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# PREVALENCE OF XENOPSYLLA CHEOPIS IN RATTUS RATTUS IN THE SALAS DISTRICT, LAMBAYEQUE

PREVALENCIA DE XENOPSYLLA CHEOPIS EN RATTUS RATTUS EN EL DISTRITO DE SALAS, LAMBAYEQUE

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## ABSTRACT

**Objective:** The study of the prevalence of *Xenopsylla cheopis* in rodents of the *Rattus rattus* species. The objective of the present investigation is to establish the prevalence of *Xenopsylla cheopis* in rodents of the *Rattus rattus* species. **Methods:** To obtain the sample, Tomahawk and Sherman traps were used that contained baits previously prepared with oatmeal and vanilla, the traps were placed in three areas: intra-home area, peridomyciliary area and in the open area. Ectoparasites were obtained using the fine comb technique. With an entomological clamp, fleas were collected in a 2ml vial, containing 70% alcohol. **Results:** Its prevalence in *Rattus rattus* rodents were evaluated, with the highest prevalence rate being the one registered in the locality of Banco in August 2016 (4.08) and the lowest index was 1.3 registered in the locality of the Ramada in November 2015. They were captured 169 rodents *Rattus rattus*, of which 399 fleas could be collected, 299 belonged to the *Xenopsylla cheopis* species. **Conclusion:** it was found that the prevalence of *Xenopsylla cheopis* in *Rattus rattus* rodents in the locations of Sauce, Banco, Kerguer, Algarrobo, and Ramada in the Salas district, in the period July - November 2015 and August 2016 was high.

**Keywords:** *Xenopsylla*; Rats; Insect vectors. (Source: MeSH NLM).

## RESUMEN

**Objetivo:** La presente investigación tiene como objetivo determinar la prevalencia de *Xenopsylla cheopis* en roedores de la especie *Rattus rattus*. **Métodos:** Para la obtención de la muestra se usaron trampas Tomahawk y Sherman que contuvieron cebos previamente preparados con avena y vainilla, las trampas fueron colocadas en tres zonas: zona intradomiliar, peridomiliar y en área descampada. La obtención de ectoparásitos se realizó mediante la técnica del peine fino. Con una pinza entomológica se colectaron las pulgas en un vial de 2ml, conteniendo alcohol al 70%. **Resultados:** Se evaluó su prevalencia en roedores *Rattus rattus*, siendo el índice de prevalencia más alto el registrado en la localidad del Banco en agosto 2016 (4,08) y el menor índice fue 1,3 registrado en la localidad de la Ramada en noviembre 2015. Se capturaron 169 roedores *Rattus rattus*, de los cuales se pudo colectar 399 pulgas, 299 pertenecían a la especie *Xenopsylla cheopis*. **Conclusión:** Se encontró que la prevalencia de *Xenopsylla cheopis* en roedores *Rattus rattus* en las localidades el Sauce, el Banco, Kerguer, el Algarrobo y la Ramada del distrito de Salas, en el periodo julio - noviembre 2015 y agosto 2016 fue elevada.

**Palabras clave:** *Xenopsylla*; Ratas; Insectos vectores. (Fuente: DeCS BIREME).

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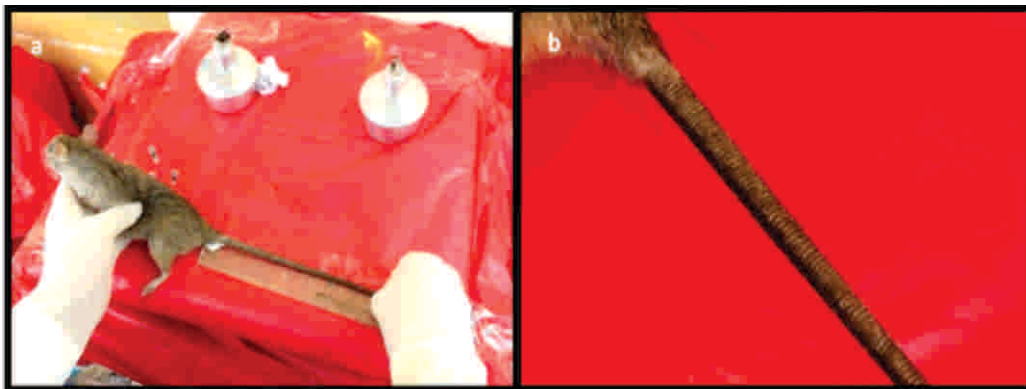


## INTRODUCCIÓN

Plague is a zoonotic disease that primarily affects rodents and can be accidentally transmitted to humans or other mammals, mainly through the bite of fleas from infected rats, and without treatment reaches high rates

of mortality<sup>(1)</sup>.

This disease has been linked to the presence of rats, mainly of the species *Rattus rattus*, *Rattus norvegicus*, and the flea *Xenopsylla cheopis* as a vector<sup>(2)</sup>.



**Figure 1.** *Rattus rattus* rodent body. to. - Measurement of the body and tail of the rodent of the species *Rattus rattus*. b.- Unicolored tail of the rodent of the species *Rattus rattus*.

(Fig. 1). Ectoparasites such as *Xenopsylla cheopis* have epidemiological importance, because they can act as transmitters of pathogens including viruses, rickettsiae, bacteria, and protozoa<sup>(3)</sup>.

The life cycle of *Y. pestis* is capable of infecting its main reservoirs through the bite of different species of fleas, *X. cheopis* is the quintessential biological vector of animals of the order Rodentia (more than 230 species involved) and, to a lesser degree, to those of the order Lagomorpha<sup>(4)</sup>. Fleas of the order Siphonaptera are important in public health, due to their role as vectors of diseases such as bubonic plague, of great historical importance due to epidemics with high mortality; murine typhus and also parasitic diseases such as *hymenolepiasis*<sup>(5)</sup>.

The main vector of bubonic plague is the rat and mouse flea, which is *Xenopsylla cheopis*, which easily leaves its host and can be transferred to other hosts of the same or another species, so it is common to find them in cats and dogs. For entomological studies, fleas should be sought on animals that live with humans, indicating the infestation rates by species and hosts<sup>(6)</sup>.

The objective of this research is to establish the prevalence of *Xenopsylla cheopis* in rodents of the species *Rattus rattus*.

## METHODS

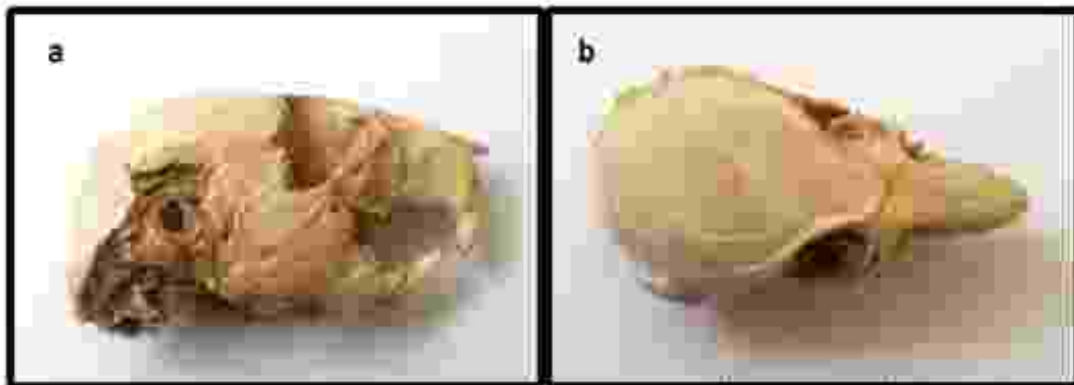
The population consisted of fleas of the order Siphonaptera of the species *Xenopsylla cheopis* collected from *Rattus rattus* rodents in the district of Salas in the sectors of: the Banco, the Sauce, the Algarrobo and la Ramada; that were processed in the Laboratory of Environmental Sciences of the Faculty of Biological Sciences and in the Reference Laboratory of Health of the Lambayeque Region.

The sample consisted of 299 fleas of the species *Xenopsylla cheopis* collected from 135 rodents of the species *Rattus rattus* in the sectors of: el Sauce, Banco, Kerguer, la Ramada and el Algarrobo in the district of Salas, June 2015 - August 2016.

To obtain the sample, Tomahawk and Sherman traps were used that contained baits previously prepared with oats and vanilla, allowing the capture of the *Rattus rattus* species (Fig. 2y 3).. 100 traps were placed per day (70 Tomahawk and 30 Sherman traps) interspersing the



**Figure 2.** *Rattus rattus* rodent dentition. a.- the incisor foramen reaches the anterior edge of the maxillary first molar or literally extends beyond it. b.- the anterior fold of the upper first molar is trilobed



**Figure 3.** Skull of a rodent of the species *Rattus rattus*. a.- Front view. b.- Dorsal view

two types of traps with a distance of approximately 5 to 10 meters between each one. The traps were placed in three zones: intra-domiciliary zone, peridomiciliary zone and in an open area.

#### **Intradomiciliary collection**

This is the collection that was made inside a house. 5% of the total number of traps were distributed inside different houses.

#### **Peridomiciliary collection**

The area surrounding the dwelling up to a radius of 25 meters away was considered as peridomicile. 25% of the traps are installed in this area, with the distance between trap and trap being 10 m. Collection in the open area: It was collected anywhere beyond a perimeter of 10 m. around a house. 70% of traps were placed at a distance of 100 m from the inhabited area along fences, irrigation aqueducts, streams, small

valleys, highways, trails, with a distance between traps of 10 m.

Subsequently, a colored plastic banner was placed on the traps and the rodent capture form was filled out, which facilitated the location of the traps. Live-captured animals were placed in a cloth bag containing cotton soaked in chloroform.

#### **Plucking and obtaining ectoparasites of *Rattus rattus***

Deflection began with brushing the animal inside a white box in order to observe the ectoparasites. Ectoparasites were obtained using the fine comb technique. With an entomological forceps, the fleas were collected in a 2ml vial, containing 70% alcohol. The samples obtained were labeled with data from each animal indicating the place of capture, productive stage, sex and date, which were transferred to the Reference Health Laboratory for identification.





The anesthetized rodents were placed on the autopsy table previously conditioned, proceeding to carry out the measurements, observation of the color of the body fur (dorsal and ventral), appearance of the tail fur, total length, head length, body length, ear, weight, sex, number of embryos and note some morphological alterations, which were recorded in a rodent evaluation form. The ectoparasites were collected and stored in a 2 ml vial and placed in a Petri dish with 70% alcohol and then visualized in a stereoscope, with the help of plastic pipettes and fine needles, the fleas were transferred to slides, with 10% sodium hydroxide clarifying solution, achieving a better visualization and identification in a stereoscope.

**Identification of the species of *Xenopsylla cheopis***

The identification of *Xenopsylla cheopis* fleas was

carried out based on the key of Acosta and Morrone<sup>(7)</sup>.

**RESULTS**

Three epidemiological surveillances were carried out in two time periods July - November, 2015 and August 2016 in the localities of: the Sauce, the Banco, the Algarrobo, Kerguer and la Ramada of the district of Salas of the department of Lambayeque, where the dwellings of the inhabitants of the mentioned localities to place the respective traps.

In July 2015, only the towns of Sauce, Banco and Algarrobo in the district of Salas were visited, where rodents of different species were captured, the rodents from the intradomiciliaries and peridomiciliaries areas all belonged to the *Rattus rattus* species; while in the wild area rodents of the species *Akodon mollis* and *Oryzomys xantheolus* were captured.

**Table 1.** Trapping index of rodents captured in the towns of Sauce, Banco, Kerguer, Ramada and Algarrobo with the Tomahawk and Sherman trap in the district of Salas.

Locality	Number of rodents captured - Tomahawk Trap		Catch Index (AI)%	Number of rodents captured - Sherman Trap		Catch Index (AI)%
El Sauce	Intradomiciliary	3	20			
	peridomiciliary	4	8,8	Wild	3	10
	Wild	0	0			
El Banco	Intradomiciliary	3	20			
	peridomiciliary	4	8,8	Wild	2	6.6
	Wild	1	10			
El Algarrobo	Intradomiciliary	3	20			
	peridomiciliary	8	17,8	Wild	3	10
	Wild	2	20			
El sauce	Intradomiciliary	4	26,6			
	peridomiciliary	8	17,6	Wild	5	16.6
	Wild	1	10			
El Banco	Intradomiciliary	9	60			
	peridomiciliary	15	33,3	Wild	3	10
	Wild	0	0			
Kerguer	Intradomiciliary	5	33,3			
	peridomiciliary	11	24,4	Wild	1	3.3
	Wild	2	20			
La Ramada	Intradomiciliary	7	46,6			
	peridomiciliary	13	28,8	Wild	2	6.6
	Wild	0	0			
El Sauce	Intradomiciliary	6	40			
	peridomiciliary	11	24,4	Wild	9	30
	Wild	2	20			
El Banco	Intradomiciliary	3	20			
	peridomiciliary	9	20	Wild	6	20
	Wild	1	10			





**Table 1** shows the catch rate with the Tomahawk trap in the Sauce, Banco and Algarrobo localities, in the intradomiciliary zone the catch rate was similar, registering 20%, while in the Algarrobo in the Peridomiciliary zone. was 17.8% and in the wild area 20%. With the Sherman trap in the wild area, a trapping index of 6.6% to 10% was obtained.

In November of the same year, the towns of El Sauce, el Banco, Kerguer and la Ramada were visited, where it was found that the trapping rate with the Tomahawk trap was relatively higher than in July and among the species captured were: *Rattus rattus*, *Akodon mollis* and *Oryzomys xantheolus*. In the locality of Banco with the Tomahawk trap, the highest trapping index was recorded with 60% in the intradomiciliary zone with respect to the other localities, while in the localities of Banco and Kerguer in the Peridomiciliary zone an index of trap of 33.3% and with the Sherman traps lower rates were recorded (Table 1).

The rate of trapping only of the species *Rattus rattus* in the month of July 2015 was between 7% and 13% in the towns of Sauce, Banco and Algarrobo, while in November 2015 in the town of Banco a catch rate of 24% being the highest percentage recorded this year.

During the month of August 2016, the towns of Sauce and Banco in the district of Salas were visited, where rodents of three different species were captured: *Rattus rattus*, *Akodon mollis*, *Oryzomys xantheolus* and marsupials of the *Didelphys albiventris* species. With the Tomahawk traps in the Sauce locality, the trapping index was 40% in the intradomiciliary zone, followed by the peridomiciliary zone with 24.4% and the lowest was in the wild zone, while in the Banco locality with Tomahawk traps in the intradomiciliary and peridomiciliary zones obtained a trapping rate of 20% and 10% in the wild zone. Using the Sherman traps, a

trapping rate of 30% and 20% was recorded in the Sauce and Banco locations, respectively (Table 1).

During the month of August 2016, *Rattus rattus* trapping rates of 12% and 17% were obtained in the towns of Sauce and Banco, respectively.

In the period that includes the months of July, 2015 - August 2016, high trapping rates were recorded (7% - 24%) higher than the risk rate according to the Pest standard, 20108 (= or > 5%)<sup>(8)</sup>.

After having obtained the *rattus rattus* rodent trapping index in the different localities of the Salas district, the general flea index and the specific flea index were evaluated, which were obtained considering only the number of rodents trapped from the species *Rattus rattus*. The fleas were collected in vials containing alcohol, which were labeled and taken to the Reference Health Laboratory to be quantified and identified.

**Table 2** shows that during the month of July 2015 in the town of Algarrobo, of the 13 *Rattus rattus* rodents, 40 fleas were collected, obtaining a general index of 3.08; while in the town of El Banco out of 7 *rattus rattus* rodents captured, the general index of fleas is 2.14, which is lower compared to the other town.

In November of the same year, high values of fleas were recorded, where it was found that in the locality of Banco, of the 24 rodents *Rattus rattus* captured, 106 fleas of different genera were obtained with an index of 4.42, while in the locality of Sauce the lowest general index of fleas was recorded with 1.75 (12 *Rattus rattus* rodents and 21 fleas). In August 2016, in the towns of Sauce and Banco, the general flea rates varied between 3 and 4.5, respectively.







**Table 2.** Índice general de pulgas en roedores de la especie *Rattus rattus* capturados con la trampa Tomahawk y Sherman en las localidades del Sauce, el Banco, la Ramada, Kerguer y el Algarrobo del distrito de Salas en el mes de Julio, noviembre 2015 – agosto 2016.

Localidad capturados	N° de roedores	N° de pulgas colectadas	Índice General de pulgas
El Sauce	7	23	3.29
El Banco	7	15	2.14
El Algarrobo	13	40	3.08
El Sauce	12	21	1.75
El Banco	24	106	4.42
Kerguer	17	44	2.59
La Ramada	20	45	2.25
El Sauce	17	51	3.0
El Banco	12	54	4.5

## DISCUSSION

In this study, the prevalence of *Xenopsylla cheopis* in rodents of the species *Rattus rattus* was investigated, from 169 rodents captured in the localities El sauce, El Banco, Kerguer, El Algarrobo and La Ramada of the district of Salas in the period of July 2015 - August 2016, it was possible to identify 135 rodents of the *Rattus rattus* species in which the presence of the trilobed first molar, the length and color of the tail were observed; which correspond to the morphological characteristics described in the Pacheco and Arana key <sup>(9)</sup>.

These results were similar to those obtained by Hamsa Leulmi<sup>(10)</sup> who, in 2014, of 199 rodents captured in Benin (Africa), 109 belonged to the species *Rattus rattus*, results that coincide with those obtained in our research, which would reflect be one of the indicators that the studied species would be the dominant one. According to what was observed, this species prefers precarious conditions such as those found in the towns of Sauce, Banco, Kerguer, Algarrobo and La Ramada in the district of Salas, in the same way as the conditions found in the city of Benin in Nigeria, in where a high index of these rodents is also shown.

399 fleas were collected from 135 *Rattus rattus* rodents, of which 75% belonged to *Xenopsylla cheopis*; however, in the investigation by Pozo<sup>(11)</sup> in Piura, of

24,025 fleas, only 0.2% were *Xenopsylla cheopis*. The observed characteristics were similar since this species presents an ocular bristle in front of the eye and a divided mesopleura; characteristics that also coincide with those described by Acosta and Morone <sup>(7)</sup>. The high rate of *Xenopsylla cheopis* in the district of Salas was higher, which could be related to the increase in reservoirs and contact with domestic animals in this area<sup>(12)</sup>.

To determine the prevalence of *Xenopsylla cheopis*, the rodent trapping rates, the general flea rate and the specific rate were established. The trapping index of *Rattus rattus* when using the Tomahawk traps in the Salas district localities was higher in the intradomiciliary zone with respect to the peridomiciliary and wild zone; on the other hand, when using the Sherman traps, the trapping rate was lower. These results were similar to those reported by Carpio<sup>(13)</sup> in 2004, who using Tomahawk and Sherman traps obtained a trapping rate of 14.4% and 11.3%, respectively.

The higher capture rate would be due to the fact that these Tomahawk traps are larger than Sherman traps, which would make it easier to capture *Rattus rattus*. Likewise, this species has a high power of adaptation, which is why it is found both in the intradomiciliary, peridomiciliary and even in the wildzone. It was also





observed that in November 2015 the trapping index was relatively higher than the results obtained in the months of July, 2015 and August, 2016; which would indicate that in the month of November the climatic conditions are different, causing the biological cycle of rodents to shorten, thus favoring reproduction and achieving between 5 – 6 litters per year<sup>(14)</sup>.

Studies carried out in the town of Shin Shin and Chilasque in the district of Kañaris reported that the trapping rate of rodents of the species *Rattus rattus* and the rate of *Xenopsylla cheopis* was low, which could be due to the fact that in these locations there are different climatic conditions and that have colder winters due to their height and this could lengthen the biological cycle.

The general flea index (1.25 to 4.5) was similar to that obtained by Carpio M.13 in 2004, where the values ranged from 1.02 to 7.20. Regarding the specific index of *Xenopsylla cheopis* during the evaluated period, it ranged from 1.3 to 4.08, being the locality of the Bank where the highest index was obtained with 4.08 followed by Sauce with 3.0 to 3.1 ; All these indices were higher than the risk index (= or > 1) according to the Plague Standard of the Ministry of Health of Peru<sup>(8)</sup>.

These results were also similar to those obtained by Carpio<sup>(13)</sup>, who in Lambayeque recorded that the Specific Index for *Xenopsylla cheopis* was 6.1 and for *Polygenis* sp. of 3, with which we could say that the prevalence of *Xenopsylla cheopis* in *Rattus rattus*

rodents has increased over this time. These high specific indices, which exceed the risk index, constitute a danger since in an eventual outbreak of plague it would be detrimental to the inhabitants of the region due to the rapid transmission of this disease because *Xenopsylla cheopis* is the main vector of bubonic plague, for This should be done every six months to stay alert to any eventuality.

## CONCLUSION

The total number of rodents captured was 169, of which 135 belonged to the *Rattus rattus* species, but other species were also identified, such as 19 *Akodon mollis*, 11 *Oryzomys xantheolus* considered wild rodents, and 2 marsupials of the *Didelphys albiventris* species. In addition to 299 *Xenopsylla cheopis*, fleas of the species 44 *Pulex irritans*, 46 *Polygenis litargus* and 10 *Ctenocephalides felis* were identified, obtaining a percentage of 75%, 11%, 12% and 2% respectively.

The prevalence of the flea *Xenopsylla cheopis* in *Rattus rattus* rodents during the evaluated period varied between 1.3 to 4.08, obtaining an average of 2.6, being higher than the Peruvian risk index. These data suggest that epidemiological vigilance should be maintained and preventive measures adopted in these areas and nearby places in order to avoid an outbreak of plague.

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