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Applied Animal Behaviour and Animal Welfare

The effect of radio-tracking collars on the behaviour and subsequent welfare of the *Nycticebus coucang.*

by

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RADIO-TELEMETRY AND PRIMATE CONSERVATION

Radio-telemetry exists as an integral aspect of primate reintroduction programs, as per the IUCN guidelines (Baker, 2002). Radio-telemetry has enabled successful post-release monitoring of primates across the world, which has in turn, improved reintroduction procedures and broadened the availability of post-release literature. Radio-telemetry monitoring offers the observer detailed information about locomotory range, socialisation, diet and habitat (Charles-Dominque, 1977; Fedigan et al,. 1988; Crofoot et al., 2010; Humleel et al., 2010). Furthermore, such monitoring augments chances of survival for release candidates (Farmer et al. 2010). Previous primate reintroduction programs have been deficient of post-release observations (Cheyne, 2009) and so increased usage of this monitoring in recent years has improved conservation procedures and enabled post-release survival (Trayford & Farmer, 2012).

A radio-collar is composed of the transmitter package containing the radio-transmitter, the battery and a protruding antenna. Collars have been the popular means of fitting radio-transmitters to primates (Pouliquen et al., 1990) making use of the head and neck as an anchor to hold the collar in place, and is thus somewhat intrusive in its nature. Radio telemetry monitoring assumes that the behaviour being observed is representative of that of an untagged animal, but there is a possibility that the collar might affect the behaviour of the animal and thus, that animal would not be an accurate representative of an untagged conspecific. Furthermore, possible adverse effects of the radio collar hold implications for the animal's welfare, and therefore its chances of survival in the wild. Therefore, possible effects of the collar on the animal's habitual behaviour must be acknowledged. Guidelines have been set up, documenting the appropriate collaring method and weight for the designated release candidate (Brander & Cochran, 1969). The weight is of great importance to minimise the impact of the animal's normal behaviour; the tolerable weight limit of the proposed collar is documented as the maximum weight that the animal can carry without eliciting any discernible impact on the its behaviour (Kenward, 1987). It is assumed that if this criteria is met, presumably there should be no notable effect of the collar on the behaviour of the animal. Literature which quantitively assesses the impact of the radio collar is plentiful but most papers focus upon reproduction and survivorship rather than behaviour (Bank et al., 2000).

Much of the previous literature focusing on the effects of radio telemetry usage has yielded varying results with some adverse effects reported; reduced survival was documented in radio marked rock ptarmigans (Cotter & Gratto, 1995), and equipping canvasbacks with radio transmitters resulted in reduced body condition (Pery, 1981). Likewise, reduced body condition was documented in bobcats that had been fitted with transmitter harnesses (Jackson et al., 1985). Adverse effects in terms of weight loss were recoded for radio collared badgers (Tuyttens et al., 20021). These findings illustrate the potential welfare implications of radio tagged animals in terms of their individual wellbeing and their survival in the wild. However, in contrast, no adverse effects of radio-collars were recorded for stress hormone levels in

African wild dogs (Gorman et al., 1992), and body weight in both leopards (Hamilton, 1976) and trasiers (Gursky, 1998). Variations in results can be explained by species variations, differences in hypotheses and methodological differences in transmitter type and size, sample size, duration of observations and quantity of observations.

Behavioural based papers have focused primarily upon avian species (Caizergues & Eliison, 1998), with much of the literature examining the appropriate transmitter to body weight ratio (White & Garrot, 1990). Behaviourally, a range of findings have been documented, with some studies reporting abnormal behaviours in radio-tagged birds (Bocig, 1972; Massey et al., 1988), increased preening behaviours (Greenwood & Sargeant, 1973; Siegfried et al., 1977) reduced courtship (Ramakka, 1972) and attempts to take off the collar (Hooge, 1991). In terms of the implications these findings have on the welfare of the animal, any time spent engaging in behaviours which are directed towards the novel external stimulus, such as attempts to take off the collar and increased preening, takes away from the normal activity budget of that animal, and therefore might affect their survival. Furthermore, the presence of abnormal behaviours with the fitting of a radio pack (Greenwood & Sargeant, 1973) holds negative connotations in terms of the welfare of the animal. However, other avian investigations documented no adverse effects on behaviour (Sodliet et al, 1991, Conway & Garcia, 2005), which again might be attributable to species variations and methodological differences.

The literature did report cases where behavioural changes were also found to be habituated after a period of adjustment (Boag, 1972; Nenno & Healy, 1979), which is promising in that normalisation of behaviour might be possible after a period of acclimatisation. Habituation is an important aspect of a reintroduction program, in terms of the animal's ease at hosting the transmitter, but also in terms of preventing undesirable behaviours which might seek to attract attention from uncollared conspecifics (Trayford & Farmer, 2012)..

A study assessing the impact of radio-transmitter weight on the behaviour and body weight of small nocturnal primates, namely tarsiers, was conducted and is the most relevant literature to the present study. The study reports that the radio collars failed to produce any statistically significant change in the tarsier's body weight post collaring, and no notable behavioural changes were recorded as a result of the increased weight of the collar, thus one might assume that the potential adversity of the collar for the nocturnal lorises might be equally as subtle.

Previous literature has revealed that there are potential effects of collaring on behaviour, which might alter the normal behavioural repertoire and activity budget of the animal, causing potential stress and discomfort, and thus hindering its chances of survival in the wild. As yet, there have been no systematic studies assessing the impact of radio-collars on the behaviour of slow lorises. Thus, to further support the survivorship of the lorises post-release, assessing any adverse effects of the collar is paramount to ensuring that if necessary, these effects are habituated prior to release.

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ABSTRACT

As a vital tool in primate conservation, radio-tracking collars frequent the reintroduction stage of release protocol; the present study assessed the impact these radio-collars have on the behaviour of the slow loris, so as to promote greater chances of survivorhsip post-release. Fifteen captive Genus *Nycticebus* were observed for a period of ten days before being fitted with very-high-frequency (VHF) radio tracking collars and observed for a further ten days. Frequency of grooming behaviour, above-neck directed behaviour, self-directed behaviour and aggression were recorded, alongside durations of stereotypy and inactivity. Behaviours from the pre-collar and post-collar stages were compared with the help of statistical analyses and the progression of behaviour over the days was analysed for evidence of habituation. Results demonstrated that fitting a loris with a radio collar led to significant increases in grooming, above-neck and self-directed behaviour, with behaviours declining in frequency as the days progressed, suggesting habituation to the collar. There was no significant difference in levels of aggression and inactivity between the pre and post collar stages, although slight increases were observed with the fitting of the collar. There was no significant difference between the duration of stereotypy in the pre and post collar stages, although durations did decrease with the fitting of the collar, which might be explained by the significant increases in self-directed behaviours. The paper offers insight into the impact radio collars have on the behavioural repertoire of the slow loris, and whilst some behaviours did substantially increase with the fitting of the collar, suggesting irritation and reduced

welfare, these behavioural changes habituated after a short period of adjustment. This is promising in terms of the welfare of the loris post-release, with the likelihood that the collar would be habituated to, and the impact it might have on the loris' chances of survival minimised.

1. INTRODUCTION

Genus *Nycticebus* (slow lorises) are nocturnal strepsirrhini primates which are native to much of South East Asia (Fleagle, 1999). Their popularity across the pet trade has contributed to the fact that the genus *Nycticebus* has been contained within CITES (Nekaris and Nijman, 2007). This paper focuses on the Greater Slow Loris, the *N.* coucang, classified as vulnerable (VU A2cd) under the IUCN Red List (IUCN, 2011). In order to prevent further classification of the *N.* coucang to extinct, efforts must be made to increase their numbers within the wild. It is documented that rehabilitation and release exists as the single sustainable means of achieving this (Cheyne et al., 2011), thus wildlife organisations are involved in reintroduction programs to conserve the slow loris.

Primate reintroduction involves a period of post-release monitoring using radio-telemetry, a per the IUCN guidelines for release protocol (IUCN, 2002a). It is a widely accepted assumption across radio-telemetry studies that the behaviour of the collared animal is representative of the animal as if it were uncollared (Moorhouse & Macdonald, 2005), however it is possible that acting as a host for the device, which is somewhat intrusive in its nature, can affect the behaviour and welfare of the animal. This may also hold implications for the animal's chances at survival post-release. Therefore, it is important to systematically assess the impact the radio collars have on the behaviour and subsequent welfare of the slow loris.

This paper addresses two areas of interest; the hypothesised behavioural changes as a result of the fitting of the collar, and the habituation of these behaviours over the observational period. Since it is recognised that stereotypical behaviours are common in captive lorises (Moore, 2012), existing as a means to cope with stressful conditions (Dantzer, 1991), we question whether collaring a loris increases stereotypy. Increased preening was reported upon collaring birds in avian-telemetry literature (Siegfried et al., 1977), and since autogrooming in primates is documented as utilitarian (Barton, 1985), we question whether attaching a collar increases self-grooming. Lorises are noticeably social, particularly in terms of visual communication (Nekaris, 2006), thus we hypothesise that allogrooming might also increase. Avian radio-telemetry literature reports collar-directed behaviours, including attempts to remove the collar (Hooge, 1991) so above-neck directed behaviours are observed with the fitting of the collar. Increased inactivity was reported for radio-collared mice (Pouliquen et al., 1990), thus we question whether such behavioural changes might be applicable to lorises. Aggression is examined since it exists as a documented response to stress (Cannon, 1915) and thus may be a possible reaction to collaring.

Hypotheses:

$H1_0$: Fitting a loris with a collar will have no effect on behaviour.

$H1_a$: Stereotypy durations will increase post-collaring.

$H1_b$: Grooming behaviour frequency will increase post-collaring.

H1c: Self-directed behaviour frequency will increase post collaring.

$H1_d$: Above-neck directed behaviour frequency will increase post-collaring.

$H1_e$: Inactivity durations will increase post-collaring.

$H1_f$: Aggression frequency will increase post-collaring.

$H2_0$: There will be no relationship between day and behaviour post-collaring.

$H2_a$: Behavioural changes post-collaring will habituate over the days.

2. METHODOLOGY

2.1 Ethical Statement

The present study was reviewed and passed by the Veterinary Ethical Review Committee of the University of Edinburgh. A research permit was granted for the country of Indonesia by Kementerian Riset dan Teknologi (RISTEK): 090/SIP/FRP/SM/IV/2014. The research permit application was overseen by Dr Rondang S.E Siregar as the Indonesian academic counterpart. The study ran from the 6th May – 18th June 2014, with the pre-pilot and pilot study from April 12th – 6th May 2014.

Non-invasive behavioural observations were conducted and although the fitting of the radio collar was expected to cause some degree of irritation and stress, it was agreed that the benefit would out way the cost, since the collars are used regularly at the centre and so a detailed understanding of their impact was necessary.

Infra-red head lamps were worn during observations to minimise effects of observer presence and possible disturbances to the animals

2.2 Location

The study was based at the Yayasan International Animal Rescue Centre, Curgug Nanka, KP. Sinarwangi, Ciapus – 16610, Bogor, Indonesia.

2.3 Animals

Sixteen *Nycticebus* coucang were selected for the present study, eleven females and 4 males, age unknown. Due to the limitations of conducting research within a functioning rescue centre, rather than a research facility, it was not possible to control for sex differences when selecting the sex ratios within the sample size. Each loris was individually distinguishable through identification of morphological variations (fur colour, coat patterns, facial markings and scars) practised within the pilot study.

The lorises had been confiscated from the illegal wildlife trade and the sample size contained only lorises which were suitable for release into the wild. The lorises were all housed in groups of 4. The date the lorises arrived at the centre was the same across the sample (Table 2.1).

Name	**Species**	**Sex**	**Approx. Age**	**Cage**	**Group Size**	**Replicate**	**Entry Date**
Mad Eye (Kabut)	*N.* Coucang	Female	Adult	S9	4	R1	9/11/2013
Monkey (Amol)	*N.* Coucang	Female	Adult	S9	4	R1	9/11/2013
Jamie (Pandam)	*N.* Coucang	Male	Adult	S9	4	R1	9/11/2013
Roundy (Ak)	*N.* Coucang	Male	Adult	S9	4	R1	9/11/2013
Tyson (Messi)	*N.* Coucang	Male	Adult	S6	4	R1	9/11/2013
Eve (Lawang)	*N.* Coucang	Female	Adult	S6	4	R1	9/11/2013
Manson (Limbad)	*N.* Coucang	Male	Adult	S6	4	R1	9/11/2013
Clare (Rinnai)	*N.* Coucang	Female	Adult	S6	4	R1	9/11/2013
Baby (Wadinah)	*N.* Coucang	Female	Adult	S9	4	R2	9/11/2013
Beth (Bunyi)	*N.* Coucang	Female	Adult	S9	4	R2	9/11/2013
Emma (Wangi)	*N.* Coucang	Female	Juvenile	S9	4	R2	9/11/2013
Jazzmin (Sinar)	*N.* Coucang	Female	Adult	S9	4	R2	9/11/2013
Mon (Cola)	*N.* Coucang	Female	Adult	S6	4	R2	9/11/2013
Rosie (Coca)	*N.* Coucang	Female	Adult	S6	4	R2	9/11/2013
Laura (Soda)	*N.* Coucang	Female	Adult	S6	4	R2	9/11/2013
Cor (Bandrek)	*N.* Coucang	Female	Adult	S6	4	R2	9/11/2013

Table 2.1: Individual Animals with names, species, sex and entry date.

2.4 Radio Collars

Biotrack Ltd © 2013 'very-high-frequency (VHF) cable-tie collars' were used in the study (Figure 2.1). Each collar was inactive but was an accurate representation of the collars used for release candidates at the IAR centre. The radio collars consisted of an antenna and a transmitter circuit containing a battery and a sensor; the transmitter circuit was embedded with a protective layer of potting. The collar was attached to the loris by way of a cable tie, encased in stomach tubing to minimise irritation. The collars were approximately 6.5 inches long, with the antenna measuring six inches and an overall collar weight of 20 grams.

2.5 Enclosures and Management

The present study was conducted across two cages, namely S6 (Figure 2.2) and S9 (Figure 2.3). Both cages were of equal size, although the positioning of the cage was different, meaning the breadth and length were switched (Table 2.2). The cages were made from wire mesh walls and concrete floors. The cages were covered with fibre-plastic corrugated roofing and were segregated from adjoining cages by way of a vertical plastic sheet. Each cage was fitted with enrichments that were present throughout the study, specifically one nest box, one feeding tray, trees, foliage, rubber ropes, bamboo hollows and baskets. Cages were outside and were lit by 1 adjacent red bulb during the night.

Cages were managed by the onsite IAR keepers. Cleaning began at 15.30 every day. Lorises were fed insects and fruits during their waking hours, specifically 18.00/18.30 and again at 23.00/23.30 each day and water was available ad libitum. Various foraging-related enrichments were added at 2.00 am.

Cage	Height (feet)	Length (feet)	Breadth (feet)	Volume^3 (feet)
S6	6	17.5	12.5	1312.5
S9	6	12.5	17.5	1312.5

2.6 Experimental Design

A pre-pilot study was conducted to accurately identify the individual lorises within the sample size, specify time categories, familiarise the observer with the behavioural repertoire of the lorises and select the behaviours within the ethogram (Table 2.3). Above-neck directed behaviours (touch neck, touch conspecific's neck and rub neck) were added to the ethogram by the observer, in anticipation of possible behavioural effects of the collars. The remainder of the ethogram was based around the International Animal Rescue (IAR) ethogram and behaviours classified within previous literature (Fitch Snyder et al, 2001., Ehrlich & Musicant, 1977) as well as observations from the pre-pilot study. Behaviours depicting grooming behaviour, social behaviours, stereotypy, above-neck directed behaviours and inactivity were selected for the study. Behaviours were categorised for the hypotheses and analyses (Table 2.4).

Behaviour	**Description**
Self-Scratch	Scratch own fur with grooming claw.
Self-Lick	Lick or tooth-comb own fur.
Social Groom	Lick or tooth-comb conspecific's fur.
Pace	Walk back and forth in repeated motions.
Sway	Repeatedly move body from side to side without walking.
Mutur	Repeated walking in same area of cage.
Touch Collar	Touch collar using hands.
Touch Conspecific's Collar	Touch the collar of conspecific.
Rub Neck	Rub neck back and forth on any surface or substrate.
Aggression	Attack, threaten or pursue a conspecific bodily or vocally.
Inactivity	Sit in a motionless position with eyes closed.

Category	Behaviours
Grooming behaviour	Self scratch, self lick, social groom
Self-directed behaviour	Self scratch, self lick, touch neck, rub neck
Above-neck directed behaviour	Touch neck, touch conspecific's neck, rub neck
Inactivity	Inactivity
Aggression	Aggression

A pilot study was then conducted to assess the suitability of the sampling method, specifically continuous sampling of the whole cage, and to ensure that the time periods for observations were sufficient for data analysis purposes.

The experimental design involved two replicates; each replicate consisted of recording continuous behavioural data for each cage at one of two time slots, 19.00-20.00 or 20.00-21.00 which had been identified as the most active periods during the pilot study. The order in which the cages were observed was alternated to prevent any order effects. The control/baseline stage for replicate one was taken at 19.30-21.00 or 21.30-23.00 each night (time slots were alternated on each day) making a total of 30 hours of observation for replicate one. Before the treatment (post-collar stage) was applied to replicate one, the time slots for data collection were altered and reduced to 19.00-20.00 and 20.00-21.00 due to unforeseen circumstances, making a total of 20 hours of observations. However, only the first 20 hours of observations for the baseline data in replicate one were included in data analysis to ensure equal amounts of data for all replicates and stages. Replicate two followed these new time slots and a total of 20 hours of observation for each stage of the study.

Frequency was recorded for all behaviours except for stereotypical behaviours (pace, sway, mutur) and inactivity, for which duration was recorded.

Each replicate had one control stage which lasted for ten days, and one treatment stage which was also ten days long. During the Control period (pre-collar) no alterations were made to the lorises in order to set a baseline for comparison with the treatment. For the Treatment period (post-collar), all lorises were fitted with an inactive collar and placed back in their respective cages.

2.7 Pathologies

During the study, one loris, namely Jazzmin (Sinar), within the second replicate had to be removed for three daylight hours and operated on due to a tooth infection. The loris was put back into the cage, still wearing its collar so that the group dynamics remained the same, but the data from this animal was discounted to avoid an effect of treatment on her behaviour, making a new sample size of 15 rather than 16 lorises.

2.8 Data Analysis

Data was analysed using Microsoft Excel 2013 and Minitab[17]. Excel was used for data input, contingency tables, histograms and descriptive statistics, whilst Minitab was used for parametric and non-parametric statistics. The paired t-test for normally distributed data and the Wilcoxon test for data that is not normal and cannot be improved by transformation were used. Regression and the relationship between day and behaviour frequency was analysed using general linear model (GLM) and Pearson's correlation.

3. RESULTS

3.1 Stereotypical behaviour

3.11 Effect of radio tracking collar on duration of stereotypical behaviours

A Wilcoxon test was conducted to compare the durations of stereotypy from the pre collar condition to that of the post collar condition. No difference was found between the 2 conditions, although there was a tendency for lorises to engage in more stereotypical behaviour in the pre collar stage of the study (Median diff=0.00; T=2.0, N=15, p=0.789). This suggests that fitting a loris with a collar reduces the amount of time spent engaging in stereotypical behaviour (Figure 3.1).

Figure 3.1: Histogram displaying the mean (±S.E) duration (mins) of stereotypy pre and post collar.

3.12 Habituation of stereotypy

Since only three of the fifteen lorises performed stereotypy, GLM was not used in this instance. Instead, Pearson's correlation was used to assess whether there was an association between day and duration of stereotypy. The histogram (Figure 3.2) shows a peak towards the 5^{th} day before durations decrease, however upon further analysis, there was no relationship between day and stereotypy duration for the three lorises involved (rp=-0.235, p=0.210).

Figure 3.2: Histogram displaying mean (±S.E) stereotypy durations across the days for the post collar condition.

3.2 Grooming behaviour

3.21 Effect of radio-tracking collar on grooming behaviour frequency

A paired t-test was conducted to compare grooming behaviour frequency for the pre and post collar conditions. There was significantly more grooming behaviour within the post-collar (M=4.45, SD=1.43) condition compared with the pre-collar (M=3.31, SD=1.38) condition; (T=2.21, p=0.044). These results suggest that collaring the lorises had an effect on grooming behaviour. Specifically, that when a collar is fitted to a loris, grooming behaviour increases (Figure 3.3).

Figure 3.3: Histogram displaying mean (±S.E) grooming frequency pre and post collar.

3.22 Habituation of grooming behaviour

A GLM was conducted to run a regression analysis on post-collar grooming behaviour. Results showed a highly significant effect of day on grooming behaviour (R^2 = 48.57, DF=1, F=49.69, P=<0.001) with grooming behaviour decreasing over the days (Coef = -0.067). These results suggest that whilst grooming behaviour increases with the fitting of a collar, this behaviour reduces as the days progress, suggesting habituation to the collar (Figure 3.4). It is worth noting that whilst the histogram below shows that there were increases in grooming behaviours on the 8th and 9th day, the GLM analysis has adjusted for individual animals and found a significant decline in frequency over the days.

Figure 3.4: Histogram displaying the habituation of mean (±S.E) grooming frequency across the days for the post collar condition.

3.3 Self-directed behaviour

3.31 Effect of radio-tracking collar on self-directed behaviour frequency

A paired T-test was conducted to compare self-directed behaviour frequency for the pre and post collar conditions. There was significantly more self-directed behaviour within the post collar (M=90.9, SD=51.4) than the pre collar (M=33.7, SD=34.8) conditions; (T=3.84, p=0.002). These results suggest that collaring lorises had an effect on self-directed behaviour. Specifically, that when a collar is fitted to a loris, self-directed behaviours increase (Figure 3.5).

Figure 3.5: Histogram displaying the mean frequency (±SE) for self-directed behaviour frequency pre and post collar.

3.32 Habituation of self-directed behaviour

A GLM was conducted to run a regression analysis on self-directed behaviour over the days. We found a highly significant effect of day on self-directed behaviour (R^2=34.03, DF=1, F=23.71, p=<0.001), with self-directed behaviours decreasing over the days (Coef=-0.059). This suggests that as the study progressed, self-directed behaviours that arose as a result of the collar being fitted reduced (Figure 3.6).

Figure 3.6: Histogram displaying the mean (±SE) self-directed behaviour frequency across the days for the post collar condition.

3.4 Above-neck directed behaviour

3.41 Effect of radio-tracking collar on above-neck directed behaviour frequency

A Wilcoxon test was conducted to compare the frequency of above neck directed behaviours from the pre collaring condition to that of the post collaring condition. There was a significant difference between the two conditions, with such behaviours only arising in the post-collaring period (Median diff=26.5; T=120, N=15, p=o.oo1). These results suggest that when lorises are fitted with a collar, above-neck behaviours arise (and are prominent) as a result of the novel external stimulus (Figure 3.7).

Figure 3.7: Histogram displaying the mean (±SE) frequency for above-neck directed behaviours in the post collar period.

3.42 Habituation of above-neck directed behaviour

A GLM was conducted to run a regression analysis on above-neck directed behaviour over the days. We found a highly significant effect of day on above-neck directed behaviour (R^2=48.57, DF=1, F=49.69, p=<0.001), with above neck directed behaviour decreasing over the days (Coef=-0.067). These results suggest that as the days progressed, the lorises habituated to the collar and so above-neck directed behaviour reduced (Figure 3.9).

Figure 3.9: Histogram displaying the mean frequency (±SE) for above-neck directed behaviours across the days within the post-collar condition.

3.5 Inactivity

3.51 Effect of radio-tracking collar on duration of inactivity

A Wilcoxon test was conducted to compare the inactivity durations for the pre and post collar periods. There was no difference between the two conditions, although there was a tendency for lorises to spend more time in states of inactivity during the post collar condition (Median diff=0.00, T=10.0, N=15, p=0.590).

3.52 Habituation of inactivity

Since there were only 6 recordings of inactivity, it was decided that further regression analysis was not suitable. The histogram (Figure 4.1) shows that there was a slight increase in inactivity with the fitting of the collar, but since this increase was slight, and that recordings of individual incidences of inactivity were so low, further interpretation here was not viable.

Figure 4.1: Histogram displaying mean (±S.E) inactivity duration pre and post collar.

3.6 Aggression

3.61 Effect of radio-tracking collar on aggression frequency

A Wilcoxon test was carried out to compare the frequency of aggression from the pre collar condition, to that of the post collar condition. There was no difference in frequency of aggression between the conditions, although there was a tendency for lorises to engage in more aggressive behaviour in the post collaring period (Median diff=0.50, $T=28.0$, $N=15$, $p=0.183$). A histogram of the aggression frequencies pre and post collaring (Figure 4.2) shows that despite the small numbers, aggression did triple in post collaring period.

3.62 Habituation of aggression

The data set was too small to infer any statistical analyses for regression over the days, but since aggressive behaviour only occurred on two of the ten days, day one and day four, within the post collaring period, compared to day seven in the pre collaring period, it is clear that any possible relationship between aggression and day is unlikely.

4. DISCUSSION

4.1 Stereotypical behaviour

It was hypothesised that fitting a loris with a radio collar would lead to increased stereotypical behaviour. The results signified that there was no significant difference between the duration of time spent engaging in stereotypical behaviour between the pre and post collaring conditions thus the null hypothesis $H1_0$ (fitting a loris with a collar had no effect on behaviour) is accepted.

Despite the lack of a significant result, descriptive statistics did illustrate how stereotypy durations decreased upon fitting a collar, which was an unexpected outcome. Stereotypy is documented as a means by which an animal responds to an unusual environmental situation (Danter, 1991), often linking with the coping hypothesis, whereby the environmental stressor instigates a coping response in the form of stereotypical behaviour (Levine at al., 1978), The fact that stereotypy reduced with the collar might suggest that the collar was somewhat insignificant in terms of its stress provocation, however a more likely explanation of this unexpected result might lie in the fact that the lorises activity budget post-collaring was taken up with new behaviours which arose as a result of the fitting of the collar and the subsequent irritation, namely ‘above-neck directed behaviours’. These behaviours only arose with the fitting of the collar, thus the loris’ activity budget was re-adjusted to account for these new behaviours. Further interpretation lies in the findings from previous environmental-enrichment research in primates, whereby stereotypical behaviour in captive chimpanzees reduced when animals were provided with enrichment that could be manipulated by the animal (Berkson et al., 1963). Similarly, above-neck directed behaviour included ‘touch collar’, ‘touch conspecific’s collar’ and ‘rub neck’, all of which can be argued to be attempts to manipulate the collar itself, and thus, providing a means of reducing stereotypy.

The subject of the welfare of the animal must be assessed, since the collar may reduce the animal’s motivation to perform stereotypy, but the collar itself is a likely cause of discomfort due to its somewhat intrusive nature. Furthermore, whilst stereotypy may reduce, the fact that the loris is spending a significant portion of its activity budget engaging in above-neck directed behaviours, which have arisen solely as a result of the collar being fitted, means that upon release, if these behaviours remain prominent, it is likely to affect that animal's chances of survival since less time is devoted to normal behaviours.

Results showed that there was no significant relationship between day and duration of stereotypy and so the null hypothesis $H2_0$ (there will be no relationship between day and behaviour post-collaring) is accepted. It is worth noting that descriptive results did demonstrate that durations reduced after an initial peak towards the fifth day of observation, suggesting possible normalisation of behaviour, although more data would be necessary to accurately explore this question.

Promisingly, within the present study, stereotypy was only recorded for lorises that were prone to such behaviours in the pre-collar stage, which suggests that lorises that were not initially disposed to abnormal behaviour, are unlikely to develop this as a result of being fitted with a collar, which hold positive connotations in terms of the animal's welfare.

4.2 Grooming behaviour

The results demonstrated that there was significantly more grooming behaviour upon the fitting of the collar, thus the hypothesis $H1_b$ (grooming behaviour frequency will increase post-collaring) is accepted. This supports previous findings assessing the effect of radio collars on avian wildlife, where increased preening behaviour has was reported as a result of the fitting of the collar (Siegfried et al., 1977, Greenwood & Sargeant, 1973).

Grooming is documented in ethology and neurobiology literature as a means of removing a novel stimulus (Spruist et al., 1992) which is likely to be unfavourable to the animal (Nicolt et al., 1980). This implies that the radio collar created a sense of irritation within the loris, increasing licking and scratching behaviours as a means to reduce this irritation, further supporting the view that autogrooming and allogrooming in primates is primarily utilitarian (Barton, 1985).

The results confirmed that there was a significant effect of day on frequency of grooming, with such behaviours reducing over the days and so the hypothesis $H2_a$ (behavioural changes post-collaring will habituate over the days) is accepted. This supports previous radio telemetry literature where initial changes in behaviours were normalised after a period of adjustment (Boag, 1972; Nenno & Healy, 1979; Sayre et al., 1981) suggesting that lorises are capable of accepting the radio transmitter after acclimatisation without eliciting behavioural changes, which is promising in terms of the welfare of the animal, and the suitability of the collar as a tool for primate conservation.

4.3 Self-directed behaviour

Behaviours that were self-directed were categorised together and compared for alterations between the pre and post collar stage; self-directed behaviours were significantly higher with the fitting of the collar, thus the hypothesis H1c (self-directed behaviour frequency will increase post collaring) is accepted.

It is documented that self-directed behaviours in primates are strongly linked with stress and anxiety (Maestripieri et al. 1992, Schino et al. 1996), with self-directed behaviours being reported to increase when primates experience stress-inducing circumstances, such as removal of offspring (Maestripieri, 1993) and social dominance conflict (Castles et al., 1999). Thus it is logical to interpret the present increases in self-directed behaviour as a sign of the potential stress collaring a loris can induce.

Self-directed behaviours were found to significantly decline over the days, and thus the hypothesis $H2_a$ (behavioural changes post-collaring will habituate over the days) is accepted, further supporting the notion that upon a period of adjustment, initial increases in behaviours can be habituated prior to release and the initial welfare concerns resolved.

4.4 Above-neck directed behaviour

Above-neck directed behaviours were added to the ethogram by the observer in anticipation of behavioural changes that might arise as a result of the collar being fitted. Such behaviours only appeared in the post-collaring period, and results demonstrated that there was a significant increase in such behaviours. Thus, the hypothesis H1c (self-directed behaviour frequency will increase post collaring) is accepted.

Collar-directed behaviours have been noted in avian radio-telemetry literature, where attempts to take off the radio transmitter were recorded (Perry, 1981; Hodge, 1999), reinforcing the present findings. This suggests that collaring is likely to cause initial irritation to the animal, which if not habituated, might reduce chances of survivorship upon release. Furthermore, such strong behavioural reactions to collaring imply reduced welfare.

Results from regression analysis demonstrated a significant decline in above-neck directed behaviour over the days and so we accept the hypothesis $H2_a$ (behavioural changes post-collaring will habituate over the days). This suggests that initial welfare concerns can be resolved since the potential for these behaviours to be normalised is strong, and habituation of these behaviours possible.

4.5 Inactivity

The results demonstrated that there was no significant difference between the pre and post collar inactivity durations, and so the null hypothesis $H1_0$ (fitting a loris with a collar had no effect on behaviour) is accepted.

Durations of inactivity were slightly greater in the post-collar period, which can be likened to research assessing the impact of radio collars on the behaviour of wild mice, where significant decreases in activity were documented (Pouliquen et al, 1990). However, incidences of inactivity were too few to infer any further suppositions.

These findings suggest that upon release into the wild, radio collars will not lead to high levels of inactivity, which would have been a serious threat to rates of survivorship. Thus, since it is documented that research cannot prove that radio collars do not adversely impact the animal's behaviour, but rather, can prove that no such impact was noted (White & Garrot, 1990), it is logical to assume that radio collars do not significantly increase inactivity in slow lorises.

4.6 Aggression

There was no significant difference in frequency of aggressive behaviour between the pre and post collaring stages, thus the hypothesis $H1_0$ (fitting a loris with a collar had no effect on behaviour) is accepted. These findings suggest that aggression is unlikely to impact on a loris' behaviour when released whilst wearing a collar, and thus should not be an issue in terms of welfare and survivorship post-release.

4.7 Implications for welfare

The present study has illustrated that fitting a loris with a collar does lead to significant increases in grooming behaviours, self-directed behaviour and above-neck directed behaviour, all of which are appear to be an attempt to reduce the irritation caused by the novel stimulus. This is a serious concern in terms of the welfare of the loris, since radio telemetry literature assumes that the behaviour of the collared animal is representative of an uncollared conspecific, and so significant behavioural changes cause a misrepresentation of the animal's behaviour if it were to be monitored.

Furthermore, such behavioural changes impact upon the normal activity budget of the loris, meaning that time spent engaging in other behaviours are reduced to account for such increases, which might affect the animal's survivorship post-release.

Optimistically, results from the present study have demonstrated how these initial increases in grooming, self-directed and above-neck behaviours reduce over time, suggesting normalisation of behaviour and acceptance of the collar, thus it is viable to suggest that after a period of acclimatisation, the welfare implications of the said collar and the negative consequences it might have on survivorship post-release, are reduced.

Stereotypical behaviours reduced with the fitting of the collar, suggesting that the novel device offered a distraction to the normal constraints of the captive environment, where the activity budget was re-adjusted to account for the irritation caused by the collar, thus more time was spent engaging in the grooming, self-directed and above-neck behaviours. Since only three lorises across the study performed stereotypy, further research into this domain is encouraged.

The study did suggest that fitting a collar onto a loris does not lead to significant increases in inactivity or aggression and thus offers a promising outlook for reintroduction protocol.

4.8 Suggestions for IAR

The findings from the study reinforce IARs ongoing practice of fitting release candidates with collars a month prior to release. This study has shown that lorises demonstrate an ability to adjust to the collar and habituate initial behavioural changes over a period of acclimatisation. Ensuring that all abnormal are habituated fully will ensure that welfare and chance of survival are high. Ensuring behaviour is normalised prior to release also benefits the researcher, since the observations taken post-release are designed to represent that of a loris as if it were uncollared (Mech & Barber, 2002).

5. CONCLUSION

Radio collars are an integral aspect of the primate reintroduction program, and are unavoidable in terms of their benefit. The present study has demonstrated the effect playing host to this device has on the behaviour of the slow loris. Specifically, increases in grooming, self-directed and above-neck behaviours can be expected, but results have demonstrated how behavioural changes have been habituated after a short period of acclimatisation, suggesting that any initial welfare concerns as a result of the collar can be resolved.

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CRITICISM OF METHODOLOGY

The results illustrate that fitting a loris with a radio collar does indeed affect their behaviour, and whilst this initial change in behaviour might prove detrimental to their survival post-release, the study has shown how behaviours habituate after a period of acclimatisation, which reinforces IAR's practice of fitting the release-candidates with radio collars a month prior to release so that the animals can adjust to the external stimulus. I would suggest to IAR, if it is not done already, that the 'above-neck directed behaviours' I described be added to the ethogram so that keepers can ensure that these behaviours have been habituated prior to release. Ensuring that these behaviours have been habituated will mean that the loris can fully engage in normal behaviours, which are likely to be of great importance in terms of their survival post-release.

Whilst the results have yielded interesting and often significant findings, it must first be acknowledged that analyses must be approached with caution. Data was purposefully analysed as n=15 rather than n=4, reflecting the number of lorises rather than the four groups. This was done with careful consideration and after seeking advice from my supervisor and my statistic's lecturer. I felt strongly that individuals were influenced independently by the collar and after trying a few tests, results were interesting and significant, but I do acknowledge that there is a possibility of a group effect. Analysing data as n=4 would have almost certainly yielded insignificant results, so it is worth using the significant findings from this paper, and then undertaking further research in the future to assess whether these findings are also present when group effect is taken into account. This should involve a larger number of groups, so as to warrant statistical testing.

The present study was not void of weaknesses in the methodology. First and foremost, the International Animal Rescue centre exists as an animal welfare organisation rather than a research facility, and so the experimental design was fitted around the existing schedules and constraints. Cages were full since recent intake had peaked following a large rescue operation. The head keeper was adamant that lorises are able to be fitted with a collar only when they are inhabiting one of the few larger cages, but since the sanctuary was full and opportunities to move groups dependent upon the individual animal’s wellbeing, it transpired that cage availability was limited. Furthermore, discontinued collars were not in abundance and so collars to use in the study were limited. Thus, the study made use of two replicates, with different animals used in the second replicate, but re-using the two available larger cages. This was in hindsight a methodological weakness, since it meant that time spent recording the behaviour of the lorises was reduced to account for the second replicate. Spending a longer period of time on each group would have yielded stronger results, especially in terms of habituation, and in suit of the IAR policy to fit lorises with collars for one month prior to release.

Following on from the constraints of working in the field, I was unable to control for sex and age differences. Groups were pre-formed and stable, and since the lorises had been rescued from various situations, exact age was unknown. This does mean that the experimental design was not as strong as it could have been had these factors been controllable.

Observations were recorded outside, and so uncontrollable variations in weather, noise, keeper disturbance were unavoidable and may have affected the behaviours exhibited by the lorises. Furthermore, despite standing at a considerable distance and the use of infra-red head lamps, there was an issue with observer presence where it was clear that the lorises were often aware of the observer, which may have affected their behaviour. This could be resolved in future through the use of video recording devices positioned in suitable places within the cage.

Stereotypy was analysed as one of the aims of the experimental design, and it transpired that only three of the 15 lorises performed stereotypy, so analysing the impact of radio-collaring the lorises and using the data from these three lorises is perhaps a weakness in terms of the methodology, and a possible overrepresentation of stereotypy by these three lorises. Further analysis of the interacting between stereotypy and radio collaring should ensure that a larger sample size is available.

In conclusion, the study aimed to assess whether collaring a loris affected aspects of their behavioural repertoire and the study, despite these methodological weaknesses, succeeded in answering these questions. This results have provided a strong basis to go on and undertake further research into these effects, but ensuring that more groups are available, and that observations are taken for a longer period of time, would be a valuable amendment to make if future research was undertaken. Following that, ensuring that data in analysed per group will warrant analysing for group effect.

PERSONAL CONTRIBUTION

The experimental design was organised and chosen by Lucy Gregson with the supervision of Prof. Natalie Warren and Dr. Susan Jarvis.

Statistical analyses were carried out by Lucy Gregson with the supervision and support of Dr Ian Handel and Dr Rick D'Earth. Dr Rick D'Earth advised Lucy Gregson when problems arose, specifically the use of pivot tables and problems that arose with the habituation histogram for grooming behaviour.

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