‘PROTECTING OUR LOCAL BIODIVERSITY THROUGH SCIENCE AND RESEARCH’

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POPULATION ASSESSMENT

Jamaican Hutia (Coney) Assessment and Conservation management plan, Blue and John Crow Mountains National Park

prepared by Orlando F. Robinson

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1.0 Study objective

In keeping with their Blue and John Crow Mountain National Park (BJCMNP) Management Plan for 2017/18 – 2026/27, Jamaica Conservation and Development Trust (JCDT) issued a Request for Proposal (RFP) to achieve the following primary objective;

- To conduct a study of the Jamaican Hutia (*Geocapromys brownii*), this study inclusive of field work, was to determine the population size of Jamaican Hutia in the selected area and also to use field findings, to aid in the preparation of a Conservation Management Plan for the species.

The focus area of the study was to be in Moore Town with possible consideration for the Cunha Cunha trail.

2.0 Background of the research project

The focus area for the study, Moore Town, which is on the outskirts of the national park, houses traditional communities of Maroons, who have a longstanding history of using this animal as a food source (pers.comm). In recent years, Maroons in the Moore Town community have reported increased interactions with the species through sightings, damage to their agricultural crops and non-target kills by pig hunting dogs. The community members are of the belief that the coney population (the animal is locally referred to as" Grazies") has grown to such numbers in recent years that they are noted closer to human populations and have also been feeding on local agricultural crops.

This prompted the JCDT along with cooperation from the Moore town community to investigate these increased interactions with an aim to determining an estimated population number in the area. Further to this, given the increased conflict between the species and farmers in particular.

It was also anticipated the study would provide additional baseline information on the wild population such as diet, breeding habits and other behaviour as well as information on genetics, physiology (blood chemistry) and parasitology.

Information gained would inform and assist with the development of conservation strategies in the form of a draft Conservation management plan for the species.

The project was designed to last 18 months, starting in January 2018 of which 12 months was dedicated to field work. Field work was to involve direct sampling of the target species through proposed methods outlined in the document 'Research Methods'. All proposed methods were aimed at determining an estimated population index such as abundance and/or density of the species in the study area.

3.0 Modification to research methodology.

The methods that were originally proposed and documented can be seen in the original proposal, “Research and approach methods”. However, due to various challenges not all the proposed methods were able to be executed. The sections that follow outline some of these changes and/or limitations.

3.1 Redefinition of project area

The focus of the study was in the Moore Town community and possibly the Cunha Cunha trail. However, given the limited resources in terms of sampling equipment and personnel, consideration of the latter was quickly eliminated.

In the delineation of the Moore town community an enumeration district (ED) was used to show clear demarcations of area and its corresponding human population numbers. This earlier delineation saw the inclusion of areas such as Millbank and Corn Puss gap.

However, this area was very extensive and again limitation of resources and ability to access these locations led to a contraction of the study to a pilot study area in Moore Town.

This area was defined by two primary considerations;

- how it was used by forest users and
- strong likelihood of finding the target species.

This delineation was guided by Maroons, through their local ecological knowledge, and location coordinates were recorded using GPS. These coordinates where then connected to create a defined study area.

Given the rarity of the species, the objective was to maximize the field effort by employing a method to increase the likelihood of information gathering, as opposed to a more randomized approach of site selection and sampling.

Figure 1 : Original study delineation using an Enumeration District

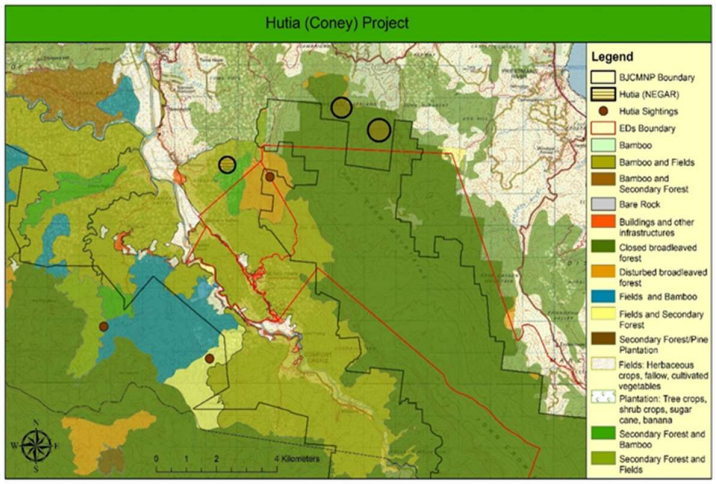
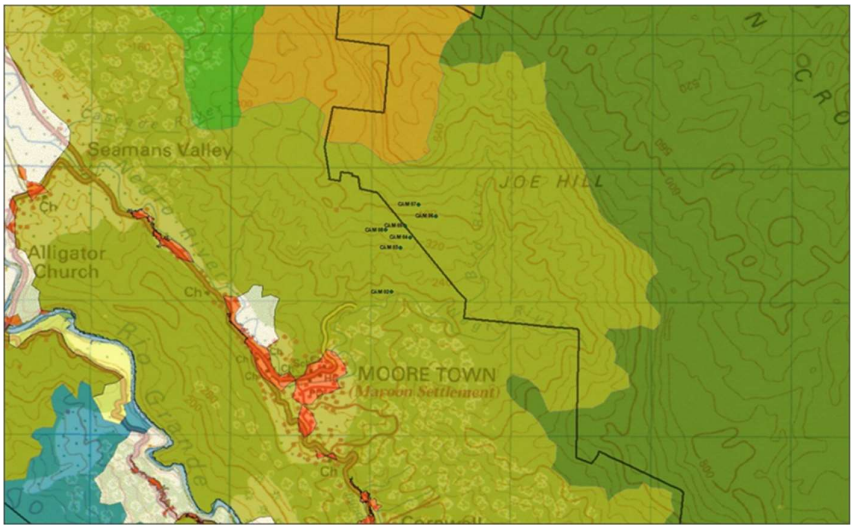


Figure 2 : Camera concentration in newly considered Core study area



3.2 Data collection

3.2.1 Literature research

a) This included the review of existing studies to determine best practices for sampling methodology.
b) Historical as well as current baseline data on the physical settings for the study area was also conducted to include rainfall, soil types, vegetation cover, land use etc.
c) Community memory and knowledge

Local community knowledge was also important in providing insight into various components of the project;

I. Behaviour of the local coney population
II. Distribution of the population and determination of camera sites
III. Factors influencing human /animal conflicts as likely pathways to resolution

3.2.2 Empirical data collection (Population assessment)

3.2.2.1 Capture –mark –recapture (CMR) activity and Random Encounter Model (REM)

Ten (10) camera traps were deployed multiple times over the extended study area. Camera trap placement was not randomized but based on potential den sites for the target species. A minimum of two weeks was the observation period but one month was the more often used period given the increased likelihood of detecting activity for the species.

Ten (10) live traps were obtained but due to procurement issues, their deployment in the field was very limited. Three (3) were deployed with the assistance of another researcher, Anna McPherran from the Stony Brook University.

Unfortunately, the target species was not caught in the live traps, although other non-target species such as rats were caught.

The CMR method could not be employed due to the absence of data.

Instead camera trap data was used to establish a den density based on the site size and a rough correlation with the number of individuals that may occupy den sites.

3.2.2.2 Occupancy models

A different approach is suggested by Royle and Nichols (2003), where the variation in detection probability of a species in space is used to estimate its abundance at each sampling point. This mode is essentially a variation on regular occupancy models and only requires detection/non-detection data and does not require the identification of individuals. The limitation of the occupancy survey is that it doesn't generate real information about absolute abundance.

This was also limited by the absence of certain data.

Camera trap data was used to establish a capture rate, which represents the number of capture images of coneys / total camera trap nights. This will provide a relative abundance index. The assumption is that the number of images taken per unit of time contains information about the population size. If the population changes increase or decreases the index should reflect, whereby an increase in population should relate to an increase in abundance, which in turn be reflected as higher incidences of capture images of the target species. The index is proportional to and reflects abundance, but it is not a true estimate of the actual population size.

3.2.2.3 Faecal indices

This method has been applied to larger mammals such as deer where there is a correlation between faecal counts and animal density (Forsyth et.al 2007).

Unfortunately, this index could not be considered, as during the study we were unable to find any significant amounts of faeces or faeces into good condition. This could have been due to two factors;

- The animal's behaviour may not allow for habitual defaecation in areas such as at the entry to den sites or these deposits may be habitual but subterranean, in the den itself where it is not visible or accessible
- The conditions of the habitat may be favouring quick breakdown of faeces by facilitating the growth of fungi or bacteria.

3.3 Baseline data (Biological parameters)

This data collection was based on the assumption that wild individuals would be live trapped and samples be taken for analysis.

Unfortunately, no individuals were caught in live traps and no samples were able to be collected.

3.4 Community questionnaire

A questionnaire was designed for this study to gather information on the following areas;

1. Attitudes and opinions
2. Hunting, eating and selling coneys
3. Farmer /coney conflict
4. General information on coneys

The aim was to the extract information to assist with the development of the Conservation management plan as well as any quantitative data as it related to hunting that could aid with the determination of population variables. A hundred (100) random interviews were conducted, divided equally between residents of Cornwall Barracks and Moore Town. Discussion of the findings can be seen in Section 4. The sample questionnaire can also be seen in the Appendices.

4.0 Field results and analysis

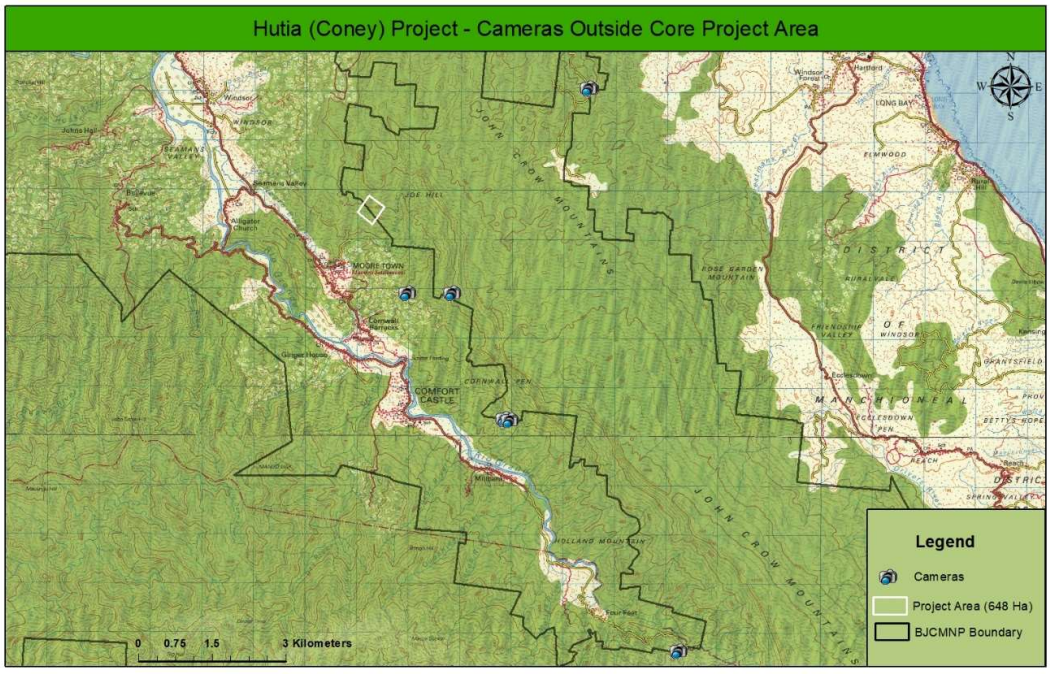
4.1 Target species distribution across study area

Cameras were deployed across four distinct areas/location during the study. Moore town, which is described as the core study site and three other locations; Cornwall Barracks, Millbank and Cambridge Backlands.

Contrary to earlier reports from Maroon members of coney sightings closer to communities of Moore Town, the study has not indicated the species occupies or visits these areas. Through camera trapping and use of local knowledge, all recorded evidence of their presence was at higher elevations, 1000ft and above. The species was found in more established forest with rocky outcrops that provided the species with the, necessary burrows in which to retreat during the days as well variety of plant for foraging. Many were located close to farming plots, but this may be more and issue of human encroachment as opposed to the species seeking out farm plots in their home ranges.

The study was unable to determine actual home ranges, as individual identification was not possible using camera traps as the animals have no unique markings.

Figure 3 - Map showing camera deployment across entire study site.



Note: In the legend, the Project area indicates the core study area and the camera icons indicate sites outside the core area. The project size should be 16ha

Figure 4 - Map showing camera deployment within core study site.

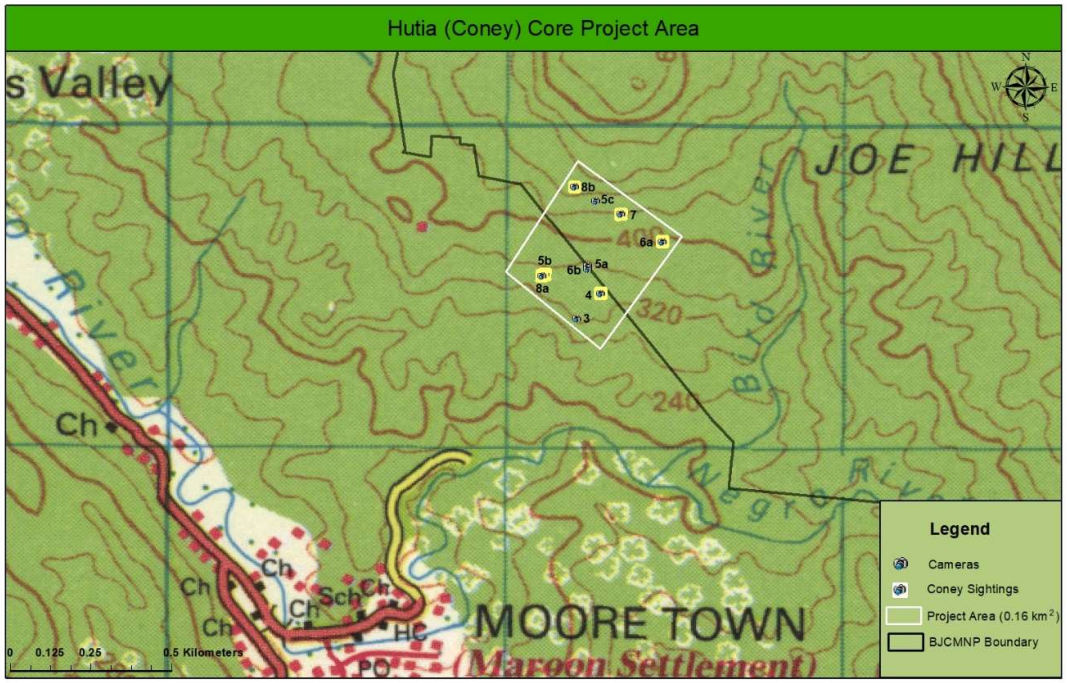


Table 1- Showing presence/absence of target species at camera sites.

Site locations	Number of camera locations	Number of camera locations with capture images of target species	Percentage camera hits
Moore Town	11	6	55%
Cornwall Barracks	1	1	100%
Millbank (including Cornpuss Gap)	4	2	50%
Cambridge backlands	1	0	0%

4.2 Den density / Individual numbers

As indicated before, the camera traps were used to identify possible den sites. Of the information recorded, four (4) of the six (6) locations with positive identification of the species could be determined to be dens. Positive identification was based on animals visible going into cavities or recesses that could be den entries.

The total study site, based on local ecological knowledge to find potential den sites with a small buffer of around 10m, was 16ha/ 0.16 km^2.

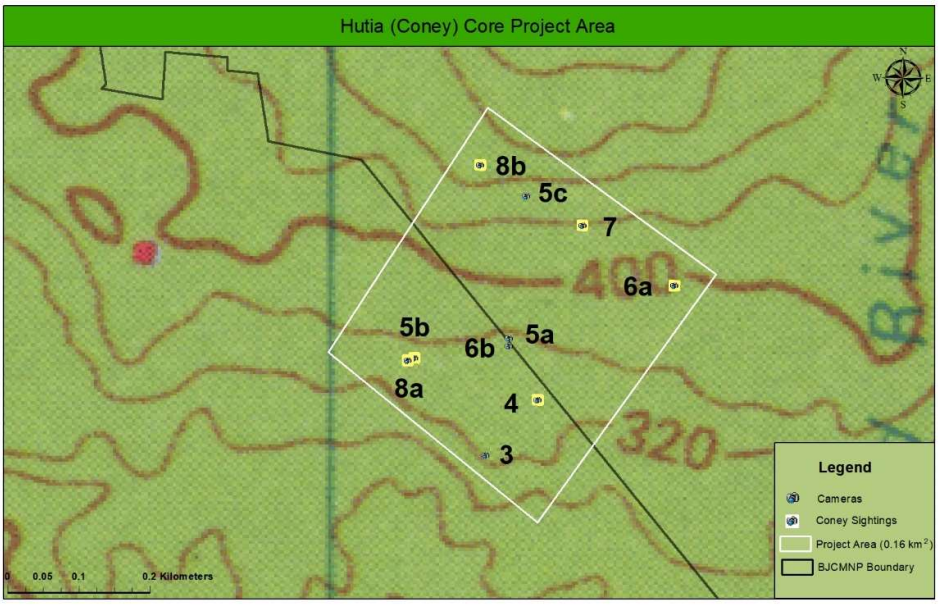
Indicating a den density of 4 dens per study site size of 16ha/ 0.16 km^2. Based on camera trap data coney sightings ranged from 1 to no more than 4 individuals captured in a frame at any one time at any one site.

The very loose assumption is that each den could be supporting 1 to 4 individuals. So, minimum number of individuals based on dens could range from (1X4) = 4 to (4X4) = 16.

Density at the minimum value could range from 0.25 individuals per ha to 1 individual per ha

It is also assumed that each individual seen at each site could be the same animal seen each time. This assumption could be true being based on the literature suggesting consistent burrow/den use as well as longterm placement of a camera at one location that repeatedly recorded animals over time. Footage suggested the animals may be the same animals. In at least one location, one animal could be positively identified because of missing hair on its flank but more distinctly only having one eye. The animal appeared repeatedly at the sight over time.

Figure 5 - Map of enlarged core study area



4.3 Relative Abundance Index/Photographic hit rates

It is plausible that the number of photo trap records of the target species is correlated to its abundance and as such could give an indication of its relative abundance. Two indices could be considered;

Relative abundance index- which is based on the number of pictures of the target species per 100 trap nights or the number of photos of the target species as a percentage of all species photographed. RAI – for each species = all detections for each species summed up for all cameras over all days x 100 then divided by total number of camera trap nights e.g. 50 detections (over 15 cameras for 10days) x 100 divided by 150 camera days (total number of cameras x total number of days)

Figure 6 - Relative abundance at four different den sites

Locations	Number of photo images	Number of trap nights		
1. Peripheral den				
2. Hunter den				
3. Highest den				
4. Stable den				

Figure 7 - Relative abundance at one den site over time

	Month 1	2	3	4	5	6	7	8	9
# of photo images									
# of trap nights									

It is also intuitive that hit rates obtained from camera traps are related to abundance, as encounters between animals and cameras are expected to increase with increasing density or population size (Rovero and Marshall 2009; Watkins et al. 2010; Hofmeester et al. 2016). Howver, using non-calibrated abundance indices, particularly for threatened species, bears a strong risk of making incorrect decisions and inferences about a population (Sollman et al. 2013). They have become so prominent that computer programs that exist purely to calculate hit rates have also been developed, such as Wild Photo Trap created by Kenney

4.4 Reproduction and body condition.

General review of camera trap footage showed individuals of good body condition. Most individuals appeared to be in good musculature and coat condition seemed fair. There were not obvious signs of injuries, with the exception of one individual that had only one eye but nonetheless in good condition.

As for the evidence of different age cohorts, only one site showed the presence of a juvenile. Only one individual was recorded at the same location about eight (8) months apart. Based on its relative size, it is suggesting its not the same animal. In addition, the cameras recorded four animals at once in a frame, one of which was a juvenile. This is suggesting a bonded pair, offspring from a previous period (8 months earlier) and the current offspring.

There was no other evidence of reproduction noted from any of the sites at any of the locations, even those outside the core study area.

Figure 8 - Photos showing juvenile coney

4.5 Human interference /Influence of hunting

As well as being documented through the survey instrument, there was evidence of hunting noted during the field activities. Coney traps were noted in Millbank and Cornwall Barracks and on one occasion in Moore there was an encounter with a Coney hunter and his dogs

Figure 9 – Photos of coney traps set up in study area

In addition to hunting using traps, there also seems to be a technique of breaking dens open with some type of blunt instrument. The animal may then be impaled or broken rocks may facilitate the access of the hunting dogs

Figure 10 - Photo showing hunting technique of breaking open limestone dens

There was also evidence of field equipment being tampered with to facilitate coney hunting. At one location, a camera was swivelled away from the entry to the den to allow breaking into the den.

Figure 11 - Photos showing human interference through tapering with cameras to avoid hunting detection.

4.6 Biological sampling

This was intended based on the study and involved the following;

- Bio-sampling methodology/protocol
    a. Phlebotomy
    b. Genetic sample collection
    c. Collection of faecal samples
    d. Post-mortem protocol

Unfortunately, bio-samples were not obtained during the study as no live animals were trapped so no field-tested recommendations or results can be made at this time.

Preliminary results were obtained from faecal samples from captive animals at the Hope Zoo. Samples were collected as a group sample and sent to a veterinary lab for analysis. Investigation was to determine the presence of internal parasites particularly, roundworms, tapeworms and protozoa such as Giardia. Test results indicated no presence of these but some of this may be attributed to the Hope Zoo's parasite control protocol.

Samples were also collected from the field to compare results but the sample that was collected was too degraded to be used for analysis. Although dens were identified, droppings were not readily seen on the outside.

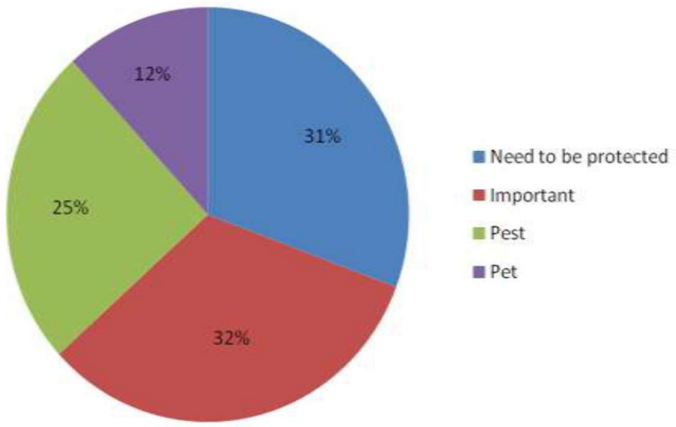
No biochemistry values were determined since no samples were collected during the period of the study. No live animals were trapped.

4.7 Questionnaire Findings

4.7.1 Background

The figure below was taken from the NEPA Survey conducted 2008-9. The pie chart result was in response to Public Perception of the Jamaican Coney for the development of a coney management plan.

Figure 12: Pie chart of Public perception of the Jamaican coney, 2009



(Source: Jamaica Hutia Management Plan 2010, NEPA.)

This study developed an exhaustive questionnaire to revisit this and many other questions vital to assessing the population and the impacts of human influence. The questionnaire looked at four main areas;

1. Attitudes and opinions
2. Hunting, eating and selling coneys
3. Farmer /coney conflict
4. General information on coneys

One hundred (100) questionnaires were administered, equally divided between the communities of Moore Tn and Cornwall Barracks. A copy of the detailed questionnaire can be seen in the Appendix.

The demographics saw a group ranging from ages 17 – 71 years with ages 19, 47 and 52 representing the major grouping. Of this group the majority were males, accounting for 60% of those interviewed.

Most of the interviewees were from the area, having been born there and those that could be considered outsiders have been living there for a significant period of time

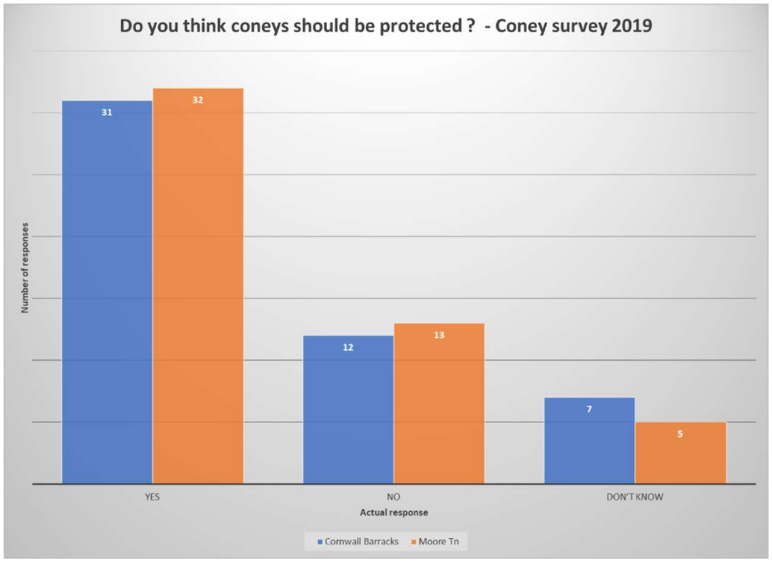
Occupations included; students, shopkeepers, labourer, mason, welder, farmer and, included one self-identified as a coney hunter. Farming was the predominant means of livelihood across the communities and featured as a stand-alone means of income or supplemental income to other occupations.

The majority of these persons were in the <25k monthly income bracket, which accounted for about 50% of the sample size, the next income earning bracket was 26-50k monthly, accounting for about 28%.

4.7.2 Attitudes and Opinions

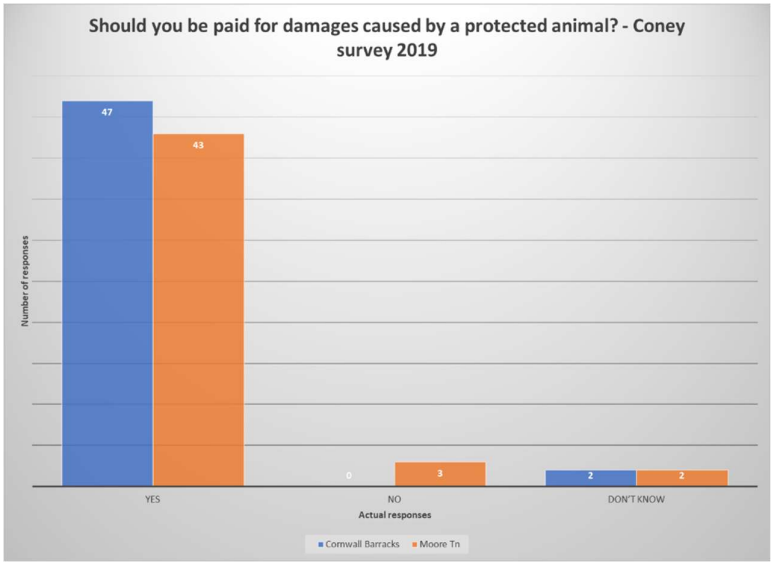
These questions focused on public perception of the Jamaican coney and their willingness or unwillingness to participate in the animal's protection and conservation.

Figure 13: Do you think coneys should be protected?



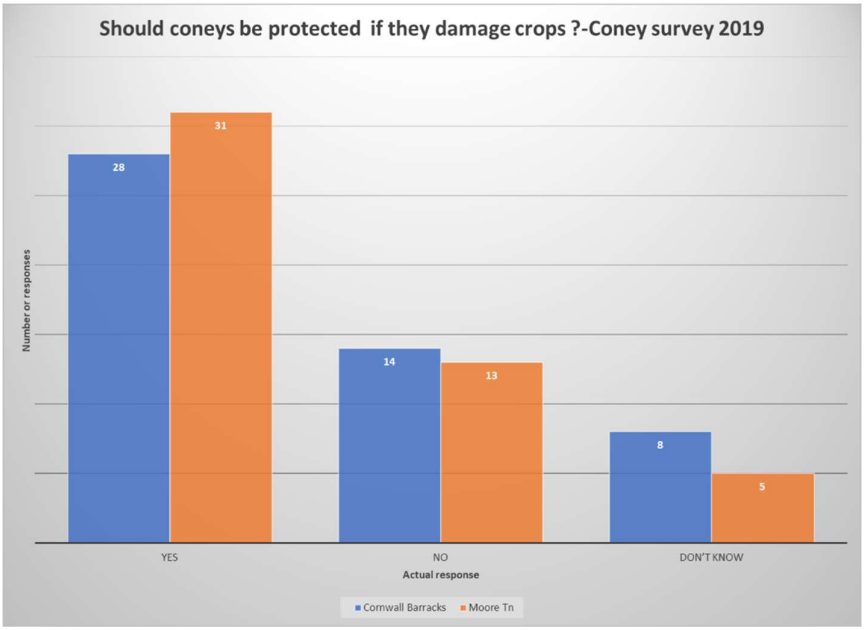
Results were similar across both communities ,62 and 64% saying 'YES' for Cornwall Barracks and Moore Town respectively. 'NO' responses were 24 and 26% for Cornwall Barracks and Moore Town, respectively. Less than 14% gave a response of 'DON'T KNOW'.

Figure 14 : Should you be paid for damages caused by a protected animal?



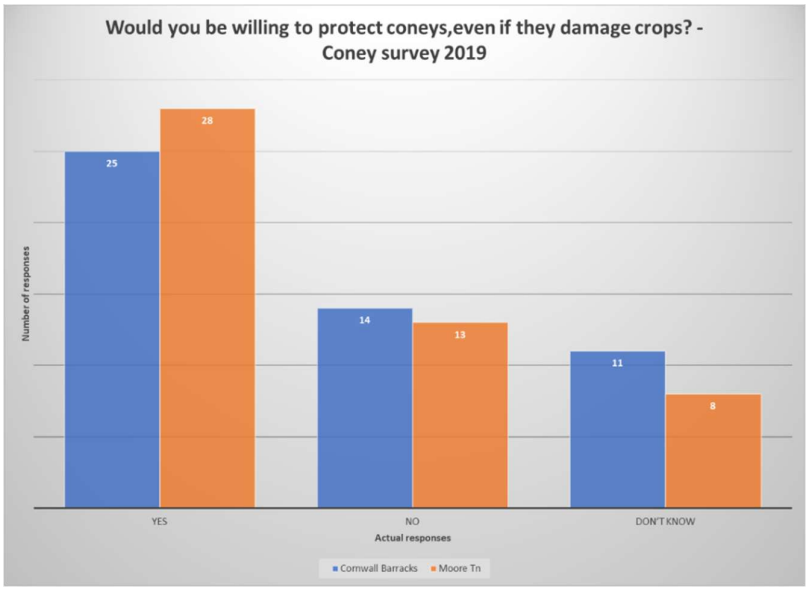
Both communities had an overwhelming response of' YES', accounting for a much as 94% in Cornwall Barracks and 86% in Moore Town. This is not surprising given the strong contingent of farmers in the survey sample.

Figure 15 : Should coneys be protected if they damage crops?



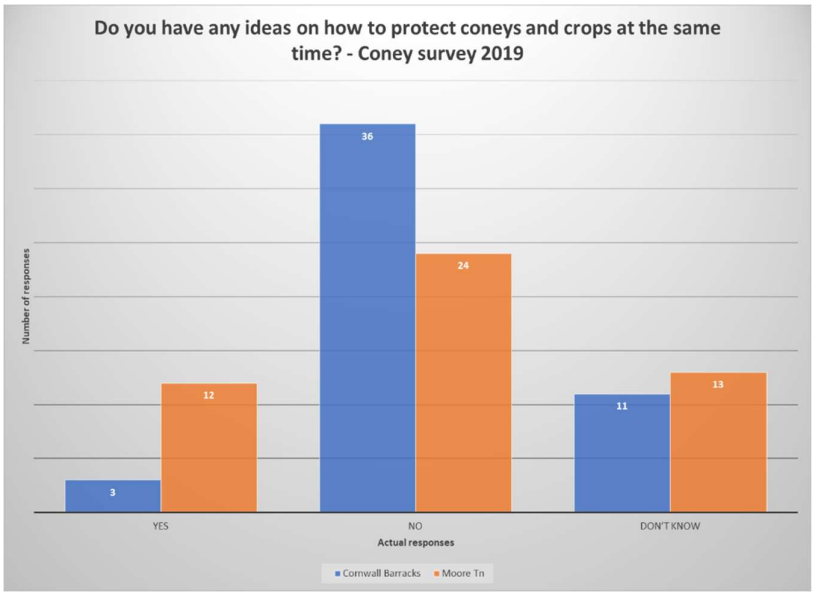
Surprisingly, there was a reasonable level of empathy with responders although they suffered directly from the animal's foraging behaviour. In fact, 37% of the responders said that farming contributed to 25-49% of their income, nonetheless, most thought they should still be protected. The number was 62% in Moore Town and 56% in Cornwall Barracks. This may be due to the fact that some understand the animal's right to live as well as some having prior knowledge of its protection status, as was the case with student responses.

Figure 16 : Would you be willing to protect coneys , even if they damage crops?



Again surprising, given the interest of the interviewees, that the 'YES' response would be this high, with over 50% for both communities. Although more responses of 'DON'T KNOW 'were noted, up to 22% were uncertain.

Figure 17: Do you have any ideas on how to protect coneys and crops at the same time?

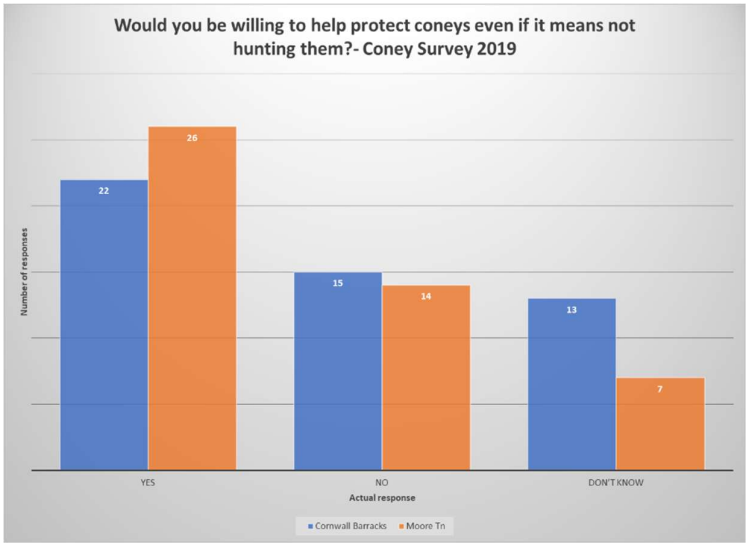


The majority of responses were 'NO', with 72% from Cornwall Barracks and 49% from Moore Town. Although in Moore Town 25% said 'YES' actual suggestions as asked by the questionnaire did not reveal many responses.

4.7.3 Hunting, eating and selling coneys

The questionnaire certainly provided information on this area, but evidence from field work, camera traps and discussion with community members all indicate it happens.

Figure 18: Would you be willing to help protect coneys, even if it means not hunting them?



The 'NO' response (30% for Cornwall Barracks and 28% for Moore Town) , clearly represents the voice of the few hunters caught in the survey but it also suggests that most persons outside of hunters do not support hunting. Conversely, the community at large, from questionnaires showed no reservation

in admitting to the delicacy of coney meat and would readily purchase or eat it when it becomes available. In fact, about 60% said they have eaten coney meat in the past.

Therefore, their actions may be complicit by providing a market for the meat. Another question, directed to hunters, indicated that 100% of the meat was sold to the community.

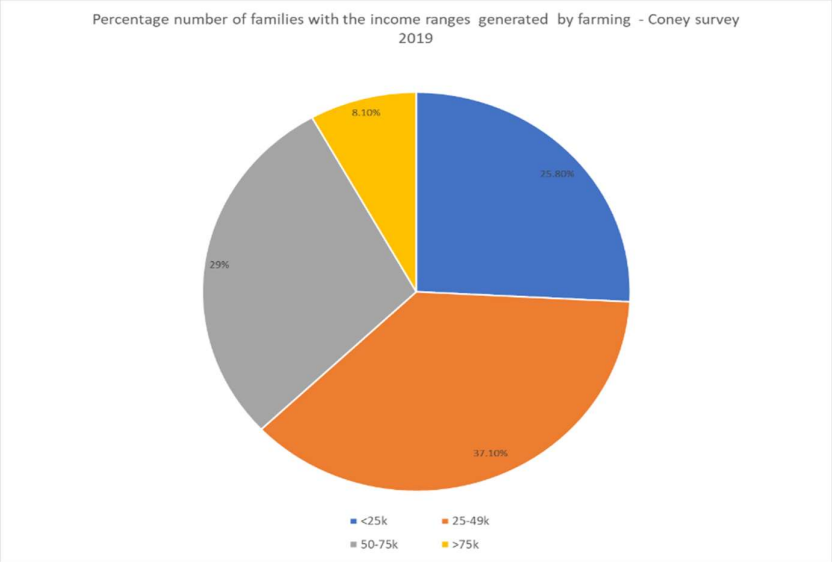
Overall, the practice seems to be localized with few hunters who go out directly to hunt coneys. The questionnaires indicate a small number maybe around five (5) to ten (10) hunters, a number which has dwindled from previous years. The practice itself seems to be on a general decline, with information coming from retired coney hunters, most of which could not speak of any younger community members who had an interest in learning how to conduct the hunt.

There are other hunters who hunt wild pig but based on distances travelled to do so may be in the forest at times that *G.brownii* is active. In such cases, it is indicated that they will opportunistically hunt the target species.

It seems clear that the techniques for hunting wild pig versus coney are quite different. One obvious difference is the time of the hunt, daytime for wild pigs and night time for coneys. Dogs used are similarly hunt specific, small dogs for coneys that can enter burrows and seize prey and larger dogs that require greater strength to corner wild pigs. This was a concern from the questionnaire of the number of dogs allowed to roam freely. Up to 58% said they owned dogs of which 64% said they did not chain the dogs at all and 66% said they did not keep the dogs in at night. Most of these owners had multiple dogs.

4.7.4 Farmer - coney conflict

Figure 19 : Percentage number of families with the income range generated by farming



Surprisingly, given the contributions of farming to household income, farmers are not more hostile towards coneys. 65% indicated they had suffered crop damages from coneys, whereas 31% indicated they suffered damage from other animals such as wild pigs, cattle and goats. However, when asked

the question, “Have you ever caught/killed coneys to protect your crops?” - 84% said ‘NO’ and another 96% said they took no real measure to protect their crops.

This is suggesting that although farmers are suffering damages it is not significant enough to generate any major reprisal against coneys.

4.7.5 General knowledge of coneys

The level of knowledge about coneys was lacking, even hunters seemed to have limited knowledge of the species behaviour and ecology. Many claimed to have knowledge of coneys , 60% in fact but when followed through with specific questions most only knew of the fact that they ate plants.

When asked about their information source, if it came from general media such as TV, print, 70% said `NO’. This suggests that many of the information may be second hand.

Most believed several coneys were in the area but were rarely seen. They also believed numbers were up because a lot less persons are hunting coneys now, but could offer no further evidence to support their claims.

One surprising trend was that the interviewees seemed to have no cultural ties to the species. When asked the question, “Do you know about any traditions, stories etc about coneys?”, all said ‘NO’.

5.0 Conclusions

5.1 Data collection

1. Qualitative and quantitative assessments methods - camera trapping proved to be most valuable during the course of the study and yielded the most conclusive evidence of the species presence and did shed some light on its ecology and behaviour. It is unfortunate, that live trapping was not successful to offer more robust determination of population numbers.

2. Another critical tool in data gathering was the use of Local Ecological knowledge. The Maroons were invaluable in assisting with the location of potential coneys dens, indicating plants that they may consume and giving insight into some of the human-animal conflicts that helped to shape the design of the questionnaire.

3. Questionnaire was equally a useful tool and community responses dunked so beliefs such as cultural ties to the species and the drivers for hunting the animal. Much of the information gained from the instrument informed the goals and strategies for the proposed management plan.

5.2 Population numbers

As mentioned before there were limitations in executing field methodology. Due to delays in the acquisition of live traps this did not allow for a robust collection of field data. Deployment of live traps in a one-month period, through a collaboration with a visiting researcher also did not yield any catches.

Camera trapping data, though useful was not designed initially as a method of collecting the type of data that could be used for modelling population variables.

Nonetheless, some crude estimates were made with the use of the data, which is suggesting very low density of target species. This is seemingly contrary to the belief of locals that the numbers of the target species have been on the rise to the point of being nuisance animals.

This low density would be more consistent with questionnaire responses that suggest the damage and the numbers of coneys are not as high as previously thought. The absence of hunting information from potential hunters and the infrequency with which the community spoke of eating coney meat is also suggesting that there is not a high take of individuals.

Reproductive rates may also be low in the population sampled. Of all the camera photos recorded, only a small percentage indicated the presence of juveniles. This will have great implications for the population if hunting continues.

In theory, the number of images taken per unit time contains information about a species population size (Rowcliffe et al. 2008, 2014). If the population increases or decreases the index should reflect that and where a species is in greater abundance, its photographic hit rate should be higher (Engeman 2005; Rovero and Marshall 2009; Rowcliffe et al. 2014). An index is expected to vary directly with population size and is proportional to and reflects abundance, but is not an estimate of the actual population size (Engeman 2005; Stanley and Royle 2005; O'Connell et al. 2011). Though controversial, indices of abundance are used as surrogate measures of

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population size as they allow rapid assessments of abundance where other methods are not feasible, and they can be used to make relative comparisons between populations (McKelvey and Pearson 2001; Engeman 2005; Kelly and Holub 2008; Rovero and Marshall 2009; Sollmann et al. 2013; Weerakoon et al. 2014). Consequently, they have become integral to resource-constrained wildlife managers.. For nondescript animals, calibrating the relationship between hit rate and density is critical if photographic hit rates are to be used as an index of abundance, however, this rarely occurs (Kelly 2008; Rovero and Marshall 2009; Foster and Harmsen 2012; Sollmann et al. 2013; Villette et al. 2016).

A

Relative abundance indices produced from camera traps, such as hit rates, have been criticised because they are rarely calibrated to independent estimates of abundance or density (Kelly and Holub 2008; Rovero and Marshall 2009; O'Connell et al. 2011; Weerakoon et al. 2014; Hofmeester et al. 2016). Therefore, calibrating the relationship between hit rates and density or abundance, as done here, allows informed decisions regarding a population to be made. For example, abundance or density can firstly be estimated and then population trends can be monitored using this information. Many management and research problems are well served by abundance indices and the use of camera trapping hit rates as an index of abundance is

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promising for the rapid assessment of rare or elusive species, or in areas where other methods are unfeasible (Rovero and Marshall 2009). It is important to note that camera traps cannot replace studies that require data that can only be obtained from handling animals, such as reproductive status, body weight or tissue samples for genetic analysis. However, the calibration between hit rates and abundance in this study indicates that camera traps could be used to make informed management decisions for this species. This is especially true if additional sites can be included in future surveys to strengthen the relationship between live trapping and camera captures. Initially, I attempted to fit a regression line to the data but it was not significant unless it was forced through the origin, in line with the assumption that if bandicoots were present they would be photographed. I resorted to using the Spearman rank correlation because of the limited number of sites and the uncertainty about this assumption. If additional sites can be added to this study, I may be able to use a regression, that would produce a predictive equation that would allow population estimates or densities to be calculated from camera trap hit rates. Additionally, an important assumption regarding indices of abundance obtained from camera traps, and one assumed here, is that of equal detectability of a species across sites. It is reasonable to assume this for comparisons of the same species across different sites as they are roughly the same size and have the same habitat requirements (Harmsen et al. 2010).

While this study is the first to calibrate the relationship between hit rates, density and abundance for quenda, similar studies have been conducted on other nondescript mammals with mixed results. Bengsen et al. (2011) found that camera trap abundance indices could monitor changes in a feral pig population and Diete et al. (2015) found that camera trapping can be used as a sampling method for the northern hopping-mouse (Notomys aquilo). Also, Villette et al. (2016, 2017) found that camera trapping can be used as a robust means to estimate density of red squirrels (Tamiasciurus hudsonicus), red-backed voles (Myodes rutilus) and deer mice (Peromyscus maniculatus). Other researchers have also found that camera traps can be used to estimate the density or abundance of the Irish and European hare (Lepus timidus hibernicus and L. europaeus), European pine marten (Martes martes), rednecked wallaby (Macropus rufogriseus), quokka (Setonix brachyurus) and ungulates (Rowcliffe et al. 2008; Rovero and Marshall 2009; Manzo et al. 2012; Dundas et al. 2014; Caravaggi et al. 2016). By contrast, Weerakoon et al. (2014) found that camera traps were ineffective at detecting changes in black rat population size and Villette et al. (2017) were unable to assess camera traps as a means of estimating density for snowshoe hares (Lepus

americanus). This study adds to this growing body of knowledge as it demonstrates that it is possible to survey and monitor a medium sized marsupial with camera traps.

6.0 Recommendations

The study was not without its limitations and challenges, as earlier mentioned. This resulted in not all the anticipated baseline or empirical data being collected. Therefore, to facilitate on-going data collection to improve on information analysis and to make better informed decisions the following recommendations are made;

6.1 Continued live trapping and use of camera traps

JCDT should continue live trapping within the pilot study area, to obtain more results that could be used in a more robust modelling or calculation of population variables. Strong consideration should be given to training ranger staff and local community members to assist with deploying and monitoring of live traps. In the initial phase, camera traps should be deployed simultaneously to monitor these traps to evaluate their effectiveness in terms of placement, bait choice and interaction from non-target species etc.

To treat the target population as closed, at least a three (3) month sampling period needs to be done. However, to account for seasonal variations and its impact on population numbers a year would be ideal.

A outline protocol for setting up live traps and cameras is provided in the Appendix.

6.2 Collection of data on biological parameters from both wild and captive populations

This information will continue to be a platform for further studies and be critical to long term conservation goals. There is still a possibility that extended live trapping may not yield individuals that can provide the desired biological , in which case ,collaboration with institutions, such as Hope Zoo which hold captive populations may be necessary to acquire this data.

These institutions may also acquire confiscated animals and even if not from the pilot study area, baseline values would still be useful.

6.3 Conduct further behavioural studies on captive population

Given the secretive nature of the species and the challenges faced with trapping, it would be to JCDT's advantage to partner with institutions which hold captive coney populations to obtain information on behaviour and diet.

Useful areas would be the following;

- Verification of local ecological knowledge of plant species eaten by the target species by testing in captive diets

- Testing the use of natural repellents on their effectiveness for reducing wild coney herbivory on agricultural crops
- Social behaviour such as aggression, mating and parental care

6.4 Expansion of the scope of the study

It should also be considered to expand this study to other areas of the BJCMNP to conduct similar population assessments. This would prove useful in obtaining what the target species distribution could be throughout the park.

It is also crucial to note, especially as it relates to human/coney conflicts that different factors or threats may apply in different areas of the park and hence conservation strategies could become very site specific.

6.5 Capacity building

Lastly the project should aim to develop succession planning and capacity building, by leaving the observation and analytical skills with members of the community. This could be through the inclusion of local farmers, students and other stakeholder groups in various components of the study, whether through field work, or community outreach.

Community members have expressed incorporating the target species into ecotourism packages and wish to improve their knowledge base. This would be a great opportunity for the study to have integrated impact.

Ultimately, it is hoped this level of inclusion of the community will cause long term behaviour modification and be consistent with the long-term conservation .

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APPENDICES

APPENDIX I - FIELD CAMERA SPECIFICATIONS AND SETTINGS

Figure 1 - Shows component parts of camera set-up. Camera itself, safe box and python lock.

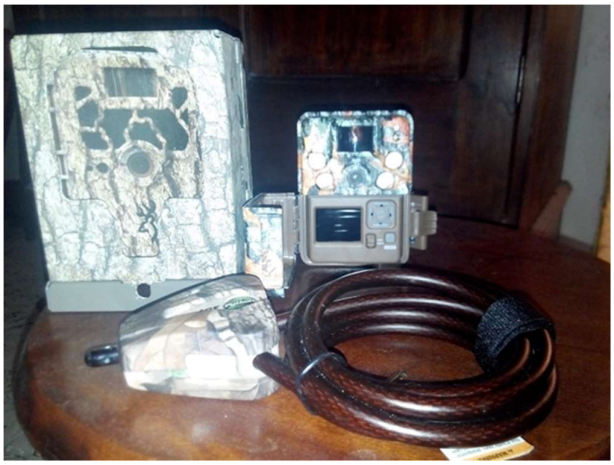

Table 1 – Camera settings for project

Parameters	Settings	Notes
Date	ON	Has to be reset once batteries are removed
Time	ON – 12 hr clock	Has to be reset once batteries are removed
Still pictures	ON	Allows for capture of still pictures vs video recording
Timelapse +	ON	Allows for set times to capture images plus motion activated pictures
Capture delay	1s	Time delay between triggers to take pictures
Picture size	Low 4mp	Maximize storage of images
Multi shot mode	4-shot	Once triggered, 4 images will be recorded 2s apart
SMART VIDEO	OFF (N/A)	Not set for videos (to maximize storage capacity)
Adjustable Infra-Red (IR) flash	Power save	Maximize battery life
Time lapse settings	Every 30 mins, all day	Allow for other data collection that may not be motion sensitive
Temperature settings	Celsius	none
Info strip	ON	Prints settings to each photo
SD Card management	OFF	Doesn’t allow the rewrite of images once card is full
Camera name	Added	Allows each camera to be identified individually

APPENDIX II - GPS co-ordinates of camera locations

Table 1- GPS Camera co-ordinates for core area- Moore Town

Camera number	GPS coordinates -Sept 2018	GPS coordinates sept to oct 2018	GPS coordinates Oct 2018 to Jan 2019	GPS coordinates Jan to May 2019	GPS coordinates - May to Oct 2019
CAM 02	N 18^0 05.011' W 076^0 25.274'	N 18^0 05.011' W 076^0 25.274'	N/A	N/A	
CAM 03	N 18^0 05.189' W 076^0 25.237'	N 18^0 05.189' W 076^0 25.237'	N /A'	N /A'	
CAM 04	N 18^0 05.231' W 076^0 25.197' C	N 18^0 05.231' W 076 25.197'	N/A	N/A	
CAM 05	N 18^0 05.278' W 076^0 25.219'	N 18 ^{0}02 135' W 076 ^{0} 23.`664' C	N 18 ^{0}02 135' W 076 ^{0} 23.`664'	N 18 ^{0}02 135' W 076 ^{0} 23.`664'	N 18 ^{0}05 386' W 076 ^{0} 25.`206'
CAM 06	N 18^0 05.318 W 076^0 25.093' C	N 18^0 05.318 W 076^0 25.093'	N /A GPS did not provide coordinates	N /A GPS did not provide coordinates	N 18 ^{0}05.272' W 076 ^{0} 25.`219'
CAM 07	N 18^0 05.364' W 076 25.`163' C	N 18^0 05.364' W 076 25.`163'	N 18 ^{0}05.364' W 076 ^{0} 25.`163'	N 18 ^{0}05.364' W 076 ^{0} 25.`163'	N 18 ^{0}05.364' W 076 ^{0} 25.`163'
CAM 08	N 18^0 05.261' W 076 25.296' C	N 18^0 05.261' W 076 25.296'	N 18 ^{0} 05.261' W 076 ^{0} 25.296'	18 ^{0} 05.410' W 076 ^{0} 25.241' (new) C	

Key

	'New 'Coordinates for Moore Tn
	Coordinates for Moore Tn that are repeat locations
	GPS did not provide coordinates due to poor signal
C	Coordinates for Moore Tn that had Coney sightings

Table 2 - GPS Camera co-ordinates outside core area

Camera Number	Location	GPS Coordinates
CAM 1	Cornwall Barracks	N 18^0 04. 375’ W 076 ^{0} 24. 817 ’ **C**
CAM 9	Millbank 1	N 18^0 02. 996’ W 076 ^{0} 23. 747’ **C**
CAM 10	Millbank 2	N 18^0 02. 976’ W 076 ^{0} 23. 690’ **C**
CAM 6	Millbank 3	GPS not provided
CAM 6	Corn puss gap	N 18^0 00. 440’ W 076 ^{0} 21. 832’
CAM 8?	Cambridge backlands	N 18^0 06. 628’ W 076 ^{0} 22. 807’

Key

	Coordinates for locations
C	Coordinates for locations that had Coney sightings

APPENDIX III - Outline of Capture -Mark- Recapture method.

Ten (10) sites are to be considered, in keeping with known sightings of coneys, for placing live traps. Locations should be sheltered from the sun and be relatively private. Leaf litter could be considered to camouflage cages. Cages should be 'locked' on to trees to ensure they are not stolen. When not in use they should also be locked to prevent any use except by the person/s manning the traps. Cameras should also be set-up simultaneously to monitor the traps and see the interaction of the target species. All camera and trap coordinates are to referenced with GPS,

In most cases, because of the terrain and the need to place cameras very low to the ground (due to animal's size and behaviour) the range of images may be limited in most cases to around 15 ft or less. Secondly, because of the risk of cameras being stolen, large trees (recommended diameter of at least 8" inches) were used to affix the cameras with a python lock. This sometimes may limit the optimal placement. A rain shield would also be recommended over each camera, even though they are designed for field use. The study area is subject to a high level of precipitation and about three (3) cameras were decommissioned because of moisture gaining access to the screen etc. The lowness to the ground may also predispose the camera to rain-splatter which can impact the infrared sensor and the lens of the camera. One can reduce this by placing the cameras above stones etc and areas less likely to produce splatter. Also, it is recommended that a mild lubricant such as WD-40 be used on the battery release button as this was subject to rust in all the cameras.

Traps are to be baited with suitable food item such as fruit and/or vegetables and set in the late afternoon. Avoid any items particularly attractive to rats as they may saturate live trap catches and diminish level of human effort. They are to be checked early the next morning. Traps are to be manned /operated for about 2-3 consecutive nights. If newly captured (previously unmarked) animals are recorded on the second night then traps may be opened for a third night. Traps are not be opened during the day and should remain locked to prevent tampering.

Captured animals should be weighed, their sex determined. Rumps were spray-painted with a bright (yellow or orange) non-toxic paint or hair dye as a method of short-term marking before release at the site of capture. Markings cannot be the same, as individuals must be identifiable.

Animals are to be recorded as a ''capture'' (new animal) or ''recapture'' (a previously marked animal). The unique marker must be noted along with each animal.

Unfortunately, no live animals were trapped during the study so there are no field-tested recommendations for restraint and capture to be made at this time. Discussions with Hope Zoo, did indicate the specimens in their collection were vulnerable to high levels of stress from physical restraint. Therefore, handling should be minimal and where necessary be limited to the shortest time possible. Also noteworthy was the biting force of the animal's incisors. The chisel-like incisors would easily go through leather -type garden gloves so a professional grade bite-proof glove would be a recommended starting point. Also restrain the animal from its blind side, with its head facing away from the handler, hold behind the head close to the juncture with neck to be able to control the movement of the head. Place a second hold to the mid back of the animal to control its body.

If any animal dies during live -trapping due to handling, prolonged confinement to a trap or due to predation, then live -trapping should be discontinued.

Appendix IV

DRAFT QUESTIONNAIRE FOR THE JAMAICAN CONEY POPULATION ASSESSMENT AND MANAGEMEMNT PLAN (2019)

QUESTIONNAIRE NO: _____ **INTERVIEWER:** _____

LOCATION: _____ **DATE:** _____

RANDOM OR TARGETED CONEY HUNTER? _____

We are researchers from XXXXX.We are interested in learning more about the local environment, and we would be very grateful if you can provide some information to help us better understand wild animals that might live around here, and how people interact with the environment.The survey is anonymous and all the information you provide will only be used for research and analysis – we will not disclose any of your details to a third party.

1. Are you willing to participate in this survey? ☐ Yes ☐ No

SECTION 1 – BACKGROUND INFORMATION

2. Age: _____

3. Sex: ☐ Male ☐ Female

4. How long have you lived in this community/village? _____

If they have not lived here all of their lives:

(a) Where did you live previously? _____

5.Please give an idea of the range of your Monthly personal income:

0-25k_____

26-50k_____

51-75k_____

76-100k_____

>100k_____

6. Occupation: _____

7. How often do you go into the forest? _____

8.What do you do when you go into the forest? _____

9. How much time do you spend in the forest on an average trip? _____

10. When do you usually go into the forest?

(a) Time of year: _____

(b) Day or night: _____

11. Has the amount of time you spend in the forest changed during your adult life?

☐ Yes ☐ No

If *YES*, describe:

(a) How much has it changed: _____

(b) When did it change: _____

(c) Why did it change: _____

12. If they are a farmer:

(a) What types of crops do you farm? _____

(b) What is your main crop? _____

(c) How many separate plots do you have? _____

(d) How large is your farm plot/s? (estimate) _____

(e) Do you use all these plots at the same time? _____

(f) Where is/are the plot/s located? _____

_____

_____

(g) Approximately how much of your household income is from farming?

☐<25%☐25-49% ☐50-74% ☐75%+

(h) Which crop is your biggest earner? _____

(i) Does the crop income vary with the time of year? (If YES, describe)

_____

13. Do you have a dog? ☐ Yes (how many: _____)☐ No

If YES:

(a) Do you chain it up at night?☐ Yes ☐ No

(b) Do you keep it indoors at night? ☐ Yes ☐ No

SECTION 2 – GENERAL INFORMATION ON CONEYS

14. Do you know what a coney / grazie is? ☐ Yes ☐ No☐Don't know

If YES:

(a)*Ask them to describe the animal, to confirm they know what it is (record how they describe it, and any natural history information etc about the species they mention)*:

_____

_____

_____

(b) What name do they use to refer to the animal: _____

If NO / DON'T KNOW, show a picture of a coney

(c) Do they recognise it now? ☐ Yes (what name: _____) ☐ No

[*Ask the following questions if they know what a coney is*]

15. What's the main thing that comes to mind about coneys/grazies?

_____

_____

16. Do you like coneys?

☐ Yes ☐ No ☐ Indifferent ☐ Don't know

(a) Explain why like/dislike coneys: _____

17. Have you ever seen a coney? ☐ Yes ☐ No ☐ Don't know

If YES:

(a) When did you last see a coney? _____

(b) Where did you last see a coney? _____

(c) About how many times have you seen coneys? _____

(d) How many people around here have seen coneys, do you think? _____

If NO:

(e) How do you know what a coney is? _____

18. Have you ever heard or read anything about coneys on TV, in the newspaper etc?

☐ Yes ☐ No ☐ Don't know

If YES:

(a) Describe _____

19. What do you think is the status of coneys around here?

☐ Very common ☐ Common ☐ Uncommon ☐ Rare ☐ Very rare ☐ None

☐ Other (describe) _____

20. Do you think that the number of coney has changed around here during your lifetime?

☐ Yes ☐ No ☐ Don't know

If YES:

(a) Has it -- ☐ Increased ☐ Decreased

(b) By about how much has it increased or decreased? ☐ <25% ☐ 25-49% ☐ 50-74% ☐ 75%+_____

(c) When did the number increase/decrease?_____

(d) What do you think caused this number change? _____

(e) What makes you think the population changed? (what evidence) _____

_____

21. Do you know anything about coney/grazies:

(a) How heavy are they? _____

(b) How long do they live for? _____

(c) How often they have young? _____

(d) What time of year they have young? _____

(e) How many young do they have when they give birth? _____

(f) What do they feed on? _____

22. Do all coneys around here look the same? ☐ Yes ☐ No ☐ Don't know

(a)*If NO*, describe: _____

23. Do you know the location of any coney/grazie dens? ☐ Yes ☐ No

If YES:Ask the respondent whether they will show you where they are

(a) How do you know it's a coney/grazie den?

_____

24. Do you know about any traditions, stories etc about coneys? ☐ Yes ☐ No

(a)*If YES*, describe: _____

_____

25. Do you know if anyone around here might have any coney bones? ☐ Yes ☐ No

If YES:Ask the respondent whether they will show you where they are

SECTION 3 – FARMER-CONEY CONFLICT

26. Have coneys ever damaged your crops? ☐ Yes ☐ No ☐ Don't know

If YES:

(a) Which types of crops are damaged? _____

(b) Do coneys damage any particular crop stages? (describe)_____

(c) In which location(s) are your crops damaged? _____

(d) How are they damaged? _____

(e) How do you know that conies/grazies cause the damage?

_____

(f) Do you think it's a big problem that conies damage your crops?

☐ Yes ☐ Not really ☐ Don't know

(g) How much damage have conies done to your crops over the past year?

☐ None ☐ <10% ☐ <20% ☐ <50% ☐ 50%< ☐ Don't know

(h) How many times has this happened over the past year?

>1 x weekly ☐ Weekly ☐ Fortnightly ☐ Monthly

☐ Once every few months ☐ At least 1 x year ☐ Less than 1 x year

☐ Varies ☐ Don't know ☐ Other (describe: _____)

(i) Does the damage happen more at a particular time of year?

☐ Yes (when: _____) ☐ No

27. Do any other animals cause damage to your crops? ☐ Yes ☐ No ☐ Don't know

If YES:

(a) Which animals_____

(b) Do these animals cause more / less damage compared to coneys/grazies?

Describe: _____

28. Has the amount of damage conies do to your crops changed compared to the past?

☐ Yes ☐ No ☐ Don't know

If YES:

(a) Increase or decrease? _____

(b) How much has this changed? _____

(c) Approx. when did it change? _____

29. Have conies damaged other people's crops around here as well?

☐ Yes ☐ No ☐ Don't know

(a)*If YES*, about what % of people who farm around here? _____

30. Have you ever tried to catch or kill coneys/grazies to protect your crops?

☐ Yes ☐ No ☐ Don't know ☐ No answer

If YES:

(a) How long have you tried to do this for? _____

(b) Have you tried to do this in the past year? ☐ Yes ☐ No ☐ No answer

(c) How do you try to catch coneys? _____

(d) How many have you caught in the past year? _____

(e) How many have you ever caught in this way? _____

(f) What do you do with the animals you've caught? _____

31. Have you ever taken any other measures to protect your crops from coneys?

☐ Yes (describe: _____) ☐ No

32. Have you ever taken any measures to protect your crops from other animals?

☐ Yes (describe: _____) ☐ No

SECTION 4 – HUNTING, SELLING AND EATING CONEYS

33. How important is it to you to go hunting? _____

(a) Why is it important? _____

(b) How culturally important is hunting to people in this community / around here?

_____

(c) How often do you go hunting? _____

(d) Where do you go hunting? _____

(e) Do you make any income from hunting? ☐ Yes (describe: _____) ☐ No

34. Have you ever hunted coneys? ☐ Yes ☐ No ☐ No answer

If YES:

(a) Why do/did you hunt coneys? _____

(b) How do/did you hunt coneys? _____

(c) Where do/did you go to hunt coneys? _____

(d) Are/were coneys your main target, or just trying to hunt anything?

Target: ☐ Coney ☐ Pig ☐ Other (describe _____) ☐ Anything

(e) About how many coneys do/did you catch on a typical hunting trip? _____

(f) Do you try to specific sexes or adult/young conies? ☐ Yes ☐ No

If YES, describe: _____

(g) What do you do with coneys that you catch? (describe in full) _____

_____

(h) Do any parts of the coney have a specific use? ☐ Yes ☐ No

If YES, describe: _____

35. Do you still hunt coneys? ☐ Yes ☐ No☐ No answer

If YES:

(a) How often do you go hunting coneys/grazies in a typical month? And on average how many do you catch_____

(b) Has this amount changed compared to the past? ☐ Yes ☐ No

If YES, describe how your hunting effort has changed: _____

If NO:

(c) When did you last hunt coneys? _____

(d) Why did you stop hunting coneys? _____

36. Do other people around here ever hunt coneys (now or in past)?

☐ Yes ☐ No ☐ Don't know☐No answer

If YES:

(a) How many other people around here still hunt coneys? _____

(b) When is last time you heard about anyone around here hunting coneys? _____

_____

(c) How many people around here used to hunt coneys 10 years ago? _____

(d) How many people around here used to hunt coneys 20 years ago? _____

(e) Why has the number of people hunting coneys changed? _____

37. Do/did people come from anywhere else to hunt coneys around here?

☐Yes☐No ☐Don't know

If YES:

(a) Where from? _____

(b) How many people do that today? _____

(c) How many people did that 10 years ago? _____

(d) How many people did that 20 years ago? _____

38. Have you ever sold dead coneys or coney meat? ☐ Yes ☐ No☐No answer

If YES:

(a) When is the most recent time you sold coney? _____

(b) How often do/did you sell coney? _____

(c) How much would coney sell for? _____

(d) How much would wild pig sell for? _____

(e) Where do/did you sell coney? _____

(f) Who would you sell coney to?

☐People in same community

☐People outside this community (describe: _____)

(g) Do other people around here sell dead coneys or coney meat?

☐Yes☐No ☐Don't know

(h) How often does this happen? _____

(i) When is the last time you heard about anyone around here selling dead coneys or coney meat? _____

39. Have you ever eaten coney? ☐Yes☐No ☐Don't know☐No answer

If YES:

(a) When is the last time you ate coney? _____

(b) How often do you eat coney? _____

40. Do people ever use conies for any other reason? ☐Yes☐No ☐Don't know

(a)*If YES*,describe: _____

41. Do you think there are enough conies to hunt? ☐Yes☐No ☐Don't know

(a) Explain what makes you give this answer: _____

_____

SECTION 5 – ATTITUDES AND OPINIONS

42. Do you think coneys should be protected? ☐Yes☐No ☐Don't know

(a) Explain why they say yes/no: _____

_____

43. Do you think if a protected animal damages your crops you should be paid for damages?

☐Yes☐No ☐Don't know

44. Do you think coneys should be protected even if they damage your crops?

☐Yes☐No ☐Don't know

45. Would you be willing to help protect conies, even if they damage your crops?

☐Yes☐No ☐Don't know

46. Would you be willing to help protect conies, even if means not hunting them?

☐Yes☐No ☐Don't know

47. Do you have any ideas on how to protectconeys and your crops at the same time?

☐Yes☐No ☐Don't know

(a)*If YES*, describe: _____

_____

48. Do you have any ideas on how to protect coneys but still protect hunting traditions?

☐Yes☐No ☐Don't know

(a)*If YES*, describe: _____

_____

49. Do you have any other comments / information about conies that we haven't discussed?

_____

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Thank you very much for your time – we are extremely grateful for everything you've told us!