General



Cat flea, *Ctenocephalides felis*, a vector of *Rickettsia felis*. Notice the combs, which gives the animal its name.



Human flea. *Pulex irritans*. © ITM

Fleas are cosmopolitan, wingless insects. They are obligate blood-sucking ectoparasites. They are not strictly adapted to a specific host and on occasions can bite unusual hosts, including humans. Although feeding on less than ideal hosts keeps the fleas alive, it reduces their fertility. The most important jumping fleas are *Pulex irritans* (the human flea), *Ctenocephalides* species (cat and dog fleas), *Xenopsylla cheopis* (Oriental rat flea) and *Tunga penetrans* (sand flea). Adult fleas live 6-12 and sometimes even 24 months. Fertilised adult females lay 3-18 eggs per day. After 2-14 days, depending on moisture and temperature, the eggs hatch to give very active legless larvae. Under favourable conditions, the larvae will pupate and emerge as adult insects. The cocoon is spun from sticky silk, so that a wide variety of substances become attached and provides camouflage. These pupae are therefore

very difficult to detect. The pupa stage usually lasts 1 to 2 weeks. Sometimes the adult insect remains in the cocoon for a long time (up to 1 year). Emergence from the cocoon is environmentally triggered (e.g. by proximity of a host: CO_2, heat, vibration). This explains why people who move into a house that has been empty for a long time can suddenly suffer numerous fleabites. Adult insects can remain alive for several weeks to months without feeding if the climate is not too harsh. Optimal conditions for their survival is high moisture and temperatures around 20°-30°C. Fleas leave dead hosts and this behaviour is important in the transmission and epidemiology of plague. Body temperature (37°C) inhibits the hatching of eggs and larval development. Reproduction occurs away from the host, on the ground, in cracks and in animal nests.

Muscles do not directly power the amazing jumps of fleas. Muscular tissue reacts too slowly. Instead, muscles are used to build up tension gradually. Fleas do not have wings but for their jumping, they use their wing stumps (their ancestors had wings). A hungry flea can jump up to 600 times per hour during three days. Fleas can jump 20 cm in height and 30 cm in distance. Bites are associated with the injection of saliva and cause a local pruritic skin irritation, principally on the legs. At night bites can occur over the whole body while people are lying down. These insects may be infected with the bacteria causing plague or endemic typhus (*Rickettsia typhi*) and *R. felis*. Other organisms can occasionally be transmitted. Fleas also transmit various sorts of minor tapeworms (*Dipylidium caninum, Hymenolepis diminuta* and possibly *H. nana*). Occasionally people develop long-lasting red skin lesions after insect bites. In such cases a Köbner's phenomenon due to psoriasis should be suspected. The original skin lesions themselves can be minimal (e.g. hidden on scalp, ear).

Simple hygiene is often sufficient to keep a house free of fleas. Insecticide resistance is increasing, including resistance to DDT. Organophosphates, carbamates and pyrethroids are used to eliminate flea infestation in a house. Pets can be washed with a shampoo with e.g. malathion or can wear a flea collar, i.e. a collar impregnated with dichlorvos. The latter provides a prolonged local vapour effect in the animal's fur. It should however be noted that most fleas are not present on the host, but in the bedding, on the ground, etc. For a cat with 25 fleas in its fur, there are some 500 adult insects, 500 cocoons, 3000 larvae and 1000 eggs present on the ground. Flea control should therefore also be directed towards the whole environment not just the animal. Cocoons are relatively resistant to insecticides.

Fleas, tungiasis

Tungiasis is a superficial infection of the skin by the sand flea *Tunga penetrans* (sarcopsilla; jigger flea; chique, do not confuse with chigger, which are trombiculid mites). *Tunga trimamillata* is a sand flea species identified in 2002 and seems to be limited to Peru and Ecuador. The lesions it causes are a bit bigger than those of *Tunga penetrans*.

With a length of about 1 mm (male and unfertilized female), it is the smallest known flea species. Both sexes live on sandy ground and bite birds and mammals, particularly pigs, but also dogs, cats, sheep, goats, cattle, horses, donkeys. Newly hatched insects are very active and the larvae jump around on the ground. They seem to prefer dry sandy ground. The insects don't do well in humid environments. The insects are a poor jumpers. The fertilized female bores into the epidermis and penetrates deep into the stratum corneum. The soles of the feet, the interdigital spaces and the skin under the nails are particularly affected. Any other part of the body that comes into contact with the ground can be infected (buttocks in beggars, children and lepers). The insect bores mechanically into the stratum corneum with the head innermost and bites onto the dermal papillae. The abdomen of the female swells as a result of the maturation of the approximately 200 eggs. After ten days the flea on average measures 1 cm in diameter. The hindmost abdominal segments are not distended and protrude out as a black central spot, through which excreta and eggs are released to the outside. After the eggs have been expelled the flea dies. The hole fills with fibrin and pus and is gradually re-epidermalised. After 3-4 days larvae emerge on the ground and pupate after approximately a week. The complete cycle takes 2-3 weeks.



Female *Tunga penetrans* under a toe nail. Photo Dr Van den Enden © ITM



Female *Tunga penetrans* burried in a finger, an uncommon site. Photo Dr Van den Enden © ITM

There is local pruritus and vague pain. In the beginning only a central black dot is visible. Later the lesion is raised, semi-transparent with a central dark spot and an erythematous halo. The number of parasites usually remains limited. However severe infestations with hundreds of sand fleas are found for example in leprosy patients, cachectic patients, alcoholics, in cases of advanced sleeping disease, in mental diseased and handicapped people or in confined communities.

Superinfection can occur during or after the primary infection, but particularly as a consequence of clumsy manipulation to remove the flea, as a result of which it breaks and parts of it remain deeply lodged. Lymphangitis can result as well as septicaemia and gas gangrene with a fatal outcome. Tetanus is a feared complication.

For treatment, the central opening in the stratum corneum is widened with a clean metal

needle. The flea is removed and the remaining hole is disinfected. Prevention consists of wearing well fitting shoes instead of walking bare-foot or with wide open sandals. Socks that are left lying on the floor are to be avoided. Local basic hygiene is essential. Regular cleaning of floors using lots of water is strongly advised, together with removal of pigs from the vicinity of houses. Affected areas of soil may be burned off. Ointment with cresol or lysol protects the feet.