


Biomedical Parasitology

Diptera




Prof Peter O'Donoghue

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Diptera (true flies)

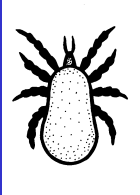
- 1 pair of wings - "di - two, pteron - wing"
- >150K species described, 175 families
- Annoying pests
 - Painful bite
 - Allergic response
- Vectors of disease
 - Protozoa
 - Bacteria
 - Viruses
 - Nematodes



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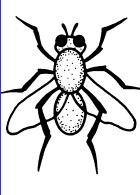
PARASITIC ARTHROPODS (two main assemblages)

ARACHNIDS



2 segments
8 legs
palps

INSECTS

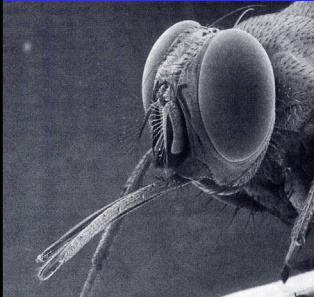


3 segments
6 legs
antennae

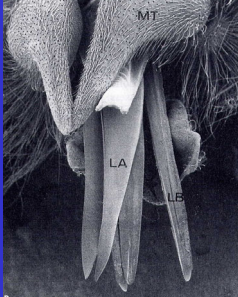
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Many are blood-feeders

sucking mouthparts



cutting mouthparts




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ARTHROPODS

INSECTS


fleas
chiggers



flies
mosquitoes




sucking lice
chewing lice



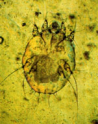
[3 segments, 6 legs, 2 antennae]

ARACHNIDS

hard ticks
soft ticks



mites



[2 segments, 8 legs, 2 palps]

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All dipterans undergo complete metamorphosis

Order	Eggs	Larvae	Pupae	Adults	
1 Simuliidae					Black fly
2 Glossinidae	Not free				Tsetse fly
3 Ceratopogonidae					Midge
4 Phlebotominae					Sand fly
5 Muscidae					House fly

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FLIES


Over 120,000 species belonging to 140 families

<p>Nematocera</p> <ul style="list-style-type: none"> - Phlebotominae (sand flies) - Culicidae (mosquitoes) - Simuliidae (black flies) - Ceratopoginidae (midges) <p>Brachycera</p> <ul style="list-style-type: none"> - Tabanidae (horse flies) - Glossinidae (tsetse flies) - Hippoboscidae (louse flies) - Muscidae (house flies) 	}	<p>adult stages parasitic</p>
<ul style="list-style-type: none"> - Calliphagidae (blow flies) - Sarcophagidae (flesh flies) - Oestridae (bot flies) 	}	<p>larval stages parasitic</p>

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Mosquitoes (Culicidae)


- Most important parasitic arthropods
- >3500 species/subspecies
- Cause severe irritation, blood loss, hypersensitivity
- Vector of serious diseases: malaria, yellow fever, dengue fever, etc
- Transmit diseases to 700M people p.a., 2M die



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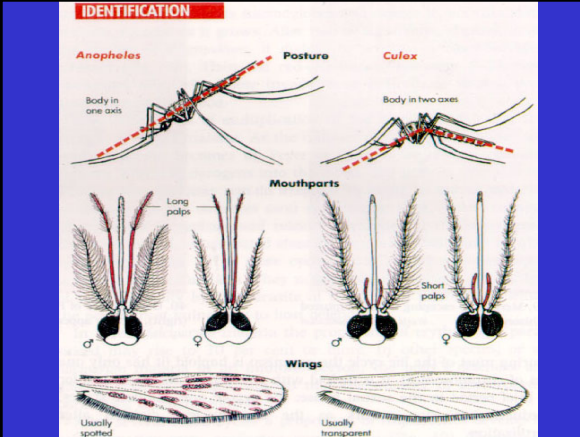
Adults parasitic

Blood-feeders	Disease agents transmitted
<ul style="list-style-type: none"> • Mosquitos (<i>Anopheles</i>, <i>Culex</i>) • Sand flies (<i>Phlebotomus</i>) • Tsetse flies (<i>Glossina</i>) • Black flies (<i>Simulium</i>) • Midges (<i>Culicoides</i>) • Horse flies (<i>Tabanus</i>) • Buffalo flies (<i>Haematobia</i>) 	<ul style="list-style-type: none"> <i>Plasmodium</i> (malaria) <i>Leishmania</i> (kala azar) <i>Trypanosoma</i> (sleeping sickness) <i>Onchocerca</i> (nematode) Arboviruses Retroviruses <i>Stephanofilaria</i> (nematode)



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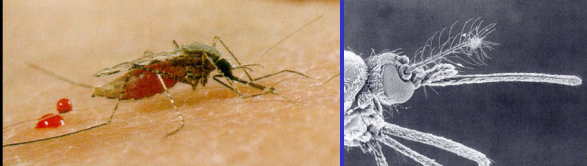
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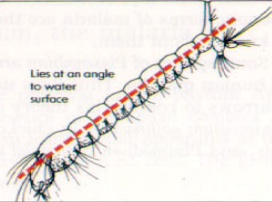
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MOSQUITOES

- adult females suck blood
- vary in host specificity
- attack rates vary (solitary – swarms)
- cause severe irritation, blood loss, hypersensitivity
- eggs/larvae/pupae require water
- transmit range of diseases (protozoan, helminth, viral)




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Anopheles	Culex
<p>Laid singly</p>  <p>Float</p>	<p>Eggs</p>  <p>Laid in rafts: no floats</p>
<p>Larvae</p>	
 <p>Lies parallel to water surface</p>	 <p>Lies at an angle to water surface</p>

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Larvae parasitic (myiasis)

Flies	Tissues
• screw-worm (<i>Chrysomya</i>)	mucous membranes
• blow flies (<i>Lucilia</i>)	body/breecch
• flesh flies (<i>Sarcophaga</i>)	wounds
• skin bot flies (<i>Dermatobia</i>)	skin
• cattle grubs (<i>Hypoderma</i>)	skin
• stomach bots (<i>Gasterophilus</i>)	stomach



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Screw-worm

Old World screw-worm fly (*Chrysomya brezziana*)

- Africa, New Guinea, Indonesia, other parts of Asia
- low host specificity (humans, domestic animals, wildlife)
- adults lay eggs near wounds, abrasions
- larvae invade tissues (cause deep lesions)
- emerge 5-7 days later



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Larvae parasitic

- Myiasis: infestation of skin by developing larvae of flies (maggots)
- Myiasis = fly strike, blowfly strike, fly-blown
- Occur in mammals and birds, including humans, domestic animals & wildlife
- Serious problem for animal industry



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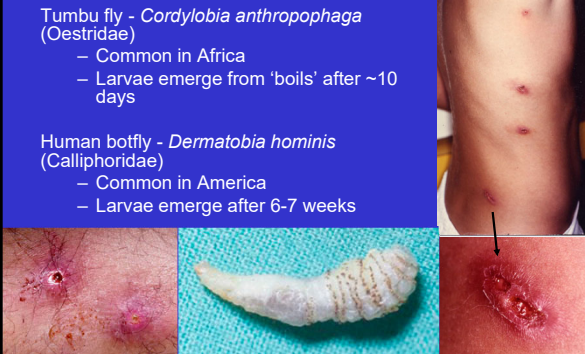
Human myiasis

Tumbu fly - *Cordylobia anthropophaga* (Oestridae)

- Common in Africa
- Larvae emerge from 'boils' after ~10 days

Human botfly - *Dermatobia hominis* (Calliphoridae)

- Common in America
- Larvae emerge after 6-7 weeks



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Treatment

- remove larvae
 - close to surface to breathe through spiracles
 - leave intact for diagnosis
- local palliatives
- antibiotics for secondary infections
- castor oil for intestinal myiasis



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Sheep fly strike

Calliphorinae – primary strike flies (*Lucilia*, *Calliphora*)
 Chrysomyinae – secondary strike flies (*Chrysomya*)

maggots secrete proteolytic enzymes and tear tissues with oral hooks
 differentiated by larval morphology and posterior spiracle arrangement

The diagram shows two long, segmented larval forms at the top. Below them are three pairs of spiracles, each labeled with a species: *Lucilia cuprina* (green bottle fly), *Calliphora stygia* (brown blow fly), and *Chrysomya rufifacies* (hairy maggot blow fly). The spiracles are shown in cross-section, highlighting their different shapes and arrangements.

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Life cycle of Australian sheep blow fly, *Lucilia cuprina*

The diagram is a circular life cycle chart divided into four quadrants:

- Adult phase:** Shows a mature adult fly and an immature adult fly. Duration: 6 - 8 days.
- Sheep phase:** Shows eggs and maggots on a sheep's back. Duration: 8 - 24 hours.
- Soil phase:** Shows pupae and pre-pupae in the soil. Duration: 3 - 4 days.
- Intermediate phase:** Shows pupae in the soil. Duration: 1 - 2 days.

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Life cycle of blowfly

The diagram shows a sheep with a blowfly on its back. The cycle includes:

- Adult flies lay eggs on susceptible part of animal.
- Eggs hatch and larvae penetrate skin.
- Larvae migrate through tissue to back.
- Larvae under skin of back with breathing hole.
- Adult fly lays eggs on floor.
- Larvae fall to ground and pupate in soil.
- Adult fly emerges from pupae.
- Adult flies emerge from pupae.
- Break in soil emerge to hard dark cover pupae.
- Fly larvae falling legs of animal.
- to animal drop to ground and burrow into soil.

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Life cycle of cattle grubs

The diagram shows a cow with a grub on its back. The cycle includes:

- Larvae migrate through tissue to back.
- Larvae under skin of back with breathing hole.
- Adult fly lays eggs on floor.
- Larvae fall to ground and pupate in soil.
- Adult fly emerges from pupae.
- Eggs hatch and larvae penetrate skin.

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Cattle myiasis

- Caused by warble flies (also called bomb flies, bot flies, heel flies, gad flies) (Oestridae)
- Hypoderma lineatum* - common cattle grub
- Hypoderma bovis* - northern cattle grub
- Occurs in the Northern Hemisphere, Africa

The images show various stages of cattle myiasis: a fly on a cow's back, a close-up of a fly on a needle, a close-up of a pupa in the skin, a close-up of a pupa in the soil, and a close-up of a pupa in the soil.

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Life cycle of warble flies

1. A female lays eggs on hairs
2. Eggs hatch & penetrate skin; larvae move up
3. Larvae develop & move further up to back area
4. Larvae emerge & fall on the ground; pupa develop & become adults

The life cycle may take a year!

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Life cycle of bot flies

ADULT FLY lives 7 to 10 days and lays up to 500 eggs

FLY EGGS on hairs 7 to 14 days

BOTS (LARVAE) inside horse 8 to 10 months, from first frost to late spring

ADULT FLY emerges from middle to late summer

PUPAL STAGE on pasture 4 to 8 weeks in early summer

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Life cycle of botfly

Horse licks off hair

Adult fly lays eggs on hair of horse

Larvae (2nd) in stomach

Hard brown pupae in horse will hatch as flies

Larvae crawl out of hair & into soil

Larvae in dung pile

Botfly eggs attached to horse hair

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Wound myiasis

- Old World screw-worm: *Chrysomya brezziana* (Calliphoridae) - Africa, India, SE Asia, New Guinea, not in Australia
- New World screw-worm: *Cochliomyia hominivorax* (Calliphoridae) - Central and South America
- Attack humans, domestic animals, wildlife
- Flies lay eggs near wounds
- Larvae invade wound tissues & cause deep lesions
- Emerge 5-7 days later

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Horse myiasis

- Caused by bot flies, *Gasterophilus spp.* (Oestridae)
- 3 common species: *G. intestinalis*, *G. nasalis*, *G. haemorrhoidalis*
- *Gasterophilus* larvae live in the gastrointestinal tract
- Occurs worldwide

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Treatment

- Remove larvae
 - Close to surface to breathe through spiracles
 - Leave intact for diagnosis
- Local palliatives
- Antibiotics for secondary infections
- Castor oil for intestinal myiasis

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Treatment

- Select resistant breeds of animals
- Seasonal forecasting
 - Prediction models
- Animal management
 - Crutching, tailing, mulesing
- Insecticides
 - Dipping, jetting, spraying
 - Emergence of resistance
 - Environmental concerns



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Control

- treat wounds
- impose quarantine
- habitat destruction
- spraying programmes
- baiting programmes
- mass sterilization campaigns



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Summary

- Huge range of parasitic flies
- Adults parasitic
 - Blood-feeders – blood loss
 - Annoyance
 - Vectors for other diseases
- Larvae parasitic
 - Tissue-feeders - lesions
 - Secondary infections
- Control: a combination of animal management, fly trapping & chemical treatment

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