

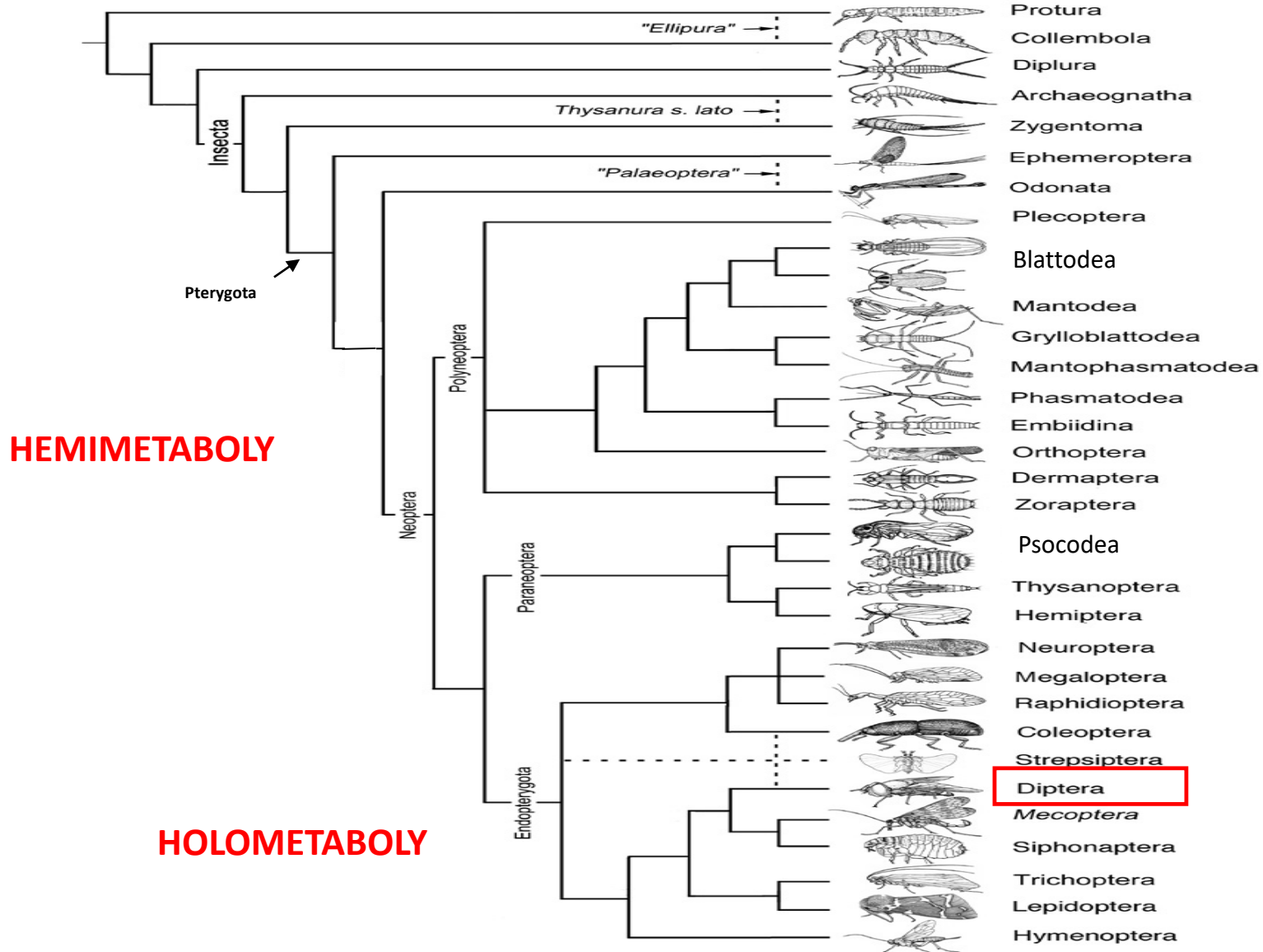


MEDICAL AND VETERINARY ENTOMOLOGY

DIPTERA

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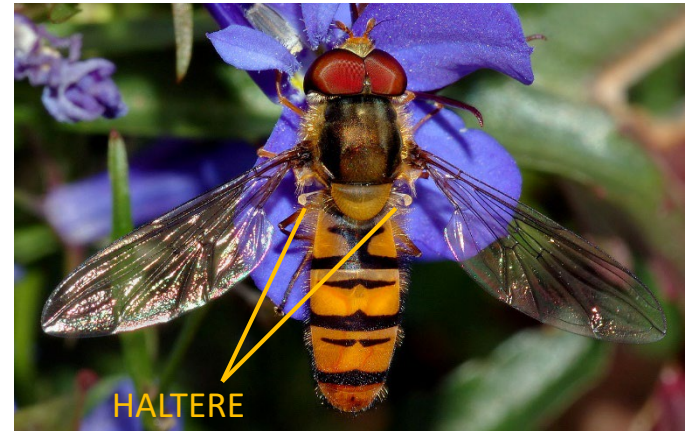
Medically significant Arthropoda - Insecta



Order Diptera – Flies



- One of the largest orders in terms of number of species (> 160,000), morphological and ecological diversity
- 1 pair of wings and 1 pair of halteres
- Holometabolous with aquatic, semi-aquatic and terrestrial larvae
- Annually, about 370 million people are infected with dengue fever, 270 million people with malaria, 90 million with lymphatic filariasis, 17 million with onchocerciasis and 12 million with leishmaniasis - a total of 3.5 billion people are at risk of contracting one of the dipteran-borne diseases



Order Diptera – Flies



- Several hundred species cause health and veterinary problems (from > 15 families)
- Very diverse ecological habitats
- The most important disease vectors are species that feed on blood
- Three modes of transmission or cause of disease
 - 1) Vectors involved in mechanical transmission of pathogens
 - 2) Vectors involved in the biological transmission of pathogens (bacteria, protozoa, viruses) and nematods
 - 3) Species that attack living tissue (Myiasis - infestation with fly larvae)



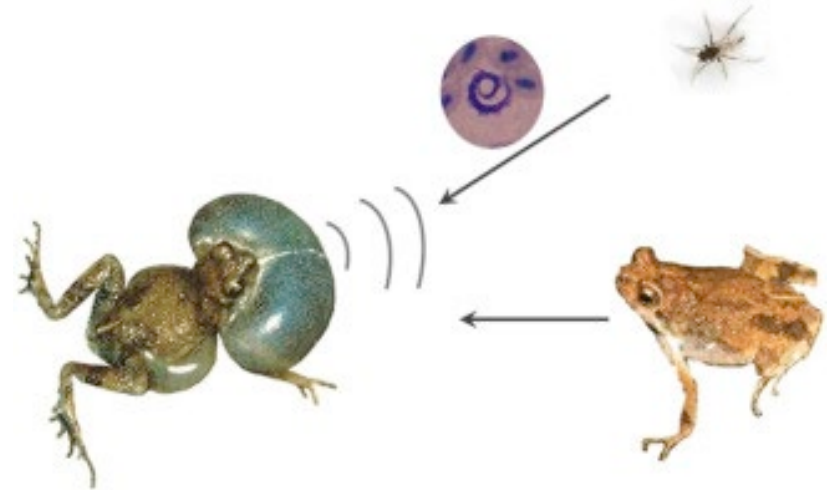
Order Diptera – Flies

- Families of Diptera of minor medical and veterinary importance
 - **Bibionidae** – sometimes a large number of emerging individuals are present - impact on visibility when driving
 - **Sciaridae** - if adults are eaten in large quantities it can lead to death in animals
 - **Chaoboridae ("Phantom Flies")** - can be a nuisance during mass emergences (increasingly rare)



Order Diptera – Flies

- Families of Diptera of minor medical and veterinary importance
 - **Corethrellidae (Frog gnats)** - only one genus (*Corethrella*) whose females suck the blood of most frogs (amphibians) and only ♂ because they use their voice to locate them
 - They transmit *Trypanosoma wirthi* and *T. tungarae*, which was recorded only in ♂, given that they do not feed on the blood of females



Order Diptera – Flies

- Families of Diptera of minor medical and veterinary importance
 - **Chironomidae (Non-biting midges)** – In the case of synchronized emergence of certain species (e.g. the Great Lakes in Africa), allergies can occur due to the presence of hemoglobin in the air, also in people who work with larvae
 - "Potential transmission of *Vibrio cholerae* (causing agent of cholera) between different water bodies"
 - Potential nuisance for people, driving cars



Order Diptera – Flies

- Families of Diptera of minor medical and veterinary importance
 - **Rhagionidae** – genera *Symphoromyia* in North America and *Spaniopsis* in Australia suck blood - they attack people, cattle, deer, most often around the head, painful bites - they do not transmit diseases
 - **Athericidae** – all hematophagous in Europe, species outside Europe are mostly predators – they attack humans, livestock, but also cold-blooded vertebrates





Order Diptera – Flies

- Families of Diptera of minor medical and veterinary importance
 - **Stratiomyidae** – *Hermetia illucens* – can be numerous in the larval stages in sewage systems, which can cause blockages - if the larvae are eaten, they can lead to intestinal pseudomyiasis
 - **Phoridae** – the most important medical species is *Megaselia scalaris*, eggs are laid in fruits, vegetables, organic matter - sporadic cases of facultative myiasis in humans documented in different parts of the world (cutaneous, pneumonic, nasal, gastrointestinal, urogenital and ophthalmic myiasis), are also related to decaying bodies, often a problem in mausoleums and morgues - *Conicera tibialis* "coffin fly"



Order Diptera – Flies

- Families of Diptera of minor medical and veterinary importance
 - **Syrphidae** – common in sewage lagoons, larvae of the *Eristalis tenax* can sometimes cause enteric pseudomyiasis, gastrointestinal or urogenital pseudomyiasis



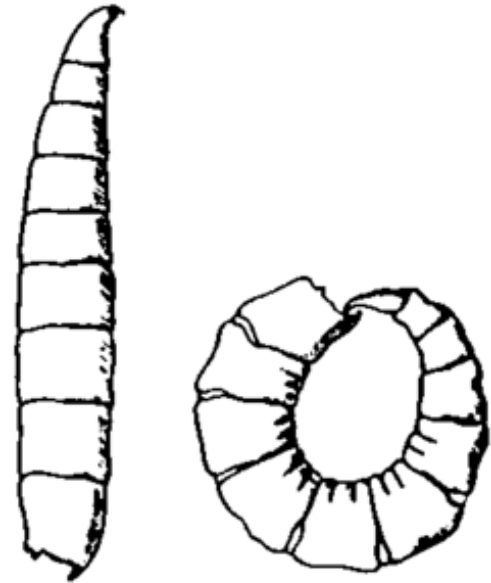
Order Diptera – Flies



- Families of Diptera of minor medical and veterinary importance
 - **Piophilidae** – The cosmopolitan species *Piophilidae casei* is a food pest, especially on cheeses and hams (prosciutto) - the name comes from the possibility of catapulting in the shape of the letter O where the larvae with its jaws holds on to the anal papilla
 - They cause numerous cases of gastrointestinal pseudomiasis
 - Larvae can often colonize corpses, especially in situations where the flies of the families Calliphoridae and Sarcophagidae cannot reach



Piophilidae casei

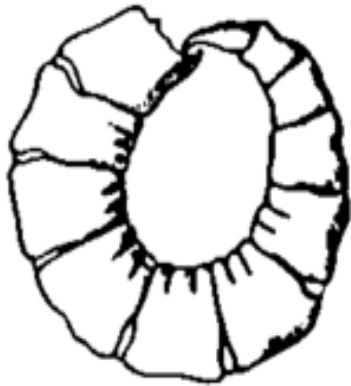


Order Diptera – Flies

- Families of Diptera of minor medical and veterinary importance
 - **Piophilidae** – cosmopolitan species *Piophilidae casei* - Casu Marzu cheese - sheep's cheese from Sardinia - the most dangerous cheese in the world (illegal?)



Piophilidae casei ličinka





Order Diptera – Flies

- Families of Diptera of minor medical and veterinary importance
 - **Drosophilidae** – the most common species used in genetic research is *Drosophila melanogaster*, of no medical significance, while the species *Drosophila repleta*, which reproduces in animal feces, can transmit pathogens by mechanical transmission
 - ♂ *Phortica variegata* species feed on ocular secretions and are vectors of *Thelazia callipaeda* in Europe - **the only known transmission of the pathogen to vertebrates by a male insect**
 - Accidental intestinal pseudomyiasis in humans by *Drosophila funebris*





Order Diptera – Flies

- Families of Diptera of minor medical and veterinary importance
 - **Chloropidae** – The genera *Liohippelates* (North and South America) and *Siphunculina* (Asia) - cause disturbances because they can be present in large numbers and fly around the heads of people and animals, the larvae develop in decaying organic matter, and by mechanical transmission they transmit some pathogens such as bacteria *Treponema pallidum pertenuis* – causes skin ulcers
 - Conjunctivitis - while they are present in large numbers, significantly more conjunctivitis



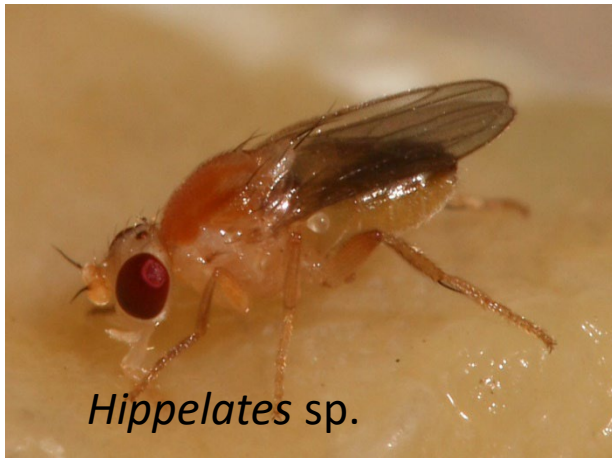
Treponema pallidum pertenuis





Order Diptera – Flies

- Families of Diptera of minor medical and veterinary importance
 - **Chloropidae**
 - Brazilian purple fever – a disease caused by *Haemophilus influenzae* biotype *aegyptius*, which starts as conjunctivitis, the bacterial vector is *Liohippelates puruanus* and *Hippelates neoproboscideus*
 - A child disease with a very high mortality rate (over 70% with the use of antibiotics, the most common reason being the late start of treatment due to not recognizing the disease)





Order Diptera – Flies

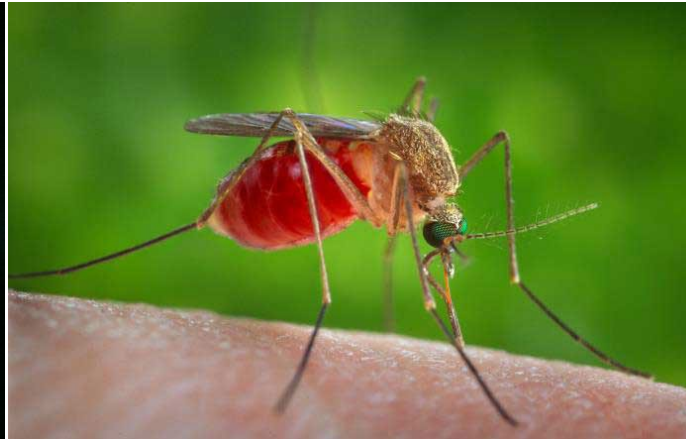
- Three modes of transmission or cause of disease
 - 1) Vectors involved in mechanical transmission of pathogens
 - 2) Vectors involved in the biological transmission of pathogens (bacteria, protozoa, viruses) and forms
 - 3) Species that attack living tissue (Myiasis - infestation with fly larvae)
- **Muscidae** (*Musca domestica* and relatives) and **Calliphoridae** - the diseases they transmit are most often related to the digestive system through drinking or food intake (eg *Vibrio cholerae*, *Salmonella*, *E. coli*, *Shigella*, *Entamoeba histolytica*, ...)
- A problem in the egg production industry - dots from feeding and faeces on eggs



Order Diptera – Flies



- Three modes of transmission or cause of disease
 - 1) Vectors involved in mechanical transmission of pathogens
 - 2) Vectors involved in the biological transmission of pathogens (bacteria, protozoa, viruses) and forms
 - 3) Species that attack living tissue (Myiasis - infestation with fly larvae)



- Malaria, Leishmania, Bartonellosis, Papatachi fever, Dengue fever, Yellow fever, Zika virus, West Nile virus, Encephalitis viruses, African sleeping sickness, Filariasis, etc....



Order Diptera – Flies

- **Psychodidae (Moth flies or sand flies)**
 - Small Diptera (2-4 mm), hairy flies with hairy wings, without cross veins (6 subfamilies - only Subfamilies Sycoracinae and Phlebotominae have stinging organs)
 - Most species do not feed on blood and do not transmit diseases and live in very clean habitats, while the species of the subfamily Phlebotominae are of medical and veterinary importance - the genera *Phlebotomus* (Old World) and *Lutzomyia* (Americas)
 - One of the oldest families of dipterans (even from the Triassic), over 200 million years old





Order Diptera – Flies

- **Psychodidae (Moth flies or sand flies)**
 - Subfamily Psychodinae - The cosmopolitan genera *Clogmia* and *Psychoda* can occur in large numbers (larvae) in sewage plants and septic tanks as the larvae feed on organic matter
 - They also come in sewer and water pipes and toilets
 - Myiasis by larvae in the urogenital, intestinal and nasopharyngeal tract is very rare



Clogmia albipunctata



Order Diptera – Flies

- **Psychodidae (Moth flies or sand flies)**
 - Subfamily Sycorinae – *Sycorax silacea* vector of filariae *Icosiella neglecta* in frogs (*Rana esculenta*), other species also feed on the blood of frogs



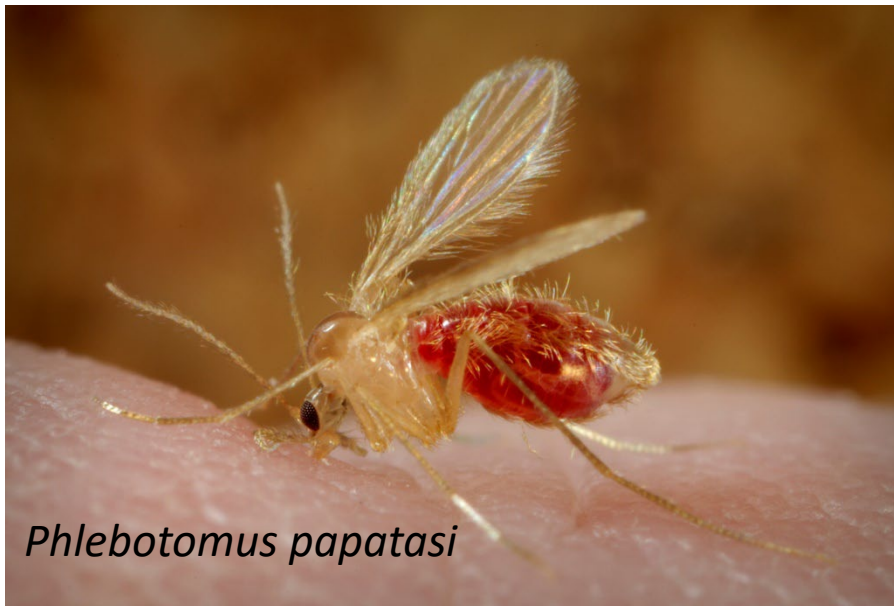
Sycorax silacea



Rana esculenta

Order Diptera – Flies

- **Psychodidae (Moth flies or sand flies)**
 - Subfamily Phlebotominae - some species are endophilic (live near humans, in homes, e.g. *Lutzomyia verrucarum* and *Phlebotomus papatasi*), and some are exophilic (do not live near humans, e.g. *Lutzomyia trapidoi* and *Phlebotomus perniciosus*)
 - Most species do not have a single host to feed on, but some species do (e.g. *Lutzomyia vespertilionis* feeds exclusively on bats)





Order Diptera – Flies

- **Psychodidae (Moth flies or sand flies)**
 - Subfamily Phlebotominae - females require a blood meal in order to develop eggs (**ANAUTOGENY**), bite more than once, bites are very itchy
 - Larvae develop in manure, sewage, places with large accumulations of organic waste, leaf litter, under stones, etc.
 - Some species are anthropophagous, and some are zoophagous, and some, depending on the conditions, can be both



Lutzomyia longipalpis



Order Diptera – Flies

- Psychodidae (Moth flies or sand flies)
 - Subfamily Phlebotominae – **Vesicular stomatitis** – is caused by **Vesiculovirus**
 - An important pathogen in livestock, and then occasionally in humans
 - Symptoms are fever, temperature and muscle pain, pharyngitis, lesions inside the mouth area, cervical adenopathy (swelling of the glands in the neck area) - it goes away on its own
 - In North and Latin America - in people who have relations with cattle, because cattle most often get sick
 - Vectors are *Lutzomyia shannoni* and *Lu. trapidoi* in North and Latin America





Order Diptera – Flies

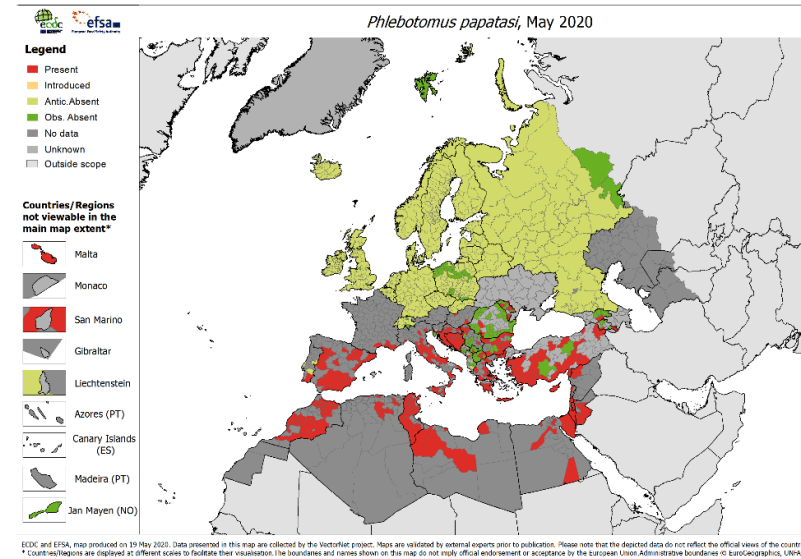
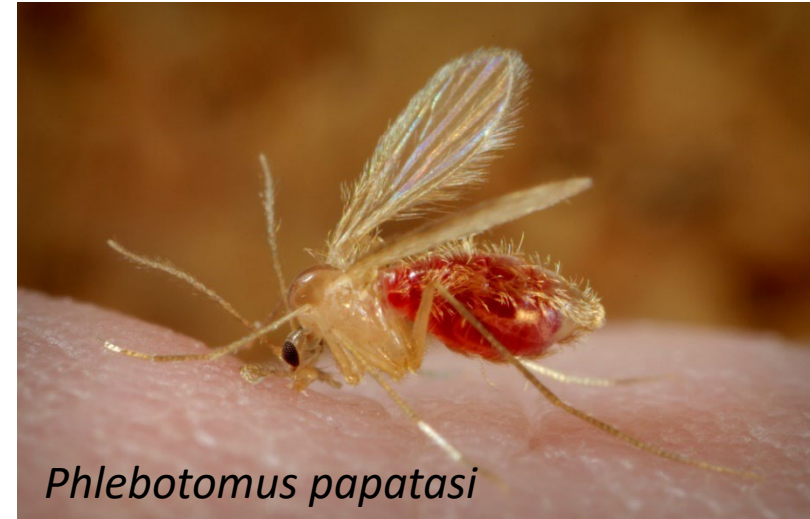
- **Psychodidae (Moth flies or sand flies)**
 - Subfamily Phlebotominae – **Chandipura virus disease** – also caused by **Vesiculovirus** (other species)
 - The virus was first isolated in 1965 in India - it is transmitted by unidentified species of *Phlebotomus* spp. and *Sergentomyia* spp.
 - Although the virus has been isolated in several different countries in Asia and Africa, the only clinical cases are in India, primarily affecting children
 - Symptoms of the disease are fever, disorientation, convulsions, vomiting, diarrhea and encephalitis, and eventually coma and death (mortality in children 56%)
 - Potential future outbreaks and spread outside India



Order Diptera – Flies



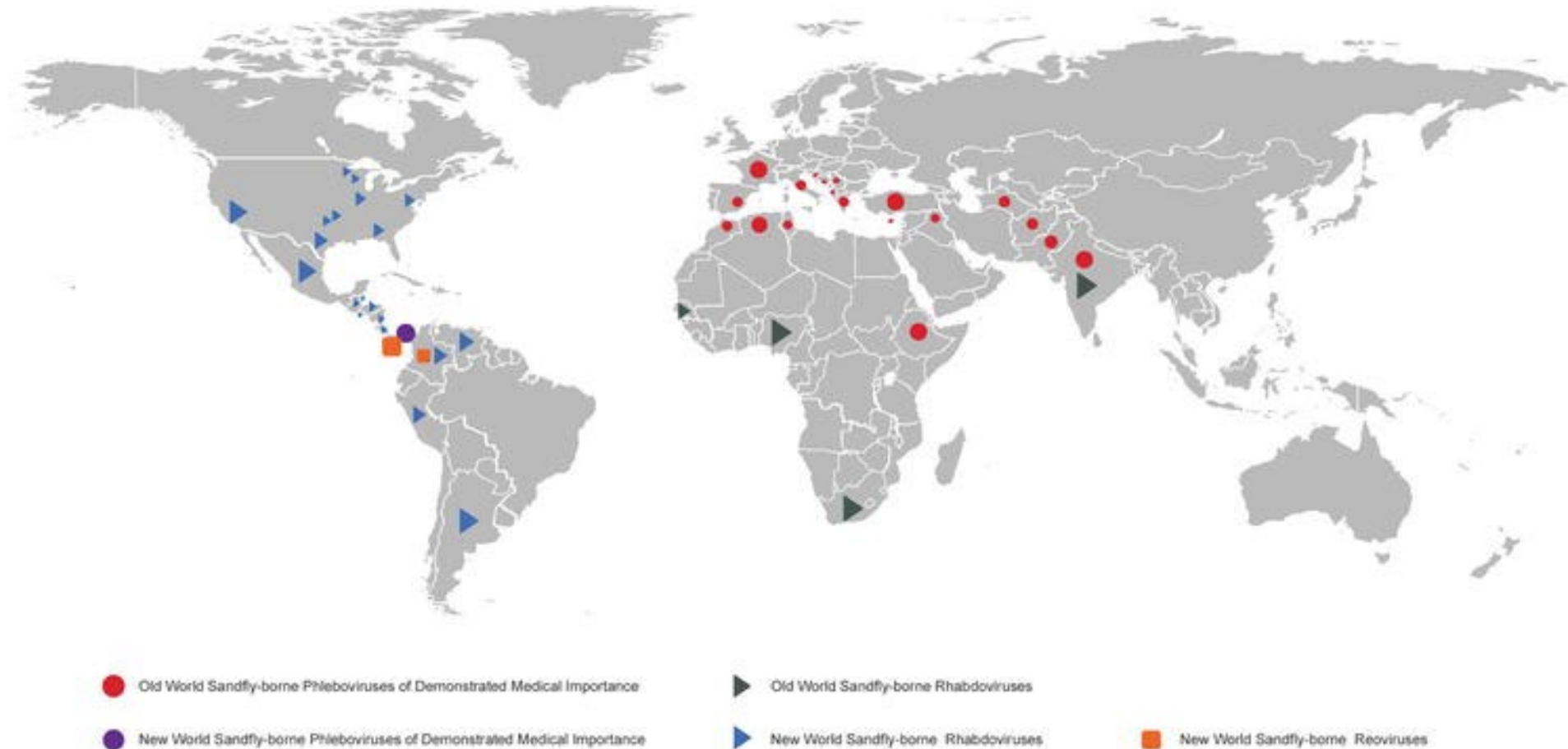
- **Psychodidae (Moth flies or sand flies)**
 - Subfamily Phlebotominae – **Pappatachi fever** - caused by viruses from the genus **Phlebovirus** (most viruses of this genus are transmitted by dwarves, only some by ticks and mosquitoes)
 - One of the first identified arboviruses at the end of the 19th century.
 - Tested as a potential bioterrorism virus
 - Usually the disease lasts about 3 days, it is not fatal and goes away by itself, it starts with headache, fever, nausea and weakness and pains in the body and suddenly everything stops - only Naples strains can cause encephalitis
 - Transmitted by multiple species



ECCDC and EFSA, map produced on 19 May 2020. Data presented in this map are collected by the VectorNet project. Maps are validated by external experts prior to publication. Please note that the depicted data do not reflect the official views of the countries.
* Countries/regions are displayed at different scales to facilitate their visualisation. The boundaries and names shown on this map do not imply official endorsement or acceptance by the European Union. Administrative boundaries © EuroGeographics, UNWTO.

Order Diptera – Flies

- Psychodidae (Moth flies or sand flies)
 - Subfamily Phlebotominae



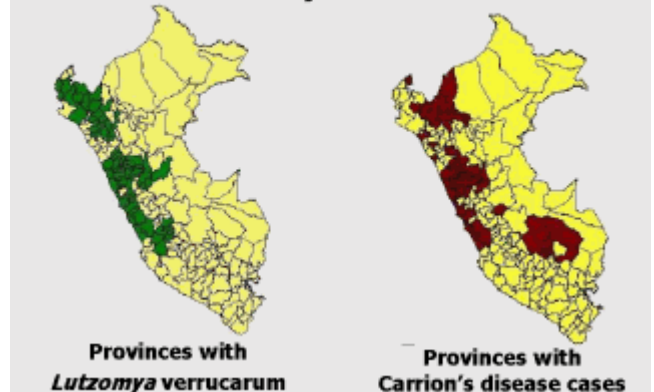
Order Diptera – Flies



- **Psychodidae (Moth flies or sand flies)**
 - Subfamily Phlebotominae – **Bartonellosis (Carrion disease)** – caused by *Bartonella bacilliformis* – two clinical forms **Oroya fever** and **Peruvian wart**
 - **2 clinical forms: 1. Oroya fever** is characterized by fever, headache, muscle and joint pain, enlarged lymph nodes and severe anemia - without treatment, mortality ranges between 10 and 90%, the precursor can be Peruvian warts or asymptomatic infection, and between it can take months
 - **2. Peruvian wart** starts with pain in the muscles and joints and many small nodules all over the body, but mostly on the extremities, it can last for years



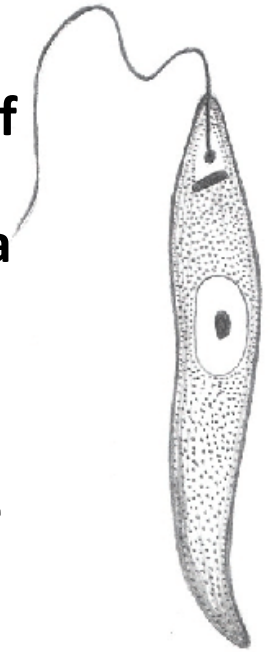
Distribution of Carrion's disease cases and *Lutzomyia verrucarum*



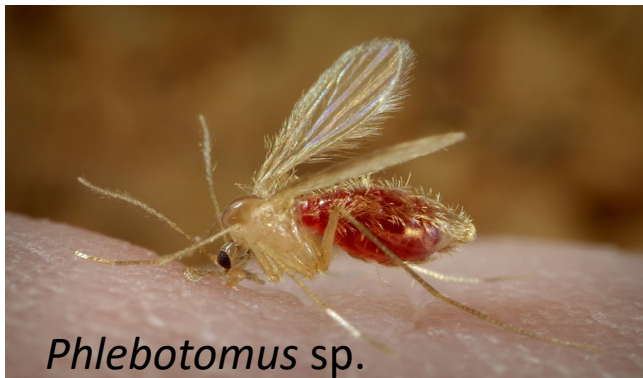
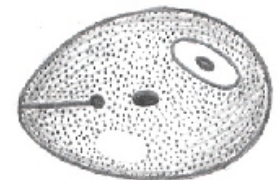


Order Diptera – Flies

- **Psychodidae (Moth flies or sand flies)**
 - Subfamily Phlebotominae - **Leishmaniasis** - a complex of diseases transmitted by sand flies in subtropical and tropical areas of North and South America, Europe, Asia and Africa
 - It is caused by phagotrophic protists of the genus ***Leishmania* spp.** (at least 20 species) members of the order Trypanosomatida - it has two forms Promastigote and Amastigote
 - Transmitted by representatives of the genus ***Phlebotomus* spp.** in the Old World and representatives of the genus ***Lutzomyia* spp.** in the New World



Promastigote

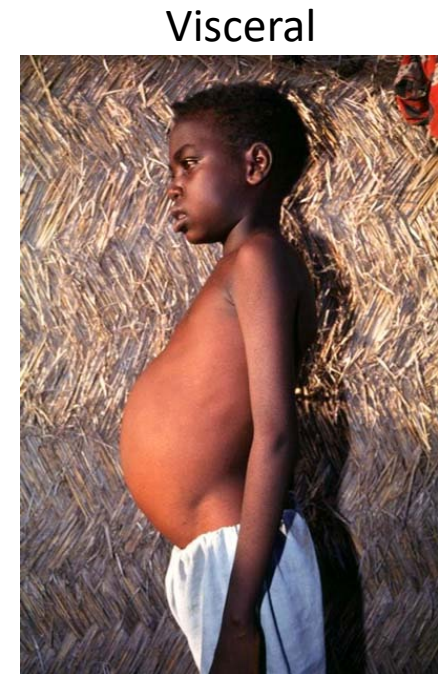
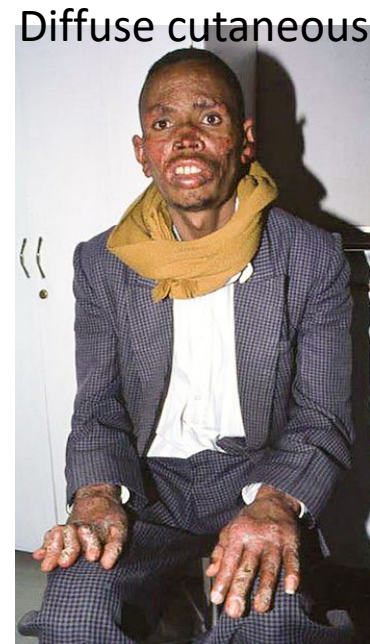
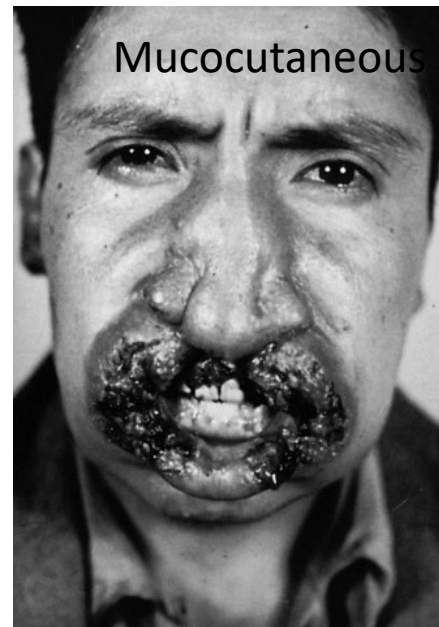
*Phlebotomus* sp.*Lutzomyia* sp.

Amastigote



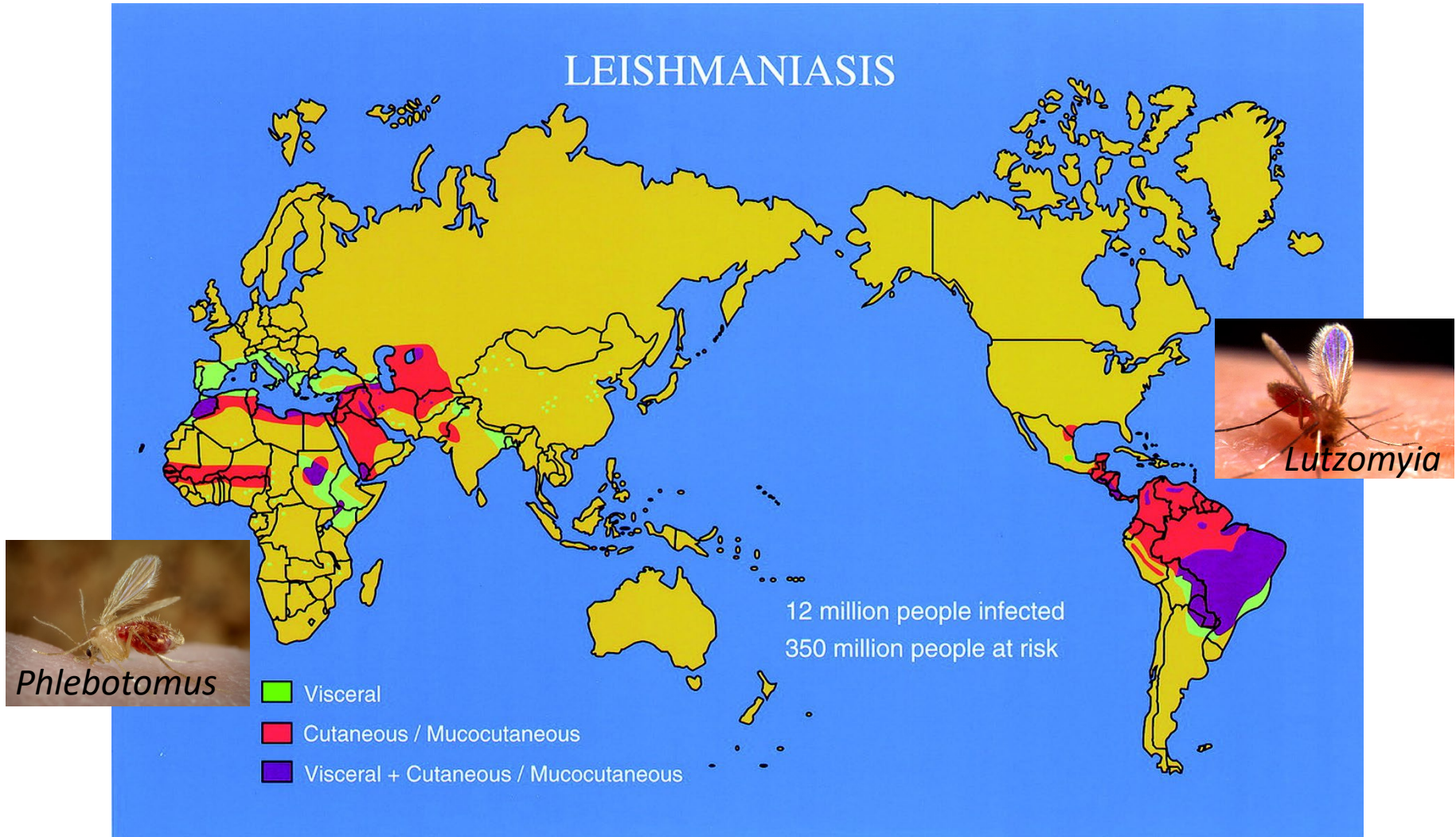
Order Diptera – Flies

- **Psychodidae (Moth flies or sand flies)**
 - Subfamily Phlebotominae – **Leishmaniasis**
 - A polymorphic disease with a whole gradient of symptoms that are grouped into three clinical forms: cutaneous (skin), mucocutaneous (skin-mucosal) and visceral leishmaniasis (attacking the abdominal organs)
 - Common zoonosis, and reservoirs for *Leishmania* species are: humans, dogs, rodents



Order Diptera – Flies

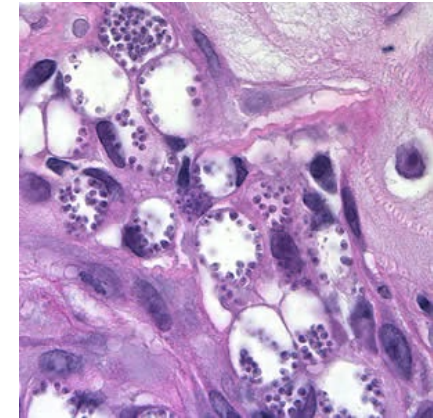
- Psychodidae (Moth flies or sand flies)
 - Subfamily Phlebotominae – **Leishmaniasis**



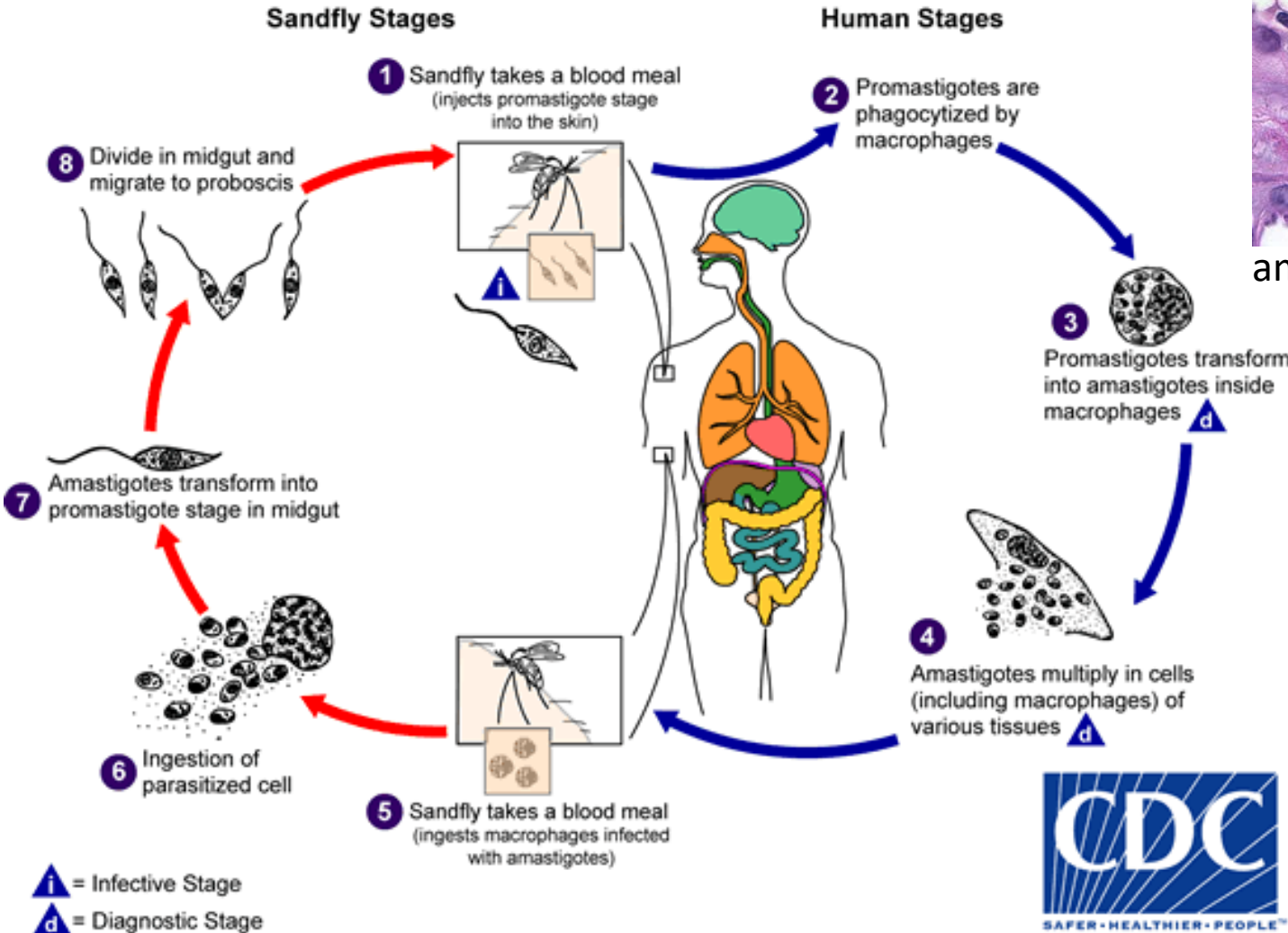


Order Diptera – Flies

- Psychodidae (Moth flies or sand flies)
 - Subfamily Phlebotominae – **Leishmaniasis**



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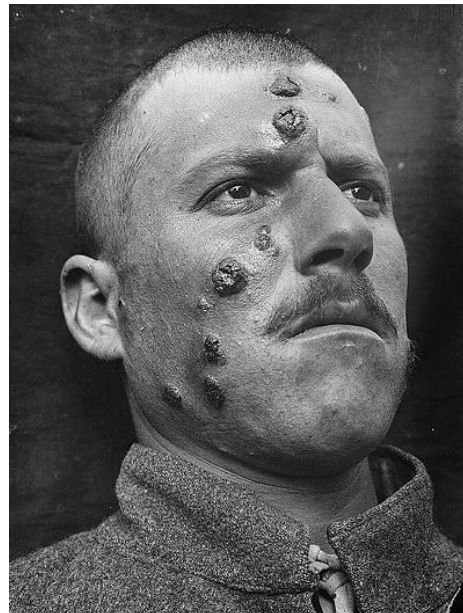


<http://www.dpd.cdc.gov/dpdx>



Order Diptera – Flies

- **Psychodidae (Moth flies or sand flies)**
 - Subfamily Phlebotominae – **Cutaneous leishmaniasis**
 - The most common, caused by several different species
 - Typically, one or more ulcers develop a week or several months after infection
 - Parasites are most often found at the site of the lesion
 - They heal spontaneously after a few months, but they leave scars and relapses are possible





Order Diptera – Flies

- **Psychodidae (Moth flies or sand flies)**
 - Subfamily Phlebotominae – **Cutaneous leishmaniasis (mucocutaneous and diffuse cutaneous)**
 - Some species are more prone to cause complications in the skin-mucosal area, such as the species *Leishmania braziliensis* in the New World (North and South America) and diffusely cutaneous (Old and New World) - perhaps the first manifestations of the disease or complications of cutaneous leishmaniasis

Disseminated Cutaneous Leishmaniasis: A Patient with 749 Lesions



Order Diptera – Flies

- **Psychodidae (Moth flies or sand flies)**
 - Subfamily Phlebotominae – **Cutaneous leishmaniasis**
 - **Diagnosis: clinical symptoms + observation of tissue for infected cells, use of PCR for confirmation (easy to get infected macrophages)**
 - **For treatment, it is very important to know which species / strain of *Leishmania* is present as well as the form of the ulcer - prevention of secondary infections is usually sufficient, although sometimes Miltefosine (the drug Impavido), pentavalent antimonials and anti fungicides such as paromocin are given orally for the treatment of complications**
 - **Relapses are possible for everyone, regardless of treatment**



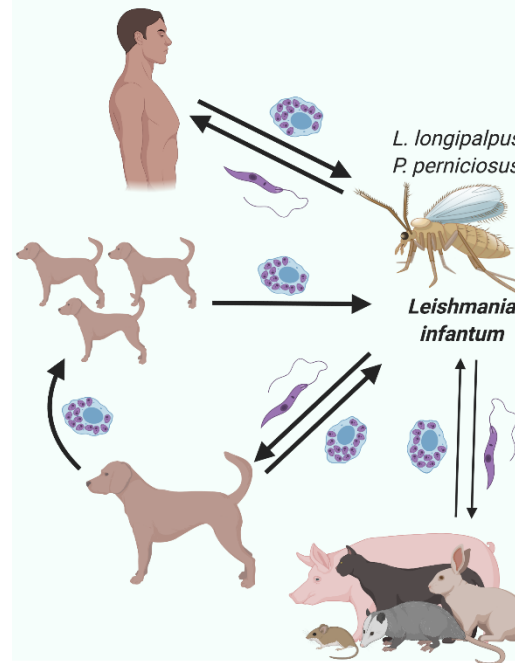
Order Diptera – Flies



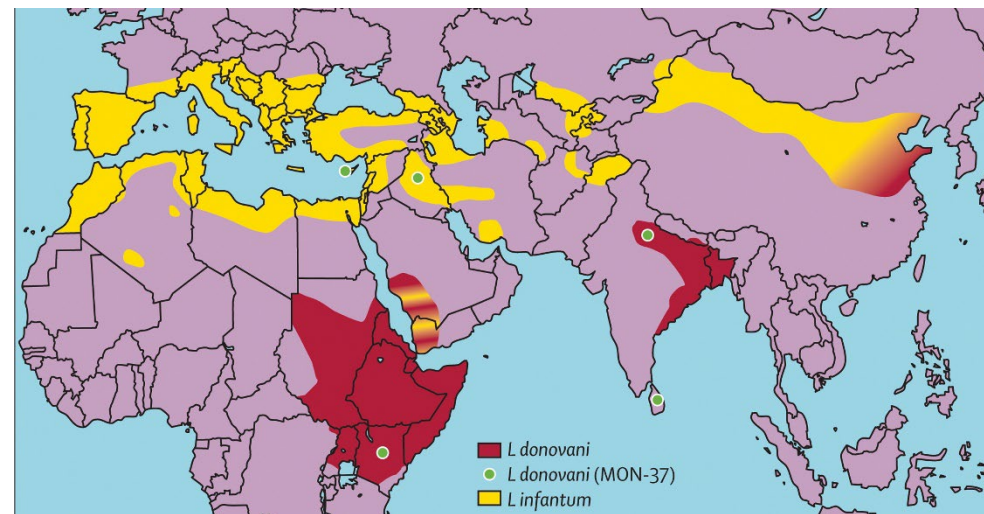
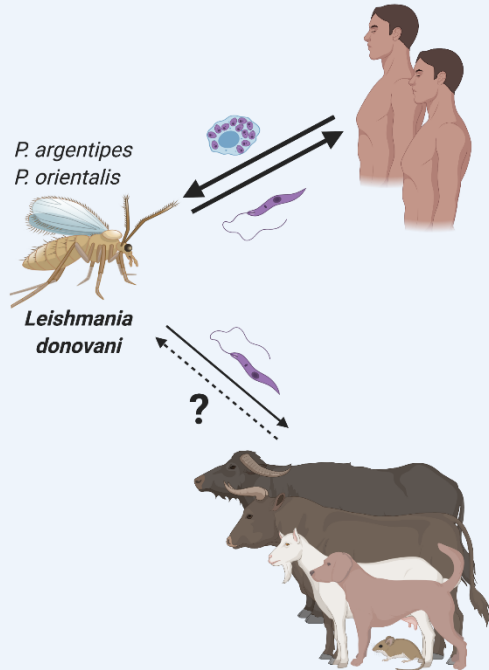
- Psychodidae (Moth flies or sand flies)

- Subfamily Phlebotominae – **Visceral leishmaniasis**
- A much rarer form of the disease, lasts from 1 to 4 months
- It is mostly caused by complexes of the species *Leishmania donovani* (Old World) and *Leishmania infantum* (Old and New World).
- The transmission of *L. donovani* is anthroponotic (human-rodent-human), while *L. infantum* is zoonotic (dogs, rodents-rodent-human)

ZOONOTIC TRANSMISSION



ANTHROPONOTIC TRANSMISSION





Order Diptera – Flies

- **Psychodidae (Moth flies or sand flies)**
 - Subfamily Phlebotominae – **Visceral leishmaniasis**
 - Most often there is no early cutaneous form
 - May cause drying and darkening of facial skin (**kala-azar disease**)
 - Fever, weight loss, swelling of internal organs, anemia and leukopenia (lack of leukocytes in the blood)
 - Mortality 90% if untreated
 - Asymptomatic 10:1 infection in *L. donovani* – implications????



Order Diptera – Flies

- **Psychodidae (Moth flies or sand flies)**
 - Subfamily Phlebotominae – **Visceral leishmaniasis**
 - **Diagnosis: Clinical symptoms + biopsy of infected cells (invasive), ELISA, PCR,**
 - **Treatment: There is no good solution... the most recommended is Liposomal amphotericin B, in combinations (LamB + Miltefosine or LamB + Paromomycin)**
 - **Pentavalent antimonials are used only if no other type of treatment is available**
 - **Unfortunately, some strains are resistant to all drugs**
 - **Relapses or post Kala-azar disease may occur in partially or fully treated individuals, particularly those who have HIV or are immunocompromised**



Order Diptera – Flies

- **Psychodidae (Moth flies or sand flies)**
 - Subfamily Phlebotominae – **Visceral leishmaniasis**
 - **Post Kala-azar dermal leishmaniasis** – skin lesions that appear 6 months to 3 years after the disease itself in treated, patients who have recovered from visceral leishmaniasis (most recorded cases in Sudan and India)





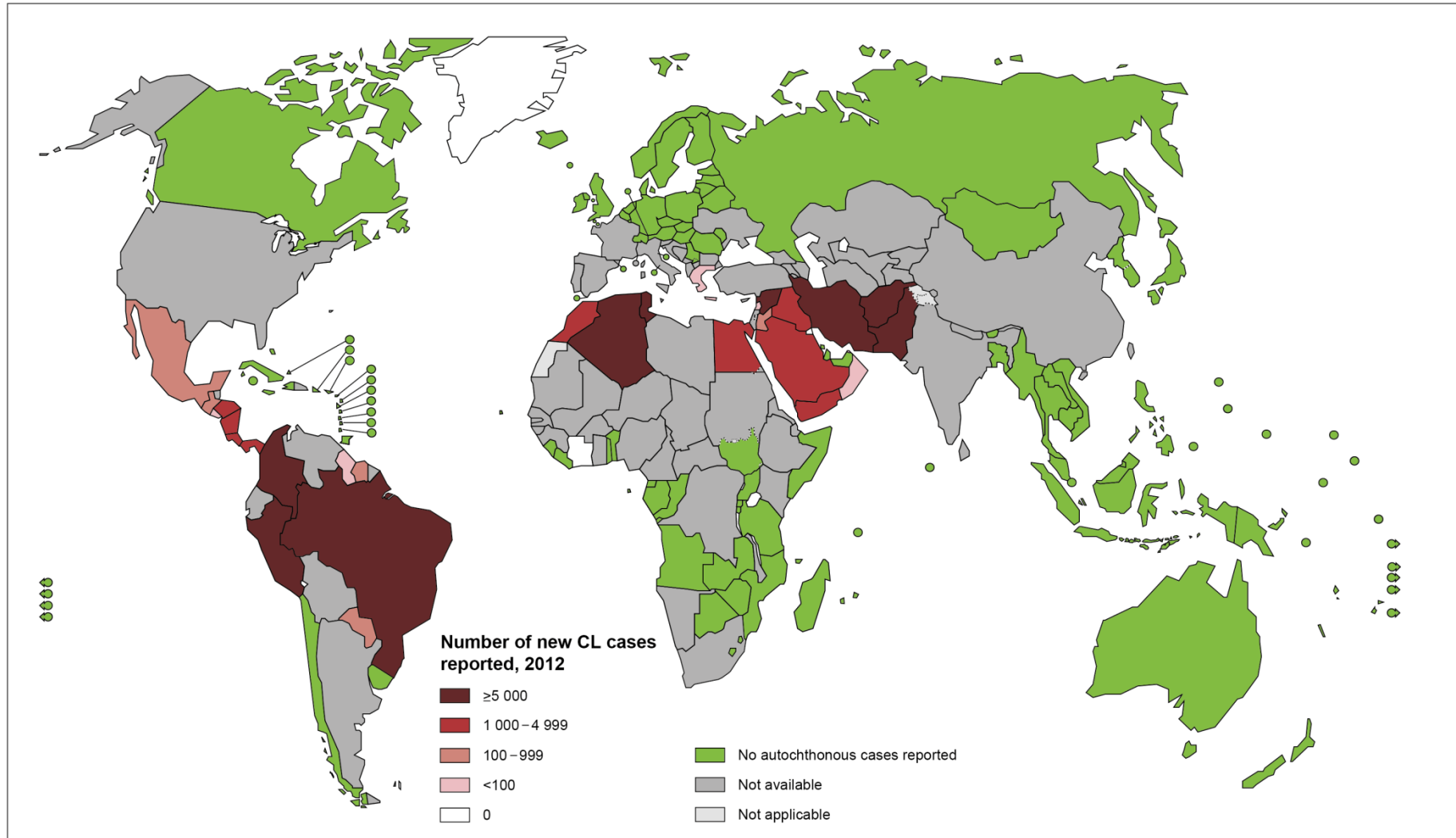
Order Diptera – Flies

- **Psychodidae (Moth flies or sand flies)**
 - Subfamily Phlebotominae – **Leishmaniasis**
 - It is almost exclusively transmitted by stings/bites of representatives of the subfamily Phlebotominae
 - Very rare cases of infection due to blood transfusion, sexual contact and transplacental transmission
 - Until recently, 50,000 people died annually from Kala-azar disease (India, Sudan, Bangladesh, Brazil)
 - About 60-80% reduction in infection and mortality since 2006 due to WHO program (WHO kala-azar elimination program)
 - Development of new drugs, development of vaccines,...



Order Diptera – Flies

- Psychodidae (Moth flies or sand flies)
 - Subfamily Phlebotominae – **Cutaneous leishmaniasis**



Order Diptera – Flies

- Psychodidae (Moth flies or sand flies)
 - Subfamily Phlebotominae – **Visceral leishmaniasis**

