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Original article

Ectoparasite incidence in a population of *Zenaida macroura* L.

Incidencia de ectoparásitos en la población de *Zenaida macroura* L.

Incidência de ectoparasitas na população de *Zenaida macroura* L.

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ABSTRACT

In the management of hunting resources, is important to know the current state of health and vitality, as well as the factors that influence the population dynamics of the species. The aim of this study was to determine the ectoparasites present in the population of *Zenaida macroura L*. (paloma rabiche) and their incidence according to age classes, sex and time of year. The field work consisted of capturing specimens of this species by hunting (78 specimens). Each bird captured was immediately tagged in the order of capture and placed in an individual sealed plastic bag, and then the feathers, wings, chest, back, anus, legs, beak and head were carefully checked for external parasites. The parasites were collected with a fine tweezer and placed in a bottle with 70% alcohol for identification. Once the ectoparasites were collected from each specimen, they were dissected to determine their sex, and classified according to age class (adult or pigeon). With the data obtained, the prevalence rate was applied. Different statistical techniques were used such as: Kolmogorov-Smirnov, Student's T-test. The pigeons studied had a moderate percentage of ectoparasites (34 %). Two types of ectoparasite were found in the population, *Lynchia americana*, which is hosted in the plumage of the species, and an unknown mite that parasitizes the legs of the pigeon.

Keywords: Age class; Ectoparasites; Prevalence rate; *Zenaida macroura.*

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RESUMEN

En la gestión de los recursos cinegéticos es importante el conocimiento del estado actual de sanidad y vitalidad, así como los factores que inciden en la dinámica poblacional de las especies. El objetivo de este trabajo estuvo dirigido a determinar los ectoparásitos presentes en la población de *Zenaida macroura* L. (paloma rabiche) su incidencia según clases de edad, sexo y época del año. Los trabajos de campo consistieron en la captura de ejemplares de dicha especie mediante la caza (78 ejemplares). Cada ejemplar abatido fue inmediatamente etiquetado siguiendo el orden de captura y colocado en una bolsa plástica individual sellada, luego se procedió a revisar minuciosamente las plumas, alas, pecho, dorso, ano, patas, pico y cabeza, para detectar parásitos externos. Con una pinza fina se colectaron los parásitos colocándolos en un frasco con alcohol al 70 % para su identificación. Una vez colectados los ectoparásitos en cada ejemplar, se le efectuó la disección para conocer el sexo, clasificándolos según la clase de edad (adulto o pichón). Con los datos obtenidos se aplicó el índice de prevalencia. Se utilizaron diferentes técnicas estadísticas tales como: Kolmogorov-Smirnov, test de la T de Student. Las palomas estudiadas tuvieron un porcentaje moderado de ectoparásitos (34 %). Se encontraron en la población dos tipos de ectoparásitos *Lynchia americana*, que se hospedan en el plumaje de la especie y un ácaro desconocido que parasita las patas de la paloma.

Palabras clave: Clase de edad; Ectoparásitos; Índice de prevalencia; *Zenaida macroura*.

RESUMO

No manejo dos recursos cinegéticos, é importante conhecer o atual estado de saúde e vitalidade, assim como os fatores que influenciam a dinâmica populacional da espécie. O objetivo deste trabalho foi determinar os ectoparasitas presentes na população de Zenaida macroura L. (pombo coelho) e sua incidência de acordo com as classes de idade, sexo e época do ano. O trabalho de campo consistiu na captura de espécimes desta espécie através da caça (78 espécimes). Cada ave morta foi imediatamente etiquetada na ordem de captura e colocada num saco plástico selado individualmente, e depois as penas, as asas, o peito, as costas, o ânus, as pernas, o bico e a cabeça foram cuidadosamente verificados quanto à presença de parasitas externos. Os parasitas foram coletados com uma pinça fina e colocados em uma garrafa com 70 % de álcool para identificação. Uma vez coletados os ectoparasitas de cada exemplar, eles foram dissecados para determinar seu sexo e classificados de acordo com a classe de idade (adulto ou pombo). Com os dados obtidos, a taxa de prevalência foi aplicada. Foram utilizadas diferentes técnicas estatísticas como: Kolmogorov-Smirnov, teste T de Student. Aplicando o programa SPSS versão 15.0 para Windows. Os pombos estudados tinham uma percentagem moderada de ectoparasitas (34 %). Dois tipos de ectoparasita foram encontrados na população, Lynchia americana, que é hospedada na plumagem da espécie, e um ácaro desconhecido que parasita as patas do pombo.

Palavras-chave: Classe etária; Ectoparasitas; Taxa de prevalência; *Zenaida macroura*.

INTRODUCTION

Zenaida Macroura L. (paloma rabiche) is the most abundant species of the order Columbiforme in Cuba. It is considered one of the most important hunting species in the country, so it has traditionally been of great interest to both national and visiting hunters. This interest is related to its main characteristics, according to Acosta and Ponce de León (2004) in Chamizo and García (2004): excellent hunting skills, which are evidenced through a fast and zigzagging flight, especially when it discovers the presence of the hunter and excellent quality meat.

It is a very abundant species from southern Canada and the United States of America to southern Mexico and the Antilles, according to Acosta and Ponce de León (2004) in Chamizo and García (2004). This pigeon is frequent in pastures and flat lands associated with forest patches, cultivated fields, residential areas and even urban parks. Garcia (2017), when studying the behavior of the species in different biotopes, found that the most important habitat for the species is agricultural biotopes with cover. In these biotopes, despite the clear predominance of herbaceous plants, which form the basis of its diet, a considerable number of tree and shrub species are also found, which are located on the edges of rural roads, perimeter fences and isolated trees in the areas of pastures. These trees serve the species as perches for rest, refuge and substrate for nesting, contrary to their behavior in the wooded areas given their poor feeding potential, as well as the structure of the vegetation itself.

One of the main aspects to be considered in the management of hunting resources is the knowledge of the current state of health and vitality of these resources, as well as the factors that influence the population dynamics of the species. According to Peiró (2003), the biosanitary analysis of hunting populations must be considered as part of their sustainable use.

Núñez *et al.*, (2011) state that the assessment of individual parasitic load should provide relevant information about the health status of the birds. Since *Z. macroura* is a species with ecological value, but also with economic and recreational value, it is important to know its health status, as well as the parasites that are related to it.

Wildlife diseases have not been given sufficient ecological importance until the 1990s Simonette (1995) in Di Mare (2003) and especially with endangered species (Cooper, 1989 in Di Mare, 2003). There are three groups of parasites that can affect the Columbids: arthropods (mites, ticks and lice), protozoa (unicellular parasites that live inside the hosts) and helminths (round worms).

Within these groups are representatives with diverse microenvironmental requirements that allow them to invade external areas of the body such as feathers, chest, anus; as well as internal areas along the digestive tract and blood system (Di Mare, 2003).

According to Schmidt and Roberts (1984), cited by Pazmiño (2007), wild birds are generally infected by several species of parasites, with most wild birds tolerating their parasite load adequately; however, these animals die when the infection is high, because of the various ravages caused by these.

Ectoparasites in birds are those species that live on the skin, hair or feathers of birds. While Podulka *et al.*, (2004) found that ectoparasites are important in the adaptability of birds, although the presence of some ectoparasites may have little effect on birds, a large infestation or parasitic load can deteriorate a bird's health, as well as

reproduction. Birds are hosts to many kinds of "blood-sucking" parasites, especially plumage flies (family *Hippoboscidae*), fleas, lice, mites and ticks.

Studying parasitism in wild birds is importance, since it can be a natural reservoir that in some way can affect birds in production (Medellín *et al.,* 2019).

Existing studies on parasitism in *Z. macroura* are scarce and fragmented in different regions of the world, highlighting those carried out in the USA by Galloway and Palma (2008) and in Mexico by Medellín *et al*. In Cuba, based on the sources consulted, it was found that there is little information about the ectoparasites that affect the populations and the body condition of this species. It is therefore necessary to investigate the incidence of ectoparasites in wild species such as *Z. macroura* in order to achieve adequate management of their populations.

The objective of this study was to determine the ectoparasites present in the population of *Zenaida macroura*, as well as their incidence according to age classes, sex and time of year.

MATERIALS AND METHODS

The research was carried out in the hunting area Damují of the municipality of Rodas, province of Cienfuegos, Cuba (Figure 1), whose center is located in the geographical coordinates 22°21,804' N and 80°33,430' W, covering a total of 645.8 ha. For the purposes of this research, this area was selected because it has the representative characteristics of the biotopes most used by the species under study in Cuba.

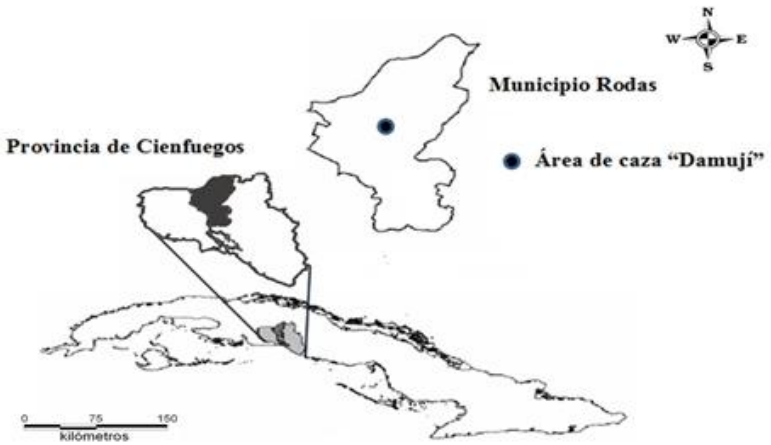

Figure 1. - Geographical location of the study area

The climate of the area is tropical lowland, widely spread towards the central and western part of the province of Cienfuegos. It is characterized by being hot, humid and rainy between the months of May to October and dry, not very humid and lower temperature from November to April. The average annual temperature ranges from 22-24 °C and the average annual rainfall is between 1 000 and 1 100 mm (Barcia and Castillo, 2015).

The relief is flat in almost all the area and with predominance of the typical red ferrallitic and reddish-brown fersialtic soils. The majority of the land is used for agriculture and livestock with a wide network of boundaries or hedges that divide these areas. A large part of the area is dedicated to intensive agricultural crops

(*Manihot esculenta*, *Ipomea batatas*, and *Zea mays*, among others), where minor crop rotations with artificial irrigation throughout the year predominate, but there are also grasses and herbaceous plants bordering the irrigation canals that are maintained with water most of the year. There are areas dedicated to livestock in which both natural and artificial pastures predominate (*Andropogon annulatus*, *Panicum maximun*, *Eleusine indica*), although in some cases there are areas of pastureland invaded by the *Dichostachys cynerea* (marabu) and other rural plants. The remaining part of the area (63 ha) is occupied by a natural semi-deciduous forest *(Samanea saman, Bursera simaruba, Guazuma tomentosa*) on limestone soil, which in some sites presents an acceptable degree of conservation and in others there are open areas (clearings) of abandoned crops.

The field work consisted in taking samples of the captured specimens from *Z. macroura* during all the months of the year. Hunting was done at random with shotguns in walking tours that covered the entire area and each specimen shot was immediately labeled following the order of capture and placed in an individual sealed plastic bag (taking care to immediately close the bag to avoid escape of ectoparasites), then proceeded to thoroughly check the feathers, wings, chest, back, anus, legs, beak and head, to detect external parasites. The parasites were collected with fine tweezers and placed in a bottle with 70 % alcohol until they were identified. Once the ectoparasites were collected from each specimen, they were weighed with a 0.01 g precision balance and dissected to determine their sex, and then classified according to age class (adult or pigeon). With these results, the incidence of these parasites in the population studied was evaluated by means of the prevalence index.

The Prevalence Index (PI) allows us to know how many birds in a defined group are sick at a given time, therefore, it indicates the weight or abundance of the event that the population is enduring (Bush *et al.,* 1997 in González *et al.,* 2004a). It was calculated by the following formula (Equation 1).

$$Ip = ni/N \times 100 \quad (1)$$

Where:
ni = represents the number of pigeons infested by the species i of parasite.
N = represents the total number of pigeons tested

Descriptive statistical techniques were applied to the data obtained initially, in order to summarize them and facilitate their interpretation (central tendency measures, calculation of percentages by age classes and sexes). Then, an exploratory analysis of the data was carried out through the Kolmogorov-Smirnov normality tests, in order to know the behaviour of the distribution and thus determine the type of statistical analysis to be used (parametric or non-parametric). When performing the analysis between the total weight of parasitized and non-parasitized specimens in the different categories, the T-Student test was applied according to the normal behavior in the data obtained. In order to compare the mean of the sample obtained with a reference value of the species in the literature, the T-Student test was used (Martínez *et al.,* 2009). In the processing of the information, the programs Excel and SPSS version 15.0 for Windows.

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RESULTS AND DISCUSSION

A total of 78 specimens were studied. In the total of samples collected only two ectoparasites were found: *Lynchia americana*, known as sparrowhawk fly and a mite (not yet classified) which was found in the tarsi of most of the specimens captured. For Núñez *et al*., (2011) the study of parasitism in wild birds still has some important limitations. Firstly, taxonomic knowledge of avian parasites is still very incomplete.

Of the 78 birds studied, 26 (34 %) presented some kind of ectoparasite, the predominant group being the foot mites, which constituted 26 % of the parasitized birds, followed by the *Lynchia americana* with 8 % of the parasitized population.

The flat or plumage flies are a group of ectoparasites of the family *Hippoboscidae* that feed on the blood of birds. They are similar to houseflies, have a highly flattened body, which allows them to move freely between the contours of the feathers. They are also known, along with other ectoparasites such as mosquitoes, lice and fleas, to be transmitters of diseases such as bird-pox.

The Figure 2 shows that *Lynchia americana* was only found in the months of March, May, June and August, with the month of June corresponding to the highest Prevalence Index (PI) (37.5 %), coinciding with the peak breeding season of *Z. macroura* and the highest number of squabs in the population. The prevalence rate in adults was 4.7 % and in pigeons 21.4 %. These months correspond to the rainiest period in our country. When analyzing the behavior of the prevalence index in both periods, a marked presence of this ectoparasite in the rainiest one is appreciated (Figure 3).

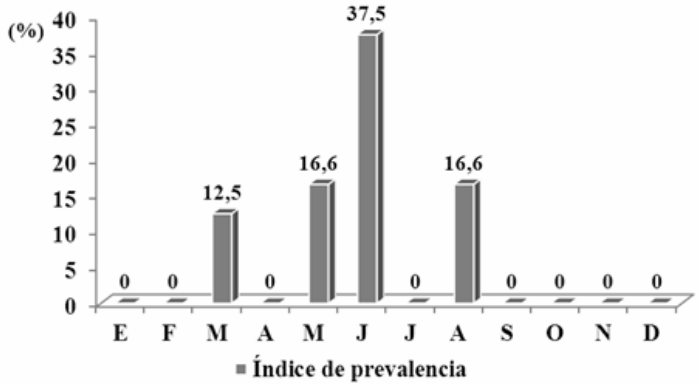

Figure 2. - Behavior of the Prevalence Index of *Lynchia americana* in the population of *Zenaida macroura* throughout the year

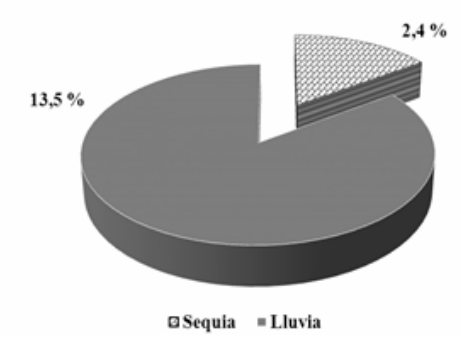

Figure 3. - Behaviour of the Prevalence Index of *Lynchia americana* in the rainiest period and low rainfall period in the study area

Similar results are reported by Di Mare (2003) in his study on *Zenaida asiatica* (white winged pigeon) in Tempisque, Costa Rica, where he reports among the ectoparasites found a *Pseudolynchia canariensis* (blood fly) in the plumage of the pigeons analysed; although its incidence in the sample studied was very low (1 % prevalence rate). As for the analysis of the monthly prevalence of ectoparasites in Tempisque, Costa Rica, the months with the highest incidence in the population corresponded to those of the rainy season (March, July, August and October). Leherman (1993) in Di Mare (2003) indicates that a high incidence of ectoparasites in the breeding season can cause the abandonment of active nests in response to a high density of ectoparasites.

In the literature reviewed so far in Cuba, no studies have been carried out systematically on the prevalence rate of this ectoparasite in the population of *Z. macroura*, or any other species of pigeon in the country, so there are no parameters to identify which prevalence rate result in a population can lead to health problems in this.

When analyzing the relationship of parasitism by this fly between both sexes in the population studied, it was found that there were no major differences in the results, which were low in both sexes. There was a slight superiority of the values obtained in males with respect to females (Figure 4). These recorded results coincide with those obtained by González *et al*. (2004a) in the study of gastrointestinal and external parasites of *Columba livia* (domestic pigeon) in the city of Chillan, Chile, where they found that there were no significant differences in ectoparasite infestation between the sexes. According to these authors it could be related to the scarce sexual dimorphism among pigeons, besides presenting similar habits in individuals of both sexes. This was not the case in the study carried out in Ñuble, Chile by González *et al.,* (2004b) when studying the parasitic fauna of the *Zenaida auriculata* (European turtle dove). These authors state that in the female-male relationship a predominance of females can be observed with respect to males, this being more notable in the less frequent ectoparasites *Hohors-tiella sp*. and *Bonomiella sp*.

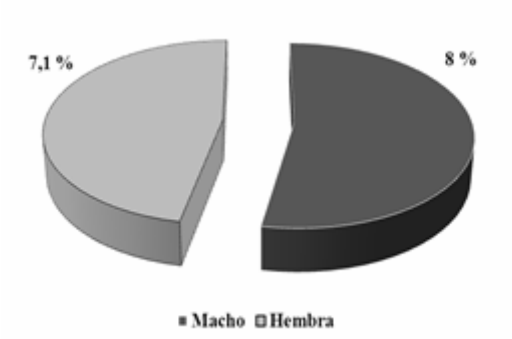

Figure 4.- Behaviour of the Prevalence Index of *Lynchia Americana* between sexes in the population of *Zenaida macroura*

Figure 5 shows the behaviour of the Prevalence Index in both age classes in the *Z. macroura* population studied, highlighting the high incidence of this ectoparasite in young pigeons. Leherman (1993) in Di Mare (2003) states that sucking ectoparasites such as feather flies, when sucking blood, produce very painful wounds, especially in young pigeons. This incidence is therefore a key factor in the reproductive success of

the species. In this regard, Núñez *et al*., (2011) explained that, in birds, physical condition significantly influences the nestling behaviour.

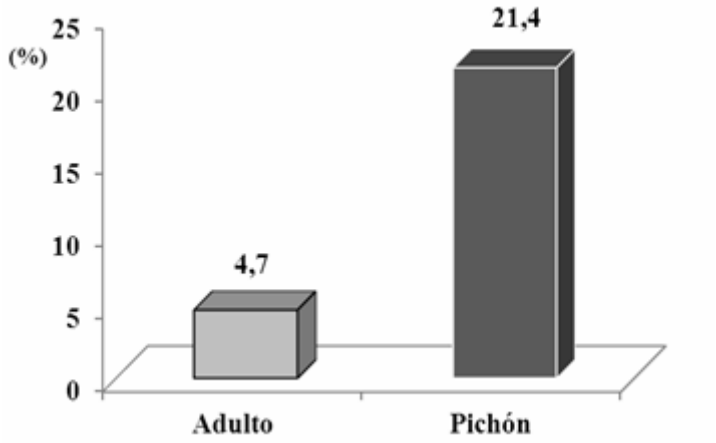

Figure 5.- Prevalence rate behavior of *Lynchia americana* in age classes in the population of *Zenaida macroura*

In the present investigation it is important to highlight that in the birds parasitized by *Lynchia americana* no pathological changes were detected at the time of the necropsies in the samples studied; nor when the Student T test was performed to compare a mean with a reference value, chosen in this case, the mean values of the body weight of the parasitized birds vs. the average weight of the population of the study area (Table 1). The total weight of a bird, in spite of being one of the simplest measures, is of great importance since in addition to being very useful to know the energy needs of the species, it is a good indicator of its possibilities of survival, since it is an indicator of the reserves needed for vital processes such as migration, reproduction and moult (Acosta *et al*., 2013). Therefore, below average or normal values for a species should be taken as an anomaly in some aspect of habitat quality or individual health.

Table 1. - Results obtained when performing the T-Student test to compare a mean with a reference value between the average weight of the *Zenaida macroura* population in the study area vs. the average weight of the birds parasitized by *Lynchia americana*

Estadísticos	Peso total medio de la población	Peso total medio de las aves parasitadas
Media	112.20	106.07
Valor de p	0.297	
Significación estadística	P > 0.05, No existen diferencias significativas	

Although there are no significant statistical differences, it is possible to observe a superiority in the average weight of birds not infested by *Lynchia americana*, which is given by the possible progressive depauperization that infested birds can suffer due to the diseases they can contract from the bites of these flies or the constant

loss of blood from the feeding of ectoparasites. In this regard, Núñez *et al*., (2011) suggest that the analysis of the physical condition through morphometric variables is important; this allows us to understand how pathogens affect the parasite population.

Among the most common arthropod parasites in birds that can affect individual fitness are mallophages, which normally feed on feathers, skin or skin products. The most common ectoparasites, however, are the mites (Núñez *et al*., 2011).

These parasitoses produced by mites in pigeons of different genera can vary in intensity and species of parasites. As a result of the analysis of the *Z. macroura* specimens studied in our case, only one mite was found parasitizing the legs; this level of parasitosis found in the population of the hunting area Damují can be considered low if compared with the results obtained by Gonzáles *et al*., (2004b) when studying the parasitic fauna of *Zenaida auriculata* (common dove) in Ñuble, Chile, where a total of eight mites of different genera were identified. In a study carried out in the city of Chillan, Chile, on the parasitosis in *Columba livia* (domestic pigeon) by Gonzáles *et al*. (2004a), only one percent of the sample was affected by a single mite (*Dipaegidia columbae*).

The Figure 6 shows the behaviour of the prevalence rate in pigeons affected by foot mites in relation to the months of the year. Thus, this ectoparasite is found practically in both periods of the year; being March, April and August the months of greater prevalence, those that correspond with the rainiest period. Pruning mites found did not show a defined seasonal pattern. Although fluctuations were observed in the prevalence rates along the year, it could be called as a common species in the community.

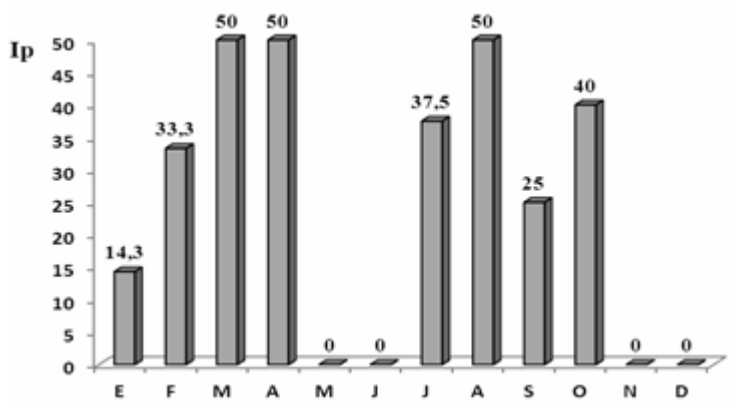

Figure 6. - Behaviour of mites (legs) Prevalence Index in the *Z. macroura* population throughout the year

The results presented above are confirmed by the relationship obtained by calculating the prevalence index in the two well-defined periods of the country (the rainiest period and the least rainy period), as shown in Figure 7.

It is considered important to mention that in this research, within the parasitized population, the birds with higher infestation (parasitic load per bird) were found during the months of March, September and October, coinciding these high index months with the rainiest period of the country, characterized by high temperatures and abundant rainfall.

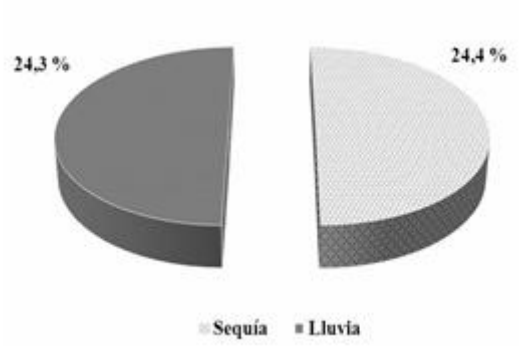

Figure 7. - Behavior of the mites (legs) Prevalence Index in two periods in the study area

When analyzing the prevalence rate of foot mites between sexes in the parasitized population of *Z. macroura* studied throughout the year, it can be seen that none exceeded 50 % or more, which would constitute a clear preference over some sexes. It should be noted that the highest degrees of infestation by this mite in the parasitized birds corresponded to male specimens (Figure 8).

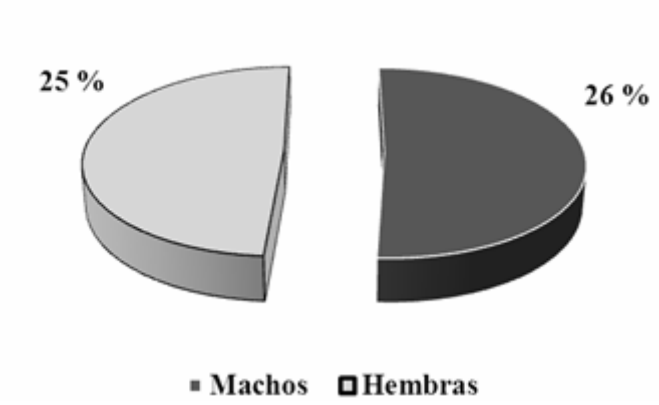

Figure 8. - Behavior of Foot Mite Prevalence Index between sexes in the parasitized population of *Zenaida macroura*

Figure 9 shows the results obtained by calculating the prevalence rate of this mites attack in relation to age classes, showing a higher incidence in the young population. These results were similar to those obtained in this study, when analyzing the specimens affected by *Lynchia americana*, where also the infestation rates by this ectoparasite were higher in the young population. It is therefore evidence of the influence of this age class (young) on the structure of the parasite communities in this *Columbidae.*

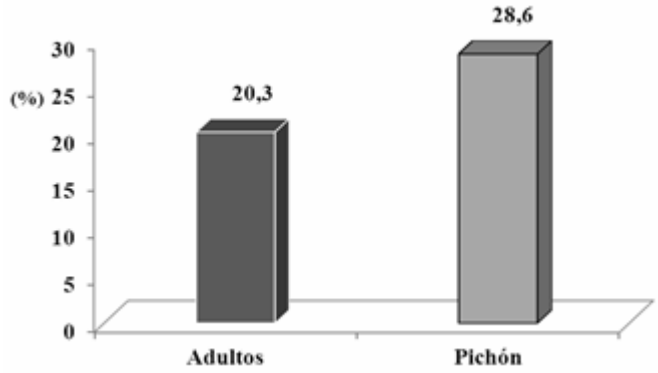

Figure 9. - Behavior of the Prevalence Index (PI) of foot mites according to age class in the population of *Zenaida macroura*

The difference observed between both age classes, and coinciding with the behaviour of *Lynchia americana* in the population studied, could be explained by the short life span of the chicks, which could lead to a different attitude towards the attack of the parasites, with a weaker response to pathogens.

According to Núñez *et al*., (2011), the immune system of birds consists of an innate and a specific (or acquired) component. The innate system responds immediately but not specifically to many pathogens, and represents a first line of defence that does not confer long-term immunity. Acquired immunity, however, is capable of producing an immunological memory that provides an enhanced defence in successive encounters with that same pathogen. The innate immune system is less subject to environmental variations, nutritional or stress levels than the acquired system, and therefore is a good indicator of immunocompetence. It also reflects the action of genes linked to the production of natural antibodies, which are subject to natural selection.

As explained above, in all the birds examined, the presence of notorious pathological changes was taken into account at the time of examination, both in the physical and in the necropsies. In none of the cases of specimens parasitized by foot mites was any kind of anomaly detected. In order to know the relationship between the weight of birds parasitized by foot mites and the general average of the population (Table 2), the Student T test was performed (comparison of the mean of a variable with normal distribution with a reference value).

Table 2. - Results obtained when performing the T-Student test to compare a mean with a reference value between the average weight of the *Zenaida macroura* population in the study area vs. the average weight of parasitized birds per foot mite

Estadísticos	Peso total medio de la población	Peso total medio de las aves parasitadas
Media	112.20	111.40
Valor de p	0.694	
Significación estadística	P > 0.05, No existen diferencias significativas	

The result of this test is similar to that obtained in the analysis of *Lynchia.Americana* The average of the population is higher than that of the infested population and although there is no statistical significance there is a slight superiority in the weight of the healthy population, this aspect should be taken into account. According to Núñez *et al.* (2011), the physical condition of an animal influences its behavior and therefore must be considered in ethological studies. Measuring physical condition in a population may also be important to assess the benefits of certain morphometric variables and thus help to understand their adaptive function.

Once the analysis of each ectoparasite found in the population of *Z. macroura* has been carried out, it is essential to have a general analysis of the incidence of both in the population; together, both determine the general state of the population's health. It is important to point out that it is currently unknown to what extent the parasites studied affect or limit the population of the species, as well as the physiological disorders they cause, so it is considered a subject for further research in the future.

When comparing the incidence of the two ectoparasites found in the population of *Z. macroura*, it can be seen that the dominant species turned out to be the foot mite, with more constant prevalence index values at different times of the year. In spite of the variations observed in this mite, the species maintained the condition of common in all the climatic periods analyzed. Few changes in the seasonal composition could indicate a great stability in time and in several characteristics of the host.

Neither of the two ectoparasite species found exceeded 55 % or more of the Prevalence Index, which would mean a large impact on the wood pigeon population. However, foot mites were the species with the highest prevalence (*PI = 50 %*) in the population, while *Lynchia americana* showed a maximum prevalence of 37.5 %. Of the two species of ectoparasites found, *Lynchia americana* showed a tendency to be found in few hosts with intensities of 1 or 2 parasites per host, except in a single specimen. This result would indicate that these ectoparasites could be classified as seasonal. These results are consistent with those obtained by Dimare (2003) in his study of *Zenaida asiatica* in Tampisque, Costa Rica, where the prevalence rate of *Falculifer spp.* was 18 % and only 1 % for the bloodsucking fly *Pseudolynchia canariensis*.

In the fluctuations observed in the ectoparasite prevalence indices between the climatic periods of the year, a tendency for *Lynchia americana* to vary inversely with the increase in the less rainy period was observed; this difference coincides with the greater abundances of this ectoparasite observed in one specimen, contrary to the behaviour followed by the foot mites which remained present in most months of the year.

For Medellín *et al.,* (2019) these behaviors may reflect seasonal parasite colonization patterns, changes in host diet between the two seasons and/or changes in weather conditions. Changing climatic conditions and the different availability of resources in different seasons can have very important effects on parasite populations. The high incidence of a parasite in a given period gives it a high predictability in this period, and therefore a preventive work consistent with the annual period.

No major differences were observed in the prevalence rates between the parasite species with respect to the sexes; this result could be related to the absence of major trophic or behavioural inequalities between males and females and, therefore, marked ecological differences between the sexes in the population of this columbus that influence the parasitic loads. These results suggest that the sex of the host is not an important factor in the structure of the parasitized communities.

The analysis of the results found in the relationships between both ectoparasites and age class reflects a higher incidence of both ectoparasites towards the young population, which is evidence of the influence of the age class of the hosts on the structure of the parasite communities in these pigeons.

Perhaps these observed differences can be explained by the characteristics of each age class and their responses to the parasites; in addition, there are other factors such as the ability to colonize, infective capacity of the parasite species, environmental and ecological factors that condition access to the host. Once the parasite reaches the host there are immunological filters typical of each age class that determine which will be able to install and prosper and which will not. For Núñez *et al.*, (2011), in general, a higher body mass is interpreted as an index of better physical condition because it presumably indicates the availability of nutrient reserves to cope with situations of high demand. It is therefore essential to determine whether there are differences in the population studied between the body weight of parasitized and non-parasitized specimens.

Once the test of normality to the weight of the captured specimens separated by the healthy and parasitized categories (includes all specimens with any of the two ectoparasites found in this study), the comparison of the means obtained in both groups was made by applying the Student T test for independent samples.

Although no statistically significant differences were observed between the groups of birds (parasitized and non-parasitized; Student's T (P= 0.189; P >0.05), a lower value can be seen in the weight of parasitized birds (Figure 10).

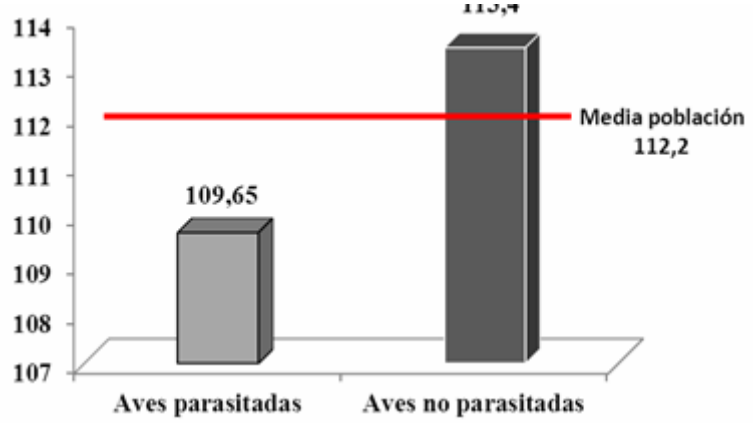

Figure 10. - Comparison of mean weight (g) of parasitized and non-parasitized birds in relation to the population mean of *Zenaida macroura*

Although it is not easy to establish the incidences that can generate parasitosis in a bird, the changes in the decrease of body mass found in this study may suggest deficiencies in the general health status of parasitized birds. For this reason, it is advisable to calculate body-mass related indices that can be reliable indicators of the health status of the population in order to determine the health status of the *Z. macroura* population.

As described above, the study of the health condition of populations under some type of management is necessary, but it presents limitations due to its complexity: techniques that are applied, difficult application in the field, economic cost of some analyses and the existence of gaps in the state of knowledge of the pathogens that could be found. Whenever possible, the application of different techniques and their

combination with indexes will give more reliable results. Therefore, applying the repeatability in time of a condition index is key in the interpretation of its results. In addition, the applicability of the indices may vary between different species, so it would be important to validate the method in each case, something that in reality happens very rarely (Núñez *et al.*, 2011).

In the specimens of *Zenaida macroura* studied, the presence of two ectoparasites *Lynchia americana*, which are hosted in the plumage of the species, and an unknown mite that parasitizes the legs of the species were determined, with greater incidence of both in the rainiest period of the country, in young specimens and without difference of parasitic loads between sexes*. Lynchia americana* presented a high seasonality in parasitized specimens, while the foot mite was present in most months of the year.

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The authors have participated in the writing of the work and analysis of the documents.