

**THE ALLURE OF LURE AND ITS IMPACT ON PERCEIVED COMMUNITY  
COMPOSITION WHEN MONITORING TROPICAL MAMMALIAN  
BIODIVERSITY**

by

Conner Maxwell

A thesis submitted to the Faculty of the University of Delaware in partial  
fulfillment of the requirements for the degree of Bachelor of Science in Wildlife  
Ecology and Conservation with Distinction

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## ABSTRACT

Due to low detection rates of high-profile target species, e.g. large carnivores, in camera trap surveys, researchers commonly implement the use of lure or bait as an attractant. It is also common to use ancillary photos, e.g. non-target species, to study additional research questions such as prey availability or biodiversity metrics. Although attractants are widely used to increase capture rates of target species, little is known of the effect on non-target species capture rates. We evaluate if the use of bait or lure can introduce bias into non-target species capture rates and community composition metrics. We deployed baited, lured, and control camera stations within the Mamoní Valley, a tropical biodiversity corridor in the narrowest stretch of the Isthmus of Panama. Across 34 cameras and ~6 months we captured 23,965 photos of animals and identified 31 different species. This data was used to evaluate spatial and temporal trends in community composition as influenced by bait or lure use. We also measured differences in species specific probability of detection among treatment and control locations. Our findings suggest that using photos to evaluate supplemental research questions such as biodiversity or prey availability is unbiased by the use or non-use of our selected lure or bait.

## **Chapter 1**

### **INTRODUCTION**

Monitoring trends in wildlife populations, including both abundance and presence/absence is a critical component in the development and evaluation of conservation efforts. However, it can be difficult to study certain species due to remote and harsh habitat, elusive and nocturnal behavior, or low population levels (Rovero et al. 2017). One option for these species is the use of remote camera traps, which have proven to be an effective non-invasive survey option to study animal behavior, activity patterns, and populations (Romero and Zimmerman 2016). Indeed, biologists now commonly use camera traps to increase the probability of detecting species that have previously been difficult to study. However, due to the elusive behavior of cryptic species, camera trap studies often still result in low capture rates and wide confidence intervals (Braczkowski et al. 2016). Consequently, these results are not accurate enough to be used in conservation planning or management strategies.

To improve upon low capture rates and thus the conservation value of camera trap surveys, there are various methods, e.g., strategic camera placement, the use of bait, or the use of artificial attractants, that can maximize the number of animal photos captured. The strategic placement of camera traps, i.e., along common paths, marking sites, or water sources, rather than in randomly selected locations while conducting camera surveys is known to increase detection probability (McCain et al. 2008). This is exemplified in large and medium-sized carnivores, which have been found to

preferentially travel along roads and popular trails, and placing cameras in these locations results in higher capture rates (Kolowski et al. 2017).

To increase the detection probability of elusive individuals and improve the accuracy of estimates researchers may also use various attractants in camera surveying (Garrote et al. 2012). These attractants can include bait, i.e. a food resource, or lure, i.e., a scent that is associated with social or feeding behaviors. In an experiment comparing trapping methods in Zimbabwe, baited camera traps led to more leopard captures and cub captures than did not baited cameras (du Preez et al. 2014). Additionally, du Preez et al (2014) found that baiting cameras was more cost effective and merits implementation to improve monitoring for large felid species. Similar to bait, lured camera stations have been shown to increase detection probabilities of individuals compared to non-lured camera stations (Garrote et al. 2012). Lures, usually a liquid or semi-liquid substance, are most commonly used in felid and mesocarnivore studies to draw animals near the camera station. Lures work by exploiting an animal's hunger or curiosity which leads to a behavioral or territorial response (Batter 2011). Lured camera traps have also been used in urban environments to increase detection of urban carnivores such as raccoons (*Procyon lotor*), opossums (*Didelphis virginiana*), and coyotes (*Canis latrans*) who serve as indications of the overall health of urban ecosystems (Zagurski 2013). Similarly, there is evidence to show that the capture probability of the Iberian lynx (*Lynx pardinus*) at lured stations is higher than the capture probability at camera stations with no attractant, which can lead to increased accuracy in capture-recapture analysis (Garrote et al. 2012).

However, different attractants may lead to different probabilities of detection as well as differences in the type of species detected. Satterfield (2014) showed a

difference in bait preference within the carnivore community in Botswana and suggested that knowledge of bait preference for target species is important to increase capture rates in future studies. For some research, i.e. live trapping, it is also important to ensure that the types of lure used are selective towards the target species, meaning they minimize the attraction of non-target species (Batter 2011). Alternatively, there is also debate whether lured camera stations may result in data that violates closure assumptions by changing the spatio-temporal pattern of individuals, causing them to temporarily immigrate or emigrate out of the study area (Braczkowski et al. 2016).

While the main goal of most camera studies is to gather sufficient data on target species, it is also important to understand the effect of lure or bait use on other species. Along with capturing photos of target species camera studies typically capture a multitude of pictures of non-target species, that may then be used for additional analyses, thus further enhancing conservation value. For example, ancillary camera-trap photos have been used to assess the beta diversity and quality of habitat between different sites (McCarthy et al. 2010), and are capable of indicating differences in mammal and bird diversity that can contribute to longstanding monitoring projects (Stein et al 2008). This is important, because by studying ancillary photos in camera surveys, wildlife managers can implement effective conservation plans specifically for the areas within which they work (McCarthy et al. 2010).

Given the conservation value, it is not surprising that it is becoming more common to see non-target photo captures used for both ancillary analyses, such as the prey availability for a predator target-species, and for standalone analyses such as biodiversity assessment. However, recent studies suggest that prey species exhibit different levels of attraction or avoidance along popular travel routes depending on the

width of the trail and the age of the individual (Kolowski et al. 2017), and little is known about their attraction or avoidance to bait and lure use. Similarly, although biodiversity monitoring plays a major role in determining the strength of management activities, and it is important to analyze data from non-target species camera photos (Pettorelli et al. 2010), bias in assessed community composition associated with bait or lure use has not been evaluated.

In this study, it is my goal to evaluate if the use of bait or lure introduced bias into non-target species capture histories during a camera survey implemented in the Mamoní Valley Preserve of Panama. To meet this goal I pursue two objectives: Objective 1) evaluate differences in species-specific capture rates at baited, lured, and control camera stations. 2) assess temporal community dissimilarity as well as effort required to maximize our understanding of community composition at baited, lured, and control camera stations. Through this goal, I will add important knowledge to the growing number of conservation activities centered around camera surveys.

## **STUDY AREA**

Mamoní Valley Preserve is 115 km<sup>2</sup> of protected neotropical forest located within central Panama, and is part of the Mesoamerican Biological Corridor. Mamoní Valley is located within the largest remaining contiguous stretch of rainforest (Mamoní) within the biological hotspot Tumbes-Chocó-Magdalena eco-region. This region is characterized by semi-deciduous tropical forests, montane forests, and swamp forests mostly between 100m-750m in elevation. Forest composition is extremely diverse throughout the vertical stratification of the forest. Dominant canopy trees include *Oenocarpus panamanus*, *Bombacopsis* spp., *Anacardium* spp., *Enterolobium* spp., *Licania* spp., and *Cipteryx* spp (Herrera MacBryde, 1997). The sub

canopy is dominated by *Oenocarpus panamanus* and the shrub story by *Mabea occidentalis*. The study area regularly receives 3000-4000mm of rainfall on average yearly (Pyke et al. 2001). Mamoní and the surrounding forest average a temperature of 75-85 degrees Fahrenheit in May to 74-87 degrees Fahrenheit in October. The topography of Mamoní Valley Preserve is dominated by forested cordilleras that run along the continental divide. The preserve serves as an important component of the habitat corridor between North and South America and borders the southern end of the Guna Yala indigenous territory and the Eastern portion of Chagres National Park (Mamoní).

## **METHODS**

Prior to field work, I conducted a pilot study at the Brandywine Zoo in Wilmington Delaware. The goal of this pilot study was to refine the methodology for the research and ensure that I was getting the best possible images for identification. I also trialed different scent lures and camera settings. For the pilot study, two cameras each were placed in the exhibits of a serval (*Leptailurus serval*), a bobcat (*Lynx rufus*), and a capybara (*Hydrochoerus hydrochaeris*). I placed scent lures at 1.2 m, 1.8 m, and 3.6 m from one of the two cameras in each enclosure to allow us to assess photo quality at different distances. I placed meat directly in front of, or on top of the remaining camera to assess the utility of extreme close up facial photos. The pilot study at the zoo generated thousands of photographs, which I used to formulate the study design for the subsequent fieldwork in Panama. From these photographs, I decided to place cameras within 2.5 meters from the cameras to ensure clear identification of species.

In Panama, I deployed 34 Bushnell HD Trophy Cam Aggressor camera traps in and around the Mamoni Valley Preserve. Each camera was powered by lithium batteries and fitted with a 32 GB SD card. Our team deployed cameras between May 25, 2017 and June 3, 2017; and picked them up between October 7<sup>th</sup>, 2017 and October 15<sup>th</sup>, 2017. The 34 cameras were deployed at 24 stations covering an area of approximately 45 km<sup>2</sup> (Figure 1). Stations were alternated in terms of setting with a single camera or double camera set. The study area was broken into 2 km<sup>2</sup> grids, with one camera station within each section. Cameras were positioned within the 2 km<sup>2</sup> grid in areas of probable wildlife use, e.g., trails with sparse vegetation, or valleys near a source of water. We placed seventeen of 24 camera stations along ridgelines, five stations in forested valleys, and two stations in farmland (Table 1). We set farmland camera stations in locations as far from livestock traffic as possible to avoid unwanted captures. We mounted all cameras on trees, using nylon webbing, approximately 40 cm above the ground. Paired trail camera stations were set by mounting cameras on trees on opposite sides of the trail. I cleared all vegetation and obstructions from in front of each camera as it has been found that removing leaves within 1.5 meters of the camera reduces false triggering events (Gregory et al. 2014).

At each site, I used one of two treatments, or a control: Calvin Klein Obsession™ (CK OBSESSION), plantains, and no lure respectively. Calvin Klein Obsession was used based on the effectiveness during the pilot study in Brandywine Zoo as well as other studies focusing on large felids. We selected plantains as an alternative bait that may attract omnivorous species, and due to its ready availability in the region. Treatments and control were alternated through each site, starting with plantain. For the plantain treatment, I mounted the fruit on a stick and placed it within

sight of the camera, and at a maximum distance of 2.5 m. For the CK OBSESSION Treatment, I placed a perfumed-soaked ball of cotton within a small length of surgical tubing. I then attached the tubing to a stick and bent it so that the open ends were pointed down and the scent would not be washed away by rain. Again, the lure was placed at a maximum distance of 2.5 m. I set The Trophy Cam Aggressors to camera mode, i.e., still images, with 8 megapixel resolution, to take a series of 3 photos, with a delay of 3 seconds between series. I set the infrared flash to medium and the sensitivity to high, cameras were set to operate on a 24 hours continuous basis.

When our team retrieved each camera they noted if any camera had been opened or damaged, as well as if any obstruction fell in front of the cameras that obscured its capturing ability. One camera was not located in its original position and could not be found, thus we could not include its captures in the data set.

Photo analysis was carried out by myself and Jennifer McCarthy, PhD. Photo information along with relevant camera station information were entered into an excel file and arranged in chronological order of the date and time they were taken for each camera. We analyzed photos by recording the species present in each photo, the number of individuals in each photo, and the sex. Additionally, we recorded any noteworthy comments, such as behavioral response to attractants or anomalous captures. For obscured photos with unknown species or sex, we recorded “Unk” in the species and sex column respectively.

To evaluate community dissimilarity between treatment and control camera stations I first reduced the dataset to a binary daily capture record for each species, i.e., 0 if a species was not captured at a given station on a given day and 1 if a species was captured. Next, to smooth the data, I applied a seven-day moving window to each

daily capture record, meaning that if a species was captured on any day within +/- 3 days it was recorded as a 1 for presence, and if not captured on any day within +/- 3 days it was recorded as a 0. To adjust for unequal camera placement dates I converted date to a value of “days since set”, i.e., the number of days since the camera station was initiated. Using the resulting smoothed data, I calculated community dissimilarity matrices, using a Jaccard index, between all camera stations for each day since set. Finally, I averaged daily dissimilarity values for all crosswise and within group comparisons, e.g., Obsession/Plantain, Obsession/No Lure, Obsession/Obsession, Plantain/No Lure, Plantain/Plantain, and No Lure/No Lure.

To construct species accumulation curves for treatment and control camera stations I used the binary daily capture record developed in step one of my dissimilarity analysis. I then subset the data into respective treatment and control groups and created species accumulation curves using random selection from within the matrix of camera stations and days since set. This effectively created an accumulation curve based off number of camera trap-nights, rather than the more traditional application of number of sites. I implemented 100 permutations for each of the three species accumulation curves to find a mean and 95% confidence intervals.

To evaluate differences in species photo capture rate between treatment and control camera stations I first calculated the daily sum of photos for a given species, within each treatment or control group, and divided that sum by the number of cameras within the respective group. I then calculated the cumulative capture rate as the sum of cumulative sum of these daily rates divided by the number of days since set.

To summarize species and camera station specific capture rates, I generated standard boxplots of the number of photos captured per day, per species, grouped by treatment and control stations. All analyses and calculations were completed in R © version 3.4.2 (R Core Team 2017).

## RESULTS

Together we examined a total of 67,619 photos collected from camera traps in the Mamoní Valley, Panama. The cameras collectively photographed 31 different species including 26 mammalian species and 5 different bird species (Table 2). Species-specific total captures ranged from one capture of bay wren (*Cantorchilus migricapillus*) to 6,835 photos of collared peccary (*Pecari tajacu*) (Table 2). Collared peccaries were responsible for 29% of identified photos, white-lipped peccaries (*Tayassu pecari*) for 20%, great curassow (*Crax rubra*) for 17%, and Central American agoutis (*Dasyprocta punctata*) for 17% (Table 2). Un-lured sites resulted in more total captures than did plantain or CK OBSESSION sites (Table 2), however sample sizes were uneven with a total of 10 CK OBSESSION sites, 9 no lure sites, and 4 plantain sites. CK OBSESSION was still pungent at retrieval dates, but plantains were typically eaten within 2 weeks of set dates. The species accumulation curves (Fig. 2) show no apparent difference in accumulation of species between different lure usage based on number of camera trap nights (which accounts for unequal sample size). The dissimilarity indices (Fig. 3, 4, 5) for each type of lure displayed high levels of dissimilarity between all camera stations but no clear differences based on lure use. Red-tailed squirrels (*Sciurus granatensis*) had noticeably lower daily cumulative capture rates at stations equipped with CK OBSESSION while central American agouti cumulative daily capture rates were

higher when using plantain or CK OBSESSION (Fig. 6). Collared peccary captures appeared to be most recurring at sites with no lure (Fig. 7). Jaguar (*Panther onca*) and great curassow captures tended to be highest at sites baited with plantains (Fig. 8). Ocelot (*Leopardis pardalis*) captures were greatest at sites with no lure (Fig. 8). Other species had little to no observable difference in capture rates (Fig. 6-10).

## DISCUSSION

Attractants have been widely used in camera studies, but they may not always have beneficial effects. In this study, I focus on only two examples of two types of attractants: Plantains as a bait and CK Obsession as a lure, and compare their use to the performance of non-lured camera stations. The captures at non-lured stations represent about 48% of the total captures of the study (Table 2), but make up 39% of the capture effort. The results suggest that there is little benefit to using the two attractants to increase the detection probability in camera surveys in Neotropical rainforests. However, further data analysis is warranted and additional studies with alternative lures or baits may show different relationships.

The plantain-baited stations served to attract an animal by appealing to its sense of taste and smell (Schlexer 2008). Failure to replenish plantains at stations could have resulted in decreased capture rates at baited stations, however our cumulative capture rate should still detect any significant benefit in the first few days since set. Restocking edible bait after consumption would be an effective approach in non-remote areas; however, in Mamoní Valley Preserve, replenishing bait would be inefficient and time costly. Installing a device that only allows part of the bait to be consumed per day would increase the time between necessary replenishments. The use

of canned or dried foods would also offer advantages over plantains due to a much slower rate of decomposition.

Camera stations equipped with the scent lure CK Obsession attempted to manipulate an animal's curiosity to draw them into the site. The effectiveness of scent lures can vary based on the temperature, precipitation, humidity, vegetation, and duration (Schlexer 2008), but camera stations in Mamoní Valley equipped with CK OBSESSION were still pungent at time of retrieval. Trap-shyness and learned avoidance or disinterest of CK Obsession could describe the lower capture rates of lured stations compared to no-lure sites. Although not present in our study area, some canid species have been found to avoid scented camera traps (Schlexer 2008). Also, the use of multiple scent lures simultaneously, i.e. at several stations, may have lessened the effectiveness of a single attractant (Long et al. 2003). If capture rates are not increased by the use of attractants, then their logistical and monetary cost cannot be justified for use in the field. Further, placing a scented or edible attractant in wildlife habitat can impact species in ways other than intended, e.g. changing the spatio-temporal pattern of individuals (Braczkowski et al. 2016).

Collared peccary and white-lipped peccary photo numbers were among the highest of any animals captured in the study (Table 2). This was partially due to the high density of peccaries wallowing at camera stations that had accumulated puddles. Great curassows photos accounted for nearly 20% of the total captures (Table 2). Collared peccaries, white-lipped peccaries, and great curassows all displayed at least some interest in Calvin Klein obsession lures and cameras, with several comments noted on individual photos of individual animals sniffing at or even licking the lure. Puddles, as well as at least a minor interest in CK Obsession and cameras, led to

extensive time spent in front of the camera and therefore more captures. Still, collared peccaries had significantly higher cumulative capture rates at no-lure stations than at lured stations (Figure 7). Central American agoutis were commonly seen across all forested areas, but had higher cumulative capture rates at stations equipped with CK Obsession and plantain. This pattern of detection could indicate a subtle effect of attractant on central American agoutis if not due to inadvertent capture of the species during their morning activity (McClearn et al. 1994).

My results also indicate that overall, the dissimilarity among the 24 camera stations in Mamoní Valley Preserve was compellingly high (>80%). Dissimilarity indices (Fig. 3, 4, 5) were produced to examine how dissimilar the communities were between different camera stations. The dissimilarity between camera locations was high regardless of what type of treatment was applied to the camera stations. This high rate of difference between stations could be due to low capture rates, biodiversity of the habitat, or the choice of camera placement. However, with adequate trap nights (>1400), deployment strategy is unlikely to affect inferences made at the community level (Cussack et al. 2015). These findings suggest that dissimilarity in this study was presumably due either to low capture rates of rare species or differences in the microhabitat at each station, or a combination of those and other unforeseen factors. Regardless it suggests that the selected bait and lure did not impact the ability to assess community structure.

The location of camera placement can contribute to variation in capture frequencies across sites (Maffei 2004). The three types of landscapes used for camera locations included forested ridgelines, rich valleys, and farmland. Unequal captures and false triggers at different sites may be more related to strategy of camera

placement than the use or non-use of attractants (Kelly 2008). Proper camera placement increases the data obtained on non-target species while still capturing target species (Kelly 2008). By repeating surveys in the same locations over time, detection rates can be analyzed in accordance to the temporal pattern of a species to achieve more accurate estimates of relative abundance or areas of occupation (Kelly 2008). Alternatively, detection probabilities can be increased by attempting to cover all habitats throughout the landscape.

Based on a lack of strong evidence for any negative or positive impact of attractants, our study suggests that using ancillary photos to evaluate additional research questions such as prey availability or biodiversity metrics is unbiased by the use or non-use of a lure or bait. However, we recognize the limited number of treatments applied and inference can not be qualified beyond the use of CK Obsession or plantains as an attractant.

My study offers a baseline for future camera-trap surveys and a community level examination of the richness and diversity of Central Panama's forest ecosystem. This study does not account for the effect of using attractants in all camera studies, but subsequent lure-no-lure camera-trap studies and large scale monitoring surveys in Central Panama will help evaluate the effectiveness of my results. I suggest that similar studies of camera trap methodology in the future expand the trapping grid to include more cameras and thus more treatment levels, e.g., meat based baits, alternative scent lures etc.

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## TABLES

**Table 1** The placement and time of placement for camera stations in Mamoni Valley. Cameras set with Calvin Klein Obsession, plantain, or no lure (control).

Station	Date Set	Date Retrieved	Paired/Single	Lure	Set
1	5/25/2017	10/15/2018	Paired	Plantain	Ridgeline
2	5/25/2017	10/15/2018	Single	Obsession	Ridgeline
3	5/25/2017	10/15/2018	Paired	None	Ridgeline
4	5/25/2017	10/15/2018	Single	Plantain	Ridgeline
5	5/26/2017	10/16/2018	Paired	Obsession	Ridgeline
6	5/26/2017	10/15/2018	Single	None	Ridgeline
7	5/26/2017	10/15/2018	Paired	Plantain	Ridgeline
8	5/26/2017	10/15/2018	Single	Obsession	Ridgeline
9	5/26/2017	Lost	Single	Plantain	Valley
10	5/27/2017	10/12/2017	Single	None	Farmland
11	5/30/2017	10/7/2017	Single	None	Valley
12	5/30/2017	10/9/2017	Paired	Obsession	Ridgeline
13	5/30/2017	10/9/2017	Paired	None	Ridgeline
14	5/30/2017	10/9/2017	Single	Obsession	Ridgeline
15	5/30/2017	10/9/2017	Paired	None	Ridgeline
16	5/30/2017	10/9/2017	Single	None	Valley
17	5/31/2017	10/10/2017	Paired	Obsession	Ridgeline
18	5/31/2017	10/10/2017	Paired	Obsession	Ridgeline
19	5/31/2017	10/10/2017	Single	Obsession	Valley
20	6/1/2017	10/11/2017	Paired	Obsession	Ridgeline
21	6/1/2017	10/11/2017	Single	None	Ridgeline
22	6/1/2017	10/11/2017	Single	None	Ridgeline
23	6/3/2017	10/7/2017	Single	Plantain	Plantation
24	6/3/2017	10/7/2017	Single	Obsession	Valley

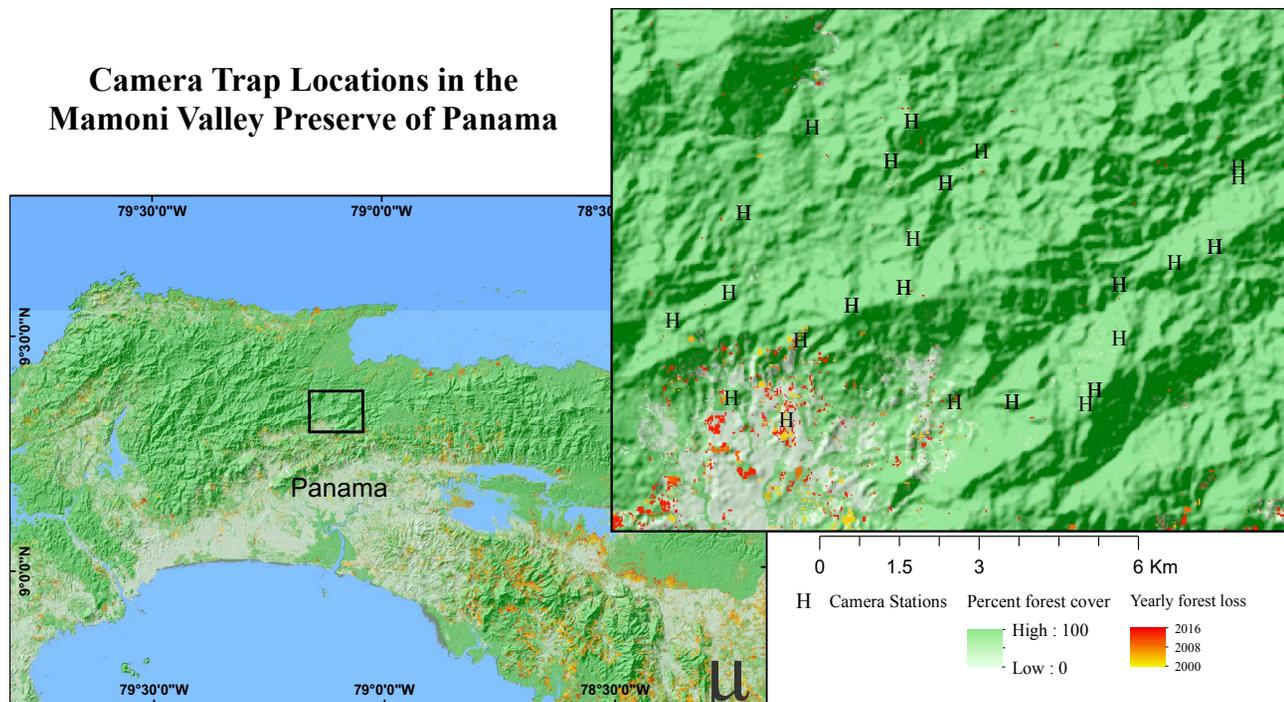
**Table 2** The number of photographs captured for each species based on treatment or control camera stations. Sampling effort was uneven, with nine No Lure camera stations, 10 CK Obsession camera stations, and four plantain camera stations. Data is from camera stations in the Mamoni Valley of Panama in 2017.

Species	No		CK	
	Lure	Obsession	Plantain	Total
Bairds Tapir	0	94	0	94
Bay Wren	1	0	0	1
Central American Agouti	772	2371	861	4004
Collared Peccary	6023	666	146	6835
Common Opossum	0	11	2	13
Crab-eating raccoon	0	0	19	19
Crested Guan	9	3	0	12
Giant Anteater	57	108	0	165
Grayheaded Tayra	0	38	22	60
Great Curassow	1891	1798	343	4032
Great Tinamou	5	33	83	121
Greyheaded Tayra	25	82	0	107
Jaguar	38	111	46	195
Jaguarundi	13	17	0	30
Little Tinamou	1	23	24	48
Lowland Paca	381	207	99	687

Margay	38	107	22	167
Nine-banded armadillo	142	65	191	398
Northern naked-tailed armadillo	107	0	1	108
Northern Tamandua	28	22	24	74
Ocelot	147	197	39	383
Puma	265	334	114	713
Red Brocket Deer	24	86	148	258
Red-tailed squirrel	132	60	159	351
Ring-nosed coati	0	52	7	59
Slaty Slender Mouse Opossum	1	0	2	3
Virginia Opossum	0	4	0	4
White-Lipped Peccary	1498	0	3473	4971
White-nosed coati	6	2	13	21
White-Tailed Deer	21	4	0	25
Total	11630	6497	5838	23965

## FIGURES

Figure 1 Map showing the location of each camera station in the Mamoni Valley of Panama in 2017 used to evaluate the impact of lure on non-target species capture rates. Also shown is the percent forest cover and the yearly forest loss in the 45km<sup>2</sup> study area.



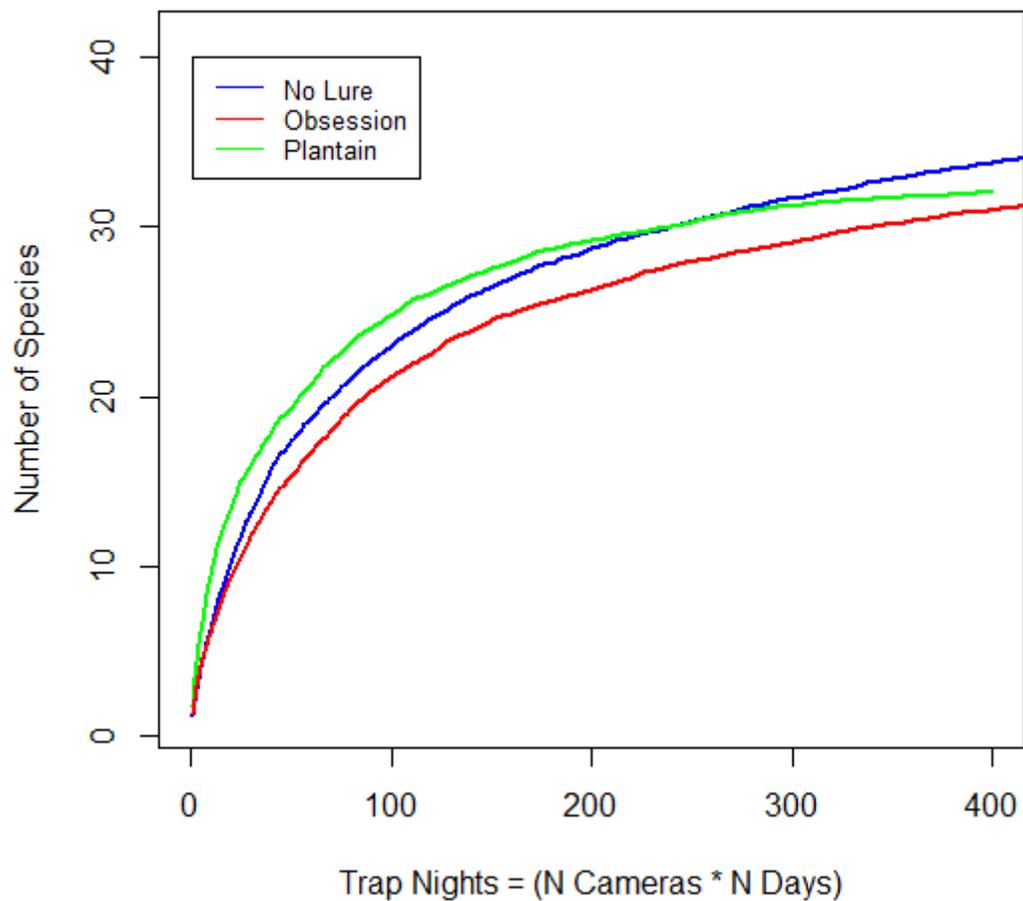


Figure 2 Species accumulation curves grouped by lure use. Curves were generated by randomly selecting from within the daily capture record for each camera station, which collectively represent the number of trap nights for a given lure type. Confidence intervals based on 100 permutations are not displayed, however they were widely overlapping.

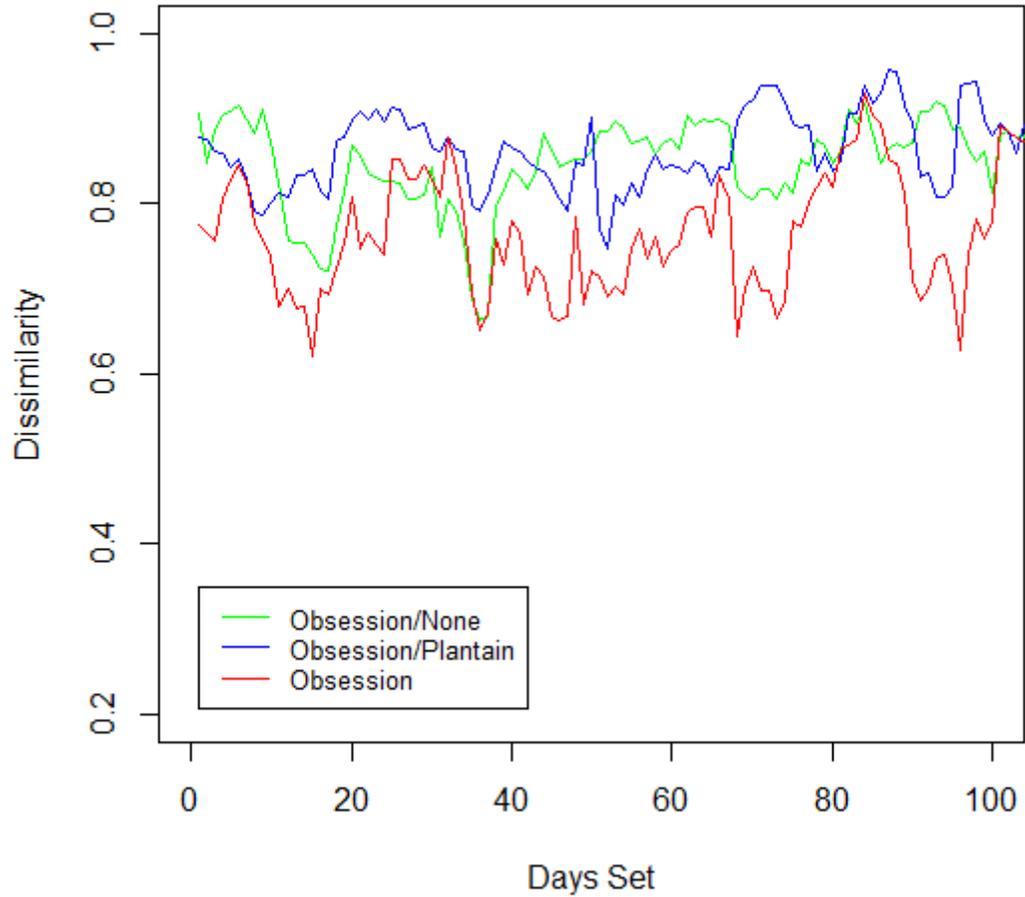


Figure 3 Community Dissimilarity Index: Average dissimilarity values comparing Calvin Klein Obsession crosswise with other treatments and within group comparisons. Binary capture records (0 = absence, 1 = presence) were applied to a seven-day moving window to adjust for different station set times. Community dissimilarity was calculated using Jaccard index. Data is from camera surveys in the Mamóní Valley of Panama, 2017.

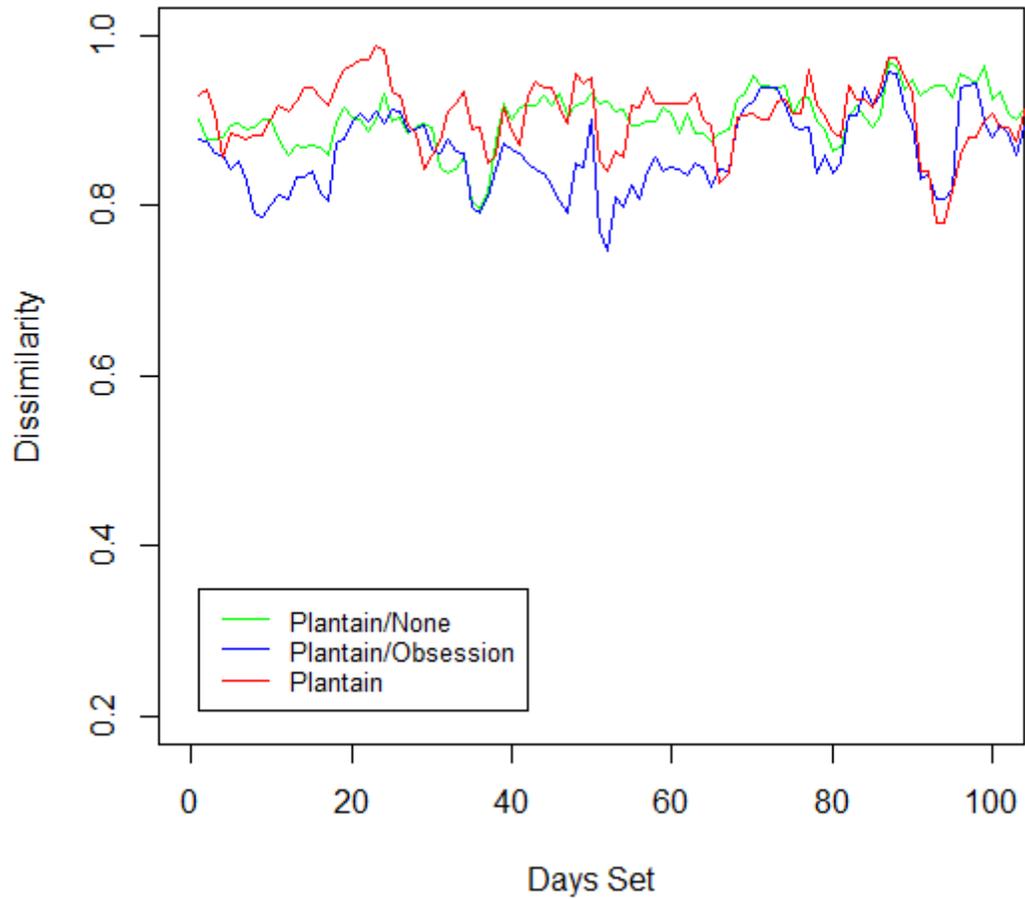


Figure 4 Community Dissimilarity Index: Average dissimilarity values comparing plantain crosswise with other treatments and within group comparisons. Binary capture records (0 = absence, 1 = presence) were applied to a seven-day moving window to adjust for different station set times. Community dissimilarity was calculated using Jaccard index. Data is from camera surveys in the Mamoní Valley of Panama, 2017.

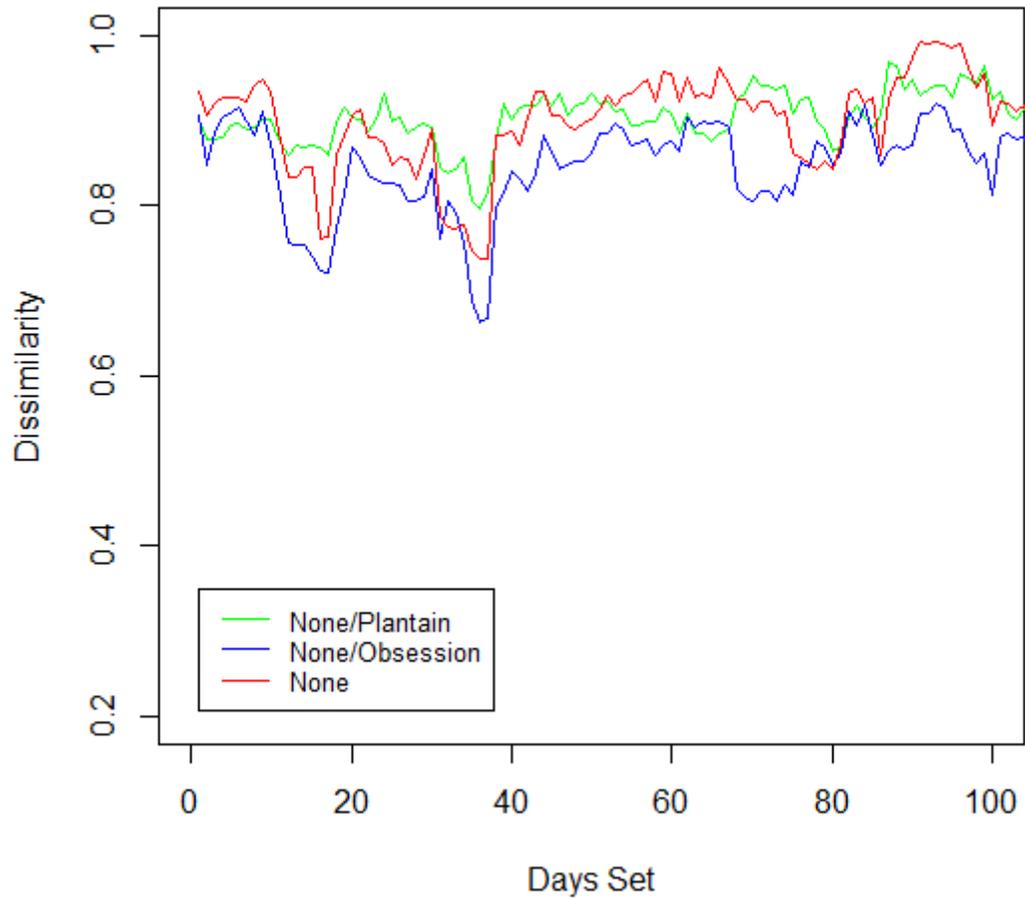


Figure 5 Community Dissimilarity Index: Average dissimilarity values comparing no-lure crosswise with other treatments and within group comparisons. Binary capture records (0 = absence, 1 = presence) were applied to a seven-day moving window to adjust for different station set times. Community dissimilarity was calculated using Jaccard index. Data is from camera surveys in the Mamoní Valley of Panama, 2017.

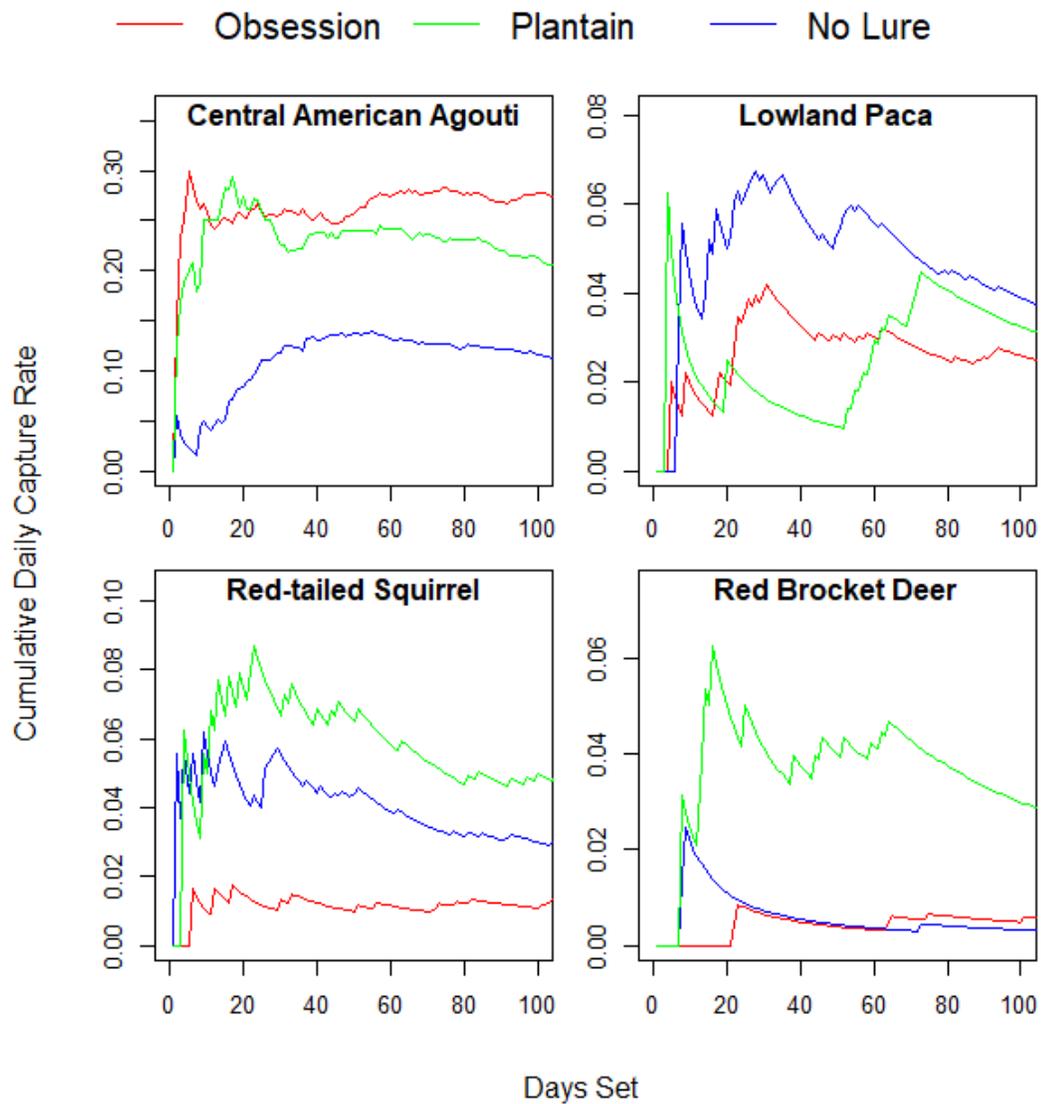


Figure 6 Cumulative daily capture rates of Central American Agouti, Lowland Paca, Red-tailed Squirrel, and Red Brocket Deer during the first 100 active camera days. Cumulative capture rates were determined by dividing the cumulative sum of daily capture rates for each species, within each treatment group, by the number of days since set to determine. Data is from camera surveys in the Mamóní Valley of Panama, 2017.

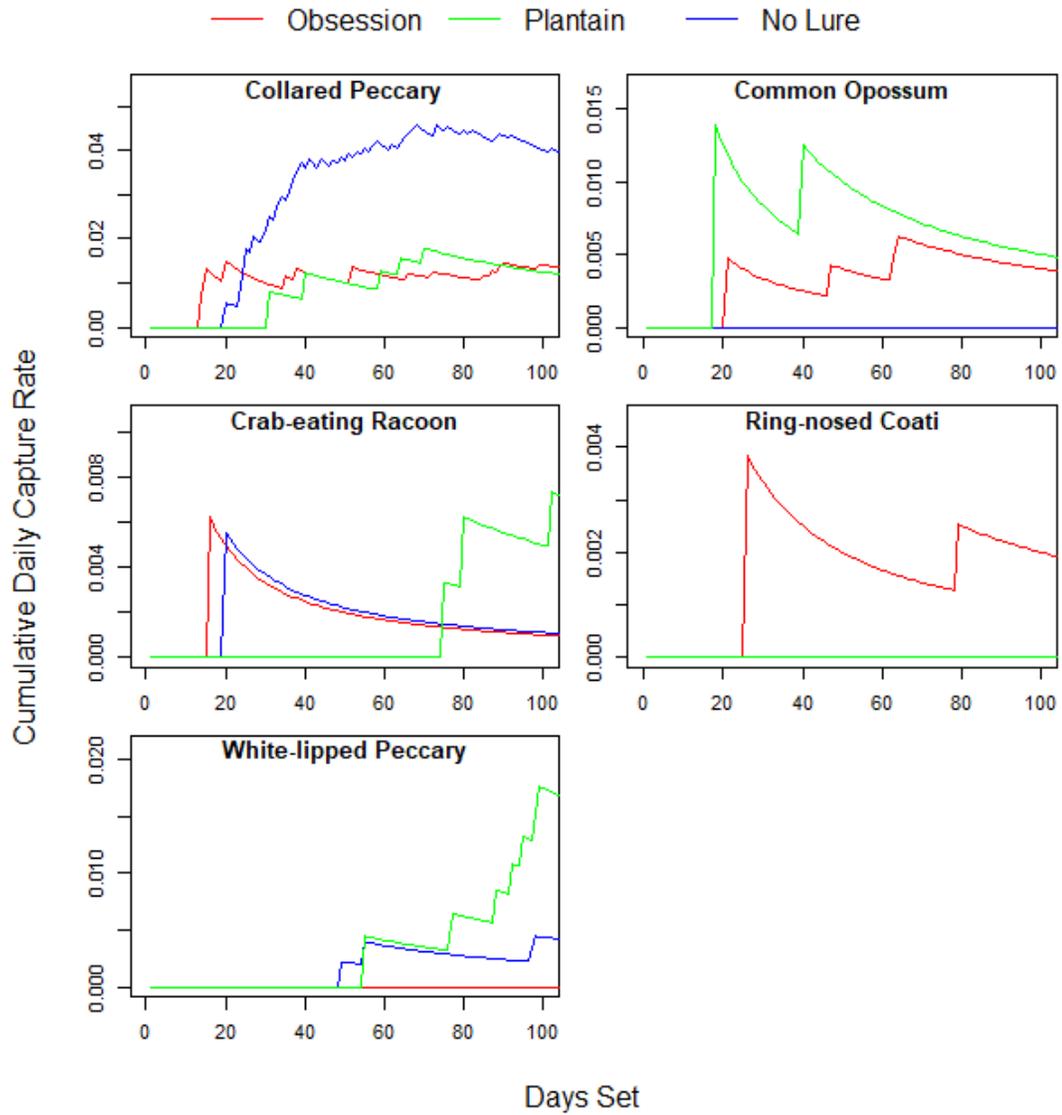


Figure 7 Cumulative daily capture rates of Collared Peccary, Common Opossum, Crab-eating Raccoon, Ring-nosed coati, and White-lipped Peccary during the first 100 active camera days. Cumulative capture rates were determined by dividing the cumulative sum of daily capture rates for each species, within each treatment group, by the number of days since set to determine. Data is from camera surveys in the Mamoní Valley of Panama, 2017.

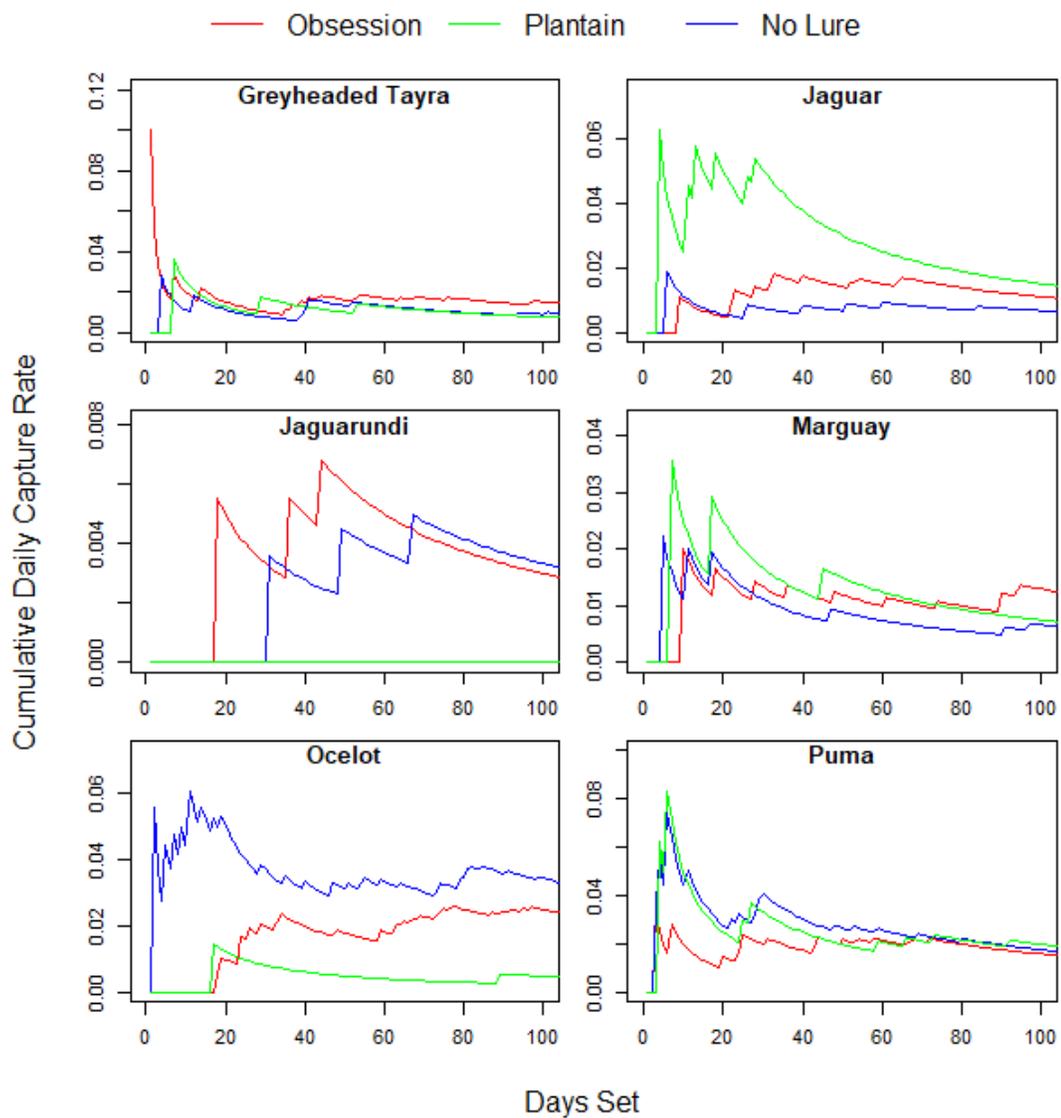


Figure 8 Cumulative daily capture rates of Grayheaded Tayra, Jaguar, Jaguarundi, Marguay, Ocelot, and Puma during the first 100 active camera days. Cumulative capture rates were determined by dividing the cumulative sum of daily capture rates for each species, within each treatment group, by the number of days since set to determine. Data is from camera surveys in the Mamóní Valley of Panama, 2017.

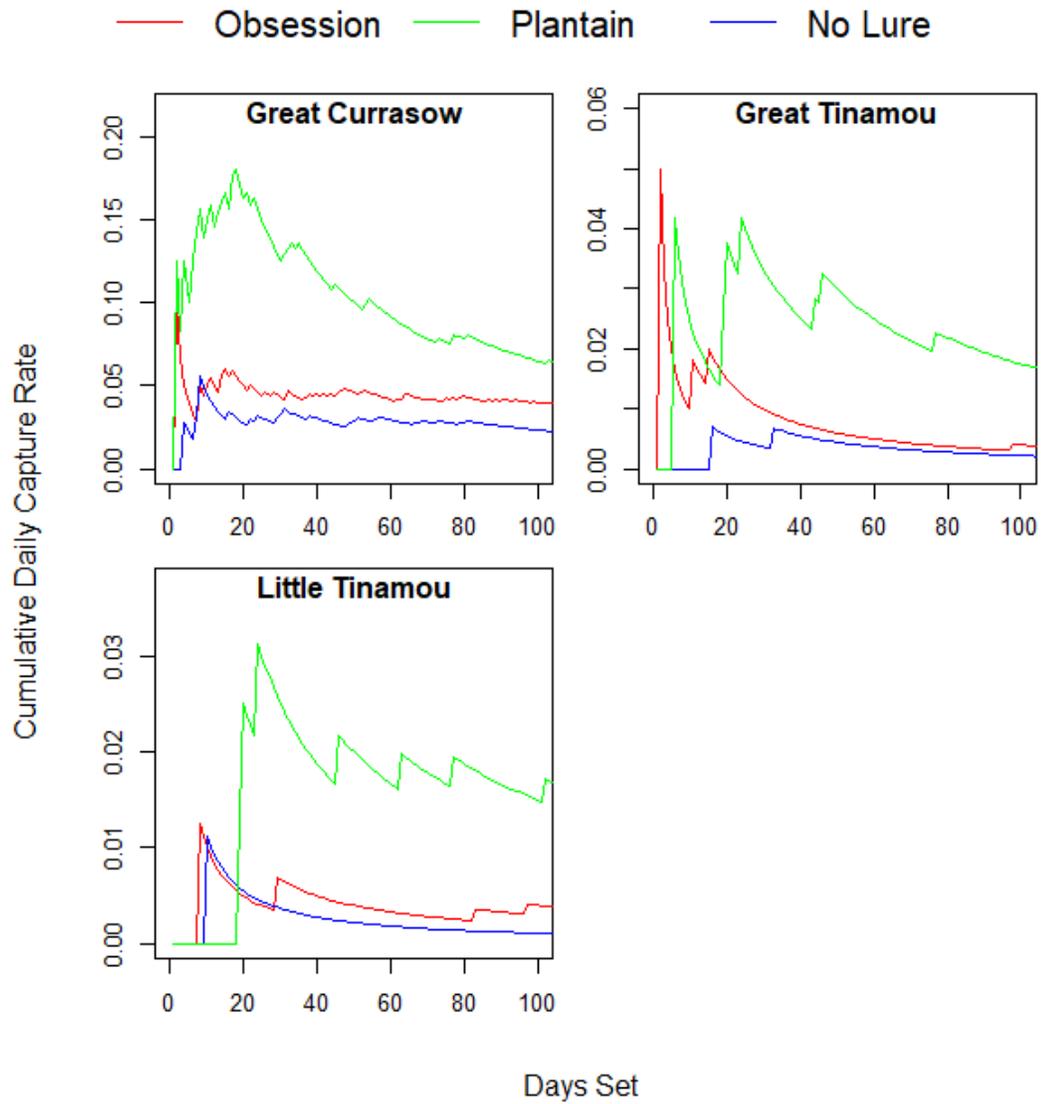


Figure 9 Cumulative daily capture rates of Great Curassow, Great Tinamou, and Little Tinamou during the first 100 active camera days. Cumulative capture rates were determined by dividing the cumulative sum of daily capture rates for each species, within each treatment group, by the number of days since set to determine. Data is from camera surveys in the Mamoni Valley of Panama, 2017.

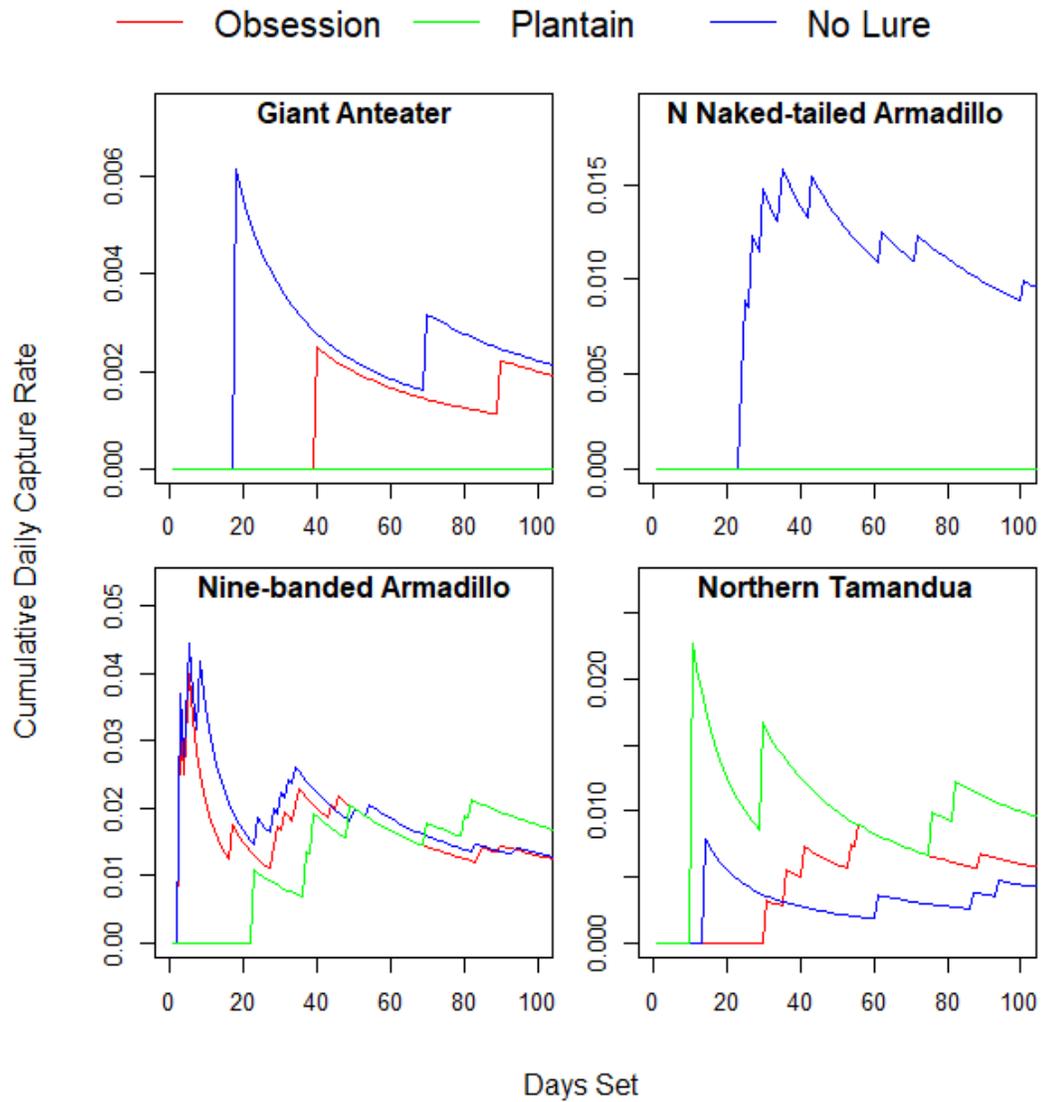


Figure 10 Cumulative capture rates of Giant Anteater, Northern Naked-Tailed Armadillo, Nine-banded Armadillo, and Northern Tamandua during the first 100 active camera days. Cumulative capture rates were determined by dividing the cumulative sum of daily capture rates for each species, within each treatment group, by the number of days since set to determine. Data is from camera surveys in the Mamoni Valley of Panama, 2017.