Short Research Article

Identification of wildlife biodiversity in a protected area with rambutan (*Nephelium lappaceum*) agroecosystem using camera traps in Huehuetán, Chiapas, México.

Abstract

The relative abundance of mammals serves as indicator of population status, highlighting spatial and temporal variations. Photo-trapping offers a reliable study, non-invasive and efficient method for biodiversity population studies. Our research focused on the shaded rambutan management system in Huehuetán, Chiapas, México. Characterized by complex vegetation structure and high habitats heterogeneity. Sampling occurred from January 5 to November 5, 2023, using twelve camera traps across four sectors, covering an area of 2500 m2 of rambutan agroecosystem. Each photo-trapping sector had 3 camera traps which operated 24 hours a day. Our study revealed the presence of eleven species, including White-tailed Deer (Odocoileus virginianus Zimmermann), Gray fox (Urocyon cinereoargenteus Schreber), Virginia Opossum (Didelphis virginiana Allen), Raccoons (Procyon lotor Linnaeus), American hog-nosed skunk (Conepatus leuconotus Lichtenstein), Nine-banded armadillo (Dasypus novemcinctus), White-winged Doves (Zenaida asiatica), Lowland paca (cuniculus paca) and Tricolored heron (Egretta tricolor). The rambutan provides habitats feeding, shelter and breeding sites for local wildlife.

However, population growth threatens biodiversity, forcing species migration and altering local wildlife dynamics.

Key words: biodiversity, heterogeneity, rambutan, wildlife

Introduction

Knowledge of animal biodiversity in tropical perennial crops is recommended in order to derive actions for their management and conservation.

The analysis should include an evaluation of the current state of the populations in terms of their structure, spatial location in the management unit, their abundance and the species that compose them [1,2].

According to Sargeant & Douglas [3], one of the simplest and most appropriate activities to carry out management and conservation actions in any protected area is to obtain data on the relative abundance of species, which are very useful for detecting changes in the dynamics of wildlife populations, thus allowing us to understand the dynamics of the species and be able to identify the effect of management actions on them.

Robinson & Redford [4] point out the population changes of fauna with deforestation and the transformation of the original vegetation, in addition to uncontrolled hunting that negatively affect numerous species. When this situation arises, Aranda [5] suggests its use through controlled management. The relative abundance of mammals is an indicator of the population situation and its evaluation in different times or spaces shows its possible spatial and temporal variation. This parameter, as well as the activity pattern, can contribute to the proposal of strategies for the conservation of the species [6]. Abundance estimation for medium and large mammals is difficult and costly due to their nocturnal and evasive habits, they are generally found in low densities, so it is advisable to record their relative abundance index [7].

Photo-trapping in biodiversity population studies is a reliable, non-invasive [8,9,10], efficient [8], easy and fast tool with possibilities to record cryptic species that move long distances or are in low densities [11, 10].

The use of remotely triggered cameras to photograph wildlife dates back to 1877, but the method was little used until the invention of cameras with automatic infrared sensors in the 1980s [12]. Since this time, the last 20 years have seen an increase in ecology and conservation studies. This is reflected in a 50% annual growth in publications involving the use of camera traps over the past decade [13,14].

Currently, the significance and importance of biodiversity is not in doubt and a large number of parameters have been developed to measure it, as an indicator of the state of ecological systems and application for conservation, management and monitoring purposes [15].

Nephelium lappaceum L. belongs to the *Sapindaceae* family, which includes more than 150 genera and about 2000 species of trees, shrubs, herbaceous and climbing plants widely distributed in the tropics and warm zones of the planet [16]. It has been successfully introduced to the Soconusco region of Chiapas [17]; commercial production of rambutan has increased considerably in southern Mexico, especially in marginal or low-lying areas to produce *Coffea arabica L.* [18].

The shaded rambutan management system presents a complex and diverse vegetation structure, which results in a high heterogeneity of habitats, and therefore, in the presence of a high richness of wildlife [19]. In addition, they act as a buffer zone between forested areas and matrixes of high-quality productive zones, reducing edge effects, and serve as corridors increasing connectivity between conserved areas and fragmented landscapes [20, 21, 22].

The rambutan agroecosystem allows the maintenance of various species of medium-sized mammals (weighing between 500 g to 10 kg) and about 70% of the species that originally existed in the coffee plantations are found there [23].

The presence and activity of each animal species in an ecosystem can be identified through its impact on it. Among the possible impacts of animal biodiversity on the plant and animal community are: seed dispersal, seed predation, and control over insect and rodents [24].

Studies on wildlife diversity in forest systems in our country began a little more than 30 years ago, with emphasis on studies related to plants, insects and birds [25].

However, although agroecosystems allow the conservation of biodiversity, today hunting is one of the factors that is threatening the animals that live within coffee plantations. Generally, the most frequently hunted animals are those that are common in the area and have high reproductive rates, as has been pointed out [26]. In some areas, hunting may be sustainable for some species, but not for all, because populations do not respond in the same way to such pressure [27].

Robinson & Redford [4] report the problems faced by animal populations in tropical regions in Latin America, along with deforestation and transformation of native forests, uncontrolled hunting negatively affects numerous species, and their monitoring could favor their exploitation [5].

Most of the animals present in agroforestry systems perform substantive actions for the maintenance of the ecosystem. However, at present, there is a struggle for the survival of both animal and plant species due to the concomitant effect of the increase in human settlements and the decrease in plant habitats. This presents an antagonistic relationship between humans and animals in the agroecosystems of the Soconusco in Chiapas. The objective will be to know the index of biological diversity in the rambutan agroecosystem in the municipality of Huehuetan, Chiapas.

4. METHODOLOGY

4.1. Geographic location

Location of the Experiment

The current investigation was developed in conditions of plantation established in the common land Tuzantán, which is located in the Municipality of Huehuetán in the State of Chiapas Mexico and is located at the GPS coordinates: Longitude (dec): -*92.295000*, Latitude (dec): *14.980556*; with an altitude of 360 meters. It is bordered to the north by the municipalities of Huehuetán, Tuzantán, Motozintla and the Republic of Guatemala; to the east by the Republic of Guatemala, the municipalities of Cacahoatán, Tuxtla Chico and Hidalgo border; to the south by the municipalities of Hidalgo border, Suchiate and the Pacific Ocean; to the west by the Pacific Ocean and the municipalities of Mazatán and Huehuetán. A route was taken over the four points where the camera traps were installed with a Garmin GPS, and waypoints were plotted at each point to mark the study area.

Coordinates, boundaries and physiography

The study area is located between parallels 14°55' and 15°07' north latitude; meridians 92°18' and 92°34' west longitude; altitude between 0 and 800 m. It is bordered to the north by the municipalities of Tuzantán and Tapachula; to the east by the municipality of Tapachula; to the south by the municipalities of Tapachula and Mazatán; to the west by the municipalities of Mazatán and Huixtla. Physiographically it is located in the Central American mountain range. In the lower part is located the Chiapas Coastal Plain to the north with hills and represents 8.11% of the region [28].

Description of climate, soil and vegetation

The climate type is warm sub-humid with summer rainfall (64.84%) and warm humid with abundant summer rainfall (35.16%) with average temperature of 24 - 30°C and between 1 500 - 4 500 mm of precipitation [28].

The dominant soil in the study area is Cambisol (33.67%), Acrisol (20.16%), Luvisol (20.22%), Phaeozem (8.68%), Regosol (6.35%), Gleysol (5.24%) and Fluvisol (3.64%).

Sampling and trap locations

Sampling was carried out from January 5 to November 5, 2023. Twelve camera traps or photo-trapping cameras were used in four sectors, covering an area of 2500 square meters with rambutan cultivation system, which was normally managed by its producers.

Each photo-trapping sector had three double camera traps brand ceyomur, lmhome, bushnell, which were in operation 24 hours, day and night, programmed with 20-second video and three photographs with each activation. Each photo-trapping sector was identified with an alphanumeric key, preceded by the letter of the site to which it belonged (A, B and C), followed by the number of the photo-trapping station according to the order in which they were located.

These photo-trapping points were recorded on a log sheet, which contained important data for the control of the project, date, time, identification key and GPS location.

Species identification

For the analysis of the data obtained, the first step was to identify the species captured by the cameras, this was done using specialized literature and guides for the identification of mammals [29]; the nomenclature was based on that described by Wilson and Reeder [30] and Ramírez-Pulido [31].

The following were taken as individual records: 1) consecutive photographs of the same individual 2) photographs taken within the same four-hour period of a species were considered as a single record, 3) in photographs where more than one individual of a species appeared consecutively and within four hours of each other, the number of individuals that appeared was taken as the number of records [32].

The cameras were installed for 6 months of rain and 3 months of drought, which consisted of almost a whole year to study the behaviors of the animals in these 2 seasons.

4.11 Activity pattern

To evaluate the activity pattern of the mammals found, only species with more than 11 records were considered, which has been considered the minimum number to describe activity patterns [33, 34, 35].

Results and Discussion

The wild life diversity captured by camera traps are shown below.

1. **Fig 1 : Common name:** White-tailed Deer

   Scientific name: *Odocoileus virginianus*

2. **Fig 2 : Common name:** Gray fox

Scientific name: *Urocyon cinereoargenteus*

3. **Fig 3 : Common name:** Virginia Opossum

Scientific name: *Didelphis virginiana*

4. **Fig 4 : Common name:** Raccoon

Scientific name: *Procyon lotor*

5. **Fig 5 : Common name:** American hog-nosed skunk

Scientific name: *Conepatus leuconotus*

6. **Fig 6 : Common name:** Nine-banded armadillo
   Scientific name: *Dasypus novemcintus*

7. **Fig 7 : Common name:** White-winged Doves
   Scientific name: *Zenaida asiática*

8. **Fig 8 : Common name:** Lowland paca
   Scientific name: *Cuniculos paca*

9. **Fig 9 : Common name:** Tricolored heron
   Scientific name: *Egretta tricolor*

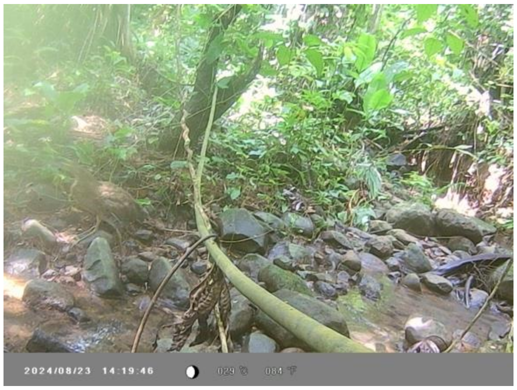

Table 1. Wildlife diversity in rambután (*Nepheliumlappaceum*) agroecosystem

Specie	Scientific name	Common name	Diversity
1	*Odocoileusvirginianus*	White-tailed Deer	Deer were commonly observed, there is a nearby community of deer in the area.
2	*Urocyoncinereo argenteus*	Gray fox	The fox population has decreased over the years, they were very common in the area years ago, but illegal hunting has decreased their local population.
3	*Didelphis virginiana*	Virginia Opossum	Virginia Opossum is a local species, frequently seen in the area
4	*Procyonlotor*	Raccoon	Raccoons are Local, there is a large population of them in the surrounding area
5	*Conepatusleuconotus*	American hog-nosed skunk	They were frequently observed in the area because they are local adapted populations
6	*Dasypusnovemcintus*	Nine-banded armadillo	The population of armadillos has decreased considerably in recent years due to illegal hunting and sale of their meat
7	*Zenaida asiática*	White-winged Doves	White-winged doves were observed every day, their populations are small but constant.

8	*Cuniculos paca*	Lowland paca	Lowland paca was observed steadily, its population is increasing.
9	*Egretta tricolor*	Tricolored heron	It was rarely observed, they are birds that are in constant movement

Source: Own elaboration with data obtained from camera traps

Discussion

Biodiversity Assessment in Rambutan Agroecosystem, Huehuetan, Chiapas

Our camera trap survey in the rambutan agroecosystem of Huehuetán, Chiapas, revealed a medium-low biodiversity. We detected 10 species, including White- tailed Deer (Odocoileus virginianus), Gray fox (Urocyon cinereoargenteus), Virginia Opossum (Didelphis virginiana), Raccoon (Procyon lotor), American hog-nosed skunk (Conepatus leuconotus), Nine-banded armadillo (Dasypus novemcinctus), White-winged Doves (Zenaida asiatica), Lowland paca (Cuniculus paca), and Tricolored heron (Egretta tricolor).

Decline in Biodiversity

The number of species found indicates a decline in local biodiversity. Similar trends have been observed in neighboring regions with comparable agroecosystems, where urbanization, illegal hunting and species trafficking have contributed to decreased wildlife diversity. Biodiversity can be lost simply as the area of natural habitat is diminished, or through the differential loss of ecosystems and their associated species and biological communities [36]

Regional Context

Studies in the central region of Veracruz have reported a 54% decline in wildlife diversity over 27 years, primarily due to urbanization and agricultural activities [37]. Structured interviews in our study area revealed the presence of 16 species, with nine being preferred by locals for hunting, resulting in high hunting pressure. Habitat destruction due to deforestation and excessive hunting are major contributors to the decline in wildlife population [38]. These findings highlight the need for sustaibale land-use practices and effective conservation strategies to protect biodiversity in the region. The costs of conservation are felt locally while many of the benefits are shared globally — from carbon sequestration to preserving genetic resources [39].

The most abundant and preferred species for hunting are the Nine-banded armadillo (*Dasypus novemcinctus*), European rabbit (*Oryctolagus cuniculus*), Virginia Opossum (*Didelphis virginiana Allen*), Collie´s squirrel (*Sciurus colliaei Richardson*), Raccoon (*Procyon lotor Linnaeus*), American hog-nosed skunk (*Conepatus leuconotus Lichtenstein*), Cacomistle (*Bassariscus sumichrasti Saussure*), White-nosed coati (*Nasua narica Linnaeus*) and Central American agouti (*Dasyprocta punctata Gray*). The above list coincides with the information reported by Gallina [24]. In general, the species present in the ecosystem match with the results reported by García [39] and Gallina [23].

Impact of anthropogenic Activities

The presence of human activities such as firewood extraction and hunting may be contributing to the decline of animal population. Notably, larger mammals like lowland paca (Cuniculus paca) are no longer found in these ecosystems, likely due to habitat loss and hunting pressure.

Conservation Concerns

Hunting can have far-reaching consequences for ecosystems, including negative impacts on plants and invertebrate communities, as highlighted by by Stoner [41].

To address these concerns, we engaged with local hunters, emphasizing the importance of biodiversity conservations in agroecosystems and the legal consequences of poaching.

Future Research Directions

Further research is necessary to understand the complex relationships between biodiversity, anthropogenic activities and population growth in this region. By exploring these dynamics, we can better inform conservation strategies and mitigate the decline of biodiversity in these ecosystems. It is necessary to maintain the importance of the biodiversity of native species so the natural balance returns to optimal levels [42].

CONCLUSIONS

This study contributes significantly to our understanding of the rich biodiversity within rambutan agroecosystem. Despite the low species density, we identified various species with differing threat levels adapting to the agricultural environment. These species have learned to coexist within the agroecosystem, exhibiting dynamics movement patterns in response to local population growth. The rambutan agroecosystem serves as vital habitat corridor, connecting disparate landscapes features and providing essential resources for local wildlife, including food, shelter, rest, reproduction, and breeding sites. However, our observation suggest that rapid population growth is detrimental to local biodiversity, driving species migration and altering regional wildlife dynamics. This disruption can lead to ecological imbalances, potentially threatening the long-term sustainability of agroecosystems in the region.

Disclaimer (Artificial intelligence)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc.) and text-to-image generators have been used during the writing or editing of this manuscript.

Competing Interests

No exist competing interests

Authors' Contributions

'Author A' University Student, wrote the protocol
'Author B' Thesis Director
'Author C' Biologist focused in tropical agroecosystems
'Author D' Managed the Metholodogy
'Author E' Thesis Advisor
'Author F' Thesis Advisor
'Author G' Thesis Advisor

All authors read and approved the final manuscript.

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