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Transmission Studies of Sylvatic Plague.*

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The evaluation of the vector efficiency of a species of arthropod incriminated in the transmission of an infectious agent must necessarily take into consideration the following factors: (1) The *infection potential,* (2) the *vector potential,* and (3) the *transmission potential.* The *infection potential* is based upon the percentage of a given species in which the infection becomes established or the disposition of this species to accept the invasion of the organism of the infection. The *vector potential* is based upon the percentage of *infected* individuals which become *infective.* The *transmission potential* is the mean number of transmissions effected by a group of *infective* individuals. The product of these factors will represent the number of transmissions effected by a given number of any species or the *vector efficiency.*

To determine if a given species of flea was capable of transmitting *Pasteurella pestis* (Yersin) mass feeding experiments were first conducted. When transmission ability was established in a species this species was then tested to determine the vector efficiency by daily individual feedings. Mass tests were conducted with *Diamanus montanus* (Baker) and *Hoplopsyllus anomalus* (Baker), predominant species of the California ground squirrel, *Citellus beecheyi* (Richardson), *Nosopsyllus fasciatus* (Bosc) and *Xenopsylla cheopis* Rothschild, the principal fleas of rats, *Rattus* spp., *Malareus telchinum* Rothschild of the field mouse, *Microtus californicus* (Peale), and *Ctenocephalides felis* (Curtis) *of domestic cats, Felis domestica* Linn.

Successful transmissions were obtained with *D. montanus, C. felis, N. fasciatus, X. cheopis* and *H. anomalus.* Only *one* of 3 mass trials with *H. anomalus* resulted in transmission indicating the possibility that this species may prove to be a rather poor vector.

To determine the vector efficiency experimentally, clean laboratory-reared fleas of each species tested were first fed upon an infected mouse in which the magnitude of bacteremia was known; thereafter each flea was given an opportunity to feed at daily intervals

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until death upon white mice. Infection of the fleas was determined by means of daily fecal cultures during the life of each flea and by subsequent histological examination. All experiments were conducted under the same laboratory conditions and employed the same strain of stock mice.

Individual feeding trials have demonstrated *D. montanus* to have an infection potential of .85, a vector potential of .52, and a transmission potential of 2.58 with a vector efficiency of 1.14. That is, of 48 fleas used 41 or 85% became infected; of these 41 infected fleas 21 or 52% became infective and transmitted the infection to 50 mice or an average of 2.58 transmissions per infective flea. Dividing the percentages by 100 the potentialities of a single flea may be obtained. In other words a group of *D. montanus* given an infectious blood meal will yield an average of 1.14 transmissions per flea. Similar individual feeding trials conducted with *X. cheopis* show this species of flea to have an infection potential of .98, a vector potential of .29, a transmission potential of 1.44 and a vector efficiency of .39 (Table I).

The vector efficiency relationship between the 2 species, as determined experimentally, should remain relatively constant; however, the actual figures obtained will undoubtedly vary depending upon the susceptibility of the species of laboratory animal used and climatic factors operating during the course of the experiment.

TABLE I.

Species	No. used	No. infected	No. infective	No. transmissions	Infection potential	Vector potential	Transmission potential	Vector efficiency
D. montanus	48	41	21	50	.85	.52	2.58	1.14
X. cheopis	50	49	14	20	.98	.29	1.44	.39

As shown in the table, although *X. cheopis* has a higher infection potential than *D. montanus,* only one-half as many *X. cheopis* become infective and these transmit but one-half as many times. Apparently then a high infection potential alone is no indication of high vector efficiency; likewise the vector potential alone without a consideration of the transmission potential will not give a true picture of vector efficiency. From the above data an accurate evaluation of vector efficiency must include a knowledge of the infection potential, the vector potential and the transmission potential.