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## Biomedical Parasitology

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# Fleas




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## SIPHONOPTERA (FLEAS)

PULICIDAE



common on mammals/birds  
transient and permanent

CERATOPHYLLIDAE



large bird fleas  
transient


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## INSECTS


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FLEAS




laterally flattened  
wingless

LICE



flattened  
wingless

FLIES




not flattened  
winged

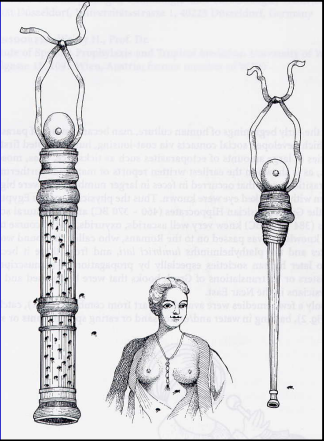
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Long association with human populations

18<sup>th</sup> century flea glooming devices





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## FLEAS

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Over 2,500 species described  
Most parasitic on mammals and birds  
Enlarged hind limbs adapted for jumping  
(use highly elastic resilin to cock legs)

- adults suck blood (piercing-sucking mouthparts)
- host specificity variable (preferred hosts)
- attachment time variable
  - transient (feeding only)
  - permanent (sticktight fleas, burrowing chigoes)

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## INFESTATIONS

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Fleas – blood suckers

cause:

- blood loss
- annoyance/irritation
- dermal lesions
- hypersensitivity
- secondary infections
- transmit other pathogens



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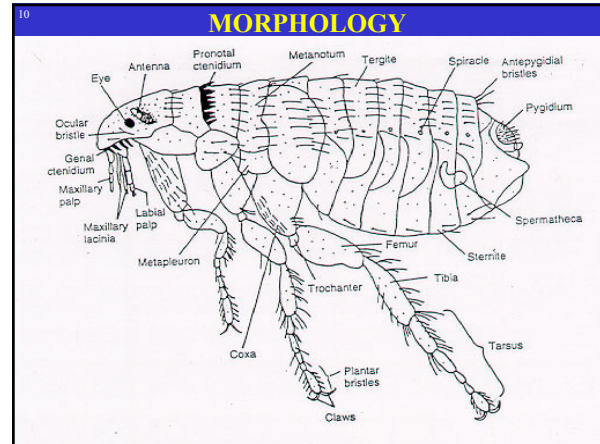
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## Morphology

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- Small (~2.5mm), wingless insects (Order Siphonaptera)
- Laterally compressed body
- Adults distinct from any other insects
- Hind legs much larger than fore legs
- Simple eyes, short antennae
- Mouthparts for piercing & sucking
- Highly adapted for jumping.
- but some species don't jump (live in bird nests)

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## Fleas - jumping champion!

<http://news.discovery.com/videos/animals-flea-jump-mystery-solved.html>

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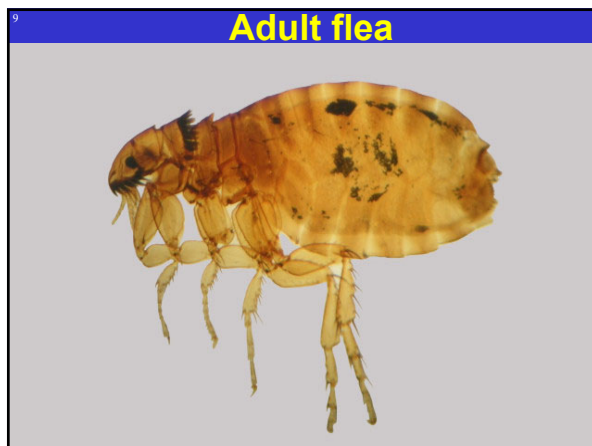
## Spines

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head and thorax often with spines (ctenidium) (spacing correlated to host hair diameter)

- genal ctenidium (GC)
- pronotal ctenidium (PC)

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## Diversity of flea fauna

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- ~2,000 species described belonging to 220 genera, 15 families
- Most species in the Northern Temperate Zone
- 75% on rodents & insectivores
- 19% on rabbits, hares, carnivores, bats, marsupials & primates
- 6% on birds

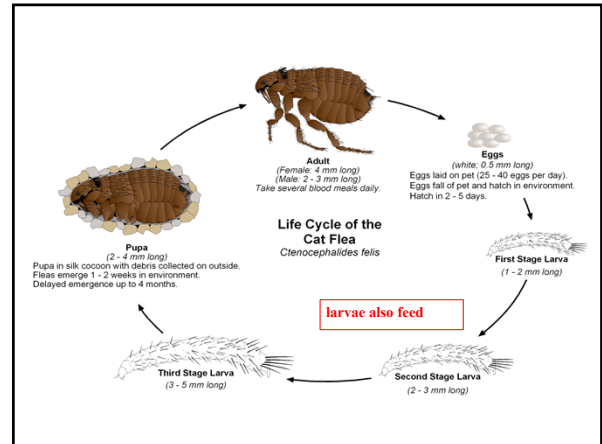
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## Host specificity

- Fleas infest mammals and birds
- Low host-specificity:  
86% of fleas parasitize 2 or more host species
- At least 5 species infest humans
  - Ctenocephalides felis* (cat flea)
  - Ctenocephalides canis* (dog flea)
  - Pulex irritans* (human flea)
  - Xenopsylla cheuopis* (oriental rat flea)
  - Tunga penetrans* (chigoe, jigger)

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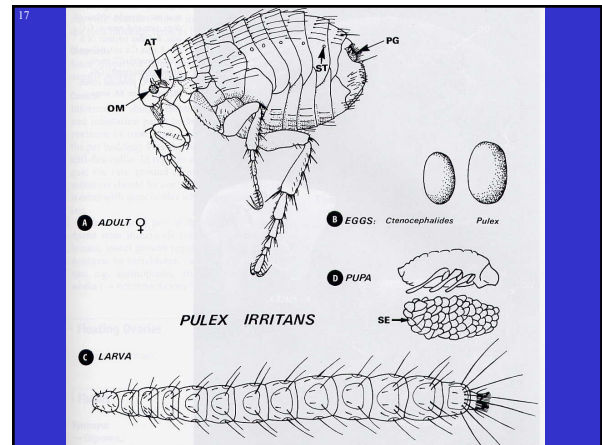
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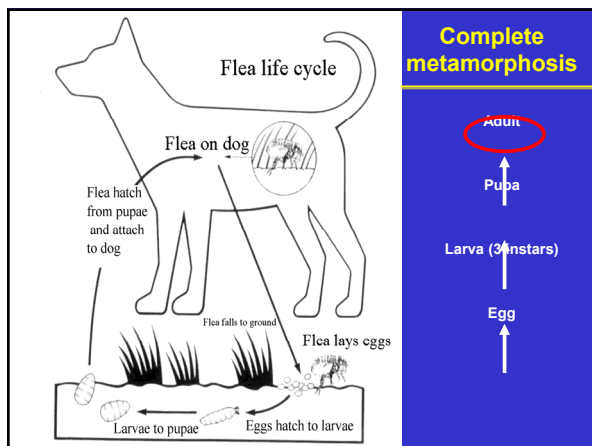
## Host specificity

- Cat flea, *Ctenocephalides felis*, is more common than dog flea on dogs
- Human flea, *Pulex irritans*, infests pigs, goats, dogs, cats, and wild carnivores
- Poultry flea, *Echidnophaga gallinacea*, infests dogs, cats, horses, humans and other mammals

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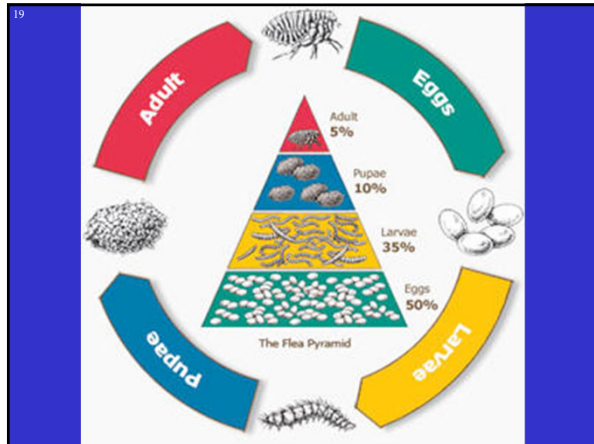
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### Tungiasis

- *Tunga penetrans* (sand flea, chigoe, jigger)
- Infects humans, pigs, & other mammals
- Females penetrate skin, esp. around nails
- Cause extreme itching, pain, inflammation
- Secondary infection (tetanus, gangrene)

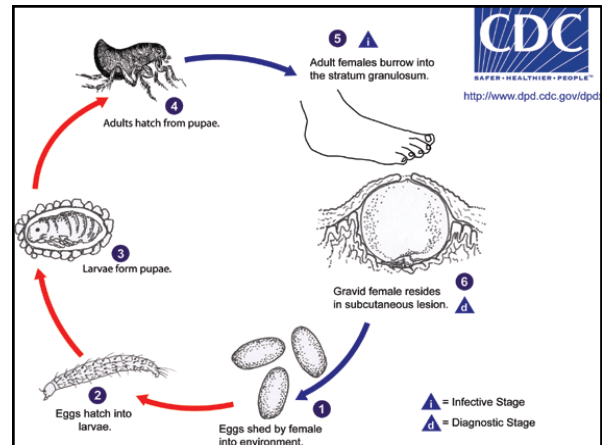
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### Effect on hosts

Adult fleas (male and female) feed and cause:

- Blood loss
- Bite site trauma
- Irritation, inflammation (itch-scratch syndrome)
- Allergy (hypersensitivity), dermatitis
- Erosive skin lesions (tungiasis)
- Predispose to secondary infections
- Transmit pathogens

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### PATHOGENICITY

- blood loss
- tissue trauma
- pain
- itching
- dermatitis
- ulceration
- allergic reactions
- hypersensitivity
- secondary infections

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### Flea-transmitted pathogens

Viruses

- *Myxoma virus* (causing myxomatosis) transmitted by rabbit flea (biological control)

Parasitic helminths

- *Dipylidium caninum* (dog tapeworm) transmitted by cat and dog fleas

Bacteria

- *Rickettsia typhi* (causing murine typhus) transmitted by rat flea
- *Yersinia pestis* (causing plague, black death) transmitted by rat fleas

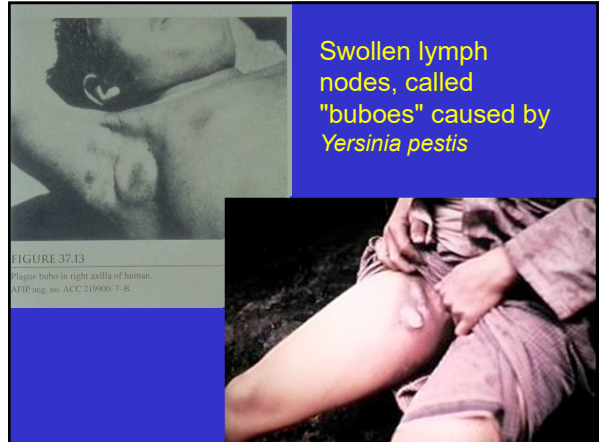
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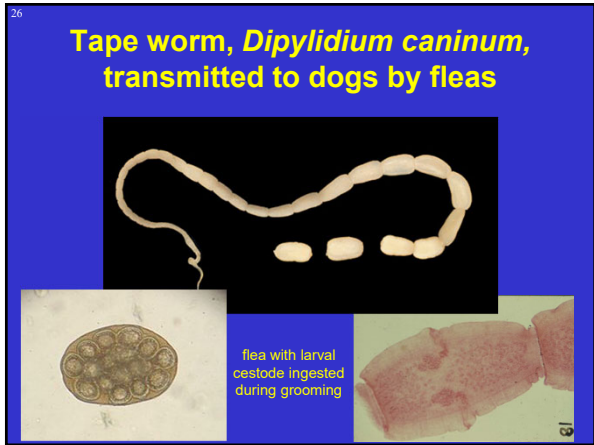


Release of *Myxoma* virus in 1950 reduced rabbit population from 500m to 100m in 2 years in Australia

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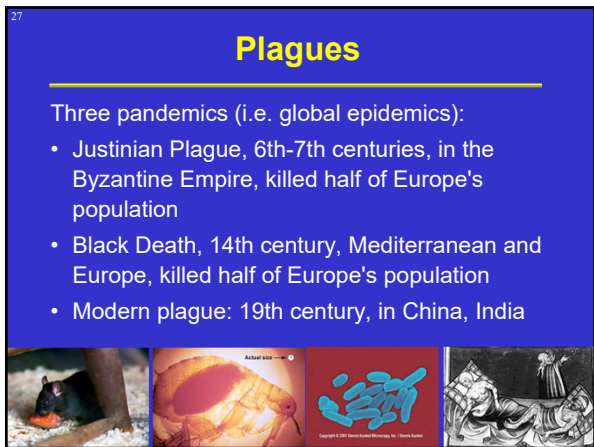
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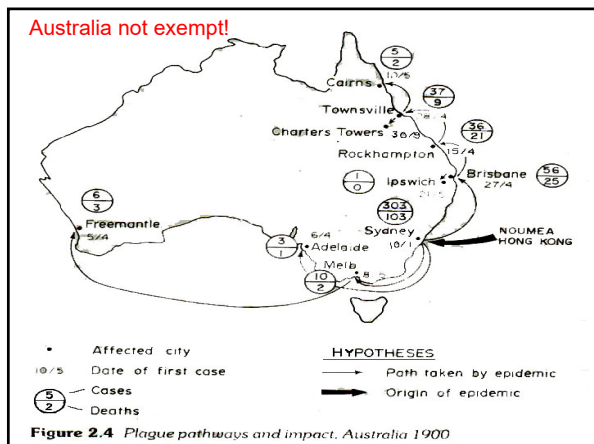
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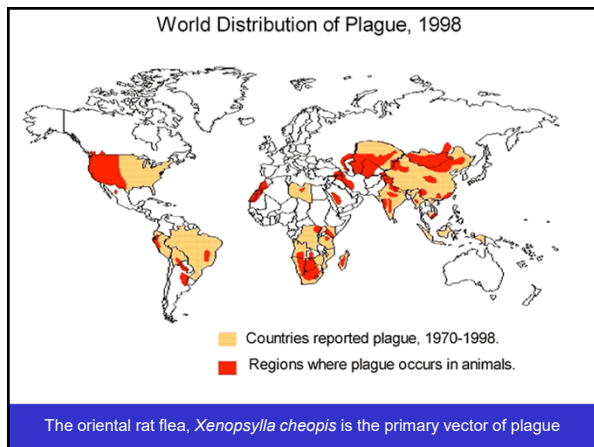


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### Arthropodicidal drugs

1940's	- chlorinated hydrocarbon (DDT)	sodium channel
	- " "	(cyclodiens, lindane) chloride channel
1950's	- organophosphates	AChE
1960's	- carbamates	AChE
1970's	- pyrethroids	sodium channel
	- amidines	biogenic amines
1980's	- avermectins/milbemycins	chloride channel
1990's	- arylpyrazole (fipronil)	chloride channel
	- chloronicotinyles (imidacloprid)	nicotinic AC res
1980's	- insect growth regulator (cyromazine)	disrupt cuticle
	- " "	(benzoylphenylureas) inhibit cuticle
	- " "	(juvenoids) mimic juvenile h

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### Summary

- Fleas are small, wingless insects (order Siphonaptera) ~2000 species described - all parasitic
- Infest mammals and birds
- Complete metamorphosis: egg, larva, pupa & adult
- Only adults suck blood; larvae are free living
- Fleas cause itching, allergy, blood loss, skin inflammation (tungiasis)
- Flea biting may lead to secondary infection
- Fleas transmit pathogenic microorganisms - plague
- Flea control: insecticides, traps, environmental Mx

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### TREATMENT

- clean bedding
- waste disposal
- rodent control
- insecticides
  - powders, washes, sprays
  - impregnated into collars
  - new generation spot-ons (e.g. Fipronil)
- environmental decontamination
  - light traps
  - indoor insecticides/flea bombs (diflubenzuron, pyriproxyfen, methoprene)

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