Sustainability and Biodiversity Conservation

Detection of *Paradoxurus philippinensis* in Mt. Calavite Wildlife Sanctuary (MCWS), Philippines, on different moon phases

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Abstract

Using a non-invasive sampling established in a 14 km² land area of MCWS, observation of *Paradoxorus philippinensis* concerning different cycles of the moon showed that most records of appearance were during the Half and Gibbous phases. A multinomial Chi-Square test points out that the amount of civet detection on various moon phases is significantly different, implicating possible inferences on the effects of moon phases in Philippine palm civet's nocturnal activity.
Keywords: *Paradoxurus philippinensis*, Moon phases, Non-invasive sampling, Nocturnal activity

Introduction

Light influences different activity patterns, such as circadian rhythms, which modulate animals' feeding and sleeping behaviors (Halle, 2000; Challet, 2007). Some animals are acclimatized to not sleeping during nighttime (nocturnal) or are active during daytime (diurnal) (Crawford, 1934). Investigation of nocturnal species is of significant interest as these animals have evolved and

developed intrinsic mechanisms to facilitate visual perception in low-light conditions, with a highly likely reason to reduce or avoid predation pressure (Steinlechner, 2012). Nocturnality is widely known to be an evolutionary adaptation for mammals as there are herbivorous mammals like the Philippine deer (*Rusa marianna*) that traverse long distances at night for available water sources to avoid losing too much water in the body due to lower temperatures (Clark, 1914), and the typical house rat (*Mus musculus*) which most of its exploratory activities like food hunting and drinking is done when there is low availability of light (Petersen, 2017). Such a pattern of activity is evident, especially for mammals who like to forage for food during the night, like the Philippine palm civet (*Paradoxurus philippinensis* Jourdan 1837). Interestingly, cycles of moonlight patterns have been reported to play an important effect on the behavior of nocturnal mammals across many species around the world. However, such determinant is still poorly understood on many terrestrial mammals in the Philippines, specifically *P. philippinensis*. These civets inhabit lowland areas due to the abundance of fruit trees since the higher elevation of MCWS comprises mostly grasslands (Alviola et al; 2023; de Guia et al., 2020). Civets also aid in non-random seed dispersal as the fruits they intake are only digested partially (Marcone, 2004), which highlights their ability to increase the vegetation of a landscape (Nakashima et al., 2010). Different sampling techniques have been widely used to study different species and their ecological significance; however, the problem arises when certain habitats become difficult to access, and species become taxing to locate because of their nocturnal, cryptic, elusive, and solitary behaviors (Faulkner, 2015), which explains why studies conducted regarding this species of *P. philippinensis* remained scanty in the Philippines. However, a gap like this in the field of research has been slowly catching the attention and interest of researchers because of the introduction and utilization of camera trapping methods (Nichols & Williams, 2006). Camera traps enable researchers to improve their understanding and knowledge of conservation and ecological relationships between different species, including underexplored nocturnal mammals (O'Connell, 2006). Hence, this study is conducted to report the possible trend of *P. philippinensis'* activity concerning different moon phases based on the bycatch camera trap observations gathered in MCWS.

Material and methods

Cameras were strategically installed over various locations covering approximately 14 km² of land area as part of the wildlife conservation project in MCWS to detect the presence of medium to large size bovines (Bonenfant, 2023). The complete sampling procedure included two divisions,

the east and west sides of MCWS, and three rounds, accounting for the dry season. The cameras, whose field of view ranges from the forest floor to the middle canopy, are relocated to new locations 300 meters apart every two months for each round. Different photographs were shot at various times, heights, temperatures, and moon phases depending on the species being photographed, as these cameras contain a motion sensor that is automatically triggered when there is a significant movement detected. Only the episodes in which civets were successfully captured were the only ones tagged using the software digiKam according to the moon phase. After sorting the data, an Excel file comprising the number of photos taken of civets in rounds one to three and their corresponding moon phase—which was divided into five categories: crescent, gibbous, half, new, and full moon—was produced. The statistical program JASP was then used to calculate a nonparametric Multinomial Chi-square Test to determine if there was a significant difference between the different moon phases in terms of the probability of detection of civets.

Results

There was a total of 26 incidences that were recorded in 16 stations, and among them were the Palm Civets, which were separated based on the five moon phases (Figure. 1). Every stage of the moon phases exhibits civet activity, but the crescent, new, and full moons saw the least number of sightings. When these things are taken into account, it is evident that civets are most active during the Gibbous and Half-moons, comprising 34.6% and 38.50% of the species being detected in the camera traps, respectively.

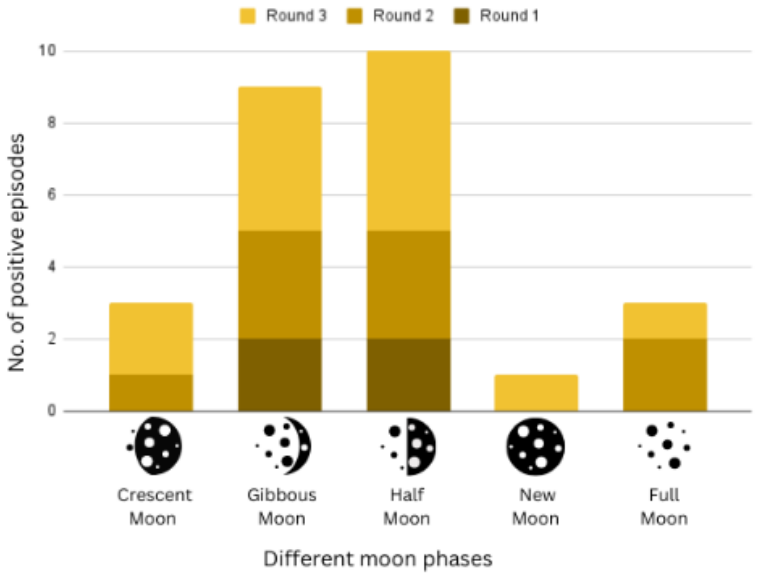

Fig 1. Distribution of *P. philippinensis* incidences on different moon phases per camera trapping rounds.

The first round of sampling resulted in the fewest civets being photographed by the cameras, which was followed by the second round containing four out of five incidents that were recorded per moon phase, while the third round of sampling recorded civet sightings during all phases of the moon (Figure 1). This may be attributed to the disturbance during the installation of the cameras. Therefore, if the camera trapping days were extended, the area is expected to return to its natural state, and all signs of human disturbance could already be eliminated. Moon phase was used as a covariate for *P. philippinensis* detection in MCWS, and it was discovered that this species spends the majority of its time active during Gibbous and Half-moons (Fig 1). The substantial difference between the moon phase and detection probability was revealed by the multinomial Chi-square test's p-value (Figure 2). The amount of civet detection on camera traps throughout the various moon phases appears to be statistically different ($p = 0.014$). Even though nocturnal species do not require as much light intensity as diurnal species, the light brought by the moon seems to play a role in the activity patterns of Philippine palm civets. This can be attributed to the sensitivity of the animal in moonlight intensity, which has been reported to affect the foraging, traversing, and predator avoidance activity of civets (Prugh & Golden, 2014). *P. philippinensis* being captured the least during the waning, new, and full moons, and mostly during the gibbous and half-moons, indicates that predation pressure might alter the periodicity of their activities (Pratas-Santiago et al., 2017) because low light during the waning and new moons might cause more challenges for civet population to discern their environment as their visual acuity will take hold of, whereas the full moon enhances the risk of being picked up by predators since larger predators mostly rely on light instead of a special sensory system to detect prey. (Bhatt et al., 2021). A study conducted by Joshi et al. (1995) discovered that palm civets switched from eating fruits to invertebrate and vertebrate prey when ripe fruits were in short supply or unavailable at the moment. Since palm civets are arboreal animals by nature (Nakashima et al., 2010), the reason that all of the observed photos of civets in MCWS show simply traversing is likely because the cameras' field of view was limited to the area between the ground and the central canopy which may have missed the species' activity when perched on a tree to search for various fruits. Such findings showcasing probable patterns of civet activities in terms of moon phases remain to warrant further investigations, however, the initial observations reported herein seem to open an uncharted ecological influence of the environment amongst the Philippine wildlife.

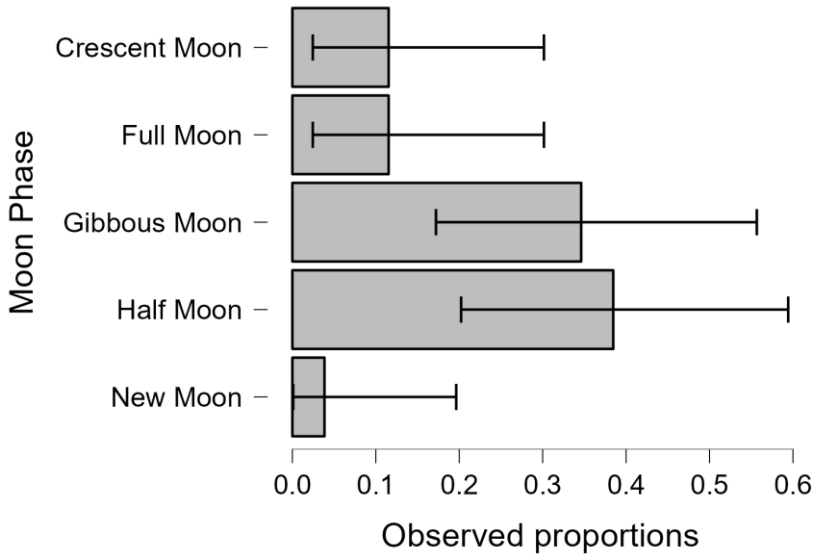

Fig 2. Observed proportions per moon phase based on JASP results

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