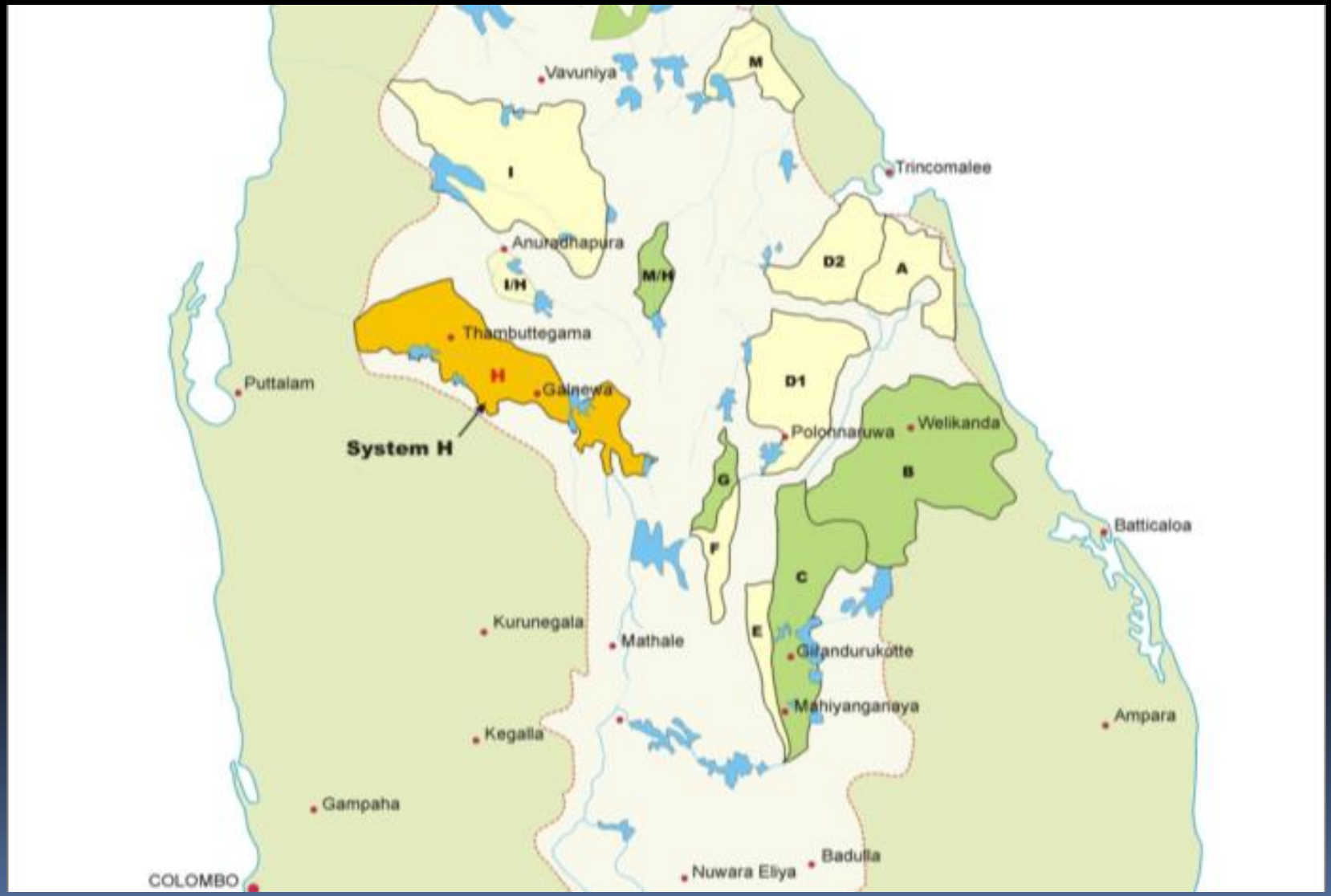
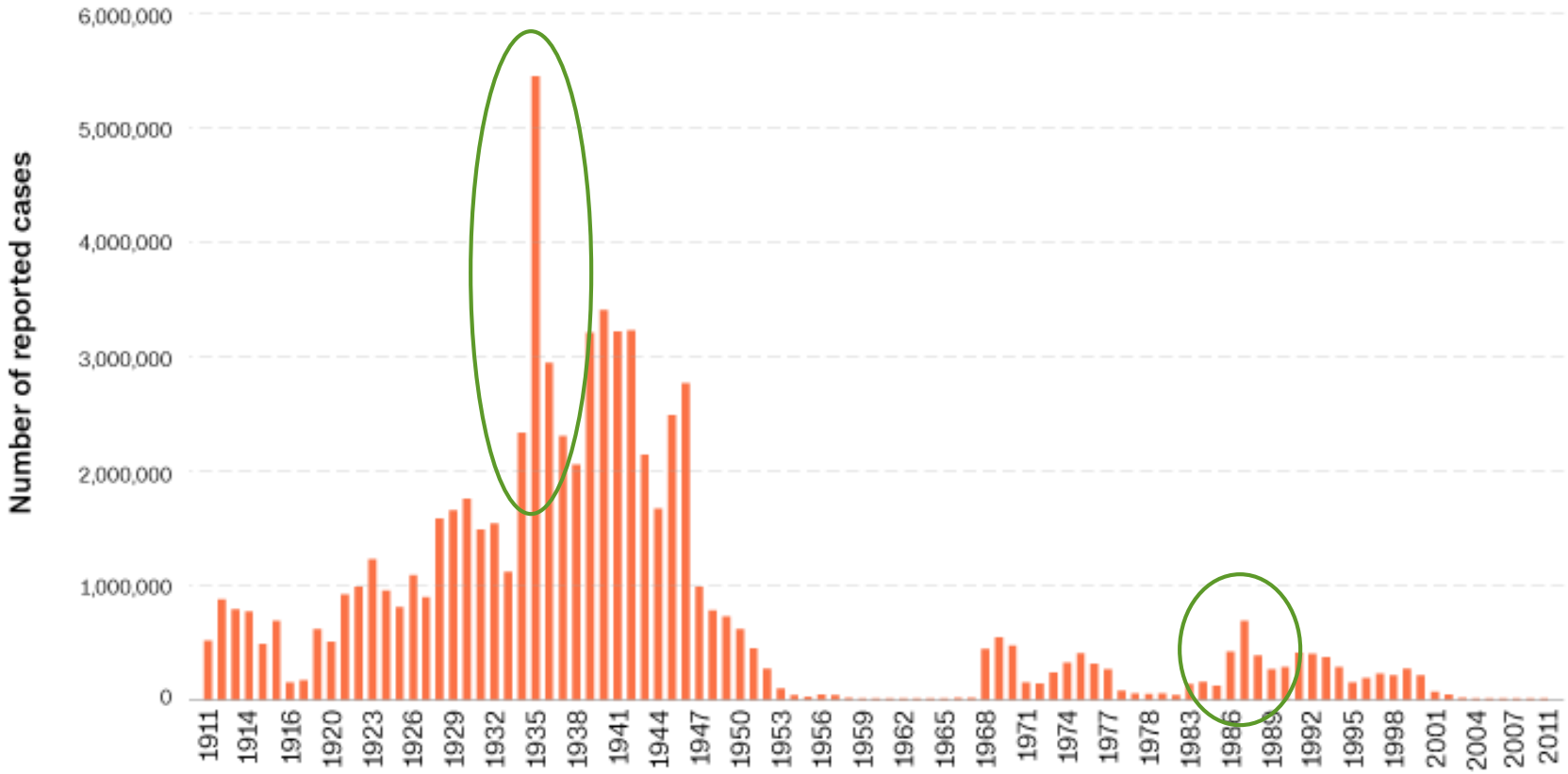
INTRODUCTION TO PARASITES, PARASITIC INFECTIONS AND VECTORS OF DISEASE

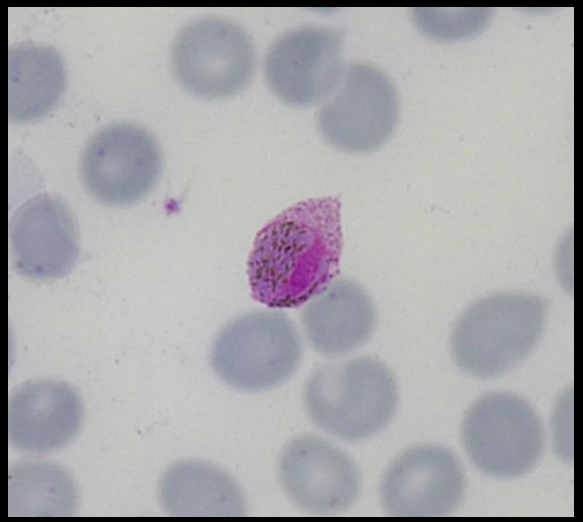
MAHAWELI DEVELOPMENT PROJECT



Malaria infections in Sri-Lanka 1911-2011



Source: Malaria Control and Elimination in Sri Lanka: Documenting Progress and Success Factors in a Conflict Setting; R Abeyasinghe et al.



An. culicifacies

Anopheles mosquito feeding on human

Parasites & parasitism

- **Parasites** live on or in another host species and benefit from this relationship in gaining food and shelter from the host
- **Parasitism** refers to the relationship between the parasite species and the host species
- **Medical Parasitology** is the branch of study that deals with organisms that parasitize humans, and the relationship between humans and these parasites

Host-parasite relationship

- Parasites are usually much smaller than their hosts and may or may not cause obvious disease in the host, but they usually reduce biological fitness
- Successful parasites do not kill their hosts, but often live in / on them for an extended period (months – years)
- Most parasites are highly adapted to their parasitic life style and have evolved complex mechanisms to evade the host's immune response

Types of parasites

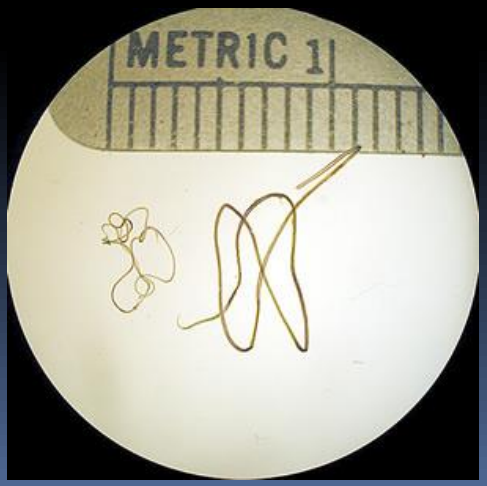
- **Macroparasites:** multi-cellular organisms which are usually visible to the naked eye
  - **Helminths**
  - **Arthropods**
- **Microparasites:** unicellular organisms which are not visible to the naked eye
  - **Nucleated organisms**
    - **Protozoa**
  - Non-nucleated organisms
    - Bacteria, Fungi, Viruses etc

Helminths ("worms")

- Multi-cellular (size: few mm – several m)
- Sexes may be separate, or both in one body
- Life cycle has several stages
  - Egg (= ovum)
  - Larva – usually >1 stage in life cycle
  - Adult – stage with reproductive organs
- Three phyla that cause human disease
  - Nematoda - roundworms
  - Cestoda - flatworms
  - Trematoda - flatworms

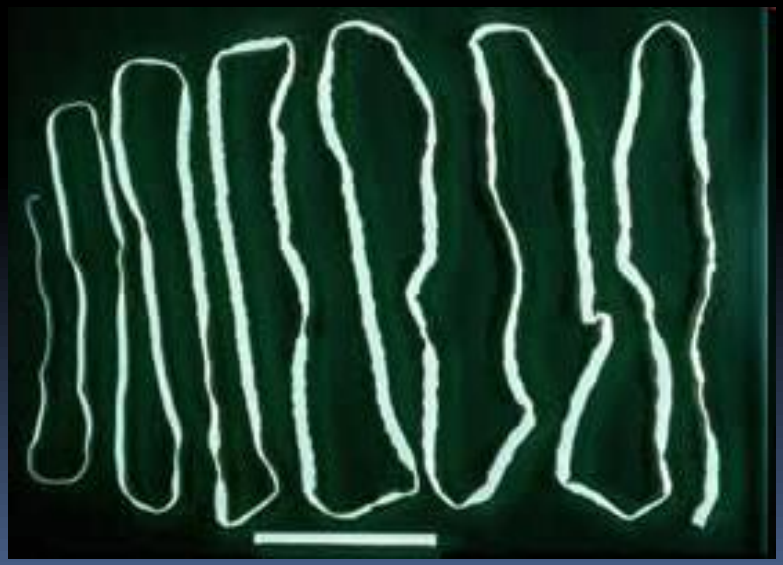
Nematodes

- Cylindrical bodies (i.e., roundworms)
- Separate male and female worms
- Important human parasites include intestinal nematodes and filarial nematodes
- E.g. large roundworms, hookworms, lymphatic filarial worms



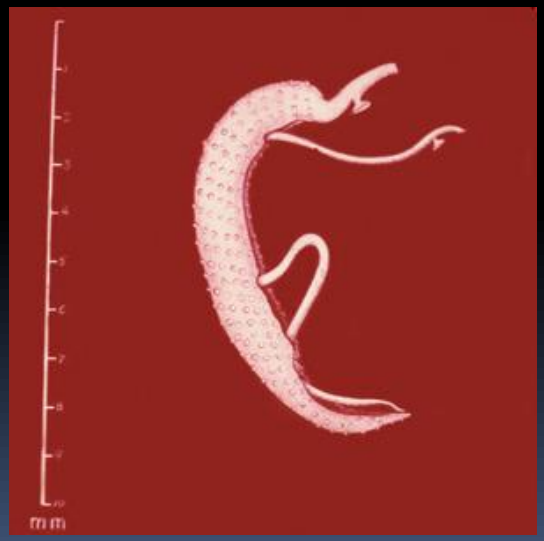
Cestodes (flatworms)

- Flat, segmented bodies
- Adult worm has both sexual organs in each segment
- E.g. beef tape worm, pork tape worm



Trematodes

- Flat, leaf-like bodies
- Sexes may be separate (schistosomes) or in one body (other trematodes)



Arthropods

- Invertebrates with an external skeleton, segmented body and jointed appendages
- Important as causative agents of disease as well as vectors of viruses, bacteria, protozoa and helminths
- Include both insects (mosquitoes, flies, fleas, lice) and arachnids (ticks and mites)

Arthropods as causative agents of disease

- Insects

- Mites

Arthropods as vectors of disease

- Vectors carry the disease agent (viruses, bacteria, protozoa, helminths) from one host to another

- Insects:

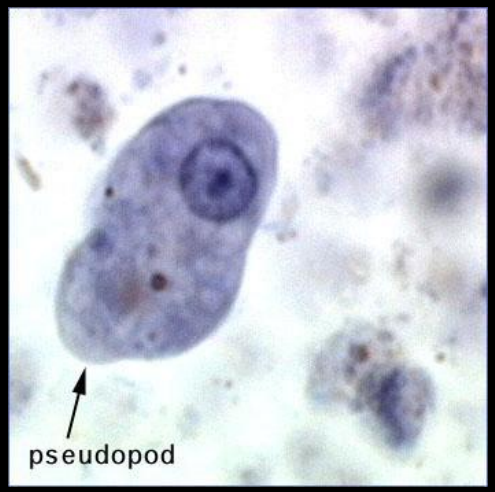
Arthropods as vectors of disease

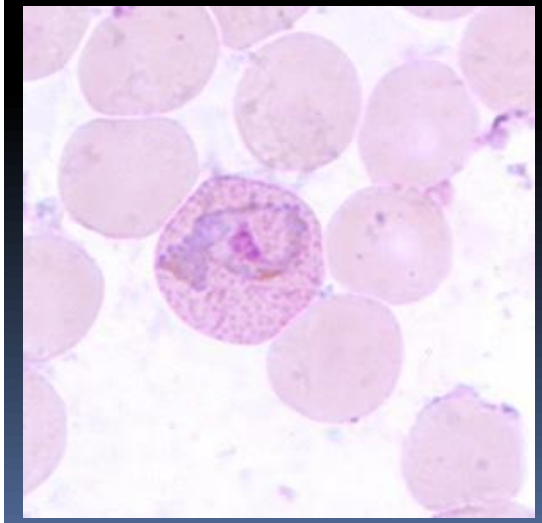
- Ticks

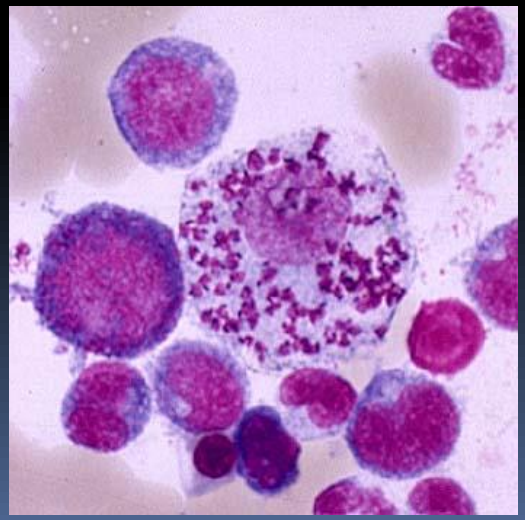
Mites

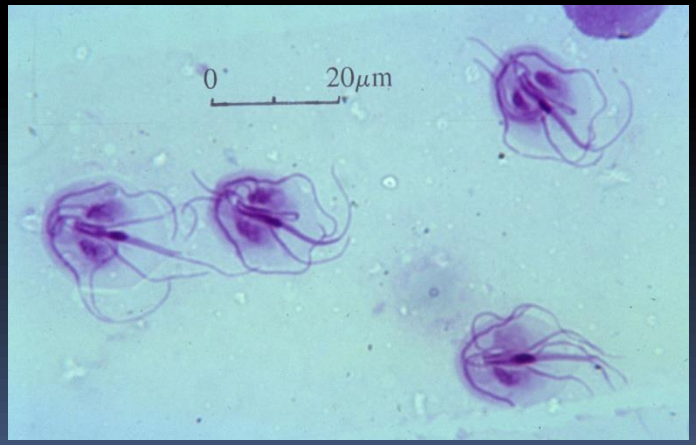
Protozoa (eukaryotes)

- Extracellular / intracellular
- Amoebae / flagellates / coccidia









Main aspects of study

- With regard to parasites and infections caused by them:
  - appearance of parasites (morphology)
  - life cycle and transmission
  - geographical distribution, epidemiology
  - clinical features, pathogenesis
  - laboratory diagnosis
  - treatment
  - prevention and control

- With regard to vectors:
  - Appearance
  - Breeding habits, life cycle
  - Disease transmission
  - Control

Life cycle of parasites

- Often complex, with several **different morphological stages**, E.g. adults, ova, larva; trophozoites, cysts
- Increase in numbers may be through **asexual** (protozoa only) **or sexual reproduction** (protozoa, helminths, arthropods)
- Completion of the life cycle may require **more than one host**
  - Definitive host / intermediate host
  - Vectors
- **Natural habitat** most often in the intestines of the host, but may also be in blood, visceral organs, or other tissues

Transmission of parasites

- Describes how a parasite gets from one host to another
- Several different modes of transmission of parasites
  - Direct person-to-person contact
  - Indirectly through water, food, fomites, soil,
  - Vector-borne
- Transmission often requires the parasite to spend long periods in the external environment
  - climate dependent - many parasitic infections are confined to **the tropics**
  - Associated with poor housing, sanitation and hygiene – more common in **developing countries**
  - **Geographical distribution is important**

Laboratory diagnosis of parasitic infections

- Only means of confirming a clinical diagnosis
- Often requires visualization of parasite with naked eye or through a microscope (parasitological diagnosis)
- Samples for examination include blood, faeces, urine, tissue biopsies, swabs
- Other diagnostic techniques include
  - **Immunological** (serological) – demonstration of parasite antigens or parasite-specific antibodies
  - **Molecular** – demonstration of parasite DNA in specimens from host
- **Radiological diagnosis** may be helpful, but is rarely confirmatory

Some frequently used terms

- *Endoparasite*: lives inside the host
- *Ectoparasite*: lives on surface (skin) of host

- *Obligatory parasite*: can live only in a parasitic form
- *Facultative parasite:* may live in a free-living form or as a parasite

- *Pathogens*: organisms that are known to cause disease in the host
- *Commensals*: organisms that are not known to cause disease in the host

Frequently used terms 2

- *Host:* animal (vertebrate or invertebrate) in which the parasite lives
- *Definitive host*: host in which the parasite completes the sexual stage of its life cycle
- *Intermediate host*: host in which the parasite completes the asexual stages of its life cycle
- *Reservoir host*: infected animals that act as a source of infection for humans

Frequently used terms 3

- *Vectors*: invertebrate animals (usually arthropods) that carry infection from one host to another
- *Biological vectors*: vectors in which the parasite multiplies or develops
- *Mechanical vectors*: vectors in which the parasite does not multiply or develop from one form to another

Frequently used terms 3

- *Zoonoses*: infections that are naturally transmitted between humans and other vertebrate animals

- *Opportunistic infections*: infections that cause disease only in patients with defective immune response

Writing parasite names

- Scientific names have 2 components: genus (starts with Capital letter) + species (starts with simple letter)

- Write in full when first mentioned; Genus name can be abbreviated to first letter when mentioned subsequently

E.g. *Plasmodium falciparum* when first mentioned,
then *P. falciparum*

Scientific names are printed in *italics*
Underlined when written by hand

Get the spelling right!

Recommended reading

- Medical Parasitology by Muller & Baker
- Basic Clinical Parasitology by Brown & Neva
- Atlas of Tropical Medicine and Parasitology by Peters & Gilles

- www.cdc.gov/parasites