A SURVEY OF THE RAT FLEAS OF THE SOUTHERN BRITISH COLUMBIA COAST WITH RELATION TO PLAGUE STUDIES

By George P. Holland
Livestock Insect Laboratory, Dominion Department of Agriculture, Kamloops, B.C.

During the period August 28 to November 27, 1939, a field crew, under the supervision of the Dominion Department of Pensions and National Health and the Division of Entomology, Dominion Department of Agriculture, at Kamloops, conducted a survey of the rodent fauna of the cities of Vancouver and New Westminster. Large numbers of the imported European and Asiatic rats and mice which infest the garbage dumps and waterfront areas of these seaports were collected. These rodents were extremely common in some localities, and constitute potential plague reservoirs of no slight importance. The rats and mice, when killed, were autopsied by the members of the field crew, and carefully inspected for lesions of the liver or spleen, or enlarged lymphs glands which might indicate the presence of plague. In addition, all fleas found infesting the animals were collected and shipped in vials of physiological saline to the Laboratory of Hygiene at Kamloops for inoculation tests. As different species of fleas vary considerably in their ability to transmit plague, the specimens were examined taxonomically before being inoculated into cavies, and the number of each species recorded. By this method a much more valuable picture of the plague potentialities of the fleas was obtained than could be shown by simply listing the gross number of specimens collected.

Areas Surveyed

(1) Vancouver:

Two main areas were studied in Vancouver, the garbage dumps and the waterfront district. These two types of collecting ground displayed very different conditions in their respective rat flea faunae. This is shown in the tables of results where the details of the flea infestation in the city dump and Keith Drive dump are listed separately. All other collecting sites are grouped under "Waterfront Area." This includes all grain elevators, warehouses and slaughter houses inspected, as well as the docks themselves.

(2) New Westminster:

Rodents in New Westminster were collected along the waterfront, at the city dump, and a local meat packing plant. As the infestations in these areas were similar to one another, the total results only are shown in the table.

Species of Rodents Collected

Four species of rodents, all of European or Asiatic origin, were collected.

(1) *Rattus norvegicus* (Erxleben). The Norway Rat, which represented 94.4% of the rodents taken, seems to be definitely on the increase in Vancouver and its vicinity, despite control measures conducted by the civic health authorities.

(2) *Rattus rattus rattus* (Linnaeus). The Black Rat was present in small numbers in the waterfront areas of Vancouver and New Westminster.

(3) *Rattus rattus alexandrinus* (Geoffroy). The Roof Rat, another species rare in this part of the world, was found, and also one rat which was a hybrid between this species and the Black Rat.

(4) *Mus musculus musculus* Linnaeus. The European House Mouse, was obtained in fair numbers, but yielded very few fleas. This cosmopolitan little rodent is common inland in British Columbia as well as at the coast.

Species of Fleas Found

(1) *Xenopsylla cheopis* (Roths.). This is the Indian Rat Flea, which has probably been present in B.C. for some years, but which was recorded for the first time in 1938 (1). This, without doubt, is economically the world's most important flea—the plague vector "par excellence", ideally adapted by nature and temperament for the dissemination of this disease. *X. cheopis* was found to be well represented in the garbage dumps of Vancouver while oddly enough, it seemed to be almost completely absent in the waterfront areas. In New Westminster it occurred in the garbage dump and in the local Packing Plant, and while no specimens were taken at the docks, it may very well occur there. Collections along the wharves were too poor to justify statements in this regard.

In his section under "Significance of the Specific Flea Index", Wu (4) states: "It may be taken as a general rule that a particular zone becomes potentially dangerous when the *cheopis* infestation reaches one flea or more per rat. This is referred to as the critical *cheopis* index of one." Computing the flea index, and particularly the *cheopis* index of the Vancouver City Dump, we find that there are 1.94 fleas per animal, and that the *cheopis* index is 1.41—which is in excess of Wu's critical figure just cited. Also, as has already been pointed out, the figures presented here can only be a conservative estimate of the actual state of affairs, and the true index is probably higher. In support of this we would like to point out that one group of 30 rats which were shot at the garbage dump, and not trapped, so that all fleas were caught, yielded a total of 103 fleas, of which 65 were *X. cheopis*. This gives a *cheopis* index of 2.17. Another group of 26 rats yielded 89 *cheopis*, which gives an index of 3.42. These may be more representative figures.

(2) *Nosopsyllus fasciatus* (Bosc). This, the so-called European Rat Flea, known to be a plague vector though not so celebrated as *X. cheopis*, was virtually the only species found on the rats and mice of the waterfront, around the docks and grain elevators of Vancouver. It was also common in the vicinity of the city dump, where it represented about 27% of the infestation.

It should be noted that *N. fasciatus* was the most difficult flea to recognize with certainty. It belongs to the *Ceratophyllidae*, a large family in which many genera and species resemble each other closely, especially when not prepared as microscope slide mounts to reveal finer details of structure. However, a number of representative specimens were mounted, and as all these proved to be *N. fasciatus*, which is the only ceratophyllid flea ordinarily found on rats, no doubt the great bulk of the fleas listed as of this species

were correctly determined. Nevertheless, there remains the possibility that a small number of fleas of related species may have been present, and not recognized as such.

(3) *Ctenocephalides canis* (Curtis).

(4) *Ctenocephalides felis* (Bouche).

The imported dog and cat fleas were found in small numbers. As they are difficult to distinguish from one another, and as neither is of outstanding importance with regard to plague, they are listed together in the tables which follow.

It is of interest that no specimens of *Ctenopsyllus segnis* (Schönherr) were found. This is the usual flea found on *Mus musculus musculus* in other parts of the world. In the rat survey work conducted in San Francisco it is regularly found in fair numbers on rats and mice, but is apparently rare in British Columbia.

All the species of flea cited here are known to be trouble-makers to a greater or lesser degree. While plague has not yet been found in British Columbia, the large and apparently increasing rat population and abundance of fleas, constitute an important latent reservoir, especially in view of the high *cheopis* index demonstrated in some areas.

TABLE 1—Vancouver Rat Flea Survey

(Rattus norvegicus Erx.*)*

Locality	Dates	No. of Rats	No. of Fleas	Flea Index	*Xenopsylla cheopis*	*Cheopis* index	*Nosopsyllus fasciatus*	*Fasciatus* index	*Ctenocephalides* spp.
Waterfront areas	Aug. 30-Nov. 12	316	615	1.95	2	—	611	1.93	2
Keith Drive dump		115	7				7		
City dump	Aug. 28-								
C.N.R. Flats	Nov. 21	725	1403	1.94	1021	1.41	358	.49	24
Total for Vancouver		1156	2025	1.75	1023	.89	976	.84	26

It is of interest to note the relatively high *cheopis* infestation in the city dump in comparison with other areas, where *N. fasciatus* was the only flea present in any quantity. The Keith Drive dump was remarkable in that it possessed virtually no flea population whatsoever, only seven fleas being obtained from a total of 115 rats.

TABLE 2—New Westminster Flea Survey
(Rattus norvegicus Erx.)

Locality	Dates	No. of Rats	No. of Fleas	Flea index	*Xenopsylla cheopis*	*Cheopis* index	*Nosopsyllus fasciatus*	*Fasciatus* index	*Ctenocephalides* spp.
City dump, Waterfront and Swift's	Nov. 16-27th	66	52	.8	16	.24	36	.54	

In addition to the above, a few fleas, all *Nosopsyllus fasciatus* (Bosc) were collected as follows:

TABLE 3

Locality	Dates	Rodent species	No. of Fleas
Vancouver City dump	Nov. 2	7 *Rattus r. alexandrinus*	7 *N. fasciatus*
Vancouver City dump	Nov. 6	1 *Rattus r. rattus*	1 *N. fasciatus*
Vancouver	Aug. 31-Nov. 6	68 *Mus musculus musculus*	3 *N. fasciatus*

As sex ratios are always of scientific interest and especially as female fleas are considered more important than males in disease transmission, a table showing the proportions of males and females in the collections studied here, is appended.

TABLE 4

Locality	*Xenopsylla cheopis*		*Nosopsyllus fasciatus*		*Ctenocephalides*	
	Males	Females	Males	Females	Males	Females
Vancouver	392	631	329	628	8	18
New Westminster	6	10	8	28		

Notes on the Flea Fauna:

Fortunately, for the purpose of this work, the species of fleas normally infesting these rodents are sufficiently widely separated taxonomically to be readily determined by the study of gross external structures, without the necessity of special chemical treatment or the preparation of microscopic slides. Thus it was possible to examine each vial of specimens with a low power direct-illumination binocular microscope and record the number of each species present, without impairing the values of the sample for subsequent inoculation tests. In a few cases, where the identity of a certain insect was considered doubtful, it was removed, cleared in KOH and mounted on a slide, and the determination confirmed by a study of finer diagnostic features; these specimens were of course lost as far as plague tests were concerned.

It should be noted that the percentage of infestation recorded here is probably less than the true flea populations of the living animals, as the bulk of the collecting was done by means of traps and, while these were visited as frequently as possible, the rats were often left dead in the traps for hours before they could be examined. As ectoparasites usually tend to leave soon after the death of the host, it is likely that many fleas were lost in this manner. Also, the fact should be considered that the greater part of the survey was conducted during the autumn. C. Y. Wu (4) points out that in China, flea populations were high during May, June, July and August, and that during other months the animals were not so heavily infested. This probably holds true here also, especially in view of the fact that the same species of fleas are being considered. Thus the figures presented here may not be representative of the percentage infestation durinig the season of principal activity, i.e. the summer, and in the case of infestation, the ideal season for the dissemination of plague.

References

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3. **Spencer, G. J.,** 1937. The menace of rat parasites in Vancouver in 1936. Proc. Ent. Soc. British Columbia, No. 33: 44-45.
4. **Wu, Chun, Pollitzer** and **Wu,** 1936. "Plague" Weishengushu, National Quarantine Service, Shanghai Station.

NOTES ON THE LIFE HISTORY OF THE JUNE BEETLE POLYPHYLLA PERVERSA CASEY*

by W. Downes and H. Andison,
Dominion Entomological Division, Victoria, B.C.

The June beetle, *Polyphylla perversa* Csy., has long been a major pest of small fruits grown on light sandy soil in most parts of southern Vancouver Island, where there is scarcely a fruit farmer who is not familiar with the fat three-year-old grubs known as "June bugs", which take such a heavy toll in the strawberry fields. Within recent years losses occurring through the attacks of this species have become general rather than sporadic, making it imperative that a study of the habits of the insect be made with a view to devising, if possible, some means of control.

Crops Attacked:

Formerly the June beetle was considered mainly a pest in strawberry fields but evidence recently accumulated shows that the larvae, through the greater part of their three-year life cycle, can do much injury to other crops on light soil. Nursery stock planted on sandy land has suffered greatly, the roots of roses, apples, pears, plums and cherries being completely destroyed;

* Formerly referred to as **P. ruficollis** Csy. See Brown, 1940, Canadian Ent., 72: 186