Colegio de Postgraduados

Flight Height and Population Fluctuation of *Euplatypus parallelus* and *Euplatypus segnis* (Coleoptera: Curculionidae) in Mangroves

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ABSTRACT

Objective: To evaluate the flight height and population fluctuation of *Euplatypus parallelus* and *E. segnis* associated with the mangrove ecosystem in the state of Tabasco, Mexico.

Design/methodology/approach: To assess the flight height of *E. parallelus* and *E. segnis*, six sampling sites were selected within the mangrove area. At each site, three interception traps were installed at heights of 1.5, 6, and 12 meters, and sampling was conducted over the course of one year. Population fluctuation was analyzed graphically by comparing monthly abundance data with environmental variables such as temperature, humidity, and precipitation. Additionally, Pearson correlation analyses were performed to evaluate the relationship between flight activity and the recorded environmental factors.

Results: A total of 216 individuals of *E. segnis* and 132 of *E. parallelus* were collected. The greatest number of individuals was captured at 1.5 meters, while the fewest were recorded at 12 meters. Statistical differences in flight height preferences were observed, with both species showing a significant preference for flying at 1.5 meters compared to 6 and 12 meters. The population fluctuation of *E. parallelus* and *E. segnis* varied by sampling month and differed across the evaluated flight heights. Correlation analyses revealed a slight negative association between *E. parallelus* abundance and precipitation, and a positive association between *E. segnis* abundance and temperature.

Limitations on study/implications: It is crucial to record environmental variables at the insect capture sites using mobile devices to ensure reliable data that accurately reflect the relationship between environmental conditions and insect behavior.

Findings/conclusions: The results suggest that *E. parallelus* prefers to settle and move below six meters in height, where larger trunk diameters provide more suitable feeding and breeding areas.

Keywords: borers, coleoptera, mangrove, scolytinae, rain forest.

INTRODUCTION

Mangroves are coastal ecosystems located in tropical areas of the planet, in the intertidal zone of the coastline where saltwater and freshwater converge. They are plant communities composed of trees and shrubs adapted to different levels of salinity and to muddy soils with high organic matter content (Pérez-De Madrid *et al.*, 2018). These ecosystems are among the most complex and productive in the world (Kathiresan & Qasim, 2005), as they provide various ecosystem services such as soil formation, nutrient cycling, food provision, habitat for a wide range of biodiversity, and protection against erosion, among others (Pérez-De Madrid *et al.*, 2018). Despite this, they are ecosystems that have suffered significant degradation and loss of area due to land competition for urban, tourism, agricultural, and aquaculture development (Calderón *et al.*, 2009), as well as attacks from various insect pests. Among the main pests attacking the mangroves of southeastern Mexico are defoliators such as *Hylesia colimatifex* (Vázquez-Vázquez, 2024), *Anacamptodes* sp. (Geometridae), *Automeris tridens* (Saturniidae), and *Rothschildia lebeau* (Saturniidae) (Ojeda-Aguilera & Pineda-Torres, 2007; Gómez-García *et al.*, 2015). Also present are wood-boring insects from the Curculionidae family such as *Coccotrypes rhizophorae* (Martínez-Zacarías *et al.*, 2017; Díaz *et al.*, 2020), *Coptoborus pseudotenuis*, Schedl 1936 (CONAFOR, 2022), and *Euplatypus parallelus*, Fabricius, 1801 (CONAFOR, 2023). Wood-boring insect species of the genus *Euplatypus* are ambrosia beetles that belong to the subfamily Platypodinae, which reproduce inside the wood of host trees. These beetles are commonly associated with some species of phytopathogenic fungi of the genus *Raffaelea* (Atkinson, 2004). The species *E. parallelus* is known in Mexico as the black mangrove borer and has been documented to be capable of killing healthy trees. The most evident damage includes canopy wilt, branch death, shiny black/brown spots, exudates, and gummosis on the trunk and branches. For its part, *Euplatypus segnis* has not been reported as a pest in mangrove ecosystems but is considered a species of economic importance in pecan (*Carya illinoinensis* Koch) plantations, and according to data collected by Gerónimo-Torres *et al.* (2016; 2021), it is one of the most abundant *Euplatypus* species in the mangroves of Tabasco. Therefore, the objective of this research was to evaluate the population fluctuation and flight height of *E. parallelus* and *E. segnis* associated with the mangrove ecosystem in the state of Tabasco, Mexico.

MATERIALS AND METHODS

Study Site

Sampling was carried out from August 2016 to July 2017 in the Chiltepec mangrove, located in the municipality of Paraíso, Tabasco, Mexico (18° 25' 15.2" N, 93° 06' 42.3" W). The Chiltepec mangrove belongs to the Mecoacán Lagoon, which in September 2019 was declared a Natural Protected Area (NPA) due to its biological relevance and need for ecological rehabilitation. This site is part of the Mecoacán-Julivá-Santa Anita Lagoon System and the Mangrove Biological Corridor of the Gulf of Mexico. It features mainly sandy and deep soil of medium fertility, known as Arenosol, and is characterized by a mix of *Rhizophora mangle* L., *Avicennia germinans* (L.) L., and *Laguncularia racemosa* (L.) Gaertn., with an average height of 12 m (Gerónimo-Torres *et al.*, 2021b).

Insect capture

To evaluate the flight height of *E. parallelus* and *E. segnis*, six sampling sites were selected in the mangrove, and at each site, three interception traps baited with 70% ethyl alcohol were installed at heights of 1.5, 6, and 12 meters (Gerónimo-Torres *et al.*, 2021a) (Figure 1).

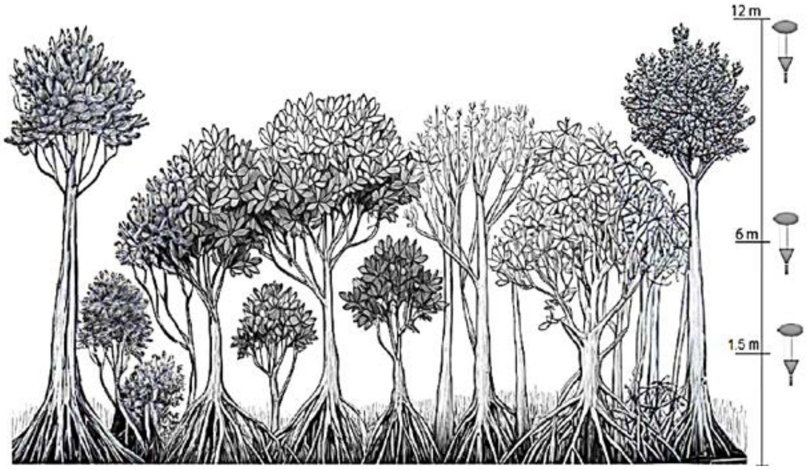

Figure 1. Vertical distribution of interception traps in mangrove.

Biological material was collected every fifteen days for one year, labeled, and preserved in 70% ethyl alcohol for identification in the laboratory (Pérez-De la Cruz *et al*., 2009a).

Taxonomic Identification

Species identification was carried out using the taxonomic keys of Pérez-De la Cruz *et al*. (2011) and confirmed through comparison with specimens from the Insect Collection of the University of Tabasco (CIUT) at the Research Center for the Conservation and Sustainable Use of Tropical Resources (CICART).

Data analysis

The flight height of *E. parallelus* and *E. segnis* at three different levels (1.5, 6, and 12 meters) was analyzed using a randomized block design, with monthly abundance at each height as the dependent variable. Median comparisons were conducted using the non-parametric Kruskal-Wallis test to determine statistical differences. Population fluctuation of *E. parallelus* and *E. segnis* was compared graphically against monthly abundance at each flight height with environmental variables such as temperature, humidity, and precipitation, based on data from the National Water Commission (CONAGUA) weather station (18° 25' 24" N, 93° 09' 20" W). Finally, a Pearson linear correlation analysis ($P<0.05$) was performed between the flight activity of *E. parallelus* and *E. segnis* and the monthly recorded environmental variables.

RESULTS AND DISCUSSION

A total of 348 specimens were collected, of which 216 belonged to *E. segnis* and 132 to *E. parallelus*, positioning *E. segnis* as the more abundant species compared to *E. parallelus*. These findings are consistent with those reported by Pérez-De la Cruz *et al*. (2011) in cacao agroecosystems, Falcón-Brindis *et al*. (2018) in rubber plantations, and Gerónimo-Torres *et al*. (2015) in the mangroves of Tabasco. This level of abundance suggests that *E. segnis* may exhibit a better adaptation to the prevailing environmental conditions of tropical ecosystems. Regarding insect abundance by flight height, the highest number of individuals was captured at 1.5 m for both species: *E. parallelus* accounted for more than 65% of captures at this height, while *E. segnis* represented 56%. Conversely, the lowest abundance percentages were recorded at 12 m, with 0.76% and 7.86% for *E. parallelus* and *E. segnis*, respectively (Table 1). Statistically significant differences were found among the abundances recorded at each flight height for both species: *E. parallelus* (Kruskal-Wallis=20.21; $p<0.01$) and *E. segnis* (Kruskal-Wallis=15.85; $p<0.01$) showed significant differences between 1.5 m and the heights of 6 and 12 m (Table 2). These findings align with those reported by Rodríguez and Barrios (2017), who observed statistically significant differences in beetle activity between the understory and canopy layers. The greater flight activity at lower strata may be linked to the feeding habits of the studied species, as Rodríguez and Barrios (2017) also reported a higher capture rate of platypod beetles in the understory of a semi-deciduous forest on Barro Colorado Island, Panama. Furthermore, Wood (1982) noted that over 99% of Scolytinae subfamily members are xylomycetophagous, relying heavily on high humidity levels to support the development of the symbiotic fungi they cultivate and feed on.

The population fluctuation of *E. parallelus* and *E. segnis* differed notably throughout the sampling months. *Euplatypus parallelus* at 1.5 m height reached its highest abundance in April and July, with 14 individuals each, showing two slight peaks in August and January, with 11 and 10 specimens respectively; at 6 m, two peaks in abundance were recorded in November and March, with 8 and 12 individuals; meanwhile, at 12 m only one specimen was captured in July (Figure 2).

The population of *E. segnis* reached its highest abundance at 1.5 m height in August and June, with 29 and 20 individuals, respectively, showing three slight peaks in November, May, and July, with 13, 11, and 14 specimens, respectively. At 6 m, the highest abundance peak occurred in April, with 19 organisms, and at 12 m, the greatest abundance was recorded in July, with 4 individuals (Figure 3). These data differ from those reported by

Table 1. Insect capture by flight height.

Species	**Mangrove**		
	1.5 m	**6 m**	**12 m**
Euplatypus parallelus (F., 1801)	86	45	1
Euplatypus segnis (Chapuis, 1865)	123	76	17
Totales	209	121	18

Table 2. Kruskal-Wallis statistical test between flight heights.

Euplatypus parallelus			***Euplatypus segnis***		
Kruskal-Wallis=20.21; p<0.01			**Kruskal-Wallis=15.85; p<0.01**		
Contrast	**Difference**	**± Boundaries**	**Contrast**	**Difference**	**± Boundaries**
1.5 m - 6 m	5.50	10.29	1.5 m - 6 m	4.33	10.29
1.5 m - 12 m*	18.25	10.29	1.5m - 12 m*	16.41	10.29
6 m - 12 m*	12.75	10.29	6 m - 12 m*	12.08	10.29

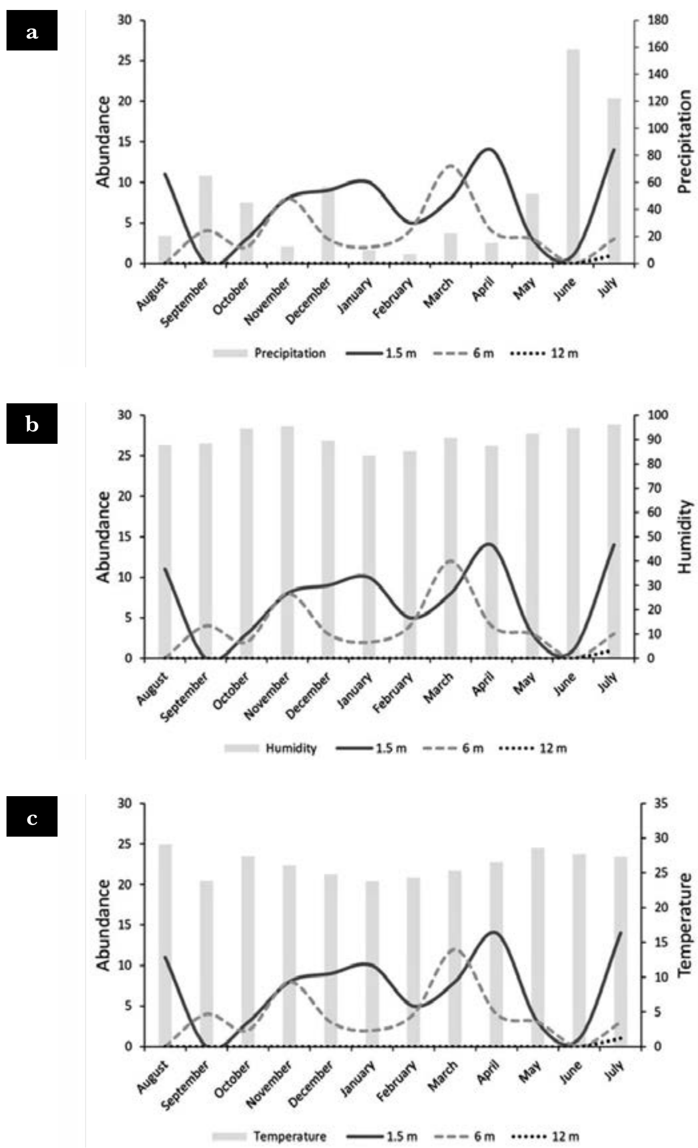

Figure 2. Population fluctuation of *Euplatypus parallelus*.

Pérez-De la Cruz *et al*. (2011) in a cacao agroecosystem, where collections made below 2 m in height showed the highest abundance of *E. segnis* in May and *E. parallelus* in November. According to Rodríguez and Barrios (2017), the population fluctuation of platypodids shows more stable patterns in the understory compared to the canopy, which largely depends on food availability, competitors, predators, and environmental factors such as temperature, humidity, precipitation, radiation, among others.

According to the graphical analysis of the population fluctuations of *E. parallelus* and *E. segnis*, no apparent relationship was observed with the fluctuation of the evaluated environmental variables. However, Pearson's correlation analysis between the monthly abundances of the species and the environmental variables showed that *E. parallelus* has a slight negative association with precipitation, while *E. segnis* shows a positive association with temperature (Table 3).

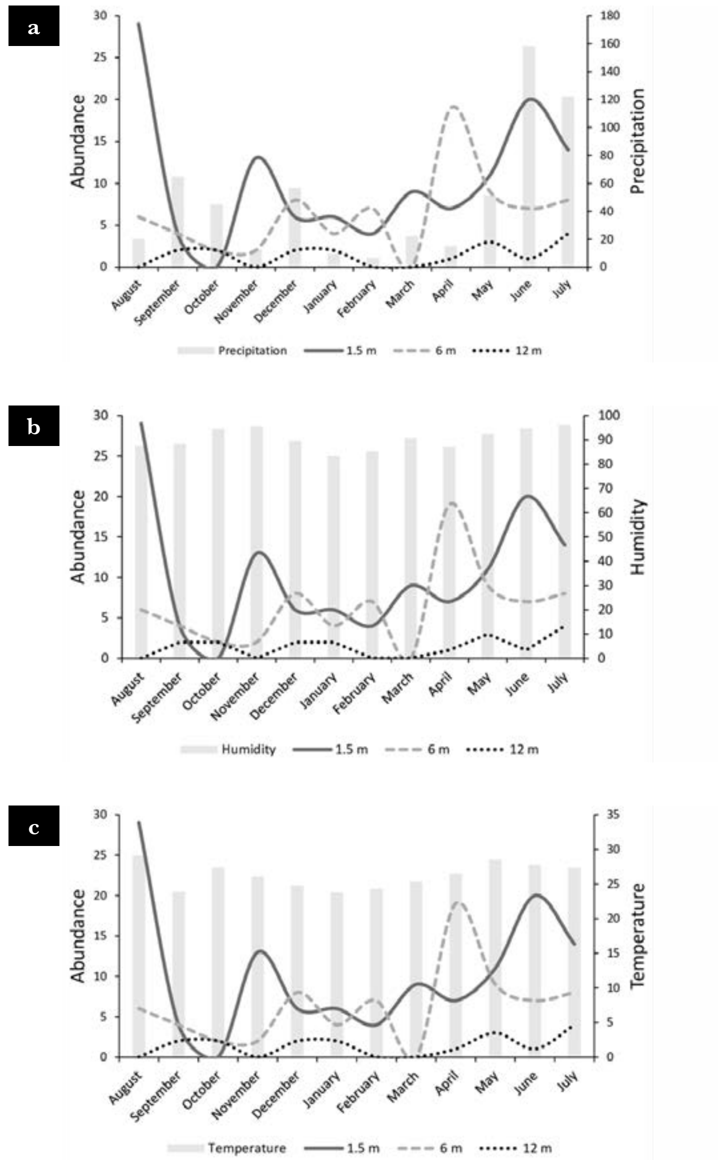

Figure 3. Population fluctuation of *Euplatypus segnis*.

Table 3. Pearson correlation coefficient of species with environmental variables.

Variables	Species	
	Euplatypus parallelus	***Euplatypus segnis***
Temperature	−0.13	0.67
Humidity	−0.04	0.10
Precipitation	−0.40	0.34

Dajoz (2001) describes that environmental variables directly or indirectly influence the dynamics and fluctuation of insects; although the graphical comparison between environmental variables and the population fluctuation of *E. parallelus* and *E. segnis* shows no apparent relationship, this does not mean that one of the variables —such as precipitation— cannot influence a condition that is developing indirectly within the ecosystem. For example, an increase or decrease in rainfall may alter the salt content in the water absorbed by mangroves, thereby affecting or benefiting the growth and proliferation of fungi associated with xylomycetophagous insects. Likewise, the low associations observed between the insect species and environmental variables are due to the fact that the data for the variables come from the nearest meteorological station to the study site and not from the exact location where the capture traps were distributed. Therefore, it is recommended to use mobile and specialized equipment such as data loggers to collect temperature and humidity data throughout the day and during the sampling period.

CONCLUSIONS

Understanding two key species that function as organic matter degraders in their natural environments is vital. However, when dealing with species like *E. parallelus* and *E. segnis*, this knowledge becomes even more significant due to their economic importance. The former has already been reported causing damage in mangroves in southern Mexico, while the latter has the potential to become a pest. According to the results of this study, populations of *E. parallelus* and *E. segnis* remain stable throughout most of the year, with *E. parallelus* showing a marked preference for lower forest strata. This behavior may be attributed to the larger trunk diameters found below the mangrove canopy, which provide a greater feeding and breeding area, along with favorable environmental conditions necessary for flight initiation. Nonetheless, it is essential to monitor the populations of these and other insect species to ensure the stability and health of mangrove ecosystems. This is especially critical in areas like the Mecoacán Lagoon State Park mangroves, which are located adjacent to and within the influence zone of oil-related activities. Such industrial pressures can lead to ecosystem disturbances, potentially destabilizing the plant community and triggering population surges in these organisms.

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