Using pre- and post-release assessments to evaluate a historic welfare reintroduction programme for orphan and ex-pet Sykes monkeys (*Cercopithecus mitis albogularis*).

A manuscript prepared for *Primates*

by

Name of student: **Zoë Edwards**

Firs House, Firs Road, Kenley, CR85LD

ze1655@bristol.ac.uk

Project Supervisor: **Dr Suzanne Held**

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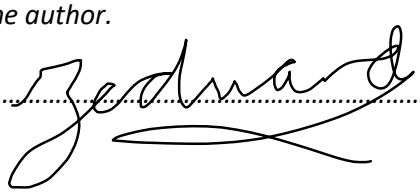
Declaration

I declare that the work in this report was carried out in accordance with the requirements of the University's Regulations and Code of Practice for Taught Programmes and that it has not been submitted for any other academic award. Except where indicated by specific reference in the text, this work is my own work. Work done in collaboration with, or with the assistance of others, is indicated as such. I have identified all material in this report which is not my own work through appropriate referencing and acknowledgement. Where I have quoted from the work of others, I have included the source in the references/bibliography. Any views expressed in the dissertation are those of the author.

SIGNED: ……  *…… DATE: 18/08/2017*

Abstract

Welfare-based rehabilitation and reintroduction programmes (RPs) are management strategies commonly used for primates, where overlaps in home ranges with human dominated landscapes have resulted in injured, orphaned and displaced individuals. Success rates for RPs are low, raising concerns for the welfare of released individuals. Primate rehabilitation is complex, survival post-release being determined by a range of biological, behavioural and individual factors. Modifying the rehabilitation process is vital to improve success, but cannot be done without species-specific evaluations. Sykes monkeys (*Cercopithecus mitis albogularis)* are widespread in Africa and are regularly admitted to Colobus Conservation (CC), a rehabilitation centre in Diani, Kenya. No evaluations of Sykes RPs however have been made, resulting in insufficient knowledge on how to improve the rehabilitation process. This study evaluated a 2016 Sykes monkey RP, using pre- and post-release assessments on behavioural data and information on individual history (including sex, age, and time in rehabilitation). The release of four individuals proved unsuccessful due to aggressive behaviours. These individuals were released as adults, hand-reared in isolation, were previously released and recaptured, were in captivity for the longest period of time and exhibited abnormal behaviours pre-release. Two individuals had natural causes of mortality, resting making up large proportions of their activity budgets prior to death. Two successful individuals were released as subadults, were not reared in isolation, had similar activity budgets in all stages, and are currently integrating with a wild Sykes (WS) troop. The results show the importance of undertaking pre-release assessments to highlight abnormal behaviours which may persist post-release, the importance of releasing a stable group, integrating individual life history into the evaluation and

modification of the rehabilitation process and serves to be the first study aiming to improve Sykes RPs.

Keywords: Sykes; *Cercopithecus mitis albogularis;* rehabilitation; reintroduction; pet trade

Introduction

Primate populations are threatened by unsustainable human activity, including extensive habitat loss, degradation and fragmentation (Hilton-Taylor 2000; Estrada et al. 2017). Consequently, primate ranges are overlapping with human-dominated landscapes, resulting in injured, displaced and orphaned individuals (Arroyo – Rodriguez and Fahrig 2014). In some regions, they are additionally at risk from the pet and bushmeat trades and human-wildlife conflicts (Nijman et al. 2011; Russon et al. 2016; Guy 2017). As climate change and anthropogenic activities continue to threaten primates, well-developed strategies such as rehabilitation and reintroduction become increasingly vital in preventing negative impacts on the welfare and extinction of many species (Guy et al. 2014).

Primate rehabilitation aims to improve the welfare of these displaced individuals by caring for the injured, hand-rearing orphans and re-teaching individuals the skills required for life in the wild, including foraging and antipredator behaviour (Downs et al 2010; Earnhardt 2010). The overall aim is to release the animals into a suitable habitat. It is defined in the nonhuman primate reintroduction guidelines, created by the International Union for Conservation of Nature's (IUCN) Species Survival Commission (SSC) Reintroduction Specialist Group (RSG) (Baker and Soorae 2002; Beck et al. 2007) as:

i) **Reintroduction for welfare (reintroduction hereafter):** The release of Least Concern primates, within or outside their historic range, where there

is evidence to indicate that welfare could be improved. These reintroductions are not considered to have a conservation impact, unless the methods and/or evaluation are serving as a model to develop and improve a larger/longer-term programme for threatened species.

The effectiveness of reintroduction programmes (RPs) relies on the outcomes of individuals post-release, which is measured by a variety of assessment criteria (e.g. survival rates, behaviour, reproduction), in addition to whether the project has achieved its specific aims (Swaisgood 2010; Brockelman et al. 2015; Chandler et al. 2015). Primate rehabilitation however is complex, and determined by a range of biological factors. Time spent in captivity, stress and individualistic traits all influence post-release survival (Preuschoft et al. 2007; Wimberger et al. 2010; Russon et al. 2016). Individuals originating from the pet trade, for example, may lack the skills required to live self-sufficiently in the wild, be habituated or aggressive to humans, and in some cases, may experience long-lasting or permanent social retardation (Yeager 1997; Healy and Nijman 2014; Guy et al. 2014). Reversing these effects in rehabilitation is difficult, the viability and welfare of the released individual being greatly implicated as a consequence (Cheyne 2009; Wimberger et al. 2010; Guy et al. 2014; Russon et al. 2016).

Detailed planning and evaluation procedures are required to identify what determines success and allow the rehabilitation process to be modified accordingly (Wimberger 2009; Wimberger et al. 2010; Cheyne et al. 2012; 2015). Primate RPs are increasing worldwide, yet success rates are low (Fischer and Lindenmayer 2000; Soorae 2008; IUCN/SSC 2013; Hopkins et al. 2016). Many are carried out with little evaluation (e.g. Collins et al. 2008), forcing project coordinators to ignore individual life history and use general, non-standardised guidelines and assessment criteria (Baker and Soorae 2002; Cheyne 2009; Guy et al. 2014). Evaluation of RPs

should be made species-specific and, when possible, tailored to the individual (Cheyne 2009; Guy and Curnoe 2013). The lack of published material may contribute to the slow improvement of RPs, putting the welfare of many individuals at stake (Cheyne 2009; Wimberger et al. 2010; Brockelman et al. 2015). The purpose of this thesis was to be the first study aiming to evaluate a RP created for the Zanzibar Sykes monkey (*Cercopithecus mitis albogularis).*

Study species

Sykes' are omnivorous, arboreal, and listed as Least Concern on the IUCN red list (Butynski et al. 2008). They occupy home ranges of 4-10 ha (Rudran 1978) and are found in social groups of 10-40 individuals consisting of one-male and multiple females (Butynski 1990). One population resides in the Diani Forest on the South Coast of Kenya, which, due to human encroachment, is now fragmented (Dunham and McGraw 2014; Dunham 2015; Dunham and Lambert 2016). Consequently, their ranges overlap with urbanized areas where many threats exist (e.g. powerlines, pet trade) causing injury and displacement (Dunham 2017; Colobus Conservation pers. comm. 2017). To combat this, Colobus Conservation (CC) are carrying out numerous Sykes reintroductions in Diani.

A limited number of Sykes RPs have been recorded (Moinde et al. 2004), and no evaluations of the rehabilitation process have been published. To increase the success rate of RPs carried out by CC, effective evaluations must be made and documented to determine what variables play a part in individual viability in the wild post-release. This information could show potential indicators of needing to intervene, aiding survival and maintaining the welfare of released individuals. This study aims to evaluate a historic reintroduction of a group of Sykes monkeys, released on 03/08/2016, where success was already determined as the following (table 1):

Outcome	Definition
Success	An individual was deemed successful if they are still surviving in the released area
Unsuccessful	An individual was deemed unsuccessful if they are i) not surviving, ii) had to be re-captured or iii) had to be re-released into another area.

Table 1. Definitions of successful and unsuccessful individuals.

The objectives of this study were to:

1) Compile individual history (e.g. outcome, time in rehabilitation)

2) Use behavioural data gathered at pre- and post-release stages to:

i) highlight differences between successful and unsuccessful individual activity budgets;

ii) highlight differences in social, aggressive and resting behaviours between individuals;

iii) describe the causes of mortality/failures at certain stages, analysing behavioural data prior to failures;

iv) compare pre- and post-release activity budgets for individuals surviving to this stage;

v) comparing pre-, post- and post-release (one year after release, +1 hereafter) activity budgets for individuals surviving to this stage;

vi) demonstrate how the reliance of individuals surviving to the post-release (+1) phase on food provided by CC to caged monkeys in comparison to feeding from natural foods has changed from post-release;

vii) demonstrate how affiliation behaviours (grooming, playing) and closeness (proximity less than 5 metres (<5m)) between wild Sykes (WS) and released individuals have changed over time.

Methods

Study Site/ Release

CC (1997), is a non-profit organisation located in Diani, Kenya. The centre carries out a rescue, rehabilitation and release programme for injured, orphaned and ex-pet primates (CC 2017). In 2016, a group of 8 Sykes monkeys were released onto the property of CC (release protocols: appendix I). This study uses data regarding this release provided by two master's research projects conducted at CC and data collected by the author.

Pre-release data

This study includes data collected by Palmer (2016) who carried out a study on the evaluation of cage enrichment used by CC. This involved observing the 8 released Sykes in the rehabilitation cage prior to release. Behavioural data was collected using instantaneous scan sampling (occurring at 15, 30 and 45 minutes after the hour), from 2pm to 6pm, five days a week from 06/05/2016 to 26/07/2016 (ethogram: appendix II). The total count data for each individual and behaviours expressed over the three-month period were converted to proportions by the author to create activity budgets.

Post-release data

A post-release monitoring study of the released group was conducted by Lindberg (2016) from 03/08/2016 to 04/10/2016. Colour tags were attached to the upper part of the ear for each individual prior to release, which allowed for identification. Behavioural data were collected via focal sampling using Prim8, a behavioural data

collection application (http://www.prim8software.com/: appendix III). The ethogram created by Lindberg (2016) was compiled from observations made on WS in Diani (table 2).

Behaviour	Description
Predator avoidance	Locomotes away, or hides from a threat whilst remaining vigilant.
Vigilance	Focal remains still and in an 'alert' position looking towards potential threat (e.g. predator, baboon).
Drinks	Oral ingestion of water.
Feeds on human provided foods	Feeds on food provided by or stolen from members of the public.
Feeds on natural foods	Feeds on natural food from the environment, such as seeds, leaves, insects and fruits.
Feeds on provisioned food	Feeds on food provided to other monkeys at CC.
Foraging	Uses hands to look for food on the ground.
Is aggressive to	Intense biting which causes a vocal or physical reaction in the individual being bitten, prolonged chasing, wrestling that has potential to cause injury, screaming, lunging.
Is attacked by	Reciprocate of 'aggressive' issues such as those listed above.
Grooms/is groomed by	Other individual/focal is using hands or teeth to pick at another individual's hair/skin.
Mounts/is mounted by	Conspecific/focal uses hands to grab the back half of the body and stands on hind legs to mount. Not used for any sexual function.
Locomoting	Using limbs in an alternate manner to perform vertical, horizontal or on ground movement. Either at a walking or running pace, including climbing.
Other behaviour	Any behaviour seen that are not included in this ethogram.
Out of sight	Focal cannot be seen.

Plays	Focal individual interacts with conspecific or another species by lunging, grappling, wrestling or chasing in the absence of aggression or intense submission.
Rests	Focal is sitting or lying still and not eating, eyes are either closed or open, sunbathing or basking.
Scratches	Uses hands or feet to rub hair/skin in a repeated motion.
Self-grooms	Uses hands or teeth to pick at hair/skin.
Yawns	Focal widens mouth with no apparent function other than yawning.

Table 2. Ethogram used for behavioral data collection (Lindberg 2016).

Data collection started at dawn and ended at dusk six days a week and totalled to 54 days. One released individual was observed for sampling periods lasting 20 minutes, this being rotated to include every individual in the released group. An average of three sampling periods per-day per-individual was collected. Behavioural codes, corresponding to the ethogram above, were entered into Prim8 per minute. At 10-minute intervals, the proximity to other individuals and height off the ground was taken (appendix III).

The total count data for each individual and behaviours expressed over the three-month period were converted to proportions by the author to create activity budgets. Data on proximity and affiliative behaviours (e.g. grooms, is groomed by, plays with) was split up into three 18-day periods starting from release.

Post-release (+1) data

The surviving individuals were subsequently monitored by a CC volunteer, using the same methods as Lindberg (2016), for an 18-day period from the 20/03/2017 to the 28/04/2017. They were then monitored for an additional 36 days over the period of 29/05/2017 to 02/08/2017 by the author. The number of focal samples collected by Lindberg (2016) for the individuals surviving to this stage were replicated, each being followed for three focal sessions per day (focal sample sizes: appendix IV).

Focal samples were rotated throughout the day, to reduce bias in possible time associated behaviours. The sampling method and ethogram used in Lindberg (2016) were replicated to ensure standardization and easy comparison between the two post-release phases. This part of the study was ethically approved by the Animal Welfare and Ethical Review Body (UB/17/017).

The total count data for each individual and behaviours expressed over the three-month period were converted to proportions to create activity budgets. Proximity and affiliation data was split up into three 18-day periods starting from the 20/03/2017.

Statistical analyses

A test for normality was used which determined that the data was non-parametric. Analyses were then conducted in R in the following stages:

Pre-release (Palmer 2016)

i) Activity budgets (proportion of time spent on each behaviour) between 'successful' and 'unsuccessful' individuals were compared using a Mann-Whitney-Wilcox test (spreadsheet: appendix V).

ii) Count data (number of times each behaviour was expressed per individual) was used to conduct Chi-Square test (χ^2) to show differences in aggressive, resting and social behaviours observed between individuals.

iii) The 'FactoMineR' package was used to conduct a principal component analysis (PCA). PCA is widely used in animal behaviour research (Budaev 2010) and was used to summarise data by converting the set of behavioural observations of correlated variables into a set of values of linearly uncorrelated variables (principal components). The output generated represents individual activity budgets by placing them closely on the map if they are positively correlated (similar).

Post-release (Lindberg 2016)

The above analyses were replicated for this data.

Post-release (+1)

i) Activity budgets of individuals surviving at this phase were compared with their activity budgets from the pre- and post-release (Lindberg 2016) phase.

Additional analyses

i) The number of times each surviving individual was observed <5m and interacting (plays, is groomed, grooms), with WS in the first three 18-day periods (compiled from the post-release phase, Lindberg 2016) were compared using a Kruskal Wallis (KW) test.

ii) A KW test was used to determine whether counts for each individual significantly differed over the first three 18-day periods.

Results

Individual history

Out of the reintroduced group, six individuals were unsuccessful and two were successful (table 3).

Individual/Sex/ Date/Reasons of admittance/ Age on admittance	**Time in wild/ Captivity prior to rehab/Time in rehab**	**Attempted releases**	**Age on 2017 release**	**Outcome**
Felice (M) 19/03/2010 Wild orphan Infant (1mo)	1mo n/a <7yr	29/11/2012 – attacked by WS 02/12/2012 – attacked by WS	A	1

		29/09/2015 – attacked staff/guests 03/08/2016 – attacked staff/guests Mid-August 2016 – Shimba Hills		
Sang (F) 07/02/2012 Ex-pet Infant (3wks)	3wks <3mo <5yr	29/09/2015 – attacked staff/guests Mid-August 2016 – Shimba Hills	A	1
Valentine (Val) (F) 14/02/2012 Wild orphan Infant (<3mo)	<3mo <3mo <5yr	29/09/2015 –taken in for treatment from poisoning on 07/01/2016. Re-released on 03/08/2016 – taken in for treatment on 25/04/2017. Re-released on 17/05/2017 – taken in for attacks made on guests.	A	1
Legend (M) 22/03/2013 Wild orphan Infant (1mo)	1mo n/a <4yr	29/11/2015 – attacked by WS 03/08/2016 - successful	SA	0
Pett (F) 25/07/2013 Ex-pet Juvenile (2yrs)	<1mo 2yrs <4yr	29/11/2015 – attacked staff/guests 03/08/2016 – attacked staff/guests	A	1
Chale (F) 29/01/2015 Wild orphan Infant (1yr)	1yr n/a <2yr	03/08/2016 - successful	SA	0
Ogeala (Oge) (M) 16/02/2015 Wild orphan	6mos n/a <2yr	03/08/2016 – fell from tree, died from head injuries 04/02/2017.	SA	1

Infant (6mos)				
Haki (M) 19/10/2015 Wild orphan Infant (2mos)	2mo n/a <1yr	03/08/2016 – died from liver and kidney infection on the 28/09/2016.	SA	1

Table 3. Individual details of Sykes monkeys. NB: Year/s = yr. Month/s =mo. (0) = Successful, (1) = Unsuccessful.

Pre-release

Activity budgets between successful and unsuccessful individuals did not significantly differ (W = 303.5, p-value = 0.7716). There was however a significant difference in resting between individuals (X-squared=396.63, df=7, p-value <2.2e-16). Chale, Felice, Haki, Ogeala and Valentine were observed resting 21%-35% of the time compared to Legend (9%) and Pett (11%). Aggression differed between individuals (X-squared = 35.121, df = 7, p-value = 1.061e-05). Chale, Haki, Ogeala and Valentine showed no signs of aggression compared to Felice, Legend, Pett and Sang. Chale, Pett and Felice spent a total of 1.9%, 2.4% and 2.5% of their time respectively on social behaviours compared to Legend (4.4%) and Valentine (5.8%) but this difference was not significant.

Felice, Legend, Pett and Sang are clustered together on the individuals factor map (IFM) (fig. 1), representing the similarity between activity budgets. Aggression and feeding levels were highest in these individuals. Sang is separated as she spent 23% of her time on ‘other’ behaviours, in comparison to Felice, Legend and Pett, where ‘other’ behaviours constituted less than 14% of their time. Valentine spent a large proportion of her time moving (21%) compared to others (<14%), thus appearing isolated on the map.

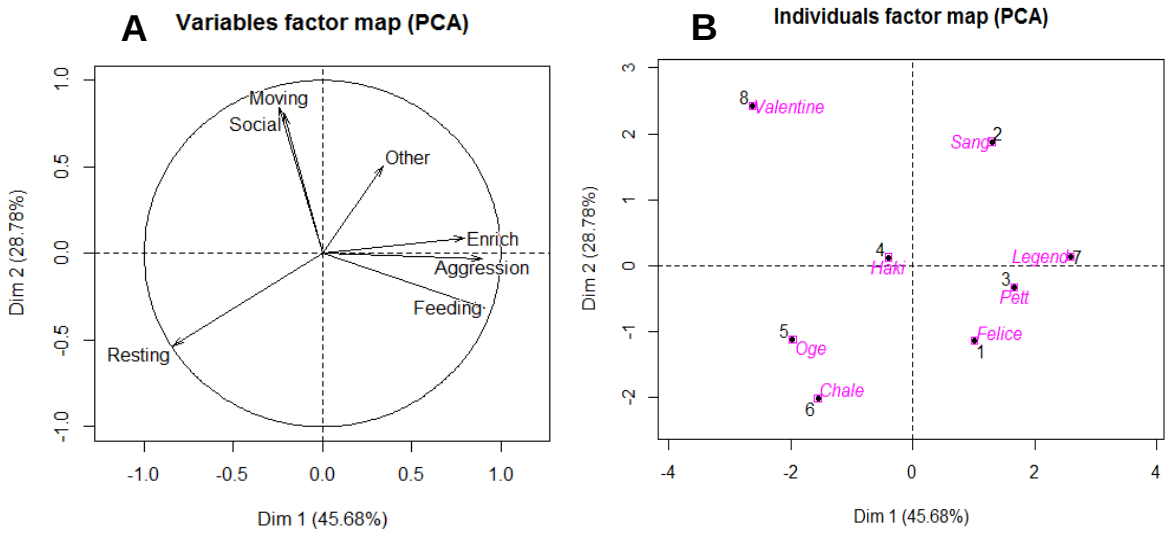


Figure 1. **A:** Variables factor map with each behaviour plotted regarding to the correlation of principle components. Behaviours that are clustered together are positively correlated, or have similar counts. Dimensions represent the 'factor loading' scores calculated by the analysis. **B:** Individuals factor map with each individual plotted on the axes in regard to the similarities between individual activity budgets. Dimensions on the map represent those seen on the variables factor map.

Post-release

Felice, Pett, Sang and Haki

Upon release, Felice, Pett and Sang showed signs of human-directed aggression, attacking guests and staff members. These individuals were recaptured and re-released into Shimba Hills, a National Reserve east of Diani.

Haki was observed for 18 days prior to his death on the 29/09/2016, which was caused by a liver infection. Vigilance (27%), resting (21%) and feeding (20%) were exhibited the most during this period. This was analysed in comparison to Legend for the same sampling period, where feeding made up 47% and resting 0.5% of time observed.

Chale, Legend, Ogeala and Valentine

Activity budgets between successful and unsuccessful individuals did not significantly differ (W = 75, p-value = 0.8851). Legend and Chale are clustered together on the IFM (fig. 2) in contrast to Valentine and Ogeala. The proportion of

time spent resting was significantly different between individuals (χ^2 = 73.025, df = 3, p-value = 9.601e-16). Ogeala spent 5.5% of her time resting compared to others where resting constituted less than 2%. There was a significant difference in aggressive and social behaviours (Aggression: χ^2 = 18.8, df = 3, p-value = <0.005; Social: χ^2 = 82.312, df = 3, p-value = 2.2e-16). Valentine expressed these behaviours the most. Legend and Chale appear to be closely plotted on the IFM. There were no significant differences between the activity budgets of individuals between the pre-and post-release phase (W = 294.5, p-value = 0.9015).

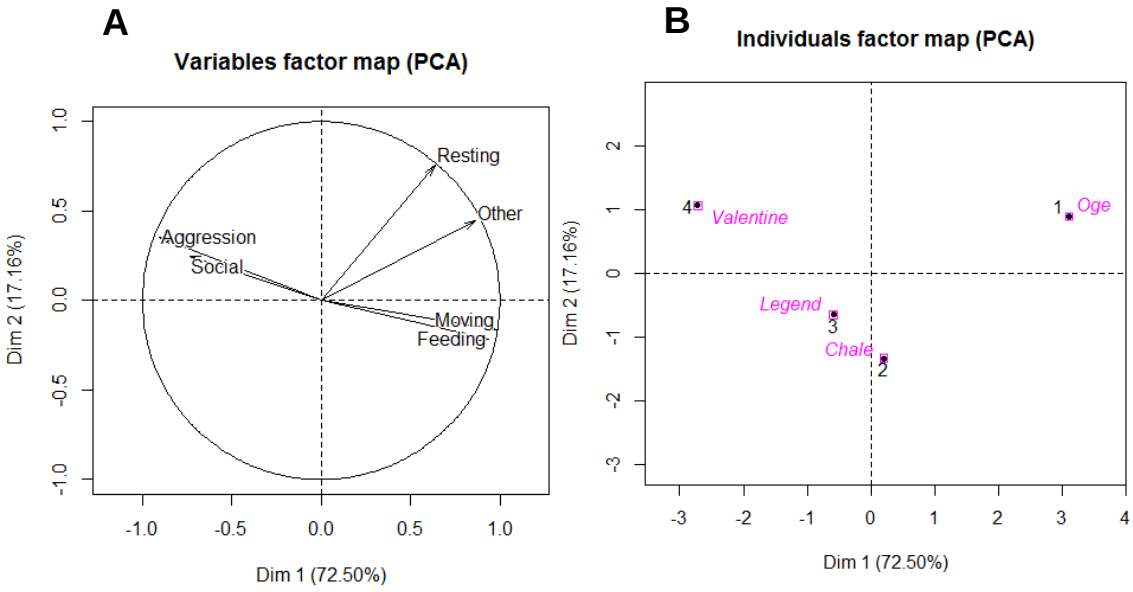


Figure 2. **A:** Variables factor map of the behaviours observed post-release (Lindberg 2016).

B: Individuals factor map of the released individuals monitored post-release.

Post-release (+1)

Oge and Valentine

Oge fell from a tree on 04/02/2017, resulting in death caused by head injuries. Valentine was observed from the 29/05/2017 until the 23/06/2017, after which she was captured due to biting a member of the public. The three behaviours expressed the most by Valentine prior to this event was locomotion (27%), feeding on natural foods (24%) and resting (12%).

Chale and Legend

The three behaviours expressed the most by Chale were locomotion (31%), feeding on natural foods (26%) and vigilance (9%). This is not significantly different from the post-release (Lindberg 2016: K-W = 0.046784, df= 2, p-value = 0.9769), but notable differences were in the expression of feeding on natural foods (35%), vigilance (26%) and locomotion (21%). Grooming and play increased from the post-release to the post-release (+1) phase.

The three behaviours expressed the most by Legend were locomotion (25%), feeding on natural foods (23%) and playing (14%). Contrastingly, during post-release, the highest proportion of time was spent on natural foods (35%), followed by vigilance (28%) and locomotion (20%), but this difference was not significant (K-W=0.14035, df=2, p-value = 0.9322). Grooming and play increased from the post-release to the post-release (+1) phase.

Provisioned food

Feeding on provisioned food and proximity (<5m) from CVs fluctuated as time after release increased (fig. 3), but decreased overall. Feeding on natural foods decreased for Chale over time in contrast to Legend, where they increased after the third monitoring period.

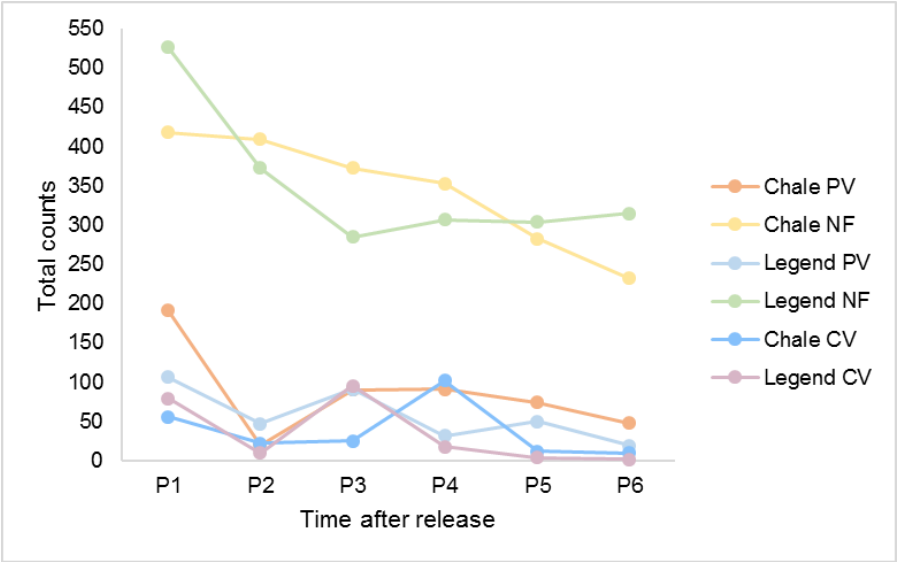


Figure 3. Total counts of instances where the focal individual was <5m with CVs and feeding on provisioned and natural foods (PV) and (NF), as time after release increased. Each period refers to 18-day periods following release.

Wild Sykes

There was a significant difference in the number of counts of observed interactions (playing and grooming behaviours) for the four released individuals, and <5m of WS for the first three periods (K-W = 7.5392, df = 3, p-value = <0.05) (fig. 4). There was no significant difference in the number of counts with regards to these three periods (K-W = 1.9395, df = 2, p-value = 0.3792). The number of counts Legend and Chale were observed interacting and <5m of WS increased as time after release increased.

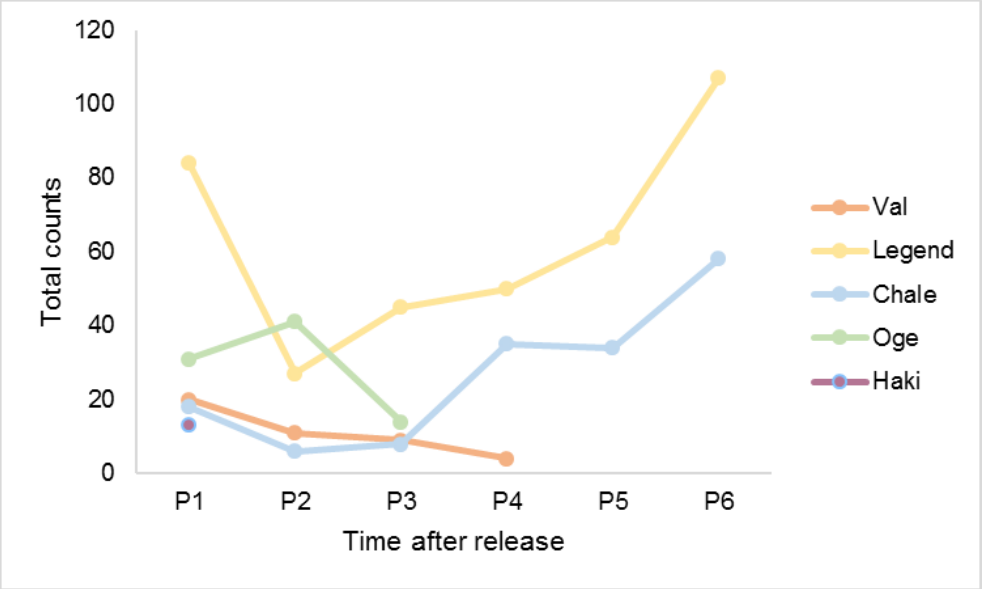


Figure 4. Total counts of instances where the focal individual was <5m and interacting with WS in affiliative behaviours as time after release increased.

Discussion

The release of four of the eight individuals was unsuccessful due to human-directed aggression. Of these individuals, three expressed aggressive behaviours pre-release, spent small proportions of time on social behaviours, and appeared 'socially isolated' in the cage compared to that of others (Palmer 2016). Individual background analysis showed that these individuals spent the most amount of time in captivity compared to others (>3 years), were hand-reared in isolation in captivity, and experienced repeated failed release attempts, whereby they were recaptured and re-released in the same area.

Individuals used in RPS that have spent a short amount of time in captivity are argued to fare better in the wild (Yeager 1997; McDougall 2005). Large periods of time in rehabilitation will increase exposure risk to stressors such as changes in group composition, dominance rank, human contact and social separation (Dettling et al. 2002; Mendoza et al. 2000; Buchanan-Smith and Waitt 2001; Honess and

Marin 2005;2006; Cheyne et al. 2012). These stressors lead to abnormal behaviours that implicate the survival and welfare of the animal pre- and post-release, such as human-directed aggression, a common failure of RPs (Yeager 1997; Dube et al. 2013; Brockelman et al. 2015). However, individuals often unavoidably remain in rehabilitation for long periods of time (>4yr) due to hand-rearing infants and requiring a sufficient group number for release (Guy et al 2013). Effective enrichment and husbandry protocols may play important roles in lowering the adverse impacts of these stressors (Honness & Marin 2006; Cheyne 2009; Novak et al. 2013; Guy et al. 2014), but a consideration of individual differences in both temperament and life history is vital when modifying these practices (Coleman 2012).

Poor quality relationships between orphaned primates used in RPs is indicative of abnormal development and is commonly associated with post-release failure (Russon 2009; Guy et al. 2012; Guy et al. 2014; Brockelman et al. 2015). They lead to unstable dominance hierarchies, aggression between individuals, stress and potentially fission and mortality post-release (de Veer and van den Bos 2000; Guy et al 2014). Releasing individuals known to be socially isolated into an area experiencing high volumes of people (like CC) will only amplify abnormal behaviours, further displacing individuals and increasing the risk of human—wildlife conflicts (Honess and Marin 2006; Guy et al. 2014; Guy and Stone 2017). Consideration of the social behaviour between individuals and their corresponding compatibility in group formations at all stages of rehabilitation should be made to ensure good welfare and reintroduction success (Beck et al. 2007; Guy et al. 2014). Strong social networks may also serve to reverse the stress caused by maternal separation and captive-rearing, but needs to be researched further in primate RPs (Latham and Mason 2008; Hoffman et al. 2010; Novak et al. 2013).

Haki spent a large proportion of time resting (21%) prior to death post-release, which was notably different to Legend (0.5%), and was not foraging efficiently (Lindberg 2016), but intervention was too late. It may be argued that Ogeala's falling from a tree was a consequence of the pre-release cage inadequately training him in locomotor skills necessary for the wild (Guy et al. 2014). Ogeala spent a large proportion of his time resting and on 'other' behaviours in the pre- and post-release phase in comparison to the other three individuals, and appeared isolated in the post-release PCA. However, from this data and the fact post-release monitoring stopped four months before he died, it is not possible to infer that this could indicate low viability post-release, or whether there were any signs indicating the need to intervene. This shows the importance of conducting post-release monitoring studies that last for at least one year and pre-release skill's assessments (Goossens et al. 2005; Cheyne 2009,2012; Guy et al. 2014; Guy et al. 2015).

Chale and Legend's activity budgets were similar throughout all stages of the rehabilitation phase and are comparable to WS (Hau et al. 2004; Buchanan-Smith et al. 2006; Foerster and Monfort 2010; Cords and Gaynor 2012) highlighting the rehabilitation process successfully encouraging wild behaviours to facilitate survival (Cheyne 2004; 2009). This is further supported by the increasing interactions for both individuals with the WS troop (Guy et al. 2015). Integration with the WS troop is ongoing and may be one factor contributing to survival, especially as the group separated upon release (Cheyne 2004;2009; Wimberger et al. 2010; Guy et al. 2012).

A large proportion of aggressive intergroup interactions between released individuals and wild conspecifics in RPs occurs between adults, due to subadults contributing little to the competition for resources (Cords and Pazol 2005; Guy et al. 2012). Upon release, Chale and Legend were subadults, were immediately

observed interacting with WS, and fed on provisioned food given to the CVs, which may have suppressed competition and conflict from dominant individuals (Henzi et al. 2003; Cords and Pazol 2005). Previous release attempts of adult individuals in the released group failed due to injury caused by WS. Future monitoring procedures should focus in greater detail on the socialisation of released primates with wild conspecifics to determine the variables (e.g. sex, age) contributing to an individual's ability to integrate (Goossens et al. 2005; Cheyne 2009).

The increase in grooming and play behaviours to the post-release (+1) phase for Chale and Legend may owe to their ongoing integration with WS, and indicate both an improvement in welfare and increased opportunities for play outside the cage (Beck et al. 2003; Held and Spinka 2011). Monitoring play and affiliation behaviours is used to demonstrate good welfare and help modify management protocols for other captive animals, but has not yet been researched for primate RPs (Bremner-Harrison et al. 2003). The expression of such behaviours in these individuals may have resulted from placing them with a partner soon after admittance, a procedure argued to improve psychological wellbeing, and enable the development of social behaviours (Honess and Wolfensohn 2005; Honess and Marin 2006; Pastor-Nieto 2014).

Limitations

The pre-release ethogram (Palmer 2016) contained less behaviours than the post-release ethogram and that Sykes are known to express (Hau et al. 2004; Corde and Pazol 2005; Cords and Gaynor 2012), making cross-comparisons between stages difficult. Additionally, the low number of individuals in this study limits the ability to generalise and compare results at different stages. However, further Sykes RPs carried out by CC will continue to be documented and therefore contribute to these findings.

The IUCN recommend that post-release monitoring should be conducted continuously for a minimum of one year and should include at least one breeding season and all climatic conditions at the release site (Baker and Soorae 2002; Beck et al. 2007; Guy et al. 2014). During dry seasons, natural food sources are low which may cause individuals to become more reliant on provisioned foods, and during the breeding season, the increase in intragroup competition and aggression levels may implicate integration (Hau et al. 2004; Corde and Pazol 2005).

The use of ear tags in this study affected the efficiency of locating the monkeys, as well as causing a tear in Chale's ear. Risk of injury is less when using degradable tracking devices and facilitates in locating individuals post-release (Chamberlan et al. 2012; Farmer and Trayford 2012; Guy et al. 2012). Telemetry devices such as radio collars may increase the specificity of the data gathered, but is controversial due to negative associated welfare impacts (Berg et al. 2011; Farmer and Trayford 2012).

Conclusion

Early maternal separation, captive rearing in social isolation, time in rehabilitation, age upon release, group composition and relationships between rehabilitated individuals may contribute to the outcomes of individuals involved in RPs. Conducting pre-release behavioural assessments, including individual life history in the evaluation and learning from previous failed release attempts is vital to improve current knowledge on the welfare and success of future RPs for Sykes monkeys. Using social network analyses may prove useful in studying relationships, and provide an informative method of investigating the strength of relationships and factors influencing them. This also provides information on the viability of group stability upon release, a main factor contributing to RP failure. These analyses

should be continued post-release, and include detailed documentation of interactions with wild individuals.

Protocols should be deployed to avoid habituation, such as providing food from behind a screen to prevent animals from associating humans with food. Although yet to be researched in primate RPs, habituation may be prevented in identifying the critical time at which human contact should be reduced to enable certain skills to develop pre-release necessary for self-sufficiency. Further research is required on the potential for individuals to learn abnormal behaviours from others in the rehabilitation cage.

It is vital to carry out detailed, standardized documentation and assessments, soon after individuals are admitted to improve knowledge on how the rehabilitation process can be modified to improve the reintroduction success of orphan and ex-pet Sykes monkeys.

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Appendix I

Release Process

- Release day was planned for two weeks after the start of the short or long rains (scheduled for a period that offers optimal resources and minimal resource competition for the monkeys being released).
- Baboons should not be present when the group are released.
- Last checks of individual health condition are to be conducted in the morning by the release team.
- After the monkeys have been fed and watered, the troop will be released by one person, quietly opening the enclosure door. No fuss or cheering is to be made.
    - Only members of the reintroduction team are to be present at the time of release.
    - Human numbers are to be kept to an absolute minimum.
- A door of the rehabilitation enclosure is to be left open in case any individual choose to return and use the enclosure as a safe refuge. The door needs to be loosely tied to prevent the door opening fully and allow baboon access. A gap adequate for the largest release animal is the maximum that is required.
- Researchers if able are to follow the monkeys throughout the day and leave them only as they are settling down for the night in their sleeping trees. Full research monitoring protocol to be conducted throughout the day.

Released primates will be monitored for a one-year period, ensuring that the research team can monitor the animals through the toughest point of the year (January-March dry season) when fallback foods are most important. This will enable assessment as to whether wild food pre-release exposure could be improved. Supplementary feeding will be provided for the first four-eight weeks post release, with quantities given reducing weekly to slowly wean the release troop off

provisioned food. Intervention in the case of illness or injury and support from predators will be given, when required, throughout the year. After this time they are subject to the same assessment as all wild primates involved in a welfare event.

Over the course of the first year post-release the contact time the research team will spend with the release troop will gradually reduce with the aim to create a self-sustaining troop over a gradual process of reduced support.

Under no circumstance should:

- Any release animal be given food to distract them while captive monkeys are fed or food delivered to site. If there is a problem monkey, alert management;
- Allow the release group to enter any house. All on site personnel are responsible for the prevention of this.

Personnel must be aware of their proximity to the release troop:

- A minimum distance of 3m must be adhered to at all time, increasing to 5m by 6 months post-release;
- If an individual approaches a researcher within this distance it is the researchers responsibility to reposition themselves to a 3m distance;
- It is appreciated that during times of dispute or fast movement this will be difficult, however, every effort must be made;
- Tour guides are responsible for ensuring correct behaviour of tourists around the monkeys during their visits.
- As a researcher it is essential that you do not bias the behaviour or movement of the troop. It is therefore recommend that the above minimum distances are adhered to;

- In addition make every attempt to move alongside the troop rather than in front (leading) or behind (herding);
- By moving alongside it will also allow the troop to turn and flee, without coming into close contact with the researchers.

Appendix II

Ethogram (Palmer 2016)

Behaviour	Description
Aggression	Biting, prolonged chasing, aggressive wrestling, screaming, eye threat, lunging, supplanting
Feeding	Placing anything in mouth and swallowing
Resting	Being still and not eating, eyes closed or open, sunbathing, in contact or not in contact with other individuals
Social	Play: one or more animals lunge, grapple, wrestle or chase in the absence of aggression or intense submission. Grooming: cleaning the fur of other
Moving	Any movement vertical, horizontal or on ground that does not involve chasing or social movement. Additionally includes climbing on cage but not enrichment.
Enrichment	Use (sniff, bite, chew, gouge, handle, pounce on, grapple with, or otherwise manipulate enrichment object) an enrichment item.
Other	Other behaviours that are not included in this ethogram. Includes different types of calling as these could not be distinguished between social and alarm.

Appendix III

Prim8 is a behavioral data collection application for use on mobile devices and android tables that is customized for the unique requirements of collecting data on primate populations. The aim of the app's development was to create a maintainable software tool for researchers at primatology research institutions to improve and standardize the collection of behavioural data. Prim8 procedures for collecting data were as follows:

1) On the device, click Prim8 icon

2) Click on follows – click start follow

3) Randomly select the individual that is to be followed from the drop-down menu

4) Select the length of the follow in minutes from the drop-down menu (20 minutes)

5) Select the scan frequency in minutes from the drop-down menu (1 minute)

6) Click start follow.

7) Type in the behaviour code in the box every minute and click return.

8) On 0, 10, and 20 minutes type in the proximity and height codes.

9) Focal animals will then be rotated according to a fixed, randomly selected schedule, through all individuals. This method prevents prominent individuals from being studied more frequently than non-prominent individuals and ensures that different age and sex classes of monkeys are studied at different times of the day.

10) To upload data, click xxport (or export + delete)

11) Connect the tablet to the laptop

12) Copy files to laptop/SD card

Once the files were uploaded onto the laptop as excel sheets, the filter function was used to show behavioural data collected for only one individual (e.g. ‘Chale’). Specific individual data was then copied and pasted into a separate excel spreadsheet and titled ‘Chale raw data’. The filter function was again used to filter counts for specific behaviours (e.g. ‘locomoting’). The total number of entries made for each behaviour was calculated. This was repeated for every individual. A separate excel sheet was made for the total count data. The count data for each behaviour was then converted into a proportion, a separate excel sheet was made for this data which was individual activity budgets. The filter function was used to generate the three 18-day periods in the post-release and the post-release (+1) data. Separate excel sheets titled “P1, P2, P3 scans” were generated.

Proximity codes

Prim8 Code	**Description**
0	On ground
1	Is less than 5 meters high
2	Is between 5-10m high
3	Is between 10-20m high
4	Is between 20-30m high
5	Is between 30-40m high
In contact with (ct)	In contact with (individual e.g. WS, caged vervet (CV))
P1	Is less than 1m from (individual)
P3	Is within 1-3m from (individual)
P5	Is within 3-5m from (individual)
PG5	Is greater than 5m from (individual)

Appendix IV

Table of focals collected for Lindberg (2016) and the author (Edwards 2017).

Lindberg (2016) post-release data 3.8-4.10														**AVERAGE** per 18-day period	**AVERAGE** per time period per 18-day period
ID	**Period 1 03/08 – 23/08 (18 days)**				**Period 2 24/08-13/09 (18 days)**				**Period 3 14/09-04/10 (18 days)**				**TOTAL**		
	6:00-9:00	9:00-12:00	12:00-3:00	3:00-6:00	6:00-9:00	9:00-12:00	12:00-3:00	3:00-6:00	6:00-9:00	9:00-12:00	12:00-3:00	3:00-6:00			
Chale	16	21	16	15	10	13	14	10	12	12	10	13	162	54	13
Legend	19	19	18	18	9	16	14	9	9	25	8	12	176	59	15
Average	17	20	17	16	9	14	14	9	10	18	9	12	165	Total/3	Average/3

Edwards (2017) post-release data 20.3 – 24.07														**AVERAGE** per 18-day period	**AVERAGE** per time period per 18-day period
ID	**Period 1 20/03 – 28/04 (18 days)**				**Period 2 09/06-22/06 (18 days)**				**Period 3 22/06-02/08 (18 days)**				**TOTAL**		
	6:00-9:00	9:00-12:00	12:00-3:00	3:00-6:00	6:00-9:00	9:00-12:00	12:00-3:00	3:00-6:00	6:00-9:00	9:00-12:00	12:00-3:00	3:00-6:00			
Chale	15	15	12	12	15	15	12	12	12	12	15	15	162	54	13
Legend	15	15	12	12	15	15	12	12	12	12	15	15	162	54	13
Average	15	15	12	12	15	15	12	12	12	12	15	15	162	Total/3	Average/3

Appendix V

Example data used for Mann-Whitney-Wilcox test

Behaviour	Individual	Proportion	Outcome
Aggression	Felice	0.01	0
Aggression	Sang	0.006	0
Aggression	Pett	0.008	0
Aggression	Haki	0	0
Aggression	Oge	0	0
Aggression	Chale	0	1
Aggression	Legend	0.0089	1
Aggression	Valentine	0	0
Feeding	Felice	0.4357	0
Feeding	Sang	0.4114	0
Feeding	Pett	0.4831	0
Feeding	Haki	0.4034	0
Feeding	Oge	0.369	1
Feeding	Chale	0.3781	1
Feeding	Legend	0.4553	0
Feeding	Valentine	0.3088	0
Resting	Felice	0.2114	0
Resting	Sang	0.0671	0
Resting	Pett	0.1195	0
Resting	Haki	0.2042	1
Resting	Oge	0.343	1
Resting	Chale	0.3493	0
Resting	Legend	0.0915	0
Resting	Valentine	0.243	0
Social	Felice	0.0249	0
Social	Sang	0.037	0
Social	Pett	0.0239	1
Social	Haki	0.044	1
Social	Oge	0.033	0
Social	Chale	0.0189	0
Social	Legend	0.0437	0
Social	Valentine	0.0578	0
Moving	Felice	0.1077	0
Moving	Sang	0.1481	1
Moving	Pett	0.1295	1
Moving	Haki	0.1051	0
Moving	Oge	0.084	0
Moving	Chale	0.0657	0
Moving	Legend	0.0746	0
Moving	Valentine	0.2092	0
Enrichment	Felice	0.1067	1
Enrichment	Sang	0.0981	1
Enrichment	Pett	0.0867	0
Enrichment	Haki	0.1221	0
Enrichment	Oge	0.045	0
Enrichment	Chale	0.0557	0
Enrichment	Legend	0.1869	0

Enrichment	Valentine	0.0538	1
Other	Felice	0.1037	1
Other	Sang	0.2322	0
Other	Pett	0.1494	0
Other	Haki	0.1211	0
Other	Oge	0.126	0
Other	Chale	0.1323	0
Other	Legend	0.1392	1
Other	Valentine	0.1275	1

Application for Ethical Approval of an Investigation Involving Animals (UIN)

This form should be used for studies on animals, other than humans, at any stage of development that is to be carried out at the University of Bristol and that is not regulated by the Animals (Scientific Procedures) Act, 1986. All experiments to be carried out by a member of the University in another establishment, including one abroad, should also be included, whether or not they have local ethical/regulatory approval. It is very difficult to define the species that should be subject to ethical approval because it is impossible to predict accurately how much a given species would suffer under particular experimental conditions. As a guide to the species for which approval should be sought, include any for which ethical issues have been raised seriously in the past. For example include lobsters but not worms. If in doubt, submit an application.

Project Title	Using pre- and post-release assessments to evaluate a historic welfare reintroduction programme for orphan and ex-pet Sykes monkeys (Cercopithecus mitis albogularis).		
Investigator	Zoe Edwards	**Supervisor** (if applicable)	Suzanne Held & Pam Cunneyworth
Department	School of Veterinary Sciences	**Telephone**	07771960499
Anticipated end date	24/07/17	**E-mail**	z.eddy@hotmail.co.uk
If appropriate, have you applied for/received approval from the Human Ethics committee (FREC)?			no

Does this investigation:	**Yes/No**
Cause pain, suffering, distress or lasting harm. These terms encompass any material disturbance to normal health and include disease, injury and physiological or psychological discomfort.	NO
Require any biological samples to be taken from living animals?	NO
Require animals to be housed under conditions that are outside the Home Office Codes of Practice*?	NO
Require animals to be placed in a modified environment, or metabolism cages/pens?	NO
Require animals to be kept in isolation?	NO
Require animals to have food or water withheld, or restricted access to diet or water (such as reduced trough space)?	NO
Will animals be offered altered (e.g. to make it unpalatable) or marked (e.g. with radioactive additives) food or drink?	NO
Will animals receive any medication (topically, parenterally or enterically)?	NO
Will any necessary medication or veterinary treatment be withheld?	NO
Will animals be killed by a method other than Schedule 1?	NO

* Home Office Codes of Practice are available at: https://www.gov.uk/government/publications/extracts-from-the-code-of-practice-for-the-housing-and-care-of-animals-used-for-scientific-purposes

*If you have answered "**Yes**" to any of the questions above, the study may require a **Project Licence** and you should consult the Home Office Liaison Team (HOLT) at asu-holt@bris.ac.uk before proceeding with your plans.*

	Yes / No
Has sufficient funding been assured for the duration of the investigation?	Yes
Have you approached ASU regarding space for this investigation? *If no, please see NACWO if work is to take place at UoB*	NO

Historical data analysis and Observational data collection	**Yes / No**
Does the study involve historical data ONLY and therefore not involve any new data collection?	NO
Does the study involve observational data collection ONLY and therefore not involve any interaction with animals beyond what they experience normally?	YES

*If you have answered "**Yes**" to either of the two questions above, simply complete the **Project Summary** box overleaf.*
If you have answered "No" to both of the two questions above, please complete the rest of the form.

The HOLT is a function of the Animal Services Unit and deals with both regulated and non-regulated research.

All applications should be submitted electronically to asu-holt@bristol.ac.uk, and include:

1. This page with your electronic signature.
2. A Lay Statement - details overleaf. Please answer all the questions as accurately as possible.
   Projects involving only historical or observational data need only to complete the Project Summary box.
3. Applications for experiments on living animals (excluding those involving Schedule 1 killing only) should include a concise description of the procedures to be carried out, and their possible adverse effects.

- Following submission of your application, it will be reviewed by the HOLT and the Animal Welfare and Ethical Review Body (AWERB). If approved, you will be notified of your University Investigation Number (UIN) and the end date.
- UINs on animals are authorised for up to **three** years.

DECLARATION BY THE APPLICANT

I understand that, if permission is granted for this research, I will be responsible for the supervision, conduct and competence of all animal users working on this project.

SIGNATURE  Date 27/03/17

Project Summary
(for projects involving historical data analysis or observational data collection ONLY)

Please provide a short abstract of your research project written in a format suitable for a lay audience. Include the species involved, main outcome measures and a brief summary of the methods involved.

Wildlife Rehabilitation Centres (WRC's) are places where sick, injured, ill and orphaned wild animals are kept for short periods of time. The animals will be treated for their injuries and illnesses and will be taught skills they need to survive in the wild, such as finding food and avoiding predators. They will then be released back into their natural habitat. If successful, WRC's can play an important role in caring for the individual, and may also contribute to preventing animals from going extinct. Post-release monitoring programmes aim to evaluate how successful the rehabilitation process and release was by following the animals after they have been released. It involves monitoring behaviour such as anti-predatory behaviours, foraging techniques and sociality. This information can be combined with behavioural data of the same animals during the rehabilitation process. The combination of information can be used to improve the rehabilitation process for that particular species to increase success rates as it may indicate which behaviours or skills are lacking/indicate individual's potential of poor success in the wild. It may also indicate where to intervene during the rehabilitation process, if certain behavioural aspects are not seen (foraging aspects). These pre-and post-release behavioural aspects can also be looked at in regards to the history of said animals, for example whether they were admitted due to injury or due to being part of the pet trade.

This study is interested in a group of Sykes' Monkeys which were rehabilitated and released in Diani, Kenya by Colobus Conservation. The group were released last year and behavioural data was take during the rehabilitation process and after they were released.

1) The time budgets for certain behaviours will be analysed in reference to what their wild counterparts show, in order to assess what they should be exhibiting (i.e. >40% of time should be spent foraging, <2% of time should be spent being aggressive).
2) Social network analyses will be conducted using the data from the post-release monitoring study. Observational data of the wild group of Sykes' Monkeys they integrated with (of which the surviving individuals are a part) will be taken following the methods of the historic post-release monitoring study to produce a social network analyses. The two will be compared to assess the sociality of the rehabilitated group as opposed to the wild group.
3) The rehabilitated group also varied in equal proportions of being pet/wild, male/female, the amount of time in captivity pre-rehabilitation, the amount of time in captivity during rehabilitation. It will analyse certain pre-and post-release behaviours in each group as mentioned above in addition to injury/aggression levels to evaluate whether these are potential indicators for success/failure post-release.

Lay Statement

Please answer all the following questions in clear non-scientific terms, (bearing in mind that some of the information you provide could be disseminated, if requested, under the Freedom of Information Act, 2000). Please restrict your submission to two sides of A4, typing your answers directly underneath the questions.

The Scientific Problem

What scientific problem are you studying?

How are you going to investigate this problem?

Primate rehabilitation and release is an increasing practice due 48% of all species being classified as vulnerable, endangered or critically endangered (IUCN/SSC Primate Specialist Group 2008). The success and justification for the time, money and effort that goes into primate rehabilitation in addition to its welfare and conservational value revolves around the success of the group post-release. Releasing individuals when they are going to fail may be seen as poor welfare. Post-release monitoring (PR-M) currently indicates the average success of primates is low, and is only one method in which the rehabilitation process and release can be evaluated. A combination of PR-M and historical data on each individual can aid towards improving rehabilitation and knowing if intervention is needed thus improving welfare.

Possible Outcomes

What do you hope to achieve?

How might these achievements benefit man or other animals?

1) What behaviours/skills should be expressed in the rehabilitation process to ensure post-release survival.
2) Highlighting potential indicators for post-release success/failure (pet/wild, time in captivity)
3) What group formation in rehabilitated individuals is and if this is similar to wild groups.
4) Indicators for intervention (signs of aggression in rehabilitation centre)

- *Increase welfare*
- *Potentially increase success rates*
- *Highlight implications of the pet trade*

Animal Source and Authorisation

State the species, stage of development and source of the animals you wish to use.

Is authorisation required for the use of any of these animals from a regulatory authority such as English Nature or DEFRA? If so, please give details.

Reduction, Refinement and Replacement

Why use living animals? What alternatives have been considered? *Which species will be used, and why?* *How many animals do you propose to use? How did you calculate that figure?* *(please give, at least, an estimate of tens, hundreds or thousands)*
Experimental Procedures (Detailed) *What are you going to do to the animals?* *Describe any possible adverse effects, and the measures you will take to prevent these from occurring.* *Describe the end-points that should be used so that animal care staff can be clear at what stage it would be necessary to terminate an experiment.* *What will happen to the animals at the end of the study?* *If the animals are to be killed, what method will be used?*
Peer Review *Have all the experiments and procedures included in this proposal been peer reviewed? (Yes/No) If yes, please list reviewers. Who will be funding this research?*