

A pilot investigation of a wildlife tourism experience using photographs shared to social media: case study on the endangered Borneo Pygmy Elephant.

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This thesis is presented for the degree of Bachelor of Science Honours, School of Veterinary and Life Sciences, of Murdoch University, 2018

I declare this thesis is my own account of my research and contains as its main content, work which has not been previously submitted for a degree at any tertiary education institution.

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Abstract

The increasing popularity of social media in the last decade has led to a considerable amount of user-generated content being shared online, with personal photography representing a significant portion of this. At the same time, the application of social media data to scientific research has also gained momentum. This thesis presents a preliminary exploration of how tourist-generated photographs sourced from social media can be applied to the analysis of both wildlife and social based dimensions of wildlife tourism experiences. To demonstrate proof of concept and a framework for how this approach can be employed, a case study on the viewing of Borneo Pygmy Elephants during riverboat tours along the Lower Kinabatangan River in Sabah, Malaysia from August to October 2017 is provided.

The wildlife-centred research presented in this study found that 73% of the reported elephant sightings occurred within 1 km of agricultural land adjacent to the river (predominantly being oil palm plantations). This finding was reflected in the results of the social analysis on tourist responses to elephant-viewing along the river, with 30% of photograph captions on Instagram making reference to conservation issues, including the loss of natural forest habitat.

To ensure sustainability of elephant-viewing tourism at this destination, site specific management requires ongoing and real-time information, particularly relating to landscape level issues. The findings of this pilot study suggest that social media derived content can be used to supplement and enhance understanding of wildlife tourism experiences by providing up-to-date information pertaining to visitor experience and the location and conditions under which wildlife is observed. The study also highlights the benefit of adopting a multiple-platform approach to researching

different aspects of wildlife tourism, reflecting the different ways that social media platforms are used. Further work is required to validate and assess the reliability of data sourced from social media against traditionally collected empirical data in order to extend this approach to larger datasets.

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List of Acronyms

BET	Borneo Eco Tours
SRL	Sukau Rainforest Lodge
BEST	Borneo Ecotourism Solutions & Technology
HEC	Human-elephant Conflict
KWS	Kinabatangan Wildlife Sanctuary
SNS	Social Network Site
EXIF	Exchangeable Image File
API	Application Programming Interface

List of Important Definitions

Social Network Site (or Social Media):

A web-based service allowing users to create online profiles and connect with other users on the website through the sharing of content (both visual and text based).

Hashtag:

A word or phrase preceded by the hash symbol (#) used within a message or caption on social media to help organise content and track topics. It is possible to run a search for a specific hashtag on a given social media platform and retrieve all public posts featuring that tag.

Exchangeable Image File Format (EXIF):

Metadata embedded in an image file at the point of capture (e.g. date, time, location, aperture, etc.).

Geotagged Photograph:

A photograph with automatically or manually assigned locational (latitude and longitude) coordinates for where the photograph was taken.

Photovoice Technique:

A social science research technique developed by Wang & Burris (1997) that utilises discussion around participant generated photographs to stimulate deeper engagement with an experience than through words alone.

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1.0 Introduction

1.1 Background

Wildlife tourism is a global industry that has evolved from the inherent human desire to see and interact with wildlife in natural settings (Curtin, 2009; Curtin & Kragh, 2014; Newsome et al., 2013). It is regarded as a non-consumptive activity, with wildlife interactions ranging from observing and feeding wildlife through to photographing wild animals in different environments (Cong et al., 2014; Newsome et al., 2013). As the economic and social significance of wildlife tourism and ecotourism continue to grow (Intel, 2008; Wood et al., 2013) (particularly for biodiverse, developing countries) understanding the ecological and social interface of these experiences is critical for achieving long-term sustainability (Rodger & Moore, 2004). Effective management of a wildlife tourism experience should not only consider the views and perceptions of visitors (Newsome et al., 2017a; Orsini & Newsome, 2005), but ideally monitor the circumstances under which wildlife is appreciated (Hansen, 2016). In the case of endangered wildlife, the conservation needs of the species must also be prioritised. Protected areas are key mechanisms for conservation, which simultaneously support opportunities for human-wildlife interactions. In turn, tourism, can generate funding and political support for the ongoing management of the protected areas (Hausmann et al., 2017a). However, to achieve management that is both responsive and adaptive, real-time information relating to the visitor experience (Walden-Schreiner et al., 2018) and the location and conditions under which wildlife is appreciated (Hansen, 2016) is required, and such data is often limited.

Citizen science and crowdsourcing data collection can provide an effective alternative to traditional, centralised research methods particularly when resources and funding

are limited (Di Minin et al., 2015). Collecting data in this way has been facilitated over the past two decades by the availability of smart devices equipped with GPS services, high quality cameras and continuous internet connection (Di Minin et al., 2015; Silvertown, 2009) alongside the exponential growth in social media and a willingness to share information online (Barry, 2014). Traditionally, retrieving up-to-date information on how tourists interact with natural areas has involved methods such as surveys and interviews, which can be laborious, time-consuming and costly (Hausmann et al., 2017a; Heikinheimo et al., 2017; Richards & Friess, 2015; Tenkanen et al., 2017; Wood et al., 2013).

The new alternative of using widespread and readily available data uploaded to social media can provide a rapid and cost-effective way to explore nature-based tourist experiences and activities (Hausmann et al., 2017a; Heikinheimo et al., 2017; Prakash et al., 2018; Tenkanen et al., 2017; Wood et al., 2013). While other studies have analysed the social dimensions of nature tourism experiences using data sourced from Social Network Sites (SNSs) (Barry, 2014; Cong et al., 2014; Sonter et al., 2016), to the best of knowledge, this is the first wildlife tourism study to ground the approach within the framework of the established photovoice method. The modified photovoice approach proposed by Yi-Frazier et al. (2015) is employed in the social application of this pilot study to explore tourist responses to a wildlife viewing experience.

As seen in tourism research, social media can also provide a novel source of biodiversity data, with users sharing images and associated metadata that include identification information and geographic references (Barve, 2014; Zhang et al., 2012). In response, numerous citizen science projects have been developed around the utilization of this data source particularly for occurrence records on a broad range of

taxa (Barve, 2014; Kirkhope & Williams, 2010; Stafford et al., 2010). It is argued that data from social media holds the potential to investigate both social and environmental factors relating to wildlife tourism research; a challenge which is explored in this thesis.

In this case study, social media platforms, Flickr and Instagram, were used to explore both wildlife-centred and social dimensions of a wildlife tourism experience focused on the viewing of wild Borneo Pygmy Elephants during riverboat tours along the Lower Kinabatangan River, Sabah, Malaysia (Figure 1). The critical importance of this region for wildlife conservation, coupled with the endangered status of the Borneo Pygmy Elephant (Choudhury et al., 2008) underpin the conservation significance of this research. Newsome et al. (2017a) identified that viewing pygmy elephants was rated as being of high importance for visitors to the Lower Kinabatangan River and a vital component of the overall wildlife-viewing tour, reinforcing the sociological significance of this study. This research explores tourist comments and aims to collect preliminary geographic information relating to where elephants are sighted. A further goal of this research is to explore the potential for implementing an innovative and low cost data collection approach that can inform future management decisions pertaining to tourist viewing of Borneo Pygmy Elephants.



Figure 1: Borneo Pygmy Elephant sighted during a riverboat cruise along the Lower Kinabatangan River.

1.2 Thesis aim and objectives

This pilot study explores how tourist-generated photographs sourced through existing SNSs can be used in wildlife tourism and conservation research. Specifically, photographs and captions will be used to gather information about the endangered Borneo Pygmy Elephant in the context of riverboat tours along the Lower Kinabatangan River, Borneo (Figure 1).

1.2.1 Aim

The aim of this study is to provide proof of concept for the use of SNSs, Flickr and Instagram, as a tool in understanding both social and ecological elements of a wildlife tourism experience.

1.2.2 Specific Objectives

Wildlife-centred application

- I. Map elephant sightings along the Lower Kinabatangan River using geotagged photographs uploaded to Flickr.
- II. Investigate the landscape matrix in the vicinity of where elephants are sighted along the Lower Kinabatangan River.
- III. Discuss the feasibility of extending the technique of using geotagged tourist photographs shared online to supplement the long-term monitoring of Borneo Pygmy Elephants.

Social application to tourist experiences with wildlife

- I. Explore tourist responses (ie. perceptions and type of visitor experience) reported on Instagram to elephant encounters along the Lower Kinabatangan River using a modified application of photovoice.
- II. Assess the feasibility of using this approach to explore tourist feedback for the purpose of enhancing tourist experiences.

1.3 Organisation of thesis

Chapter 1 – Introduction. This chapter encompasses relevant background information about wildlife tourism as an industry and requirements for management. This proceeds into how crowdsourcing data from social media can be applied to the management of wildlife tourism experiences. The chapter concludes with the overarching aim of the thesis and specific objectives.

Chapter 2 – Literature Review. A quantitative systematic literature review that explores how tourist photographs can and have been applied to wildlife tourism research in the current literature. Specifically, focusing on the application to both social and ecological aspects of an ecotourism experience.

Chapter 3 – Preliminary Research and Method Validation. Preliminary research required for the development and validation of the Methods. In this section, three photo-sharing SNSs (Flickr, Instagram and Facebook) are reviewed for their suitability for data collection in this pilot study.

Chapter 4 – Research Site. A description of the Lower Kinabatangan River region in Sabah, Malaysia including its significance as a world premier ecotourism destination and biodiversity hotspot.

Chapter 5 – The Borneo Pygmy Elephant. This chapter will discuss why the Borneo Pygmy Elephant was selected as the target species for this pilot study and provide an overview of current research on the ecology, status and distribution of populations in Sabah, including major threats.

Chapter 6 – Methods. This chapter details the inductive approach employed to investigate the application of tourist photographs sourced from social media to both wildlife and social based research, respectively. The exploratory approaches for each of these applications will be discussed in respect to both data collection and analysis.

Chapter 7 – Results. Aligned with the structure of the Methods, this chapter reports the findings of the wildlife and social research applications, respectively. The results of the pilot citizen science project are reported in terms of project involvement,

geographic locations of elephant sightings and the observed landscape matrix in which they occur along a section of the Lower Kinabatangan River. A separate analysis, reporting on word frequency usage and key themes, reveals tourist responses to elephant viewing as provided through photograph captions on Instagram.

Chapter 8 – Discussion. The structure of the Methods and Results carries over into the Discussion to provide a critical interpretation of the results for both the wildlife and social based research applications. The research objectives are revisited in respect to the results of this study and the published literature. A critical analysis of the limitations of this study is also provided.

Chapter 9 – Future Work. In this section, recommendations for additional research are proposed to build on this emerging field of study, particularly in respect to improving the quality and efficiency of data collection.

Chapter 10 – Conclusion. The thesis will conclude with a summary of the most significant findings from both the wildlife and social based applications presented in this pilot study.

2.0 Systematic literature review: applying tourist-generated photography to wildlife tourism research

The quantitative systematic literature review below has been written and formatted as a manuscript for publication in a peer-reviewed journal. The review provides a broad and encompassing background on the use of tourist photography as a research method and how it has been applied to wildlife tourism research so far. The findings from this section were essential for developing the research methodology adopted in this pilot project. The references to support this literature review manuscript are incorporated into the full reference list that appears in Section 11 of this thesis.

2.1 Introduction

2.1.1 Photography as a research method

Photography is a long-established tool in scientific research, with a strong foundation in anthropology. The camera's ability to create a permanent visual record of a moment in time makes it capable of achieving accurate and automatic documentation (Basil, 2011; Collier, 1957). The recorded information can then be explored beyond a literal image to also investigate emotive and social elements. Over time, as society has become increasingly digital and the taking of photographs has become more instant, the application of this approach has gained greater relevance and momentum in modern research (Zhang et al., 2012).

The photo-elicitation technique epitomised this evolving application of photography in social research. Traditionally, photo-elicitation is based on the idea of inserting a photograph into a research interview and asking interviewees to comment on the photographs (Harper, 2002). The basis behind this process is that the parts of the brain

involved in processing visual information are evolutionary older than the parts involved in processing verbal information (Harper, 2002). Harper (2002) reports that this causes our discussion around images to evoke deeper elements of consciousness than through verbal inquiry alone.

The photovoice technique developed by Wang & Burris (1997) branches off from photo-elicitation and empowers participants to engage more deeply in the process through the requirement that photographs be participant-generated as opposed to researcher-generated. Photovoice puts emphasis on action-orientated results (Given et al., 2011) by giving participants control over the selection and generation of photographs and then using the insight drawn from this process to influence management on a particular issue (Miller et al., 2016). At its core, photovoice provides a process for participants to amplify their voices in order to influence and direct change. This process is particularly useful for engaging groups who may have difficulty articulating their views (e.g. second language learners), thereby increasing the scope of participation (Given et al., 2011). It is important to note, however, that photographs alone cannot function as a dataset, and that discussion on and around the images is required to establish meaning and relevance (Given et al., 2011).

One particular aspect of this review explores the adoption of a modified application of photovoice (Yi-Frazier et al., 2015), incorporating the use of user-generated photographs uploaded to online image-sharing platforms with the analysis of associated captions and comments providing the basis for discussion. This adaptation of the photovoice method reflects today's modern world and the evolving nature of photography, community discussion and social media (Yi-Frazier et al., 2015; Zeglin & Mitchell, 2014). Rather than providing participants with cameras and asking them

to photograph a topic, this modified approach to photovoice analyses photographs that have been taken and shared online. In doing so, this overcomes limitations in respect to resources, funding and time (Given et al., 2011). Furthermore, this crowdsourcing approach provides an alternative to using directed surveys, which can also be expensive to execute and are generally conducted on limited spatial and temporal scales (Barve, 2014; Hausmann et al., 2017a; Richards & Friess, 2015; Wood et al., 2013).

When crowdsourcing data is used in this way it can be difficult to determine the source, particularly within a social network setting. Whilst the proposed research topic focuses on tourist-generated photography, whereby a tourist is defined as “one who ventures away from home, alone or in a group, to see or do something that is unusual relative to the daily round of life” (Chalfen, 1979), this review extends to encompass photographs generated by other groups such as members of the general public. The broad nature of the term “tourist” makes it difficult to isolate tourists within an online setting without knowing their place of origin. However, this limitation is largely overcome by the content of the photographs themselves. Given that photographs taken in a national park setting or of unique/charismatic wildlife are closely associated with a wildlife tourism experience (Newsome et al., 2005; Smith et al., 2006), it is safe to assume that a majority of these photographs are generated by people engaged in a tourism experience. This view is further reinforced by Chalfen (1979) who describes the activity of taking photographs as one of the most common tourist attributes.

2.1.2 Application to wildlife tourism research

Applying photovoice and tourist-generated photography to wildlife tourism research is opportunistic in drawing on tourists’ natural willingness to take and share

photographs during a wildlife experience (Hansen, 2016; Willemen et al., 2015). These photographs and accompanying narratives can then be used to answer questions about wildlife tourism experiences such as (1) ecological aspects of the target species, (2) the location of the wildlife and (3) circumstances under which the wildlife was appreciated and how tourists felt about the experience (Hansen, 2016).

The diversity of studies that have used tourist photographs to monitor species or explore social interactions with wildlife are analysed in this article. This systematic quantitative literature review (Pickering & Byrne, 2014) explores how recent academic literature approaches the use of both photovoice techniques and tourist-generated photography within the context of a wildlife and nature-based tourism setting.

2.2 Method

2.2.1 The systematic literature review method

A systematic quantitative literature review of recent studies on the application of photovoice and tourist-generated photography to wildlife tourism research was carried out using the technique of Pickering & Byrne (2014) and Pickering et al. (2015). This method provides a more straightforward and systematic approach than the more traditional narrative method and aims to ameliorate potential biases by structuring the literature collection process in a series of defined and reproducible steps. By following the criteria of this systematic approach in the identification of relevant literature, this review provides a comprehensive overview of the current peer-reviewed articles.

Research articles were obtained using the Murdoch University Findit online-search tool, which searches globally on over 100 subscribed databases including Scopus and

Web of Science. The Findit search tool also provides access to articles that may be available through BONUS+ or ArticleReach. The initial review parameters (Figure 2) included peer-reviewed articles from the last five years available in electronic format. This provided a starting point for the review and, given the nature of the topic as being a relatively new field, captured a high portion of the most relevant literature. The Findit online tool was searched in May 2017 and again in February 2018 using multiple combinations of keywords. The terms “wildlife” and “tourism” were searched in combination with “photo” and “social media”. The inclusion of the keyword “photo” was useful in not only capturing studies that utilized photographs, but also studies that used photovoice and photo-elicitation approaches. The reference lists from these initial articles were then cross-checked to locate additional and key older publications not identified by the electronic database search. Reference lists of additional articles were also cross-checked until no new articles were being identified (Figure 2).

2.2.2 Screening and data extraction

The keyword searches identified a total of 422 articles, which were subsequently screened to reject articles that (1) were written in a language other than English, (2) did not incorporate the use of photographs, (3) incorporated the use of photographs produced and analysed exclusively by researchers or (4) could not be applied to wildlife tourism or nature-based tourism. Whilst the application of tourist-generated photography to wildlife tourism research is the primary focus of this review, articles discussing nature-based tourism are also included, due to the strong overlap in these fields of research. Newsome et al. (2005 & 2013) highlight the important role that wildlife presence and observation plays in the recreational experience of visitors to natural areas, which validates the decision to include these articles. The decision to

reject articles that used photographs gathered and analysed exclusively by researchers was necessary to exclude the large volume of wildlife studies that utilize techniques such as camera-trapping. Such studies were not relevant to the topic of this review, as they did not incorporate the use of photographs generated by tourists or members of the public. In addition, it is a requirement of the photovoice methodology that photographs be participant-generated, further supporting the need to exclude such studies. After the consecutive cross-checking of reference lists, 50 articles were selected for further analysis.

2.2.3 Key variables and questions to assess

The 50 selected articles were quantitatively assessed to provide a structured overview of the published literature. Data collected from each article included publication information (author(s) and journal), temporal and geographic information (country and continent), whether the article was research based or a review article, target species (for ecological studies), who was providing the photos, what type of online platform was used to access photographs, whether the study method was qualitative or quantitative, sample size (number of photographs), sampling period, whether geotagged photographs were used and finally a summary of the main findings of the study. It is important to note that in some cases where information was sourced from online platforms, the actual location of the study site was different to the published location of the article. Subsequently, for the purpose of this review, location was defined as the locality of the study site. These variables, including descriptions of relevant categories, are outlined in Table 1.

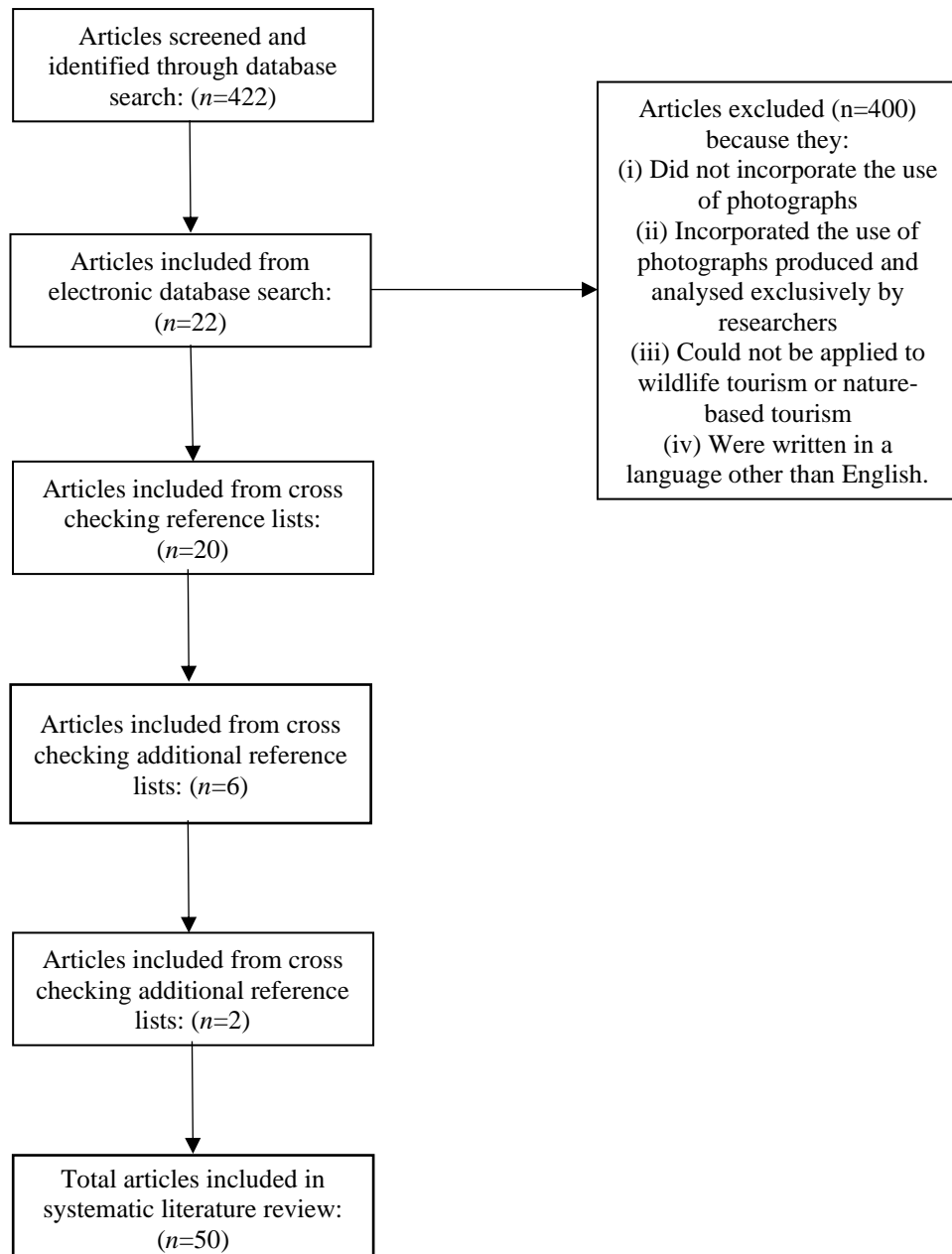


Figure 2: Flow diagram of the literature review process. The number of studies that were located, retained and discarded are shown at each stage of the process.

Table 1: List of variables collected from articles in the review.

Variable	Description/ List of Categories	Data type
Author (year)		Text
Journal		Text
Location of study		Text
Target species		Text
Focus of study		Text
Photographs uploaded/ taken by	General public, Tourists, Researchers & General public, Researchers & Tour Operators	Categorical
Online platform - dedicated vs SNS	Dedicated, SNS, Other, Dedicated and SNS, Dedicated and other, SNS and other, Dedicated and SNS and other	Categorical
Name of dedicated platform	Wildbook, Wildbook for Whale Sharks, iNaturalist, eBird, Pic4Turtle, TORSOOI, Waarnemingen, Whale shark photo library	Categorical
Name of SNS	Flickr, Youtube, Instagram, Facebook, Vimeo, TripAdvisor, Twitter, Panoramio, LinkedIn	Categorical
Name of other	Wikipedia, PPGIS, OpenStreetMap, Google Earth, GBIF, Map of Life, NBN	Categorical
Method	Quantitative, Qualitative, Both	Categorical
Review or research paper	Review, Research, Both	Categorical
Sample size (Number of photos)	Less than 50, 50-100, 100-500, 500-1000, 1000-10000, Greater than 10000	Categorical
Sample period	Less than 1 month, 1-6 months, 6 months - 1 year, 1-2 years, 2-5 years, greater than 5 years	Categorical
Geotagging	Were geotagged photographs used/ discussed?	Yes/ No
Main findings		Text

2.3 Results

The following sections will report on the results of the systematic quantitative literature review whereby sample size (n) is expressed as the total number of peer reviewed articles.

2.3.1 Overview of research characteristics

After four iterations of the search process, a total of 50 peer reviewed articles reporting on the application of photovoice and tourist-generated photography to wildlife tourism research were analysed. There has been increasing academic interest in this research topic in the last three years (Figure 3), with a total of 11 articles (22%) published in the 2016 calendar year. Geographically, the research is spread over 20 countries (Figure 4) and 6 continents (Figure 5). The majority of these studies were from Australia ($n=11$; 22%) and the United States of America ($n=11$; 22%). The only other countries with multiple studies were the United Kingdom ($n=3$; 6%), South Africa ($n=2$, 4%) and Finland ($n=2$, 4%).

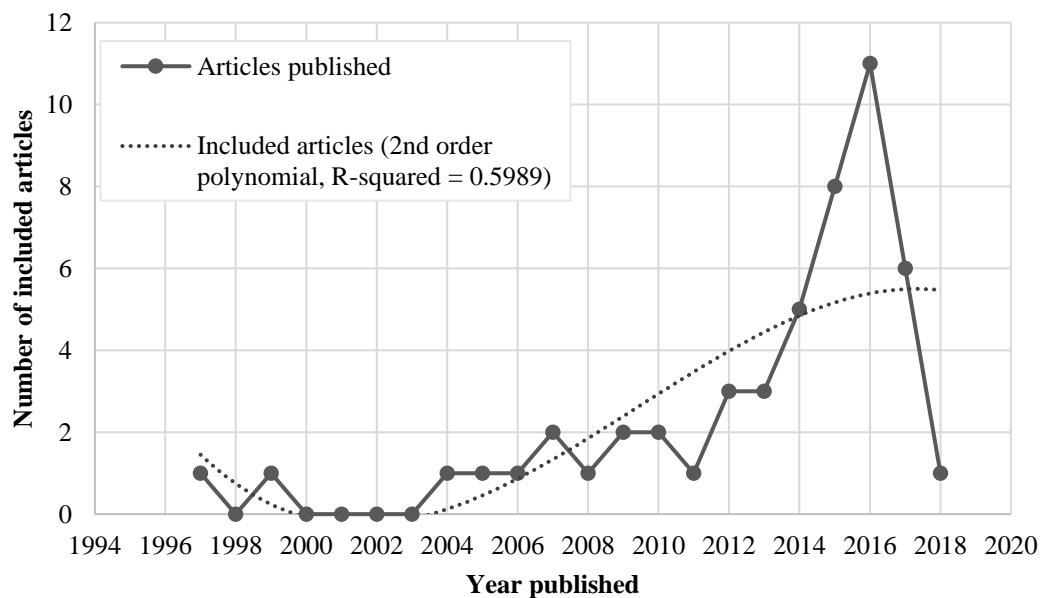


Figure 3: Number of peer reviewed articles published each year.

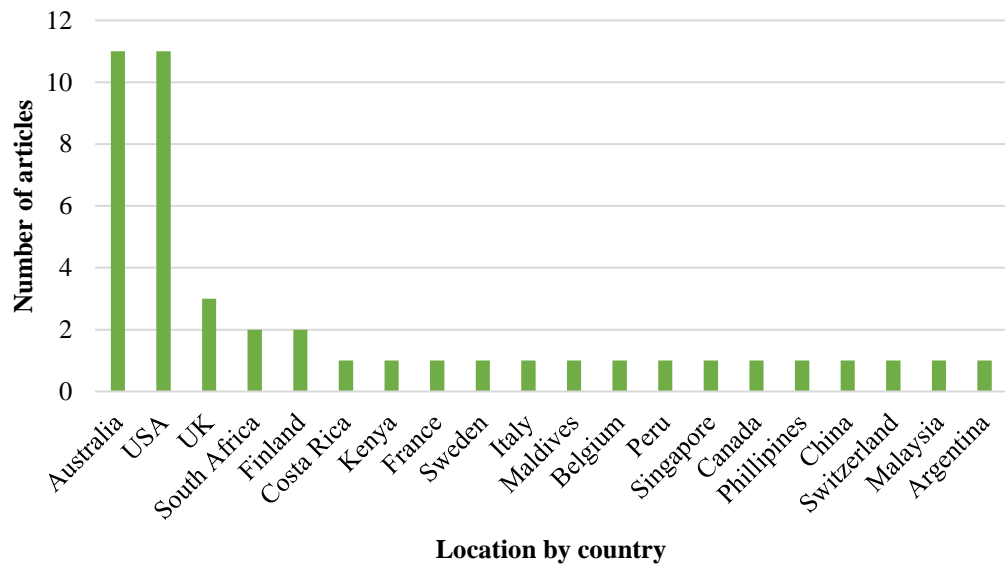


Figure 4: Geographic distribution of peer reviewed articles by country.

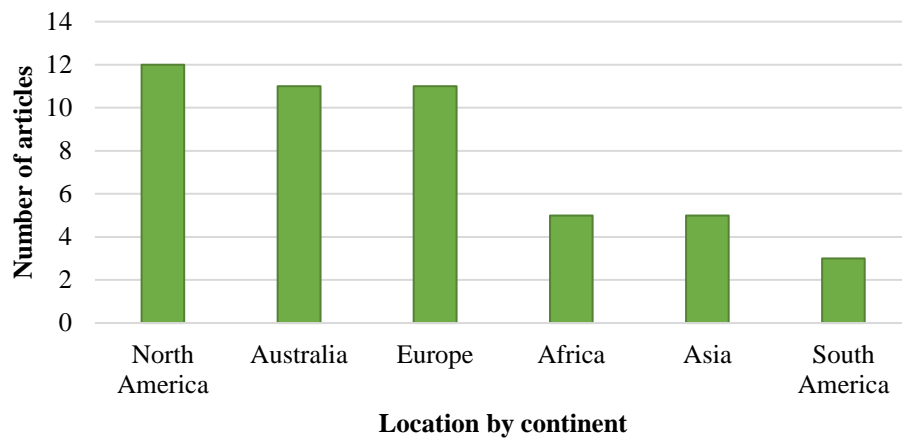


Figure 5: Geographic distribution of peer reviewed articles by continent.

Photographs were predominantly sourced from people identified as the general public ($n=31$; 65.96%) and then from people identified as tourists ($n=13$; 27.66%). Combinations of contributors were included in cases where researcher-generated photos were also incorporated (Figure 6). Two articles used photographs produced by the general public in combination with researchers (4.26%) and another used photographs produced by tour operators in combination with researchers (2.13%).

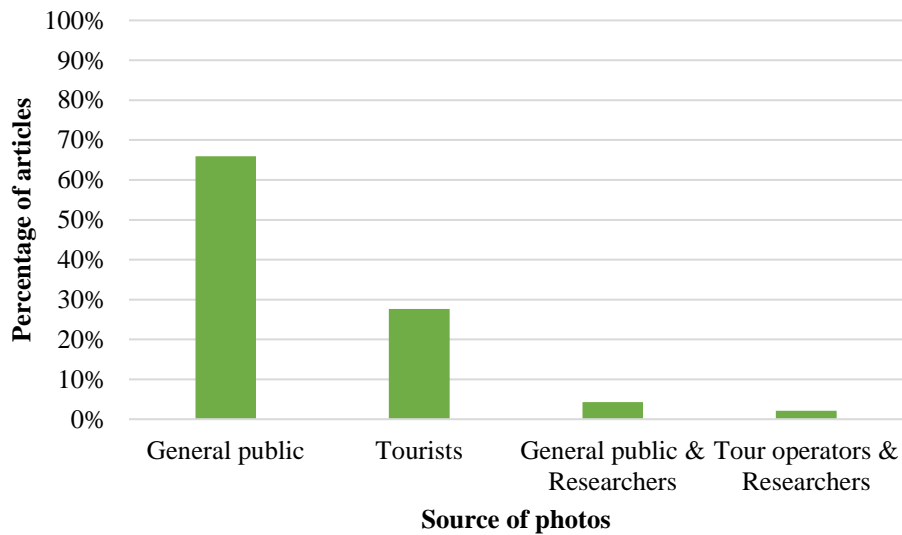


Figure 6: Who provides the photos? Percentage of peer reviewed articles using photos provided by different groups.

Of the 50 articles analysed, the majority were research studies ($n=40$; 80%) with five articles being exclusively review based (10%). In addition, the five research articles that featured their own dedicated literature review section were analysed separately and these accounted for 10% of the literature. With respect to method, 31 studies adopted a quantitative approach (62%), ten used a qualitative approach (20%) and nine studies used a combination of both (18%). The incorporation of geotagged photographs (with locational data stored in the images EXIF file) was detected in 59.42% of studies that collected data from online platforms. With respect to the types of online platforms used, 25 studies exclusively collected data from SNSs whilst nine articles exclusively accessed photographs from a dedicated platform (Table 2). The most commonly used SNS by studies was Flickr ($n=23$), followed by Instagram ($n=7$) and Facebook and Twitter equally ($n=6$) (Table 2).

Table 2: Range of online platforms utilised in studies to source photographs. Some studies referred to multiple platforms and for the purpose of this table have been recorded as separate results.

Platform Type	Total Studies	Platform	No. of Studies Utilising Platform	Author/s
Dedicated	15	Wildbook for Whale Sharks	8	Araujo et al. (2016), Arzoumanian et al. (2005), Davies et al. (2012), Holmberg et al. (2008), Holmberg et al. (2009), Norman (1999), Norman et al. (2016), Pearson et al. (2016)
		BeeWatch	2	Pearson et al. (2016), van der Wal et al. (2015)
		iNaturalist	2	Dickinson et al. (2012), White et al. (2015)
		Wildbook	2	Dunbar et al. (2016), Parham (2015)
		Waarnemingen	1	Vantieghem et al. (2016)
		Pic4Turtle	1	Dunbar et al. (2016)
		eBird	1	Dickinson et al. (2012)
		TORSOOI	1	Carpentier et al. (2016)
Social Network Site	32	Flickr	23	Araujo et al. (2016), Barry (2014), Barve (2014), Davies et al. (2012), Di Minin et al. (2015), Hausmann et al. (2017a), Keeler et al. (2015), Kirkhope & Williams (2010), Levin et al. (2015), Levin et al. (2017), Pearson et al. (2016), Richards & Friess (2015), Sessions et al. (2016), Sonter et al. (2016), Stafford et al. (2010), Straumann et al. (2014), Tenkanen et al. (2017), van Zanten et al. (2016), Walden-Schreiner (2017), Walden-Schreiner et al. (2018), Willemen et al. (2015), Wood et al. (2013), Zhang et al. (2012)
		Instagram	7	Di Minin et al. (2015), Hausmann et al. (2017a), Hausmann et al. (2017b), Heikinheimo et al. (2017), Pearson et al. (2016), Tenkanen et al. (2017), van Zanten et al. (2016),
		Facebook	6	Araujo et al. (2016), Di Minin et al. (2015), Dickinson et al. (2012), Pearson et al. (2016), Stafford et al. (2010), White et al. (2015)
		Twitter	6	Di Minin et al. (2015), Palomino et al. (2016), Pearson et al. (2016), Roberge (2014), Tenkanen et al. (2017), White et al. (2015)
		Youtube	3	Araujo et al. (2016), Davies et al. (2012), Di Minin et al. (2015)
		TripAdvisor	2	Cong et al. (2014), Lu & Stepchenkova (2012)
		Vimeo	1	Araujo et al. (2016)
		Panoramio	1	van Zanten et al. (2016)
		LinkedIn	1	Di Minin et al. (2015)
		Wikipedia	1	Levin et al. (2017)
Other	4	PPGIS	1	Levin et al. (2017)
		OpenStreetMap	1	Levin et al. (2017)
		Google Earth	1	Orsi & Geneletti (2013)
		GBIF	1	White et al. (2015)
		Map of Life	1	White et al. (2015)
		NBN	1	van der Wal et al. (2015)

A separate analysis classified articles into three categories: (1) ecological studies on wildlife, (2) social studies on people's interactions with wildlife and natural areas or (3) incorporating elements of both (Figure 7). The number of yearly publications across all three categories have been shown to increase over recent years, with the majority of ecological studies ($n=14$, 70%), social studies ($n=24$, 85.71%) and combined studies ($n=2$, 100%) being published after and including 2010 (Figure 8). The analysis revealed an overall bias towards social research studies ($n=28$; 56%) in the application of tourist-generated photography. Studies from North America focused on social research, primarily relating to visitation rates and tourist perceptions (Figure 9). In contrast, studies from Australia predominantly applied tourist-generated photography to ecological research (on whale-sharks), with these accounting for 63.64% ($n=7$) of the Australian studies. Ecological studies from Asia (which also focused exclusively on whale sharks) represented 40% ($n=2$) of the total studies from Asia (Figure 10), whilst 60.00% ($n=3$) were social science based (Figure 9). Research from Europe showed an even distribution between social ($n=6$) and ecological ($n=5$) studies.

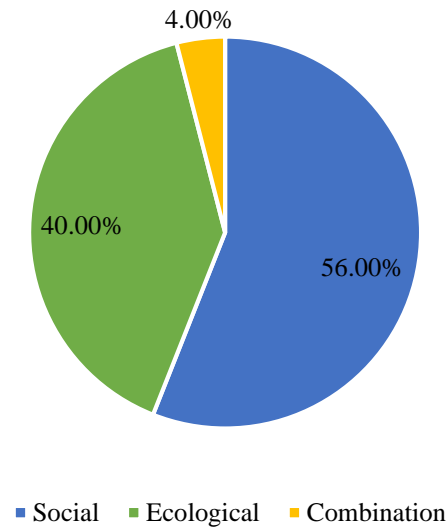


Figure 7: Proportion of peer reviewed articles focusing on social based and ecological based research using tourist-generated photography.

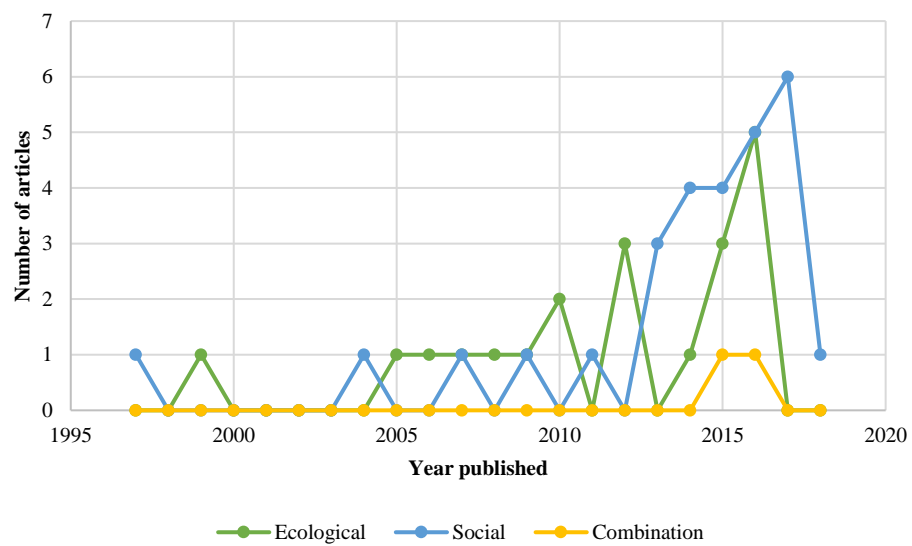


Figure 8: Publications by year in relation to study focus (social, ecological and combination).

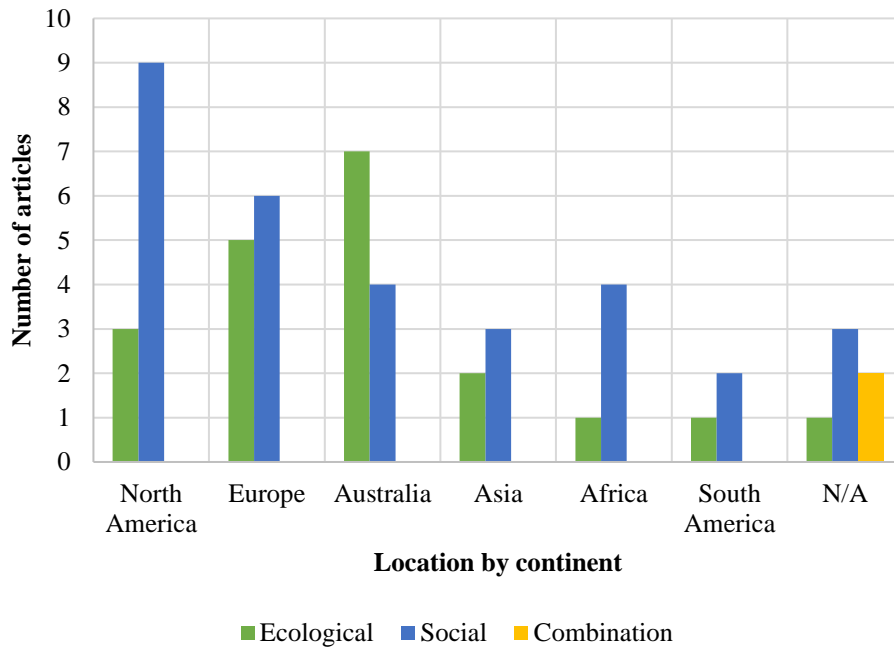


Figure 9: Location of publications by continent in relation to study focus (social, ecological and combination). “N/A” represents studies without a defined study site, with these typically being review articles.

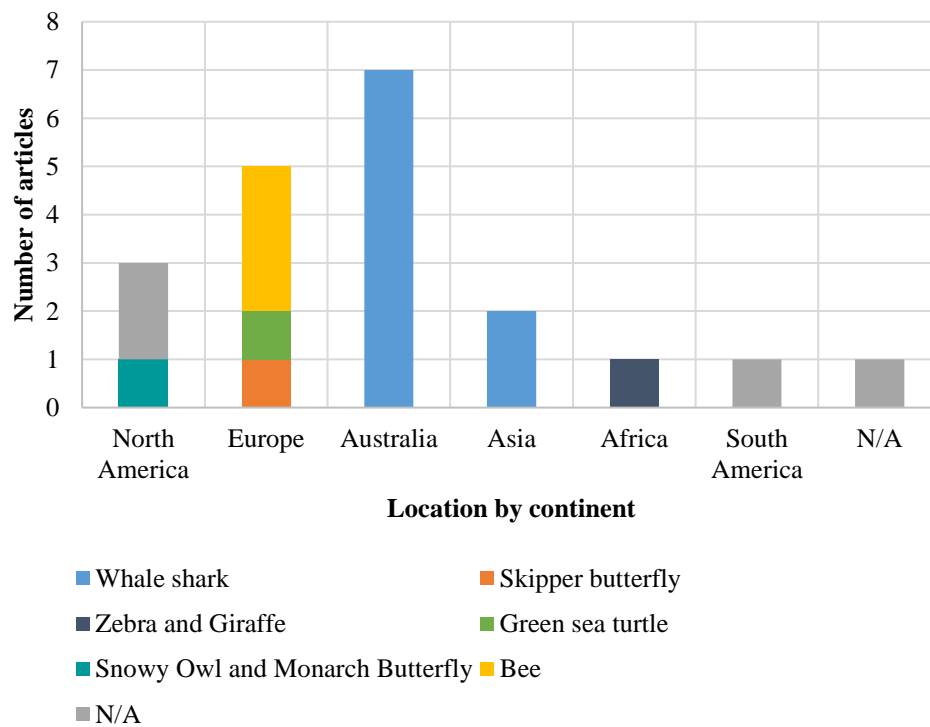


Figure 10: Location of publications by continent in relation to target species for ecological studies. “N/A” represents ecological studies without a target species.

Sample size of the reported studies was analysed from the perspective of both duration of study (Figure 11) and the number of photos collected (Figure 12). The majority of studies had data collection periods of greater than five years (45.71%), but there is evidence of a bimodal nature for study length with 37.15% of studies running for less than one year (Figure 11). The reported studies analysed a large number of photographs (Figure 12) with a majority (68.76%) analysing more than 1000 photographs and 84.39% of studies analysing more than 500 photographs. The relationship between the number of collected photographs and platform type (i.e. dedicated vs. SNS) was also analysed and revealed that studies using SNSs typically returned larger datasets (Figure 13).

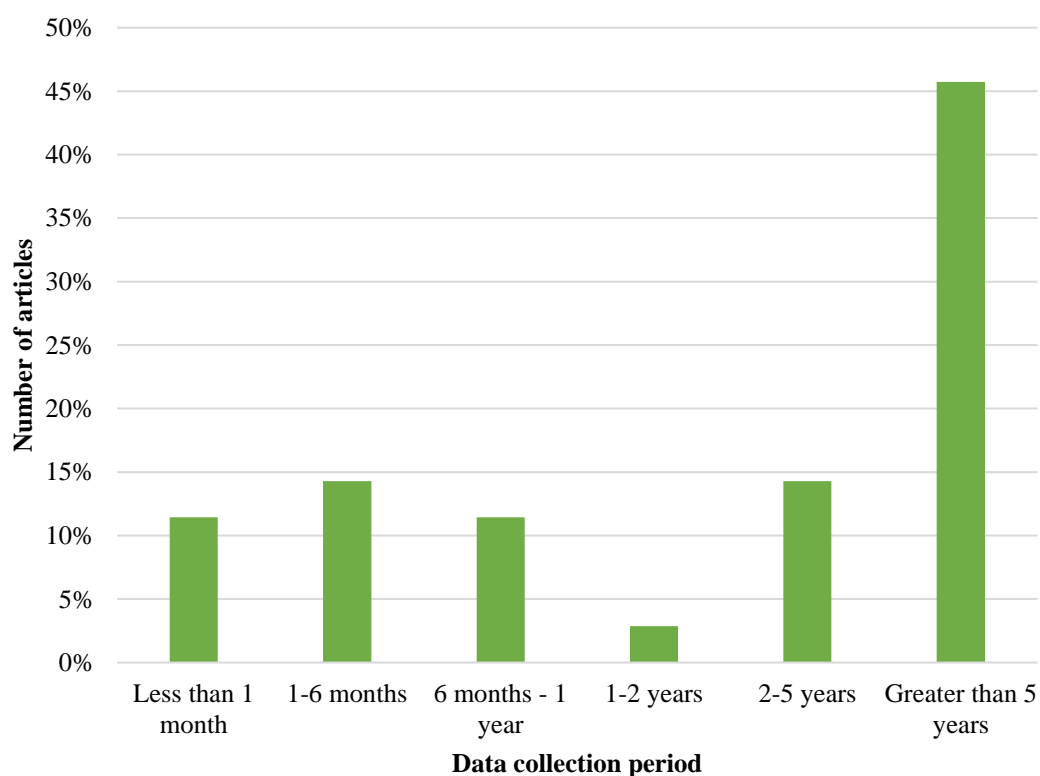


Figure 11: Percentage of included articles categorized based on the duration of the study period.

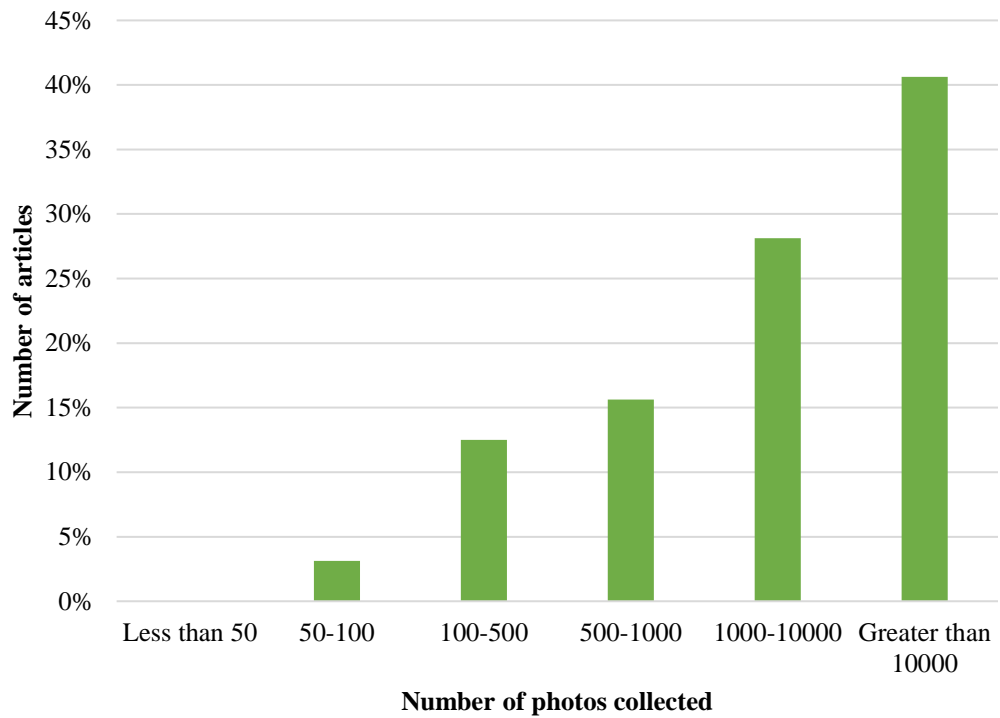


Figure 12: Percentage of included articles categorized based on sample size (number of collected photographs).

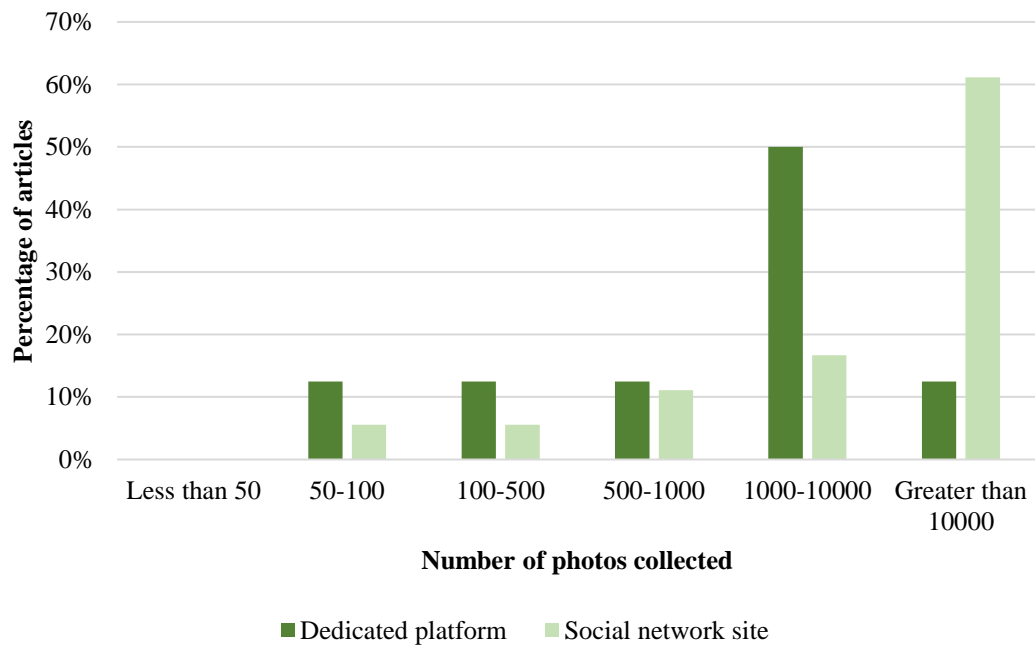


Figure 13: Relationship between online platform (dedicated vs SNS) and sample size (number of photographs).

2.4 Discussion

2.4.1 Publication trends and geographic distribution

Markwell (1997), the earliest article included in this review, provides a foundational discussion of tourist-photography research within the context of a nature-based tour. This review highlights how the application of tourist-generated photography has increased steadily since that time, drawing particular interest in the last three years. This increased usage overlaps with the recent and exponential growth of social media and the willingness of people to share photographs via image-sharing applications and internet communities (Barry, 2014). With the peak year for publications on this topic being 2016, it will be interesting to observe how this trend continues to grow over the next decade with the increasing evolution of Web 2.0 applications and devices that enable people to collaborate and share information online (Levin et al., 2015; Orsi & Geneletti, 2013).

Published studies are geographically distributed in favour of the USA, Australia and the UK. Studies from North America demonstrated a preference towards social research on topics such as visitation rates and tourist perceptions. Ecologically focused research in Australia (and Asia), primarily targeted the distribution and population structure of whale-sharks using tourist-generated photographic data. Interestingly, the three ecological studies from the UK all investigated the use of photographs generated by the public to contribute to the monitoring of bee populations. The limited number of published studies from South America, Africa and Asia highlights a gap in the literature, particularly when these regions contain many of the world's biodiversity hotspots (Myers et al., 2000). There is, however, possible bias that must be considered when interpreting the dominance of studies undertaken in the USA, Australia and the

UK given the inclusion criteria of studies being written in English. Consequently, a similar systematic review of articles published in languages other than English is worthy of future research.

2.4.2 Collection of photographs

This review analysed articles that collected photographs and data from dedicated online platforms, publicly available SNS and combinations thereof. Dedicated platforms are developed by researchers to provide an avenue whereby people can upload relevant images that are analysed by professionals in the field, for example the identification of whale-shark individuals by marine biologists using the platform *Wildbook for Whale Sharks* (Araujo et al., 2016; Norman, 1999; Norman et al., 2016). Wildbook is an open source software framework that captures citizen science data, including photographs, to support collaborative mark-recapture and social ecology studies (Wild Me, 2016). In October 2016, Wildbook was created after a name change from the former, Image Based Ecological Information System (IBEIS) project, which was utilized in Parham's (2015) research to estimate the size of zebra and giraffe populations in Nairobi National Park.

The benefit of dedicated platforms, such as Wildbook, is the increased relevance of the user-generated information uploaded for the purpose of its incorporation in research compared to SNSs where platforms are often non-specific, differing in purpose, popularity and user-profile (Heikinheimo et al., 2017). The attraction of using SNSs lies in the ability to facilitate greater participation and reduce the costs of storing photographic records on specialised databases (Stafford et al., 2010). Limitations however arise in the large degree of 'noise' in data collected from SNSs caused by misleading tags and ambiguous visual content (Zhang et al., 2012). Such errors are

often compensated for in these situations by analysing large datasets. As demonstrated in Figure 13, studies sourcing visual content from SNSs are more likely to use a sample size of greater than 10,000 photographs in their analysis, whilst the number of photographs collected on dedicated platforms are more likely to lie between 1000 and 10,000 photographs. It was also found that Flickr is the most frequently used platform amongst SNS-based studies (see Table 2). The published studies justify this selection on the basis that Flickr is a well-established image-sharing platform with more than 8 billion photographs and over 87 million registered users in 2013 (Levin et al., 2015). In addition, Flickr allows the storing of metadata for the uploaded images, including where the photograph was taken. Users can attach this metadata manually or automatically when using GPS enabled devices such as smartphones and some digital cameras to record geographic information.

The utilisation of geotagged photographs in research was identified in 59% of studies using online platforms. This feature is particularly useful for studies estimating visitation rates and the presence and interaction of people with natural areas (Hausmann et al., 2017a; Heikinheimo et al., 2017; Keeler et al., 2015; Levin et al., 2015; Levin et al., 2017; Orsi & Geneletti, 2013; Richards & Friess, 2015; Sonter et al., 2016; Straumann et al., 2014; van Zanten et al., 2016; Wood et al., 2013). An alternative application of geo-positioning metadata is for wildlife monitoring programs, as demonstrated in the studies from the UK that use geotagged photographs from Flickr to map the distribution of bees (Kirkhope & Williams, 2010; Stafford et al., 2010). Stafford et al. (2010) report that the most useful approach to such monitoring programs, particularly when funds and time are limited, is the use of a specialist group within the framework of an existing social network such as Flickr.

A key question when crowdsourcing information in this way is who provides the photos? This review demonstrates that the general public provided photographs in 66% of the included articles. This dominance can be explained by those studies using SNSs to collect and analyse very large datasets. In such cases, it is often difficult to identify the specific character of the people sharing their photographs (i.e. tourists/visitors versus residents). Depending on the focus of the study knowing this information may not however be a distinction of importance or even necessary. An example of where this information was needed is the research by Straumann et al. (2014) who compared the photo-taking behaviour of foreign tourists and residents in Zurich, Switzerland. This study examined Flickr user profiles to determine the country of origin of the photographer. Other studies that exclusively use images provided by tourists often did not draw information from online platforms, but instead recruited tourists as participants and requested them to take photographs using a supplied camera or other means (Dorwart et al., 2009; Hansen, 2016; Mackay & Couldwell, 2004; Tonge et al., 2013). Evidently, such direct contact with study participants is required when identification of who provides the photographs is important, which highlights a potential limitation of using online platforms to source images for social research, for example, as in the case of nature-based tourism studies.

2.4.3 Application to research

Social studies relating to visitors' connection to wildlife

The distribution of articles was skewed in favour of social studies focusing on visitors' thoughts, behaviours and interactions with nature. These articles explored visitors' relationship with nature and wildlife in different ways. A number of studies investigated tourist perceptions about species attractiveness and the cultural benefits of natural area tourism using information drawn from social media (Hausmann et al.,

2017a; Heikinheimo et al., 2017; Richards & Friess, 2015; Willemen et al., 2015). Generally, these studies found that social media provided a reliable alternative to survey-based information gathering and gave useful insight into the popularity of certain species and the value of cultural ecosystem services, such as opportunities for wildlife focused recreation. This information can be directed towards management strategies to safeguard biodiversity and certain ecosystem services (Willimen et al., 2015). Other studies used geotagged content to investigate visitation rates and visitor flows in natural areas (Levin et al., 2015; Orsi & Geneletti, 2013; Sonter et al., 2016; Wood et al., 2013). These articles revealed that geotagged photographs provide a reliable surrogate for visitor numbers and that as online material grows, crowdsourcing information in this way may open up a new and revolutionary approach to understanding questions about where people recreate in natural areas.

Ecological studies on wildlife

Ecological studies focusing on the monitoring of species and ecological phenomena accounted for only two out of five (40%) of the reviewed articles, suggesting that the application of tourist-generated photographs and comments to such research is not being utilized to the extent of social research. The application of tourist-generated photography does however appear to be gaining more momentum in the most recent literature, with most ecological studies (70%) having been published after 2010 (Figure 8). Currently there is limited diversity in the species targeted by this method, but those that have been studied were often the subject of replicate and/or longitudinal research. This was particularly true for whale sharks (seven articles) and bees (three articles). This trend suggests that once such a citizen science program is established, and has been running for long enough to accumulate enough photographs, it is then possible to conduct numerous studies on the ecology of the target species. For

example, all of the Australian ecological studies focused on the monitoring of whale-sharks (Arzoumanian et al., 2005; Holmberg et al., 2008; Holmberg et al., 2009; Meekan et al., 2006; Norman, 1999; Norman et al., 2016; Speed et al., 2007). This breadth of literature on whale-sharks, often incorporating a combination of researcher and publicly supplied photographic information, provides a case study for the application of this approach for long-term ecological monitoring and conservation of other wildlife.

Only 4% of studies explored the combination of both social and ecological elements in their use of tourist-generated photography. The majority of these studies were review papers discussing the general application of social media and user-generated information in conservation and sustainability science (Di Minin, et al. 2015; Pearson et al., 2016). Evidently, the application of tourist-generated photographs and comments to research on both wildlife tourism experiences and the monitoring of the wildlife itself is an area that has received little attention in the published literature to this point.

2.4.4 Implications and further research

It was the aim of this systematic review to document how the current peer-reviewed literature has approached the use of tourist-generated photography and photovoice techniques to research wildlife tourism. The review identifies different online platforms used to source photographs, the appropriateness of the platform depending on the focus of the study and the different sample sizes attributed to research using dedicated or SNS platforms. This review also provides an overview of the application of tourist-generated data to either social or ecological research. It highlights that little research has been conducted on the application of tourist-generated photography to

the combined analysis of both the social and ecological elements of wildlife tourism experiences. Included articles demonstrated the ability to use geotagged content to map and monitor species distribution and the effectiveness of conducting content analysis on photographs and comments to draw on tourist perceptions. Few studies, however, address both these elements in the context of wildlife tourism experiences. This approach could be particularly useful for tourist interactions with endangered wildlife, wildlife that has not yet been well researched, or for improving conservation efforts in biodiverse developing countries that may be limited by funding and access to resources (Barve, 2014). It was also noted that there are relatively few dedicated review articles on tourist photography in wildlife research, emphasizing the contribution of this review.

Expanding the geographic application of this research to South America, Africa and Asia should be prioritized, particularly considering the highly unique and diverse natural areas found on these continents (Myers et al., 2000). Given that the literature on this topic is still beginning to emerge, there is great need for more quantitative studies building on the foundational research to improve our understanding and to validate the use of such data sources in wildlife tourism research. Many of the reviewed articles report the need for more studies comparing social media data to data collected by traditional means when using SNSs (Barry, 2014) and to further explore potential sources of bias, representation and other limitations in using these technological strategies (Hansen, 2016; Heikinheimo et al., 2017; Keeler et al., 2015). Applying this approach to different taxonomic groups (Roberge, 2014), at different tourism destinations (Mackay & Couldwell, 2004) and to different ecological phenomena (e.g. distribution of blooming flowers) (Zhang et al., 2012) may also warrant investigation to further explore potential ecological applications.

2.4.5 Significance of review to this thesis

The systematic literature review above played a critical role in informing the direction of this thesis. Reviewing a broad spectrum of studies relating to the application of tourist-generated photography to wildlife tourism research allowed for the identification of gaps in the literature. As discussed in the previous section, there is currently limited research articles that utilize SNSs for the simultaneous investigation of both social and ecological dimensions of a wildlife tourism experience. There is also a need to expand this area of research geographically and taxonomically. To address these gaps, this case study on the viewing of endangered Borneo Pygmy Elephants in the Lower Kinabatangan River region of Sabah, Malaysia has been adopted. Using this wildlife tourism experience, this pilot study will build on foundational research reported in the systematic review and will explore the overall feasibility of applying tourist-generated content sourced from SNSs to the field of wildlife tourism research.

3.0 Preliminary research and method validation

During the initial planning stages for this pilot study, it was first necessary to explore various image-based SNSs in order to determine which would be most appropriate for gathering data to answer the research questions. The selection of SNSs would then guide the development of the research method based on the characteristics and features of the selected SNSs. The systematic quantitative literature review discussed in Chapter 2 played a pivotal role in informing this decision-making process, by identifying approaches used in aligned studies. The three platforms reviewed were Flickr, Instagram and Facebook (Table 3), as they all, to varying degrees, provide popular photo-sharing services. In order to effectively guide data collection for this research, it was critical that the platform(s) could support the upload of geotagged photographs, aid discussion around images, were easy to use/access and could allow for efficient searching and filtering of content by the researcher.

Table 3: Comparison of three image-sharing SNSs (Di Minin et al., 2015). Statistics regarding number of monthly active users sourced from Cowling (2017).

Name of Platform	Description	Available search parameters	Retains photo EXIF data	Number of monthly active users
Flickr	Image/video hosting and storing website. Popular amongst photographers.	User, location (latitude/longitude), photos, keyword, tags, people, groups, galleries, favourites, contacts, comments, places	Yes	480,000
Instagram	Sharing of photos and short videos via mobile application. Captions often include hashtags to organise/ categorize photo content and to connect users around a subject.	User, location (selected by user), keyword, tags, followers, photos, popular items, comments. likes	No	9,000,000
Facebook	Popular social networking site. Allows sharing of statuses/ photos/ videos and links with friends. Supports interactive online discussion.	User, page, event, group, place	No	15,000,000

3.1 Flickr

While Flickr was not found to be the most popular of the three image-sharing platforms in terms of number of active users (Table 3), it is a stand-out platform in terms of its use as a data source in GIScience, geography and in the tourism literature (Walden-Schreiner, 2017; see Chapter 2: Table 2). This can be attributed to the distinction that Flickr, unlike most other SNSs, does not wipe the Exchangeable Image File (EXIF) data attached to photographs which contain useful information such as where and when the photograph was taken. Flickr also supports an easily accessible Application Programming Interface (API), which allows developers to write programs that can then be used by researchers to retrieve relevant photograph metadata. Traditionally, Flickr has been more targeted towards photographers uploading high resolution pictures taken with professional cameras (Hausmann et al., 2017a). In 2012, however, Flickr responded to growing competition in the field of image-sharing platforms, particularly from Instagram, by developing a new and updated Flickr application for iOS and Android mobile devices (Kanalley, 2012). The application includes the ability to edit, add filters, leave comments and attach a geo-location either manually or based on an external GPS device (such as the inbuilt GPS in most smartphones). Flickr also supports the ability to tag photos with keywords or hashtags allowing for simple and effective searching of content. This development of Flickr over time is reflective of the changing nature of photography, with smartphones being amongst the most common devices used in 2014 to share and capture images on Flickr (Dove, 2015).

The versatility of Flickr and its range of capabilities has led to its use in multiple conservation research projects (Araujo et al., 2016; Barve, 2014; Davies et al., 2012; Kirkhope & Williams, 2010; Stafford et al., 2010; Zhang et al., 2012). Barve (2014)

provided a proof of concept assessment for the use of Flickr in collecting primary biodiversity data. He described Flickr as a suitable SNS to document species occurrence in time and space as the platform hosts a large number of users sharing images of wildlife and associated metadata. Stafford et al. (2010) also explored the citizen science potential of Flickr to study bee distribution across the United Kingdom. This BeeID project, as it was named, was setup as a special interest group on Flickr in order to keep the project focused within the framework of a SNS. In respect to this pilot study, these earlier studies confirmed that Flickr was equipped with the necessary features to support the upload of accurately geotagged photographs of elephant sightings along the Lower Kinabatangan River. It was therefore decided that Flickr would be the most suitable platform for exploring this aspect of the investigation. During the early planning stages for this project, a similar approach to that used in the BeeID project (Kirkhope & Williams, 2010; Stafford et al., 2010) involving a specialised and dedicated group was explored. It was eventually decided, however, that in order to maximise involvement and ease of use for participants, it would be more appropriate to track posts using a unique hashtag. The steps involved in this process are discussed in greater detail in Chapter 6 of this thesis.

3.2 Instagram

Instagram allows users to capture and share instant, real-time experiences through a mobile application (Di Minin et al., 2015). The platform is image-based and primarily used for sharing self-generated content (Di Minin et al., 2015), as opposed to sites such as Twitter and Facebook, which can often be used to pass on content and links provided by other users, public figures or businesses. Instagram has been used in a number of studies on nature tourism, from visitor monitoring in parks (Heikinheimo et al., 2017; Tenkanen et al., 2017) to understanding tourist preferences for nature-

based experiences (Hausmann et al., 2017a). The decision was made to use Instagram to supplement data collection for this study as the application is high in popularity (Table 3), allows for organised filtering of content using hashtags and typically puts more emphasis on captions and the discussion around images than Flickr does. Instagram was therefore an appropriate platform for the photovoice analysis segment of this research (discussed in section 6.1). The geotagging feature on Instagram allows users to manually add a location, landmark or public place to posts, but, as Instagram removes all EXIF data from photos uploaded to the service (Mueller, 2013), it is not possible to pinpoint the exact location of where a photo was taken using metadata. For that reason, it was decided to use a combination of Flickr and Instagram to address the research objectives of this thesis.

3.3 Facebook

Given its high popularity (Di Minin et al., 2015; Sensis, 2017) and inclusion of photograph/video sharing services, Facebook was initially considered as a platform for data collection in this investigation. As revealed in the systematic literature review, there are citizen science based studies that have utilized Facebook in the collection of photos for research on wildlife (Araujo et al., 2016; Stafford et al., 2010). In the Stafford et al. (2010) approach, however, Facebook is only used to assist with online promotion of the research project and not for the actual upload and collection of photographic data. This was because, although the website does support photograph uploading, it removes much of the useful EXIF information during this process for privacy reasons (Stafford et al., 2010). Additionally, as Facebook is not solely an image-sharing platform, it can be difficult to filter through the many text-based posts in order to access photographs. Therefore the decision was made to exclude this

platform as a data source and to focus on Instagram and Flickr as the two image-based SNSs for the investigation.

4.0 Research Site

The nature of this emerging research approach is distinct in that the same methods and techniques can be applied to a broad spectrum of ecotourism destinations and experiences. This is achieved by using tourist-generated photographs uploaded to online image-sharing platforms, which can be accessed from any internet connected location at any time. This frees up both time and resources in respect to site-based fieldwork and also allows for on-going data collection. The chosen destination for this pilot study was the Lower Kinabatangan River region of Sabah, Malaysia. Being a premier ecotourism destination and one of the foremost wildlife viewing locations in South-East Asia (Newsome et al., 2017a; Newsome et al., 2017b), the Lower Kinabatangan River provided an excellent site to investigate tourist experiences with rare and endangered wildlife.

4.1 The Lower Kinabatangan Region

The Lower Kinabatangan region is located on the Kinabatangan River in South-Eastern Sabah, Malaysia. This region is dominated by a river system that flows 560 kilometres eastwards towards the Sulu Sea, with the catchment covering approximately 23% of the total land area of Sabah (Loong, 2014). The Lower Kinabatangan is one of the largest alluvial floodplains in Malaysia (Fletcher, 2009) comprising a matrix of fragmented forest ecosystem habitats including riverine and limestone hill forest formations, freshwater swamps, mangroves, oxbow lakes and dryland *Dipterocarp* forests (Fletcher, 2009; Newsome et al., 2017a; Tuuga, 2010). The dominant land-use matrix outside of these forest fragments includes extensive oil

palm plantations, processing mills, roads, human settlements and small food-crop farms (Ancrenaz et al., 2014). At present, only 4% of the Kinabatangan River catchment comprises natural forest of which 60-70% is protected through the establishment of forest reserves and wildlife sanctuaries such as the Kinabatangan Wildlife Sanctuary (KWS) (Ancrenaz et al., 2014; Newsome et al., 2017a).

The KWS was created in 2005 by the Sabah State Government under the Wildlife Conservation Enactment (Fletcher, 2009; Tuuga, 2010). The sanctuary is approximately 29,000 hectares in size (Newsome et al., 2017a) and consists of blocks of land linking pockets of forest reserves with mangrove forests near the coast to provide a habitat corridor through the lower portion of the river (Fletcher, 2009; Hutton, 2004). Protected areas found closer to the headwaters of the Kinabatangan River, however, are significantly smaller and more sparse than those located further downstream (Bruford et al., 2010; Newsome et al., 2017a). Although these reserves play a critical role in maintaining wildlife habitats and ecosystem processes along the Kinabatangan River, they exist within a severely fragmented landscape that is dominated by oil palm plantations and logged forested areas (Ancrenaz et al., 2014; Bruford et al., 2010; Fletcher, 2009), which pose an on-going threat to the ecological values of the KWS (Newsome et al., 2017a).

4.2 Significance of Research Site

Despite high levels of habitat degradation and fragmentation, the Lower Kinabatangan floodplain remains as one of the most important wetland ecosystems in Malaysia for biodiversity (Bruford et al., 2010; Newsome et al., 2017b). By encompassing a range of wildlife habitats (and variation within those habitats), the KWS supports a very high level of biological diversity (Myers et al., 2000). The sanctuary contains over 250

species of birds, 90 species of mammals, 90 species of freshwater fish, 20 reptiles and 15 amphibians (Hutton, 2004; Tuuga, 2010). It is also one of only two sites in the world (the other being Danum Valley - also located in Sabah) where ten species of primates occur together, with four of these being endemic to Borneo (Fletcher, 2009; Hutton, 2004; Newsome et al., 2017a). Iconic and rare wildlife, such as the endangered Borneo Pygmy Elephant, also inhabit and migrate through the forests of the sanctuary providing a significant drawcard for tourists to the region (Newsome et al., 2017a).

Being a world premier ecotourism destination (Newsome et al., 2017b), tourism in the Lower Kinabatangan has become a highly significant socioeconomic value to the region (Newsome et al., 2017a). The Sabah Tourism Masterplan (1996) identified the Sandakan - Kinabatangan region for tourism development, describing the Kinabatangan as “top quality wildlife viewing under threat from surrounding development” (Sabah Ministry of Tourism and Environmental Development, 1996, p. 181). The promotion of the Lower Kinabatangan for nature-based tourism activities has attracted long haul tourist markets, such as those sourced in Europe and North America, to the region (Chan & Yeoh, 2001; Newsome et al., 2017a) with estimated tourist arrivals at around 17,000 in 2015 (Newsome et al., 2017a). Wildlife tourism experiences are facilitated through the numerous ecolodges found along the river, often providing their own knowledgeable and experienced tour guides, many of whom are local to the area. Riverboat cruises are the primary ecotourism activity, which provide a unique and alternative way of viewing wildlife under natural conditions (Chan & Baum, 2007b; Newsome et al., 2017a).

The tourism industry is directly dependent on the Kinabatangan River and the wildlife it supports making it a primary conservation focus. In response, the Kinabatangan-

Corridor of Life Tourism Operators Association (KiTA) was established as an advocacy group for sustainable tourism, comprising of local tour operators and WWF Malaysia (KiTA, 2005). KiTA's mission is to "promote and implement a globally recognized sustainable tourism industry" through good environmental management practices, providing opportunities to local people/ businesses and preserving a balance whereby agriculture, people and nature can co-exist (KiTA, 2005; Newsome et al., 2017a). To ensure the on-going sustainability of the Lower Kinabatangan as an ecotourism destination it is essential that further environmental degradation is prevented through proper law enforcement and effective government planning (Newsome et al., 2017b; Simpson & Newsome, 2016). Unless wildlife conservation is made priority, the foundation of nature-based tourism in this region will continue to be threatened by surrounding agriculture and development.

4.3 Sukau Rainforest Lodge

Base camp for the fieldwork segment of this research was Sukau Rainforest Lodge (SRL) (Figure 14), an ecolodge located on the banks of the Kinabatangan River in Kampung Sukau approximately 70 km upstream from the coastal city of Sandakan (Fletcher, 2009). The lodge has been designed and built based on the principles of ecotourism and embraces conservation, community development and sustainable tourism as part of its green policies (Sukau Rainforest Lodge, 2018). The lodge's commitment to conservation and green operations contributed to its accreditation as one of the National Geographic Unique Lodges of the World. In addition, SRL operates in collaboration with the non-profit organisation Borneo Ecotourism Solutions & Technology (BEST) Society to help implement innovative community and environmental projects. Altogether, such initiatives and developments make for SRL being an excellent site to launch this pilot project involving tourists, guides and

lodge staff in a unique citizen science approach to researching encounters with the endangered Borneo Pygmy Elephants.



Figure 14: Sukau Rainforest Lodge.

5.0 The Borneo Pygmy Elephant

5.1 Selection as Target Species

The Borneo Pygmy Elephant (*Elephas maximus borneensis*) was chosen as the target species for this study for a number of reasons. In respect to conservation status, the Borneo Pygmy Elephant is increasingly recognized as a sub-species of the Asian elephant (*Elephas maximus*) (Fernando et al., 2003; Sharma et al., 2018), which has been listed as an endangered species on the International Union for Conservation of Nature Global Red List since 1986 (Choudhury et al., 2008). Furthermore, research on these elephants has primarily been limited to the past 15 years with the first satellite tracking efforts undertaken by WWF in 2003 (Alfred et al., 2007). Consequently, there still remains a degree of uncertainty about the elephants' population size and distribution through eastern Sabah and despite their high conservation priority (Fernando et al., 2003), the WWF claims that Borneo's elephants remain the "least-understood elephants in the world" (World Wildlife Fund, 2018). Whilst, the extent and duration of this study is limited in its ability to comprehensively address such questions, it remains a long-term objective that this project guides the establishment of a citizen science program that involves the public in research that is valid and useful in conserving these elephants.

The Borneo Pygmy Elephant is one of the "Borneo Big 5", a phrase which is used by tour operators in the promotion and marketing of their wildlife viewing tour packages. The pygmy elephant is one of the top five most iconic wild species found in Borneo, with the remaining four being the orangutan, proboscis monkey, rhinoceros hornbill and saltwater crocodile. Being a keystone species for both the long term sustainability of the Bornean rainforest ecosystem (Granados et al., 2017), and also the Sabah

tourism industry further justifies the selection of the Borneo Pygmy Elephant as the focus of this study. Newsome et al. (2017a) revealed that visitors to the Lower Kinabatangan River region had a strong desire to see the wild elephants, however they were ultimately not satisfied with this aspect of their visit. In order to support the development of sustainable elephant-viewing based tourism and improve visitor satisfaction, it is important to understand where the elephants are being sighted and what tourist perceptions and responses are in regard to this experience.

Previous studies have reported on the difficulty of visually tracking pygmy elephants through the dense forests of Sabah (Alfred et al., 2007; Alfred et al., 2012) particularly when tracking smaller individual groups and lone adult males. Whilst satellite collaring can provide an effective and accurate method for tracking the elephants, it is not without limitations. The process of tranquilizing and fitting collars to the elephants can be invasive and there have been reports of collars failing, not sending reliable data and/or falling off the elephants (Alfred et al., 2007). A non-invasive and cost effective alternative to supplement this research could be the development of a photo-identification library that uses pattern recognition to identify individuals and trace their movements. Ardovini et al. (2008) employed such an approach using wild African elephants by developing a reference system based on shape comparisons of the nicks characterizing elephants' ears. This proposed method is said to be capable of dealing with lower resolution images taken in the wild, implying that the quality of photographs taken by tourists during riverboat tours using modern smartphone cameras should provide sufficient detail for this method (providing that the photograph is taken from a suitable distance to the elephant and clearly shows the ear outline). There is, evidently, significant potential for future research that utilises this photographic identification approach to identify and answer questions about the

Borneo Pygmy Elephant, particularly in respect to population sizes, interactions and movement patterns.

5.2 Current Research

The distribution of the elephants is restricted to approximately 5% of the island of Borneo, predominantly inhabiting the north-eastern Malaysian state of Sabah (Goossens et al., 2016). The most recent population estimate for the elephants in Sabah was carried out by Alfred et al. (2010) using a systematic line transect survey and a long-term monitoring of dung decay rates. This survey indicated that 2040 (95% CI: 1184 - 3652) elephants remain in the five main elephant managed ranges in Sabah (Figure 15). These ranges include the Lower Kinabatangan (~400km²), North Kinabatangan (~1400km²), Central Sabah (~7900km²), Tabin (1200km²) and Ulu Kalumpang (~510km²). The presence of elephants in North Kalimantan, Indonesia occurs as part of the range in Central Sabah, with the number of individuals in Kalimantan estimated to be less than 20 (Alfred et al., 2011). The focus site for this study, the Lower Kinabatangan Range, is estimated to contain 298 (CI: 95% 152-581) elephants. This particular range is isolated from the North Kinabatangan Range and from the Central Sabah Range by plantations and by a public highway (Sabah Wildlife Department, 2011). Given that these estimates are considerably broad and increasingly more dated, there is a recognizable need for further research to improve and update our understanding of the population size and distribution of these elephants in Sabah.

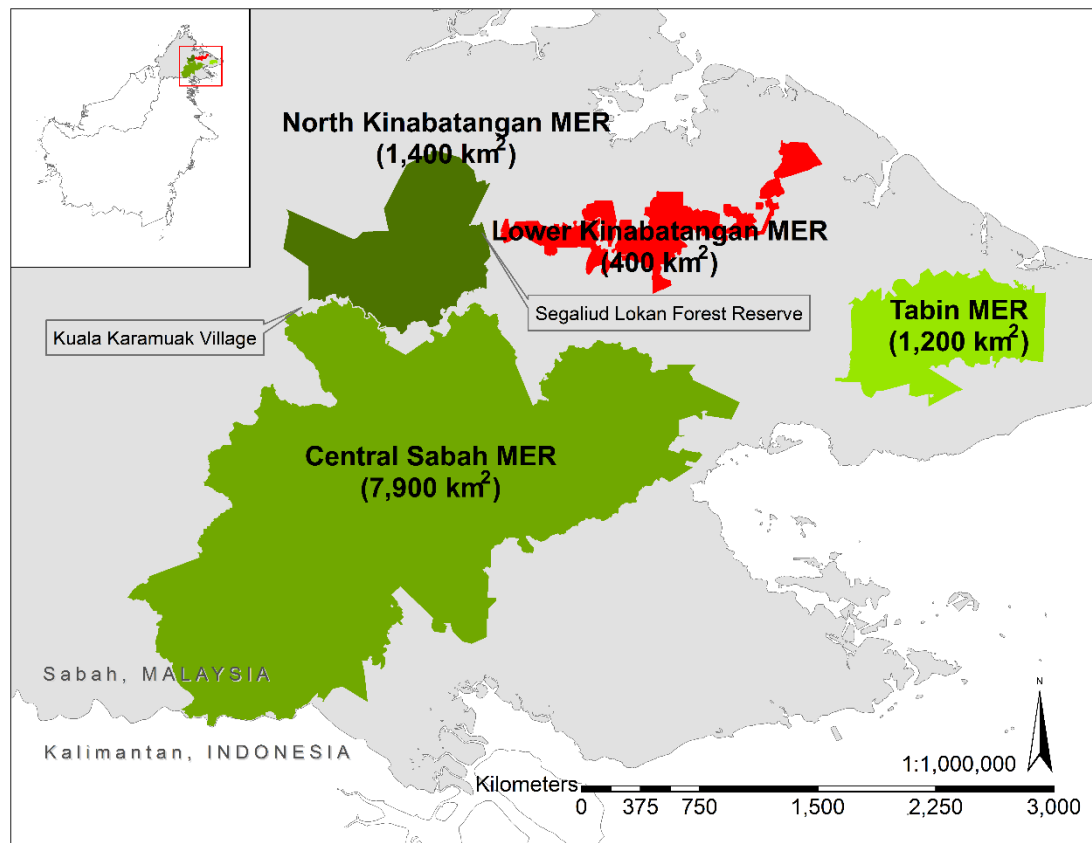
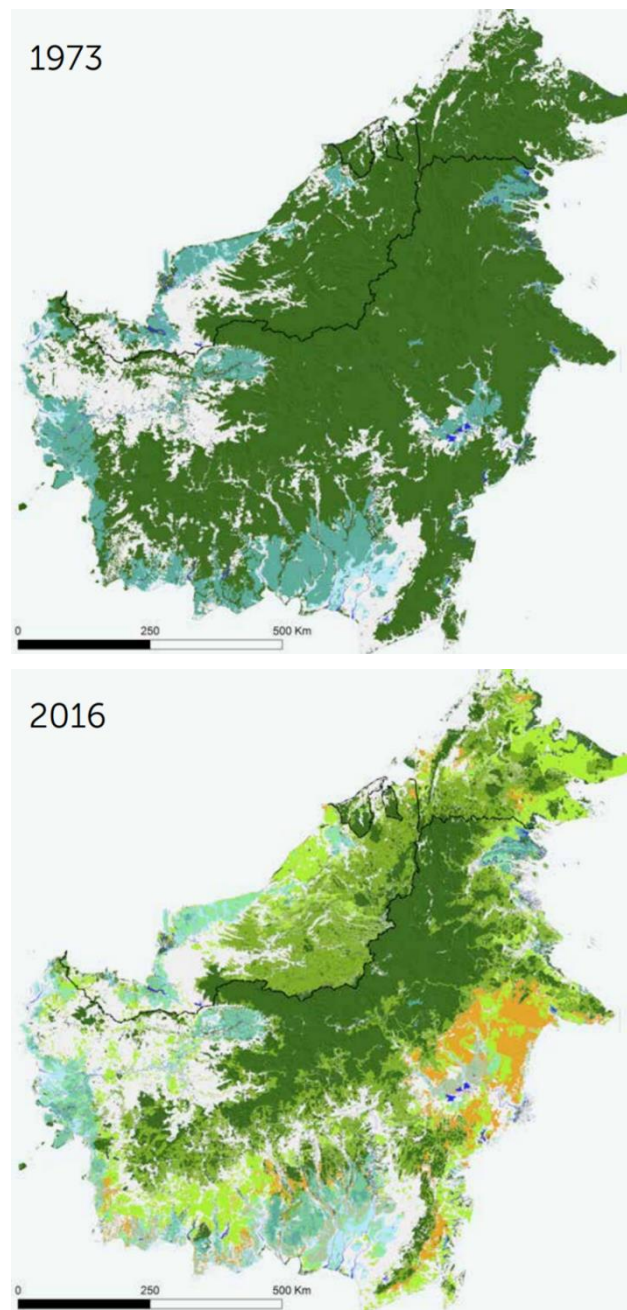


Figure 15: Managed elephant ranges in Sabah, Malaysia (excluding Ulu Kalumpang) (Estes et al., 2012).

The major threats facing the Borneo Pygmy Elephant primarily include habitat loss and the fragmentation of continuous forest (Estes et al., 2012; Goossens et al., 2016; Sabah Wildlife Department, 2011). Habitat loss in the Lower Kinabatangan has occurred through conversion of existing forests to agriculture and human settlement (Estes et al., 2012). In respect to habitat, the elephants show preference for low-lying areas, avoiding steep-slopes and mountainous terrain which hinder movement (Alfred et al., 2011). Forested areas close to rivers, allowing for plenty of food and shelter to retreat into during the heat of the day, are features that have also been identified as synonymous with elephant habitat (Alfred et al., 2011). In the last 50 years, an estimated 80% of the Lower Kinabatangan floodplain forest has been converted for agriculture and settlement (Estes et al., 2012; Goossens et al., 2016). An insight into

the level of deforestation across the island of Borneo is provided in Figure 16, and whilst not all of the original intact forests would have provided usable elephant habitat, this figure nevertheless highlights the immense impact the plantation industry has had on the island's landscape overall. The lack of connectivity between elephant ranges and subsequent increases in elephant densities has also contributed to Human-Elephant Conflict (HEC). As local people and elephants continue to compete for space and resources, there are costs to both sides in the form of economic losses from crop raiding and damage to infrastructure with resulting retaliative actions towards the elephants sometimes causing serious injury or death (Othman et al., 2013). Whilst, historically, poaching has not posed a serious threat to the elephants (Sabah Wildlife Department, 2011), reports of illegal killing (shooting and poisoning) do occur, typically as a result of the elephants entering oil palm plantations. In Sabah, the elephants are listed as a "Totally Protected Species" under the Sabah Wildlife Conservation Enactment 1997 (Othman et al., 2013). Any person found guilty of killing or hunting an elephant will receive a fine of RM 50,000 and/or up to a five year jail sentence (Sabah Wildlife Department, 2011).



Visual legend:



Figure 16: Deforestation in Borneo since 1973 (Gaveau, 2017).

6.0 Methods

To explore the use of SNSs in understanding both wildlife and social based elements of a wildlife tourism experience it was necessary to divide the study into these two separate applications. The framework of the study is illustrated in Figure 17, comparing the different SNSs used, the type of data collected and the over-arching objective of each. The following sections will discuss the methods employed within a wildlife and social research context, respectively. Ethics approvals were obtained from the Murdoch University Human Research Ethics Committee (2017/161) to extract publically available photographs and captions shared on Instagram and from Murdoch University Animal Ethics Committee (O2961/17) to study the location of elephant sightings along the Lower Kinabatangan River using geotagged photographs uploaded by tourists to Flickr.

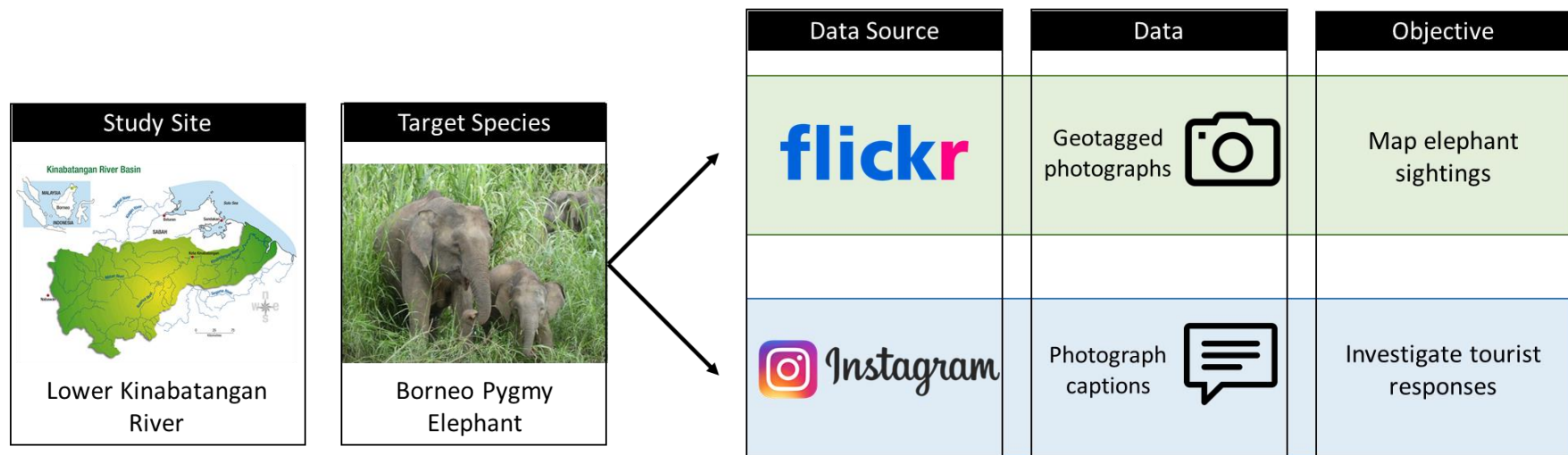


Figure 17: Logical framework of study outlining the wildlife-centred research (green) and social-centred research (blue) applications of the study.

6.1 Wildlife research application

A key focus of this research is to explore the application of tourist photography to study a wildlife tourism experience using crowdsourced data from SNSs. Following on from this, the aim is to provide a case study that would demonstrate proof of concept for the use of publicly shared geotagged photographs as a spatial and temporal data source. To demonstrate this, the following three objectives are addressed:

- I. Map elephant sightings along the Lower Kinabatangan River using geotagged photographs uploaded to Flickr.
- II. Investigate the landscape matrix in the vicinity of where elephants are sighted along the Lower Kinabatangan River.
- III. Discuss the feasibility of extending the technique of using geotagged tourist photographs shared online to supplement the long-term monitoring of Borneo Pygmy Elephants.

In setting out to achieve these objectives, the study required a combination of both site-based fieldwork at SRL in the Lower Kinabatangan and online data collection and analysis in Perth, Western Australia.

6.1.1 Borneo Based Fieldwork

This pilot study comprised a translational research collaboration with industry partners Borneo Eco Tours (BET), SRL, BEST Society and Murdoch University's MOU research partners at the University of Malaysia Sabah. BET is a tour operator providing services across the island of Borneo since 1991 (Borneo Eco Tours, 2018), and is also the sister company of SRL. BEST Society is the not for profit organisation set up by BET and SRL to address local environmental and community issues through

innovative projects. To successfully explore the on-ground implications of coordinating this citizen science pilot study, it was necessary to design and create appropriate marketing materials to engage tourists and promote their involvement in the project. Part of the fieldwork phase involved spending two weeks with the BET marketing department to create informational posters (Figure 18) and brochures (Appendix A) to be provided to guests staying at SRL. The project was also promoted through social media via the BET and SRL accounts on Facebook and Instagram. This was effective in generating more public interest and allowing travellers to hear about the project online before their arrival.

Transferring to SRL, lodge staff and tour guides were engaged in a series of presentations and discussions to address the logistics of running this pilot project along with explanations as to why such research was important and valuable for tourism operators in the Kinabatangan. During these sessions, there was discussion about how to optimise the education and inclusion of guests in the project. Upon arrival at the lodge, guests would receive a welcome briefing including details about their stay and scheduled activities. During this briefing, guests were provided with a short overview about the research project and how to become involved. Informational brochures highlighting key details (Appendix A) would also be handed out at this time. Participation required guests to switch on location services, when using their smartphone or GPS enabled camera device, and if they did encounter and photograph elephants, to upload those images to Flickr. Step by step guides on how to do this (Appendix B) were provided throughout the lodge and could be emailed on request. This enabled guests to upload their photographs at a later date, and potentially, through use of a more stable internet connection.

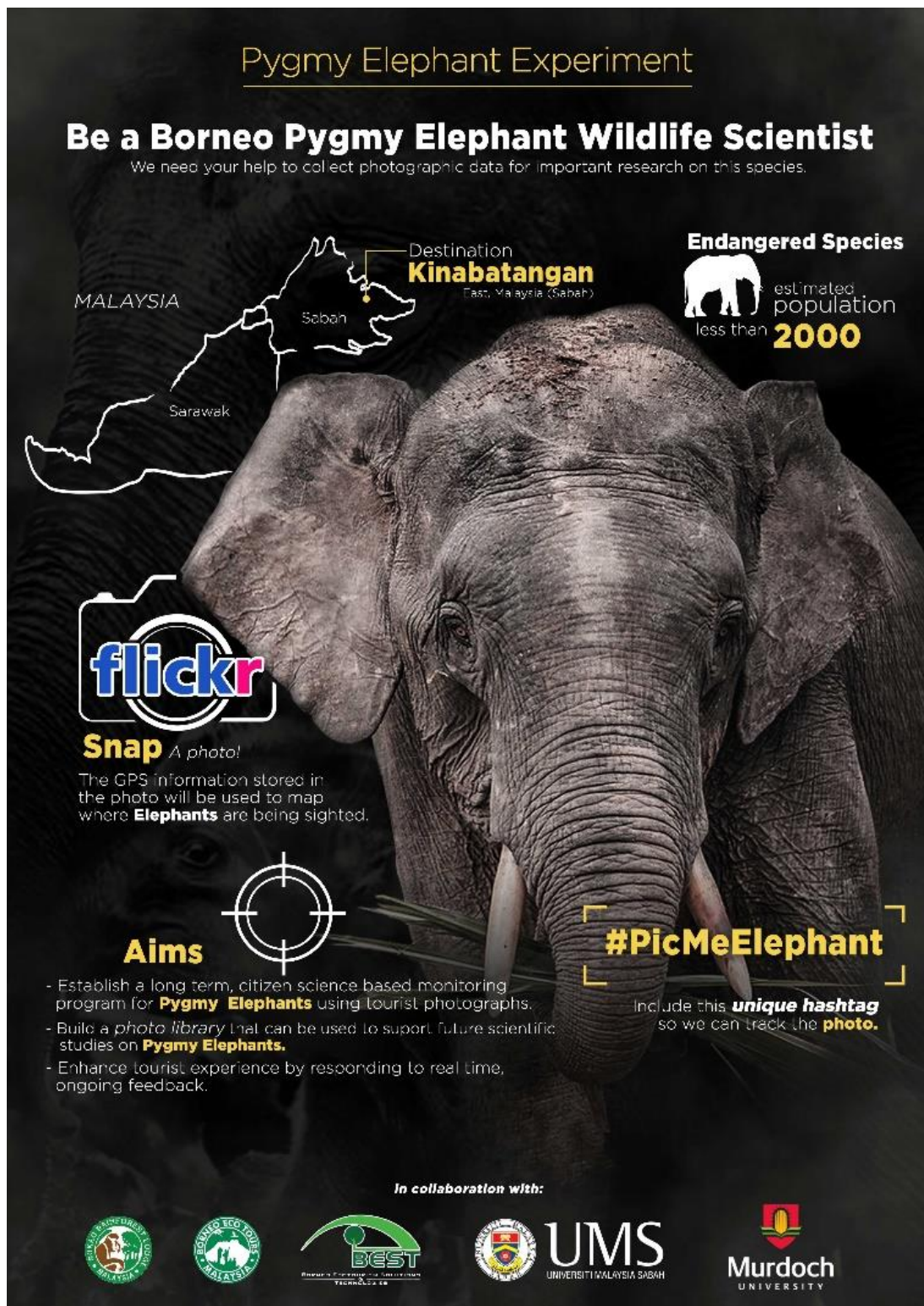


Figure 18: Project poster on display at Sukau Rainforest Lodge.

The process of tracking photos was made possible through the use of a unique hashtag created for the project. Guests were asked to include #picmeelephant in their posts to Flickr, so that it was possible to quickly access and compile posts into a growing dataset. Previous citizen science projects using Flickr have used a dedicated group to compile photographs on a relevant target species (Kirkhope & Williams, 2010; Stafford et al., 2010). However, this process requires people to not only sign up to Flickr, but to search and locate the group on Flickr, request to join it and then add their already uploaded photo to that group. This process therefore required more steps than simply including a specific and trackable hashtag. Keeping the process as straight forward as possible by using the hashtag tracking approach was essential for avoiding confusion, maximising participation over a short period of time and engaging a wider audience, including those that may be less confident with technology.

Another factor was the reliance of the project on internet connection. Almost all smartphones today and some modern DSLR cameras feature a built in GPS receiver that draws location data from satellites around the globe (Gupta, 2018). This is critical as it means that as tourists are taking photos (with location service switched on) during tours on the Kinabatangan (where internet connection is not guaranteed) the photos will retain the location information from where the photo was taken in the image EXIF. Once uploaded to Flickr (a process which does require access to mobile data or Wi-Fi) the geotag reference will be for the location of where the photo was taken and not for where it was uploaded from. This means that even if images are uploaded weeks later, the coordinates are fixed to the location of where the image was taken. Consequently, guests could upload geotagged photos for the project even after returning home from their holiday.

6.1.2 Online Data Collection and Analysis in Australia

Location information was extracted from the geotagged photographs using the “flickr.photos.getInfo” application made publically available through the Flickr App Garden. This application was created using the open API in Flickr which allows users and developers to write their own programs to present public Flickr data. The latitude and longitude coordinates for each geotagged photograph were plotted onto a map using the Google My Maps service. Photographs were grouped as a single sighting if they took place on the same day, during the same riverboat trip and within 100 metres of each other. BET offer several different riverboat tours throughout the day, including the Morning Cruise, Afternoon Cruise and the Elephant Search, which was offered as an optional add-on tour. Using time, date and location information, it was possible to determine the type of tour upon which elephants were encountered. Arrival and departure trips to and from Sandakan were also included in this analysis as they provided additional opportunities for wildlife viewing.

After mapping sightings on Google My Maps it was possible to view and interpret the landscape matrix (Newsome et al., 2013) in which elephants were being encountered. When displayed on satellite view, agricultural areas could be identified as distinct patches consisting primarily of oil palm monoculture. This was also confirmed during the two and a half months of on-ground fieldwork in Sukau and experiencing firsthand the clear distinction between primary/secondary rainforests and oil palm trees. The distance from each sighting to the nearest oil palm plantation was measured to the nearest 10 m using the “measure distances and areas” tool provided in Google Maps.

6.2 Social research application

Understanding tourist experiences and responses to encountering wild Borneo Pygmy Elephants along the Lower Kinabatangan River was another principle objective of this research. A modified application of the photovoice methodology (Yi-Frazier et al., 2015) using photographs and associated text extracted from the social media platform, Instagram (<https://www.instagram.com/>) was adopted to explore this aspect. Further, the feasibility of applying this adaptation of the social science validated photovoice method in regards to nature tourism research is investigated. This modified photovoice approach is both reflective of the evolving nature of photography and online discussion (Zeglin & Mitchell, 2014) and of the engagement of tourists with social media and the sharing of travel photographs (Memon et al., 2014). As discussed in Chapter 2, photovoice is an evolution of the photo-elicitation research technique, with the shared objective of evoking deeper insight on an experience than through words alone (Harper, 2002; Miller et al., 2016; Tonge et al., 2013; Wang & Burris, 1997). To the best of available knowledge, this is the first study to apply an adaption of the photovoice method to wildlife tourism using tourist-generated content sourced from SNSs.

It was originally thought that Flickr would act as the designated SNS for both the wildlife and social aspects of this research. It was quickly revealed that Flickr, however, is primarily used by individuals to upload and store photographs, but not so much as a forum for discussion around these images. For this reason, the method was altered to use Instagram to capture data for the photovoice analysis of tourist photograph captions. Datasets were developed from photographs already taken by individuals and posted on Instagram along with the hashtag #pygmyelephant, #borneoelephant or #borneopygmyelephant. All posts to Instagram between 1/1/2017

and 31/12/2017 that contained one of these hashtags were included in the analysis providing that, to the best of judgement, the photographs featured Borneo Pygmy Elephants in the wild. To ensure the dataset remained geographically focused, only posts featuring a geotag or referencing the Kinabatangan region were included. This excluded photographs taken of elephants in other Sabah based ecotourism destinations such as the Danum Valley or Tabin Wildlife Reserve. The analysis involved both quantitative and qualitative elements. The quantitative methods included a text frequency analysis of all captions in the data set, which would then aid in the detection of emerging themes. Qualitatively identified themes were then explored further using direct quotations from those posting about their experience to Instagram.

6.2.1 Word frequency analysis

A dataset of 163 captions was manually extracted from Instagram and captured in a Microsoft Excel spreadsheet. A project-specific algorithm was developed to generate frequency statistics for English words. This approach was based on a method used by Cong et al. (2014), in their analysis of a wildlife tourism experience using reviews posted to TripAdvisor. To achieve the most interpretable and reflective results from this text-mining analysis, the following protocols were applied. Words were excluded if they did not contribute to the meaningful interpretation of the content. This exclusion included linking words and terms such as 'the', 'of', 'to', 'and', 'you', 'is' amongst others. Words were manually grouped to resolve inconsistencies caused by singular and plural nouns, different tenses for verbs and misspelling of keywords. For reasons of practicality, classification was limited to the 200 most frequently used words, at which point the word frequency had reduced to three and these words appeared in less than 2% of the captions. Efforts were made to ensure that words were only grouped as necessary, so as to avoid bias arising from over classification. Names

and phrases which contained multiple words (e.g. palm oil, Kinabatangan River) were compounded into a single word prior to conducting the text frequency counting algorithm to avoid separate counting.

6.2.2 Thematic analysis

Braun and Clarke (2006, p. 79) define thematic analysis as a “method for identifying, analysing and reporting patterns (themes) within data. It minimally organizes and describes your data set in (rich) detail”. Using the results of the word frequency analysis in combination with manual interpretation of the captions, it was possible to detect emerging themes. The number of captions in which each of the identified themes was discussed, was then recorded as a frequency score. Supplementary to the manual process of checking for themes, themes were also detected based on the prevalence of associated keywords across the dataset as identified by a Visual Basic script. The purpose for running this alternative, automated process of theme detection was to assess the feasibility of its application in future studies using larger datasets, whereby manual reading and checking for themes would not be practical. The script identified themes by searching each caption for predetermined and representative keywords relating to themes. For each caption, the script would return a Boolean (true or false) value per theme to avoid separate counting in cases where a caption mentions keywords of a particular theme more than once. As highlighted in Braun and Clarke (2006), however, rigid rules and processes are not always effective in revealing the truest interpretation of content and underlying meanings. For this reason, the results reported in the following section are based on the findings of the formerly described manual theme identification process.

7.0 Results

7.1 Wildlife research application

This section reports on the findings of the pilot citizen science based project established and implemented at SRL. Primarily, the following sections explore locational, temporal and landscape factors in respect to where elephants were sighted by tourists along the Lower Kinabatangan River using geotagged photographs uploaded to Flickr.

7.1.1 Project involvement at Sukau Rainforest Lodge

The project was launched at SRL in August 2017 and promoted to both guests and staff as a citizen science program to explore spatial and temporal information relating to the elephants, in particular where and when the animals were being seen by tourists on tours. Being a pilot study, testing the feasibility of this approach for wildlife research was essential. Over the ten week on-ground research phase of this project, a total of 207 photographs featuring the project-specific hashtag (#picmeelephant) were uploaded to Flickr (equivalent to 2.95 photographs added per day). Of these, 135 photographs (65.2% of the 207 images) featured a geotag, and 95.6% of these geotagged photographs were taken using mobile smartphones. Following the on-ground project implementation, a further 40 photographs of the elephants were uploaded to Flickr featuring the #picmeelephant. This brought the total dataset between October 2017 and December 2017 to 247 photographs from 17 individual contributors.

7.1.2 Mapping elephant sightings

The latitude and longitude coordinates for each of the geotagged photographs on Flickr featuring #picmeelephant were extracted from the associated EXIF information. Photographs taken on the same day, during the same riverboat trip and within 100 m were grouped as a single sighting, resulting in a total of 22 recorded sightings over the duration of ten weeks. These sightings, including the relevant tour type and approximate times, are displayed on a satellite map in Figure 19. Of the 22 sightings, three were recorded during morning cruises, six during afternoon cruises and ten sightings were from designated elephant search tours. During the arrival trips (from Sandakan to Sukau) two sightings were recorded and during departure trips back to Sandakan, one sighting was recorded. Photographs were taken during riverboat cruises along approximately 100 km of the Lower Kinabatangan River from Batu Puteh to Abai, Sabah, Malaysia.

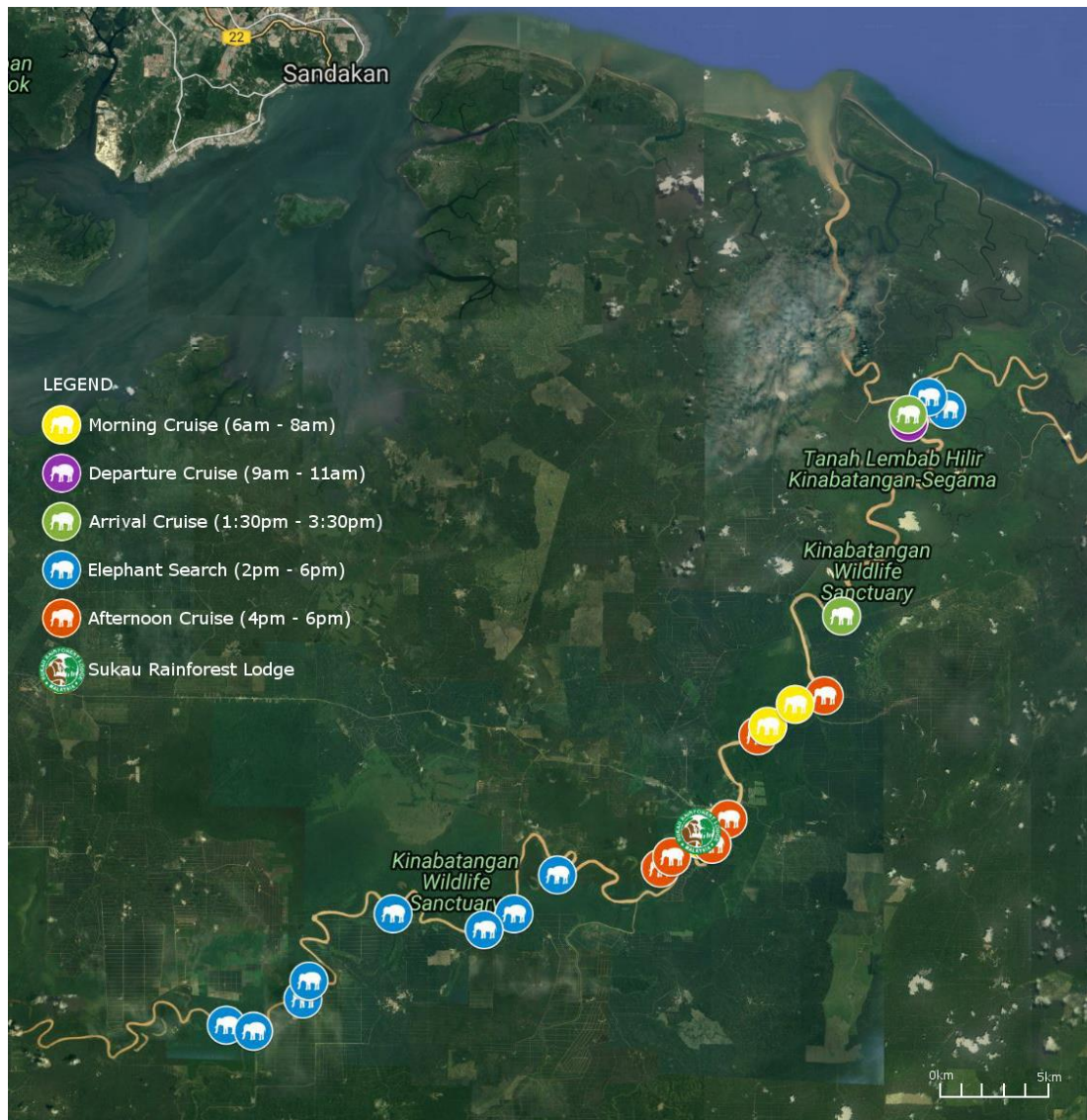


Figure 19: Elephant sightings during tours on the Lower Kinabatangan River. Coordinates sourced from geotagged photographs uploaded to Flickr.

7.1.3 Assessment of landscape matrix

From visual inspection of the satellite image (Figure 19), it was possible to identify different vegetation patches occurring within two distinct landscape matrices; a cleared agricultural matrix and a natural forest cover matrix (Forman, 1995; Newsome et al., 2013). An example of the juxtaposition between the continuous natural forest areas and the distinct blocks of oil palm monoculture is shown in Figure 20. The distance of a sighting to the closest plantation was measured to the nearest 10 m. The average distance of an elephant sighting to the nearest oil palm plantation was found to be 1.25 ± 0.70 km (95% Confidence Interval). For the 22 recorded sightings, 72.7% were identified as being within a 1 km radius of an agricultural plantation (Figure 21).



Figure 20: Snapshot highlighting the overlap of elephant sightings and agricultural areas.

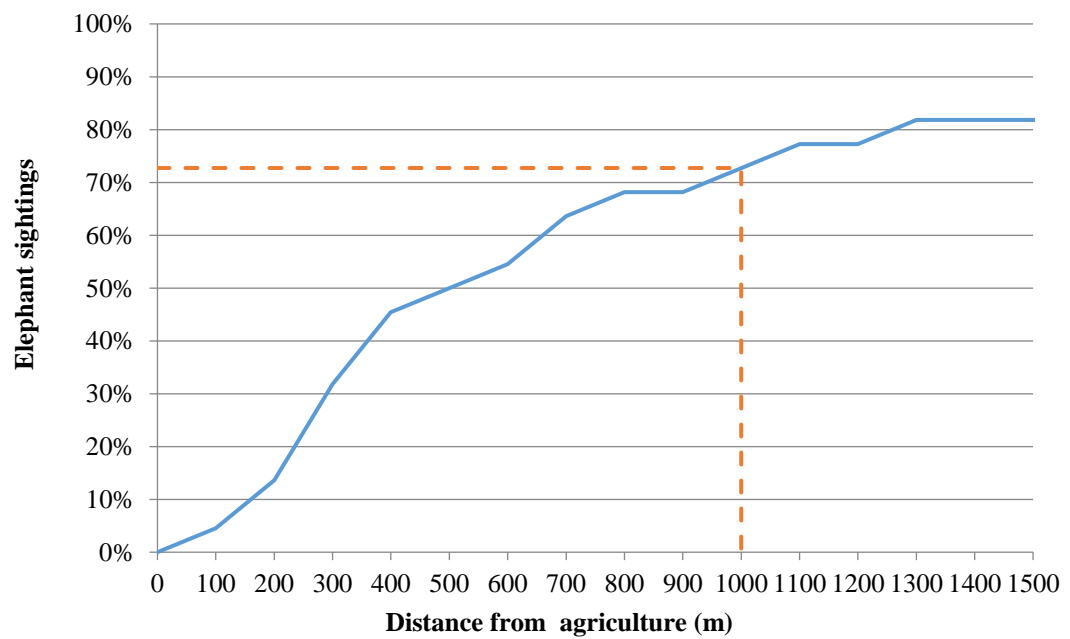


Figure 21: Cumulative distribution of elephant proximity to agricultural plantations. This figure demonstrates that 72.2% of elephant sightings during tours were within 1 km of a plantation.

7.2 Social research application

This section reports on the findings of both the word frequency analysis and thematic analysis using the captions drawn from Instagram. After first revealing the most commonly used words, it was then possible to detect emerging themes which were further illustrated using direct quotations from posts. This section also explores the effectiveness of the project-specific algorithm (Section 6.2.2) in automatically detecting themes.

7.2.1 Word frequency analysis

A word frequency analysis was performed to provide a general overview and feel for what was being said in the captions and to guide the selection of themes in the thematic analysis phase.

A total of 163 captions were included in the text analysis section of this study. After applying exclusions and groupings as discussed in Section 6.2.1, approximately 1500 different words were returned and the 50 most commonly used of these words drawn from captions are displayed in Table 4. Not surprisingly, “#pygmyelephant” ($n = 456$) returned the highest word frequency score as this was one of the key search terms used to retrieve captions. “#borneo” ($n = 201$) ranked second and “#kinabatanganriver” ($n = 195$) ranked third. The relative frequency of the terms are graphically summarised in Figure 22.

Table 4: Word frequency statistics for the 50 most commonly used words detected in the photograph captions.

Rank	Word	Frequency	Rank	Word	Frequency
1	#pygmyelephant	456	26	big	14
2	#borneo	201	27	swim	13
3	#kinabatanganriver	195	28	endangered	13
4	river	99	29	#natgeo	13
5	see	87	30	#travelphotography	12
6	#wildlife	84	31	#palmoil	12
7	#sabah	80	32	crossing	12
8	#malaysia	74	33	#borneowildlife	12
9	#travel	65	34	#conservation	12
10	wild	47	35	#naturephotography	11
11	#wildlifephotography	43	36	#instatravel	11
12	#rainforest	42	37	#travelgram	11
13	#nature	36	38	#backpacking	11
14	#animals	32	39	habitat	11
15	little	29	40	#sukaurainforestlodge	11
16	lucky	24	41	rare	11
17	#jungle	23	42	#passionpassport	11
18	#wanderlust	23	43	#naturelovers	11
19	#sukau	21	44	boat	10
20	photography	19	45	explore	10
21	#rivercruise	19	46	#adventure	10
22	herd	18	47	world	10
23	baby	17	48	incredible	10
24	#sandakan	15	49	amazing	10
25	beautiful	14	50	#wildanimals	10

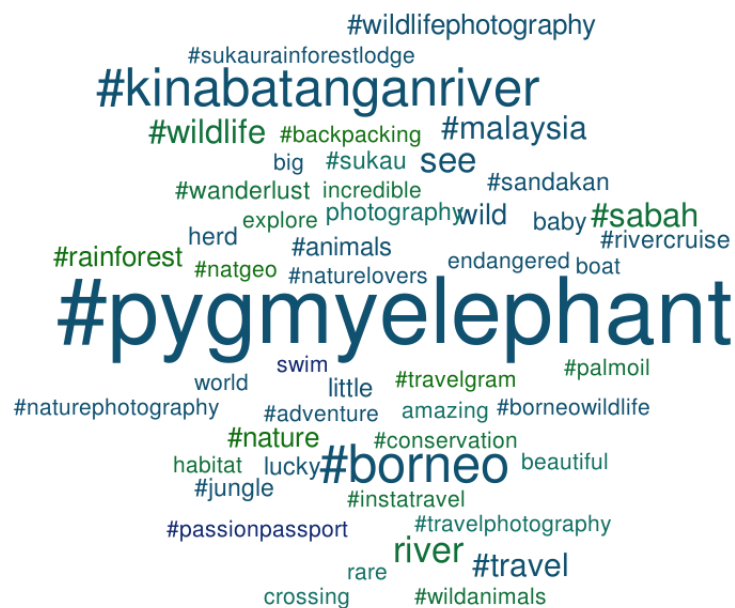


Figure 22: Word cloud providing visual representation of the 50 most commonly used words.

7.2.2 Thematic analysis

The key words from the text frequency analysis (Table 4 and Figure 22) were categorised into eight overarching themes shown in Table 5. Of the themes raised in the analysed captions, features relating to *Setting* ($n= 158, 96.9 \pm 2.6\%$) were most discussed followed by comments relating to *Wildness* ($n=116, 71.2 \pm 7.0\%$). The discussion of *Elephant Attributes* ($n=88, 54.0 \pm 7.7\%$) then ranked third followed by reference to *Appreciation of Experience* ($n=65, 39.9 \pm 7.5\%$). The overarching themes of *Setting* and *Elephant Attributes* were further divided into sub-themes (Table 5) to achieve deeper insight into two otherwise quite general categories. Manually reading and checking through the captions confirmed that theoretical saturation (Morse, 2004; Tonge et al., 2013) had been reached, as no new concepts were being raised that weren't already captured by these eight overarching themes.

Table 5: Results of the manual theme analysis.

Theme	Sub-theme	Frequency	Percentage (%)
Setting		158	96.9%
	Location	158	96.9%
	Landscape	97	59.5%
Wildness	-	116	71.2%
Elephant Attributes		88	54.0%
	Description	55	33.7%
	Behaviour	47	28.8%
	Abundance	42	25.8%
Appreciation of Experience	-	65	39.9%
Travel	-	60	36.8%
Photography	-	59	36.2%
Conservation	-	55	33.7%
Other Wildlife	-	18	11.0%

A comparison of the themes and sub-themes (total of eleven including sub-themes) are displayed in Figure 23. From visual interpretation of the confidence intervals (Cumming et al., 2007), *Location* was significantly greater than all other themes. *Wildness* and *Landscape* were the next most significant themes raised by tourists. The occurrence of all other themes and sub-themes were statistically similar, and appeared in approximately three out of every ten captions. The discussion of *Other Wildlife* was significantly less than all other themes in this analysis, which was unsurprising given the focus of the dataset towards elephants.

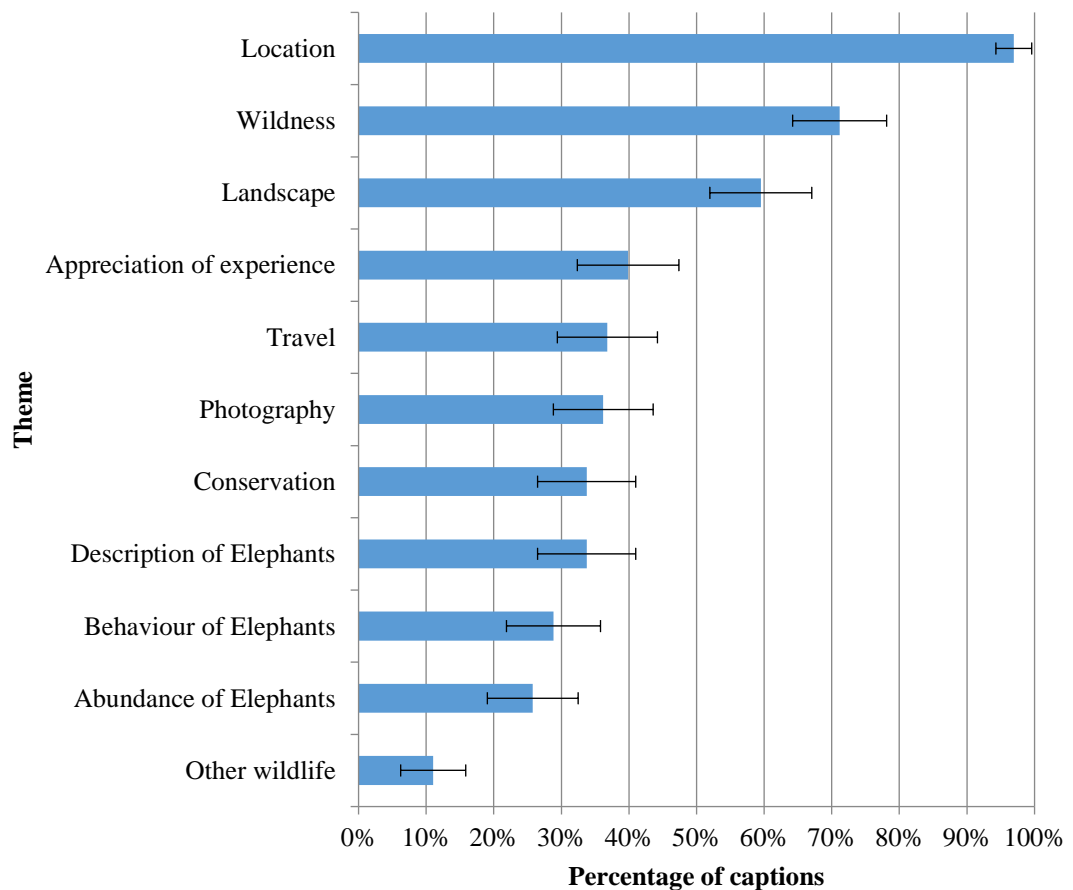


Figure 23: Frequency of theme presence across captions as identified in the manual theme analysis.

The keywords used by the automated script to detect prevalent themes are shown in Table 6. These keywords were chosen based on selective judgement about which words would most accurately represent themes, a process that was guided by interpreting the word frequency list in Table 4. Some words from Table 4, however, could not be included for use in theme identification, as they were too general to associate to a specific theme (e.g. “#nature”, “#animals”, “explore” and “world”). More general words such as these would require interpretation within the context of a sentence in order to determine their association to a theme and could therefore not be used as standalone representative words in this analysis. Manually cross-checking the expression of these themes to validate the automated script determined that the script was effective in identifying themes ($93.2 \pm 3.9\%$). Further, the automated script detection of the theme *Location* was most effective, with this being correctly identified in $99.0 \pm 1.5\%$ of captions. The lowest accuracy score was for the theme of *Appreciation of Experience*, with this being correctly recognized in $84.1 \pm 5.6\%$ of cases.

Table 6: Effectiveness of automated script in the theme identification.

Theme	Representative keywords used in automated script	Correctly identified by script
Location	#borneo, #kinabatanganriver, #sukau, #asia, #sabah, #sandakan, #malaysia, #sukaurainforestlodge, #borneowildlife	98.97%
Landscape	river, #jungle, #rainforest, #palmoil	94.87%
Photography	#photography, #wildlifephotography, #naturephotography, #canon, #travelphotography	92.82%
Description of Elephants	cute, little, big, ear, ears, tail, tails, mother, baby, cutie, cuties, juvenile, juveniles, male, female	89.74%
Behaviour of Elephants	dine, swim, feeding, crossing, feed	89.23%
Abundance of Elephants	herd, pair, family, lone	89.74%
Conservation	#conservation, endangered, protected, #palmoil, extinct, #notopalmoil, rare, deforestation, poachers, poaching, habitat	92.82%
Appreciation of Experience	amazing, lucky, awesome, magnificent, luck, highlight, highlights, grateful, incredible, beautiful	84.10%
Travel	#travel, #wanderlust, #backpacking, #travelphotography, #instatravel, #travelgram, #passionpassport	97.44%
Wildness	wild, #wildlife, #wildlifephotography, wilderness, #borneowildlife, #wildanimals	97.95%
Other Wildlife	#proboscismonkey, proboscis, orangutan, orangutans, #orangutan, #orangutans, monkey, monkeys, bird, birds, crocodile, crocodiles	97.95%
TOTAL		93.24%

7.2.3 Thematic analysis: Direct quotations

Exemplar photographs and associated captions are shown in Figure 24 to provide additional context to the data collection process. These screenshots were taken directly from the Instagram website (written permission provided by users). To illustrate the responses that emerged through the modified photovoice analysis, the following quotations were selected to represent and provide examples for each of the theme categories described in the previous section.

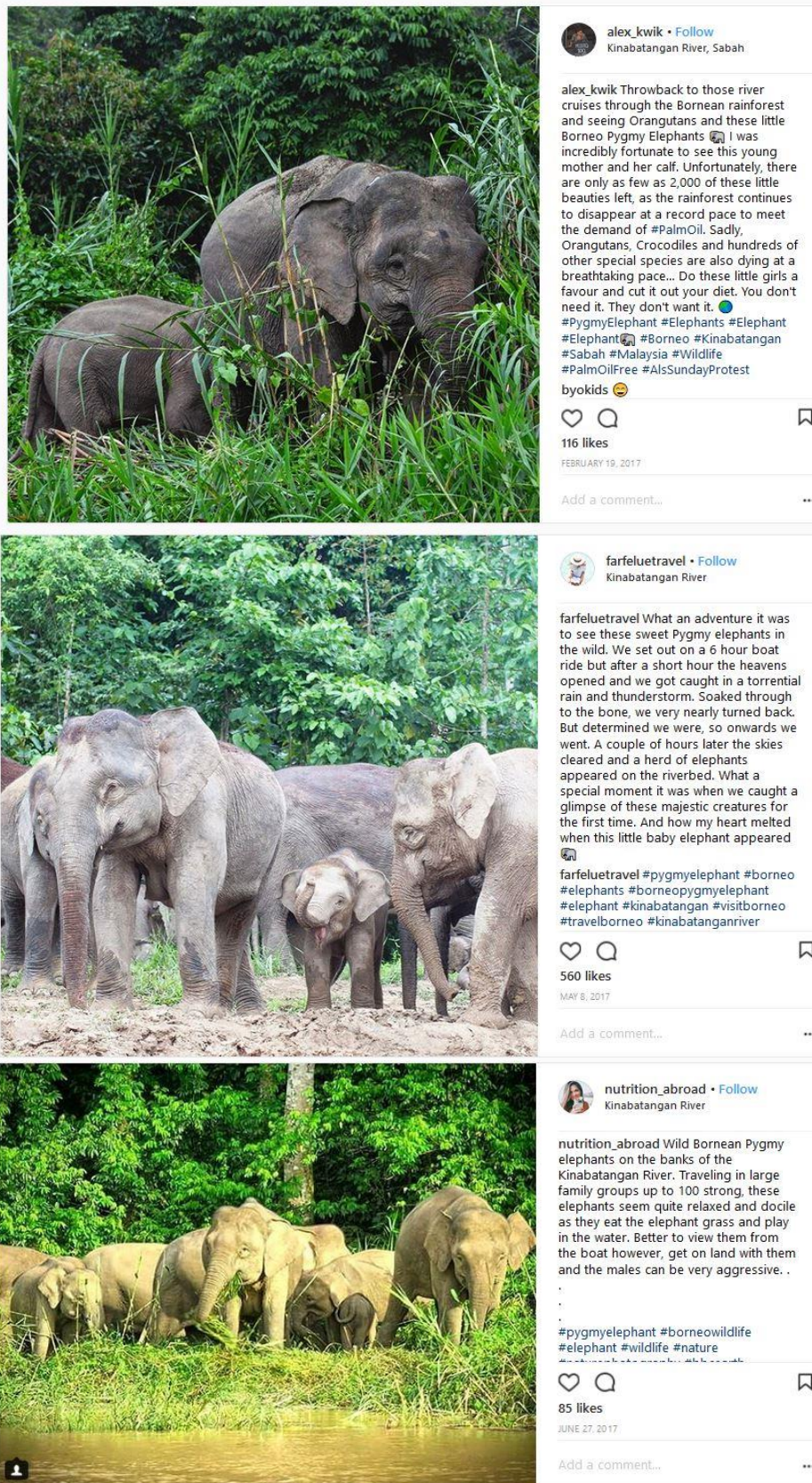


Figure 24: Example photographs and captions posted to Instagram. Content provided with written permission by Instagram users in accordance with Murdoch University Ethics Approval (2017/161)

Setting

Features relating to *Setting* (either *Location* or *Landscape*) were the most discussed in the dataset, with some reference to *Setting* being made in $96.9 \pm 2.6\%$ of captions ($n=158$). These comments were generally descriptive in nature, providing additional context about where the elephants were sighted as well as the significance of this destination and its biodiversity:

A mom & baby pygmy elephant feeding along the Kinabatangan River, Sabah, Borneo // Borneo is an incredible place, with so much beauty and biodiversity in both flora and fauna. Rainforests that are hundreds of millions of years old...

(Anonymous Instagram User)

Wildness

The theme of *Wildness* arises from the concept of nature being undomesticated. The theme of *Wildness* was attributed to captions which made reference to wildlife, as either plants or animals, in some way. This reference to seeing and experiencing the wild appeared in $71.2 \pm 7.0\%$ of posts ($n=116$). There was often specific mention made about the importance of observing these elephants in the wild, as opposed to captivity:

Rare sighting of a #pygmyelephant crossing the river. 25 years of waiting to see one ... totally worth it to see him in the wild where he belongs 🐘!

(Anonymous Instagram User)

Elephant Attributes

Elephant Attributes encompassed features relating to the description of elephants, the abundance of elephants during a tour and observed elephant behaviour. Once again, such comments are predominantly descriptive in nature and based on direct

observations made by tourists during elephant encounters. The discussion of elephant related attributes were identified in $54.0 \pm 7.7\%$ of posts ($n=88$).

Descriptive comments, accounting for $33.7 \pm 7.3\%$ of captions ($n=55$), typically related to the size, age, sex and distinguishing features of the elephants:

A herd of elephants including a very small baby (only a couple months old) appeared at a corner of the river just before we were about to end our cruise.
(Anonymous Instagram User)

The abundance of elephants seen during a tour was discussed in $25.8 \pm 6.7\%$ of posts ($n=42$). Comments describing abundance ranged from the depiction of lone elephants to herds and families of varying sizes:

Saw so much wildlife along the Kinabatangan River, with the highlight being a herd of about 30 Borneo Pygmy Elephants. (Anonymous Instagram User)

Behaviours displayed by the elephants were discussed in $28.8 \pm 7.0\%$ of captions ($n=47$) with these predominantly including swimming (either to cross the river or for “play”) and feeding:

These giants are calm and even peaceful as they watch you from the banks of the river as they eat the 'elephant grass' and play in the water. (Anonymous Instagram User)

Appreciation of Experience

Captions included reference to personal *Appreciation of Experience* in $39.9 \pm 7.5\%$ of cases ($n=65$). This theme incorporated positive responses from tourists, describing the experience as a “trip highlight” or “bucket list” moment for example:

This was truly a dream moment for me as these beloved pygmy elephants have been on my bucket list for some time, and the magic of sitting and watching them contented in their natural habitat is not something I will forget.
(Anonymous Instagram User)

Travel

Discussion of *Travel* related elements appeared in $36.8 \pm 7.4\%$ of captions ($n=60$). The theme of *Travel* incorporated references to tourists’ desire for travel and identification as travellers. It was also broad in encompassing other elements of a journey such as time, type and mode of travel:

These adorable pygmy elephants are the reason I travelled for days by planes, cars and boats to get to the remote heart of Borneo. (Anonymous Instagram User)

Photography

As the dataset is comprised of photograph captions, to some degree the theme of *Photography* is intrinsically present in the taking and posting of photographs to Instagram. However, $36.2 \pm 7.4\%$ of posts ($n=59$) did make specific reference to photography elements such as type of camera used, lighting, etc. *Photography* was also expressed as a motivational element for going on a wildlife tour, with the inclusion of hashtags such #wildlifephotography and “#naturephotography. The

caption quoted below provides an example of this emphasis towards aspects of photography:

A wide habitat shot of a Borneo Pygmy Elephant enjoying the fresh grass on the river bank...Canon 1DX II | f/8 | 1/320 | 100-400ii + 1.4xiii| ISO 4000 | handheld on a boat in flowing river. It is impressive how modern cameras can capture photos in such low light with good image stabilization. (Anonymous Instagram User)

Conservation

Conservation related issues were raised in $33.7 \pm 7.3\%$ of captions. These included landscape factors such as palm oil, deforestation and pollution. But of greater prevalence was the direct reference of the elephants being endangered and threatened. This was particularly highlighted in the word frequency count that ranked “endangered” as the 28th most commonly used word. The examples provided below illustrate this theme from the perspective of both deforestation as a result of agricultural development and pollution respectively:

Unfortunately, one of the reasons we saw so much wildlife is because deforestation has occurred as close as 100m to the river, to make room for palm oil plantations. Not kidding, we drove for hours through plantations just to get here. (Anonymous Instagram User)

Notice the plastic bottle in the jungle river though... not such a rare sight unfortunately. (Anonymous Instagram User)

Other Wildlife

The theme *Other Wildlife* recorded captions that made mention of other Bornean wildlife providing that tourists had also posted about their elephant-viewing experience. This theme was detected in $11.0 \pm 4.8\%$ of captions ($n=18$), typically including reference to other charismatic species in Borneo:

...so happy that the Sandakan region is so rich in wildlife 🌿 other wildlife sightings: Proboscis monkeys, orangutans, crocodiles, wild boars, hornbills, storm stocks, eagles. (Anonymous Instagram User).

Overall, the analysis of these photograph captions posted by tourists to Instagram has provided insight into the level of attention directed towards different themes. While the level of inference possible on this dataset is limited (for reasons that are discussed in the following chapter), the quantitative analysis of words and themes combined with the qualitative analysis of direct quotations has identified potential aspects of this elephant-viewing experience that are worthy of further examination within the context of previous research.

8.0 Discussion

8.1 Wildlife research application

The following sections will review the findings of the citizen science based pilot project launched at SRL and the implications for elephant-viewing along the Lower Kinabatangan River. In addition, these results will be assessed in terms of the potential to upscale and expand this approach to supplement future population monitoring on the Borneo Pygmy Elephants inhabiting this range.

8.1.1 Tourist-elephant encounters

By crowdsourcing geotagged photographs from Flickr that featured the project specific hashtag, #picmeelephant, it was possible to extract information about where and when the elephants were being sighted on tours. Whilst the sampling period for this study was limited to just over ten weeks, given more time it could be possible to detect elephant-viewing hotspots over this stretch of the river. Being a dynamic and continuous data source, such information would be particularly valuable not only to tour operators wanting to provide this experience and optimize viewing opportunities, but also for informing species monitoring and protected area management (e.g. elephant habitat usage along the river) (Hausmann et al., 2017a). Similarly, by accessing time taken information stored in a photograph's EXIF data, it would be possible to determine if there is a particular time of the day that elephants are most likely to be sighted along the riverbank. Anecdotal reports from tour guides suggest that the elephants are more likely to be seen during the afternoon tours.

Over time the mapping of tourist-elephant encounters in this way could also be useful for investigating the seasonality of elephant sightings, i.e. dry season versus wet

season. A clearer understanding of this would be valuable for informing marketing decisions by lodge and tour operators. It may, for example, be worth de-emphasizing elephant sightings and marketing other species that can be viewed more reliably during certain times of the year in order to avoid visitor disappointment when the elephants are not present (Newsome et al., 2017a).

8.1.2 Landscape context of elephant sightings

One of the most notable analyses in this study was the examination of the landscape matrix in which elephants were sighted during tours. The finding that almost 73% of reported elephant sightings were within 1 km of a plantation is an indication of the damaged landscape in which this tourism activity occurs. Human-elephant conflict, alongside habitat loss and fragmentation, has been identified as an increasing threat to the elephant populations in Sabah (Othman et al., 2013). This study provides insight into the increased exposure of elephants to human disturbance and changing land use along the Lower Kinabatangan River. Damage to crops and subsequent economic losses as a result of elephants entering plantation zones has led to extreme incidents of elephants being killed or severely injured (Othman et al., 2013; Suba et al., 2017). The data provided in this pilot study alone is insufficient for effectively guiding specific management decisions to mitigate HEC in Sabah and, as identified in previous studies, further collection of location specific data is required to enhance management (Othman et al., 2013).

The Elephant Action Plan 2012-2016 was created with the objective of addressing issues associated with HEC, as well as targeting underlying threats from habitat loss and fragmentation, disruption to migration routes and poor genetic diversity (Sabah Wildlife Department, 2011). The plan proposes site specific management actions,

including the institution of a “moratorium on new oil palm development within 500m on both side of the Kinabatangan River” (Sabah Wildlife Department, 2011, p. 19). Enforcement of this exclusion zone in the riparian area of the river will not only be critical for re-establishing habitat connectivity, but also for improving the natural setting in which elephants are viewed and appreciated, which is a topic that will be explored further in the social analysis of tourist experiences.

These findings highlight potential concerns and questions about the long-term sustainability of elephant-viewing for tourism in the Lower Kinabatangan. Attention must be given to restoration of degraded land and improvement of wildlife corridors (Estes et al., 2012; Evans et al., 2018; Goossens et al., 2016). Action plans should be regularly revised and updated as necessary (Newsome et al., 2017a). Ecotourism and conservation in this region are inter-dependent (Fletcher, 2009; Newsome et al., 2017a) and the prospect of further agricultural development will have serious implications on the sustainability of elephant-viewing based tourism. Efforts should be made to increase involvement of local people in tourism as an alternative livelihood option and to reduce the need for further clearing of privately owned, forested land for the purpose of oil palm cultivation. Such a shift towards ecotourism as a primary industry could thus help to ensure sustained wildlife conservation along the Lower Kinabatangan River (Fletcher, 2009).

8.1.3 Feasibility for long-term species monitoring

It was an objective of this pilot study to explore what type of information could be gathered from an image-sharing SNS, Flickr, and the suitability of its application to species monitoring. The citizen science based project established and implemented in this study provided proof of concept, on a small scale, for the potential to map and

locate wildlife using geotagged photographs shared by tourists and guides. Given that the Borneo based fieldwork and data collection ran for a relatively short time (ten weeks) and was focused to a single lodge, the amount of photographs ($n = 207$) collected in that time was relatively large and comparative to other published citizen science projects using Flickr. The BeeID project, which was spread across the United Kingdom, acquired an almost equal number of photographs ($n = 206$) over the same period (Stafford et al., 2010). Similarly, 59% of the photographs uploaded for the BeeID project (Stafford et al., 2010) featured geographical information compared to the 65% collected in this study. This comparison provides evidence to support the success of the brochures (Appendix A), instructional guides (Appendix B) and one-on-one interaction with guests to educate about how to correctly upload geotagged photographs to Flickr. These findings illustrate the potential to upscale and expand this approach over time. For example, if scaled up to the period of one year, over a thousand photographs could be generated at the pilot study upload rate of approximately three photographs per day. This then leads to the question of how these large photographic datasets can be applied to species monitoring.

Inspiration for the method used in this pilot study first came from the innovative use of photographic identification on publically sourced images of whale sharks in a mark-recapture approach to studying population dynamics and migration routes (Andrzejczek et al., 2016; Davies et al., 2012; Meekan et al., 2006; Norman et al., 2016). Extensive monitoring of this species has been made possible through a robust citizen science based data-collection program (Norman et al., 2016) using photographs sourced from both members of the public (tourists, ecotourism operators and residents) and researchers (Davies et al., 2012). The natural spot and stripe patterns present on the flanks of the sharks can be used to identify individuals. These natural markings

can then be analysed by the public domain pattern-recognition software I3S (Interactive Individual Identification System) to look for matches at sites and track movement patterns over time (Andrzejaczek et al., 2016).

The dedicated platform, *Wildbook for Whale Sharks* (<https://www.whaleshark.org/>), is an online mark-recapture database that provides the basis for photograph collection and identification in this whale-shark research program (Norman et al., 2016). *Wildbook for Whale Sharks* database is operated by the non-profit scientific organisation, *Wild Me* (<http://www.wildme.org/>). Looking forward, adapting this pilot monitoring program on the Borneo Pygmy Elephants in the Lower Kinabatangan range through integration with Wildbook photo-collection and identification software warrants further exploration. Long-term, such collaboration may assist in improving the focus, validity and security of information gathered in this citizen science approach to monitoring the elephants.

Like whale-sharks, elephants can also be identified through their distinguishing features, which in the case of elephants, are the unique nicks and notches which characterize their ears (Ardovini et al., 2008). Ardovini et al. (2008) propose a semi-automated method for wild elephant photo-identification by performing shape comparison of the ear nick curvature using a matching algorithm. This approach is said to be capable of dealing with low resolution photographs with cluttered backgrounds, which would be a requirement when analysing publically sourced photographs taken in a rainforest setting. Photo-identification also offers a non-invasive and cost-effective alternative to satellite collaring of elephants, with the potential for this data to supplement and enhance the current satellite tracking research on the elephants' movements in the Lower Kinabatangan range (Alfred et al., 2007;

Othman et al., 2013; Evans et al., 2018). In East Africa, the Southern Tanzania Elephant Program has established an elephant monitoring program in Ruaha National Park through the development of an elephant identification database to assess trends in elephant density, map elephant distribution and evaluate the impacts of HEC (Southern Tanzania Elephant Program, 2018). The program involves regular vehicle and aerial transects, camera trapping and citizen science contributions of sighting data, particularly from Ruaha tour guides. The Southern Tanzania Elephant Program, therefore, demonstrates the adoption of combined approaches to data collection and monitoring to improve understanding and optimize protection of these elephants. It is suggested that citizen science and the inclusion of tourists and guides in data collection on the pygmy elephants be further investigated for the Lower Kinabatangan population.

There are, of course, inherent limitations when using crowd sourced data from SNSs particularly in respect to sampling bias. Not all guests who participated on the riverboat tours chose to take photographs and not all those who did take photographs uploaded them to Flickr (Walden-Schreiner et al., 2018). In this sense, geotagged photographs uploaded to Flickr are not entirely representative of all elephant sightings along the river as this approach is only capturing data from a limited number of content producers (Hardy et al., 2017; Stefandis et al., 2011). Furthermore, being a less popular social media platform (Table 3), many guests would have to first download and create a Flickr account in order to contribute, which posed a significant barrier to participation. There was also spatial bias in respect to photographs only being taken of elephants when they were present on the riverbank (i.e. location data not available for elephants inside the rainforest), and limited to where and when tours would operate. Concerns regarding such bias were partly ameliorated by the fact that the

section of river covered in this study was bordered by Lots 1-7 of the Lower Kinabatangan Wildlife Sanctuary (i.e. excluding Lot 8), capturing 82% of the total river length from the villages of Abai to Batu Puteh (Estes et al., 2012). The village of Abai (located 40 km from Sandakan harbor) features vast mangrove forests, restricting elephant movement past this point. Conversely, whilst, the Kinabatangan River does continue from Batu Puteh, elephant movement upstream is blocked by a major highway and settlement in this area (Estes et al., 2012). Increasing participation not only amongst guests at SRL, but with additional ecolodges located on this portion of the river would be beneficial in increasing sampling effort and reducing uncertainties identified in this pilot project.

To overcome issues surrounding the amateur nature of contributors providing location information (Walden-Schreiner et al., 2018), GPS data was automatically rather than manually attached to images (i.e. location coordinates sourced from built in GPS receivers in smartphones) to improve the precision of mapped sightings. When possible, geotagged photographs were also displayed on a map and shown to tour guides at SRL to further verify the locations of sightings. Although such efforts were made to optimize data quality, the relatively small sample size and short sampling period for this project makes interpretation of results at this stage largely hypothetical (Daume et al., 2014). However, whilst a larger data set accumulated over an extended duration of time is required, the presented findings do suggest and provide proof of concept for the potential applications of photographs sourced from SNSs to wildlife monitoring within a tourism context.

8.2 Social research application

A modified application of photovoice using tourist-generated photographs and captions was employed in this study to examine tourist responses when viewing Borneo Pygmy Elephants along the Lower Kinabatangan River. The key research question for this aspect of the study was - providing that tourists viewed and photographed elephants during riverboat cruises, what did they choose to say and share about the experience? From a management perspective, such insight into tourist experiences is important in revealing both physical and cognitive elements that influence visitor satisfaction (Hansen, 2016; Patroni et al., 2018b). Assessing visitor satisfaction is necessary for delivering high quality experiences whilst also ensuring the long term sustainability and success of a wildlife tourism product (Newsome et al., 2017a; O'Neill et al., 2010; Patroni et al., 2018a). Accordingly, the following discussion highlights the findings of this case study and provides proof of concept for applying the social media focused research method trialled in this study to future studies on wildlife tourism experiences. To do this, the following sections report and expand on previous research relating to key themes raised by tourists and identified in this study, as well as reviewing the effectiveness and feasibility of the modified photovoice method.

8.2.1 Findings from thematic analysis

Landscape level aspects

The discussion of aspects relating to *Setting*, both *Location* and *Landscape*, returned the highest frequency value in the thematic analysis. As discussed, this is partly due to the descriptive nature of captions in communicating the context in which the photograph was taken. However, in respect to *Landscape* in particular, this theme has also been identified in previous studies on nature tourism in the Lower Kinabatangan

region as an aspect of value to tourists. Adopting a “big picture” landscape perspective, Newsome et al. (2017a, p. 12) highlighted not only the need to uphold the ecological integrity of the KWS, but also the significance of the river viewscape. The report of Newsome and his co-authors (2017a) is consistent with the thematic analysis of this study that found tourists paid tribute to Borneo’s beauty and biodiversity and its ancient rainforests. Similarly, Chan and Baum (2007a), reported in their study on ecotourist perceptions to experiences in the Lower Kinabatangan that tourists expressed concerns about the expansion of oil palm plantations leaving “no scenery to enjoy” (Chan and Baum, 2007a, p. 585).

The concept of landscape aesthetic as a biological factor in attracting tourists to protected areas was also explored using data mined from Instagram in a study by Hausmann et al. (2017b) that focused on sub-Saharan African protected areas. Those authors reported that the richness of charismatic species did not always explain social media usage (active users, posts and likes), rather other factors, including open vegetation, corresponded with higher social media usage. Evidently, the findings of this thematic analysis in combination with those of the aligned research reveal the potential significance of landscape and scenery aspects to tourists participating in wildlife-viewing cruises along the Lower Kinabatangan. This specific topic concerning tourist perceptions of landscape qualities (Jacobsen, 2007) warrants further investigation. Conserving the unique river viewscape may then also provide an additional argument for greater protection of the riparian vegetation and native rainforest that borders the river. Such measures may contribute to the overall wildlife-viewing experience and help to ensure the long-term sustainability of the ecotourism industry that is so important to this region (Newsome et al., 2013; Newsome et al., 2017a).

Conservation issues raised

The theme *Conservation* revealed reference to aspects such as the endangered status of the elephants, issues surrounding deforestation and habitat loss and the effects of the plantation industry on the surrounding landscape. These issues were detected in 34% of captions. Given the nature of online photo-sharing and discussion as typically being in a more positive light (Barry, 2014; Qui et al., 2012; Yi-Frazier et al., 2015), the inclusion of these more negative aspects in over a third of captions is of particular interest. These findings are also consistent with those of Newsome et al. (2017a), whereby nearly 50% of tourists responding to a survey felt that more needed to be done to protect the Kinabatangan River and its wildlife. The quotations drawn from captions provided in Section 7.2.3, regarding the visual impact of oil palm plantations on a tourist's journey to the Lower Kinabatangan was best exemplified by, "we drove for hours through plantations just to get here". In respect to viewing the elephants, statements such as, "we were lucky to see a big herd of them, although it is sad as these creatures have nowhere else to go" highlights the bitter-sweet nature of wildlife-viewing along the Lower Kinabatangan River, as the clearing of forest habitat (Estes et al., 2012) further from the river continues to restrict wildlife to this corridor. Such comments also reflect the findings reported in the previous section (Section 8.1.2) describing landscape level issues, including the close proximity of elephant sightings to plantations. This pilot study therefore highlights the value of adopting a combined social-ecological perspective when studying wildlife tourism experiences, particularly when exploring complex and multi-dimensional issues.

Perception of Elephants

Discussion of specific features relating to the elephants were clustered into the three categories of physical description, behaviour, and abundance. Physical descriptions of

the elephants were detected in 34% of captions and included reference to size, gender, age and other physically distinguishing attributes. Particular attention was given to the uniquely small stature of the pygmy elephants, with “little” being the fifteenth most frequently used word found in captions. A previous study into tourist perceptions of elephants in nature reserves in South Africa (Edge et al., 2017) similarly reported that smaller elephants may offer preferred viewing opportunities due to their distinctly charismatic appearance. Discussion of elephant behaviour observed during tours was identified in 29% of captions. One tourist described how they enjoyed watching the elephants “eat the 'elephant grass' and play in the water”. This importance of witnessing an animal’s natural active behaviours was reflected in Hacker & Miller (2016), which explored visitor perceptions and attitudes to viewing elephants in a captive setting. This study found that seeing the elephants engage in a range of apparently natural, species-appropriate behaviours was important to tourists and lead to greater intent to take conservation related actions after the experience.

Appreciation for a viewing experience in the wild

The *Appreciation of Experience* theme was detected in almost 40% of captions and recorded positive comments written directly in response to seeing and photographing the elephants. This theme, in particular, highlights the appropriateness of using a photovoice inspired approach when studying tourist responses to wildlife encounters. Curtin (2009, p. 459), reported that such connections often unlock an intangible feeling that is “beyond words”. The emotional responses of wonder and awe noted by Curtin (2009), were first revealed in the text-frequency analysis of this study performed on photograph captions (Table 4, Figure 22), with references to “beautiful”, “incredible” and “amazing” all appearing in the 50 most frequently occurring words. Seemingly, the theme of *Wildness*, which was detected in just over 70% of the captions,

contributed to this overall feeling of appreciation, with tourists often making direct mention to the importance of seeing elephants “in the wild where they belong”.

What factors motivate and influence the sharing of content online?

When interpreting the results of the thematic analysis, it is important to first consider the context of the dataset, and in particular what factors motivate people to post photographs and content to SNSs. Van House (2007) explored this question in an empirical study that identified four social uses of personal photography within a public online setting: (1) memory, narrative and identity, (2) relationships, (3) self-representation and (4) self-expression. In respect to *memory, narrative and identity*, people post photographs to create a visual record of an experience and these memories are then important in constructing their personal story and sense of identity. People may also post photographs for the purpose of *self-representation* and *self-expression*, to present themselves in a way they wish to be seen by others or to display a unique perspective or aesthetic.

These factors must be taken into account when interpreting the themes raised in the dataset sourced from Instagram. Of particular note, is the point that *self-expression* is more often skewed in a positive direction (Barry, 2014; Qui et al., 2012; Yi-Frazier et al., 2015), which may affect the extent to which tourists convey negative sentiments in their posts. Furthermore, in the process of using photography to record a memory or develop a narrative, people are more inclined to caption photographs in a descriptive manner (Barry, 2014). This would then contribute to the increased reference to contextual aspects, such as *Setting*.

8.2.2 Effectiveness of the automated thematic analysis

A desired outcome of this pilot study was to construct a foundational framework that could be adopted by tourism operators and researchers in the Lower Kinabatangan region. Its purpose being to gain real-time information and feedback about the quality of the local wildlife tourism product. For this reason, it was decided to use Microsoft Excel, a universal, affordable and highly accessible application, to perform analyses on word frequency usage and the presence of themes in photograph captions uploaded to Instagram. The project-specific script was written in order to judge the feasibility (i.e. accuracy) of using an automated approach to thematic analyses. If proven to be an accurate alternative to manual theme identification, this automated approach could potentially provide tour operators and researchers with a means of more efficiently investigating tourist responses than through traditional methods, such as surveys and interviews. This, in turn, would allow for the analysis of larger datasets using information sourced from SNSs than could be reviewed manually by a researcher(s). As shown in Table 6, this pilot study revealed that the automated script was effective in identifying themes with 93.24% accuracy. It was most effective in identifying clear and easily definable themes such as *Location* (98.97%) and *Landscape* (94.87%). While slightly less effective in detecting more general, intangible themes, the automated script still provided 84.1% accuracy for the *Appreciation of Experience* theme. These findings suggest that an automated approach to thematic analysis, within the context of a wildlife tourism experience, is capable of providing accurate results when compared against a manual theme identification process.

8.2.3 Feasibility of the modified photovoice approach

An objective of this study was to assess the feasibility of using a SNS, in this case Instagram, for the crowdsourcing of tourist photographs and associated captions

featuring Borneo Pygmy Elephants along the Lower Kinabatangan River. In doing so, this would demonstrate the suitability of the modified photovoice approach for use in future wildlife tourism research. Adopting a photovoice inspired approach grounds this application of social media content within an established social science research methodology. Instead of providing participants with cameras, this modified approach analysed the discussion of photographs already taken by tourists and shared to Instagram. The level of detail achieved in the thematic analysis segment of this study and the consistency of findings with previous surveys conducted in the Lower Kinabatangan region (Chan & Baum, 2007a; Newsome et al., 2017a) would suggest that, this modified photovoice approach has promising application for future wildlife tourism research. A critical analysis of the advantages and disadvantages of the modified photovoice approach follows.

Traditionally, sociological approaches to researching tourist experiences has involved surveys, interviews and focus groups, which may provide higher quality and more detailed information, however are often time consuming, costly and limited both spatially and temporally (Hausmann et al., 2017a; Heikinheimo et al., 2017; Richards & Friess, 2015; Tenkanen et al., 2017; Wood et al., 2013), lacking the longitudinal component required for effective monitoring (Newsome et al., 2013). Consistent with the peer-reviewed literature reported in Chapter 2, this study demonstrates the value of using data sourced from SNSs to support and enhance traditional conservation and tourism research methods (Di Minin et al., 2015; Richards & Friess, 2015), particularly when resources and funding are limited. Additionally, adopting a broader view regarding what tourists are saying online can reveal topics worthy of further investigation. The importance of landscape elements to the overall enjoyment of an elephant-viewing experience identified in this study is one such example.

Social media can provide a rich source of information that is both readily available and accessible (Di Minin et al., 2015; Hausmann et al., 2017a; Heikinheimo et al., 2017; Willemen et al., 2015; Wood et al., 2013). The case study used in this pilot study was of a highly focused tourism experience concerning encounters with Borneo Pygmy Elephants during riverboat cruises along the Lower Kinabatangan River. Despite this level of specificity, it was still possible to source 163 photographs and captions for the period 1st January to 31st December 2017. The use of social media hashtags (e.g. #pygmyelephant) as a tool for searching and tracking what people were posting about the elephants was effective for assembling the public posts in one place. However, the task of manually entering this data into Microsoft Excel was laborious, particularly when also filtering out irrelevant content (i.e. photographs not taken in the Lower Kinabatangan study site). The development of a more efficient method of extracting and capturing this data would be beneficial.

Being a pilot study, the methods used were exploratory in nature and not without limitations. Careful consideration should be given to the generalization of findings based upon data sourced from Instagram and the specific demographic of its users. This bias in respect to user-demographic stems from the fact that not everyone uses social media and not everything that is experienced is shared and reported online (Di Minin et al., 2015). Newsome et al. (2017a) report that the most common age group to visit the Lower Kinabatangan was 25 to 34 year olds (36%), which is relatively consistent with the average age of Instagram users being between 18 to 29 years old (59%) and 30 to 40 years old (33%) (Aslam, 2018). As discussed in greater detail in Section 8.2.1, there are also inherent issues with self-disclosure online and the increased sharing of positive over negative emotions (Barry, 2014; Qui et al., 2012; Van House, 2007; Yi-Frazier et al., 2015) and this should be considered when

interpreting findings drawn from social media data alone. Future studies comparing empirical data to data concurrently sourced from SNSs are required to further validate this approach.

9.0 Future Work

It is hoped that this pilot study stimulates further research to validate the use of social media content in both tourism and conservation research. The two applications explored in this study revealed that further work is required in different aspects to improve the quality and efficiency of data collection based on crowdsourcing tourist photographs from SNSs and the interpretation of this data within a wildlife tourism context. In respect to both applications, it is important for future research in this field to compare findings against empirical data to assess its reliability as an alternative research approach in ecotourism.

Focusing on the application to wildlife research, the process of extracting relevant data and storing it within a Microsoft Excel spreadsheet was found to be relatively time-consuming and labour intensive. Despite using the Flickr API service, the process of recording date, time and location data from individual photographs could potentially be made more efficient through the establishment of a dedicated platform, such as the likes of Wildbook, which is administrated and operated by researchers. Furthermore, by capturing data on a private, dedicated platform as opposed to a publically available social media platform, this would overcome security concerns regarding the sharing of species location information online (Berger-Wolf et al., 2017). Whilst the risks associated with uploading georeferenced photographs of the elephants in this pilot study were deemed to be low, going forward it would be responsible to adopt a cautionary approach to ensure such information is not putting species at risk. These considerations regarding cybersecurity should be considered by all future projects using social media and citizen science to collect location data on species.

From a social science perspective, future studies are required to investigate sources of bias, representation and interpretation of findings from social media produced data (Hausmann et al., 2017b; Di Minin et al., 2015; Keeler et al., 2015). Particular attention is required to assess possible bias stemming from the demographics of social media users (e.g. age groups, nationalities, etc.) and participation inequality as a result of only a limited portion of the population producing the content (Hausmann et al., 2017b). Applying the modified photovoice approach presented in this pilot study to different photo-sharing SNSs other than Instagram also warrants further study to explore the different ways in which people share content online. As mentioned for the wildlife application of the study, there is again need for a more efficient data mining process when extracting photographs and associated text data. This will be particularly necessary in future studies using larger datasets to extend the reach of interpretation regarding tourist interactions with wildlife.

10.0 Conclusion

This pilot study has explored how tourist-generated photographs sourced from the image sharing SNSs, Flickr and Instagram, can be applied to wildlife tourism research. Despite it still being early days for this emerging field of study, social media data shows increasing potential as a dynamic and supplementary information source.

The findings suggest that adopting a multiple-platform approach to concurrently studying both wildlife and social based dimensions of wildlife tourism experiences shows promise for further research. The value in adopting of a broad, socio-ecological approach was particularly evident in this case study at a landscape level, with the close proximity of elephant sightings to agricultural plantations being reflected in the analysis of tourist photograph captions on Instagram reporting on the prevalence of oil palm and loss of natural forest habitat.

Proof of concept was demonstrated for the ability to use geotagged photographs to map elephant sightings and interpret the landscape matrix in which these encounters occur along a portion of the Lower Kinabatangan River. Extending this citizen science based approach to supplement current monitoring efforts on the elephant population in the Lower Kinabatangan range also shows significant potential. To ensure the long-term success of such a program, consideration of a dedicated platform for photograph collection and identification should be explored. Additionally, the on-ground presence of a committed individual to educate and promote a citizen science project in this way is important for optimising project involvement, particularly during the foundational stages.

The findings from the social research application suggest the potential for a modified photovoice approach to be applied to photograph captions on image-sharing SNSs to explore tourist values and responses to wildlife viewing experiences. Comparing the themes that emerged from content sourced from Instagram to previous tourism research in the Lower Kinabatangan region helped to assess the consistency of findings with those developed using traditional methods. As discussed, future studies are required to continue validating the use of information derived from social media by measuring datasets against those collected via traditional means.

Going forward, despite recognised challenges, the availability of social media data provides opportunities to study people and wildlife in innovative ways. The findings of this pilot study suggest potential for using crowdsourced tourist photographs from social media to support and compliment traditionally collected data in order to inform management strategies, protect natural resources and enhance a wildlife tourism product.

11.0 References

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Appendix A: Informational brochures



How to get involved?

Step 1
Activate location services on smartphone camera.

Step 2
Photograph the rare Borneo Pygmy Elephants

Step 3
Sign up to Flickr + change settings

Step 4
Upload photo with #PicMeElephant

If using a device that is not equipped with location services, simply upload your photo and comments to Flickr with the hashtag #PicMeElephant.

All contributions are valuable to our research and are greatly appreciated!

Contact Us:



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Pygmy Elephant Experiment

Be a Borneo **Pygmy Elephant** Wildlife Scientist

flickr

We need your help to collect photographic data for important research on this species.

Overview

The Pygmy Elephant Experiment is a pilot project exploring a citizen science approach to conservation research on the Borneo Pygmy Elephant using photographs taken by tourists.

This project is an industry focused research collaboration between Borneo Eco Tours, Sukau Rainforest Lodge, BEST Society, BTRC University Malaysia Sabah and Murdoch University.

Research Goals

Short-Term

- Map where tourists and Elephants are interacting on tours along the Kinabatangan River.
- Apply a photovoice approach to photo captions in order to investigate feedback and perspectives relating to Pygmy Elephant interactions.
- Engage tourists directly in important conservation research on the Elephants and raise awareness about the species.

Long-term

- Develop an on-going, citizen science project which engages tourists directly in important research on the geographic distribution of Pygmy Elephants.
- Compile a photo library that can be used in future scientific studies and identification research on the Elephants.
- To establish a framework whereby tourist feedback/ comments can be collected at real time and directed into adaptive management, thereby enhancing tourist experience.

Research Significance

Pygmy Elephants are endangered and the least studied of all Elephant species meaning there is a strong need to expand scientific data on this species.

The Elephants are under threat from:

1. Habitat fragmentation from deforestation.
2. Increased human-elephant conflict as development encroaches on Elephant habitat.

Information on the geographic distribution of the Pygmy Elephants is critical for habitat management and decisions about which areas of rainforest are conserved.




Figure A1: Informational brochures used to promote the project at Sukau Rainforest Lodge.

Appendix B: Instructional guides for uploading geotagged photographs to Flickr

Pygmy Elephant Experiment: Upload Guide for Android

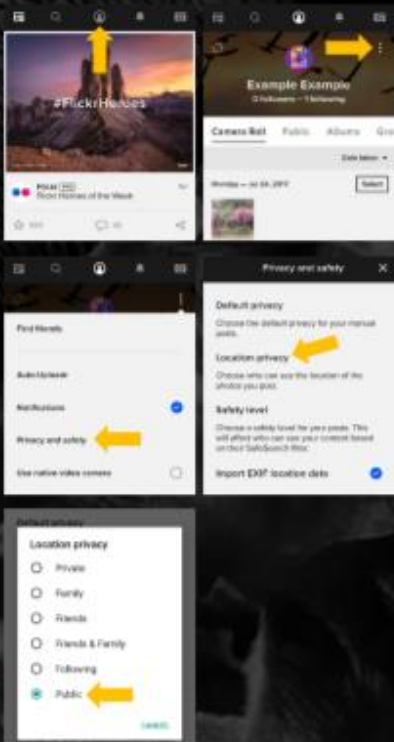
Step 1: Flickr Setup

a) Download the free Flickr App.




b) Follow prompts to create account.

c) Go to your Flickr profile to change location privacy to "Public". This allows us to locate where the Elephant was sighted.




Step 2: Upload Photo

a) Upload photo by clicking on the "Camera" icon on the right of the taskbar on Flickr home screen.




b) To access your camera roll, click on the image in the bottom left hand corner.



c) Select your photo and click "Next".

d) Include a caption describing aspects of your experience, the Pygmy Elephants and the surroundings.



Be sure to include **#PicMeElephant** in the description so we can track the photo!

Figure B1: Step-by-step guide for uploading geotagged photographs using Android.

Pygmy Elephant Experiment: Upload Guide for iPhone

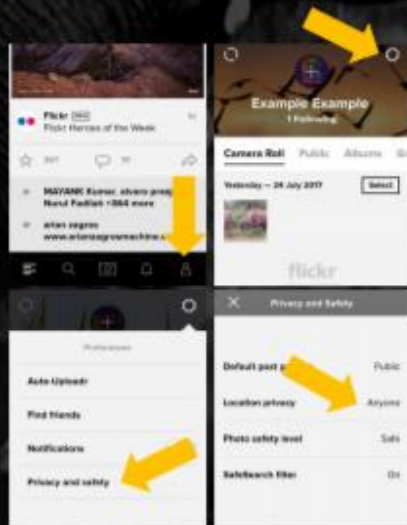
Step 1: Flickr Setup

a) Download the free Flickr App.



b) Follow prompts to create account.

c) Go to your Flickr profile to change location privacy to "Anyone". This allows us to locate where the Elephant was sighted.



Step 2: Upload Photo

a) Upload photo by clicking on the "Camera" icon in the centre of the taskbar on the Flickr home screen.

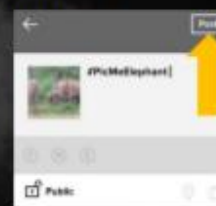


b) To access your camera roll, click on the image in the bottom left hand corner.



c) Select your photo and click "Next".

d) Include a caption describing aspects of your experience, the Pygmy Elephants and the surroundings.



Be sure to include **#PicMeElephant** in the description so we can track the photo!

Figure B2: Step-by-step guide for uploading geotagged photographs using iPhone.