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Conservation and tourism in the Monteverde Cloud Forest Biological Reserve

Kurtis Bonano

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Kurtis Bonano
Department of Ecology, Evolution and Marine Biology
University of California, Santa Barbara
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ABSTRACT

The goal of protected areas is to protect the flora and fauna contained within them. Tourism may adversely affect the species contained in the protected area while also generating revenue to keep a protected area open. This study aimed to find if there is a correlation between number of tourists and the abundance of wildlife within the Monteverde Cloud Forest Biological Reserve. Mammal and bird abundance and tourist abundance estimates were made using Bushnell HD camera traps over 96 trap nights. A positive correlation was found between the number of visitors and the number of animal individuals photographed at night (R^2=0.1461), the number of species photographed (R^2=0.2227) and the number of positive captures (R^2=0.1948). My results indicate that in this season the number of tourists in the Monteverde Reserve does not have a negative effect on the wildlife there and that tourism in the Reserve is sustainable from the point of view of animal use of the area.

Conservación y Turismo en la Reserva Biológica Bosque Nuboso Monteverde

RESUMEN

El objetivo de las áreas protegidas es preservar la flora y fauna que contienen. El turismo podría afectar negativamente a las especies en tales áreas, aunque también puede generar ingresos para mantener dichas áreas funcionando. Este estudio evalúa la relación entre el número de turistas y la abundancia de vida silvestre en la Reserva Biológica Bosque Nuboso de Monteverde en ésta época del año. Estimé la abundancia de mamíferos y aves, así como también la de turistas usando cámaras Bushnell HD durante 96 noches trampa. Encontré una correlación positiva entre el número de visitantes y el número de individuos animales fotografiados durante la noche (R^2=0.1461), el número de especies fotografiadas (R^2=0.2227) y el número de capturas positivas (R^2=0.1948). Mis resultados indican que para ésta época la cantidad de turistas en la Reserva Monteverde no tiene un efecto perjudicial en la vida silvestre, y que el turismo en la Reserva es sostenible desde la perspectiva del uso del área por parte de los animales.

Conserved areas are essential, not only to protect wildlife but to allow people to experience the world outside of developed areas. Costa Rica is a center for this type of tourism and in 2015 2.66 million tourists came to the country (ICT, 2016). One destination is the area of Monteverde in the province of Puntarenas. As time goes on the number of visitors has increased, and as a result visitors to protected areas (ICT, 2016). This made me wonder, does hiking in these protected spaces cause the birds and mammals to stop using them? According to a review, recreation has a negative effect on bird physiology, behavior and reproductive success (Steven et

al., 2011). In addition, human recreation seems to displace large mammals temporally, making mammals adopt more nocturnal habits, and spatially, decreases their abundance in an area (George & Crooks, 2006). The goal of many protected areas is to protect the flora and fauna occurring in that area. If the presence of tourists negatively impacts that fauna, it would stand to reason that tourists should be barred from the protected area. The issue is that tourism generates revenue which keeps a protected area open and expanding. This problem is an ethical one but has the potential to become a financial one for a park. If too many tourists come and cause the amount of wildlife to decrease, fewer people will encounter animals and may be less satisfied with their visit. This dissatisfaction could lead to decreased visitor traffic and financial trouble for a protected area. If visitors severely decrease the amount of wildlife in an area it may be necessary to limit the number of visitors to that area. I intend to find out of there is a relation between amount of visitors and abundance of wildlife in the Monteverde Cloud Forest Reserve.

Methods and Materials

I collected data from the Monteverde Cloud Forest Reserve in Monteverde, Puntarenas. I used trails Wilford Guindon, Jose Tosi, Quebrada Cuecha, Camino and research. Two camera traps were placed on each trail for a total of 10 camera traps. Camera traps were placed on the Guindon, Tosi, and Cuecha trails on 22 November 2016. Camera traps were placed on the research and Camino trails on 26 November 2016. I estimated mammal and bird abundance and species diversity for each trail based off of number of individuals and species captured. If I encountered an animal which I could not identify I considered it a unique species. The number of visitors using each trail was estimated by counting numbers of individuals in camera trap photos using a manual counter, then calculating the average number of visitors caught by the two cameras on each trail. To obtain a more accurate visitor estimate on the Quebrada Cuecha trail the number of visitors which passed by camera 3 was halved; visitors who passed by camera 3 went to the waterfall and had to pass by the camera again to leave the waterfall viewpoint. In addition, if a camera had not photographed animals after three trap nights it was assumed that the camera was not in the best position to sense and photograph animals and was moved. In this study each camera which was active for 24 hour period generated a trap night. For example, if five cameras were out for one 24 hour period that would be considered five trap nights. I moved cameras 3, 4, F1 and C which were on Senderos Cuecha, Guindon, Camino and Tosi respectively (Appendix 1). I collected the cameras for the final time on 4 December 2016.

Data Analysis

I recorded data from trail cameras and then organized it by date and time of day. Data from the 22 November 2016 through the night of 3 December 2016 was analyzed. I considered day time from reserve open at 7 AM until an hour after reserve closing, at 5 PM. I considered the time from an hour after closing, 5 PM, until reserve open the next morning at 7 AM as nighttime. In total, eight comparisons to visitor number were made: number of animal individuals photographed, number of animal individuals during the day, number of animal individuals during the night, number of individual rare carnivores, number of individual rare carnivores during the day, number of individual rare carnivores during the night, number of positive captures and number of species. An animal individual was one animal in a series of photographs and I did not differentiate animals based on individual traits. This means the same coati could have walked in front of the camera in the morning and then in the afternoon and it

was considered an individual each time. I treated all carnivores which were not coati as rare. I considered positive capture as a set of photos containing one or a group of animals. For example, if a single group of coati were captured over twenty photos the series of images would be counted as one capture. I made the comparison between visitors and captures try to account for variation in group size of different animal species. For example, coati could be present in a group of ten and ocelots which were never photographed together. Regression analyses were run on all eight comparisons to test for significance. Finally a chi-squared test was used to determine if there was a significant difference in the number of animals captured in the day and during the night.

Results

Over 96 trap nights 183 animal individuals were photographed within 14 confirmed species (Table 1). Six mice were not identified along with one bat, bird and squirrel. In addition there were 12 unknown individuals. The number of animals photographed at night was correlated with an increase in the number of visitors, this effect had an R^2 value of .1461. Similarly number of positive captures over the entire day went up with the number of visitors who used the trail. The final significant result was that number of species present on a trail increased with the number of visitors. The other five regressions did not return significant values (Table 2).

Table 1. Identifiable Species Captured. Predator species are in darkened cells.

Common Name	Scientific Name
White-nosed Coati	*Nasua narica*
Central-american Agouti	*Dasyprocta punctata*
Red Brocket Deer	*Mazama americana*
Paca	*Agouti paca*
Striped hog-nosed Skunk	*Conepatus semistriatus*
Common Opossum	*Didelphis marsupialis*
Alfaro's Pygmy Squirrel	*Microsciurus alfari*
Black-breasted Wood-quail	*Odontophorus*
Nine-banded Armadillo	*Dasypus novemcintus*
Slaty-backed Nightingale-	*Catharus fuscater*
Ocelot	*Leopardus pardalis*
Margay	*Leopardus wiedii*
Tayra	*Eira barbara*
Puma	*Puma concolor*

Table 2. P-values and R2 Values of Each Regression between number of visitors and animals in the reserve. Only regressions highlighted in gray showed significant P-values.

Regression	R^2	P-
Number of visitors vs. Number of Animal individuals	0.0574	0.0872
Number of visitors vs. Number of Animal individuals	0.0023	0.7378
Number of visitors vs. Number of Animal individuals	0.1461	0.0052
Number of visitors vs. Number of Positive Captures	0.2227	0.0004
Number of visitors vs. Number of Species	0.1948	0.0011
Number of visitors vs. Number of Rare Carnivores	0.0664	0.4724
Number of visitors vs. Number of Rare Carnivores	0.0029	0.8984
Number of visitors vs. Number of Rare Carnivores (day)	0.0663	0.4724

There were 97 individuals photographed in the daytime and 86 individuals photographed in the nighttime. There was not a significant difference between the numbers of individuals captured at night and during the day as the chi-squared test for these values returned a P-value of 0.4155.

Discussion

An increase in human visitation when the reserve was open correlated with an increase in the number of individual animals caught during the night, the number of positive captures and the number of species photographed. This pattern does not match with the majority of the literature (George & Crooks, 2006) (Steven et al., 2011). First I think a contributing factor to this unexpected trend may be litter. Visitors may leave food-trash in the park which would create a high calorie food source for the animals. More visitors produce more trash and a stronger attractant for foraging animals. This may partially contribute to the trends but during my time at the reserve I did not notice much trash or people actively eating.

Another possible cause of these unexpected trends may be habitat selection by prey species. Human use of roads and trails can cause the number of predators using those trails to decrease, creating a preferred habitat for prey species (Muhly et al., 2011) (Miller, Hobbs, 2000). This hypothesis would require that predator sightings decrease along trails with an increase in visitor number. I did not capture enough predators to create a significant trend, so further research specifically into predator's response to visitor abundance would be necessary to further support this hypothesis.

Another possible factor which may have contributed to the increase of animals along with the increase in visitors may be the weather. Over the study period Hurricane Otto moved through the region. The hurricane resulted in the closure of the Monteverde Reserve for two days. The approaching hurricane also caused rainy and windy conditions during the first week of the project period. During the first week of the study there were fewer visitors and fewer animal sightings than in the second week. I believe humans and the studied animals were reacting to the weather in the same way. When the weather was worse more animals were taking shelter and fewer tourists wanted to hike through the reserve. When the conditions improved more visitors decided to go to the reserve and the animals which had been sheltering came out to forage. More research on the reaction of jungle mammals and birds to weather conditions would be helpful to support this hypothesis.

One more point to discuss is that the each species photographed in the reserve may exhibit a unique response to the number of tourists. Researchers have found that there are differences in the response to tourists between White-Face Capuchins (*Cebus imitator*) and Mantled Howlers (*Alouatta palliata*) (McKinney 2014). This same phenomenon could be happening at the reserve and there might be a species or group of species which gains an advantage with the presence of tourists, or is more disturbed by their presence. I found one species, the coati, which seems to act in the opposite way to the other animals captured; it may decrease in presence as more tourists arrive. I found that the result of the regression of the number of individuals total was insignificant while the regression of number of positive captures was significant. Each of these regressions contained the same amount of data points and relied on data collected at the same time. Number of individuals heavily favored the behavior of animals which travelled in packs, most often the Coati. I found significance when the effect of coati packs was dampened with the use of the positive capture metric. This change indicates that Coati was likely acting in the opposite way of most species since giving Coati more statistical weight resulted in an insignificant result. If an endangered species with low abundance was negatively impacted by tourism but the rest of the species in a protected were not, we could be blind to the plight of that endangered species. As a result I believe more research into species-specific responses to tourism is warranted so as not to overlook negative effects on at risk species.

I have found that human visitation does correlate with animal abundance but not in the way I predicted. In the beginning, I thought human usage would cause a depletion of wildlife in the reserve; however, there were more mammals and birds as the number of visitors increased, contrary to the literature. This study lends credence to the Monteverde Reserve's claim of engaging in sustainable tourism. That said the Monteverde Reserve has set sustainability as a goal, and other types of eco-tourism like all-terrain vehicle tours might have a greater impact on wildlife. In addition this study happened in a season with low numbers of tourists and does not reflect a trend found in high season. In summary, I have shown that it is possible to enjoy natural spaces without adversely affecting the mammals and birds we are trying to protect.

Acknowledgements

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Literature Cited

George, S., Crooks, K. 2006. Recreation and Large Mammal Activity in an Urban Nature Reserve. *Biological Conservation, 133*, 107-117.

Instituto Costarricense de Turismo. 2016. *Anuario Estadístico de Turismo 2015*. San Jose, CR: Instituto Costarricense de Turismo.

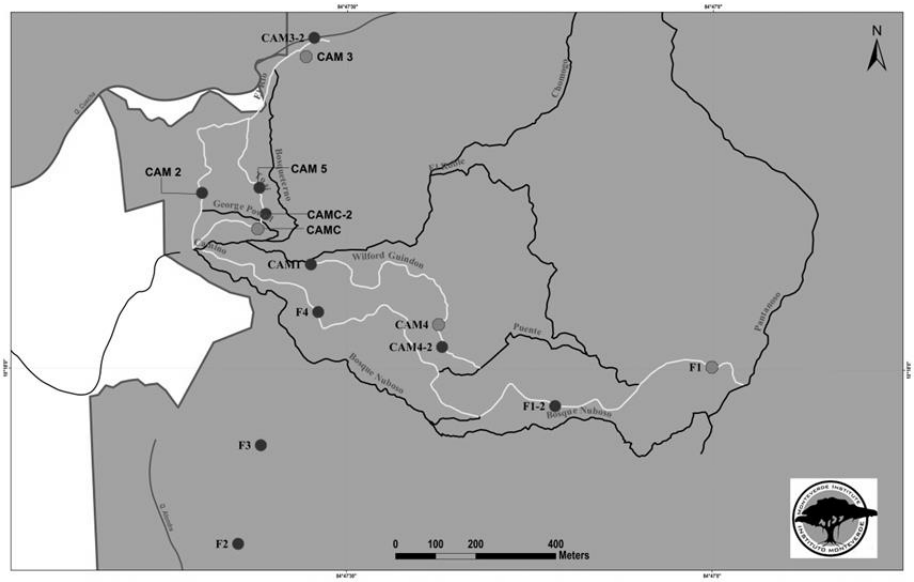
McKinney, Tracie. 2014. Species-Specific Responses to Tourist Interactions by White-Face Capuchins (*Cebus imitator*) and Mantled Howlers (*Alouatta palliata*) in a Costa Rican Wildlife Refuge. *International Journal of Primatology, 35*, 573-589.

Miller, James R., Hobbs, N. Thompson. 2000. Recreational trails, human activity, and nest predation in lowland riparian areas. *Landscape and Urban Planning*, 50, 227-236.

Muhly TB, Semeniuk C, Massolo A, Hickman L, Musiani M. 2011. Human Activity Helps Prey Win the Predator-Prey Space Race. *PLoS ONE* , 6(3):

Steven, R., Pickering, C., & Castley, J. G. 2011. A review of the impacts of nature based recreation on birds. *Journal of environmental management*, *92*(10), 2287-2294.

Appendix



Appendix 1. Monteverde Cloud Forest Reserve and Camera Sites. Sites marked in darker dots represent the final site of each camera and lighter dots represents the original location of cameras which were moved. Cameras 1,2,3,4,5 and C were placed on 22 November 2016. Cameras F1, F2, F3 and F4 were placed on 26 November 2016. I used the trails marked in white and did not use the trails marked in black.