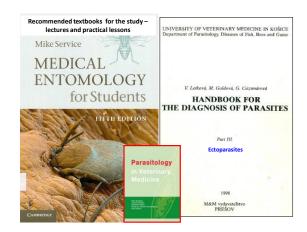
INTRODUCTION TO ARACHNOENTOMOLOGY

Essential morphological features of arthropods, General introduction to subclass ACARI and outline of the important species of ticks in relation to their life cycles, epidemiology, pathogenic significance and importance as vectors of pathogens

(IXODIDAE - hard ticks, ARGASIDAE - soft ticks).



What are ARTHROPODS?

- the name arthropod is derived from two Greek words "arthros" meaning joints, and "podes" meaning feet.

- Phylum Arthropoda vary in size, shape, and habits;
- More than a 3 million arthropod species have been described;



- > ecto- or endoparasites of animals and humans;
- > vectors of pathogens;
- > poisonous animals:
- > household and storage pests

PHYLUM ARTHROPODA INCLUDES

- 3 classes of medical importance:
- 1. CRUSTACEA: cyclops, crabs.





flies, bugs, lice, fleas.





Phylum: ARTHROPODA (Arthropods)

Subphylum: TRILOBITOMORPHA Subphylum: CHELICERA

Class: ARACHNIDA

Subclass: ACARI (mites in the large sense = ticks and mites) Order: IXODIDA (METASTIGMATA) Order: GAMASIDA (MESOSTIGMATA) Order: TROMBIDIFORMES (PROSTIGMATA)

Order: SARCOPTIFORMES (ASTIGMATA)

Order: ORIBATIDA

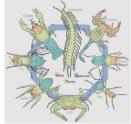
Subphylum: CRUSTACEA Subphylum: TRACHEATA

Class: INSECTA Order: HETEROPTERA (true bugs) Order: PHTHIRAPTERA (lice) Order: DIPTERA (flies) Order: SIPHONAPTERA (fleas)

General Features of Arthropods

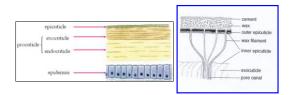
- 1. Segmented bodies
 - (tagmata/tagmatization) divided to three parts: the head, thorax and abdomen.
- Exoskeleton (rigid material chitin) must 2. moult to grow
- Jointed limbs
- Open vascular system dorsal blood vessel
- Haemocoel (haemolymph)
- Ventral nerve cord; various sensory organ Mouthparts with different functions
- Respiratory system present (gills, trachea) or absent (respiration directly through
- Separate sexes (sexual or parthenogenetic

reproduction)



Their body parts and appendage segments are joined by flexible membranes which allow the various parts to move.

Structure of the Exoskeleton



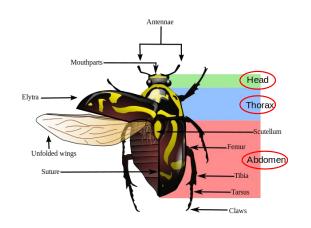
Intermolt condition In preecdysis, old procuticle separates from epidermis, which secretes new epicuticle secretes new epicuticle Molting

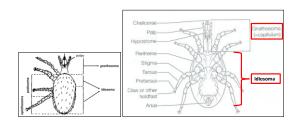
At ecdysis, the old epicuticle and exocuticle are discarded

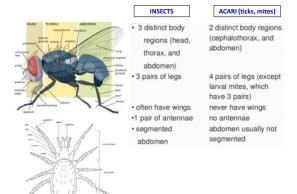
and ecdysis

In postecdysis, new cuticle is stretched and unfolded, and endocuticle is secreted

Moulting







Jointed Appendages

- > Jointed Appendages each segment may have one pair of appendages, such as:
- **≻** legs
- ➤ wings

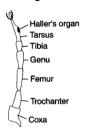


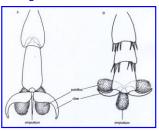




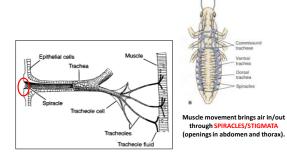
ARTHROPODA – jointed legs

- > arthron joint + podos leg
- > the legs are usually six-segmented





Arthropod Respiratory system – spiracles and gas exchange



Class: ARACHNIDA
Subclass: ACARI

Distribution according localisation of stigmata

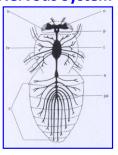
ORDER: IXODIDA (METASTIGMATA)

ORDER: GAMASIDA (MESOSTIGMATA)

ORDER: TROMBIDIFORMES (PROSTIGMATA)

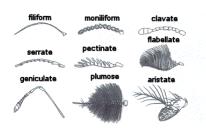
ORDER: SARCOPTIFORMES (ASTIGMATA)

Nervous System



Antennae

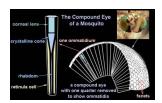
 The sensory receptors of arthropods are usually associated with modifications of the chitinous exoskeleton (seta);



Eyes

- Compound Eyes
 - visual structure withmany lenses
- Simple Eyes
- simple Eyes
 visual structure with one lens for detecting light
- one pair of compound eyes and 3-8 simple eyes





Circulatory System

> Open circulatory system haemolymph

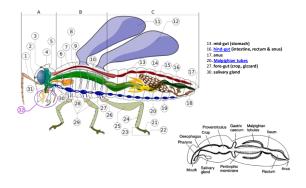
Digestive System

> Complete digestive system with mouth, intestine, and anus



➤ Mouthparts are highly modified;

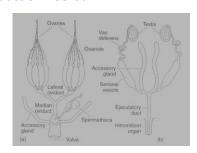
Digestive System



ARTHROPODA – reproduction

- > sexes are separate
- > MATING is usually required for the production of fertile eggs
- ➤ PARTHENOGENESIS production of identical copies of themselves
- > most arthropods lay EGGS
- > some species are ovoviviparous or viviparous -**MAGGOTS**

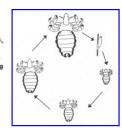
Reproduction – Sexual



Incomplete Metamorphosis (Hemimetabolous)

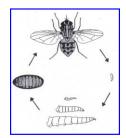
➤ Early developmental stages are very similar to the adults; only the wings and the reproductive structures gradually develop
➤ The immature stages are called nymphs





Complete Metamorphosis (Holometabolous)

- ➤ Each of the developmental stages is structurally and functionally very different
- The egg develops into an immature larva;
 Followed by a transitional stage pupa;
- > Metamorphosis occurs within the pupal exoskeleton, a sexually mature adult



NEAD TORNA ACCIONAL A

3 distinct body regions (head,

thorax, and abdomen) 3 pairs of legs

INSECTS

- often have wings1 pair of antennae
- 1 pair of antennaesegmented

abdomen

ACARI (ticks, mites)

- 2 distinct body regions (cephalothorax, and abdomen)
- 4 pairs of legs (except larval mites, which have 3 pairs) never have wings no antennae abdomen usually not segmented

Class: ARACHNIDA



Introduction to Phylum Arthropoda









Arthropoda

Importance

- > Intermediate hosts for various parasites.
- ➤ **Vectors** for bacteria, viruses, parasites and other pathogens.
- ➤ Direct causal agents of skin diseases. Produce venoms that may be toxic.
- Nuisance pests.

Ectoparasite damage - direct harm

- ➤ BLOOD LOSS
- > MYIASIS
- \succ SKIN INFLAMATION AND PRURITUS
- > TOXIC and ALLERGIC RESPONSES

Ectoparasite damage - indirect harm

- > DISTURBANCE
- > SELF-WOUNDING
- > SOCIAL NUISANCE

Arthropods as a **VECTORS** of **pathogens**:

viruses, bacteria – MECHANICAL VECTOR (passive carrier) protozoa, tapeworms (Cestoda), round worms (Nematoda) - BIOLOGICAL VECTOR undergoes specific stages of their life cycle - development and/or reproduction of pathogen before it becomes infective

	Common Arthropod Vectors and Select Pathogens			
* Arthropods	Vector	Species	Pathogen	Disease
ood-feeding	Black By	Skrukum эрр,	Onchocence volvulus	Onchoorciasis (niver blindness)
	Fina	Xengasylla chegasi	Pickemia typiV	Murine typfius
vectors			Yersina pestis	Plague
而來。亦	Klasing bug	Ystatoma spp.	Тураневона съв	Chagas disease
	LOVER	Pediculus Aurusrus Numanus	Startonelle quintane	Trench lever
(大)			Dovella recurrentis	Religining fever
			Pockettsia prowazelik	Typhus.
	Miler (chapper)	Leptomombidum spp.	Orientia trutsugamushi	Scrub hydrus
		Lipsonymounders sanguineum	Rickettria allari	Dickettninknox
Vertebrates Vertebrates	Mosquito	Aedes sop. Hawrungogus spp.	Yellow Rever whos	Yellow fever
		Anopheies app.	Plasmodium faloparum	Materia
		Culter pipiers	West falle veus	West Nile disease
Nairovirus Filovirus	Sand By	Phietotomos spp.	Lestmans spp.	Leishmanasis
Phlebovirus Arenavirus	Tick:	Avoden spal.	Dorreita spp.	Lyme disease
hobunyavirus Bornavirus Influenza virus		Dermacentor app. and others	Prickettise rickettali	Flocky Mountain sported lever
culovirus Paramyxovirus Lyssavirus Hantavirus	Tueto fy	Crissina spp.	Турмпоноты длиси	African typanosomiasis (sleeping sickness)

Pathogen development in body of vector arthropods



Class: ARACHNIDA

Subclass: ACARI (ticks and mites)

- Acari small mites (0.2-2 mm) + ticks (engorged females up to 30 mm);
- Unsegmented body
- > 4 pairs of legs (nymfa, adult); 3 pair of leg (larva)
- ➤ Mouthparts (pedipalps + chelicerae)- separated from the body = **GNATHOSOMA**
- > Light sensory organs eyes are reduced or missing
- > Tactile and chemical sensors well developed
- ➤ Life cycle: egg larva nymph adults (males, females) moulting
- ightharpoonup Respiration: stigmata (openings) or through cuticle
- > Importance: causative agent of skin diseases and allergies; vectors of pathogens; household and storage pests

Subclass: ACARI (MITES)

Order: IXODIDA (METASTIGMATA) Ixodidae (Amblyoma, Anocentor (Boopi Argasidae (Argas, Carios, Ornithodoros, Order: GAMASIDA (MESOSTIGMATA) Dermanyssidae (*Dermanyssus*, *Liponysson* Macronyssidae (*Ophionyssus*, *Ornithonyss* Order: TROMBIDIFORMES (PROSTIGMATA) Demodecidae (*Demode*x) Cheyletiellidae (*Cheyletiella, Omitocheyletia*) Trombiculidae (*Neotrombicula, Trombicula*) Order: SARCOPTIFORMES (ASTIGMATA)

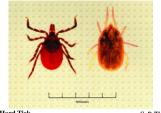
Order: ORIBATIDA
Family: Scheloribatidae (Scheloribates); Oeratozetidae (Trichoribates); Galumnidae (Galumna, Pilogalumna)

Order: IXODIDA (METASTIGMATA) - ticks

> stigmata are posterior of the 4th pair of legs

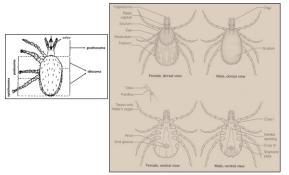
➤ 2 families: Ixodidae (hard ticks) - Amblyoma, Anocentor (Boophilus), Dermacentor, Haemaphysalis, Hyalomma, Ixodes, Rhipicephalus

Argasidae (soft ticks) - Argas, Carios, Ornithodoros, Otobius

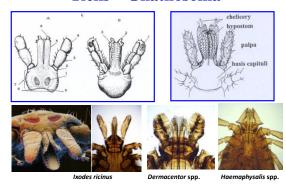


Hard Tick Soft Tick

Ixodidae (hard ticks)



Ticks - Gnathosoma

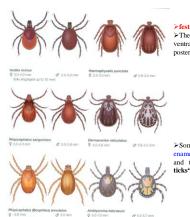


Sensory organs









➤ festoons
➤ The genital opening is in the ventral mid-line and the anus is



>Some ticks have coloured enamel-like areas on the body and these are called "ornate ticks".

According to the number of hosts, the ticks are divided into:



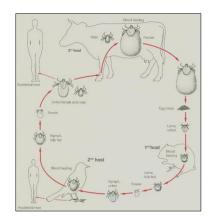
- Three-host (all stages on different hosts (<u>Ixodes, Haemaphysalis, Dermacentor</u>)
- ➤ Two-host (Rhipicephalus, Hyalomma)



➢ One-host (Amblyomma, Boophylus)



Life cycle



Medical Importance of Ticks

- 1. Dermatosis inflammation, itching, swelling at site of bite
- 2. Anaemia can result from heavy infestation
- 3. Otoacariasis auditory canal infestation, poss. secondary infection
- 4. Predispose to myiasis and infection
- 5. Tick paralysis (envenomization)
- 6. Pathogen transmission (virus, rickettsia, bacteria, spirochaete, protozoa, filarial worms)

Factors Accounting for High Vector Potential of Ticks

- 1. Persistent haematophagous feeders
- 2. Relatively slow feeding time allows time for pathogen transfer
- 3. Typically have a wide host range
- 4. Longevity increases chances of acquiring and transmitting a pathogen
- Transovarial, transstadial transmission of some pathogens
- Few natural enemies, highly sclerotized (resistant to environmental stress)
- 7. High reproductive potential up to 18,000 eggs and parthenogenesis in some species

Ixodes ricinus

(wood tick; castor bean tick; common sheep tick)





Ixodes hexagonus (hedgehog tick)







Genus *Haemaphysalis*

- > cca 165 species
- Most occur in Africa, South Asia, western and central Europe
- > H. punctata, H. concinna, H. inermis



Haemaphysalis puncata (red sheep tick)







Genus Rhipicephalus

- > cca 80 species
- > Africa, Europe

Rhipicephalus sanguineus s.s. (brown dog tick, kennel tick)



A: larva (mounted in Hoyer's medium; bar = 400 µm). B: nymph (mounted in Homedium; bar = 0.5 mm). C: female (bar = 1 mm). D: male (bar = 1 mm).

Genus **Dermacentor**

- > cca 35 species in Asia, Europe, Africa, America
- > D. marginatur, D. reticulatus, D. variabilis, D. andersoni,

Dermacentor marginatus (ornate sheep tick)





Dermacentor reticulatus (ornate sheep tick)





Genus Hyalomma

- > 25 species; eyes
- Arid-semiarid regions of Africa, Asia, southern Europe
- H. anatolicum vector of: Theileria annulata, T. equi, T. lestoquardi
- H. marginatum 2-host tick; virus Crimean Congo fever, Babesia occultans, Theileria equi
- ➤ H. aegyptium 3-host tick





Genus Amblyomma

- ➤ 140 species
- ➤ Sub Saharan Africa, America, **not in Europe**
- A. hebraeum, A. variegatum, A. americanum, A. maculatum, ...
- > 3-host species mammals, birds, reptiles, amphibians...



Pathogenesis and clinical signs

≻ Local lesions

- trauma of tick
- various changes:

hyperaemia erythema itching necrosis ulceration

bleeding – inflammation thickening of the skin

formation nodules/granulomas
- complication from secondary infections (myiasis)

➤ Systemic diseases

- non specific toxicosis; specific toxicosis;

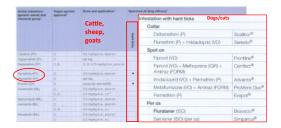
Diagnosis

- > Engorged females easily recognised
- > Species identification
- > Collection from animals, "flagging" from environment



Therapy and control

Acaricides



Family: Argasidae (soft ticks)

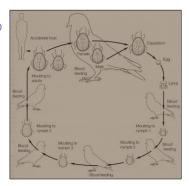
- > Argas, Ornithodoros, Otobius
- > Arid souther regions
- LC: egg-larva-mostly 4-7 (minimum 2, maximum 8) nymphal stages adults
- ➤ Blood feeding lasts 20-30 minutes





Genus Argas

Argas reflexus (pigeon tick)



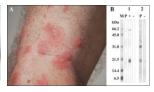
Pathogenesis and clinical signs

- > bite at featherless sites on innert surface of the thighs, under the wings, at neck
- > red-blue, bloodshot wheals form
 > pigeon are: restless at night, devitalised, poor flight performance
- repeated infestation blood loss (up 0.3 ml per blood meal) = life-threatening anaemia = death in nestling and young animals;

- Diagnosis
 ➤ inspection nesting and resting places
- > presence ticks Control

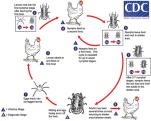
➤ acaricides





Argas persicus (chicken tick)





OTOBIUS

>Otobius megnini (North America, Africa, India) – larvae and nymphs are found inside the ear. Adults are difficult to find as they breed in hidden cracks of barns, fences, and trees.

➤ Only larvae and nymphs infest hosts.





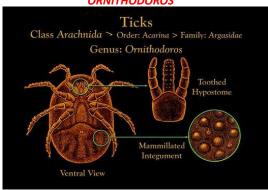








ORNITHODOROS



ORNITHODOROS

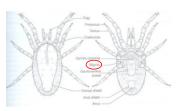
- > ca. 100 species;
- Ornithodoros lahorenia Ornithodoros
- O. moubata
 O. moubata porcinus
- O. Savignyi
- Pathogenicity: blood loss and local reactions; severe irritation and toxicosis paralysis to death of animals (O. savignyi);



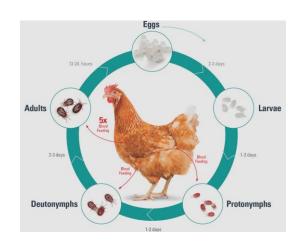


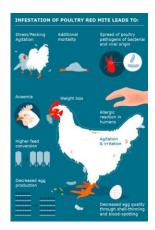


Order: GAMASIDA (MESOSTIGMATA) **Dermanyssus**



Dermanyssus avium Dermanyssus hirundinis Dermanyssus passerinus Dermanyssus chelidonis Dermanyssus sanguineus



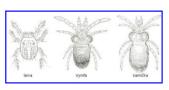


Treatment and control:

➤ palliative — cleaning with boiling water and acaricide
➤ individual birds may be treated with an acaricide
➤ SYNERGIZED PYRETHROIDS

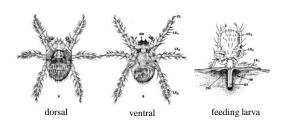
Order: TROMBIDIFORMES (PROSTIGMATA) *Trombicula* (Neotrombicula)

Family: Trombiculidae - chiggers - parasites of terrestrial vertebrates

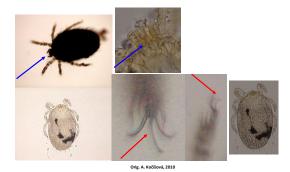




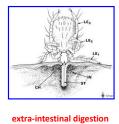
Neotrombicula autumnalis – parasitic larva



MORPHOLOGY

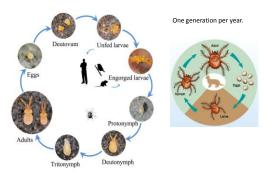


Feeding





Life cyclus



Pathogenesis and clinical signs



Diagnosis

➤ anamnesis

➤ clinical finding





Trombiculosis lesion in Henry's pocket of the ear of a cat.

> microscopic evidence – red larvae confirm diagnosis



Therapy:

➤ fipronil, selamectin – cats

➤ permethrin-pyriproxyfen combination – dogs

Prophylaxis

➤ should avoid known *Trombicula* foci during the season;