment, protected areas, and the management of fragile natural attractions. The more data and accurate information collected about a destination, the more policies for its conservation or restoration can be better implemented.

Validity and Limitations of the Research

This section explores the validity and limitations connected to the study design, research process, time frame and accessibility of data. Maxwell (2013, 122) points out that validity is “the correctness or credibility of a description, conclusion, explanation, interpretation, or other sort of account”. As Price and Murnan (2004) described, limitations have an influence on the generalizability and applicability in practice and need to be acknowledged.

The validity of this research stems, among others, from the chosen mixed method research design. By triangulating quantitative and qualitative methods, we were able to offset the weaknesses (e.g. the researcher bias) of the predominantly qualitative research design. Researcher bias refers to the subjectivity of the researcher (Maxwell 2013), and the mixed method helped to enhance the objectivity of our results by adding a quantitative strand to validate the findings from the interviews.

Since we were aware of potential biases, we mainly used triangulation to validate our findings. For instance, we assigned two persons for conducting each interview, and the other two transcribed and coded the interview. Having two individuals in the room for conducting interviews, whereby one person acted as a control person, ensured that all relevant questions were asked in the most objective way possible. The fact that the two others were responsible for transcribing and coding the interviews ensured that all team members had a similar level of knowledge, which was necessary to validate, expand, or clarify the findings from the interview. Other tools to enhance the validity of our study involved making use of scientific methods for acquiring more knowledge like Snowballing during the literature review. Preparing the research by using a system’s perspective enabled us to examine all relevant aspects connected to the topic of ecotourism and citizen science.

We alternated the individuals conducting the interviews, transcribing, and coding. In order to avoid the topic of reactivity, which Maxwell (2013, 124) refers to as “the influence of the researcher on the setting or individual studied”, we prepared standardised questions for the semi-structured interviews to assure the least possible differences between interviewers’ question.

In regards to limitations, the limited amount of literature about ecotourism and citizen science combined made it difficult to validate findings and make definitive conclusions. Because of the relative newness of these products, the possibility for qualitative research incorporating a large sample size of interview partner was limited. Identifying ecotourism providers already offering these products was also difficult as the terms used in their marketing varied from one provider to the next. The study ended up with five exploratory interviews with ecotourism providers who represent a minor part of the ecotourism market. This influences the generalizability of the study to the whole ecotourism market. Another limitation in regards to the exploratory interviews were that the interviewees only had limited time available for the interviews.

The exploratory interviews were conducted with a variety of providers in multiple locations throughout the globe. This is a definite strength of this study since the presented results and discussions are as general as possible since it involved findings from the different locations, tour set-ups, tour operations such as marine or land-based tours.

However, it needs to be noted that this study might be affected by many factors linked to the differences in destination, consumer, equipment, and the perception of ecotourism providers about the right process. Overall, this influences the comparability of data, the discussion and the conclusions about a process. Ideally, the study would show the same variety of investigated tourism products with more ecotourism providers doing the same kind of tours in the same region. This would have helped identify patterns within, for example, land-based operations and would have also allowed for more nuances in the process for specific types of tourism providers.

According to Saunders, Lewis, and Thornhill (2009), the general weaknesses of using the quantitative method of a questionnaire are only having one chance to collect data, problems in identifying respondents, and no possibility to return to respondents to gather additional information. For this research, it was only possible to collect data from one market (Costa Rica) since it was the one that the researchers had access to. This mono focus made the study limited in terms of proving the competitive advantage for ecotourism provider worldwide.

The limited amount of time for the research influenced the number of interviews we were able to conduct. Because of time constraints, a more thorough analysis of the ecotourism products and their contribution to sustainability was not possible. This would have helped to understand the differences of the products better and would have supported the development of more detailed recommendations for the process and the optimization of the contribution towards sustainability. The limited time prevented us from creating a prototype to test the best-practice process on a new tourism product and check for the effectiveness. This would have added validity to the recommendations given in the previous sections.

Overall, the study design was credible because of the mixed method research design and triangulation used during the process, but it also showed limitations in regards to the sample size, the geographical dispersity for the exploratory interviews, the geographical focus for the questionnaire, and the limited time frame for the study.

Future research

It is important to consider that although our research indicates that these products *may* encourage ecological and social sustainability progress through the travellers who experience them as well as the communities they visit, we were not able to interview either of these groups.

In order to further the understanding of whether the incorporation of citizen science into ecotourism will benefit the sustainability awareness of the travellers who experience it, the field of behavioural science should measure the activities and opinions of travellers before and after they participate in an ecotourism product that incorporates citizen science. The perception of these individuals is crucial in order to understand how these products move society towards sustainability. This research is challenging because it involves assessing the baseline environmental awareness of an individual before they visit a destination. However, it would provide invaluable insights about how to foster these transformational experiences in ecotourism products. In addition to evaluating the impact on the travellers, future research should also explore how these citizen science projects are perceived by local residents. Tourists generally have a bad reputation in the destination community and it would be interesting to understand if the notion that these travellers are paying to contribute to the health of the local environment would impact the perception local residents have of ecotourism activities

The audience for our research and the stakeholders that our guidelines will benefit the most are ecotourism providers. However, it would also be interesting to evaluate how tour operators, instead of tour providers are reacting to the increase in popularity of citizen science projects within ecotourism. In some nature-based tourism industries, the tour operator plays a major role in the options that are available to the consumers. Lozano, Arbulu and Rey-Maquiera (2016) found that tourism operators are often more capable of coordinating the management of natural resources in comparison to smaller tour providers. This finding was supported in some interviews because the presence of an organization that dealt with a larger network of small suppliers was able to coordinate the implementation of large scale citizen science projects across multiple tourism providers

It would also have increased the validity of our results if we had the opportunity to test the adaptations we proposed to the CLO toolkit in the field. It would be valuable to distribute the version we proposed in our discussion to the ecotourism providers we interviewed. This would enable us to verify whether there are any aspects to the toolkit that are missing from our recommendations. Future research could also provide these instructions to a tourism operator who has yet to integrate citizen science into their ecotourism product and clarify what needs to be added for a practitioner who is not familiar with the concept of citizen science.

Future research could also develop the understanding of the benefits of integrating citizen science into ecotourism products by investigating whether it is the education of travellers, the outcomes of the citizen science projects, or the focus on sustainability initiatives in destination communities that has a larger impact on societies transition towards sustainability.

Conclusion

Tourism continues to be one of the strongest global economic growth drivers, but it has also been critiqued for being a major cause of negative environmental impacts, loss of cultural identity, and the perpetuation of economic inequality. The number of annual international tourists is expected to grow to 1.8 billion by 2030, the tourism industry is in a unique position to either positively influence sustainability issues faced in society or risk having greater negative impacts. The effects of climate change will have the biggest impact on the tourism providers who depend on the natural environment for their success. One such susceptible type is nature-based tourism (NBT) expected to represent 25% of the global tourism industry by 2020. Its growth can be attributed to ecotourism which is a type of NBT that prioritizes environmental conservation and the well-being of the local community.

Due to the expected growth in tourism industry and the impacts attached to it, it is important for society that there are clear guidelines in place to mitigate the unsustainable practices and promote conservation and restoration efforts. If implemented true to its definition, ecotourism has the potential to have positive effects on the environmental and social well-being of the areas where it is applied. Ecotourism providers were established as a crucial leverage point for strategic sustainable development in the tourism sector because they are responsible for designing their products and have the potential to greatly influence tourists through strong interactions with consumers. Furthermore, if tourism providers continue to neglect the impacts they have on society and on the environment and do not push for conservation and regenerative measures, they run the risk of hitting the funnel walls as described within the FSSD.

Our research indicated that ecotourism and citizen science applied separately had potential to positively impact the transition towards a sustainable society; however, there was a gap in literature about how the combination of these concepts could enhance one another and their contributions to sustainability. One of the biggest barriers that we found in order to integrate citizen science into ecotourism products, is that the ecotourism providers do not know how to effectively design and implement this kind of product or the business benefits that it can deliver to the organization. After analyzing several citizen science guidelines, the group chose to use the Cornell Laboratory for Ornithology Citizen Science Toolkit as a base in order to make a series of recommendations to adapt it and facilitate the integration of citizen science to the ecotourism providers. This toolkit was chosen because it represented the most exhaustive and well-researched framework for the implementation of citizen science projects. The integration of citizen science within ecotourism presents an innovative opportunity to transform the ecotourism industry towards a more transparent, authentic and sustainable sector. We therefore created a series of recommendations for ecotourism companies to apply in their products in order to support this transition.

The collection of data can be used to create an understanding of sustainability impacts which can then drive more effective sustainability-focused policies. The integration has also been shown to support an increase of environmental awareness and scientific literacy of travellers which could have important implications for changing behaviours and attitudes regarding sustainability. The ecotourism products integrating citizen science have the potential to meet all three key elements that result in pro-environmental behavioural change: high equality interpretive experiences, direct contact with wildlife and the opportunity to engage in environmentally related behaviour on site. However, further research needs to be done in order to verify if and how behavior change is stimulated by these products and if this can be sustained

over time. Although the transition towards sustainability is the focus of this research, we have also found that the integration of citizen science into ecotourism products has an additional value for the success of ecotourism providers. Since the integration delivers a more profound and unique experience for travellers and vast possibilities for the differentiation of the organizations in a highly competitive market.

The integration of citizen science in ecotourism has the potential to influence the global transition towards a sustainable tourism sector. These products impact the relationship with nature of the consumers who pay for them, the ecotourism providers, and the local communities where these projects occur. The tourism industry has access to a number of individuals who may not normally be exposed to the scientific process. Citizen science will encourage research in regions that may not otherwise have the ability to influence the shift towards sustainability and provide a platform for local communities to affect policies in their area. Furthermore, these products could provide a platform for reaching people across diverse backgrounds and help them understand the importance of a healthy environment without directly using highly polarized and politicised topics such as climate change. They could transcend political, socio-economical, cultural, religious, and other divides and promote sustainability in a novel way. If ecotourism and citizen science products are designed and implemented correctly, carefully planned and respecting their different stages, they have the potential to have positive effects on the environmental and social well-being of the areas where it is applied. Furthermore, it is highly probable they can influence the global transition towards a sustainable tourism sector.

References

- Andereck, L. Kathleen, Karin M. Valentine, Richard C. Knopf and Christine A. Vogt. 2005. "Residents Perceptions of Community Tourism Impacts." *Annals of Tourism Research* 32, no. 4:1056-76. Accessed April 11, 2018. <http://dx.doi.org/10.1016/j.annals.2005.03.001>.
- Anderson, Lucy G. Steve Rocliffe, Neal R. Haddaway, and Alison M. Dunn. 2015. "The Role of Tourism and Recreation in the Spread of Non-Native species: A systemic review and Meta-Analysis" *PloS One* 10, no. 10: 1-15. Accessed May 23, 2018. <http://dx.doi.org/10.1371/journal.pone.0140833>.
- Almeyda, Angélica, Eben N. Broadbent, and William H. Durham. 2010. "Social and Environmental Effects of Ecotourism in the Osa Peninsula of Costa Rica: The Lapa Rios Case". *Journal of Ecotourism* 9, no.1: 62-83. Accessed April 26, 2018. <http://dx.doi.org/10.1080/14724040902953076>.
- Almeyda, Angélica, Eben N. Broadbent, Miriam S. Wyman, and William H. Durham. 2010. "Ecotourism Impacts in the Nicoya Peninsula, Costa Rica". *International Journal of Tourism Research* 12: 803–19. Accessed April 20, 2018. <http://dx.doi.org/10.1002/jtr.797>.
- Ardoin, Nicole M., Mele Wheatson, Alison W. Bowers, Carter A. Hunt and William H. Durham. 2015. "Nature Based Tourism's Impact on Environmental Knowledge, Attitudes, and Behaviour: A Review and Analysis of the Literature and Potential Future Research." *Journal of Sustainable Tourism* 23, no. 6: 838-58. Accessed January 14, 2018. <http://dx.doi.org/10.1080/09669582.2015.1024258>.
- Bastakis, Constantinos, Dimitrios Buhalis, and Richard Butler. 2004. "The Perception of Small and Medium Sized Tourism Accommodation Providers on the Impacts of the Tour Operators' Power in Eastern Mediterranean." *Tourism Management* 25:151–70. Accessed April 30, 2018. [https://doi.org/10.1016/S0261-5177\(03\)00098-0](https://doi.org/10.1016/S0261-5177(03)00098-0).
- Blamey, Russel K.. 1997. "Ecotourism: The Search for an Operational Definition." *Journal of Sustainable Tourism* 5, no 2: 109-30. Accessed March 10, 2018. <https://doi.org/10.1080/09669589708667280>.
- Bliss, John, Greg Aplet, Cate Hartzell, Peggy Harwood, Paul Jahnige, David Kittredge, Stephan Lewandowski, and Mary Lou Soscia. 2001. "Community-Based Ecosystem Monitoring." *Journal of Sustainable Forestry* 12, no.3-4: 143–67. Accessed April 20, 2018. http://dx.doi.org/10.1300/j091v12n03_07.
- Bonney, Rick, Caren B. Cooper, Janis Dickinson, Steve Kelling, Tina Phillips, Kenneth V. Rosenberg, and Jennifer Shirk. 2009. "Citizen Science: A Developing Tool for Expanding Science Knowledge and Scientific Literacy." *BioScience* 59, no. 11: 977–84. Accessed February 20, 2018. <http://dx.doi.org/10.1525/bio.2009.59.11.9>.
- Buckley, Ralph. 2012. "Sustainable Tourism: Research and Reality." *Annals of Tourism Research* 39, no. 2: 528-46. Accessed January 2, 2018. <http://dx.doi.org/10.1016/j.annals.2012.02.003>.

- Budeanu, Adriana. 2005. "Impacts and Responsibilities for Sustainable Tourism: A Tour Operator's Perspective." *Journal of Cleaner Production* 13: 89–97. Accessed February 10, 2018. <http://dx.doi.org/10.1016/j.jclepro.2003.12.024>.
- Broman, Göran and Karl Henrik Robèrt. 2017. A framework for strategic sustainable development. *Journal of Cleaner Production* 140: 7-31. Accessed on April 26, 2017. <http://dx.doi.org/10.1016/j.jclepro.2015.10.121>.
- Bryman, Alan. 2006. "Integrating Quantitative and Qualitative Research: How Is It Done?" *Qualitative Research* 6 (1): 97–113. Accessed April 28, 2018. <https://doi.org/10.1177/1468794106058877>.
- Capra, Fritjof. 1985. *Criteria of Systems Thinking*. Butterworth & Co (Publishers) Ltd.
- Ceballos-Lascuráin, Hector. 1987. "The Future of Ecotourism." *Mexico Journal*: 13-14. Quoted in Slocum, Susan L. Carol Kline and Andrew Holden. 2015. *Scientific Tourism: Researches as Travellers*. London: Routledge.
- Choi, Hwan-Suk Chris, and Ercan Sirakaya. 2005. "Measuring Residents' Attitude toward Sustainable Tourism: Development of Sustainable Tourism Attitude Scale." *Journal of Travel Research* 43, no.4: 380–94. Accessed February 8, 2018. <http://dx.doi.org/10.1177/0047287505274651>.
- Choi, Hwansuk Chris, and Iain Murray. 2010. "Resident Attitudes toward Sustainable Community Tourism." *Journal of Sustainable Tourism* 18, no.4:575–94. Accessed February 10, 2018. <http://dx.doi.org/10.1080/09669580903524852>.
- Citizen Science Center. 2015. "Citizen Science: Definition." Citizen Science Center. September 24. Accessed March 5, 2018. <http://www.citizensciencecenter.com/citizen-science-definition/>.
- CLO. 2018. "Mission: Citizen Science." Cornell Lab of Ornithology. Accessed March 1, 2018. <http://www.birds.cornell.edu/page.aspx?pid=1664>.
- Cornell Lab of Ornithology. 2018. "About the Toolkit." Citizen Science Central. Accessed March 1, 2018. <http://www.birds.cornell.edu/citscitoolkit/toolkit/about>.
- Creswell, John W., and Vicki L. Plano Clark. 2011. *Designing and Conducting Mixed Methods Research*. 2nd ed. Thousand Oaks, CA: SAGE Publications.
- Deery, Margaret, Leo Jago, and Liz Fredline. 2012. "Rethink Social Impacts of Tourism Research: A New Research Agenda." *Tourism Management* 33:64-73. Accessed March 22, 2018. <http://dx.doi.org/10.1016/j.tourman.2011.01.026>.
- Davis, Derrin, and C.A. Tisdell. 1998. "Tourist Levies and Willingness to Pay for a Whaleshark Experience." *Tourism Economics* 5, no. 2: 161-74. Accessed April 26, 2018. <http://dx.doi.org/10.1177/135481669900500203>.
- Dickinson, Janis L., Benjamin Zuckerberg, and David N. Bonter. 2010. "Citizen Science as an Ecological Research Tool: Challenges and Benefits." *Annual Review of Ecology*,

- Evolution, and Systematics* 41, no.1: 149–72. Accessed March 30, 2018. <http://dx.doi.org/10.1146/annurev-ecolsys-102209-144636>.
- Evans, Celia, Eleanor Abrams, Robert Reitsma, Karin Roux, Laura Salmonsens, and Peter P. Marra. 2005. "The Neighborhood Nestwatch Program: Participant Outcomes of a Citizen-Science Ecological Research Project." *Conservation Biology* 19, no.3: 589–94. Accessed March 20, 2018. <http://dx.doi.org/10.1111/j.1523-1739.2005.00s01.x>.
- Frauman, Eric and Sarah Banks. 2011. "Gateway Community Resident Perceptions of Tourism Development: Incorporating Importance-Performance Analysis into a Limits of Acceptable Change Framework". *Tourism Management* 32:128-140. Accessed April 28, 2018. <http://dx.doi.org/10.1016/j.tourman.2010.01.013>.
- Gössling, Stefan. 2002. "Global Environmental Consequences of Tourism." *Global Environmental Change* 12, no.4: 283–302. Accessed January 15, 2018. [https://dx.doi.org/10.1016/S0959-3780\(02\)00044-4](https://dx.doi.org/10.1016/S0959-3780(02)00044-4).
- Handriana, T., and R. Ambara. 2016. "Responsible Environmental Behaviour Intention of Travellers on Ecotourism Sites." *Tourism and Hospitality Management* 22, no. 2: 135-50. Accessed February 7, 2018. <https://dx.doi.org/10.20867/thm.22.2.4>.
- Haley, A.J., Tim Snaith, and Graham Miller. 2005. "The Social Impacts of Tourism a Case Study of Bath, UK." *Annals of Tourism Research* 32 (3). Pergamon:647–68. Accessed May 8, 2018. <https://doi.org/10.1016/J.ANNALS.2004.10.009>.
- Heiman, Michael K. 1997. "Science by the People: Grassroots Environmental Monitoring and the Debate Over Scientific Expertise." *Journal of Planning Education and Research* 16, no.4: 291–99. Accessed April 30, 2018. <http://dx.doi.org/10.1177/0739456x9701600405>.
- Higham, James E. S., Scott A. Cohen, and Christina T. Cavaliere. 2013. "Climate Change, Discretionary Air Travel, and the "Flyers' Dilemma"." *Journal of Travel Research* 53, no. 4: 462-75. Accessed May 11, 2018. <http://dx.doi.org/10.1177/0047287513500393>.
- Honey, Martha. 2008. *Ecotourism and Sustainable Development: Who Owns Paradise?* Washington, DC: Island Press.
- Hunsberger, Carol. 2004. "Exploring Links between Citizen Environmental Monitoring and Decision Making: Three Canadian Case Examples." Thesis. University of Waterloo.
- Hunt, Shelby D. and Robert M. Morgan. 1995. "The Comparative Advantage Theory of Competition." *Journals of Marketing* 59, no.2: 1-15. Accessed May 9, 2018. <http://dx.doi.org/10.2307/1252069>.
- Jere Jakulin, Tadeja. 2017. "Systems Approach to Tourism: A Methodology for Defining Complex Tourism System." *Organizacija* 50 (3):208–15. Accessed May 9, 2018. <https://doi.org/10.1515/orga-2017-0015>.

- Johnson, David. 2006. "Providing Ecotourism Excursions for Cruise Passengers." *Journal of Sustainable Tourism* 14, no. 1: 43-54. Accessed on April 26, 2018. <http://dx.doi.org/10.1080/09669580608668590>.
- Johnson, R. Burke, Anthony J. Onwuegbuzie, and Lisa A. Turner. 2007. "Toward a Definition of Mixed Methods Research." *Journal of Mixed Methods Research* 1, no.2 :112–33. Accessed May 2, 2018. <https://dx.doi.org/10.1177/1558689806298224>.
- Juvan, Emil and Sara Dolnicar. 2017. "Drivers of Pro-environmental Tourist Behaviours are not Universal." *Journal of Cleaner Production* 166:879-90. Accessed May 11, 2018. <https://dx.doi.org/10.1016/j.jclepro.2017.08.087>.
- Kim, Daniel H. 1999. *Introduction to Systems Thinking*. Pegasus Communication. Accessed April 24, 2018. <https://thesystemsthinker.com/wp-content/uploads/2016/03/Introduction-to-Systems-Thinking-IMS013Epk.pdf>.
- Kariminia, Shabab, Sabarinah Sh. Ahman, Rugayah Hashim and Zulhabri Ismail. 2013. "Environmental Consequences of Antarctic Tourism from a Global Perspective." *Social and Behavioural Sciences* 105: no. 3:781-91. Accessed May 11, 2018. <https://doi.org/10.106/j.sbspro.2013.11.081>.
- Kosmala, Margaret, Andrea Wiggins, Alexandra Swanson, and Brooke Simmons. 2016. "Assessing Data Quality in Citizen Science." *Frontiers in Ecology and the Environment* 14, no.10 :551–60. Accessed February 10, 2018. <http://dx.doi.org/10.1002/fee.1436>.
- Kullenberg, Christopher, and Dick Kasperowski. 2016. "What Is Citizen Science? A Scientometric Meta-Analysis." *PloS One* 11, no.1. Accessed February 16, 2018. <https://dx.doi.org/10.1371/journal.pone.0147152>.
- Krüger, Oliver. 2005. "The Role of Ecotourism in Conservation: Panacea or Pandora's Box?" *Biodiversity and Conservation* 14: 579–600. Accessed April 25, 2018. <http://dx.doi.org/10.1007/s10531-004-3917-4>.
- Luštický, M., and M. Musil. 2016. "Towards a Theory of Stakeholders' Perception of Tourism Impacts." *Czech Journal of Tourism* 5, no.2: 93–110. Accessed April 10, 2018. <http://dx.doi.org/10.1515/cjot-2016-0006>.
- Lozano, Javier, Italo Arbulú, and Javier Rey-Maqueira. 2016. "The Greening Role of Tour Operators." *Environmental Management* 57:49–61. Accessed March 1, 2018. <http://dx.doi.org/10.1007/s00267-015-0587-9>.
- National Research Council. 1996. "Principles and Definitions." In *National Science Education Standards*, 19-24. Washington, DC: The National Academies Press. <http://dx.doi.org/10.17226/4962>.
- Mason, Peter. 2008. *Tourism Impacts, Planning and Management (2nd Edition)*. Burlington, MA: Butterworth-Heinemann. Accessed February 18, 2018. <http://dx.doi.org/10.1016/B978-0-7506-8492-7.00014-4>.

- Maxwell, Joseph A. 2013. *Qualitative Research Design: An Interactive Approach*. 3ed. Thousand Oaks, CA: SAGE Publications.
- McDaniel, Carl, and Roger Gates. 2013. *Marketing Research*. 9ed. Singapore: Wiley & Sons.
- McNamee, David. 2014. "Why Is Scientific Literacy among the General Population Important?" *Medical News Today*, August 22. Accessed April 22, 2018. <https://www.medicalnewstoday.com/articles/281470.php>.
- Missimer, Merlina. 2015. "Social Sustainability Within the Framework for Strategic Sustainable Development." PhD Diss., Blekinge Institute of Technology. Accessed May 21, 2018. <http://bth.diva-portal.org/smash/record.jsf?pid=diva2%3A852857&dswid=-1602>.
- Mitchell, Brooke. 2017. "From Tourist to Scientist: Using Citizen Science to Increase Conservation Action." Accessed February 8, 2018. <https://seethewild.org/tourist-scientist-using-citizen-science-increase-conservation-action/>.
- Park, Minkung and Patricia A. Stokowski. 2009. "Social Disruption Theory and Crime in Rural Communities: Comparisons across Three Levels of Tourism Growth." *Tourism Management* 30: 905-15. Accessed April 12, 2018. <http://dx.doi.org/10.1016/j.tourman.2008.11.05>.
- Price, James H. and Judy Murnan. "Research Limitations and the Necessity of Reporting Them." *American Journal of Health Education* 35 (2004): 66-67. Accessed May 8, 2018. <https://doi.org/10.1080/19325037.2004.10603611>.
- Porter, Michel E. 1985. *Competitive Advantage: Creating and Sustaining Superior Performance*. New York, NY: The Free Press.
- Ryan, Chris and Huimin Gu. 2010. "Constructionism and Culture in Research: Understandings of the Fourth Buddhist Festival, Wutaishan, China." *Tourism Management* 31:167-78. Accessed March 17, 2018. <http://dx.doi.org/10.1016/j.tourman.2009.01.003>.
- Rogers, E. 2003. *Diffusion of Innovation*. 5ed. New York: Free Press.
- Saldana, Johnny. 2009. *The Coding Manual for Qualitative Researchers*. London: SAGE Publications. Accessed May 2, 2018. http://stevescollection.weebly.com/uploads/1/3/8/6/13866629/saldana_2009_the-coding-manual-for-qualitative-researchers.pdf.
- Savan, Beth, Alexis J. Morgan, and Christopher Gore. 2003. "Volunteer Environmental Monitoring and the Role of the Universities: The Case of Citizens Environment Watch." *Environmental Management* 31, no.5: 561-68. Accessed April 25, 2018. <http://dx.doi.org/10.1007/s00267-002-2897-y>.
- Saunders, Mark, Lewis, Philip, and Adrian Thornhill. 2009. *Research Methods for Business Students*. 5th ed. Harlow, Essex: Pearson Education Limited.

- Savin-Baden, Maggi, and Claire Howell Major. 2013. *Qualitative Research: The Essential Guide to Theory and Practice*. London: Routledge.
- Slocum, Susan L., Carol Kline, and Andrew Holden. 2015. *Scientific Tourism: Researches as Travellers*. London: Routledge.
- Socci, C. Y. Ali, M. Ciaschini, R. Pretaroli, F. Severini. 2016. Estimating the economic impact of tourism industry through the MM approach. *Economic Sciences* 9: no. 2:127-52. Accessed on May 11th, 2018.
http://webbut.unitbv.ro/Bulletin/Series%20V/BULETIN%20I/15_Socci.pdf
- Stronza, Amanda, and Javier Gordillo. 2008. "Community Views of Ecotourism." *Annals of Tourism Research* 35, no. 2: 448-68. Accessed January 3, 2018.
<http://dx.doi.org/10.1016/j.annals.2008.01.002>.
- TIES. 2015. "TIES Announces Ecotourism Principles Revision". The International Ecotourism Society. Accessed January 14, 2018.
<http://www.ecotourism.org/news/ties-announces-ecotourism-principles-revision>.
- TOI for Sustainable Tourism Development. 2003. *Sustainable Tourism, The Tour Operators' Contribution*. Accessed May 1, 2018.
http://apps.unep.org/redirect.php?file=/publications/pmtdocuments/-Sustainable%20Tourism_%20The%20Tour%20Operator%27s%20Contribution-2003647.pdf.
- Toomey, Anne, and Margret Domroese. 2013. "Can Citizen Science Lead to Positive Conservation Attitudes and Behaviors?" *Human Ecology Review* 20, no. 1: 50-62. Accessed February 8, 2018. <http://www.jstor.org/stable/24707571>.
- UNEP & UNWTO. 2008. *Climate Change and Tourism Responding to Global Challenges*. Accessed May 2, 2018. <https://sdt.unwto.org/sites/all/files/docpdf/climate2008.pdf>
- UNWTO. 2017. *Tourism and the Sustainable Development Goals – Journey to 2030*. Accessed April 30, 2018. <http://www.e-unwto.org/doi/book/10.18111/9789284419401>.
- Valentine, P. 1993. "Ecotourism and Nature Conservation: A Definition with Some Recent Developments in Micronesia." *Tourism Management* 14, no.2: 107-15. Accessed January 20, 2018. [http://dx.doi.org/10.1016/0261-5177\(93\)90043-K](http://dx.doi.org/10.1016/0261-5177(93)90043-K)
- Vitousek, Peter M. 1994. "Beyond Global Warming: Ecology and Global Change." *Source: Ecology* 75, no.7:1861–76. Accessed January 8, 2018.
<http://www.jstor.org/stable/1941591>.
- Vitousek, Peter M. Harold A. Mooney, Jane Lubchenco, Jerry M. Melillo. 1997. Human Domination of Earth's Ecosystems. *Science* 277:494-499. Accessed May 11, 2018.
http://dx.doi.org/10.1007/978-0-387-73412-5_1.
- Wearing, Stephen, and John Neil. 1999. *Ecotourism: Impacts, Potential and Possibilities*. Oxford: Butterworth-Heinemann.

- Weaver, David B., and Laura J. Lawton. 2007. "The State of Contemporary Ecotourism Research." *Tourism Management* 2: 1168-79. Accessed February 10, 2018. <http://dx.doi.org/10.1016/j.tourman.2007.03.004>.
- Weiss, Robert S. 1994. *Learning from Strangers: The Art and Method of Qualitative Interview studies*. New York, NY: The Free Press.
- West, Sarah, and Rachel Pateman. 2017. *How Could Citizen Science Support the Sustainable Development Goals?* Accessed February 15, 2018. <https://www.sei-international.org/mediamanager/documents/Publications/SEI-2017-PB-citizen-science-sdgs.pdf>
- Wight, P. 1993. "Ecotourism: Ethics or Eco-sell?" *Journal of Travel Research* 31, no.3: 3-9. Accessed March 2, 2018. <http://dx.doi.org/10.1177/004728759303100301>.
- Willard, Bob. 2012. *The New Sustainability Advantage: Seven Business Case Benefits of a Triple Bottom Line*. Gabriola Island: New Society Publishers.
- Wohlin, Claes. 2014. "Guidelines for Snowballing in Systematic Literature Studies and a Replication in Software Engineering." *Proceedings of the 18th International Conference on Evaluation and Assessment in Software Engineering - EASE '14*, 1–10. Accessed May 3, 2018. <https://doi.org/10.1145/2601248.2601268>.
- World Economic Forum. 2017a. "Digital Transformation Initiative Aviation, Travel and Tourism Industry in Collaboration with Accenture." Accessed January 3, 2018. <http://reports.weforum.org/digital-transformation/wp-content/blogs.dir/94/mp/files/pages/files/wef-dti-aviation-travel-and-tourism-white-paper.pdf>.
- World Economic Forum. 2017b. "The Travel and Tourism Competitiveness Report 2017." Accessed February 18, 2018. http://www3.weforum.org/docs/WEF_TTCR_2017_web_0401.pdf.
- Yoccoz, Nigel G., James D. Nichols, and Thierry Boulinier. 2001. "Monitoring of Biological Diversity in Space and Time." *Trends in Ecology & Evolution* 16, no.8: 446–53. Accessed March 28, 2018. [http://dx.doi.org/10.1016/s0169-5347\(01\)02205-4](http://dx.doi.org/10.1016/s0169-5347(01)02205-4)

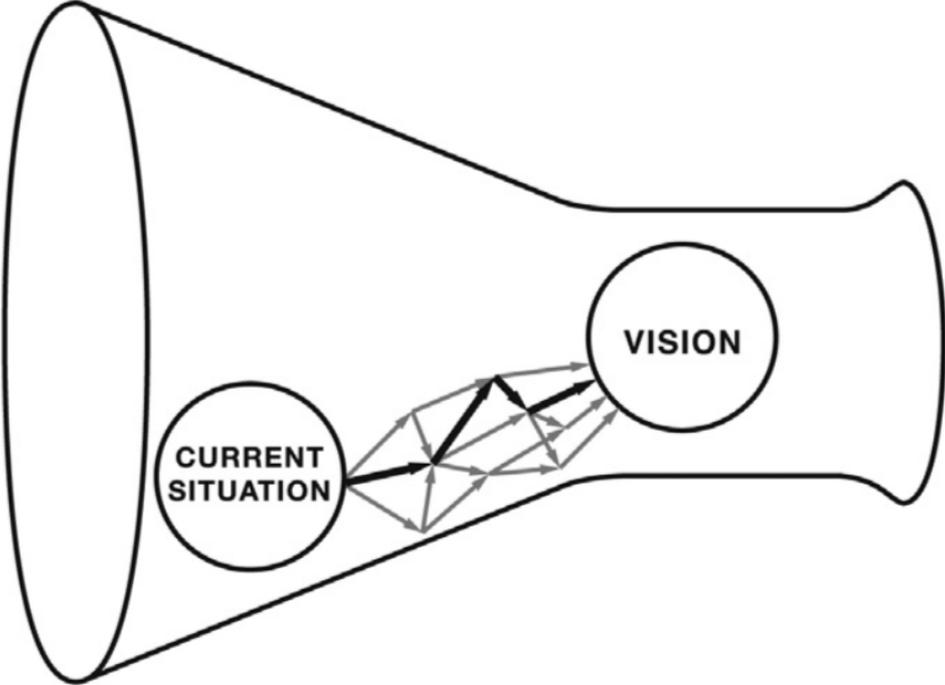
Appendix A

Table: Major Climate Change Impacts and Implications for Tourism Destinations (UNEP & UNWTO 2008, 61).

Impact	Implications for tourism
Warmer temperatures	Altered seasonality, heat stress for tourists, cooling costs, changes in: plant-wildlife-insect populations and distribution range, infectious disease ranges
Decreasing snow cover and shrinking glaciers	Lack of snow in winter sport destinations, increased snow-making costs, shorter winter sports seasons, aesthetics of landscape reduced
Increasing frequency and intensity of storms	Risk for tourism facilities, increased insurance costs/loss of insurability, business interruption costs
Reduced precipitation and increased evaporation in some regions	Water shortages, competition over water between tourism and other sectors, desertification, increased wildfires threatening infrastructure and affecting demand
Increased frequency of heavy precipitation in some regions	Flooding damage to historic architectural and cultural assets, damage to tourism infrastructure, altered seasonality (beaches, biodiversity, river flow)
Sea level rise	Coastal erosion, loss of beach area, higher costs to protect and maintain waterfronts and sea defences
Sea surface temperature rise	Increased coral bleaching and marine resource and aesthetic degradation in dive and snorkel destinations
Changes in terrestrial and marine biodiversity	Loss of natural attractions and species from destinations, higher risk of diseases in tropical-subtropical countries
More frequent and larger forest fires	Loss of natural attractions, increase of flooding risk, damage to tourism infrastructure
Soil changes (such as moisture levels, erosion and acidity)	Loss of archaeological assets and other natural resources, with impacts on destination attractions

Appendix B

Funnel metaphor including the last step of the ABCD procedure (Broman and Robèrt 2017).



Appendix C

List of Keywords

Topic/Theme	Related keywords	Other relevant search terms
Tourism	Ecotourism Nature-based tourism Sustainable tourism Wildlife tourism Conservation Tourism Scientific Tourism	Impacts Impacts on sustainability Challenges Benefits Statistics Guidelines Principles System
Citizen Science	Public participation in scientific research (PPSR) Volunteer biological monitoring Community science Community-based monitoring Crowd-sourced science Participatory monitoring	Impacts Impacts on sustainability Challenges Benefits Framework Guidelines Principles Scientific Literacy
Sustainable Development	Sustainability Destination Development	Environmental Social Economical

Appendix D

Overview of the interview subjects

Interview Respondent	Location of Project	Role of Interviewee
Ecotourism Providers (ETP)		
ETP 1	Juneau, Alaska	General Manager and Owner
ETP 2	Peru	Project Manager
ETP 3	Costa Rica	Co-Director
ETP 4	Turks & Caicos	Owner
ETP 5	Antarctica, Arctic	Expeditions Operations Manager
Scientists		
Scientist 1	California	PhD Candidate
Scientist 2	Juneau, Alaska	Scientist
Non-Profit Organizations		
NPO 1	Montana	Project Creation Coordinator
NPO 2	Antarctica, Arctic	Expedition Guide

Appendix E

Overview of the ecotourism products and the activities of the NPO's

Name of the Organisation	CS/ET Product Description and NPO's Activities
ETP 1	Hands on experiences may include collecting water samples, invasive species monitoring, plankton sampling, humpback whale identification, and recording marine mammal observations. The completed observational data-logging will improve scientists' understanding of the local food chain and other environmental variables that affect local marine wildlife populations.
ETP 2	Participants have the option to participate in 3 citizen science projects. They can collect insect specimens and identify them. They can travel to motion sensor activated cameras in the jungle to maintain them and collect and replace the memory cards. They can also participate in an aerobotany project that involves accessing a view point where guides fly a drone over the tree top to get aerial photos of a specific species of tree.
ETP 3	<p>Sea Turtle Conservation: Tourists will patrol the beach and learn how conservationists locate nests and triangulate their position for future beach patrols. Then visit the hatchery where vulnerable nests are relocated and release newly-hatched turtles on the beach.</p> <p>Tropical Reforestation: OC field staff will take the travellers on a hike to identify and collect native seeds replant seedlings from the nursery out into the wild.</p> <p>Wildlife Monitoring: Involves a walk through our extensive trail system to observe the network of camera traps used to detect the presence of Osa's large cats and mammal species. Travellers will learn how to identify and differentiate between the various tracks led by Osa's cat species.</p> <p>Stream Biodiversity: Travellers can participate in water quality monitoring station where they will conduct aquatic biodiversity sampling measures, using kick-nets and leaf pack samples to collect macroinvertebrates from the two streams.</p>

<p>ETP 4</p>	<p>This excursion brings guests into the waters to snorkel with the wildlife while searching for sea turtles (hawksbill and green sea turtles). If a turtle is spotted, it is captured, and data is collected including measurements, signs of damage or injuries (such as scratches on the shells from boat motors), and signs of disease (such as papilloma or other growths). An identification tag is then applied to the turtle's front flippers (or the number is recording if tags are already in place), and the turtle is released.</p> <p>The information collected is sent to the scientist who is doing research aimed at safeguarding the Turks and Caicos Islands turtle population.</p>
<p>ETP 5</p>	<p>The citizen science activities included deck bird watching and monitoring, cloud cover reporting to NASA, collection of plankton from zodiacs. These activities during the excursions were performed in remote areas such as Antarctica and Arctic.</p>
<p>NPO 1</p>	<p>Their role is to facilitate the dialogue between scientists and outdoor enthusiasts who are interested in participating in citizen science projects. Unlike the remainder of our interview subjects they use volunteers to collect data who are capable of accessing remote locations due to their outdoor expertise.</p>
<p>NPO 2</p>	<p>The organisation is responsible for bridging the gap between scientists and ecotourism providers. The citizen science projects they were handling were cloud observations, seabird surveys, a study about phytoplankton, and whale identification. The majority of the projects collected their samples in remote areas such as Antarctica and Arctic.</p>

Appendix F

Exploratory Interview Questions

Research Aim	Primary Question	Sub Question	5 Level Framework	Code	
How can Ecotourism provider incorporate Citizen Science into their products?	Can you give us a detailed description of the current products and services that the org is currently providing		Systems	CS products	
	What is your definition of Citizen Science?		Systems	CS definition	
	What are the required components of a citizen science project?	Do you ever have to compromise on any of the components? Which will you never compromise on?	Systems	Components	
	If we were to take the tour with you today, can you describe the itinerary and what can we expect?		Systems	Itinerary	
	Can you give us a detailed description of the process to set up a CS-ET product? (From initial stages up to completion)	Who initiated the contact?		Actions	Initial contact
		Who are the researchers that you work with in the present?		Systems	Researchers
		Why do you work with them?		Strategic Guidelines	Reason for collaboration
		How did you get in contact with them?		Actions	Contact method

		Which tools do you use in order to support and effectively implement the ET-SC products?	Tools	Implementation tools
		What was your desired end result/vision of success?	Success	Product vision
		Who and how are determined the components of the products?	Strategic Guidelines	Decision making
		How is the training and managing/delivery of data?	Strategic Guidelines	Training / Data
		Who are all the stakeholders required to implement your product?	Systems	Key Stakeholders
		What changes did you have to make in order to offer the product?	Actions	Changes
		What additional costs are associated with your ET-CS products?	Strategic Guidelines	Costs
		Why did you decide to implement this product?	Strategic Guidelines	Reason for Implementation
		What are your biggest challenges in setting up and implementing the ET-CS product?	Success	Set-up Challenges

Research Aim	Primary Question	Sub Question	5 Level Framework	Code
How does the incorporation of CS into ET products contribute to strategic sustainable development?	What is your definition of Sustainability?		Success	Sustainability definition
	How does the ecotourism product contribute to the local and global eco-systems?		Success	+/- SP 1-3
	How does the ecotourism product contribute to the local community and the global society?		Success	+/- SP 4-8
	What are the negative impacts of the product?		Success	SP 1-8
	What could the product do to contribute even more to the environment and society?		Success	Further contribution social/environmental
	What is preventing the organization from implementing these changes?		Strategic Guidelines	Barriers to Change
	Do you take sustainability into account when you make decisions about the product design and implementation?		Strategic Guidelines	Sustainable decision making

Research Aim	Primary Question	Sub Question	5 Level Framework	Code
How the incorporation of citizen science might provide a competitive advantage for the ecotourism providers in the tourism market?	What are the benefits of incorporating citizen science into an ecotourism product?	What would you say to an ecotourism provider who does not citizen science products in order to convince them of their value?	Success	Benefits to business
		How can ET-CS products give you a competitive advantage in the tourism market?	Success	Competitive Advantage
		Do you think ET-CS products provide an added value experience to the consumer?	Success	Benefits to consumers
	How can ET-CS products grow in the tourism sector?		Systems	Barriers to ET-CS growth
	Are there any other products that you think have the potential to incorporate CS?	Would you be willing to? Why or why not?	Strategic Guidelines	Product expansion
	What percentage of your yearly clients participate in CS-ET products?		Systems	Business Data

Appendix G

CLO framework

The considerations in the table below were adapted from the “reality check” and “how to” categories, and the overviews/descriptions were taken from the “overview” section of the respective steps.

	Overview/Description	Considerations
Choose a Question	<p>Where and how does a citizen science project start? Science-based projects often begin with a question best answered with numerous observers. Others may develop in response to an issue that calls for community action. Some projects target a specific audience, such as a school group, and evolve to meet that group's needs. This step addresses common details that should be considered at the outset of any program.</p>	<ul style="list-style-type: none"> - What is the driving force of your particular project? - For you and your partners, which must come first, deciding on the question or the audience? - Choose a topic and question of interest to participants - Ask the community, "what is needed? what can we help with?" - Choose a question in conjunction with appropriate protocols - Know the abilities, interests, and limitations of your volunteers - "Piggy-back" on existing projects - Be flexible, responsive, and opportunistic

<p>Form a Team</p>	<p>Whether you are working at a local organization or a large institution, citizen science projects are inherently collaborative endeavors. A design team with diverse expertise can be useful from the outset to help address the needs of scientists and volunteers, build infrastructure for data management and communication, and to evaluate project success.</p>	<ul style="list-style-type: none"> - articulate goals as clearly as possible - keep the project goals at the forefront - be honest and transparent about your goals - identify areas where your project can benefit from expertise (e.g. educators, researchers, technologists, etc.) - bring in partners early in the process - listen to the needs of other partners - maintain ongoing communication of needs and goals <p>Connecting with scientist:</p> <ul style="list-style-type: none"> - provide resources they cannot find elsewhere (e.g. network) - offer research support (e.g. mini-grants)
<p>Refine Protocols</p>	<p>The question so often asked about volunteer-based research is, "how good are the data?" Every scientific study, volunteer-based or not, should address this concern in the same way: by designing and refining protocols and data forms that facilitate accurate data collection. Here are resources for reaching this goal, which can also provide the most rewarding experience for volunteers.</p>	<ul style="list-style-type: none"> - use proper study design to meet scientific objectives - understand and account for potential biases of research design - ensure study design also facilitates other objectives (e.g., educational) - develop a clearly written protocol - choose protocols within capacity of volunteers - keep protocols transparent (observers should know why they're being asked to do things a certain way) - plan for reasonable equipment intensity (cost, maintenance, usability) <p>See online Toolkit for the following info:</p> <ul style="list-style-type: none"> - Plan ahead for usable data - Make smart use of technology - "Monetize" data for project efficiency - Adapt and improve as necessary

<p>Recruit Participants</p>	<p>Whether knocking on doors or utilizing social networking software online, volunteer recruitment involves a unique skill set. To start, it is advisable to have a target group in mind: do you want to recruit a handful of neighbors, or thousands around the globe? Or perhaps the participants you seek are scientists. Regardless, look here for innovative ideas and tools for recruitment</p>	<ul style="list-style-type: none"> - tap into recruitee interests: <ul style="list-style-type: none"> • Choose a topic with charisma or relevance • capitalize on something that people already like to do - keep your goals in mind, but also: <ul style="list-style-type: none"> • be flexible and responsive to community interests and needs • communicate objectives clearly • be transparent about project goals and rationales - highlight the efforts and results of current volunteers - invite ideas and recruitment material from existing volunteer base - learn from marketing techniques and make use of technology (see toolkit) <p>(Also see toolkit for range of recruiting venues)</p>
<p>Train Participants</p>	<p>Whether you have recruited novice researchers or tapped into amateur expertise, your project will depend on volunteers' familiarity with and commitment to the data collection protocols. Striking the appropriate balance between precision in research and a rewarding experience with science may come down to how this step is handled. Look within for training resources and ideas.</p>	<ul style="list-style-type: none"> - assess volunteers' skill levels - have solid, tested protocols and data sheets prepared (see Refine Protocols) - assure access to all necessary equipment and resources - provide training in both the protocols and the technology they need to implement them - offer optional background training workshops - explain technical terms (e.g. zero data) - provide training on demonstrating data quality and communicating conclusions - keep protocols transparent - provide clear instructions and guidelines for volunteers - plan for protocols that are not equipment-intensive (easier training and maintenance, better overall cost/benefit) - plan straightforward protocols - offer a tiered system for participation (from simple to complex)
<p>Accept Data</p>	<p>"Data" is often considered the be-all and end-all of citizen science work. From a pencil on a datasheet to sophisticated infrastructures for data management, this step offers tips and resources on how to manage the logistics of collecting, storing, and sharing the information on which citizen science is based.</p>	<ul style="list-style-type: none"> - determine technology needs for data collection, analysis, data visualization, archiving (backed up), and delivery - plan a strong user interface for entering, accessing, and viewing data - train volunteers and staff to use the technology - consider needs for integrating data management across projects - discuss these needs during the design phase - minimize steps and avoiding multiple transfers of data (e.g. from paper to excel spreadsheet to internet...)

		<ul style="list-style-type: none"> - create an easy platform for data entry - provide data entry portals at collection sites - ensure the usability of data collection/data entry technology - provide tech support and customer service for users - train all staff in use of data entry platform - provide data visualization/manipulation tools (see toolkit)
Analyze Data	<p>Having tens, hundreds, or even thousands of volunteers collecting data can increase the statistical power of research, but may also result in a large, messy data set. Dealing with such data can raise both technical and philosophical questions. Looking for sophisticated data reduction techniques? Seeking tools to make data analysis accessible to volunteers? Find tips and links to resources here.</p>	<ul style="list-style-type: none"> - provide access to data and data analysis tools - develop training and support for use of analysis and predictive tools - make metadata available for deeper analysis - recognize that not all volunteers will want to be involved in analysis - know the data needs/expectations of those you wish to inform (e.g., policy makers, scientific community) - ensure local relevance - offer local conferences in support of scientific analyses of data - provide support and feedback for participants using data locally
Disseminate Results	<p>Getting the word out validates the contributions of all participants and can increase the impact of your project. First, share results with volunteers and project partners. Then, think big: whether to affect policy, inform a community, or even to publish in a peer-reviewed journal, find resources here.</p>	<ul style="list-style-type: none"> - Inform public policy: <ul style="list-style-type: none"> • report analyses in a timely manner • report via varied outlets ("hard" science as well as popular media) • communicate directly with decision makers and stakeholders • provide information to communities, allowing them to take appropriate steps - Add to the body of scientific knowledge <ul style="list-style-type: none"> • ensure high-quality scientific output • publish peer-reviewed journal articles • raise new research questions - Work with media outlets
Measure Effects	<p>Measuring project effects can best be accomplished by having specific goals in mind from the outset. Do you want to reach a certain number of volunteers this</p>	<ul style="list-style-type: none"> -embed evaluation into project design, rather than having it be an "afterthought" -know project effectiveness will be measured in terms of project goals -have "SMART" goals <ul style="list-style-type: none"> • Specific

	<p>year? Impact policy decisions? Increase student learning? You may be well-served to partner with a professional evaluator. But with or without professional advice, links herein can help you measure project successes and target areas of improvement for the future.</p>	<ul style="list-style-type: none"> • Measurable • Achievable • Realistic • Timely <p>-explicitly identify the demographics of the project's audience -use the impact categories outlined in the NSF Framework for Evaluating Informal Science Education (Friedman et al. 2008)</p> <ul style="list-style-type: none"> • Knowledge • Engagement • Skills • Attitudes • Behaviour • Other
--	--	--

Appendix H

Results from the Questionnaire

1. The organization that I represent offers the following services:

Answer	%	n
Hotel Provider	18.75%	6
Tours and Thematic Activities	12.50%	4
Both	21.88%	7
Tour Operator	15.63%	5
Travel Agency	9.38%	3
Other**	18.75%	6
TOTAL	100%	32

2. The International Ecotourism Society defines Ecotourism as: "responsible travel to natural areas that conserve the environment, maintain the welfare of the local population and involve interpretation and education." Under your criteria, do your organization's operations are aligned with this definition?

Answer	%	n
Strongly agree	78.13%	25
Agree	15.63%	5
Neither	6.25%	2
Disagree	0%	0
Strongly Disagree	0%	0
TOTAL	100%	32

3. I think that currently ecotourism products have a need for innovation.

Answer	%	n
Strongly agree	56.25%	18
Agree	40.63%	13
Neither	0%	0
Disagree	0%	0
Strongly Disagree	3.13%	1
TOTAL	100%	32

4. Currently the organization I represent invests - financial capital, natural capital, human capital, etc. - in innovation of ecotourism products to create different experiences for consumers.

Answer	%	n
Strongly agree	62.5%	20
Agree	18.75%	6
Neither	15.63%	5
Disagree	0%	0
Strongly Disagree	3.13%	1
TOTAL	100%	32

5. I know, and I am aware of the concept of Citizen Science, its benefits and procedures.

Answer	%	n
Strongly agree	21.88%	7
Agree	9.38%	3
Neither	34.38%	11
Disagree	15.63%	5
Strongly Disagree	18.75%	6
TOTAL	100%	32

6. I am interested in offering an ecotourism product in which, in addition to the normal activities of the products, there may be a dynamic space where consumers participate in practical and stimulating activities that contribute to research (for example, identification of species, monitoring of wildlife, other forms of data collection).

Answer	%	n
Strongly agree	71.88%	23
Agree	15.63%	5
Neither	9.38%	3
Disagree	3.13%	1
Strongly Disagree	0%	0
TOTAL	100%	32

7. I believe that this type of practical activities creates an added value for ecotourism consumers.

Answer	%	n
Strongly agree	75%	24
Agree	21.88%	7
Neither	0%	0
Disagree	3.13%	1
Strongly Disagree	0%	0
TOTAL	100%	32

8. What obstacles could prevent ecotourism providers from incorporating these practical and dynamic activities? Please rate the importance of these obstacles on a scale of 0 to 3 (3 being a major obstacle, 2 a significant obstacle, 1 is a minor obstacle and 0 represents not being an obstacle):

	Major Obstacle		Significant Obstacle		Minor Obstacle		Not an Obstacle	
	(3)		(2)		(1)		(0)	
Challenges	n	%	n	%	n	%	n	%
Lack of information and knowledge on how to structure these activities effectively	16	50%	12	37.5%	3	9.3%	1	3.2%
Lack of time	6	18.7%	8	25%	8	25%	10	31.3%
Lack of interest from my consumers	1	3.2%	17	53.1%	6	18.7%	8	25%
Can complicate my products' operation	4	12.5%	11	34.4%	8	25%	9	28.2%
Lack of vision of the decision makers of the value that this type of activities can generate	15	46.9%	7	21.9%	3	9.3%	7	21.9%



Master's Programme in Strategic Leadership towards Sustainability
Blekinge Institute of Technology, Campus Gräsvik
SE-371 79 Karlskrona, Sweden

Telephone: +46 455-38 50 00
Fax: +46 455-38 55 07
E-mail: sustainabilitymasters@bth.se