# The Fleas of Puerto Rico[1]

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THE PRIMARY PURPOSE of this paper is to aid workers in the prompt and correct identification of the flea species occurring in Puerto Rico. A simple key with drawings showing their important taxonomic characters is attached. The relation of these fleas to disease, as well as their relation to the rat species found on the Island, is briefly discussed.

Only seven flea species have been thus far reported from Puerto Rico. Although not yet collected, the species *Nosopsyllus fasciatus* Bosc is included, as it is the commonest of the fleas and of world-wide distribution. These species are listed below under their respective families and subfamilies, according to the classification by Ewing and Fox.[2]

| *Scientific Name* | *Common Name* |
|---|---|
| Dolichopsyllidae Baker | |
| Dolichopsyllinae Baker | |
| *Nosopsyllus fasciatus* (Bosc) | European Rat Flea |
| Hystrichopsyllidae Tiraboschi | |
| Leptopsyllinae Rothschild | |
| *Leptopsylla segnis* (Schonherr) | Mouse Flea |
| Pulicidae Stephens | |
| Spilopsyllinae Oudemans | |
| *Xenopsylla cheopis* (Rothschild) | Oriental Rat Flea |
| *Ctenocephalides canis* (Curtis) | Dog Flea |
| *Ctenocephalides felis* (Bouche) | Cat Flea |
| Pulicinae Tiraboschi | |
| *Pulex irritans irritans* (Linnaeus) | Human Flea |
| Hectopsyllidae Baker | |
| *Echidnophaga gallinacea* (Westwood) | Sticktight Flea |
| *Tunga penetrans* (Linnaeus) | Chigoe, Jigger, Sand Flea, *Nigua* |

*Identification of flea species.* The identification of adult fleas will be more accurate if the specimens are first prepared and permanently mounted on Canada Balsam, in accordance with one or another of

1. Received for publication January 29, 1945.

2. H. E. Ewing and I. Fox, The fleas of North America. U. S. Department of Agriculture Misc. Publ. No. 500, 1943.

the methods described by Fox.[3] It is necessary to remove unsclerotized structures and intestinal contents so as to obtain a clearer view of the important body parts.

The flea species, occurring on the Island, may be identified by the use of the following key. Two contrasting characters are given; select the one that fits the specimen and proceed to the couplet corresponding to the number following the selected character; repeat until a name is reached. Specimens should then be compared with the drawings and the recognition characters following the key.

*Artificial Key to Puerto Rican Fleas*

1. With pronotal comb . . . . . 2
   Without pronotal comb . . . . . 5
2. With genal comb . . . . . 3
   Without genal comb (Fig. 1) . . . . . *Nosopsyllus fasciatus* (Bosc)
3. Eyes vestigial. Genal comb consisting of a vertical row of 4 teeth on posterior border of gena (Fig. 2) . . . . . *Leptopsylla segnis* (Schonherr)
   Eyes large. Genal comb consisting of 7–8 teeth distributed horizontally along gena . . . . . 4
4. Short head. First teeth of genal comb shorter than second (Fig. 3) . . . . . *Ctenocephalides canis* (Curtis)
   Long head. First teeth of genal comb about equal in length to second (Fig. 4) . . . . . *Ctenocephalides felis* (Bouche)
5. The three thoracic terga together longer than first abdominal tergum . . . . . 6
   The three thoracic terga together shorter than first abdominal tergum . . . . . 7
6. Ocular bristle below eye. Females: spermatheca round (Fig. 5) . . . . . *Pulex irritans irritans* L.
   Ocular bristle higher above, in front of eye. Females: spermatheca sausage-shaped (Fig. 6) . . . . . *Xenopsylla cheopis* (Rothschild)
7. Hind coxa with a group of spinules on the inner side. Front angulate along anterior margin but not produced into a tubercle (Fig. 7) . . . . . *Echidnophaga gallinacea* (Westwood)
   Hind coxa without such group of bristles. Front produced into an angular tubercle along anterior margin (Fig. 8) . . . . . *Tunga penetrans* L.

3. I. Fox, Fleas of Eastern United States. The Iowa State College Press, 1940; The use of creosote in mounting fleas and other arthropods on slides. Science, 96:478, 1942.



*Notes on other recognition characters.*[4] The following differential characters must also be considered in order to avoid confusing the species under study with other closely related or similar species. Secondary sexual characters exist in the head, and specific characters occur in the male genitalia. For the sake of simplicity and, as far as exactness permits, these characters are not mentioned unless absolutely necessary.

*Nosopsyllus fasciatus.* Setae on front spine-like, not pigmented; ocular row of only three setae. In front of antennal groove, above ocular row of spines, in the males there are 4 to 6 bristles, in the females only 2. Labial palpus not reaching apex of trochanter I. Thin bristles on the inside of coxae II and III in apical half only. Femur I with several setae on outer surface. Bristles on tibia normally distributed. Last tarsal segment with five plantar bristles. Female with only one receptaculum seminis. The tail of the receptaculum is long and curved above head.

*Leptopsylla segnis.* Structure of genal comb is characteristic of this species and sufficient for exact identification.

*Xenopsylla cheopis.* Mesosternite broad, divided into two areas by a pleural ridge. Ocular bristle in front of and above center of eye. Females can be separated from other closely related congeneric species by shape of spermatheca (Fig. 6). Males have antepygidial bristle on short pedestal. Lobe of 9th sternal plate is club-shaped.

*Ctenocephalides canis* and *C. felis.* Hind coxa with row or patch of spinelets on inner surface. Fox and Ewing call attention to the possibility of these two species intercrossing with a consequent mixing of characters, therefore it is not possible to separate them in some instances.

*Pulex irritans irritans.* Mesosternite narrow, not divided into two areas. Genal comb represented by only one poorly pigmented long spine. Ocular bristle located below eye. Rostrum reaches to about one half length of anterior coxa.

*Tunga penetrans* and *Echidnophaga gallinacea.* These two species belong to a family that can be immediately separated from all others by the greatly reduced thorax (Fig. 7). *Tunga penetrans* has distinct eyes. The fifth tarsal segment of *Echidnophaga gallinacea* has two ventral apical bristles; in the female there is a small lateral lobe projecting backwards on the hind margin of the head.

4. H. E. Ewing and I. Fox, *op. cit.*
1. Fox, *op. cit.* (3).
C. Fox, Insects and Diseases of Man (Philadelphia: P. Blakiston's Son & Co., 1925).

*Fleas and their relation to disease.*[5] Normally, fleas are ectoparasites of birds and mammals, showing a marked preference for certain host species. They feed avidly on the blood of their hosts and, during this process, ingest organisms and parasitic forms which they are later able to transmit to healthy or uninfested hosts.

Three major peculiarities in their habits increase the ability of fleas to transmit disease: (1) prompt escape from the cold body of the dead host, (2) easy transfer from animal to animal despite host preference, (3) excreting or regurgitating of blood heavily infected with plague or typhus microorganisms, which have multiplied within the body of the flea. The first two factors are of great importance. Injection of microorganisms into the host may occur in two ways: (1) by direct inoculation through the bite of the flea or (2) by scratching the infected blood or feces of the flea into the bite.

Among the fleas that can transmit disease, certain species stand out as better vectors. All Puerto Rican species are able to transmit disease or, at least, to initiate dangerous secondary infections. The diseases and parasites they transmit are briefly summarized below, with the corresponding vector species.

*Nosopsyllus fasciatus* is an intermediate host for *H. diminuta*, a tapeworm of rats and mice, occasionally found in man. Though an efficient plague carrier, it plays an unimportant part in its spread, as it seldom bites man. *N. fasciatus* is also a vector of endemic typhus fever.

*Leptopsylla segnis* is said to transmit plague from rat to rat, serving as host of *H. diminuta*.

*Xenopsylla cheopis* is considered the chief agent in the transmission of bubonic plague, wherever it may occur. It is also implicated in the transmission of endemic typhus and serves as intermediate host of *H. diminuta*.

*Ctenocephalides canis*, an important intermediate host of *D. caninum*, has also been reported as an intermediate host of *H. diminuta*, *D. immitis*, *L. donovani*, and *L. infantum*. As it abounds considerably, this species may be of importance in the transmission of plague during epidemics.[6] Dogs have been found to be carriers of endemic typhus, hence this species, occurring commonly in dogs, may be able to transmit the disease to man.[7]

5. C. Fox, *op. cit.*
W. A. Riley and O. A. Johannsen, Medical Entomology, 1st Ed. (New York: McGraw-Hill Book Company, 1932).
6. H. E. Ewing and I. Fox, *op. cit.*
7. L. Mazzotti and G. Varela, Reacción de Weil-Felix en perros de la ciudad de México. Medicina, México, 22:135–136, 1942.



*Ctenocephalides felis* has been recorded as the intermediate host of *D. caninum* and of the nematode, *D. immitis;* it may be an important vector of plague during epidemics. This species has been shown, experimentally, to be an efficient carrier of endemic typhus.

*Pulex irritans irritans* has been proved experimentally to be an efficient carrier of endemic typhus, but it is not a good vector of plague. The species was found to be one of the more common hosts of *D. caninum*.

*Tunga penetrans* burrows into the epidermis, causing irritation, and unless promptly and completely removed and the bite well disinfected, serious secondary infections may occur, sometimes resulting in gangrene, tetanus, or septicemia. Plague bacilli have been found in encysted females, and several human cases of the disease have been attributed to transmission by this species.[8]

*Echidnophaga gallinacea* may cause secondary infections due to its burrowing habits. The species usually attacks the head, legs, or other exposed surfaces on poultry and, if the head becomes severely infected, the fowl may be blinded. As birds carry the organism from one place to another, this species is a potentially important disseminator of plague in noninfected areas. Virulent plague bacilli have been found in this species.[9]

All the above mentioned diseases, with the exception of *L. donovani* and *L. infantum*, are present, or have been recorded at some time, in Puerto Rico. The presence of *D. immitis* on the Island is somewhat doubtful, but it is said to occur in St. Croix, Virgin Islands.

During the present century, Puerto Rico suffered two outbreaks of plague, the first in 1912 when 56 cases and 36 deaths were reported, and the second in 1921, with 32 cases and 20 deaths. The source of infection in both instances was believed to have come from the Canary Islands.[10] Dead rats, showing plague lesions, were found days before the first cases of human plague appeared,[11] which fact confirms the observation made in other countries that enzootics may have epizootic outbreaks resulting in human epidemics.

Characteristic syndromes and positive Weil-Felix reactions show that there is endemic typhus in Puerto Rico and the Virgin Islands;[12]

8. Alfredo E. Gachicoa, La peste bubónica en Tampico en 1920–1921. Trab. pres. al VII Cong. Médico Nacional, Monterrey, Dec., 1927. Bol.Ofic.san.panam., 21:874, 1942.
9. C. M. Wheeler, J. R. Douglas, and F. C. Evans, The role of the burrowing owl and the sticktight flea in the spread of plague. Science, 94:560–561, 1941.
10. A. A. Moll and S. O'Leary, Plague in the Americas. The West Indies and certain European-African Islands. Bol.Ofic.san.panam., 21:989–994, 1942.
11. P. Morales Otero, Epizoötic survey of the epidemic of bubonic plague in Puerto Rico in the year 1921. Porto Rico Rev.Pub.Health & Trop.Med., 3:51–58, 1927.
12. S. Riera López, J. Watt, and J. A. Doull, An epidemiological study of reported cases of typhus fever in Puerto Rico. Puerto Rico J.Pub.Health & Trop.Med., 17:216–222, 1942.

the majority of cases in Puerto Rico have been reported from San Juan. The following table shows that either endemic typhus is gradually on the increase in Puerto Rico or that more cases are diagnosed as a result of improved laboratory procedures and general interest in the condition.

TABLE 1

*Reported Cases of Endemic Typhus in Puerto Rico 1939–1944*[a]

| *Year* | *No. of Cases* |
|---|---|
| 1939 | — |
| 1940 | 2 |
| 1941 | 25 |
| 1942 | 83 |
| 1943 | 102 |
| 1944 (To Aug. 20) | 157 |

[a]A. de Juan, Personal communication. Bureau of Epidemiology, Puerto Rico Department of Health, October 1944.

*Rat species and their relation to the fleas of Puerto Rico.* There are three species of rats in Puerto Rico: *Rattus norvegicus*, *Rattus rattus alexandrinus*, and *Rattus rattus rattus*. A fourth type, *Rattus rattus frugivorus*, may have been overlooked. The house mouse, *Mus musculus*, abounds considerably; occasionally, wild white mice are found. These species may be identified by the following characteristics.[13]

(a) *Rattus norvegicus*, commonly known as the Norway or brown rat, is the largest of the species noted above, inhabiting drains, sewers, basements, burrows, and so forth. It has a blunt snout, short ears, and large feet, and its tail, which is thick and rough, is shorter than its body.

(b) *Rattus rattus alexandrinus*, called the roof or Alexandrine rat, inhabits human dwellings. It has a white chest overlapped with the gray of the body, its belly hair being always slate- or dark-colored at base; its tail is smooth and longer than the body. In general appearance it resembles

(c) *Rattus rattus rattus*, which is the smallest of these species, with a long snout, big, round ears, and a smooth and tapering tail, longer than the body. This species is black all over and hence called the black rat.

(d) *Rattus rattus frugivorus*, called the white bellied rat, has a smooth tail longer than the body, the white of the chest and gray

13. Courtesy of Dr. C. A. Chapin, Curator, U. S. National Museum, Washington, D. C.



of the body meeting in a sharply defined line. Its belly hair is always white at the base, otherwise it is similar to the last species.

A rat-flea survey of the City of San Juan was performed by the Insular Department of Health during the years 1926 to 1929.[14] An anti-rat campaign was conducted by the same Department of Health during 1943. Some of the species captured during these two periods are tabulated below.

TABLE 2

*Rat-Flea Survey of San Juan*

| *Species* | *Year 1926–1929* | *Percentage* | *Year 1943* | *Percentage* |
|---|---|---|---|---|
| *R. norvegicus* | 723 | 72 | 1,849 | 70 |
| *R. rattus alexandrinus* | 147 | 15 | 708 | 27 |
| *R. rattus rattus* | 135 | 13 | 60 | 3 |
| | 1,005 | 100 | 2,617 | 100 |

The above table shows that *R. norvegicus* is the species that abounds most in San Juan, though a slight increase in *alexandrinus* can be noted in the 1943 collections due, perhaps, to the place of collection. During the 1943 anti-rat campaign, 1,965 house mice (*Mus musculus*) were gathered. It is estimated that 8 percent of the rat population are carriers of endemic typhus.

Only a small number of rats were examined for fleas during 1943 and the data on this are not significant. However, careful collections were made during the rat-flea survey and the results as to species abundance are tabulated below.

TABLE 3

*Flea Species Collected 1926–1929*

| *Species* | *No. of Fleas* |
|---|---|
| *Xenopsylla cheopis* | 7,040 |
| *Echidnophaga gallinacea* | 93 |
| *Ctenocephalides canis* or *felis* | 7 |
| *Pulex irritans irritans* | 4 |
| *Leptopsylla segnis* | 1 |
| | 7,145 |

*Xenopsylla cheopis* represents 98.5 percent of the total number of fleas captured, which gives a *cheopis* index of 7 as compared to a flea index of 7.1. The sex ratio was found to be 13.10 (males to females). Fleas were found in only 57 percent of the captured rats.

14. A. L. Carrión, Final report on a rat-flea survey of the City of San Juan, Puerto Rico. Puerto Rico Rev.Pub.Health & Trop.Med., 6:273–282, 1931.

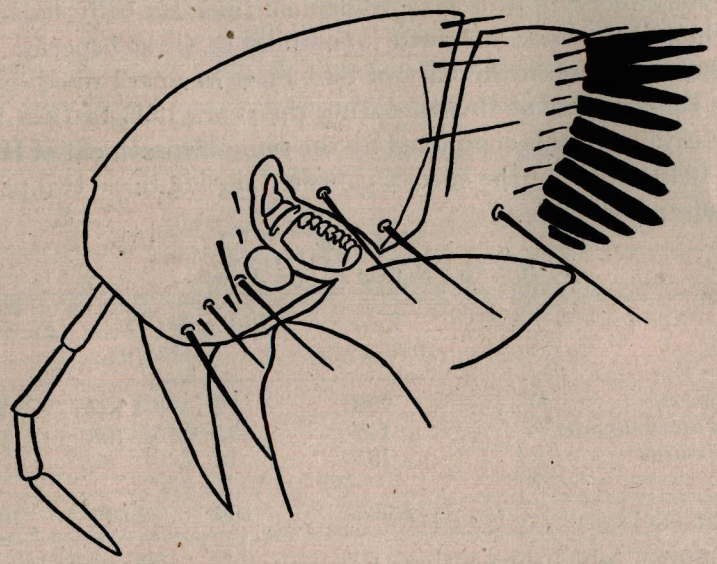

FIG. 1- NOSOPSYLLUS FASCIATUS

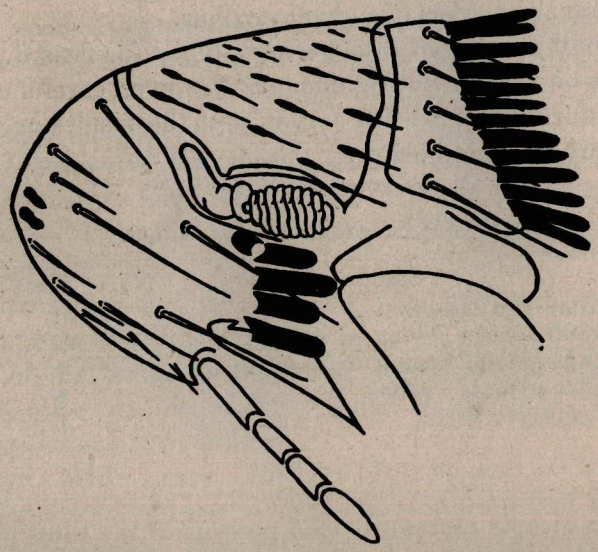

FIG. 2- LEPTOPSYLLA SEGNIS



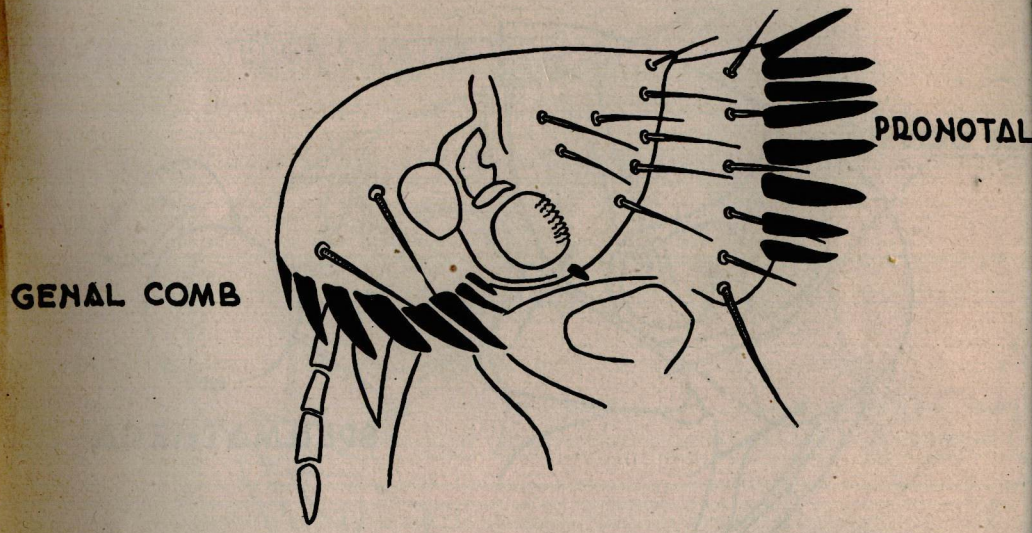


FIG. 3 - CTENOCEPHALIDES CANIS

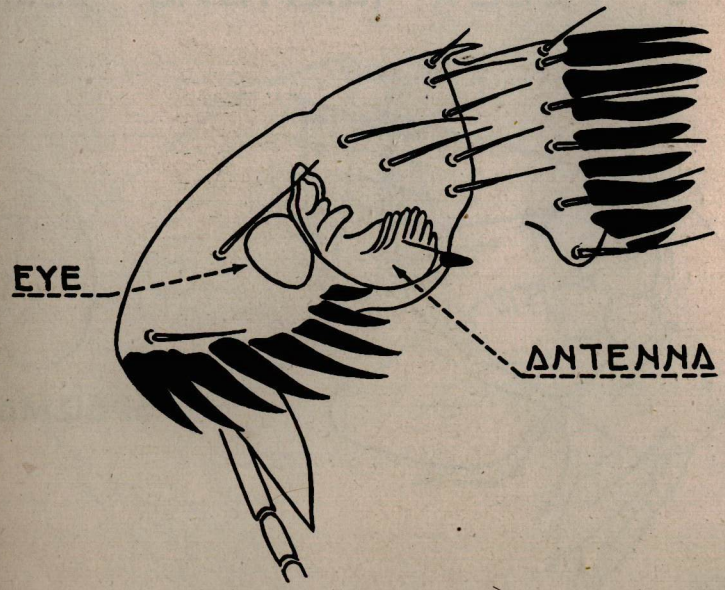


FIG. 4 - CTENOCEPHALIDES FELIS

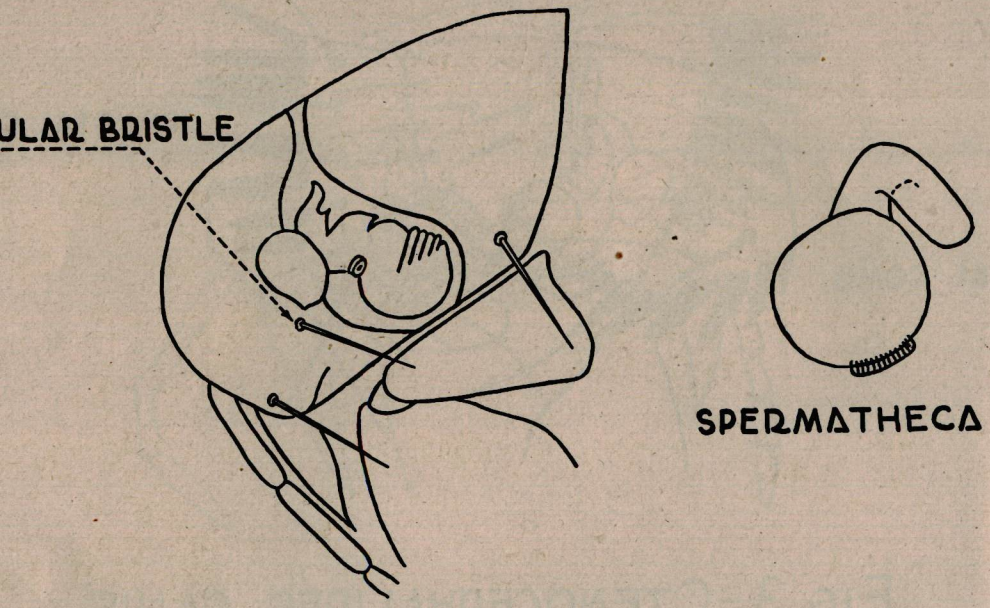


FIG. 5 - PULEX IRRITANS IRRITANS

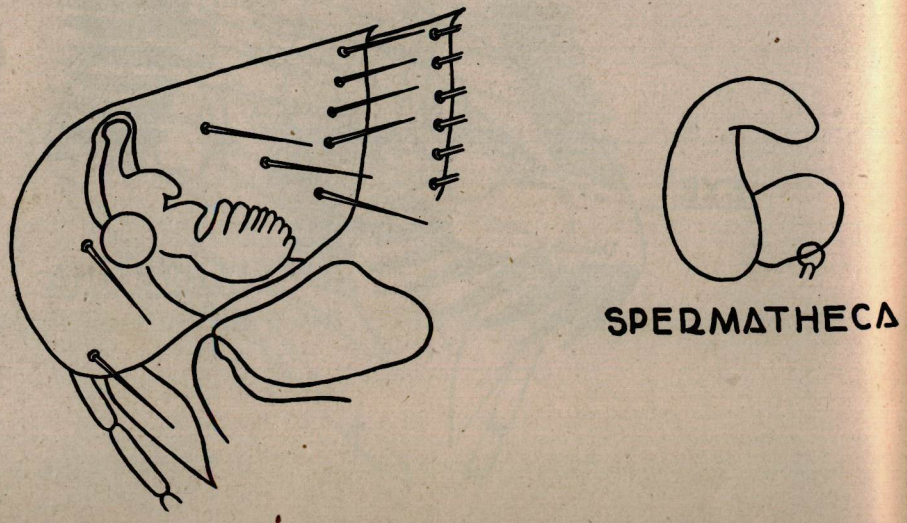


FIG. 6 - XENOPSYLLA CHEOPIS



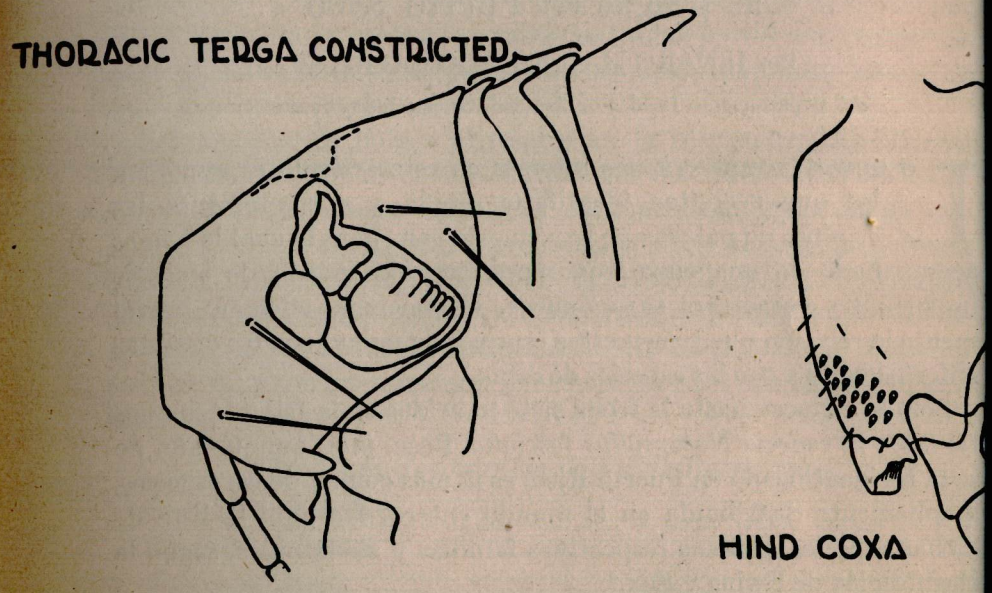


FIG. 7 - ECHIDNOPHAGA GALLINACEA

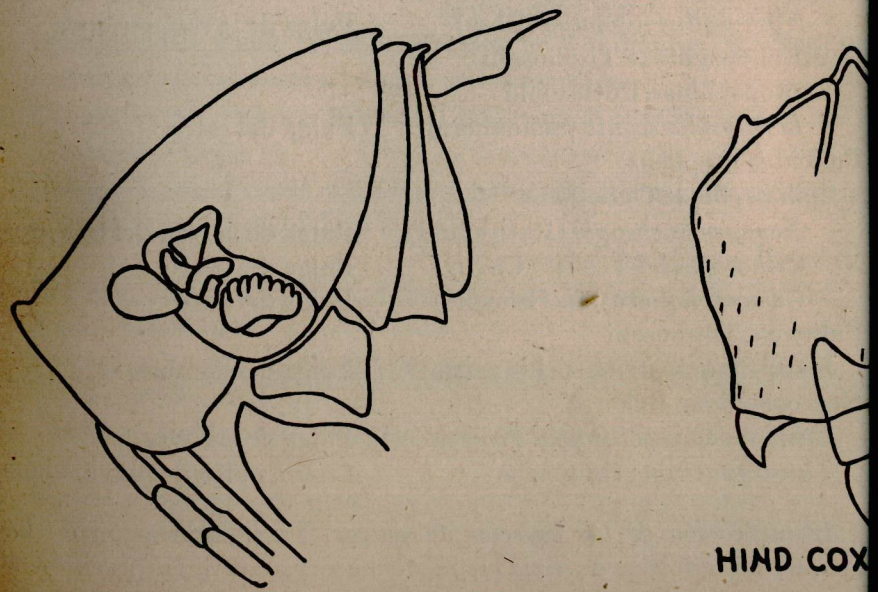


FIG. 8 - TUNGA PENETRANS