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### Using Social Media for Conservation Monitoring of Rule-Breaking Behaviour in Provisioned Macaque Populations and the Effects of Eco-Tourism.

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**Using Social Media for Conservation Monitoring of  
Rule-Breaking Behaviour in Provisioned Macaque  
Populations and the Effects of Eco-Tourism.**

**Toby Ridehalgh**

**A Thesis Submitted to Bangor University School of Natural Sciences**

**September 2020**

## **Abstract**

Macaques are one of the most well studied non-human primate species, however assessment of provisioned (wild primates that are provided with food by local humans, tourists, or designated rangers) troops is relatively untouched, with some suggesting that the study of provisioned populations provides unusable behavioural and social data. Gathering data via Instagram can potentially allow for en-masse crowd sourcing from a practically unused data vein, with hundreds of thousands of pieces of biodiversity data at our fingertips. In this study we outline the definitions, potential benefits and drawbacks of ecotourism, as well as quantify data gathered over the course of four months via Instagram from four provisioned macaque sites across the globe. The study investigates what are the main preferences for photos of the tourists visiting the area, the interactions between tourists & macaques and whether visitors of National Parks are more or less likely to record acts of deviancy than of sites with more relaxed rules. It was found that rule breaking, and interactions were significantly lower in the National Parks than in the Provisioned sites. In each individual site, instances of tourists adhering to the rules were also significantly higher than instances of deviancy across all four sites, which could be beneficial to the health of the troop, allowing for a more natural living environment. Data gathered via social media could hold the key to quick, accurate and vast sources of data, however preliminary studies may need to be conducted in order to compare social media data with more traditionally gathered data to see if they positively correlate.

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## Introduction

Interactions between groups of humans and other primates have always been commonplace in areas where the two species coexist (McLennan, Spagnoletti and Hockings, 2017), with the non-human primate species often being offered provisions by the people (Soumah and Yokota, 1991). "Provisioning" in the case of human/non-human primate interactions can be defined as "the supply or offering of food to local non-human primate populations" (Soumah and Yokota, 1991). This provisioning can lead to increased interactions between the two groups who would otherwise keep separate, in turn increasing the likelihood of "deviant behaviour" exhibited by the human groups (Goh, 2019).

Deviant behaviour within humans has been defined as "a form of non-compliance and often deliberate acts of rule-breaking within provisioned natural parks" (Saunders et al., 2019; Goh, 2019). The discouragement and prevention of deviant behaviour can be one of the most problematic and serious tasks faced by local park authorities (Goh, Ritchie and Wang, 2017), with serious implications for any visitors found to be taking part in deviant behaviour (Girasek, Marschall and Pope, 2015). Deviant behaviour within primate sites can include littering, walking off designated trails, swimming in restricted areas, coming into contact or feeding the local fauna and illegal hunting (Goh, 2019, Hilborn et.al 2006). Feeding the animals is one of the major forms of deviant behaviour exhibited by tourists visiting populations of primates, which can lead to problems such as habituation towards humans within troops of primates and an over-reliance on them for food (O'Leary and Fa, 1993).

The aim of this project is to understand whether data gathered from Instagram can explain the variation in human-macaque interactions, namely instances of rule breaking within the sites and what the different preferences are for tourists visiting these sites (such as are they focusing on the primates themselves, are they there for the landscape etc). Data gathered from each site will be compared with one another to determine whether what tourists prefer to take photos of can be observed, how prevalent rule breaking is within the park, how exactly the rules are being broken and whether data gathered from Instagram can be used to help these parks understand the prevalence of rule breaking, to effectively combat it. We will be comparing data gathered on instances of rule breaking from two national parks (Jigokudani Monkey Park, Japan & Yushan National Park, Taiwan), which have direct and strictly enforced rules, with two more relaxed sites that have more indirect rules (Gibraltar) or no rules at all (Galta Ji, India ). The project will cover the pros and cons of observational research by gathering data via Instagram and discussing what went well during the study and the challenges encountered, the benefits and limitations of solely using social media for data gathering purposes and whether data gathered in this way has a part in the future of conservation.

The study will investigate the area of rule-breaking, namely **(i) Do rules set by national parks decrease the likelihood of rule breaking compared to more relaxed areas?** This question will allow us to examine each site individually in order to see the effectiveness of set guidelines, which vary with each site. We will then discuss the overall apparent effectiveness of rules and what can potentially be done in future to enforce a tighter hold on rule breaking. Secondly, variation between the four sites will be compared to see if there is any significance within the actions of tourists. For this the study will be working with the



research question of **(ii) Can data gathered via Instagram explain the variation in human-macaque interactions?**

Finally, in the discussion section we will be looking at the usefulness of social media within conservational research. Can full studies be conducted via the internet? Or is Social Media research only useable when coupled with studies in person at the respective sites? Does the user data on Instagram match with the relative popularity of the sites? Or is there a disproportionate number of Visitors when compared with Instagram posts? Does Geotagged Instagram data allow for accurate research into a Troops overall health when compared to an in-person study? Could data gathered via social media be a cost-effective replacement for traditional visitor-based surveys? These ideas will formulate the question **(iii) Does social media have a future in conservation science?**

For data analysis purposes and to assess the potential effectiveness of rules within both provisioned areas and national parks, this thesis has worked with the null hypothesis: **“There will be no significant difference between the rate of deviant behaviours exhibited by tourists in national parks vs provisioned areas”**

## **Literature Review**

### **Rule Breaking & “Deviant Behaviour”**

The most common ways to combat deviant behaviour is through direct or indirect management strategies (Hockett, Marion and Leung, 2017). Direct strategies use methods such as by-laws and defined rules in order to strictly enforce adherence to rules, such as removal from the area if caught carrying out deviant behaviour, or in some cases even a fine (Gundersen et al., 2015) and area design, such as intentional barriers placed between the visitors and fauna (fences, natural barriers etc). Indirect management strategies include more laid-back methods of teaching and enforcement such as educational demonstrations throughout the park, or persuasive messages dotted through the park, such as signage reminding visitors of the guidelines (Saunders et al., 2019).

While direct management strategies can be very effective in terms of management of deviant behaviour, the authoritarian nature of them can lead them to being more of a last resort for the park authorities, who want to promote a more friendly and enjoyable atmosphere for the visitors (Hockett, Marion & Leung, 2018), whereas indirect management methods are designed more to allow the visitors the liberty of choice while gently nudging the visitors into the right frame of mind. A combination of both direct and indirect strategies are the most common way of combating deviant behaviour within most national parks (Goh, 2019), for example, educational billboards throughout the park (indirect) and fencing off of certain areas with high deviant activity (direct).

Deviant behaviour can have numerous reasons behind it. Visitors often engage in rule-breaking behaviour because they are uneducated on the risks and implications of their behaviour (Saunders et al., 2019), others seek the thrill of knowing they are conducting illicit activities (Marengo, Monaci & Miceli, 2017) or there are even instances when the visitors are aware of the risks, however choose to ignore these, as they believe their behaviour and the danger to be manageable (Hu et al., 2018).

## **Understanding & Management of Deviant Behaviour**

One of the main issues that management groups of national parks face is trying to come up with effective strategies that combat deviant behaviour exhibited by tourists within the boundaries of the parks, which puts both the wildlife and the tourists themselves at risk (Goh, Ritchie and Wang, 2017). Despite the clear danger presented by these behaviours, tourists continue to break the rules and exhibit deviant behaviour. This raises the following questions: Why do tourists knowingly exhibit deviant behaviour? What determines the likelihood of exhibiting this behaviour? It is very important for the governing bodies of National Parks to assess and understand these questions in order to reduce the levels of deviant behaviour.

There is a wide range of strategies that can be deployed by conservation management companies in order to reduce the level of rule-breaking behaviour exhibited by tourists, many of which depend on sets of defined rules and guidelines that vary in severity and strictness (Gaveau et al., 2009; Keane et al., 2008). Strategies that have been used in the past involve protecting areas by prohibiting certain behaviours within the boundaries of the parks (Jachmann, 2008), legislation that protects specific species within parks (Lee et al., 2005) and rules that disallow the farming of certain resources (Takahashi 2009). Previous literature has suggested that the existence of rules as a sole deterrent of deviant behaviour is ineffective (St. John et al., 2010) and that it is important to fully understand the levels of rule breaking in order to come up with effective management strategies. It is difficult to accurately quantify levels of actual deviancy, as tourists who engage in rule-breaking behaviour are likely to not own up to such out of fear of implications and potential punishments (St John et al., 2010). Tourists who are likely to engage in deviant behaviour may also not engage in this if they know they are being watched, presenting a particularly challenging problem when using observational studies in this area (Bramwell and Lane, 2013), however some studies have been able to effectively use observational data to predict types of tourist behaviours, specifically littering within national parks (Mateer et al., 2020).

## **Tourist Interactions with Macaque Species**

With the current popularity of primate-based tourism, and the diversity in both range and species of Macaques, it is no surprise that their populations are among the most visited of all primate species, with some particularly popular tourist hotspots such as Gibraltar and Bali (Fuentes, Shaw and Cortes, 2007). Becoming increasingly coincident with tourist groups, as more and more travellers flock to these wildlife destinations, the Macaques feed, touch, share space and otherwise interact with humans daily. These populations either reside within the attractions, such as the Galtaji temple, or are in fact the attractions themselves, such as in Gibraltar (Fuentes, Shaw and Cortes, 2007). While these interactions can provide a constant and sustainable source of income for the local people, via tourist shopping in the local area, eating at local restaurants etc, it also results in habitat and resource competition between the Macaques and both locals & tourists (Priston and McLennan, 2013). It is important to find a balance between tourist satisfaction and macaque safety, especially for the local areas such as Gibraltar. Using sites such as Galtaji and Gibraltar within the study, it allows us to assess the issues these sites contain and discuss ways around these challenges, so that these areas can still benefit fully from the tourism the macaques provide, while also

providing a beneficial environment to the macaques themselves, away from invasive and detrimental tourist interactions such as unnecessary contact and overfeeding.

While these increased interactions between tourists and Macaques can benefit the local populations of humans, there has been only a small amount of documentation on how these interactions can potentially affect the Macaques themselves. Conflicts between wild populations and humans has always been one of the biggest challenges that threatens global biodiversity, and Macaques are no exception to this rule. Out of all the nonhuman primate species, Macaques are perhaps the most adept at traversing and exploiting the human environments, be it rural or urban (Priston and McLennan, 2013). With this level of interaction between Macaques and humans, there is an inevitable clash of species, which can often be detrimental to the Macaque. We are therefore using this study to assess whether we can monitor the interactions via Instagram in order to use the data to decrease these clashes.

Studies have found that groups of Macaques that co-exist with tourists and local populations are much more likely to engage in different, unhealthy behaviours in the presence of humans, while wild populations tend not to do this (Matheson, Sheeran, Li and Wagner, 2006). These behaviours included increased aggression towards juveniles from adults, and increased likelihood of juvenile aggression towards tourists, potentially due to redirection (Matheson, Sheeran, Li and Wagner, 2006). Other studies have shown that humans are much more likely to initiate the contact than the Macaques, with human initiations as high as 84.6% compared to 15.4% from the Macaques (McCarthy et al., 2009). Common human behaviours included rail slapping, shouting (both to attract the attention of and repel Macaques) and attempting to feed the primates, potentially causing the higher levels of aggression (Matheson, Sheeran, Li and Wagner, 2006).

These interactions have the potential to cause elevated levels of anxiety and stress within the Macaque populations, shown via increased aggression and self-scratching, particularly in males (Maréchal et al., 2011). This increased anxiety could lead to group infighting, as well as providing an explanation for the potential increase in adult aggression towards infants, which could in turn result in higher infant-mortality rates (McCarthy et al., 2009).

### **Direct Effects of Human-Primate Interactions**

Human-animal interactions have been characterised in many ways, from commensalism (interaction between two organisms in which one benefits, while the other neither gains benefit nor detriment), to competition, fellowship and collaboration, however conflict is often at the forefront of the mind when one mentions human-animal interactions (Woodroffe, Thirgood and Rabinowitz, 2005). Conflict can be the most damaging aspect of interactions for any animal group, no less in the macaque species (Radhakrishna, Huffman and Sinha, 2013). It is vital to understand the causation of these conflicts, in order to be able to accurately monitor the health of any troop. Previous study has found that majority of interactions have involved food (Fuentes et al., 2008), whether intentionally provided by tourists or stolen by the macaques. We discuss whether this is the case in this study and offer up new opinions on what the driving force between the Macaques and tourists could be in a different scenario.

It has been found that adult and subadult males within a troop of long-tailed Macaques were much more aggressive than expected, while the females and juveniles participated in these behaviours at a lower rate than expected (Fuentes and Gamerl, 2005), hypothesising that the variations in behaviours and interactions may have substantial effects on the management of the provisioned groups, as well as increasing the risk of disease transmission. Studies into body size, coat condition and endoparasite diversity of three different groups of Barbary Macaques, each exposed to different levels of tourism showed larger hips and deeper stomachs (measured externally from the top of the back to the bottom of the stomach) in groups exposed to tourism compared to those exposed to little/no tourism (Borg, Majolo, Qarro and Semple, 2014). Males within the tourist group had poorer quality coat condition than those of the non-tourist groups, however this was not seen in the female groups (Borg, Majolo, Qarro and Semple, 2014). Studies into ring-tailed lemurs have also shown poorer quality coats in groups with tourist interactions when compared to more wild groups (Jolly, 2009). Poor coat quality can be linked to external factors such as overgrooming, excessive contact and stroking from tourists, skin infections, nutrient deficiencies, endoparasite infections, and stress (Jolly, 2009; Borg, Majolo, Qarro and Semple, 2014; Honess, Marin, Brown and Wolfensohn, 2005). While coat condition cannot properly assess the exact ailment of the individual, it can be a good indicator of overall health when comparing between large groups (Jolly 2009).

Evidence has been presented that may indicate increased parasite concentration and diversity in wild primates with increased human interactions. Groups of Indri with increased human contact have been shown to house higher numbers of both endo and ectoparasites, as well as a wider range of parasite species than their undisturbed, deep jungle dwelling neighbours (Junge, Barrett and Yoder, 2011). These increases in the diversity of parasites within the primates are cause for concern, as polyparasitism has been shown to bring synergistic and cumulative effects to the host (Bordes and Morand, 2011). Disease transmission is often most prevalent in areas where tourists feed the primates by hand, as individuals come within proximity to both the tourists themselves and conspecifics (Russon and Wallis, 2014). In addition, studies have shown that the elevated levels of stress within the species of primates with more tourist's interactions can potentially lead to immune system suppression, increasing the likelihood of a parasitic infection and transmission between conspecifics (Maréchal et al., 2011).

### **Social Media: The Solution to Modern Data-Gathering Constraints?**

In current times, the natural world is in crisis. Experts have predicted that by 2050, all coral reefs will be at risk of some form of human activity, whether that be overfishing, unsustainable tourism, dredging or coral mining (Hoegh-Guldberg et al., 2007). Between the years of 1999 and 2015, roughly 100,000 Bornean Orangutans have thought to have been lost due to natural resource extraction, deforestation and poaching (Voigt et al., 2018). These are just a few examples of the threat the natural world faces and while most governments seem to have bigger priorities in the way of energy usage, terrorism and security threats, pandemics and economic growth, it is unlikely that nations will pull together to prioritise or help fund conservation research or monitoring (Wu et al., 2018). With the increasingly less popular idea of biodiversity conservation and the way modern life

is becoming more reliant on immediacy (Tomlinson, 2007); it is clear that there needs to be more accessible and perhaps radical actions taken to provide us with a workable amount of research and appropriate solutions to the monitoring of biodiversity, a way to collect the necessarily vast sets of useable data without the time and cost constraints found in more traditional methods of research.

Since the beginning of scientific conservation research stretching all the way up to the modern day, collecting data to answer questions on the natural world, monitor biodiversity and come up with effective strategies to combat the global decline in wildlife (Walker, 1992) has involved time-consuming and potentially expensive/resource-intensive methods carried out by a single or multiple teams of researchers spending often long periods of time in the field, firstly manually gathering data such as habitat information, species classification and behavioural analysis; subsequently labelling such data and often then sending off these datasets for validation from peers (Di Minin, Tenkanen and Toivonen, 2015). This process is always long and can often be arduous, therefore there is now some call for other, more immediate methods of the collection of high-quality, large-scale datasets. One such solution presented by several trailblazers is the use of social media (Stafford et al., 2010, Di Minin, Tenkanen and Toivonen 2015).

While unsustainable tourism is one of the leading factors in the declining health of biodiversity (Wearing and Neil, 2009), this can potentially form part of the solution, with a good example of this being the growing community of divers appearing on social media. The growing interest in scuba diving as a whole, coupled with the popularity of social media and the affordability of equipment such as underwater cameras and diving equipment increasing, has resulted in countless diving groups, enthusiasts and pages on most social media sites (Hoegh-Guldberg et al., 2007). Whether these divers are practicing sustainable tourism or not, this has resulted in a giant dataset of annotated pictures, videos, screenshots and descriptions of many of the world's coral reefs and the species that call them home. With more and more environments being casually "monitored" by tourists uploading to social media, this has perhaps paved the way to allow for global monitoring of biodiversity on a scale never seen, in terms of size, accessibility and affordability.

While the general idea of social media platforms is for sharing user-generated content, almost all social media platforms contain a rich vein of biodiversity and conservation related content, uploaded by users all over the world, with Facebook, Flickr, Twitter and Panoramio being increasingly used for data-gathering purposes (Stafford et al., 2010; Barry, 2014; Richards and Freiss, 2015). In 2015, Di Minin, Tenkanen and Toivonen set out to gather a better understanding of the popularity and usage of different social media platforms for the purpose of nature-based content and found Facebook to be the most popular for posts related to nature, followed by Instagram, Twitter and Youtube respectively, with 40% of posts being Geotagged. Knowing the popularity of the websites is essential for this study, as we can then focus our efforts into looking at the areas where the most data are available. While Facebook was the most popular website, we found that Instagram has a similar, yet slightly smaller amount of data, while being relatively unexplored when compared to Facebook, allowing for the study to tap into a rich vein of unused macaque wildlife data.

While Citizen Science has proven to be an effective method for crowd sourcing data online (Silvertown, 2009), within the early days of widespread internet use it was only possible if the users have access to either a laptop or desktop computer that they have moved their data onto from the devices they used to collect it, and this can slow down the process of uploading data sets (Kennett, Danielsen and Silvius, 2015), but with the new age of smartphones, tablets, high-definition cameras and 4G internet allowing users constant connectivity to the internet, even on the go, social media users could perhaps revolutionise old methods of citizen science into something much more accessible within the modern age of technology (Di Minin, Tenkanen and Toivonen, 2015). With an estimated 2.7 billion users by 2019 (billions, 2019), over a quarter of the world's population are connected to some form of social media website concurrently, and can upload pictures, videos, attachments and posts from anywhere in the world (Anderson-Wilk, 2009). This vastly larger number of users than typical citizen science websites, as well as how quick and simple it is to upload posts to the websites, can allow for even quicker and easier crowd-sourced conservation data than ever before.

There is a plethora of platforms that allow users to create, share, annotate, comment on and discuss content and media (Most used social media platform | Statista, 2020), with posts widely sharing common features such as text, photos, locations, videos and tagged accounts. Along with information gathered via user content, information about the user themselves and their social circles/networks can be accessed. These data can be accessed in forms such as direct links between users (Twitter # or Instagram @, number of followers etc) or from popularity ratings (Facebook likes, Twitter Re-Tweets etc). Each platform specialises in its own way of content sharing. Facebook, the world's most popular social media platform, is mostly used for sharing an individual's photos or albums from a point earlier in time (for the most part), while Instagram and Twitter focus more on real-time posting (with Instagram being almost exclusively for self-made content or photos, and Twitter allowing the sharing of other's links, as well as real time discussions of current events). Other platforms, such as Panoramio, are more for sharing content not specifically tied to the user (e.g. landscapes). For data collection purposes, most data from social media can be accessed via external data extraction interfaces (onemilliontweetmap.com, sproutsocial.com, later.com), programming tools such as Python, or even data sellers. Each tool has a varying degree of security on their interfaces, however most are controlled by search parameters, such as keywords or locational searches. Thus far, studies have been carried out looking at the effects of tourism within provisioned macaque populations (O'Leary, H. and Fa, J., 1993; O'Leary, H., 1996; Fuentes 2004, Burman et al. 2004) however, comparing multiple sites using data gathered from a single source (Instagram) has yet remained untouched.

Social Media is not without its shortcomings, however, as users can easily be selective of the photos they choose to upload, potentially hiding any illegal activity from public view by not sharing these photos online, which would diminish the accuracy of the data that can be gathered via social media (Stafford et al., 2010, Di Minin, Tenkanen and Toivonen 2015). This is a very important point that needs to be considered when collecting data via social media, as in order to be accepted as a new tool for data gathering, we need to ensure accuracy within what we can get from social media sites.

## **Exploring Instagram as a Tool for Conservation**

While there have been numerous studies into the usefulness of Facebook, Twitter and Flickr for conservation purposes (Di Minin et al., 2013, Tenkanen et al., 2017, Longley et al., 2015, Di Minin, Tenkanen and Toivonen, 2015), Instagram has been a subject of very little study. Instagram is the third most popular social media website with roughly one billion active users (Top 15 Most Popular Social Networking Sites, Dreamgrow, 2019) with the primary focus being picture-based uploads, with videos of under ten seconds also being allowed. While little research has been conducted on the benefits social media can have in aiding conservation efforts, studies have shown Instagram to be the superior social media site for crowd sourcing data (Tenkanen et al., 2017). The reason for this is due to Instagram's larger user base, ease of "geotagging" and its focus on "self-uploads" rather than "re-tweets" or "Reposts" (Tenkanen et al., 2017). It was found that data collection on websites such as Twitter and Facebook were often slowed down due to these reposted uploads, whereas on Instagram, a user is able to search for either a location or using a # (hashtag) symbol (for example #Ecotourism), and many more unique posts would be presented to the user, allowing for faster and more accurate data sourcing (Tenkanen et al., 2017).

On Instagram, any single post can (and commonly does) contain the date of the post (down to the minute the image was posted) and the location of the poster when the image was shared (as either latitude & longitude or a name of the location, more recently even a picture on google maps). When both are used by the image uploader, data can potentially be collected at a higher rate both temporally and spatially than many modern and more used data collection services (Longley et al., 2015). As well as the potential for faster collection, social media can also offer information that other services do not provide. Each Instagram post can be uploaded with a description written by the account, which can often include what species the user saw, what type of landscape was there, why there were visiting that place, what activities they were taking part in and what they enjoyed or disliked about that particular area. Instagram accounts also often have a bio, containing information about the user such as their country of origin and gender. Altogether these factors can help answer the questions of who, what where, when and why, which can often not be answered by one single method of data collection so easily (Tenkanen et al., 2017). For the purpose of answering the questions outlined in this study, Instagram format allows us to easily focus on self-uploaded, temporal data in the form of a photograph, where with clear outlined parameters can be quantified easily, with macaque-human interactions being easy to record and analyse.

Care must be taken when gathering the data, however, as there are several concerns when using data not generated by oneself. Content on media platforms such as Instagram can be uploaded at a staggeringly fast rate, however the content can often come from a small number of highly active accounts, rather than being evenly distributed over many more (Li et al., 2013), this can lead to less evenly distributed data, and therefore precautions must be taken in order to ensure the data collected is of even distribution. In relation to the study on the Macaque-tourist interactions, the data gathered is relatively small when compared to the actual number of Instagram posts overall, care must be taken in order to only quantify each account once. Recording a single account as 10 separate uploads for example, could

give inaccurate data on how tourists are interacting with the primates, as a single tourist should only be counted as a single interaction. One major flaw of social media is the requirement for internet access in order to upload. Should users not have 4G internet on their devices, uploads will take place at hotels, nearby Wi-Fi locations etc, this can cause skewed and inaccurate spatial data if the user accidentally uses their current location when uploading their post, as this is sometimes done automatically; however people can tag locations they have been to even if they have left the area, which could be a solution to this problem. Again, precautions must be taken in order to ensure only correctly labelled spatial data is analysed. Interpretation of the observational data is also down to human judgement, which can cause varied conclusions in datasets. There are still potential drawbacks to the data gathered in this way, distractions could arise which can lead to entering data into the wrong categories or missing certain important aspects of the photos (such as a human-primate interaction in the background of a photo).

Another issue with this style of data gathering is that the users may selectively upload photos, as naturally they would not want to show any incriminating activity, such as photos of them breaking the rules or touching any of the local monkeys (when it is not allowed by the local authority) (Li et al., 2013 Tenkanen et al., 2017). This issue must be remembered when gathering data, as selective uploading can result in inaccurate data, which can damage the core arguments of the thesis.

### **Key Aspects of Social Media Usage and How They Can Be Used for Conservation**

Before we begin to use Instagram to gather data on tourist-primate interactions, we need to define the key aspects of social media and how they can be used to answer questions on tourist-primate interactions within the provisioned macaque sites selected. As mentioned, social media allows data gatherers to answer the questions:

- Who are the users?
- What do they find interesting?
- Where are they visiting?
- When did they travel?
- Why did they go?

Who are the users? – Almost every user on Instagram have a bio containing their age, gender, nationality and even a short paragraph about themselves (such as profession interests) or should the profile be for a company, a short description of what they do. Should this information not be available, there are websites (such as [www.how-old.net](http://www.how-old.net)) which can estimate age and gender from a “selfie”. Di Minin et al., 2013 has even identified processes of econometrics to identify different types of users. This data can be used to assess which types of people are more or less interested in conservation, such as important business figures, local populations and global groups (Knight et al., 2006). This sort of data can also be used in general spatial data to assess which social groups are interested in which types of species/environmental areas, allowing focus on the less engaged groups.



Information on the users is important for this study, as we can gauge which demographics are more likely to interact with the macaques, allowing us to focus on the groups that seem more likely to target the macaques and provide potential solutions if problems are seen to arise.

What do they find interesting? – This area of the data collection is the most time consuming, as correctly interpreting both the picture and attached text is a lengthy process. Modern methods revolve entirely around human analysts sifting through swathes of data, generating a rather arduous task, however recent studies have been looking into using tools to aid the analysis, such as automatic collection of data and these are developing rather quickly (Schwartz and Ungar, 2015, Ozel and Park 2012, Angus, Stuart and Thelwall, 2010). Such data can be used for important stakeholders such as governing bodies, volunteer organisations, national parks etc, as both observational data on species and landscapes can allow these organisations to see which areas have the least attention, and then focus efforts to either promote or maintain these properly, as well as distribute the funding fairly so all areas share adequate treatment. This type of data collection could be considered similar to a questionnaire, however it can be gathered in much higher volumes and at greater speed; as well as this, the time stamps on the Instagram posts can be recorded as temporal data, and this then used to keep track of any shifts in interest over time, allowing for the re focus onto the areas where help is needed most (Stuart and Thelwall, 2010). Using this question, we can find out which aspects of the tourist destinations selected for this paper the users find the most interesting, as each site has more than one drawing point, not just the local macaque populations. Allowing us to see user preference in these areas will allow us to determine whether tourists are significantly more interested in the primates, showing us whether extra care and monitoring is need in these areas in order to keep interactions down to a minimum.

Where are they visiting? – While many social media platforms allow for “geo tagging” of posts, Instagram’s is by far the most accurate (Tenkanen et al., 2017), and this spatially explicit data could be of great use to conservation efforts. The exact location of posts can be used as indicators for population densities and movements, as well as knowing exactly which parts of the world the users are in, for example, a non geo tagged picture may be from inside a provisioned national park, or just outside in a wild area, making it much harder to focus conservation efforts, if the location is given it allows focus in exact areas, rather than estimating and maybe wasting time and money on areas not in need of help (Margules and Pressey, 2000). The locational data gathered for this study will allow accurately answer questions on human-primate interactions solely within the provisioned sites chosen, for example, in the Jigokudani monkey site, primates are known to exit the site from time to time as there are no boundaries keeping them within the park (Tanaka, Hayama and Nigi, 1993), the locational data will allow us to focus on interactions within the park, where the primates are intentionally provisioned by rangers.

When did they travel? – (Wood et al. 2013) suggested that data gathered by social media can be used as temporal data to analyse trends in visitor patterns of many provisioned nature hot spots (national parks, monkey temples etc). Point being elaborated on by Ardon et al., 2013, suggesting that the inclusion of spatial data can allow for the tracking of trends over time, such as species movement, invasive species impact and spread over areas, and

changes in landscape in responses to ecological pressures such as tourism, comparing these visible changes to temporal data will allow organisations to pre determine plans of action to help combat the stresses of tourism in ecologically vulnerable areas. It is important for this study that the temporal data is gathered, as we are working within the specific time frames of January to May 2019, we want to ensure that all data gathered from each site is within the same time frame, to allow for more comparable data.

Why did they go? – Instagram, unlike most image sharing sites, encourages real time uploads, which can shed light on the activities undertaken by the many tourists who travel to their chosen destinations. These data can allow for appropriate actions to be taken, such as preparation for certain more popular activities, closely watching more vulnerable species that will attract more attention than most, or perhaps even aiding in stopping illegal activities, should users choose to upload images of poached animals from an illegal safari hunt, which has been known to happen (Di Minin et al., 2015). Recording why the tourists travel to these destinations is important as we need to know whether the macaques are the primary focus of the trip. Once this is established, we can outline specific actions needed in order to keep interactions to a minimum, as while it is beneficial to get tourists to come to the area for the purpose of seeing the primates, it is imperative that we keep the levels of interaction down in order to ensure the troops are healthy.

### **Conclusions of Current Literature**

With rule breaking behaviours exhibited by tourists being one of the main issues within national parks, the effectiveness of rules must be assessed in order to accurately combat deviant behaviours exhibited by tourists. Comparing how tourists behave in national parks with more relaxed provisioned areas allows us to review the overall effectiveness of rules within these parks and provide alternative measures should rules be deemed not enough to combat deviancy. With the continually growing interest in more eco-friendly tourist ventures, it is so important to keep on top of the rates of deviant behaviours in order to come up with effective preventative measures. Despite the current efforts into reducing the amounts of rule breaking tourists, the constraints that traditional observational research methods hold makes it hard to accurately quantify and understand the reasoning's behind deviant behaviour. With the general popularity of primates and the majority of species at risk of extinction, it is more important than ever to understand deviant behaviour within primate parks, to allow the health of the troops within both national parks and provisioned sites to flourish. Because of the natural sensitivity of rule breaking, it is unlikely that we will be able to observe tourist activity without changing the way tourists act, in order to not be caught rule breaking, therefore more discreet methods need to be used in order to view the tourists in their more natural states. Due to the ever-growing amount of primate eco-tourism, there is now also more data than ever to analyse, therefore on top of a discreet method of data gathering, the rate at which we need to gather the data supersedes how fast we can collect it via traditional methods. Social Media may be the key behind both of these, allowing for fast collection of huge datasets, all from uploads of users at the sites, meaning that travel to the sites and disturbance of tourists is not necessary, however, data gathered via social media cannot immediately be trusted as a viable and accurate data source, with more comparisons needed to be made between it and more traditional

methods of data gathering in order to assess the effectiveness of gathering data via social media.

## **Methods**

All data was collected via Instagram, from four popular provisioned monkey sites around the globe: Gibraltar (UK), Galta Ji (India), Jigokudani Monkey Park (Japan) & Yushan National Park (Taiwan). The four visitor sites in this study were chosen due to their popularity, difference in cultures and macaque species, allowing for a varied dataset over four distinct areas, while also staying within the same ballpark of measurements, it would be less informative to compare the interactions of a macaque group to a provisioned group of chimpanzees, for example.

### **Deviant Behaviours**

While three of the study sites have defined rules allowing for easy quantification of data, Galta-Ji has no set rules with regards to tourist-primate interactions, therefore in order to standardise the data for accurate comparisons, we will be counting the following behaviours as “deviancy”:

- Clear direct contact between a tourist and a macaque
- Feeding of a macaque by a tourist
- Provocation or attempted contact by tourist to Macaque (while there may be no direct contact between the two, the act of trying to initiate contact is still regarded as “rule-breaking” by all parks except Galta-ji, therefore it is counted as deviancy for the purposes of this study)

### **Gibraltar, UK**

Gibraltar is a UK overseas territory (part of the UK but not within the mainland territories) situated at the southwestern tip of the Iberian Peninsula. It is widely recognised as the most southern point in Europe (visitgibraltar; 2019). At just 2.6 square miles, Gibraltar is a tiny island, meaning that there is often contact between the Macaque species and residents. Due to the proximity of the Atlantic Ocean, Mediterranean Sea and African Strait, the climate of Gibraltar is often changing and can be subject to meteorological extremes. Summer temperatures on the rock range from 27 – 34 Celsius, while in winter these values drop to between 10 – 18 (Upper Rock Nature Reserve; 2019).

Perhaps the most iconic species of the island is the Barbary Macaque (*Macaca Sylvanus*), easily the most distinct and recognisable of the island’s permanent animal species, the Barbary Macaque alone brings tourists from around the globe, due to their habituated nature and calm presence around the majority of humans (O’Leary and Fa, 1993).

Originating from the Atlas and Rif Mountains of Morocco, the Barbary Macaque is Europe’s only non-human, free-living primate population. While the species as a whole is currently listed as endangered (ICUN, 2019) and are in a state of decline, mainly due to human activities such as hunting and deforestation, the Gibraltar population is actually increasing (Modolo, Salzburger and Martin, 2005). It is thought that currently around 300 individuals

live within 5 troops, mainly residing within the Gibraltar Nature Reserve, but occasionally making their way into the nearby and only town on the rock.

Barbary Macaques are a tailless, ground dwelling primate, roughly 61 centimetres long with light yellow/brown fur and a bald, pinkish face. The name “Barbary Macaque” is derived from the ethnic group of the Berber people of Morocco, who have had close ties with the regional animals for many years. “Barbary” is not unique to the Macaques, with animals such as the Barbary Lion and Barbary partridge sharing the namesake, giving evidence of how close the Berber people were to these animals. The exact date as to when the primates arrived on the island is subject to debate, with some reports suggesting it was during the Islamic period of the island’s history at which they were introduced (711 – 751 AD), while others proposing that it was during British rule (1713 – present) when the monkeys were introduced (Fuentes, Shaw and Cortes, 2007). Despite the suggestions, the many changes in the island’s rulers, coupled with the repeated introduction of species and lack of real data gathering has left the origin of the island colonies somewhat blurred (Modolo, Salzburger and Martin, 2005). There has been some question over whether the Gibraltar population is derived from the extant African colonies, or the extinct European populations, however the distinct lack of Macaque fossils on Gibraltar coupled with all extant mtDNA of the Gibraltarian population being present in North Africa points toward a North African origin for the species, not European (Molodo et al., 2008).

As previously stated, the Barbary Macaque is one of the main drawing points to the island, with many billing them as the number one reason for tourism, and one of the most important sources of income for the island (Upper Rock Nature Reserve; 2019). The most popular troop is thought to be the group residing within a small area around the Queen’s Gate, an old city gate just outside of the popular attraction the “Ape’s den”, an old Artillery bunker now used for as a park for the Macaque troops of the island. This troop is thought to be so popular due to how close tourists can get to the monkeys, with many instances involving individuals coming into direct contact with the tourists, even climbing on them. While regular contact does take place between the Macaques and tourists, any form of contact is heavily discouraged, as there have been recorded instances of Macaque aggression towards humans, especially when frightened by large or especially invasive tourists. While contact is only discouraged by local authorities, feeding the monkeys of any kind is punishable by law, and can carry a fine of up to £4,000 (Upper Rock Nature Reserve; 2019). While the only actions on the island involving the primates that is punishable legally is the feeding of them, there are clear and concise guidelines posted by HM Government of Gibraltar in order to keep both the tourists safe and the troops healthy. These guidelines are listed below (all information collected visitgibraltar, 2019; gibraltar, 2019):

- **Do not Touch** – While the animals may seem tame and are somewhat habituated to the presence of humans, they should be treated as wild animals and no contact between human and monkey should be made. Instances of contact have been known to cause stress in the monkeys and can lead to threat displays or even bites.
- **Do not Feed** – Even ignoring the legal consequences of the act of feeding the primates, processed or unnatural foods can have serious repercussions on the health of some individuals (O’Leary and Fa, 1993).

- **Conflict of Interest** – While tourists may be fascinated by the Macaques and want to initiate contact with them, the monkeys themselves have simply learnt to tolerate human presence, and any sort of interaction or contact is likely an attempt to get food off of the human.
- **Food and Bags** – Macaques are known to associate bags with food, and will therefore attempt to get inside any they see lying around, in order to keep belongings safe and the Macaques healthy, tourists should leave bags in their vehicles, hotel rooms, or keep them close to their person at all times.
- **Warning Signals** – The local government provides regular signage and information to tourists regarding Macaque warning signals, mainly the warning involving a Macaque pouting its mouth. This is known as a Round Mouth Threat (RMT), and all Tourists are briefed on how to look out for this, to avoid and unnecessary aggression between the two groups of humans and macaques.
- **Giving the Primates Space** – All tourists are encouraged to give the primates as much space as possible, as a cornered or stresses individual could potentially attack. Tourists are told to look out for any scratching or fidgeting displayed by the Macaques, as this is usually a precursor to an RMT.
- **Announce Yourself to Them** – Tourists are encouraged not to sneak up on primates in order to get closer to them, as this increases the risk of startling an individual, putting it under stress and encouraging an aggressive nature.
- **Avoid Staircases and Tight Spots** – Cornering a monkey can lead to an aggressive interaction, therefore all tourists are told to pause and assess the possible risk of the situation if crossing the path of a primate in a tight space.
- **If a Macaque Touches/Climbs on a tourist** – Even when following all guidelines, sometimes contact cannot be avoided, especially in the case of younger, more boisterous individuals. Tourists are told to avoid leaning on walls or features with monkeys already on, and to not crouch down next to juvenile members. If a monkey climbs onto a tourist, they are told to remain calm and keep all belongings tight to themselves, to avoid losing any equipment or startling the primate.

### Why Gibraltar?

Gibraltar has always been a huge tourism destination. Maintaining over 7.5 million visitors annually and peaking at almost 12 million in 2011 (statista, 2019), Gibraltar offers a large group to gather data from. The habituated nature of the monkeys also allows for looking at what kind of interactions the tourists have with the Macaques, especially when it comes to following the rules of the island.

### Galta Ji, Jaipur, India

The city of Jaipur is the largest city in the state of Rajasthan, and one of India's premier tourist destinations. As India's first established city, it has a rich history and cultural heritage, which sees thousands of tourists visit each year. The Galta Ji Temple, located roughly 10km away from Jaipur, is an ancient holy site. The site is shared year-round by both

Hindu pilgrims and tourists, with the complex temple structure overseeing vast freshwater springs, as well as 7 “Kunds”, tanks of water that is holy to the pilgrims. The site was designed to look more like a palace than a temple and is purposely situated on a backdrop of the city, which may have an impact on the numbers of tourist visitors (Jaipur, 2019). Another major drawing point of the temple is the large colony of Rhesus Macaques (*Macaca mulatta*) that reside within the temple and the surrounding habitat. These individuals are so prevalent within the temple, the locals and travel guides colloquially refer to Galta Ji as the “Monkey Temple” (*Galwar Bagh*). The monkeys and locals of Jaipur have lived in harmony for many thousands of years, leading to a strong habituation within the Macaque troops. In Hinduism, which makes up roughly 80% of the Indian population, Monkeys are thought to be the worldly form of the god Hanuman, who represents power and strength (Sarkar, 1994, Walk Through India; 2019). Due to this, Hindus believe monkeys to be sacred, and therefore both feed and worship them, adding to the already habituated nature of the primates (Sarkar, 1994). Monkeys within Galta Ji regularly get close to both locals and tourists, even following and climbing on them to find food.

Due to the holy nature of the site, the temple is not governed by any laws regarding the monkeys. Tourists are free to touch, feed and interact with the monkeys, however tourists are encouraged to only feed the primates if absolutely sure of their own safety, as there is a tendency for the monkeys to swarm anyone with food (Jaipur Travel Guide, 2019). Tourists are also encouraged not to feed the Macaques with food brought themselves, as this is unnatural and can harm the primates, but to purchase the appropriate food from local vendors, which both ensures that the monkeys are receiving a healthy diet and boosting the local economy, providing local residents with a stable income; this is not an enforced rule however, tourists are free to feed the monkeys whatever they wish. It is believed that roughly 200 primates live within the vicinity of Galta Ji, with roughly 4 females to every male. The temple sees the most activity during the mid-January festival of Makar Sankranti, where Hindus take pilgrimage to the site to bathe in the holy Kunds of the temple.

Rhesus Macaques are one of the most populous species of primates on earth. Being native to central, south and southeast Asia, they occupy a wide range of habitats, from forested areas, to grasslands, to arid desert environments to even human settlements. They hold the widest geographical range of any non-human primate and are listed as “Least Concern” on the ICUN red list, the safest category a species can hold (Gibbs et al., 2007; ICUN, 2019). Distinguishing features of the species include a pink face with brownish grey fur. Individuals average 48 – 51 centimetres, with a tail of roughly 20 – 23 centimetres. Both Arboreal and Terrestrial, they have a mainly frugivorous diet, but are known to also feed on bark, seeds roots and insects (Belzung and Anderson, 1986).

### Why Galta Ji?

Jaipur is a very popular tourist destination within India, attracting millions of tourists each year. The main drawing point of Galta Ji is the mixing of both tourists and locals/pilgrims within the temple, allowing for study on how each group interacts with the local populations of primates. The lack of any defined rules also allows us to assess whether tourists act more freely in terms of direct contact or feeding, leading us to look at the usefulness of defined guidelines.

### Jigokudani Monkey Park, Japan

Located in the town of Yamanouchi, Nagano Prefecture, Japan; Jigokudani Monkey Park is one of Japan's most popular wildlife tourist destinations and is a part of the much larger Jōshin'etsu-kōgen National Park. The geography of the area includes relatively high elevation (850m), hill and mountain areas, large forests and particularly heavy snowfall in the colder months. The most unique feature of the park is the hot water springs spread around the area, as well as the boiling water that often pours out of crevices within the cold ground, earning the park the name of Jigokudani, or "Hell's Valley" (Suzuki, 1963)

The park is home to a diverse range of flora & fauna, with easily the most popular and recognisable species being the Japanese Macaque (*Macaca fuscata*). The park is known worldwide for its large population of Japanese Macaques, known more commonly as Snow Monkeys, who usually travel to the park during the winter to bathe in the hot springs and feed off of the provisions given to them by the park rangers. During the summer months, many of the Macaques look elsewhere for food, often ranging into the more secure forested areas (Tanaka, Hayama and Nigi, 1993). While Jigokudani Valley has been named for many years prior, the park was established in 1964 as a conservation area to allow the monkeys to live freely and safely within their own natural habitat. The park was relatively unknown until 1970 when LIFE magazine featured the Macaques on their front cover (see **fig. 1**); since then the picture has become a famous image in wildlife photography and the park itself has been a very popular tourist destination.



**Fig 1** – Typical social media photo from the view of a mobile device

In an attempt to make the park as natural for the troop as possible, there are no enforced barriers within the area that would keep the tourists and primates separate, instead there are regular ranger patrols to keep the contact to a minimum. Feeding the primates is also forbidden within the park and can result in expulsion from the area if caught by a ranger (Snow Monkey Resorts, 2019). The Monkeys are known to be somewhat habituated, sometimes venturing toward the tourists if particularly brave, however the majority stay within the troop at the hot springs, and only gather food from the provisions given by the rangers. Like Gibraltar, there are a clearly defined and strictly enforced official set of guidelines to adhere to within the park, for the safety of the tourists and health of the troop (Snow Monkey Resorts, 2019):

- **Do not Feed** – Feeding the primate unnatural foods can not only cause harm to the troop, but also overfeeding if they also take from the food provided from the park staff. Competition can also occur within the troop, as some monkeys may be fed more often than others.
- **Do not Touch** - Unnecessary contact with the monkeys can cause several detrimental effects, such as over-habitation, disease transmission, aggression towards tourists and stress to the monkeys.
- **Do not eat or drink on the trail** – Open food and drink containers may cause the troop to steal, ask for or even attack tourists in order to obtain food.
- **Keep 1 to 2m away** – Keeping a safe distance from the monkeys not only protects the safety of the tourists, but also keeps the monkeys from becoming frightened, stressed or aggressive towards tourists.
- **No selfie sticks or flash photography** – Phones can easily be taken from a selfie stick by a monkey, so it is always encouraged to keep phones on your person. Flash photography can cause stress or surprise in the monkeys, making them more likely to be aggressive or defensive over young.

These rules are not enforced by law but breaking them can lead to being removed from the park.

The park is visited year-round, however most tourists visit in the winter (December – February), when the Macaques are in greater number and particularly photogenic in the snow (Japan Guide, 2019). The park costs 800 Japanese Yen to enter, the equivalent of £5.80 (2019 Lloyds Bank conversion).

Snow monkeys are a terrestrial species of old-world monkey, with a pink face & posterior and thick greyish brown coat that changes length to adapt to the changing conditions within the environment. The Macaque can withstand temperatures of up to -20 Celsius (Nakayama et. al, 1977). The Japanese Macaque is the most northern living species of non-human primate and is known to live within the coldest regions. Snow Monkey societies exhibit a matrilineal behaviour, with females staying with their natal groups for life, while males tend to move out before becoming sexually mature. This results in large groups of female and juvenile individuals, with normally one Alpha male within the troop (Fooden & Aimi 2005).



### Why Jigokudani?

Jigokudani is an ideal area for this study, as it offers the most natural view of Macaques within their habitat, unlike Gibraltar which has many tourist infrastructure & disused military building built into the habitat of the Macaques, and Galtá Ji which has a lot of influence from locals and again, unnatural habitats in which the Macaques reside.

Jigokudani is designed to emulate the Macaques living in their most natural state, except from the main Tourist information building. It gives good insight into how Macaques will interact with tourists when there are no other features apart from the tourists themselves.

### Yushan National Park, Taiwan

Yushan National Park is one of the nine national parks dotted around the Island of Taiwan, named after Mount Yushan, the highest peak within the park. With an area covering four counties and 105,490 hectares, Yushan is well known for being the largest national park on the island. The wide altitudinal and geographical changes within the park result in a huge diversity of flora and fauna; while only covering 3% of the island, it is home to over 50% of all island species, including 50 mammal species, 151 bird species and 228 species of butterfly (YSNP, 2019). The park is of great importance to the government of Taiwan due to its eco-tourism, environmental conservation, academic research and environmental education purposes, therefore it is well protected, and the species that reside inside the park flourish. In areas below 3400m in elevation, the park is home to troops of Formosan Rock Monkeys, known more commonly as the Taiwanese Macaque (*Macaca cyclopis*). The Taiwanese Macaque is endemic to the island of Taiwan and can only be found in a few parks around the island. There is no entry fee for Yushan, however visitors must obtain an entry permit before arriving at the park. This may have resulted in Yushan becoming one of the least-visited parks on the island, however it still attracted over 1 million visitors in 2015 (cpami, 2019). Like Gibraltar, feeding of the animals in Yushan is prohibited by law, and carries an initial fine of 900 NTD (New Taiwanese Dollar, equivalent to roughly £25), with repeat offences carrying a fine of 3000 NTD.

Formosan Rock Monkeys are a mainly terrestrial group of Macaque, feeding mainly on fruits, leaves and arthropods. Individuals range from 19 – 24 inches, with moderately long tails (10 – 16 inches). Rock Monkeys have a pink face with greyish brown fur. While the species is regularly hunted for fur and traditional medicine, they are listed as “Least Concern” on the ICUN red list (ICUN, 2019). There is a strong tradition of feeding the Macaques within the national parks, which is currently being combated by the Taiwanese government, as this can lead to unnecessary habituation, making it easier for poachers to trap and kill the monkeys.

### Why Yushan?

Yushan National Park offers a unique view into how tourists interact with primate populations within a permit-only area. Unlike Jigokudani, which is also a more natural habitat for the monkeys, the breaking of rules within the park can result in a fine, and banning from the park, this may offer greater incentive for the tourists to adhere to the rules, rather than just expulsion from the park.

Data for all four study areas was gathered manually via Instagram, between the months of January and April 2019, using specific search criteria (see below). Each day between January 1<sup>st</sup> 2019 and April 1<sup>st</sup> 2019, data collection involved logging onto Instagram, searching relevant hash tagged and geotagged posts, and recording observations. All included posts must be both geotagged and contain at least one relevant hashtag relating to the area of study (See table 1). Once the posts were filtered by both location and suitable hashtags, the links of the specific posts were then noted down and each image was placed into specific categories, these categories were as follows:

- **Monkey focused photo**– Any photo in which a monkey or group of monkeys are the focus of the photo
- **Contact between human and monkey**– Any instance in which a human and a monkey come into direct contact, whether it be an outstretched arm, or a monkey climbing on a human’s head.
- **Landscape focused photo**– Any photo in which the focus is a panoramic view of a landscape.
- **Human Activity (Hikers, locals, Car driving past etc)**– Any photo including humans who are within the area, but not aware that a photo is being taken of them or are not clearly acknowledging the photo.
- **Human Posing for Photo**– Any photo where a human is the focus and is clearly acknowledging/posing for it.
- **Humans feeding Primate**– Any instance of a human clearly giving food to a monkey.
- **Month of Upload** (Metadata associated with each image included in the study)

Each photo was placed into the appropriate categories, with some overlap being accepted (e.g., a monkey focused photo with tourists in the background would be placed in both the “Monkey focused photo” and “Human Activity” category). Any posts without a relevant geotag were not included, as these posts cannot be confirmed to have been taken by the user, possibly being a re-upload. Any posts showing other irrelevant information (such as advertisements), were discarded from the study.

The months of January – April were chosen due to the increased number of tourists in both Galta-Ji and Jigokudani. While Gibraltar and Yushan receive a steady stream of visitors throughout the year, Galta-Ji and Jigokudani receive a higher influx of activity during these months due to the festival of Makar Sankranti in Galta-Ji and the large amount of snowfall in Jigokudani, which is when the Snow Monkeys are at their most iconic (Jaipur Travel Guide 2019; Japan Guide 2019).

| Gibraltar         | Galta-Ji        | Jigokudani            | Yushan              |
|-------------------|-----------------|-----------------------|---------------------|
| #Gibraltar        | #GaltaJiMonkeys | #JigokudaniMonkeyPark | #YushanNationalPark |
| #GibraltarMonkeys | #MonkeyTemple   | #SnowMonkeyPark       | #YushanMonkeys      |
| #TheRock          | #Jaipur         |                       |                     |
|                   |                 |                       |                     |

**Table 1 – Hashtags that were searched for on Instagram for each area of study**

The number of active users were noted down. Any single account can only be counted as an active user once per month, even if they upload on multiple different days within the same month. For example, any profile that uploaded more than once in the same month was only counted once towards active users, however all uploads were still noted down as separate posts.

Statistical Analysis

Once all data for a specific site was collected on an excel sheet, the data was transferred to SPSS for statistical analysis. Initially a Kolmogorov-Smirnov test was carried out for normality, using 0.05 as the alpha value. The P value was calculated at  $p = 0.200$ , therefore the dataset could be accepted as normally distributed. Chi Squared was chosen as the statistical test to determine significance of deviancy between the National parks and the normal provisioned areas, as the dataset is a normally distributed set containing two categorical variables (rule breaking vs rule adherence). Data from the national parks was combined together, as was the data from the provisioned sites, to provide us with two categorical variables that could be compared to see if one had a significantly larger number of clear deviant behaviour within the posts. Visitor preferences was also calculated by testing for significance between different categorical variables, these variables were:

- Primate focused photo
- Landscape focused photo
- Human focused photo

**Results**

Number of Posts

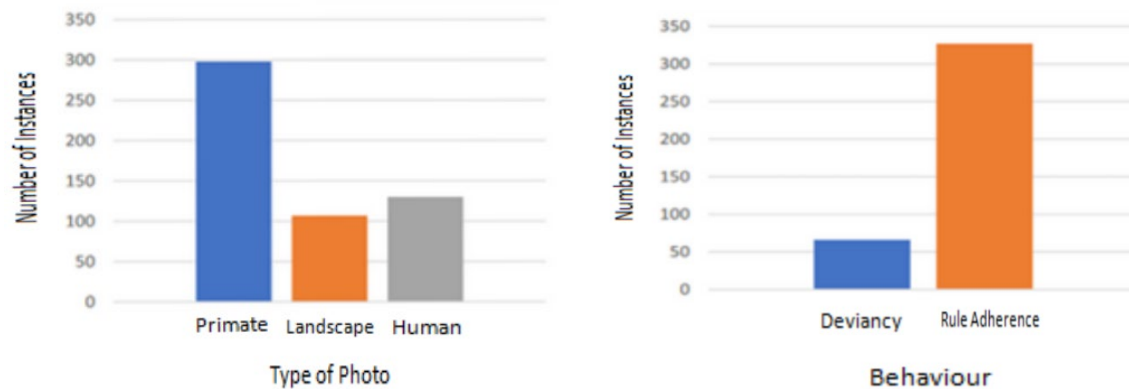
A total of 1,367 posts were collated and assessed over the four areas. Jigokudani was by far the most popular park, with 808 posts collected during the study months (Jan – May 2019) and over 15,000 total posts (all geotagged or hashtagged posts of the study site since the beginning of Instagram, October 2010). Galta Ji and Gibraltar were second and third respectively, with 403 (9,290 total posts) posts for Galta Ji and 394 (7,949 total posts) for Gibraltar. Yushan National Park had a dramatically lower number of posts, with only 82 posts over the three months and 1,623 posts total. Each group of posts was placed into its own excel sheet, in order to avoid confusion over which post was from which area.

Once a post was noted down, it was cross referenced with the established rules of each area, along with how exactly the tourist in question was engaging in a deviant activity.

Gibraltar

Gibraltar had a significantly higher visitor interest in primates when compared using chi squared to visitor preference of landscapes of the area ( $X^2 = 187.839 df = 1, P < .001$ ) with 298 uploads with macaques as the main interest and 107 with landscapes as the focus. In addition, focus on macaques was significantly higher than humans, with 120 uploads focusing on either tourists or locals than the visitors themselves, such as selfies, group

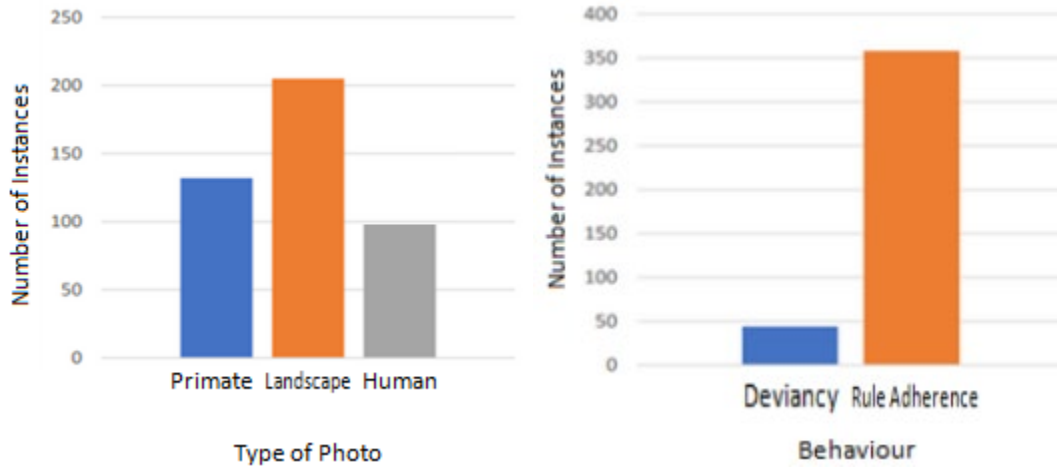
photos etc ( $X^2 = 203.381 df = 1, P < .001$ ). There was a significantly lower number of recorded instances of deviancy (66 uploads) when compared to photos of rule-abiding visitors (327 uploads) ( $X^2 = 348.447 df = 1, P < .001$ ). Out of the instances of rule breaking, there were 51 instances of either direct contact between the macaque and tourist, or tourists trying to instigate contact and 15 instances of macaques being fed by the tourists. See **Fig 2** For exact numbers of photos and number of deviant behaviour instances exhibited by Tourists within Gibraltar.



**Fig 2** – Bar charts to show the number of photos with different focal points (left) and the number of instances of deviant behaviour vs rule adherence exhibited by tourists (right) in Gibraltar

### Galta Ji Temple

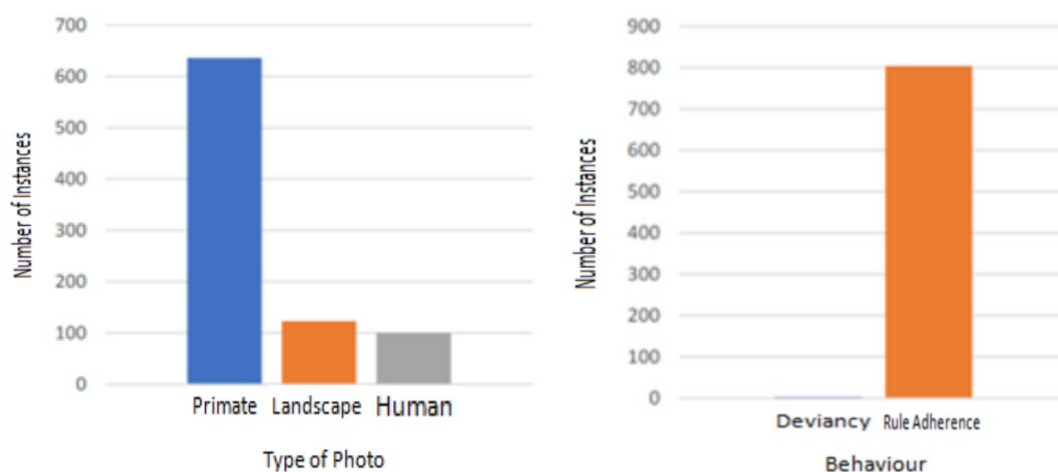
The most popular focal point among visitors within Galta-Ji was photos of the surrounding landscape and temple, with 205 uploads focusing on the landscape having significantly higher uploads focusing this than both primates, with 132 uploads focusing on the macaques ( $X^2 = 27.127 df = 1, P < .001$ ) and human focused photos, of which there were 97 uploads ( $X^2 = 5.090 df = 1, P = .024$ ). *The visitors showed no significant preference when comparing primate focused and human focused photos* ( $X^2 = .015 df = 1, P = 0.902$ ). There was also a significantly higher number of rule-abiding visitors than instances of deviancy ( $X^2 = 494.337 df = 1, P < .001$ ). The total instances of deviancy were 44, with 30 instances of direct contact or a tourist trying to instigate contact with a macaque and 14 instances of macaques being fed by tourists. See **Fig 3** For exact numbers of photos and number of deviant behaviour instances exhibited by Tourists within Galta-Ji.



**Fig 3** – Bar charts to show the number of photos with different focal points (left) and the number of instances of deviant behaviour vs rule adherence exhibited by tourists (right) in Galta Ji Temple, Jaipur

#### Jigokudani Monkey Park

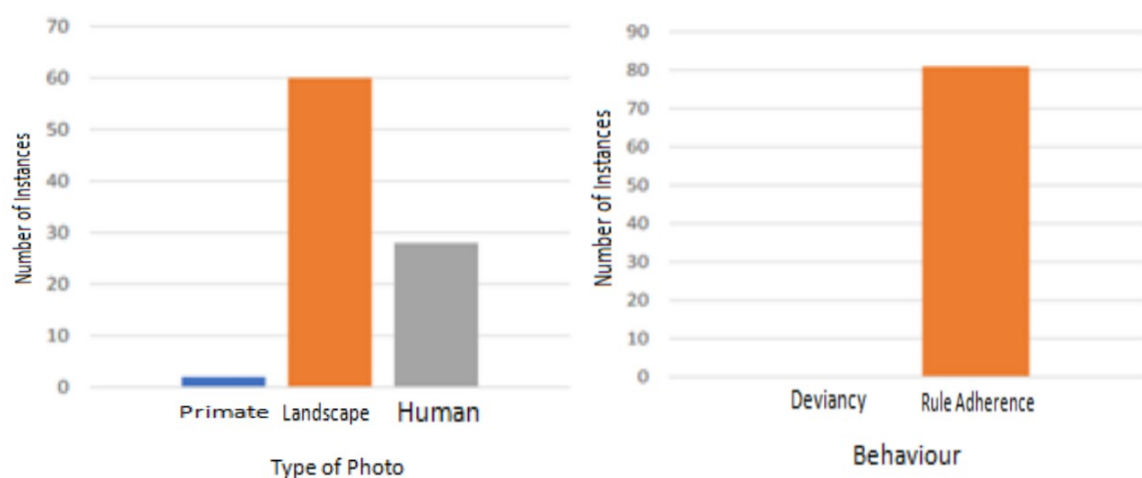
Monkeys were an overwhelmingly popular focal point in Jigokudani, with 636 of the uploads focusing on the macaques. This number being significantly higher than landscape photos, with 123 uploads focusing on landscapes. ( $X^2 = 653.098$   $df = 1$ ,  $P < .001$ ) and human focused ( $X^2 = 679.955$   $df = 1$ ,  $P < .001$ ) photos, with 100 uploads focusing on humans. There was no significant preference between landscaped focused photos and human focused ( $X^2 = .496$   $df = 1$ ,  $P = .481$ ). Once again, there were significantly higher rule-abiding visitors than visitors who were conducting deviant behaviour ( $X^2 = 1594.089$   $df = 1$ ,  $P < .001$ ). Out of the 3 instances of rule breaking recorded at Jigokudani, all 3 were macaques being fed by tourists. See **Fig 4** For exact numbers of photos and number of deviant behaviour instances exhibited by Tourists within Jigokudani.



**Fig 4** - Bar charts to show the number of photos with different focal points (left) and the number of instances of deviant behaviour vs rule adherence exhibited by tourists (right) in Yushan National Park

## Yushan National Park

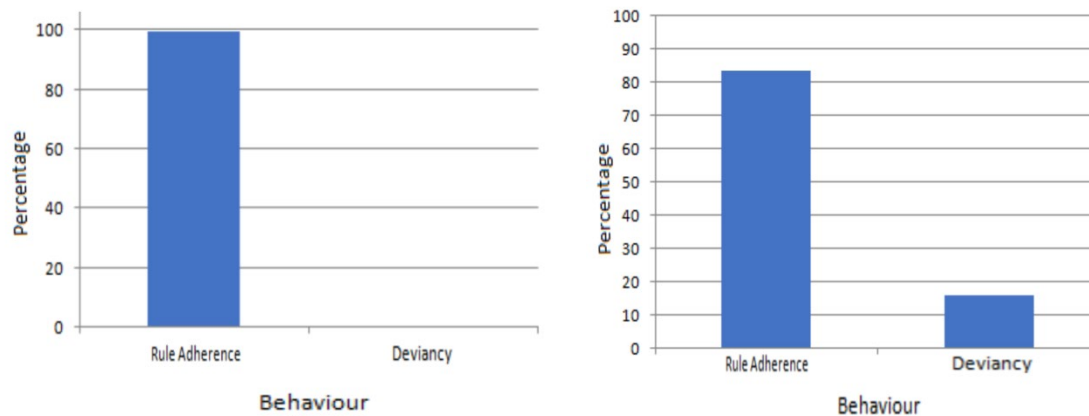
with 60 uploads, photos with a landscape focus were the most popular image type for visitors of Yushan National Park, with a significantly higher number of recorded landscape focused photos than primate focused, of which there were only 3 uploads with a macaque focus ( $X^2 = 87.238$   $df = 1$ ,  $P < .001$ ) or human focused ( $X^2 = 25.110$   $df = 1$ ,  $P < .001$ ). Photos with a visitor focus were also significantly more prevalent than photos with a primate focus, with 25 uploads focusing on humans ( $X^2 = 27.578$   $df = 1$ ,  $P < .001$ ). As there were 0 instances of deviant behaviour within Yushan, a statistical comparison was not able to be carried out. See **Fig 5** For exact numbers of photos and number of deviant behaviour instances exhibited.



**Fig 5** - Bar charts to show the number of photos with different focal points (left) and the number of instances of deviant behaviour vs rule adherence exhibited by tourists (right) in Yushan National Park

## National Parks vs Provisioned Areas

When using chi squared to compare the significance in deviant behaviour between the total number of instances within the two National Park areas (Jigokudani & Yushan) with the total number within the provisioned sites (Gibraltar & Galta-Ji), it was found that there were a significantly higher number of instances of deviancy within the provisioned sites than the National Parks ( $X^2 = 1896.025$   $df = 1$ ,  $P < .001$ ). Even when considering the higher number of overall posts within the National Parks overall (890 total posts vs 796 total within provisioned areas), deviant behaviour accounted for just 0.34% of the total posts within the national park areas, compared to 16% in the provisioned sites.



**Fig 6** - Bar Charts to show frequency of instances of deviant behaviour in National Parks (left, sample size 890) and provisioned sites (right, sample size 796).

## **Data Analysis**

National Parks had a much lower rate of deviant behaviour than the provisioned monkey sites, meaning we can reject the null hypothesis. The data gathered yielded low levels of rule breaking and different user preferences in each area of study. While Gibraltar and Jigokudani yielded the results of primarily primate focused photos, both users uploading in Yushan and Galta Ji clearly prefer to take in the surrounding landscapes, focusing less on the primate populations within the area. While it was unusual for landscapes to take precedence over primates in these areas, there may be some explanations for this. As Galta Ji is nearer to a bustling city than any other study area, this may bring in more tourists who are more interested in the cultural aspects of the area, rather than the eco-tourist parts of the temple. Most human activity photos taken in Galta Ji was during January, when the festival of Makar Sankranti is in full swing. This festival is likely to bring in tourists who are less interested in the primates and would like to experience the festival itself. Also, being a place of holy pilgrimage, many tourists may themselves be at the temple to take part in a pilgrimage of their own, making it less likely that they have travelled to see the primates. The temple itself is likely to be a big drawing point for tourists, a feature that none of the other study areas have, possibly leading to an increase in preference for landscape photos, as this temple is built into the surrounding mountains.

Given the largely open policy for feeding and direct contact between human/non-human primates Galta Ji had very low instances of “rule breaking”. As stated earlier, warnings are given to tourists regarding potential swarming of individuals with food by the primates, which could have led to a decrease in feeding, out of fear of personal safety from the tourists. Another reason could be the much larger influx of tourists during January, due to Makar Sankranti, which may drive off some of the primates further into the landscapes or down to the city of Jaipur in an attempt to find food there, potentially seeing the locals and pilgrims as competition. A low number of tourist infrastructure was observed, as tourists do not stay in the temple, and signage is likely to be kept to a minimum due as to not deface the temple. There were no recorded instances of locals or pilgrims in Galta Ji engaging with the monkeys, likely due to their sacred nature and the fact that the primates are so common within the city of Jaipur they would be like coming across a pigeon in London.

The lack of local human presence within the national parks is likely to have a large affect on the levels of deviant behaviour, as a constant, local presence of humans who are part of the surrounding area can lead to higher levels of habituation in groups exposed to this as opposed to more irregular groups of visitors (Strier, 2014). The high number of local people in both Gibraltar and Galtaji could have directly influenced the macaque's behaviour, leading to a higher rate of human-primate interactions than that of the national parks. Signage and pathways could also play an important part in the separation of the macaques and tourists, as a clearly defined pathway with clear signs and barriers directing the tourists could both result in less tourists wandering off of their own accord, and give the primates clear areas in which they can avoid, whereas in the more casual layouts of Gibraltar and Galtaji, where there are no real pathways, signs or directions, just areas which are off limits, can result in a more random distribution of the tourists, making it more likely for any wandering primates to accidentally bump into a human, potentially causing a deviant interaction.

It was found that the majority of visitors to Yushan are climbers and hikers rather than ecologists or nature lovers (Cho, 2003), with landscape photos taking the top spot in this group. This potentially being due to the permit licence needed to enter the park, as there are other parks around Taiwan that do not need a permit, making it much easier for casual tourists to visit (cpami, 2019). It is natural to assume that a hiker or climber may be more interested in landscapes than biodiversity (Hausmann et al., 2017), therefore this could explain the significantly higher number of landscape photos. Formosan Rock Macaques are known to live arboreal lives and reside mainly in the trees, being fairly unhabituated towards human presence (Su and Lee, 2001); coupled with the lack of any real tourist hotspots which allow for mass gatherings (unlike all 3 other sites), may lead to decreased contact or path crossing between tourists and the primates. Studies into tourist/rock macaque interactions in other national parks have shown that the monkeys are likely to run away, show submissive behaviour or avoid contact completely with tourists (Hsu, Kao and Agoramorthy, 2009), which can safely be assumed is the case within Yushan, as the macaques are no more habituated in Yushan than other national parks. This being the case could mean it is very difficult for a tourist to capture a picture of a rock macaque without startling it or causing it to run away. The fine and banning from the park may also carry weight here, putting off tourists from interacting with the primates, however given the scale of the park and likelihood of being caught, this may not be a factor to consider. The controlling body of the park have also issued warnings in the past regarding rock macaques biting and scratching tourists who get too close, which is another incentive for the tourists to leave the macaques alone (cpami, 2019).

Gibraltar yielded a significant preference for pictures of the local barbary macaques than any other category; given that the main factor for tourism is the primates themselves, this was no surprise. What was more surprising however was the very low level of interactions between primates and humans. With studies showing that as much as 50 percent of the macaques' diets on Gibraltar (especially the Ape's Den) could consist of tourists-derived foods (O'leary, 1996) and the habituated nature of the macaques, it would not be unusual to observe high numbers of feeding. The law against feeding the macaques on Gibraltar was introduced in 2016, which could have played a significant role in the reduction of feeding



interactions between tourists and primates, as tourists are fearful of receiving a fine, or even legal repercussions if caught. On the other hand, this could show that data gathered via Instagram is not representative of what interactions are occurring within the site, as tourists who knowingly conduct deviant behaviour would perhaps be less likely to knowingly upload evidence of their behaviours to a social media site, as this could land them in serious trouble. This observation would likely need to be followed up with an on-site study to assess whether the data on Instagram is accurate. Another example simply could be due to tourists hiding their rule breaking actions, not uploading it to Instagram for widespread viewing. Either way, it seems that the introduction of defined guidelines and laws could potentially have a significant impact on how tourists act when visiting macaque sites, which is beneficial to the health of the troops that live in the areas; however, more research into this needs to be conducted in order to draw full conclusions. There is also a possibility of the macaques of Gibraltar simply not having an interest in the tourists any longer, as studies have shown that as little as 13 percent of the troop interact with tourists (O'Leary and Fa, 1993), preferring to get their provisions elsewhere on the island, away from the large congregation of tourists.

Jigokudani Monkey Park had an overwhelming and significantly larger number of primate focused uploads, yet 0 instances of direct contact and 3 instances of direct feeding. For a site with much higher focus on primates than Galta Ji and Gibraltar, there was a dramatically lower amount of rule breaking. Several reasons could contribute to this lower rate of observed rule breaking; firstly, the macaques within Japanese parks are known to be very strictly monitored by park officials, in order to keep tourists safe and monitor the overall health of the troop (Knight, 2011; Russon and Wallis, 2018), this close monitoring involved regular checks from park rangers to keep the primates and tourists apart, relying less on both the initiative of the tourist and man-made barriers, unlike Gibraltar and Galta Ji. Park rangers within Japan also very closely monitor the provision levels of the macaques, in order to keep tourist-primate interactions to a minimum (Knight, 2010), this may contribute to the lower levels of feeding, as the macaques do not feel the need to gather food from the tourists, as easier, more nutritious and more plentiful food is available on tap from the rangers. The photos uploaded from Jigokudani showed in almost all instances, a safe distance between the macaques and tourists, much greater than the recommended level provided by the local authority. This could be down to the regular patrols, or perhaps the stricter guidelines set by the park itself, when compared to the looser rules on distance in Gibraltar and lack of rules in Galta Ji. The macaques are also known to spend most of their time within the hot springs in the snowy winter (Yamagiwa, 2010), an area which is off limits to tourists, and can result in expulsion from the park if entered. This creates a natural barrier between the tourists and primates, which can help keep rule breaking down to a minimum, allowing for a healthier troop (Knight, 2011). Macaques within these parks are known to be "herded" by the authorities and rangers in order to look more appealing and bring in more tourists, which can lead to an over-reliance on the park rangers for provisions (Knight, 2010). This habituation could have potentially led to the macaques not recognising the tourists as a potential food source, instead over-relying on the park rangers. This can have positive implications in the sense that it has kept tourist-primate interactions down, however this over reliance can lead to decreased health if the troop ventures outside the park and has to fend for themselves (Knight, 2010; Knight, 2011; Russon and Wallis, 2018).

It is important to note that the socioecology of the four groups must be taken into account, as while all four are macaques, they can still differ wildly in behaviour. Little is truly known about the social structure or ecology of the Barbary Macaque, however the groups are thought to have high levels of habituation due to the years on the island, surrounded by local humans and tourists (Majolo et al., 2012). This sharing of territory within Gibraltar may have caused the socioecology of the Barbary Macaques to revolve around direct interactions with humans, leading to more inevitable instances of “deviant” behaviours, which may not have been instigated by the tourists. Likewise, the absence of any staff or local populations in Yushan National Park, coupled with the macaque’s preference to scavenge their own food (Hsu, Kao and Agoramoorthy, 2009), is likely to result in a society of macaques structured around the avoidance of tourists, rather than the reliance. The same ideas can be applied to both Galtaji, where the crossing of paths between human and macaque is a daily occurrence, and Jigokudani, where geographical barriers force the separation of the two groups, has probably resulted in the different species forming different socioecological behaviours. This is important to note, as this must be taken into consideration when comparing the groups, because different behaviours will result in datasets that cannot be fairly compared, due to too many differing factors. Despite these differences, previous study has shown that similar management techniques for different macaque species can be applied and be effective (Thierrey, 2000). This, coupled with the similarity in rules across the areas in which deviancy was lowest (Jigokudani and Yushan), it is safe to assume that while the four species included in the study could have different behaviours, the same or similar management strategies drawn from further study into deviancy could work between different areas/species.

The significance in the instances of deviant behaviour between National Parks and Provisioned sites suggests that direct monitoring significantly reduces the rate of deviant behaviour. With the direct monitoring effects of Jigokudani and Yushan National Park, a rate of deviancy of 0.34% is extremely low, especially compared to the 16% deviancy rate of the provisioned parks. The direct monitoring also does not seem to cause visitor numbers to drop, as overall the National parks had a higher number of overall Instagram posts (890) than the provisioned sites (796), assuming that the Instagram posts accurately correlate with visitor numbers, which has shown to be the case in previous studies (Tenkanen et al., 2017; Wood et al., 2013); this however can never be truly accurate, therefore it is important to note that while previous work does support the assumption, we must be aware that this may not be the case with every park, therefore it may be useful to undertake work within the 4 sites used in the study in order to accurately assess the correlation between visitor numbers and Instagram posts. While Gibraltar does have a direct management process of a fine for feeding the primates, the rate of deviancy is still significantly higher than that of the National parks. The integration of more laws, with perhaps the setup of a more organised ranger patrol will encourage the visitors to adhere to the rules (Vu, Li, Law and Ye, 2015; Weber, Kalema-Zikusoka and Stevens, 2020; Jenks, Howard and Leimgruber, 2012), as previous works have shown increasing the resources and training quality of local enforcement bodies can help reduce the amount of illegal activity within natural areas (Hilborn et al., 2006). The patrols can act both as a direct monitoring method, preventing the visitors from breaking the guidelines, but also as an indirect monitoring process, as they

can be ready to answer any questions from the visitors, as well as educating them through guided tours perhaps.

## **Discussion**

### **Manual Data Gathering vs Application Programming Interfaces**

While manual data gathering was sufficient for the purposes of this study, in order to gather larger amounts of social media data, with broader categories, it may be beneficial to use an application programming interface (API). An API employs programming to filter out all, but specific categories defined by the programmer, to allow for sourcing of huge levels of data in a short amount of time. This is especially useful if conducting a particularly large study, or looking at more complex patterns, such as spatial or temporal data (Hausmann et al., 2017; Tenkanen et al., 2017). With the use of an API, thousands of images can be collated in a short amount of time, however the data would still need to be sorted through manually. On top of this, knowledge of a programming language (most commonly Python) is needed, therefore it was deemed that the geotags and hashtag searches were suitable enough for data collection within this study. Should further work be done on this topic, the use of an API may be employed in order to answer more complex questions. Most social media websites allow open access to their API (Including Instagram) (Tenkanen et al., 2017), however you must have an approved developer account before starting usage, as well as sending off a plan for the gathering of your data to the relevant company in order to be granted access.

### **The Future of Social Media in Conservation Research**

In the age of new and rapid technological advancements, digital breakthroughs, including social media, allow for new avenues to be explored within the world of conservation and biological sciences (Toivonen et al., 2019). This paper has presented arguments for the use of social media within current and future conservation science, as well as the challenges that face this type of research. While relatively unexplored, the body of research and literature surrounding the exploration of social media data gathering is increasing, with majority of current studies following the same path as ours; studying animal and human interactions based on locational data (Sonter et al., 2016). While most existing work revolves around analysing locational data, there is certainly great potential to start “moving beyond the geotag” (Crampton et al., 2013), moving away from the traditional and laborious work of sifting through large quantities of locational data, favouring more developed and advances analytical techniques in the future of conservation research. Looking into the possibilities of more sophisticated and complex analysis methods, from user networks and activity to spatially or temporally tagged data, can provide a deeper and richer vein of data, allowing for a more detailed picture to be painted, gaining information from the perspective of the users, rather than just a simple upload, which could be interpreted the wrong way (Ruths and Pfeffer, 2014; Toivonen et al., 2019), as understanding the behaviour of people and how they interpret environmental issues are key factors in providing useable and successful environmental change (Bennett et al., 2017; Crampton et al., 2013; Tenkanen et al., 2017).

Social media has been referred to numerous times as “big but small data” (Toivonen et al., 2019; Crampton et al., 2013; Kitchin 2015), there is a staggering amount of data readily available via social media, with billions of images now populating hundreds of websites, hence “big data”. Such data can seem a mountain to climb, however the workload and data “noise” can be reduced significantly when working through defined parameters with a set goal i.e. “small data” (Hausmann et al., 2017). Data is readily available with text, images, videos, locational data, in different languages and both spatially & temporally, allowing for gigantic study areas and data pools (Toivonen et al., 2019). Despite this slightly staggering amount of data, it is entirely possible, and sometimes simple to control the “noise” and filter out irrelevant information, allowing for sample sizes ranging from a single cul de sac to a global study (Hausmann et al., 2017; Hausmann et al., 2019). However, Social media currently appears most useful when applied to areas of high activity (e.g. national parks, tourist hotspots) or when referencing topics or debates relatively popular among active users (Tenkanen et al., 2017). While it is entirely possible for a study to be conducted on smaller groups of data, it may be the case that any analysis does not result in a meaningful outcome (Toivonen et al., 2019).

The quality of the data gathered can at times be suspect, with data gathering still a challenging aspect of any social media study (Kapoor et al., 2017), as there is the obvious constraint of biased data when targeting specific people or locations (Toivonen et al., 2019). Social media users tend to stay within their preferred groups, being more likely to share positive, more relatable data rather than negative, conflicting information/posts (Ceron, 2015), which can clearly cause heavy bias, resulting in possibly inaccurate data. Despite the somewhat large chance for bias and misinformation, social media across multiple platforms (namely Instagram, Flickr, Facebook and Twitter) has been found to reflect surveyed activities, preferences and flow of tourists and local visitors in the biggest national parks of South Africa and Finland (Hausmann et al., 2018), with active users positively correlating with official visitor statistics in parks across the globe (Tenkanen et al., 2017; Wood et al., 2013), showing that it is entirely possible for data gathered via social media to be both accurate and reliable.

Bias is not the only challenge faced within social media data gathering. Acquiring data solely via digital methods can introduce additional problems to the acquired data (Tumanov, 2020). Text-based content, while potentially rich in information, can be very hard to quantify due to its variety and variability. Satirical posts may be hard to discern from genuine posts, meaning that some real data may be discarded as it is viewed as satirical or sarcastic, and likewise a satirical article may slip through the cracks and end up being analysed along with the real data, watering down the reliability of the study. There is also the problem of language barriers, where one phrase or word may mean something completely different in another language, or a post regarding “dolphins” may be filtered into the data pool, while in reality the user is referring to the American football team. In order to combat these issues, citizen science campaigns can be introduced to source more reasonable data with relative ease. An example could be a group of scientists opening a Facebook group related specifically to wildlife photography in a certain area, with members only being allowed to post if their content meets the relative criteria. Using social media in this way (for citizen science), rather than the traditional methods of setting up a separate

website or application, can both save time and money for the researchers, but can allow for a much wider audience to source data for the study (Bonney et al., 2014).

While data gathered solely from social media can certainly be useful, when possible, it should be paired with more widely accepted and used methods of data gathering, such as statistical methods, in person study or surveys (Tenkanen et al., 2017; Hausmann et al., 2018), to more accurately assess the data and have a solid base for comparison, to check the social media data for reliability and accuracy. The slower and more traditional methods of data gathering can pair well with the quicker and more spontaneous data gathering via social media, to paint a picture of how people act within important nature areas.

### **User Privacy and Data Access Issues**

In the past, traditional methods of data gathering such as manually gathering data in field studies, conducting surveys and outsourcing to research companies (Chung and Weld, 1996) have involved active citizen science, working with licenced conservation and government agencies, universities or solo. All these methods have clear and well-defined rules when conducting a study, with pre-determined plans that all members are aware of before conducting research. Comparatively, social media derived data has often no communication between the company, data gatherer and active users. The platforms are not for data gathering purposes, acting primarily as for-profit organisations, who are known to change their policies on their data, including who can access it, how people can use API's, or how data can be stored and used by the company (Toivonen et al., 2019). Because of this, it is a challenge for both active users, users who regularly upload and data miners to keep up with the constant changes, potentially leading to a breach in the terms and conditions of the platform. This is a particular challenge for research topics that require a long time for their data gathering period, as the terms and conditions may be vastly different when they finish from when they started, hence why the data gathering period of this thesis was 3 months, allowing for sufficient amount of data without fear of the guidelines changing halfway through the period. Data gathered in this way can also be hard to replicate, due to the constant changes in policies (Toivonen et al., 2019). The ideal way to combat this shortcoming is clear and constant communication with the company or platforms being worked on. Getting in touch with these platforms before starting the data gathering can allow both parties to be open on how the data will be used, what changes may occur during the period and how long it will take, so that there is not miscommunication that could potentially lead to serious repercussions down the line. Another method could be for large conservationist organisations to collaborate with these social media platforms, to allow users to donate their posts directly to the conservationist company, perhaps with an opt-in opt-out program that allows users to send their data directly to these companies with one tick of a box. This eliminates any confusion in what exactly the data is being used for and may help reduce the amount of data "noise" that needs to be sifted through.

## **Conclusion**

It is clear from the Data that tourist-primate interactions can vary greatly in different environments, with defined rules & laws potentially working as a deterrent against rule breaking within the parks, although this may not be the case, as many tourists could simply be afraid and aware of the dangers that wild animals pose to them. The culture of the area also seems to affect the likelihood of interactions, with areas such as Galta-Ji having low levels of interactions despite a lack of rules. Tourists generally seem to respect the rules and boundaries of the primates, however in order to say for certain it would be beneficial to conduct on site surveys, which would diminish the effectiveness of Social Media data gathering should the data not correlate. The positive take from the study is that as far as data gathered via social media shows, there are significantly more tourists who do not directly interact with the macaques than those who do, which is likely to be beneficial to the health of the Primates. Jigokudani and Yushan have shown the effectiveness of national parks, where tourist-macaque interactions are kept to a minimum, allowing for a more, albeit not truly natural way of living for the primates. Data gathered from Gibraltar and Galta-Ji show that interactions are perhaps unavoidable, however these seem to be kept to a minimum by visitors to the area.

While not without its shortcomings, there is clear and concrete evidence that data gathered via social media can and likely will have a place within the future of conservation science. The Idea has generally been accepted positively (Toivonen et al., 2019) yet more work still needs to be done to assess the true potential of social media. With the currently rapid advancement in technology, paired with the apparent openness and interest in social media data mining, it is natural to assume that more and more researchers will pick up on the idea within the next few years, opening up new avenues, larger studies and potentially bringing about a revolution in how we gather data. However, with this hopeful boom in interest of social media data gathering, researchers must be careful with how they conduct their studies; looking up guidelines on how to safely gather data, ethical problems, potential bias, and anonymity, as well as ideally pairing the gathered data with more traditional studies to ensure accuracy, in order to ensure the future of social media data gathering is safe and continues long into the future.

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