Faculty of Science & Technology

The effects of human disturbance on the behaviour of gentoo penguins (Pygoscelis papua) in the Falkland Islands

A dissertation submitted as part of the requirement for BSc Ecology and Wildlife Conservation

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ABSTRACT

In recent years gentoo penguins have been extending their breeding range as a reaction to changes in habitat availability caused by climate change, already having a latitudinal range that is one of the most extensive of all the penguin species. However, they are being impacted by the rise in human populations and anthropogenic pressures. The Falkland Islands is home to 34% of the total gentoo penguin population, making the islands population globally significant. The tourism industry in the Falkland Islands is growing meaning human and penguin interactions are increasing at a significant rate. To research the impact this has on the gentoo penguin populations and their behaviour, observations were made throughout their breeding season (October 2021-May 2022) at four sites across the Falkland Islands each with different levels of past human exposure. Observational videos between 5 and 6 minutes were recorded and analysed looking at levels of calm and agitated behaviour displayed by individuals. A total of 103 observations were made making up around 10 hours. Data showed significant relationships between past human exposure and agitation, colonies with low past exposure were more reactive to the presence of humans. Chicks also displayed higher levels of agitation compared to adults. Volunteer Point colony is one of the most popular tourist attractions in the Falkland Islands, exposing the gentoo penguins there to high levels of human visitation. The penguins here showed higher levels of calm behaviour with an average of 90%, whereas at Yorke Bay (which has only been exposed to human presence for two years) had an average calm behavioural display of just over 60%. Breeding stage also had an impact on calm and agitated behaviour, with the penguins being most alert during breeding stage 3 (February-April) where chicks were independent of adults but not yet fledged. Other studies have found that energetic expenditure is impacted by human disturbance. A wider study into this area would be valuable in understanding the impacts of the increasing human interaction with gentoo penguins in the Falkland Islands and how best to protect the species health and productivity.

Figure 1. Adult gentoo penguin at Yorke Bay at sunset.

Acknowledgements

There are many people I owe thanks to for support during this project, firstly Falklands Conservation, the Falkland Islands Government and Tom Busbridge who made this project possible.

I would also like to sincerely thank my supervisor Richard Stillman for his ongoing guidance and wisdom throughout the past 18 months.

A huge thanks goes out to my family and friends, especially to those who came to the colonies with me or who listened to me talk about penguins for hours on end.

Finally, I would like to send gratitude to the gentoos of the Falkland Islands who I totally fell in love with.

Figure 2. The first day of gentoo observations at Yorke Bay.

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1.INTRODUCTION

1.1. Human disturbance

As human populations grow, interactions between humans and wildlife are increasing year after year (Goumas et al., 2020). Remote, and until now largely untouched, habitats are also starting to be impacted. The implications of these growing interactions are in the most part unknown and unresearched. Anthropogenic pressures occur in many forms and affect species and ecosystems in different ways. The world is changing quicker than most species are equipped to adapt to. Evolution cannot keep up in most cases meaning lots of wildlife populations are decreasing. With habit decrease and fragmentation (Yeager et al., 2020), higher resource competition (Pardew et al., 2018), noise pollution (Shannon et al.,2016), rise in extreme weather events (Ummenhofer and Meehl, 2017), and rising temperatures animals are fighting for survival on every front.

As the human population hits 8 billion the demand for resources has increased exponentially, resulting in local recourse capacity being overflowed by consumption (Wakernagel et al., 2004). The wealthier countries in particular have elevated consumption, creating a demand for significant resource extraction (Lindsey at al., 2022). This is creating ripple effects for most species on the planet as resource competition is hitting an all-time high. We are overfishing the oceans (Scheffer et al., 2005), over-farming the earth, and needing more and more land for livestock and crops (Wibbelmann et al., 2013). Human-induced pressures leading to environmental changes on a large scale have caused major declines in wildlife populations and their distribution. These declines have been described by Ceballos et al. (2017) as an “ongoing sixth mass extinction”.

1.2. The negative impacts of human disturbance

The global rise in human population is negatively impacting wildlife behaviour and populations worldwide (Broekhuis et al., 2019). The impacts of anthropogenic pressures vary; some include evoking changes in feeding behaviour (Arueira et al., 2022), circadian rhythms (Tallec et al., 2013), movement patterns (Zickgraf et al., 2016), and spatial use (Schuette et al., 2013). These behavioural changes and added energy expenditure (Marn et al., 2020), caused by changing environments and human disturbance are likely to have an impact on disease transitions (Martinelii et al.,2017), resilience to extreme events (Best and Darby, 2020), offspring survival and recruitment (Oudi et al., 2019) and community interactions (Gaynor et al., 2018).

As well as widescale anthropogenic pressures, many species are also negatively impacted by direct human disturbance. It has been a point of controversy in recent decades over the extent to which human uses of the countryside adversely impact wildlife (Gill et al., 1996). Examples of these uses include infrastructure (Neumann et al., 2013), tourism (Meyer et al., 2019), recreation (Boyle and Samson, 1985), and industrial expansion (Davis, 1976). Human induced habitat fragmentation, although measured in different ways, has consistently been linked to negative impacts on biodiversity (Fahrig, 2003). Animals have many adaptations to conserve energy; however, human disturbance can impact this often forcing the animal to expend energy as a response (Speakman et al., 1991). Human disturbances can have significant consequences on the survival rate of many species (Boyles and Brack, 2009).

Different animals react in various degrees to human disturbance; this often comes down to individual variation (Hertel et al., 2017), fitness and health of the individual, frequency of human interaction in the past (Stankowich, 2008) and individual temperament (Martin and Reale, 2008). Another factor that could impact the level of reaction is stage of breeding cycle. There is a limited amount of research in this area, however it is theorised that some species will be more disturbed at certain times of the year during their breeding season as they may feel more vulnerable. It has been found in some studies that females or groups with young show a larger disturbance response (Stankowich, 2008). Human disturbance can impact survival rate, reproduction, and growth. Behavioural responses to disturbances are trade-offs between fitness enhancing activities (feeding, mating, etc) and avoiding perceived risks, an evolved antipredator response (Frid and Dill, 2002). The increase in human and wildlife interaction and disturbance is leading to an imbalance in these trade-offs. In many cases human disturbance also effects species resilience and ability to cope with environmental changes such as fragmentation (Nystrom et al., 2000).

1.3. Effects of human disturbance on birds

Birds (*neornithes*) worldwide are being affected by climate and environmental changes from the poles to the tropics. As mentioned, many large-scale factors have negative consequences, however, this isn't to say that small scale human induced changes or pressures don't play their part. For example, small-scale agriculture in the tropics that has deforested areas for coffee plantations have been linked to decreases in insectivore bird populations (Canaday, 1996). Windfarms are another factor that can alter bird behaviour and often reduce their survival chances by causing the functional habitat loss of many migratory birds (Marques et al., 2019).

Many bird species breeding success is negatively impacted by human presence and activities. The New Zealand dotterel (*Charadrius obscurus aquilonius)* is a perfect example, with the chicks of this species decreasing their foraging time in the presence of humans, likely having a significant impact on energetic expenditure (Lord et al., 1997). There have been many other behavioural changes observed as a result of human disturbance including the amount of parental care given to young. One way to counteract human disturbance is to create physical barriers between habitats and areas of human recreation such as fences to create refuge for the animals. Studies show that creating areas of refuge within a highly visited area and by reducing visitation on site with protective barriers could allow animals to behave as if they were in an undisturbed habitat (Ikuta and Blumstein 2003). Scientific research is not exempt from impacting birds negatively. Research has been shown that procellariform seabirds heart rates are significantly raised when being handled by humans in the colony. Studies have also shown that smaller sea birds including storm petrels (*hydrobates*) are particularly sensitive when handled during their incubation period sometimes leading to lowered reproductive success and higher 'divorce' rates between pairs (Carey, 2008). Physiological changes have also been seen, including heart rate increase because of human presence and approach as seen in adelie penguins (*Pygoscelis adeliae*) (Culik et al., 1990). Wilson et al, (1991) found that both human presence and aircrafts had substantial impacts on Adelie penguins (*Pygoscelis adeliae)* causing birds to deviate from used pathways. Some birds were also observed to flee from their chicks; this was seen at a higher rate when nests consisted of larger chicks rather than small chicks or eggs, leading to a nest mortality increase of 8%.

1.4.Gentoo Penguins (Pygoscelis papua), and the impact human disturbance has on the species

Gentoo penguins (termed gentoos henceforth) have one of the most extensive latitudinal ranges of any penguin, breeding from 46°S to 65°S (Otley et al., 2005). They appear to be one of the few species that seem to benefit from climate change with a population rise of 11% since 2013 across the Western Antarctic Peninsula (Herman et al., 2020), however the Falkland Island population did not change during this period. Their global population size is estimated at 387,000 breeding pairs (Dunn et al., 2019). The rise in population size is theorized to be due to ice melt creating more habitat for the gentoos. Gentoos have been identified as an important sentinel species in the sub-Antarctic Prince Edward Archipelago for the local marine ecosystem (Kling et al., 2019). Their inshore foraging behaviour also makes them a good indicator of the prey assemblages in local waters.

Gentoos have a strong resilience to mass mortality events (for example harmful algae blooms) with rapid recovery (Pistorius et al., 2010). Falkland Island gentoos are seasonally opportunistic in their foraging (Handley et al., 2016), they are generalists. This could be why total breeding failure has never been observed in the Falkland Islands with on average only 4% of breeding pairs failing. However, total breeding failure is not atypical in gentoos and usually occurs at sites where artic krill make up large part of their diet. Oil pollution and bycatch also can have major impacts on the penguins (Boersma and Stokes, 1995). A study by Cobley and Shears (1999) looked at the effects human disturbance had on breeding performance in multiple gentoo colonies in the Antarctic. They concluded that visitor disturbance did not have a major overall impact on hatching success or single-chick brood numbers.

The Falkland Islands is home to 34% of the total gentoo population (Baylis et al., 2011), making this population globally significant. Penguins (Spheniscidae) winter strategies vary between species, with many migrating significant distances while other stay sedentary, gentoos are neither migratory nor sedentary, individual variations impact both spatial and temporal patterns (Black et al., 2017). Unlike the majority of sub-Antarctic species, gentoos have a long laying season (Bost and Jouventin, 1990). They lay two eggs in October and then take it in turn with their mate to incubate their eggs. The chicks in most cases hatch in December/January and are then totally dependent on their parents for the next few weeks before moulting and fledging around February/March. Breeding pairs forage in close proximity to the colony, with a maximum recorded range of 25km. Nonbreeding adults (or adults out of breeding season) tend to exceed this maximum range and have much higher levels of individual variation in their foraging patterns. Baylis et al. found that penguins move between breeding colonies on the Falkland Islands typically returning to original colony to breed. This likely aids in their breeding dispersal, playing a crucial role in their gene flow and population dynamics. Historically, currents have been the major factor impacting penguins' dispersal, with specific island location influencing the structures of the populations. It is becoming more important to understand environmental changes and how population structures and dispersal will be impacted (Munro and Burg, 2016). The rise in tourism and human disturbance may also have repercussions on the genetic flow between different colonies and the health of the gene pool in general.

1.5. Ecology of the Falkland Islands

The Falkland Islands are an isolated archipelago located in the south-western Atlantic at around 52°S (McDowall, 2004), with native flora and fauna highly adapted to the harsh climate. Invasive species, brought to the islands by humans, have had huge impacts on the native species. Rats, cats, and mice being some of the most problematic as they often predate on ground nesting birds. Some native species such as thin billed prions have adapted to coexist with introduced mammals for over 100 years (Quillfeldt at al., 2007), others have been negatively impacted. Gentoo populations have been affected by the introduction of invasive mammals in the late eighteenth and nineteenth centuries (Armstrong, 1994). Invasive species can create significant threats to biodiversity, particularly in island habitats (Tabak et al., 2014).

The Falkland Islands are home to specialised predators adapted to the severe environment of the islands. Anthropogenic activities are putting pressure on these highly adapted species, with increased competition and decreased prey availability due to overfishing impacting population fitness. Gentoos have many natural predators including birds of prey, southern sealion, orca, and fur seal. They also compete for resources with many species, research has found significant overlap between diet composition of gentoos and sea lion suggesting they are not only predators but also competitors (Thompson et al., 1998). The intrinsic ecology of the Falkland Islands is also home to rare species such as the striated caracara a specialised raptor (Catry et al., 2008) that predates on gentoo eggs and chicks.

2. *AIMS & OBJECTIVES*

The study's aim was to test whether stage of breeding cycle and past human exposure had an impact on the reaction of individual gentoos to human presence.
To achieve this, the following research questions were answered:
Is there a relationship between past human exposure and reaction to human presence?
To answer this question, individuals will be compared from colonies with high levels of past human exposure to those from colonies with very little exposure to humans.
Is the response to human presence related to the stage of the breeding season?
To address this question, the responses of gentoos to human presence while adults were incubating eggs, while adults had dependant chicks and while chicks were independent of adults was compared.
Do gentoo chicks react differently to human presence compared to gentoo adults?
The research will look at whether gentoo chicks react differently to human presence compared to gentoo adults during stage 2 of the breeding cycle.
Does the reaction to human presence differ to the behavioural response to natural predators and disturbances?
Comparisons will be made of the reaction to human presence to the behavioural response to natural predators and disturbances.
Do additional observations show individual variation in behaviour?
Additional behavioural observations that occurred during the study will be included, such as stand out behavioural reactions and specific scenarios.
What additional conservation measures could benefit gentoo penguins by mitigating against the rise in tourism in the Falkland Islands?
Using the answers to the previous research questions and additional observations made during the study, conservation measures will be proposed that could reduce the impact on gentoo penguins of increasing numbers of people visiting the Falkland Islands.

3. ***METHODS***

3.1. The Falkland Islands

This study of breeding gentoos and their behavioural reaction to human disturbance was carried out over four main colonies across the East and West Falkland Islands. Gentoos are generalists when it comes to nesting environments. Gentoo colonies across the Falkland Islands are located in many different habitats including tussac, sand dunes, low grass land and rocky substrates. Extensive farming over the past two centuries has depleted the health of the natural vegetation of the Falkland Islands (Woods, 1970). Many avian species, including gentoos, rely on this vegetation for shelter, protection, and nesting. Gentoos do not migrate from the Falkland's, they stay year-round, the number of breeding pairs does however have a high level of inter-annual variability. Baylis et al. (2011) found that a broad-scale climatic variation index and the number of gentoo breeding pairs has a positive correlation. Their yearly breeding cycle starts in October when they lay their first egg spanning to around April when their chicks are fully independent. The data collection period for this study began in September 2021, ending in May 2022.

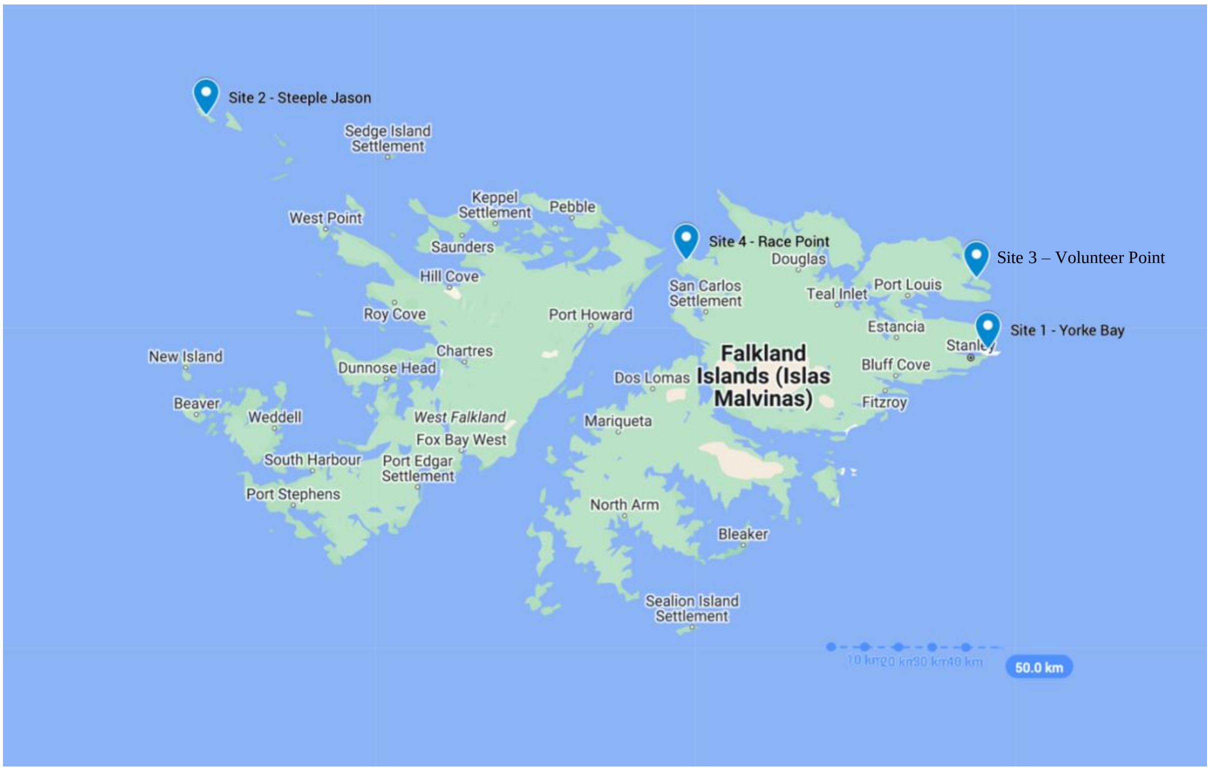

Figure 3. Map of the Falklands Islands showing all four colony locations: Site 1 – Yorke Bay, Site 2 – Steeple Jason, Site 3 – Volunteer Point and Site 4 – Race Point.

Table 1. A table outlining the different colonies describing their past human exposure, size, habitat and make up of observations.

Colony	Colony Size	Habitat	Previous Human Exposure	Number of observations	Breeding stages observed
Yorke Bay	300	Sand Dunes	Low until 2020 now moderate	66	1,2,3
Steeple Jason House	2200	Tussac	Low	5	1

Steeple Jason Neck	3200	Exposed ground	Low	7	1
Volunteer Point	2000	Grassland	High	21	1,2
Race Point	880	Grass Valley	Very Low	4	2

3.2. Site 1 – Yorke Bay

Yorke Bay was the main research Site, located a 5-minute drive from the capital city of Stanley. Yorke Bay is home to around 300 gentoo penguins (Bax and Bayley, 2022), located high up in the sand dunes a few hundred meters from the shoreline. The sand dunes offer some protection from the harsh weather of the island but are constantly moving with the winds so are not always the most reliable shelter. There is some sand grass growing in this habitat that some of the gentoos use for nest building but mostly they just make a slight indent in the sand and nest there. Yorke bay is located just outside of Stanley harbour in a large bay facing into the channel and is located around a kilometre from gypsy cove which is home to large populations of magellanic penguins (*Spheniscus magellanicus*).

Being so close to Stanley makes Yorke Bay a popular walking location for the local community, and occasionally dog walkers. This is a particularly interesting colony to research as during the Falkland Islands War in 1982 the sand dunes were armed with active mines. This meant that Yorke Bay functioned as a de facto protected area until it was declared “landmine free” in November 2020. Therefore, the gentoo population in this colony have only been exposed to humans in the last two years.

Figure 4. Map of Yorke Bay colony.

Figure 5. Yorke Bay colony during breeding stage 2.

3.3. Site 2 – Steeple Jason

Steeple Jason was the second study colony, located in the northwest of the Falkland Islands. It is a small island spanning around 10km long and 1.5km wide, however regardless of its size it is one of the most ecologically abundant islands in the whole archipelago. It is a very remote island with extreme geography, there is a steep ridge running along the middle of the island, the cliff edges created by this ridge makes the island a bird paradise. It is home to the largest black-browed albatross population in the world, huge numbers of southern-rockhopper penguins, southern giant petrels, skuas, and gentoo penguins as well as large populations of fur seal and southern sea lion. Gentoos have nested in many areas on the island, I studied three of the colonies. Two of them were located in deep tussac grass which acts as protection from sealions and from the elements. The other was at the neck of the island which is much larger and more exposed but an easier journey from the ocean. Being a very remote island, the animals here have not had very much exposure to humans in the past. Every year a few research teams visit the islands for various scientific projects and a few tourists are allowed to stay on the island for a high price. So all in all the birds of the islands aren’t very used to humans.

Figure 6. Map of Steeple Jason showing all colonies observed across the island.

Figure 7. Map of Steeple Jason house/tussac colony.

Figure 8. Map of Steeple Jason neck colony.

Figure 9. Steeple Jason gentoo penguin house/tussac colony during breeding stage 1 (adults incubating eggs).

3.4. Site 3 – Volunteer Point

Another research colony Site was Volunteer point, Site 3. Volunteer point is a peninsula located in the northeast of East Falkland and is part of Johnson's Harbour farm which is privately owned land. It has been labelled an Important Bird Area and is now a Nature Reserve. This is one of the most visited tourist areas in the islands being accessible via off road driving and helicopter. Found here is the largest king penguin colony in all of the islands as well as high numbers of magellanic and gentoo penguins. Volunteer point is an area of beautiful long white sand beaches making it very photogenic for people to visit. It also makes it a perfect place for penguin colonies as they can get to land safety and easily. The tourists are taken straight to the colonies, where there are stone markings showing how close to the colony they are allowed to get (within 6m). However, this doesn't take into account all the birds coming back from sea. This makes human bird interaction very common. The gentoos here are exposed to humans in huge numbers every year, much more so than any other colony on the islands. The gentoo colony is located on grass a few hundred meters from the ocean. There are three colonies (sometimes splitting into more) of reasonably high numbers (totalling around 2000 birds).

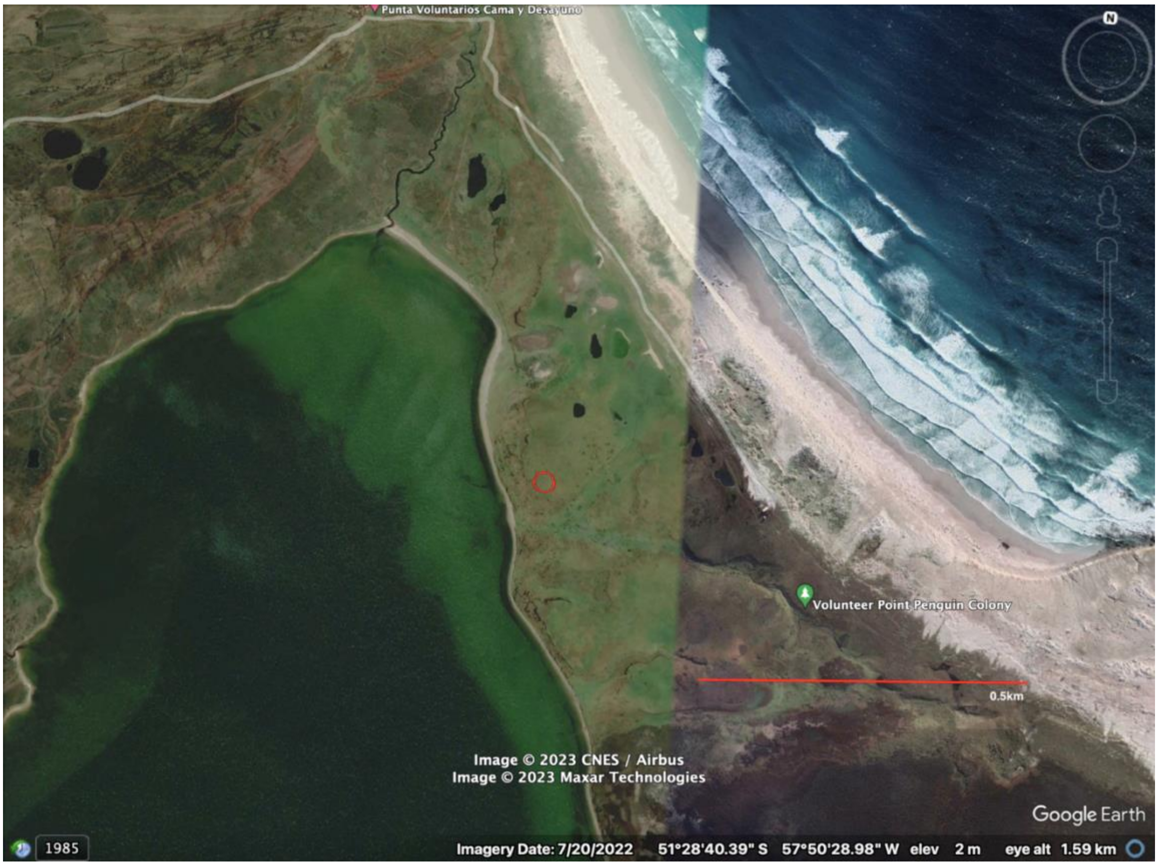

Figure 10. Map of Volunteer Point colony, the red circle indicating the location of the gentoo colony.

Figure 11. Volunteer Point gentoo penguin colony during breeding stage 2.

3.5. Site 4 – Race Point

The final research colony was located on Race Point Farm. Race Point is in the northwest of East Falkland in Port San Carlos, around a 1.5-hour drive from Port Stanley. The farm is open to the public year-round however the gentoo colony is difficult to get to involving lots of off-road driving and complex navigation. This colony is located high up on a grass bank and due to it being so secluded the small colony very rarely experiences human interaction. Likely they will see conservationists once or twice a year for population counts, which will amount to about 10 to 20 minutes at the colony. They may see the farmer occasionally, but this is unlikely as the farm covers a huge amount of land and is run by one family.

Figure 12. Map of Race Point colonies, 'Race Point Rookery Sands 3' was the research colony for this location.

Figure 13. Race Point gentoo colony during breeding stage 2.

3.6. Data collection

Observational data collection began in October to coincide with the beginning of the breeding season. At the beginning of the study, observational data was collected using eye observations and the ethogram method of 5-minute intervals for individual gentoos. However, this was not very time efficient or precise, so the method was changed to recording observational videos lasting between 5-6 minutes.

To record the observational videos, a range of camera equipment was used including iPhone camera, Go-Pro 10, and others with various DSLR cameras depending on availability. To do this the camera would be set up on a tripod around 40 meters from the colony. Being 40 meters away was not always possible as some colonies are in deep tussac habitats meaning to have a vantage point of the gentoos observations would be made slightly closer. Notes would be taken on the colony, the habitat, the surroundings and any disturbances or predators in the area.

Each observation video was categorised by the Site of the colony, whether it was captured in the colony or at the shoreline and the breeding stage it fell into. Other aspects that were recorded were time of day, human presence, distance humans were from colony if present, other animal disturbances, date and time.

Breeding stages were split into three groupings, breeding stage one (September-November) included adults on nests with eggs, breeding stage two (December-January) involved adults with young dependant chicks, and finally breeding stage three (February-April) was adults and independent chicks.

Figure 14. Researcher observing gentoo behaviour at Yorke Bay while camera captured observational video.

3.7. Video analysis

The videos were then analysed on an observational analysis programme called Boris (https://www.boris.unito.it). To build a dataset, random gentoo individuals were selected in each video as a focal point. Within colonies that had different groups displaying different behaviours, to depict an accurate representation of the colony stratified random sampling was used. Individuals within different groups were selected to try and represent the variety of behaviours across the colony. For example, if around 50% of the colony was preening and 50% was resting the individuals selected for observation would represent this having half from the resting group and half that were preening.

A total of 45 videos were recorded, some were used for multiple observations. A total of 103 observations were collected across all four colonies, 66 at Yorke Bay, 12 at Steeple Jason, 21 at Volunteer Point and 4 at Race Point. This amounts to between 515-618 minutes (around 10 hours) of behavioural observations.

Five behaviours were chosen to be the main point of focus, these were: resting, walking, running, alert and preening. These behaviours were chosen to be of specific focus as they are good indicators of how the individuals stress levels were and how much they react to surrounding disturbances. Boris allowed the data to be compartmentalised into percentage of time each individual spent displaying these behaviours over the 5-to-6-minute observation. The behaviours displayed were then split into two groups, agitated behaviour (which included running and alert) and calm behaviour (which included walking, preening, and resting).

3.8. Data analysis

These data were then analysed by looking at the percentages of behaviour displayed in different scenarios. SPSS (Statistical Package for the Social Sciences) was used to explore relationships within the data using statistical tests such as Analysis of Variance and T-tests. Data were subset for each research question specifically:

Is there a relationship between past human exposure and reaction to human presence?
The colonies in focus in this study have all had different levels of past human exposure. The behaviours observed in the colonies were compared to determine if the past human exposure influenced how a gentoo reacted to human presence. Volunteer point had the highest past human

Figure 15. A human walking along the shoreline at Yorke Bay while a group of gentoos preen after returning from the ocean (a couple of magellanic penguins are amongst the group).

exposure, with huge numbers of tourists visiting the site each year, calculated at 1070 visitors in 2001 (Otley, 2005). In contrast, the Race Point colony was only exposed to humans once, maybe twice per year in very small numbers.

Is the response to human presence related to the stage of the breeding season?

This data was then analysed looking at the differences in behaviours observed in different colonies and at different stages of the breeding season which was split into three defining stages. Stage 1 was adults in nests sitting on eggs, Stage 2 was adults with dependant chicks and Stage 3 was independent adults and chicks.

Do gentoo chicks react differently to human presence compared to gentoo adults?

The behavioural reaction to both human and non-human disturbances of adult gentoos were compared to gentoo chicks during breeding stage 2. During this stage the chicks are dependent on their parents for food but are slightly more independent within the colony and still easily distinguishable from the adults. Data was analysed from multiple colonies looking at the differences to determine if chicks react in a similar way to their adults and does this differ between colonies.

Does the reaction to human presence differ to the behavioural response to natural predators and disturbances?

There were lots of natural predators and disturbances observed within all four colonies, including turkey vultures, dolphin gulls, kelp gulls, striated caracara, crested caracara, and other birds of prey. The level of alertness and agitation of individual gentoos was analysed looking at what disturbances were present, and if the behavioural reactions differed as a result of human presence compared to non-human disturbance.

Figure 16. Straited caracara's patrolling the edge of the gentoo colony on Steeple Jason during breeding stage 1 (while adults are incubating eggs).

Do additional observations show individual variation in behaviour?
Alongside the observational videos, eye observations were made looking at specific scenarios and behavioural reactions. Individual variation in the reaction of individuals to certain disturbances were taken note of and later analysed.

4. RESULTS

Figure 18 shows the sites and breeding stages for which data were collected; Table 2 describes the different letters used to represent behaviours shown in Figure 18. Not all sites could be visited during each breeding stage due to ability to access certain colonies. Therefore, analysis of changes between breeding stages will focus on Yorke Bay (Site 1) and differences between sites will focus on breeding stage 1.

Table 2. Table legend describing the five behaviours observed.

P	Preening
W	Walking
X	Running
A	Alert
R	Resting

Figure 17. An adult gentoo preening at Yorke Bay shoreline.

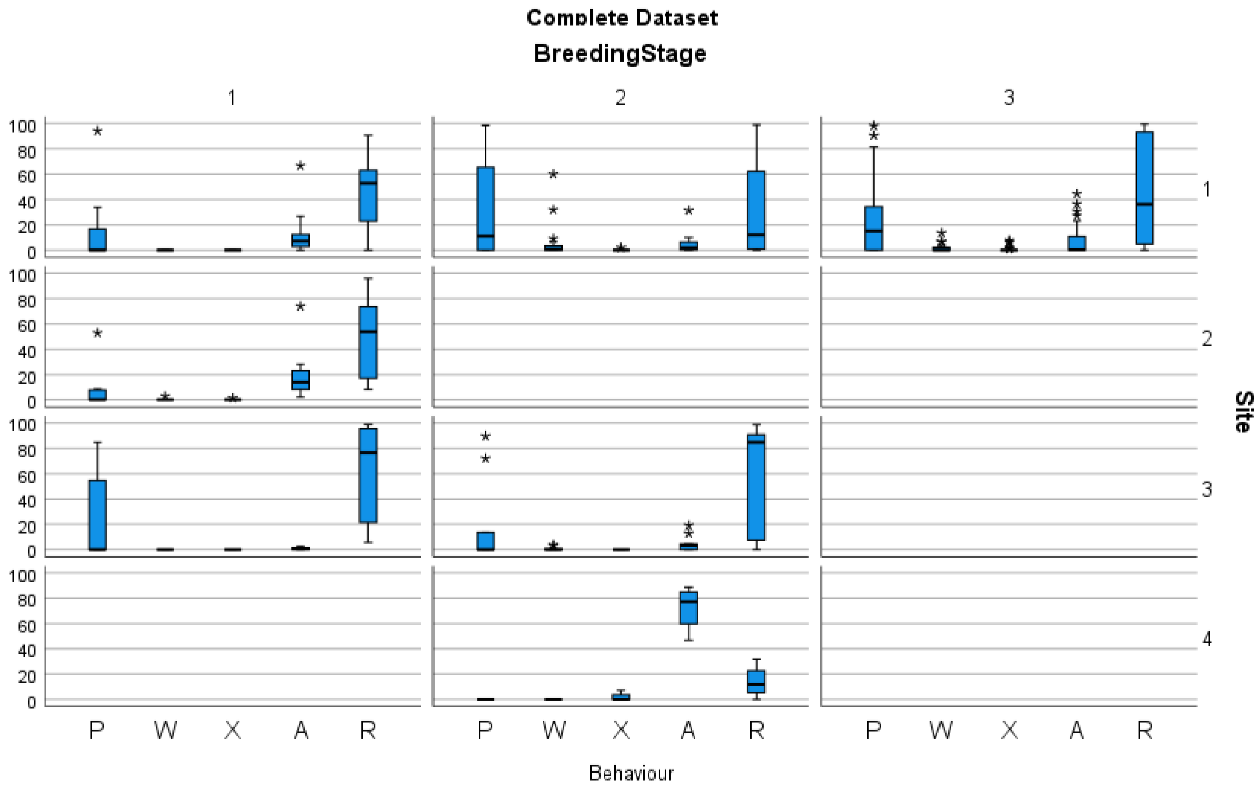

Figure 18. A box plot describing the different breeding stages and sites that data was collected over the 8-month study.

4.1. Is there a relationship between past human exposure and reaction to human presence?

As shown Figure 19 there was a significant difference in calm behaviour (rest, preening and walking) between Site 1, 2 and 3 (Analysis of Variance; F=4.991; df=32,2; p=0.013). All three sites show high levels of calm behaviour, however as you can see it is more condensed in Site 3 with a much higher average of both resting and preening. Preening is not hugely visible in Site 1 and 2 in contrast to Site 3 where it makes up a large proportion of the behavioural make up. Displays of alert behaviour was also significantly different between the 3 sites (Analysis of Variance; F=4.381; df=32,2; p=0.021). At all three sites (excluding Site 4 as there was a limited amount of data collection at this colony) there is very little movement during this breeding stage as adults were incubating eggs making running and walking infrequent behaviours, alertness is however clearly present. At Site 1 and 2 there is a considerable proportion of alert behaviour shown, being slightly more prevalent at Site 2. Alert behaviour at Site 3 it was very low, barely showing up on the graphs.

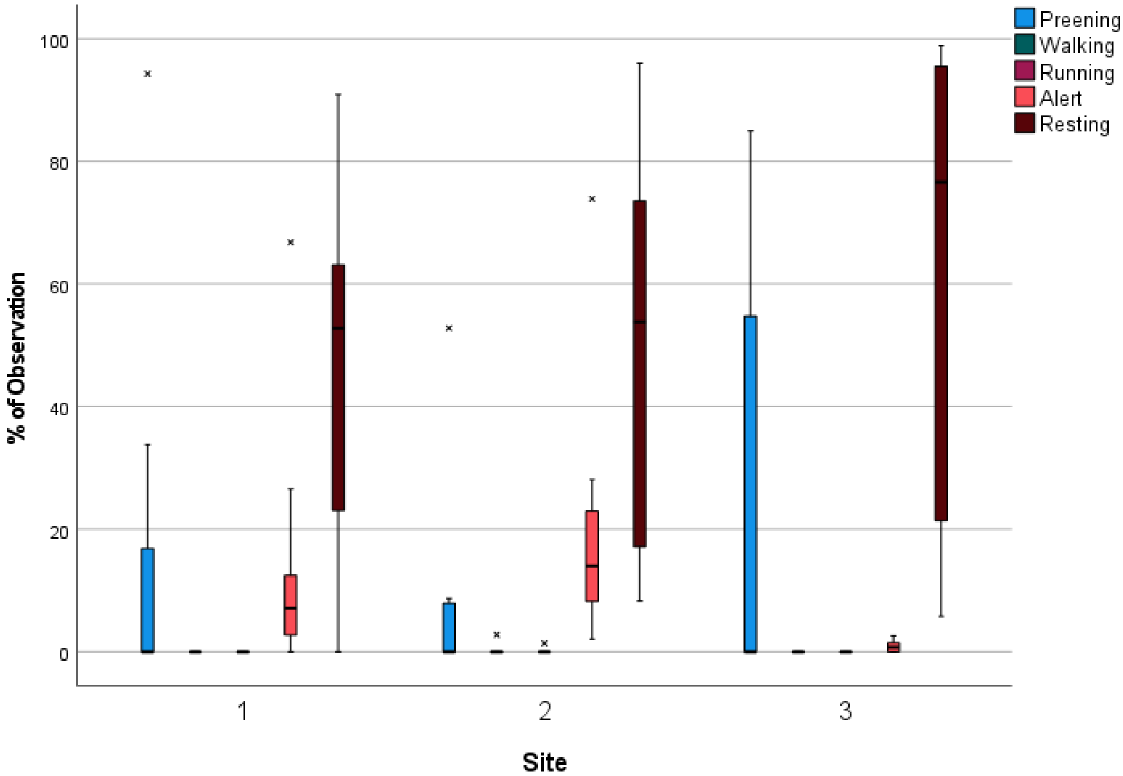

Figure 19. A box plot displaying all five observed behaviours across three sites during breeding stage 1.

Figure 20 shows the observed behaviour split into two categories of calm behaviour (including resting, preening, and walking) and agitated behaviour (including running and alert). Looking at the three sites (Site 1 – Yorke Bay, Site 2 – Steeple Jason, Site 3 – Volunteer Point) and their error bars, a higher proportion of time was spent displaying calm behaviour at all three sites, with Site 1 and 2 having a larger range. It is worth noting that the agitated behaviour is considerably lower at all three sites than the calm behaviour, however there was a significant difference in agitation between the three sites (Analysis of Variance; F=4.440; df=32,2; p=0.020). There are also a few high outliers of agitated behaviour in Site 1 and 2 showing that some individuals spent high percentages of their observed interval agitated, this does not appear to have occurred at Site 3.

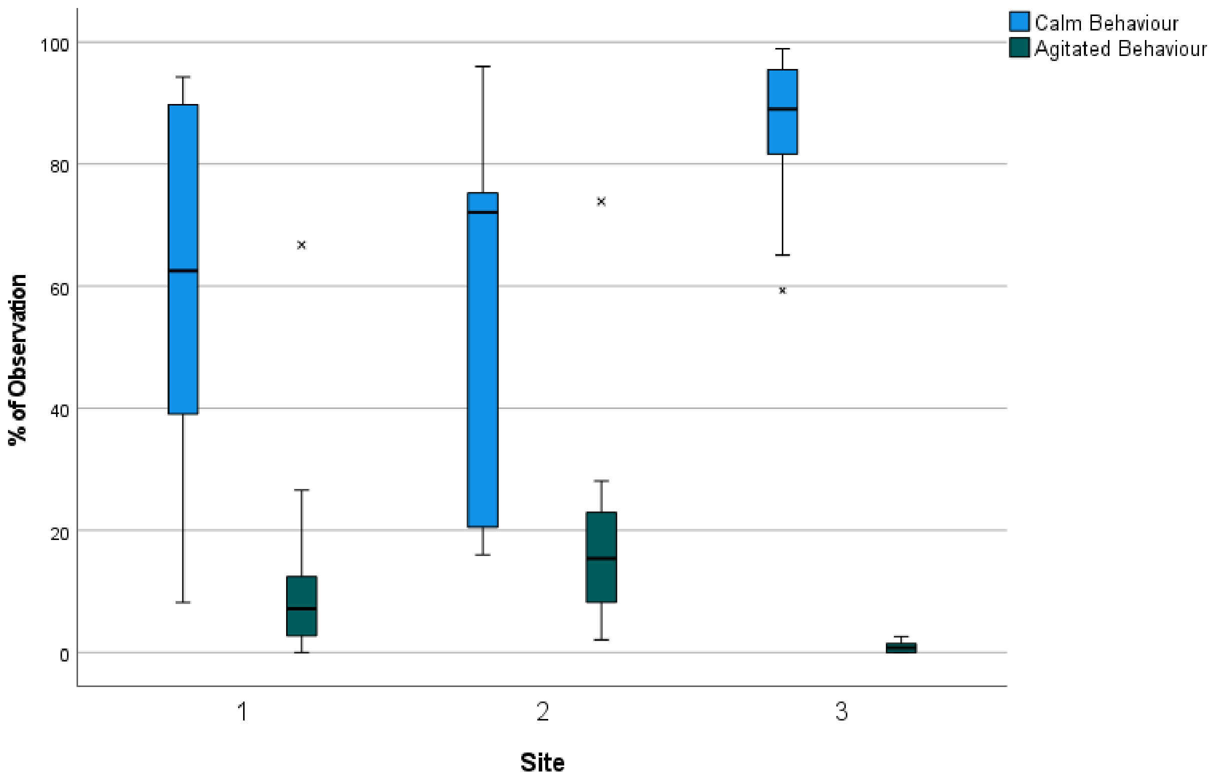

Figure 20. A box plot showing calm and agitated behaviour displayed across the three sites during breeding stage 1.

Figure 21 shows a more in-depth contrast between Site 1 and 3 during breeding stage 2. The agitated observed behaviour is around the same at both sites, with a slightly higher range at Site 3 but no significant difference (T-test (equal variance assumed as Levene's Test >0.05); t=-0.067; df=25; p=0.947). The calm behaviour observed is much higher at Site 3 with an average of just under 90% of the 5-minute interval spent displaying calm behaviour whereas at Site 1 it is just over 60%, however, there was also no significant difference in calm between the two sites (T-test (equal variance assumed as Levene's Test >0.05); t=-0.628; df=25; p=0.536). The top range of calm behaviour is also much higher at Site 3 reaching just under 100% in contrast to site one which is at around 85%.

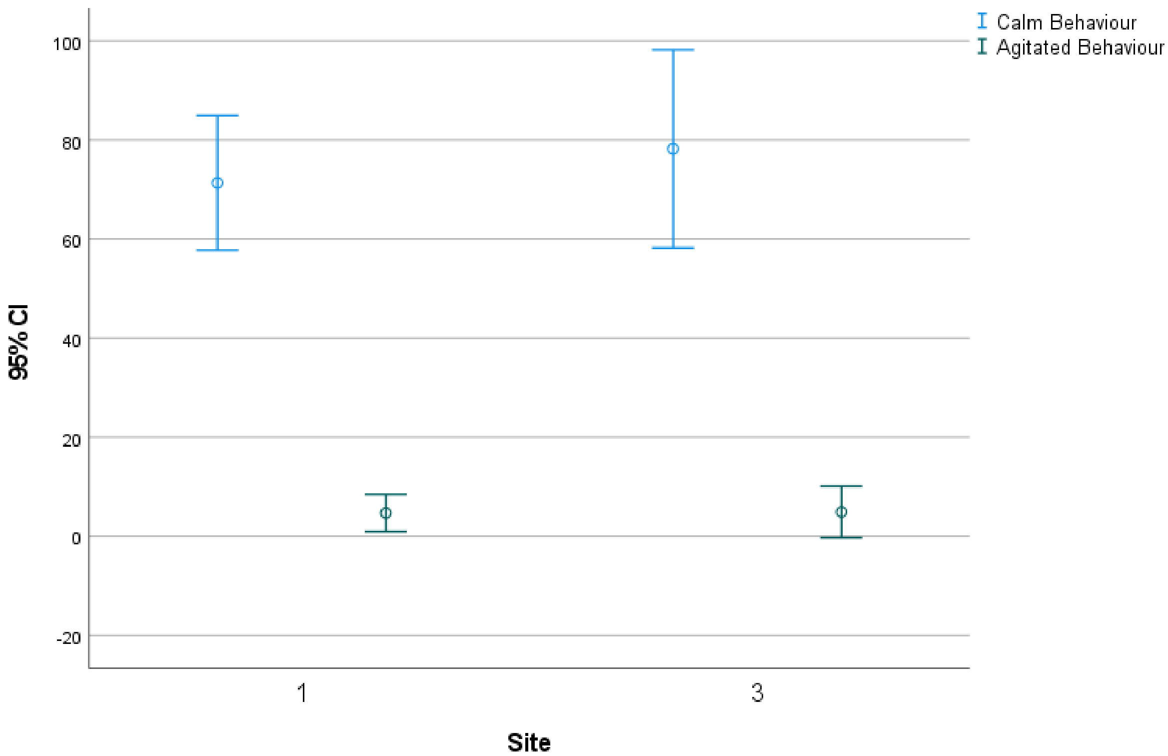

Figure 21. An error bar comparing the calm and agitated behaviour observed at Site 1 (Yorke Bay) and Site 3 (Volunteer Point) during breeding stage two.

When looking at the behaviour across the main three sites it is also important to think about the location of the individual gentoo being observed. The observed individuals were located either in the colony or on the shoreline. If they were on their way to the colony, they were counted as shoreline. When on the shoreline they are mostly either preparing to go to sea by preening their feathers and oiling themselves for insulation or coming back from sea in which they also then spend lots of time preening before heading back to the colony. It is therefore unsurprising that as shown in Figure 22 there was significantly higher levels of calm behaviour at the shoreline due to preening being categorised as a calm behaviour (T-test (equal variance not assumed as Levene's Test <0.05); t=-5.284; df=43.562; p=<0.001). The percentage of time displaying agitated behaviour at the shoreline was significantly lower than in the colony as displayed in Figure 22 (T-test (equal variance not assumed as Levene's Test <0.05); t=5.299; df=94.040; p=<0.001). However, there was some alert behaviour displayed at the shoreline which is unsurprising as they are often in small numbers so more vulnerable to disturbances and predators. It is also where they may encounter their natural sea dwelling predators such as the southern sealion.

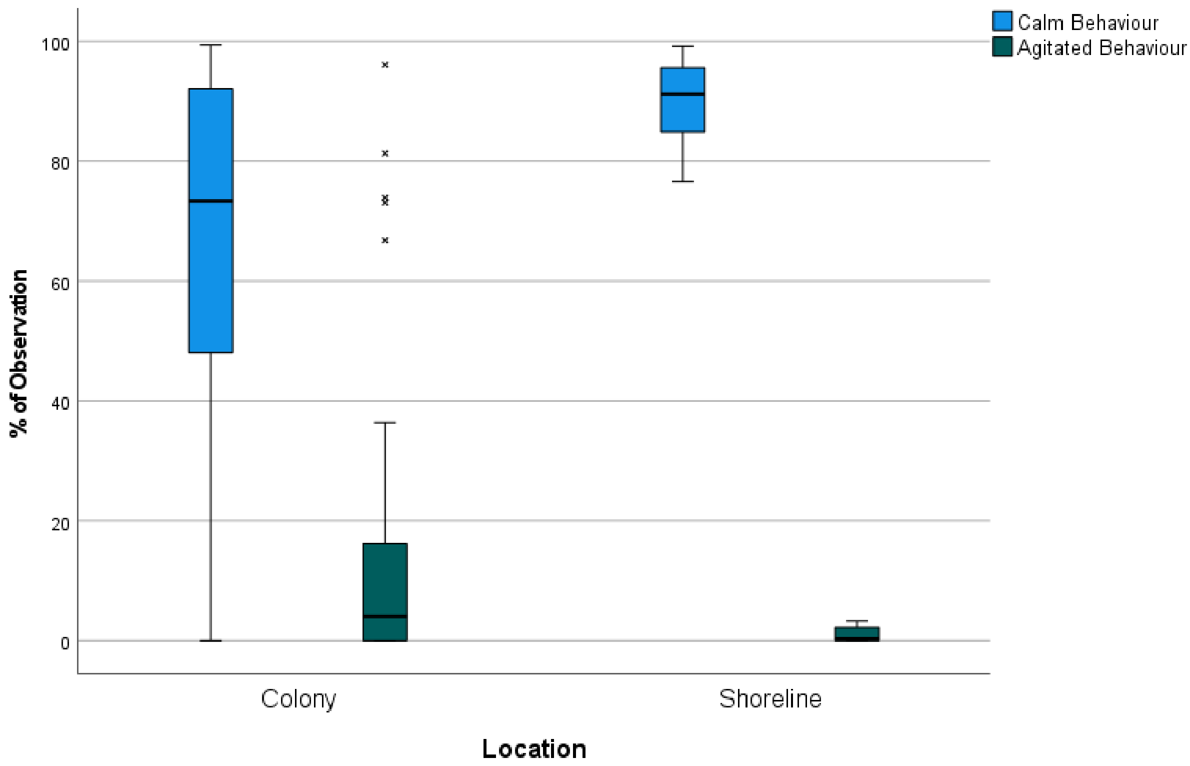

Figure 22. A box plot displaying behaviour observed at the shoreline against within the colony across the whole dataset.

4.2. Is the response to human presence related to the stage of the breeding season?

Yorke Bay was the only colony that was observed throughout the whole breeding season, through the three stages being: adults on eggs, adults with chicks and finally independent chicks and adults, it is therefore the focus colony of this research question. There is a clear pattern through all three stages of large range of calm behaviour observed with varying agitated behaviour as shown in Figure 23. The observed calm behaviour was higher at breeding stages 2 and 3 with a higher condensed amount of calm behaviour at breeding stage 2, however there was no significant corelation between breeding stage and calm behaviour (Analysis of Variance; F=0.831; df=62,2; p=0.441). The calm behaviour observed had a large range at all three breeding stages ranging from around 10% to 95% at most stages. At breeding stage 2 the calm behaviour is more condensed at a higher percentage than the other two stages. However, the mean is highest at breeding stage 3. There was considerably less agitated behaviour observed at breeding stage 2, with the mean line extremely low. In breeding stage 3 there was a higher rate of agitated behaviour observed, with a high outlier of 45%. At all three stages the lowest agitated observed behaviour displayed ranges from 0%.

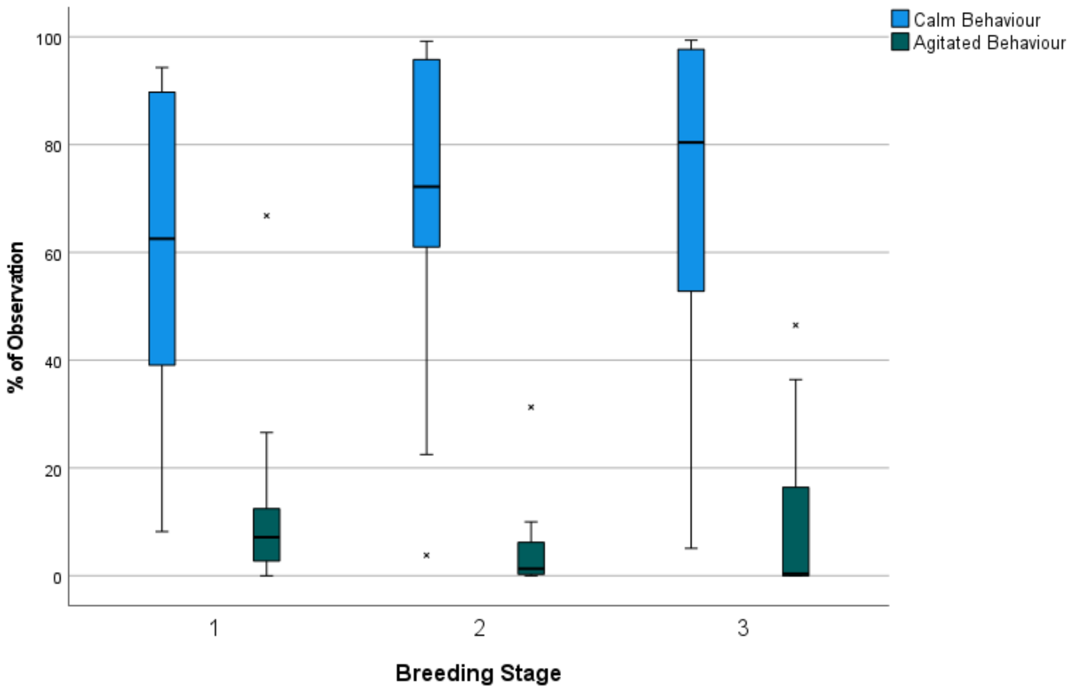

Figure 23. A box plot looking at calm and agitated behaviour shown at different stages of the breeding cycle at Site 1 (Yorke Bay).

4.3. Do gentoo chicks react differently to human presence compared to gentoo adults?

During the second breeding stage both young chicks and adults could be observed, before the chicks became independent and hard to differentiate in breeding stage 3. The ranges of both agitated and calm behaviour displayed were greater for chicks than for the adults as displayed in Figure 24. With the range for calm behaviour being around 60%-99% for adults in comparison with chicks which ranged from 5%-99%. The average calm behaviour line is also considerably higher for the adults being at around 90% and only 70% for the chicks. The chicks also displayed more agitated behaviour with the main range going from 0%-20%. Whereas the adults' range was 0% to less than 10%, however, there was no significant corelation between chicks and adults (T-test (equal variance assumed as Levene’s Test >0.05); t=0.085; df=29; p=0.993). There are also more high outliers for the chick's showing agitation. It is clear from these results that the adults were displaying much more calm behaviour and the chicks were often more agitated.

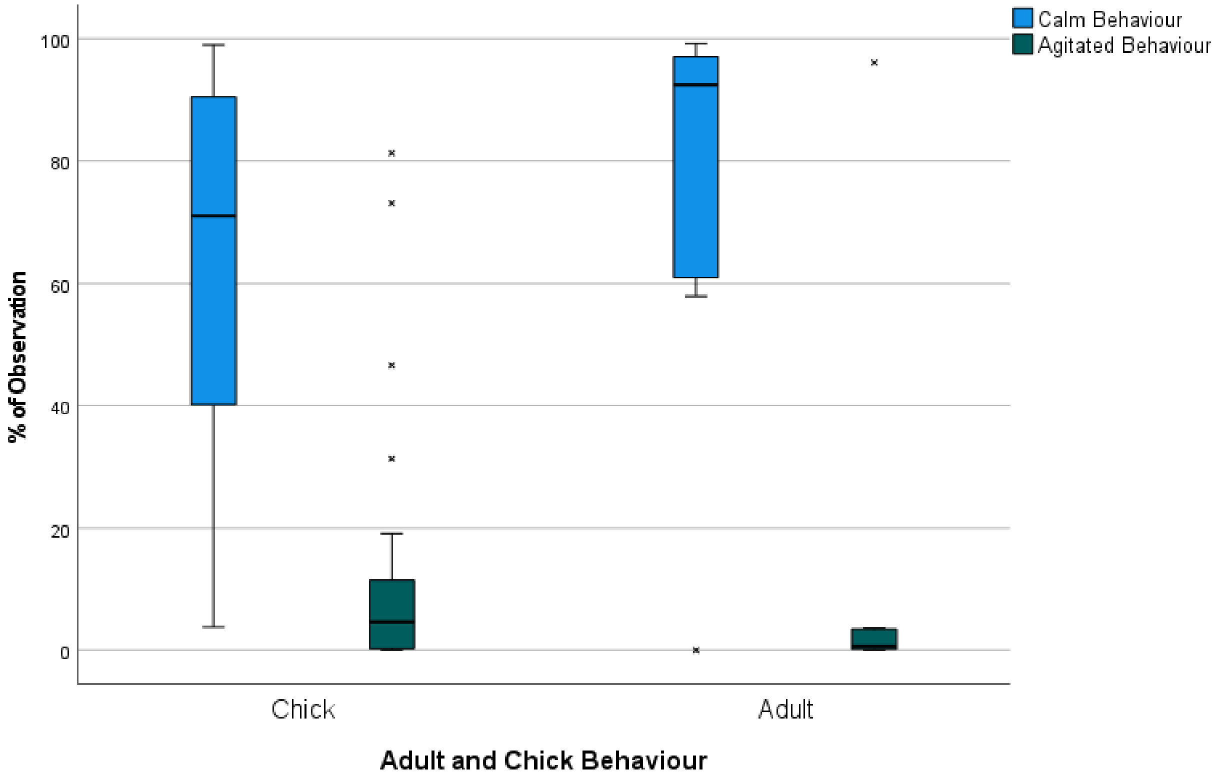

Figure 24. A box plot showing the difference in calm and agitated behaviour shown by adults and chicks during stage two of the breeding cycle.

4.4. *Does the reaction to human presence differ to the behavioural response to natural predators and disturbances?*

Figure 25 shows the behaviour of the individual gentoos grouping them into either disturbed (by human or other animal) or non-disturbed. Calm behaviour was significantly higher when no disturbance was present than when a disturbance was observed (T-test (equal variance not assumed as Levene's Test <0.05); $t=-2.356$; $df=34.993$; $p=0.024$). The non-disturbed group showed much higher frequencies of calm behaviour observed than the disturbed group. There is also a stark contrast in agitated behaviour with the non-disturbed group displaying significantly lower levels of agitation (T-test (equal variance not assumed as Levene's Test <0.05); $t=4.637$; $df=95.604$; $p=<0.001$). In the disturbed group however levels of displayed agitation were considerably higher with the error bar range reaching just under 40% and including outliers almost reaching 100%.

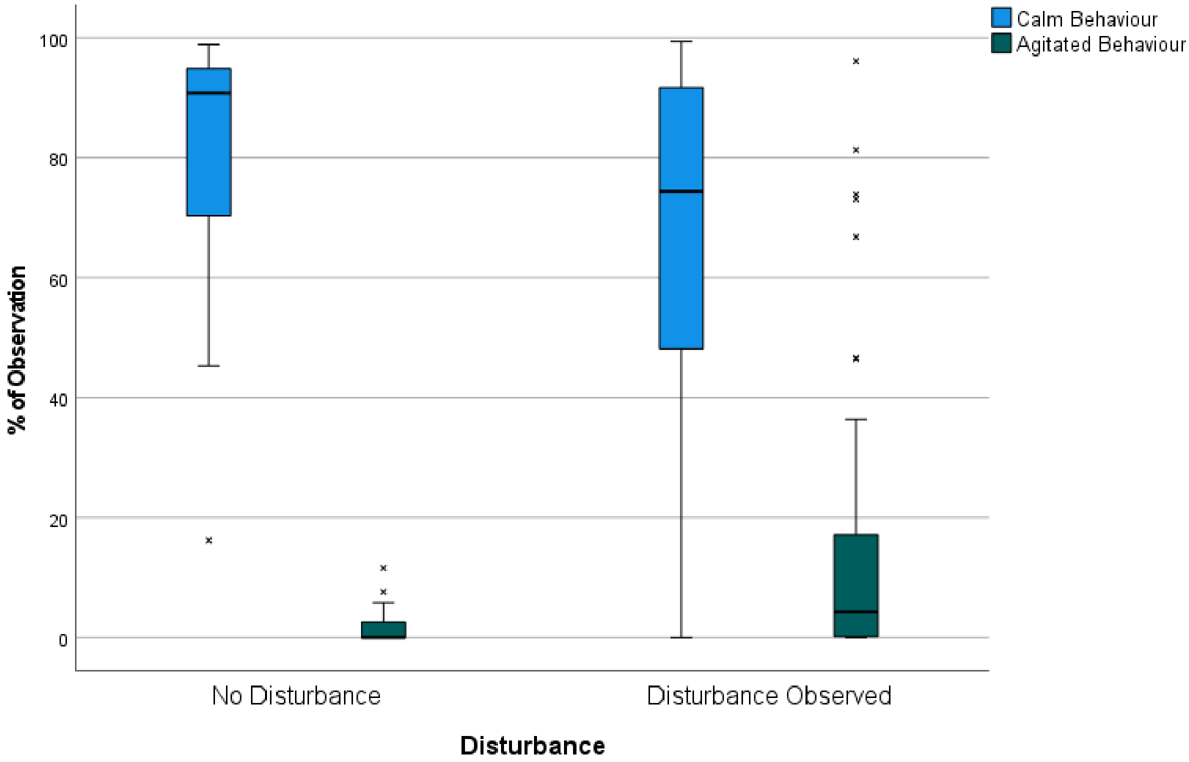

Figure 25. A box plot displaying the presence of disturbances (both human and other animal) and the behavioural response split into calm and agitated behaviour.

Figure 26 displays the presence of non-human disturbances which included gulls, turkey vultures, straited caracara, and other birds of prey. The range of calm behaviour is similar in both the disturbed group and the non-disturbed group, however there was a higher density of calm behaviour shown in the non-disturbed group. When looking at the agitated behaviour displayed by these two groups there is a slight difference. The disturbed group has a higher range reaching over 30% whereas for the non-disturbed group the range reached just under 20%. This shows there was more agitated behaviour displayed by the disturbed group, however, the difference between the groups was not significant (T-test (equal variance not assumed as Levene's Test <0.05); t=-0.456; df=70.303; p=0.650). It is worth noting the outliers in the non-disturbed group show high levels of agitated behaviour.

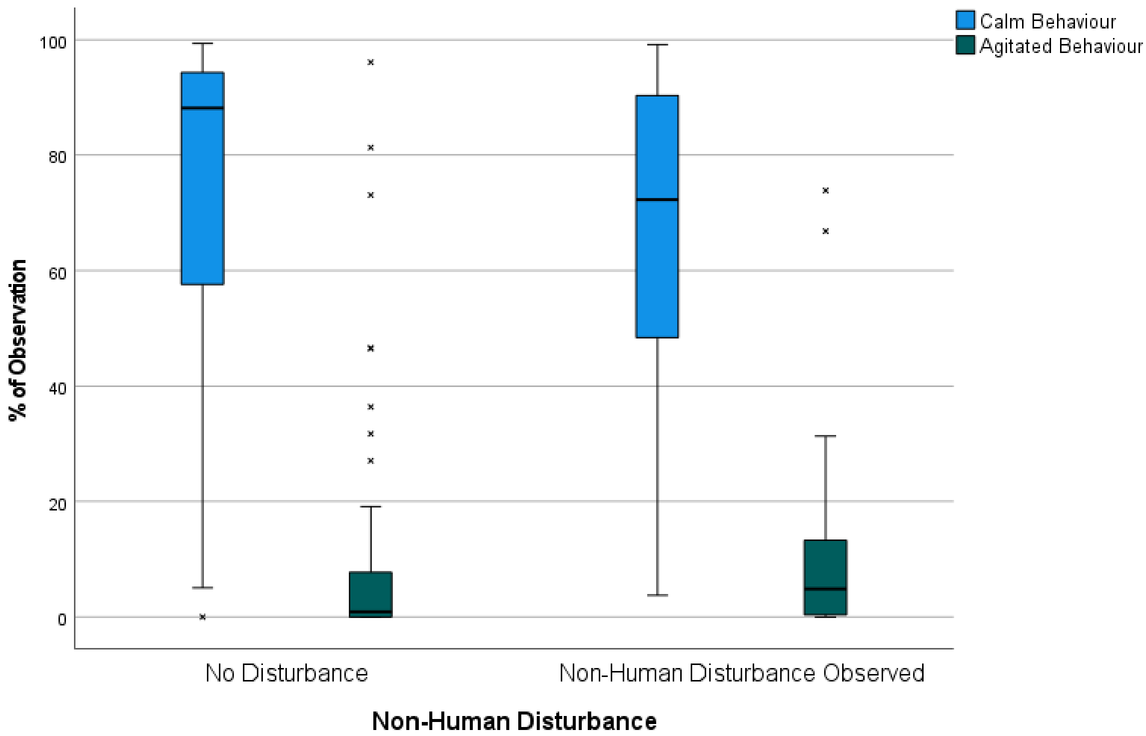

Figure 26. A box plot displaying the presence of animal (not human) disturbances and the behavioural response split into calm and agitated behaviour.

Figure 27 depicts the calm and agitated observed behaviours when looking at disturbances across the board including both human and other animal disturbances. This grouped the individuals into four groups categorised by different disturbances including: no disturbances of any kind, no humans present but disturbed by other animals, humans present but no other animals noted, and finally disturbed by both humans and other animals. The highest levels of calm behaviour were observed unsurprisingly at times when no disturbance was noted. This is also the group that displayed considerably lower levels of agitation. The ranges of calm behaviour in the other categories were all similar in that they had large ranges. The average level of calm behaviour displayed was higher in both categories that humans were present over the group that were disturbed by other animals but with no humans present.

The level of displayed agitation was similar in both groups that were disturbed by other animals, one also having humans present. However, the group that showed a significantly higher rate of agitated behaviour was the group that had humans present but no other animal disturbances, with a huge range from 0%-70% including multiple outliers even higher than this range. This is a large contrast from the other three categories with none of them ranging higher than 35% in their displayed agitated behaviour.

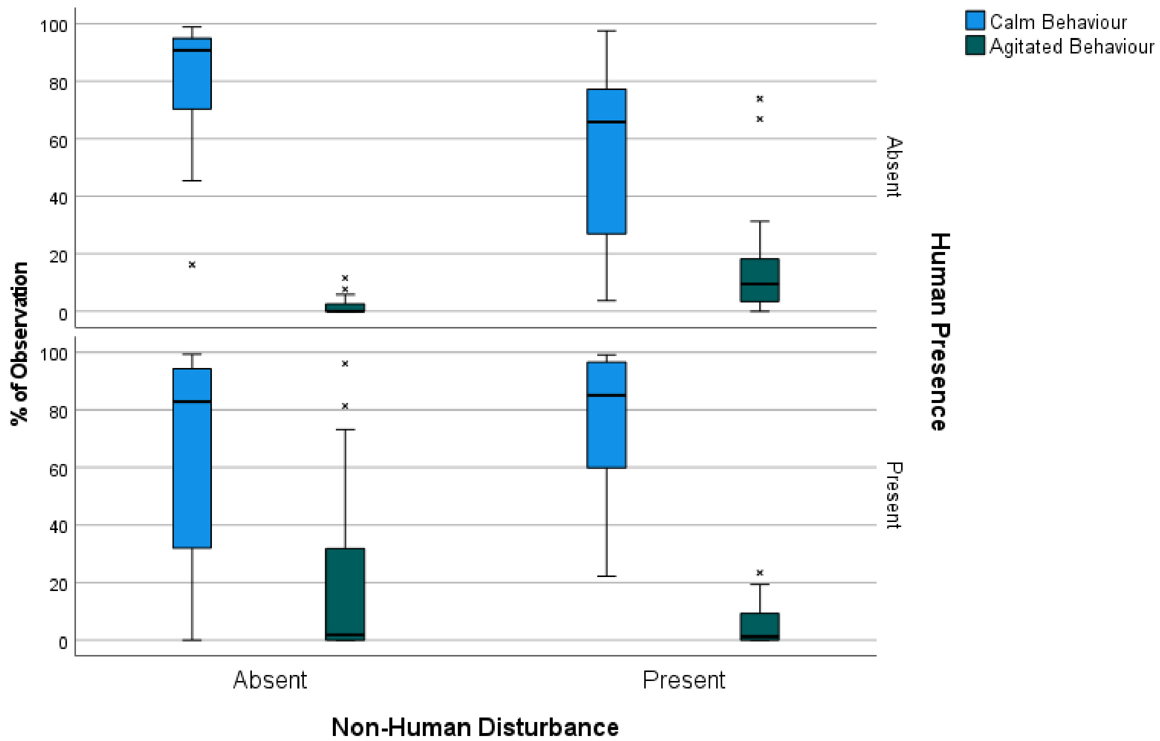

Figure 27. A box plot displaying the behavioural responses to both human and other animal disturbances split into calm and agitated behaviour.

5. ***DISCUSSION***

The study shows Gentoo penguins are particularly sensitive to human presence during the incubation stage of the breeding cycle and at colonies that have had little to no past human exposure. There are high levels of individual variation that impacts the behavioural response to human and non-human disturbance however there are clear patterns. Chicks are more sensitive to disturbances and all birds are on high alert when they are not within the safety of the colony. With the rise in human interaction due to tourism, it is important to understand the impact this may have on the health of gentoo populations and reproductive success.

Over the past 20 years there has been a huge rise in tourism in the Falkland Islands (Ingham and Summers, 2002), especially through cruise ships. With a rise in residents in Port Staley the population has grown to around 3000. In 2017 the Annual Tourism Report recorded 57,496 cruise ship visitors to the islands which accounted for 4.3% of the Falkland Islands economy (Smith, 2019). One of the main tourist attractions is of course the incredible wildlife, meaning that tours to penguin colonies are one of the most popular attractions. Hundreds of people can descend on one colony all at once creating huge human disturbance. Certain colonies have had more exposure to this over the years (Otley, 2005), while some are very new to this disturbance.

The closest colony to Stanley is in Yorke Bay, a small gentoo colony of around 300 individuals (Bax and Baylay, 2022). This colony is unique as during the war with Argentina in 1982 the sand dunes surrounding the colony were covered in land mines. These mines were only disarmed in 2020 so for the first time in 40 years the area was opened to the public, however due to the COVID-19 pandemic the islands were still very limited to tourists until the summer season of 2022/2023. As gentoos live to around 15-20 years of age this means most will have never been exposed to human disturbance before in their lives. As it is the closest colony to Stanley it has become a popular walking location meaning the gentoos are now coming into close contact with humans regularly. Numbers of people walking there is at its highest in summer months which also correlates to the months that the adults are caring for young or incubating the eggs and are at their most vulnerable.

5.1. *Is there a relationship between past human exposure and reaction to human presence?*

The degree of exposure to human stimuli plays a significant role in influencing wildlife responses to human activity (Holmes et al., 2006). The response wildlife has to humans can be regarded as a measure of threat perception, meaning humans could be interpreted as 'pseudo-predators' (Beale and Monaghan, 2004) as seen in the high levels of agitation displayed at Site 4, the Race Point colony.

Colonies with high levels of past exposure to humans react with less stress responses and agitation to human disturbance than that of individuals in colonies with lower past levels of exposure, as a form of habituation (Nisbet, 2000). Penguin individuals often display less defensive behaviour when approached by humans in colonies with high exposure to humans (Otley, 2005). This behaviour was observed at Site 3, the Volunteer Point colony, where adults were very unreactive to the presence of humans and chicks were curious to the point of approaching humans who were stood stationary close to the colony. These individuals may have also learnt to accurately distinguish between humans and their natural predators, no longer associating humans as a threat (Whittaker and Knight, 1998). It is worth noting that on land adult gentoos are not at huge risk of predation as seals and sea lions hunt in the water, and birds of prey aren't able to kill an adult unless it is already very sickly. However, chicks are much more vulnerable to land predators as birds of prey and vultures can predate on small chicks and eggs (Emslie et al., 1995).

5.2. Is the response to human presence related to the stage of the breeding season?

The stage of breeding cycle did have an impact on behavioural trends observed. Calm behaviour was observed at higher rates during breeding stage 2 and 3, and agitation was seen in particularly low rates during stage 2. This may be because their eggs have hatched, and the chicks are a lot less vulnerable than eggs. More agitation in breeding stage 1 is to be expected as the adults have to be on high alert to protect their eggs. They are also unable to leave their eggs for long periods, they must wait for nest relief from their mate (Quintana et al., 2005) which makes the adults themselves more vulnerable. The level of agitated behaviour displayed then rose again during breeding stage 3, this is likely to corelate to the chick's becoming juveniles and being more independent and responsible for their own protection making them more highly alert as they learn about threats they face. Synchronisation of behaviours linked to predator avoidance and feeding patterns might also be impacted during most vulnerable stages of life cycles (Quintana et al., 2005). The data however, did not show a significant relationship between behaviour and breeding stage.

5.3. Do gentoo chicks react differently to human presence compared to gentoo adults

There is a significant difference between chick and adult responses to disturbances and the proportion of time displaying calm and agitated behaviour. There was a lot more agitation observed in chick individuals when compared to adults, and a much wider range of calm behaviour. It is not surprising that chicks are on higher alert than their adult counterparts as they are still learning about disturbances and threats in their environment. This contrast was particularly prevalent in colonies with very low past human exposure, the chicks were extremely agitated by the presence of humans at Site 4 for example. Chicks at colonies with high past human exposure were much more calm and even inquisitive to humans in their environment, likely learning this behaviour from the adults of the colony. However, even in these colonies there was still a contrast between adult and chick behaviour.

5.4. Does the reaction to human presence differ to the behavioural response to natural predators and disturbances?

The results did show a corelation between human presence and agitation displayed, with more alert behaviour and energy use being highlighted by the data. This linked to a marginal proportion of calm behaviour displayed within the 5-minute observations. When contrasting this with the disturbance of other animals such as birds of prey and vultures the disturbance rate was much more significant with humans. This may be because in many of the colonies the gentoos are not very familiar with humans, and therefore display more of a stress response whereas they know the risks of birds of prey and vultures and can make informed decisions about when they need to be alert and expend energy. This links to the theory of habituation, that wildlife exposed to high level of human activity will become less stressed and will display less/no behavioural responses to human presence.

5.5. Do additional observations show individual variation in behaviour?

Race Point as previously mentioned, is a colony with very low past human exposure. An adult gentoo was observed at Race Point with a very young chick (days old) which had hatched at least two months later than other chicks in the colony. This suggests it was a young breeding bird, with a likelihood that it was its first year of breeding as its nest was right at the edge of the colony. This colony was being photographed as part of a population count meaning two conservation workers approached the colony to within 6m of the outer nests to take a photo using a GoPro suspended on a large pole. This individual became alert at the presence of humans very quickly showing signs of aggression and hissing, it then left its chick to run to safety amongst the rest of the gentoos in the colony who were all huddled at the back of the colony, staying away from its nest for 25 seconds. Without the protection of a parent, exposed young chicks and eggs are vulnerable to predation (Yorio and Quintana, 1996). Disturbance by scientists has been identified as a major threat to many seabirds with research activities being corelated with desertion and chick/egg mortality (Safina and Burger, 1983).

One of gentoos natural predators are sealions (Pascoe et al., 2020), which hunt gentoos in the ocean. The species are integrally linked, though land based behavioural observations between the two species are rare. A small sealion was observed hunting in the shallows at sunset at Yorke Bay on 15th April. The sealion patrolled the shallows popping its head up between the waves every so often. At this time of day lots of gentoos are coming to shore after hunting. The gentoos in the water became panicked and quickly jumped ashore for safety. The individuals on the shoreline also became alert and panicked some running to the colony at higher ground in the sand dunes. However, not all individuals ran to the colony for safety, many stayed at the shoreline on alert. What was interesting was that they didn't stay alert for long, and less than 2 minutes after the sealion was first visible some gentoos re-approached the shallows for a drink.

There are four main breeding penguin species on the Falkland Islands: gentoo, magellanic, king and southern rockhopper. Each penguin has different behaviours and nest in varying habitats. They are all being exposed to rising levels of human interaction with tourism and the rising human population on the islands. The magellanic penguin are very reactive to disturbances, often running for shelter in their burrows. Research has found that human presence near the nest site without any capturing or handling can alone impact the penguins inducing physiological stress (Fowler, 1999). On the opposite scale the smallest of the Falkland penguins, the southern rockhopper, seem to be the species that is the most bold and protective, often even showing signs of aggression while protecting their eggs and chicks.

On multiple occasions other species of penguins were observed in the gentoo colony at Yorke Bay. Groups of king penguins were often seen resting at Yorke Bay, though this didn't seem to impact the surrounding gentoos behaviour. During the third stage of the breeding season (between March and April) there were often magellanic penguins moulting within the gentoo colony at Yorke Bay. Magellanic penguins are particularly sensitive to disturbances, often acting with high alert to human presence. While there were magellanic penguins in the colony gentoos were more reactive to human presence than usual, with the whole colony being in a slightly panicked state if humans were close by. The mean percentage of calm behaviour during the observation time was 59.2% on a day where magellanics were present, compared to a day with no magellanics having a mean calm behaviour of 88.5%.

Figure 28. Southern Rockhopper penguins, the smallest breeding penguin species in the Falkland Islands.

Figure 29. King penguins at Volunteer Point.

Figure 30. A magellanic penguin at Volunteer Point.

5.6. Limitations and future research suggestions

Restrictions to access and limited time to collect data meant there were a few gaps in the research, a multiple-year research project would likely show more significant patterns. It would also be interesting to see behavioural patterns and reactions to disturbance outside of the breeding cycle (May-August).Identification of certain individuals would also be very beneficial in looking at gentoo behaviour and responses to disturbances. This would allow research into individual variation and the extent this impacts their reactions to human presence. It would also open the research up to the avenue of being able to accurately identify the individuals age and analyse how/if this has an impact on the individual's reaction to disturbances. This would allow research questions to be asked such as how long a variation in reactions from juveniles is there that contrast to that of adults.

A research project across a wider range of colonies would also be interesting to compare. It would be interesting to research gentoos in completely different environments such as in the Antarctic, in which you could compare the reaction penguins had to human disturbance in colonies that are regularly exposed to cruise ship tourists against colonies in very remote parts of the continent.
It would be useful to understand the patterns of behavioural changes over gentoos circadian rhythms, looking at how they react to disturbances in the night for example. Gentoos have a diurnal pattern of movement for feeding to and from the ocean (Bagshawe, 1938), however, understanding their circadian rhythms in terms of behaviour would be thought-provoking. A study in the Antarctic looked at movement patterns of king penguins and found that older individuals moved around more at night than younger individuals suggesting older penguins have more confidence in navigation and predator avoidance (Nesterova et al., 2010).

Further research could also look at how other species react to human and non-human disturbances in the same habitats and analyse this against other habitats to see if all species a certain area react in the same extent. A main area that would be very valuable to study would be energy expenditure as a result of human disturbance. How much energy is expended reacting to human disturbance and does this effect their behaviour following the disturbance (e.g., do they need to spend more time foraging for food). This would entail tracking devices and/or behavioural observations in the water.

5.7. Conservation Recommendations

The polar regions are some of the most effected places by anthropogenic climate change (Royles and Griffiths, 2014), the impacts of these changes on specific species are very difficult to predict. Penguins play a significant role in the balance of the Antarctic marine ecosystem making up approximately 80% of the avian biomass (Xavier et al., 2017). Climate change could unbalance this system creating a ripple effect to all species involved. Research has shown that gentoos react to climate changes by extending their ranges, so in theory are benefitting from the environmental changes. However, many species in the ecosystem aren’t which is leading to many population crashes which will likely have a knock-on impact on the whole ecosystem. It is not only the rising climate that is causing changes in population dynamics and the ecosystem health as a whole, the fishing industry is also having significant impacts on the environment; Antarctica being a key example of this. Overfishing one species can lead to impacts on other species both directly and indirectly. In some areas of the Antarctic, adelie penguin population numbers have increased significantly. Scientists have theorised this is due to the fishing industry decimating the toothfish population reducing trophic competition between them and penguins over prey species such as silverfish (Ainley et al., 2017). Removing one species means another dramatically increases and this will likely lead to trophic cascades and impact the ecosystems biodiversity. The decrease in certain populations can cause alterations to the energy flow in marine food webs. An example being the decimation of whale populations through the whaling industry which has had huge impacts on the pelagic ecosystem due to the importance of top-down processes and whales' high consumption (Croll et al., 2006).

Funding for conservation efforts is limited; due to this it is always of vital importance that they are prioritised in the most effective and efficient way. Lots of research is required to understand a species and ecosystem to know where best to focus conservation. Falkland gentoos populations are currently stable, with a global population rise of approximately 11% since 2013 (Herman et al., 2020). However, their breeding success is not consistent (Putz et al., 2001), and it is important to understand why some years it is much lower to prevent low reproductive success becoming the norm. Community engagement and education could help mitigate human disturbance, making people aware of when gentoos are most vulnerable could encourage them to take extra precautions during these periods.

The rise in tourism in the Antarctic is disproportionate at certain sites which have had high amounts of condensed visitation, meaning the impacts of the rise in tourism is not evenly distributed (Lynch et al., 2009). There are both pros and cons to this. Habituation is a key theme in tourism management proposals in the Antarctic, with many studies showings no impact caused by human activity on breeding success or heart rate increase in habituated colonies (Nimon et al., 1995). However, responses can be site-specific meaning that general studies may produce misleading results when applied to a wider range of gentoo colonies.

Even though many studies have shown little to no detrimental effects of human presence on habituated colonies when looking at breeding success, negative impacts may only become evident after a longer period. It is also unclear how the gentoos will react during non-breeding times such as during their moult. As a management method, it is important for policy makers and governments to understand that breeding populations will react differently and not all will become habituated to human activity without being impacted by negative consequences (Holmes et al., 2006).

Gentoos also have a moulting period towards the end of their breeding cycle, during which they are unable to hunt and often loose a large percentage of their body weight. Research has found that king and emperor penguins loose up to 45% of their body mass during their moulting period (Groscolas and Cherel, 1992). This makes it very necessary for them to conserve as much energy as possible often spending most of their moulting period in once place to save energy. During this period penguins are also using large amounts of energy to produce new feathers (Lee et al., 2019). Due to these extreme energetic demands this is a particularly stressful time for penguins (Cherel et al., 1994), with research showing the energetic expenditure is greater during the moult than during the breeding season while the penguins are onshore (Green et al., 2004). This implies that the moulting period is the most vital time to manage human disturbance impacts as it is when the birds need to conserve their energy the most.

6. ***CONCLUSION***

- The results suggest that gentoos are more reactive to human presence and vulnerable to human disturbance at certain stages of the year. Colonies with high levels of past human exposure showed a significantly lower level of agitation to human presence at all stages through the breeding cycle than that at colonies with low past human exposure. It has also been found that there is less individual variation at sites with high past human exposure (Williams et al., 2020).

- Preening was observed at higher levels in Volunteer Point compared to Steeple Jason and Yorke Bay. Colonies with high past human exposure reacted with agitation to a considerably lower degree than that of colonies without past exposure, likely linking to the theory of habituation.
- Certain behaviours are more prevalent in different situations, at the shoreline gentoos spend more time preening in preparation to enter the ocean or as a result of being in the ocean. The percentage of calm behaviour was significantly higher at the shoreline than in the colony where they are alert to disturbances. However human presence has an impact on the amount of time penguins spend preening by increasing the time spent alert (French et al., 2018).
- The research showed chicks are more commonly disturbed than adults, displaying more agitation and a wider range and lower median of calm behaviour. Other research has found that human presence also impacts the foraging behaviour of chicks which may infer with energetic constraints (Lord et al., 1997).
- As theorised, disturbances both human and non-human are directly linked to the amount of agitation displayed by the gentoos. The highest range of agitation was observed in situations where there was no animal disturbance but there was human presence. Individual variation likely plays a large role in the reactivity of an animal to disturbances (Martin et al., 2010) and human presence, however, this research showed clear corelations between agitation and human disturbance.
- Studies have shown that the frequency and magnitude of the disturbance is the determining factor of whether the fitness of the individual is affected (Holmes et al., 1993). Further research into the energetic expenditure as a result of human disturbance would be beneficial in understanding the wider impact of human exposure. This is particularly prevalent as human and penguin interactions are increasing in the Falkland Islands as ecotourism rises.
- Conservation practice suggestions for other species of penguins have included putting in place protections during vulnerable periods of the breeding season and during their moulting period. This is particularly important for highly sensitive species such as the humbolt penguin (Ellenberg et al., 2006). Similar conservation methods paired with education of the public would highly benefit the health and resilience of the gentoo penguins in the Falkland Islands.

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8. APPENDICES

8.1. Learning contract

Bournemouth University

LEARNING CONTRACT:
INDEPENDENT RESEARCH PROJECT

The learning contract is an agreement between student and supervisor: it should clearly indicate what is expected from both sides. The text in Sections 2 and 3 provides guidance and can be modified to give more details reflecting what has been agreed, such as deadlines for submission of drafts and provision of feedback, word count limits/exclusions and number/timing of meetings.

Importantly, the document checklist helps students to follow the required procedures (e.g. ethical approval and risk assessment) and communicate what has been done to the supervisor.

The student should submit a draft of the completed form to the supervisor and request a meeting to discuss and finalise the content. Both the student and the supervisor are responsible for keeping a signed copy of this document and following what has been mutually agreed.

1. YOUR DETAILS

Student name: Hannah Gatenby

Degree Programme: BSc (Hons) Ecology and Wildlife Conservation

Proposed IRP Title or Set Project: *The effects of human disturbance and the behaviour of Falkland Island gentoo penguins*

Supervisor name: Richard Stillman

2. As the student undertaking the above project I agree to:

- E-mail my supervisor on a fortnightly basis with a progress report
- Meet with my supervisor at least once a month to discuss progress and I understand that it is my responsibility to organise these meetings
- Comply with the terms of this learning contract and the guidance set out in the Guide to Independent Research Projects
- I understand that this is an *independent* project and that I am solely responsible for its completion
- I agree to comply with all ethical, laboratory and fieldwork protocols established by the Faculty.

3. As the supervisor of this project I agree to:

- Meet with the student undertaking this project on at least a monthly basis and to respond to the progress e-mails as appropriate

- To meet formally with the student during the first week in November to undertake the interim interview
- To provide guidance and support to the student undertaking this project bearing in mind that it is an *independent* research project. This is inclusive of commenting on drafts of the final report in a timely fashion.

3. DOCUMENT CHECKLIST

Research Proposal or Plan Attached? ☒ **YES** ☐ **NO**

☒ **YES**	☐ **NO**	**Risk Assessment for fieldwork and evidence of COSSH assessment for all laboratory procedures (online risk assessment completed)**
☒ **YES**	☐ **NO**	**Completed booking for all field equipment**
☒ **YES**	☐ **NO**	**Letters of permission where appropriate providing evidence of access to such things as field sites and/or museum archives**
☒ **YES**	☐ **NO**	**Completed Ethics Checklist**

4. INTERIM INTERVIEW – Progress evaluation

Will keep Richard up to date with my progress every two weeks via email, and will ask advise around data collection through ethograms. Interim review will take place in September 2022 before I start my third year.

Have kept in regular contact with Richard having fortnightly meetings over the past year.

Interim Review Date: September 2022

5. Variance from the Independent Research Project Guide

The IRP assessment is normally governed by the guidance provided in the Independent Research Project Guide. Any variance in terms of format (e.g. technical report, scientific paper) and word limit should be agreed and specified here. Submission date cannot be changed unless evidence of mitigating circumstances is provided in accordance with the standard BU Guidelines.

Any changes? ☐ **YES** ☒ **NO** If YES please provide details below:

Both of the undersigned parties agree to be bound by this learning contract:	
Student Signature:	HG.
PRINT NAME:	Hannah Gatenby
Date:	20/04/23

Supervisor Signature:	R.A. Stillman
PRINT NAME:	Richard Stillman
Date:	20/04/23

8.2. Research licence form

THE FALKLAND ISLANDS GOVERNMENT

Policy and Economic Development Unit,
Stanley Falkland Islands

Telephone: (+500) 28427
E-mail: environmental.officer@sec.gov.fk Web: www.fig.gov.fk

RESEARCH LICENCE APPLICATION

APPLICATION FOR A PERMIT TO CONDUCT ENVIRONMENTAL RESEARCH IN THE FALKLAND ISLANDS

Project title:	The effects of human disturbance and the behaviour of Falkland Island penguins at different stages of their breeding season

SECTION 1 – APPLICANT DETAILS	
Name of the person leading the research	Hannah Gatenby
Affiliation	Bournemouth University
Position	Student
Postal Address	3 John Biscoe Road, Stanley, FIQQ 1ZZ
Phone number	62333
Email	hannahgatenby@yahoo.com

SECTION 3 – ORGANISATION PARTNER/POINT OF REFERENCE IN THE FALKLAND ISLANDS

Falklands Conservation

SECTION 4 – PURPOSE OF RESEARCH

Data collection for university dissertation

SECTION 5 – RESEARCH PROCEDURE

My aim is to collect data on what extent penguins are disturbed by humans in different circumstances, including distance, period of breeding season, and number of humans.

Looking at if the penguins act differently when they are in the presence of humans, and if this is different if the penguins are from colonies that have been heavily exposed to human disturbance (looking at if they react on a lesser level to those with very little human disturbance).

And finally, does the period of breeding season have an impact on the extent penguins are disturbed by humans.

I will collect most of my data from a Gentoo penguin colony (200 pairs of birds) at Yorke Bay. I have chosen Yorke Bay due to the fact that it has not long been open to the public being an ex- mine field. I want to see if this has an impact on how the Gentoo penguins react to humans, I will do this by comparing the data to another colony that is more familiar with human disturbance.

For my data collection I will use a series of ethograms to record the penguins behaviour and reactions to different situations. I will observe the penguins behaviours by sitting at the site at least 40m away from the colony. As shown in a study by French et al., 2019 penguins were seen to not respond when people were at least 40m away from a colony so this will eradicate any disturbance by my presence.

I will record how they react when people walk past. I will also take note of how many people are in the group, if they have dogs and at what approximate distance from the colony they walk.

I will repeat this at a different colony that has been more exposed to human disturbance than Yorke Bay.

This will all be repeated at different stages of the breeding season to see if they react in a more or lesser extent at different times of year. This will include when the pairs have eggs, to when the chicks have hatched, to when they grow to juveniles.

I am also going to leave a camera at one of the colonies for a few weeks to later amylase in more detail the behaviour over the breeding season.

SECTION 6 – ETHICS STATEMENT (Please include copies of any ethics permits issued for the project by your own institution or nation or permits issued by other nations for this project).

I will always abide by the Falkland Islands guidelines and laws by always keeping at least 6 meters away from the penguins. Due to this being a solely observational study, I will no impact the animals in any way.

SECTION 7 – PLEASE STATE QUALIFICATIONS AND EXPERIENCE OF EACH MEMBER OF THE RESEARCH TEAM (please also attach relevant CVs of the research team)

Name – surname	Qualifications
Hannah Gatenby	Second year MSc Ecology and Wildlife Conservation

SECTION 8 – DATE OF THE FIELD WORK	
From	To
September 2021	March 2022

SECTION 9 – LOCATION OF THE FIELD WORK
Majority of data will be collected at Yorke Bay. Additional data is likely to be collected from Steeple Jason and Volunteer Point

SECTION 10 – LANDOWNER PERMISSION OBTAINED (please cross)	
X YES	☐ NO

Yes - Through FC FISMP project

SECTION 11 – INSURANCES (please cross if you have any of the following types) All people entering the Falkland Islands must have medical insurance that covers medical evacuation.

Type	All individuals	Group
Medical	X	
Personal Accident	X	
Public liability		
Professional indemnity		
Travel	X	

SECTION 12 – PROTECTED WILDLIFE RESEARCH LICENCE REQUEST (Species protected under the Conservation of Nature and Wildlife Ordinance, see Appendix 1 of the researchers' guideline)

SECTION 12.1 PURPOSE OF RESEARCH

The intended benefits of this research is to assess the impacts that human disturbance has on the penguins in order to understand if there should be any protective measures put in place to reduce this impact.

SECTION 12.2 PRINCIPAL FIELD WORKERS LIST

Hannah Gatenby

SECTION 12.3 PRECAUTIONS AND MITIGATIONS

The aim of this study is to observe any disturbance humans may have on the penguins and by doing this ensure to have no impact myself. I will do this by keeping my distance from the colonies (around 40m) and making slow/as quiet as possible movements.

SECTION 13 RESEARCH TOPIC CATEGORY (indicate the main category your research falls in)

- X Flora and fauna in natural environment
- ☐ Climatology-meteorology-atmosphere
- ☐ Economy
- ☐ Earth science
- ☐ Hydrography
- ☐ Oceanography
- ☐ Society and culture
- ☐ Environmental baseline survey
- ☐ Ecosystem services/Natural capital assessment
- ☐ Media and film production
- ☐ Other (specify the topic below)

SECTION 14 PROPOSED TIME REQUIRED BEFORE SENDING COPY OF THE DATA COLLECTED IN THE CURRENT RESEARCH TO THE FALKLAND ISLANDS GOVERNMENT (notice that the maximum time is within 2 years from data collection and researchers should send only quality checked data)

Within 2 years

I will share my finished dissertation.

SECTION 15 FEES (If your research is subject to a fee indicate if you agree to pay this by cheque)

N/A

I, the undersigned, am applying to the Falkland Islands Government for a permit to carry out the research detailed within this application. **By signing the application form I agree with the terms and conditions stated by the Research Licence Agreement guidelines which include:**

- **returning to the IMS-GIS data centre data manager a complete metadata form and data submission agreement**
- **sending any subsequent scientific paper and/or report to the environmental officer**

All the information provided is, to my knowledge, correct and is the planned course of research action. Should any changes be made to any of the information above I shall notify the Environmental Officer accordingly.

Signed: HG.

Date: 26/10/21

8.3. Data

1	Site	Breeding Stage	Location	No. of People	Distance from colony	Other disturbance	Video length	Date	Time of day	Adult/Chick	Preening	P %	Walking	W %	Running	X %	Alert	A %	Resting	R %	Notes	Video ID
2	2	1	Colony	0	N/A	SGP	2m20s	5.11.21	5pm	A	126.7s										Beginning an	SJ-05/11/21-5pm1
3	2	1	Colony	0	N/A	Gentoo & SC	5m24s	5.11.21	5pm	A							239.6s	73.9	54.9s	16.9	Nest at the ec	SJ-05/11/21-5pm2O1
4	2	1	Colony	0	N/A	Gentoo & SC	5m24s	5.11.21	5pm	A	171.4s	52.8					22.9s	7.1	63.3s	19.5	Outter edge n	SJ-05/11/21-5pm2O2
5	2	1	Colony	0	N/A	SC	5m43s	5.11.21	5pm	A	26.5s	7.7					93.7s	27.3	28.5s	8.3	Outer edge of	SJ-05/11/21-5pm3
6	2	1	Colony	0	N/A	SC	5m59s	6.11.21	10am	A							66.6s	18.6	257.9s	72.1	About 3 rows	SJ-06/11/21-10am2O1
7	2	1	Colony	0	N/A	SC	5m59s	6.11.21	10am	A	31.2s	8.7					44.8s	12.5	239.4s	66.9	One row fron	SJ-06/11/21-10am2O2
8	2	1	Colony	0	N/A	SC	5m1s	9.11.21	9am	A	9.2s	3.1					16.4s	5.4	162.4s	53.8	One of two i	SJ-09/11/21-9am1.1O1
9	2	1	Colony	0	N/A	SC	5m1s	9.11.21	9am	A							28.3s	9.4	239.1s	79.2	Adult on nes	SJ-09/11/21-9am1.1O2
10	2	1	Colony	0	N/A	SC	5m26s	9.11.21	9am	A							91.4s	28.1	56.8s	17.4	Adult on nes	SJ-09/11/21-9am1.2O1
11	2	1	Colony	0	N/A	SC	5m26s	9.11.21	9am	A	26.3s	8.1	41.8s	2.8	4.6s	1.4	45.7s	14	41.8s	12.8	Adult in sma	SJ-09/11/21-9am1.2O2
12	2	1	Colony	0	N/A	SC	5m1s	9.11.21	9am	A							53.3s	17.7	226.1s	75	Adult on nes	SJ-09/11/21-9am2.1O1
13	2	1	Colony	0	N/A	SC	5m33s	9.11.21	9am	A							7s	2.1	320.2s	96	Adult on nes	SJ-09/11/21-9am2.2O1
14	3	1	Colony	1	6m	Skua	5m52s	20.11.21	10am	A	35.6s	10.1							264.7s	75	Adult on nes	VP-20/11/21-10am1.1O1
15	3	1	Colony	1	6m	Skua	5m52s	20.11.21	10am	A							3.5s	1	345.5s	97.9	Adult on nes	VP-20/11/21-10am1.1O2
16	3	1	Colony	1	10m	Skua	5m52s	20.11.21	10am	A	271s	76.8							32.3s	9.2	Adult stood i	VP-20/11/21-10am1.1O3
17	3	1	Colony	1	15m	N/A	5m50s	20.11.21	10am	A	223.7s	63.8					2.3s	0.6	82s	23.4	Adult on nes	VP-20/11/21-10am2.1O1
18	3	1	Colony	1	6m	N/A	5m50s	20.11.21	10am	A							3.1s	0.9	334.7s	95.5	Adult on nes	VP-20/11/21-10am2.1O2
19	3	1	Colony	1	8m	N/A	5m50s	20.11.21	10am	A							9.2s	2.6	207.9s	59.3	Adult on nes	VP-20/11/21-10am2.1O3
20	3	1	Colony	0	N/A	N/A	5m1s	20.11.21	10am	A									298s	98.9	Adult on nes	VP-20/11/21-10am3.1O1
21	3	1	Colony	0	N/A	N/A	5m1s	20.11.21	10am	A									287.6s	95.5	Adult on nes	VP-20/11/21-10am3.1O2
22	3	1	Colony	0	N/A	N/A	5m28s	20.11.21	10am	A							8.5s	2.6	256.6s	78.2	Adult on nes	VP-20/11/21-10am3.2O1
23	3	1	Colony	0	N/A	N/A	5m28s	20.11.21	10am	A	150s	45.7							63.6s	19.4	Adult stood i	VP-20/11/21-10am3.2O2
24	3	1	Colony	0	N/A	N/A	5m21s	20.11.21	10am	A	273.2s	85					4.5s	1.4	18.7s	5.8	Adult stood i	VP-20/11/21-10am5O1
25	3	1	Colony	0	N/A	N/A	5m21s	20.11.21	10am	A							4.7s	1.5	296.7s	92.3	Adult on nes	VP-20/11/21-10am5O2
26	1	1	Shoreline	0	N/A	N/A	5m3s	10.12.21	1pm	A	1.2s	0.4					8s	2.6	276s	90.9	Adult resting	YB-10/12/21-1pm.1O1
27	1	1	Shoreline	0	N/A	N/A	5m3s	10.12.21	1pm	A	286.3s	94.3									Adult at shor	YB-10/12/21-1pm.1O2
28	1	1	Shoreline	0	N/A	N/A	5m3s	10.12.21	1pm	A	102.8s	33.8					8.9s	2.9	174s	57.3	Adult on sho	YB-10/12/21-1pm.1O3
29	1	1	Colony	0	N/A	Skua	5m12s	10.12.21	1pm	A							83.2s	26.6	151.1s	48.2	Adult on nes	YB-10/12/21-1pm.2O1
30	1	1	Colony	0	N/A	Skua	5m12s	10.12.21	1pm	A	28.6s	9.1					21s	6.7	215.2s	68.7	Adult not on	YB-10/12/21-1pm.2O2
31	1	1	Colony	0	N/A	Skua	5m12s	10.12.21	1pm	A							209.2s	66.8	25.6s	8.2	Adult on nes	YB-10/12/21-1pm.2O3
32	1	1	Colony	0	N/A	Dolphin Gull & Skua	5m7s	10.12.21	1pm	A							40.9s	13.3	92.4s	30	Adult with yc	YB-10/12/21-1pm.3O1
33	1	1	Colony	0	N/A	Dolphin Gull & Skua	5m7s	10.12.21	1pm	A							31.9s	10.4	176.7s	57.4	Adult with yc	YB-10/12/21-1pm.3O2
34	1	1	Colony	0	N/A	Dolphin Gull & Skua	5m7s	10.12.21	1pm	A	75.6s	24.6					15.8s	5.1	131.9s	42.9	Adult standir	YB-10/12/21-1pm.3O3
35	1	1	Colony	0	N/A	N/A	5m5s	10.12.21	1pm	A							35.4s	11.6	49.4s	16.2	Adult with yc	YB-10/12/21-1pm.5O1
36	1	1	Colony	0	N/A	N/A	5m5s	10.12.21	1pm	A							23.2s	7.6	176s	57.6	Adult on nes	YB-10/12/21-1pm.5O2
37	1	1	Colony	0	N/A	N/A	5m5s	10.12.21	1pm	A							6.6s	2.2	270.4s	88.4	Adult resting	YB-10/12/21-1pm.5O3
38	4	2	Colony	3	4m	N/A	5m12s	20.01.22	11am	C							254.3s	81.3	41.8s	13.4	Chick in sma	RP-20/01/22-11amO1
39	4	2	Colony	3	4m	N/A	5m12s	20.01.22	11am	C							145.8s	46.6	99.8s	31.9	Chick in sma	RP-20/01/22-11amO2
40	4	2	Colony	3	4m	N/A	5m12s	20.01.22	11am	A					23.3s	7.4	277.4s	88.7			Adult on extr	RP-20/01/22-11amO3
41	4	2	Colony	3	4m	N/A	5m12s	20.01.22	11am	C							228.7s	73.1	33.9s	10.8	Chick on edg	RP-20/01/22-11amO4
42	3	2	Colony	4	6m	Turkey Vulture	5m5s	19.01.22	8am	C	15.6s	5.1							263.3s	86.1	Chick in colo	VP-19/01/22-8am1O1
43	3	2	Colony	4	6m	Turkey Vulture	5m5s	19.01.22	8am	C			11.7s	3.8					278.3s	91	Chick in colo	VP-19/01/22-8am1O2
44	3	2	Colony	4	6m	Turkey Vulture	5m5s	19.01.22	8am	C	274.5s	89.8					10.2s	3.3			Chick preenir	VP-19/01/22-8am1O3
45	3	2	Colony	4	6m	Birds of prey	5m7s	19.01.23	8am	C									301.6s	98.2	Chick lying cl	VP-19/01/22-8am4O1
46	3	2	Colony	4	6m	Birds of prey	5m7s	19.01.23	8am	C	42.2s	13.7	2.3s	0.8			58.8s	19.1	23.4s	7.6	Chick in colo	VP-19/01/22-8am4O2
47	3	2	Colony	4	6m	Birds of prey	5m55s	19.01.23	8am	C			10.5s	2.9			16.2s	4.6	166.7s	46.9	Chick standir	VP-19/01/22-8am5O1
48	3	2	Colony	4	6m	Birds of prey	5m49s	19.01.22	8am	C	252s	72					45s	12.9	8.5s	2.4	A chick spen	VP-19/01/22-8am3O1
49	3	2	Colony	4	6m	Birds of prey	5m49s	19.01.22	8am	C									345.6s	98.8	Chick standir	VP-19/01/22-8am3O2
50	3	2	Colony	4	6m	Birds of prey	5m49s	19.01.22	8am	C							15.1s	4.3	297.5s	85	Chick standir	VP-19/01/22-8am3O3
51	1	2	Shoreline	1	5m	Gulls	5m59s	22.01.22	2pm	A	339.7s	94.6					1.4s	0.4			Adult just ou	YB-22/01/22-2pm6O1
52	1	2	Shoreline	1	25m	Gulls	5m59s	22.01.22	2pm	A	345.4s	96.2					0.9s	0.3	1.5s	0.4	Adult just ou	YB-22/01/22-2pm6O2
53	1	2	Shoreline	1	25m	Gulls	5m59s	22.01.22	2pm	A	354.2s	98.6							2.2s	0.6	Adult just ou	YB-22/01/22-2pm6O3
54	1	2	Colony	5	20m	Gulls	5m40s	22.01.22	2pm	C							7.7s	2.3	204s	59.9	Chick high oı	YB-22/01/22-2pm9O1
55	1	2	Colony	0	N/A	Birds of prey	5m22s	06.01.22	10am	C			9.7s	3			101s	31.3	63s	19.5	Chick in Z co	YB-06/01/22-10am2O1
56	1	2	Colony	0	N/A	Birds of prey	5m22s	06.01.22	10am	C			5.7s	1.8			30.9s	9.6	227.2s	70.4	Chick in mid	YB-06/01/22-10am2O2
57	1	2	Colony	0	N/A	Dolphin Gull	5m41s	06.01.22	10am	C	65.2s	19	8.4s	2.5			34.3s	10	92.1s	26.9	Chick in high	YB-06/01/22-10am5O1
58	1	2	Colony	0	N/A	Dolphin Gull	5m41s	06.01.22	10am	C			4.5s	1.3			21.1s	6.2	8.7s	2.5	Chick in high	YB-06/01/22-10am5O2
59	1	2	Colony	0	N/A	N/A	5m4s	06.01.22	10am	C			27.3s	9			17.5s	5.8	163s	53.2	Chick massiv	YB-06/01/22-10am6O1
60	1	2	Colony	0	N/A	Gulls	5m57s	06.01.22	4am	A	88.1s	24.7	113.6s	31.8			12.8s	3.6	4.9s	1.4	Adult walkin	YB-08/01/21-4am1O1
61	1	2	Colony	0	N/A	Gulls	5m57s	06.01.22	4am	C			24s	6.7			1.7s	0.5	318s	89.1	A chick spen	YB-08/01/21-4am1O2
62	1	2	Shoreline	0	N/A	Gulls	5m43s	06.01.22	4am	A	310s	90.3					11.2s	3.3			Adult half wa	YB-08/01/21-4am2O1
63	1	2	Shoreline	0	N/A	Gulls	5m43s	06.01.22	4am	A									334.9s	97.5	Adult close t	YB-08/01/21-4am2O2
64	1	2	Shoreline	0	N/A	Gulls	5m5s	06.01.22	5am	A	9.4s	3.1	183.6s	60.1			2.8s	0.9	2.5s	0.8	Adult on sho	YB-08/01/21-5am3O1
65	1	2	Colony	1	6m	Gulls	5m49s	06.01.22	5am	C	229.4s	65.6	11.8s	3.4	7.1s	2	25.4s	7.3	7s	2	Chick oat edg	YB-08/01/21-5am4O1
66	1	2	Colony	1	6m	Gulls	5m49s	06.01.22	5am	C	195.4s	55.8	1.6s	0.4			4.4s	1.3	16.7s	4.8	Chick in mis	YB-08/01/21-5am4O2
67	1	2	Colony	1	6m	Gulls	5m49s	06.01.22	5am	C									346.4s	99	Chick in mis	YB-08/01/21-5am4O3
68	1	2	Colony	1	6m	Gulls	5m49s	06.01.22	5am	C	89.4s	25.6	0.9s	0.3					89.4s	62.3	Chick in mid	YB-08/01/21-5am4O4
69	1	3	Colony	1	40m	N/A	5m7s	04.04.22	12pm	A	11.7s	3.8					0.9s	0.3	263.9s	85.9	Adult in sanc	YB-04/04/22-12pm1O1
70	1	3	Colony	1	40m	N/A	5m7s	04.04.22	12pm	A	83.5s	27.2					1.5s	0.5	191.8s	62.4	Adult in dun	YB-04/04/22-12pm1O2
71	1	3	Colony	1	40m	N/A	5m7s	04.04.22	12pm	A	278.4s	90.6							11.5s	3.7	Adult in dun	YB-04/04/22-12pm1O3
72	1	3	Colony	1	40m	N/A	5m7s	04.04.22	12pm	A									300s	97.6	Adult in quie	YB-04/04/22-12pm1O4
73	1	3	Colony	0	N/A	N/A	5m56s	04.04.22	12pm	A	52.5s	14.7	9.9s	2.8					99.1s	27.8	Adult (likely	YB-04/04/22-12pm3O1
74	1	3	Colony	0	N/A	N/A	5m56s	04.04.22	12pm	A	213.6s	60							55.5s	15.6	Adult in sma	YB-04/04/22-12pm3O2
75	1	3	Colony	0	N/A	N/A	5m56s	04.04.22	12pm	A									350.4s	98.4	Adult in sma	YB-04/04/22-12pm3O3
76	1	3	Colony	0	N/A	N/A	5m56s	04.04.22	12pm	A									350.4s	98.4	Another in th	YB-04/04/22-12pm3O4
77	1	3	Colony	0	N/A	N/A	5m56s	04.04.22	12pm	A	349.5s	98.2									In same grou	YB-04/04/22-12pm3O5
78	1	3	Colony	1	20m	N/A	5m2s	04.04.22	12pm	A	140.7s	46.5							124.9s	41.2	Adult in large	YB-04/04/22-12pm4O1
79	1	3	Colony	1	20m	N/A	5m2s	04.04.22	12pm	A									300.8s	99.3	Adult high in	YB-04/04/22-12pm4O2
80	1	3	Colony	1	20m	N/A	5m2s	04.04.22	12pm	A									299.9s	99.1	Adult in the l	YB-04/04/22-12pm4O3
81	1	3	Colony	1	20m	N/A	5m2s	04.04.22	12pm	A	152.8s	50.5							84.5s	27.9	Adult in the l	YB-04/04/22-12pm4O4
82	1	3	Shoreline	0	N/A	Dolphin Gull	5m54s	11.04.22	2pm	A	128.5s	36.2							184.4s	52	On shorline,	YB-11/04/22-2pm1O1
83	1	3	Shoreline	0	N/A	Dolphin Gull	5m54s	11.04.22	2pm	A	289.5s	81.6					6.2s	1.8			On shorline,	YB-11/04/22-2pm1O2
84	1	3	Shoreline	0	N/A	Dolphin Gull	5m19s	11.04.22	2pm	A	243.6s	76.2							1.2s	0.4	On shorline,	YB-11/04/22-2pm3O1
85	1	3	Colony	11	2m	N/A	5m43s	06.03.22	12.30pm	A	81s	23.6	9.2s	2.7	4.6s	1.4	59.5s	17.7	107.2s	31.2	In dunes in t	YB-06/03/22-12.30pm1O1
86	1	3	Colony	11	1m	N/A	5m43s	06.03.22	12.30pm	A	2.3s	0.7	9.3s	2.7	6.6s	1.9	153s	44.6	5.9s	1.7	In dunes in t	YB-06/03/22-12.30pm1O2
87	1	3	Colony	11	5m	N/A	5m43s	06.03.22	12.30pm	A	110.6s	32.2	4.1s	1.2			93.2s	27.1			In dunes in t	YB-06/03/22-12.30pm1O3
88	1	3	Colony	11	10m	N/A	5m43s	06.03.22	12.30pm	A									341.2s	99.4	In dunes in t	YB-06/03/22-12.30pm1O4
89	1	3	Colony	11	20m	N/A	5m43s	06.03.22	12.30pm	A	9.3s	2.7	13.8s	4	3.6s	1.1	105.2s	30.6	19.6s	5.7	In dunes in t	YB-06/03/22-12.30pm1O5
90	1	3	Colony	11	25m	N/A	5m43s	06.03.22	12.30pm	A							56.9s	16.6	248s	72.2	In dunes in t	YB-06/03/22-12.30pm1O6
91	1	3	Colony	11	8m	N/A	5m50s	06.03.22	12.30pm	A	61.9s	17.7					2.8s	0.8	260.5s	74.4	In the dunes	YB-06/03/22-12.30pm2O1
92	1	3	Colony	11	8m	N/A	5m50s	06.03.22	12.30pm	A							26.9s	7.7	312.8s	89.3	In the dunes	YB-06/03/22-12.30pm2O2
93	1	3	Colony	11	1m	N/A	5m50s	06.03.22	12.30pm	A	89.8s	25.7	5.7s	1.6			127.6s	36.4	10.3s	3	In the dunes	YB-06/03/22-12.30pm2O3
94	1	3	Colony	11	10m	N/A	5m50s	06.03.22	12.30pm	A									347.6s	99.2	In the dunes	YB-06/03/22-12.30pm2O4
95	1	3	Colony	11	7m	N/A	5m50s	06.03.22	12.30pm	A	92s	26.3	10s	2.9			13.4s	3.8	109.2s	31.2	In the dunes	YB-06/03/22-12.30pm2O5
96	1	3	Colony	2	25m	Birds of prey	5m51s	16.03.22	3pm	A	109.4s	31.1	23.8s	6.8	22.5s	6.4	45.7s	13	7.6s	2.2	In the dunes	YB-16/03/22-3pm1O1
97	1	3	Colony	2	50m	Birds of prey	5m51s	16.03.22	3pm	A							82s	23.3	211.2s	60	In the dunes	YB-16/03/22-3pm1O2
98	1	3	Colony	2	50m	Birds of prey	5m51s	16.03.22	3pm	A	4.2s	1.4	8.5s	2.4	20s	5.7	25.8s	7.3	189.5s	53.9	In the dunes	YB-16/03/22-3pm1O3
99	1	3	Colony	2	50m	Birds of prey	5m51s	16.03.22	3pm	A	45.3s	12.9	7.3s	2.1	26.8s	7.6	30.4s	8.6	47.2s	13.4	In the dunes	YB-16/03/22-3pm1O4
100	1	3	Colony	1	15m	Birds of prey	5m3s	16.03.22	3pm	A	75s	24.7	19.5s	6.4			14.9s	4.9	51.7s	17	Up in the du	YB-16/03/22-3pm2O1
101	1	3	Colony	1	15m	Birds of prey	5m3s	16.03.22	3pm	A									298s	97.9	Up in the du	YB-16/03/22-3pm2O2
102	1	3	Colony	1	15m	Birds of prey	5m3s	16.03.22	3pm	A	240.3s	79.2					3.6s	1.2			Up in the du	YB-16/03/22-3pm2O3
103	1	3	Colony	1	15m	Birds of prey	5m3s	16.03.22	3pm	A									296.7s	97.8	Up in the du	YB-16/03/22-3pm2O4
104	1	3	Colony	1	5m	Birds of prey	5m3s	16.03.22	3pm	A	47.4s	15.6	41.4s	13.6			56.9s	18.7	50.5s	16.6	Up in the du	YB-16/03/22-3pm2O5

8.4. Ethics checklist

Risk Assessment Form

About You & Your Assessment	
Name	Hannah Gatenby
Email	s5221574@bournemouth.ac.uk
Your Faculty/Professional Service	Faculty of Science and Technology
Is Your Risk Assessment in relation to Travel or Fieldwork?	Yes
Status	Approved
Date of Assessment	12/05/2021
Date of the Activity/Event/Travel that you are Assessing	10/09/2021

What, Who & Where	
Describe the activity/area/process to be assessed	Penguin behaviour observations. Data to be collected between October 2021-April 2022
Locations for which the assessment is applicable	Falkland Island penguin colonies
Persons who may be harmed	Student

Hazard & Risk	
Hazard	Lone Working
Severity of the hazard	Medium
How Likely the hazard could cause harm	Medium

Risk Rating	Medium
Control Measure(s) for Lone Working : When collecting data alone restrict areas to those that are close to other people Make sure someone always knows where I am Keep in areas of mobile signal and make sure my mobile always has charge When in isolated colonies make sure I am within communicating distance from my research group Be familiar with where I am going	
With your control measure(s) in place - if the hazard were to cause harm, how severe would it be? Low	
With your control measure(s) in place - how likely is it that the hazard could cause harm? Low	
The residual risk rating is calculated as: Low	
Hazard	Personal Injury
Severity of the hazard	Medium
How Likely the hazard could cause harm	Medium
Risk Rating	Medium
Control Measure(s) for Personal Injury : Stay away from the ocean Bring something to sit on incase the ground is rocky Stay away from cliff edges Wear appropriate footwear at all times incase landscape is rocky and uneven Be within mobile signal incase I fall and injure myself	
With your control measure(s) in place - if the hazard were to cause harm, how severe would it be? Low	
With your control measure(s) in place - how likely is it that the hazard could cause harm? Low	
The residual risk rating is calculated as: Low	
Hazard	Tussac peat fire
Severity of the hazard	High

How Likely the hazard could cause harm	Low
Risk Rating	Medium

Control Measure(s) for Tussac peat fire:

No smoking or camp fires at any point during the research project

With your control measure(s) in place - if the hazard were to cause harm, how severe would it be? Low

With your control measure(s) in place - how likely is it that the hazard could cause harm? Low

The residual risk rating is calculated as: Low

Hazard	Covid-19
Severity of the hazard	High
How Likely the hazard could cause harm	High
Risk Rating	High

Control Measure(s) for Covid-19:

Quarantine on arrival to the Falkland Islands for two weeks

Follow local guidelines at all times

Make sure I have multiple negative covid tests before I get on the plane

With your control measure(s) in place - if the hazard were to cause harm, how severe would it be? Medium

With your control measure(s) in place - how likely is it that the hazard could cause harm? Low

The residual risk rating is calculated as: Low

Hazard	Health
Severity of the hazard	Medium
How Likely the hazard could cause harm	Medium
Risk Rating	Medium

Control Measure(s) for Health :

Wear suncream and take it with me if there is sun

Bring protective thick clothing when low temperatures to keep warm Always have an inhaler with me for my asthma Always have food and water with me for energy Take gloves to keep my hands warm
With your control measure(s) in place - if the hazard were to cause harm, how severe would it be? Low
With your control measure(s) in place - how likely is it that the hazard could cause harm? Low
The residual risk rating is calculated as: Low

Review & Approval

Any notes or further information you wish to add about the assessment	Data will be collected between October 2021 - April 2022
Names of persons who have contributed	
Approver Name	Richard Stillman
Approver Job Title	
Approver Email	rstillman@bournemouth.ac.uk
Review Date	

Uploaded documents

No document uploaded