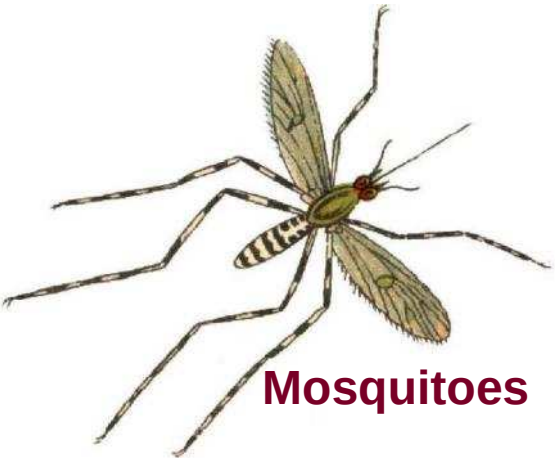
Vectors and Disease



Mosquitoes

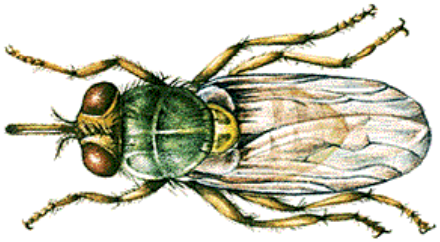
Ticks

Sand flies

Fleas

Chigger Mites

Lice



Tsetses

LTC Jason H. Richardson

Walter Reed Army Institute of Research

Outline

- Threats
  - Understanding vectorborne disease epidemiology
  - Area specific, risk assessment.
  - What are the threats?
- Resources
  - Where can you find answers?
- Prevention
  - What can you do to minimize risk?

WRAIR
Walter Reed Army Institute of Research
Soldier Health • World Health

What are the **priority threats?**

It always depends but, in general according to "the experts"…

DEPARTMENT OF THE ARMY
BROOKE ARMY MEDICAL CENTER
3851 ROGER BROOKE DRIVE
FORT SAM HOUSTON TX 78234-6200

REPLY TO
ATTENTION OF
MCHE-MDI

23 April 2010

MEMORANDUM FOR RECORD

SUBJECT: Infectious Disease Threats to the US Military Prioritization Panel Results

1. A panel was hosted by the Directorate of Combat and Doctrine Development (DCDD) and the Military Infectious Diseases Research Program (MIDRP), US Army Medical Research and Materiel Command (MRMC), under the umbrella of the Medical Force Protection Integrated Capabilities Development Team (ICDT) Charter to prioritize the current infectious disease threats to the US Military (Appendix A).

2. Panel objectives were to identify and operationally prioritize the infectious disease threats to US Forces to assist in the determination of capability requirements.

3. References included "Initial Capabilities Document (ICD) for Infectious Disease Countermeasures (IDCM)," 2006, and "Infectious Diseases Investment Decision Evaluation Algorithm: A Quantitative Algorithm for Prioritization of Naturally Occurring Infectious Disease Threats to the U.S. Military," *Military Medicine* 2008;173:174-181.

Appendix A
Prioritization of Infectious Disease Threats to the US Military

1.	Malaria
2.	Dengue
3.	Diarrhea, bacterial
4.	Multidrug-resistant (MDR) wound pathogens
5.	Leishmaniasis
6.	Q fever (*Coxiella burnetti*)
7.	Norovirus and other viral diarrhea
8.	Influenza
9.	Adenovirus
10.	Leptospirosis
11.	Diarrhea, protozoal
12.	Tuberculosis (TB)
13.	Crimean-Congo hemorrhagic fever
14.	Human immunodeficiency virus (HIV/AIDS)
15.	Hemorrhagic fever with renal syndrome (HFRS)
16.	Chikungunya
17.	Meningococcal meningitis
18.	Plague
19.	Rickettsioses
20.	Viral encephalitides
21.	Hepatitis E
22.	Lassa fever and other arenaviruses
23.	Tick-borne encephalitis
24.	Rift Valley fever
25.	Hepatitis C
26.	Brucellosis
27.	Other arboviral illnesses
28.	Typhoid fever
29.	Cholera
30.	Schistosomiasis
31.	Tularemia
32.	Trypanosomiasis
33.	Ebola/Marburg hemorrhagic fever
34.	Chagas' disease
35.	Yellow fever
36.	Lyme
37.	Bartonelloisis (Oroya fever)
38.	Soil-transmitted helminths

PRIORITY THREATS

1. Malaria

2. Dengue

4. Leishmaniasis

13. CCHF

16. Chikungunya

18. Plague

19. Rickettsioses

20. Viral enceph

23. TBE

24. Rift Valley fever

27. Other arboviruses

WRAIR
Walter Reed Army Institute of Research
Soldier Health • World Health

Risk

What are the threats in my AO?

Depends on **where** you are and **when** you are there.

NATURAL NIDALITY OF TRANSMISSIBLE DISEASES- By E. N. Pavlovsky (1964)

- Pavlovsky introduced the concept of natural nidality of human diseases
  - Defined by the idea that **microscale** disease foci are determined by the entire ecosystem
  - Thus the nidus of a disease "exists under definite conditions of climate, vegetation, soil, and favorable microclimate."

- According to Pavlovsky, "nidus" is a translation of the root word "ochag," meaning a hearth.
  - Thus a nidus of disease is its nest, home, or habitat (equivalent to the Latin "focus").

- The central concept is that a disease has its own natural habitat in the same way as a species.

Disease Nidality

- E. N. Pavlovsky. 1964. *Natural focality of transmissive diseases in connection with landscape epidemiology of zooanthroponoses.*
- Introduced the Russian word “ochag” meaning hearth or breeding ground.

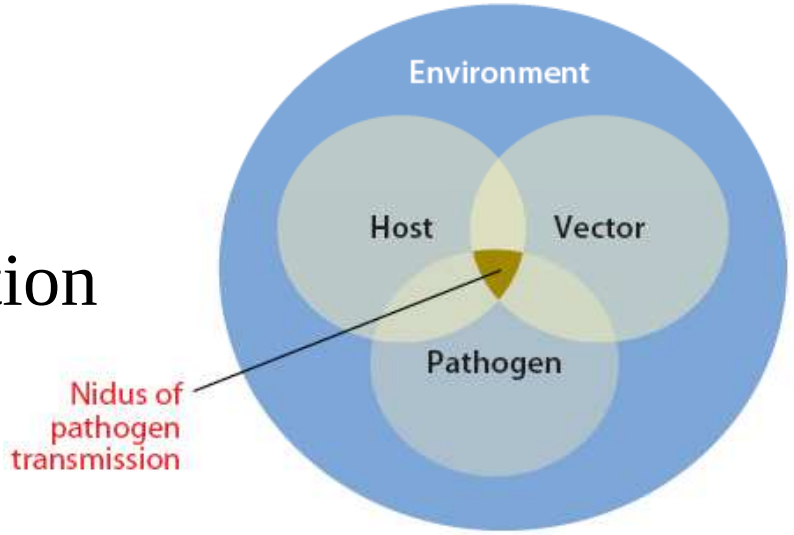
- **Nidus (Latin) – nest.**
- **The nidus of a disease**

"exists under definite conditions of climate, vegetation, soil, and favorable microclimate.”

Nidality –Landscape Epidemiology

For vector-borne diseases, transmission depends on the **transient interaction** of a given:

- Vector species
- Pathogen genotype
- Host (human) population
- Ecological setting



Everything depends on space and time

Components of transmission

- **Pathogen**
  - Imported genotypes, mutations, replication rate
- **Vector**
  - Feeding behavior, host preference, habitat, vector competence, density, life span
- **Host and reservoir populations**
  - Immunity, density, living conditions, movement
- **Landscape**
  - Climate, rainfall, temp., humidity, habitat

Everything depends on space and time

FACTORS TO HELP ESTIMATE RISK

1. What pathogens and strains/species are present?

   (*P. falciparum is far more serious than P. vivax)*

2. Will the mission put personnel into close contact with vectors?

   - VECTOR BEHAVIOR
     - *Anopheles* mosquitoes are nighttime biters.
     - *Aedes* mosquitoes are daytime biters.
     - Sandflies fly close to the ground.
   - VECTOR HABITAT…Will personnel operate in areas with vectors?
   - BILLETING…in buildings with doors and screened windows?

3. Will conditions support disease transmission?

   - SEASONALITY
   - RECENT WEATHER (especially rain)
   - DENSITY OF VECTOR
   - INFECTION RATE

4. What is the Incubation Period?

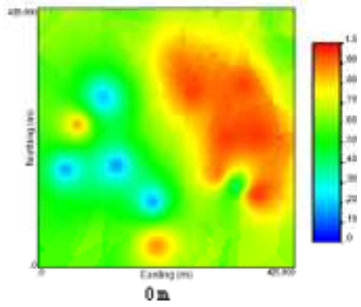
WRAIR
Walter Reed Army Institute of Research
Soldier Health • World Health

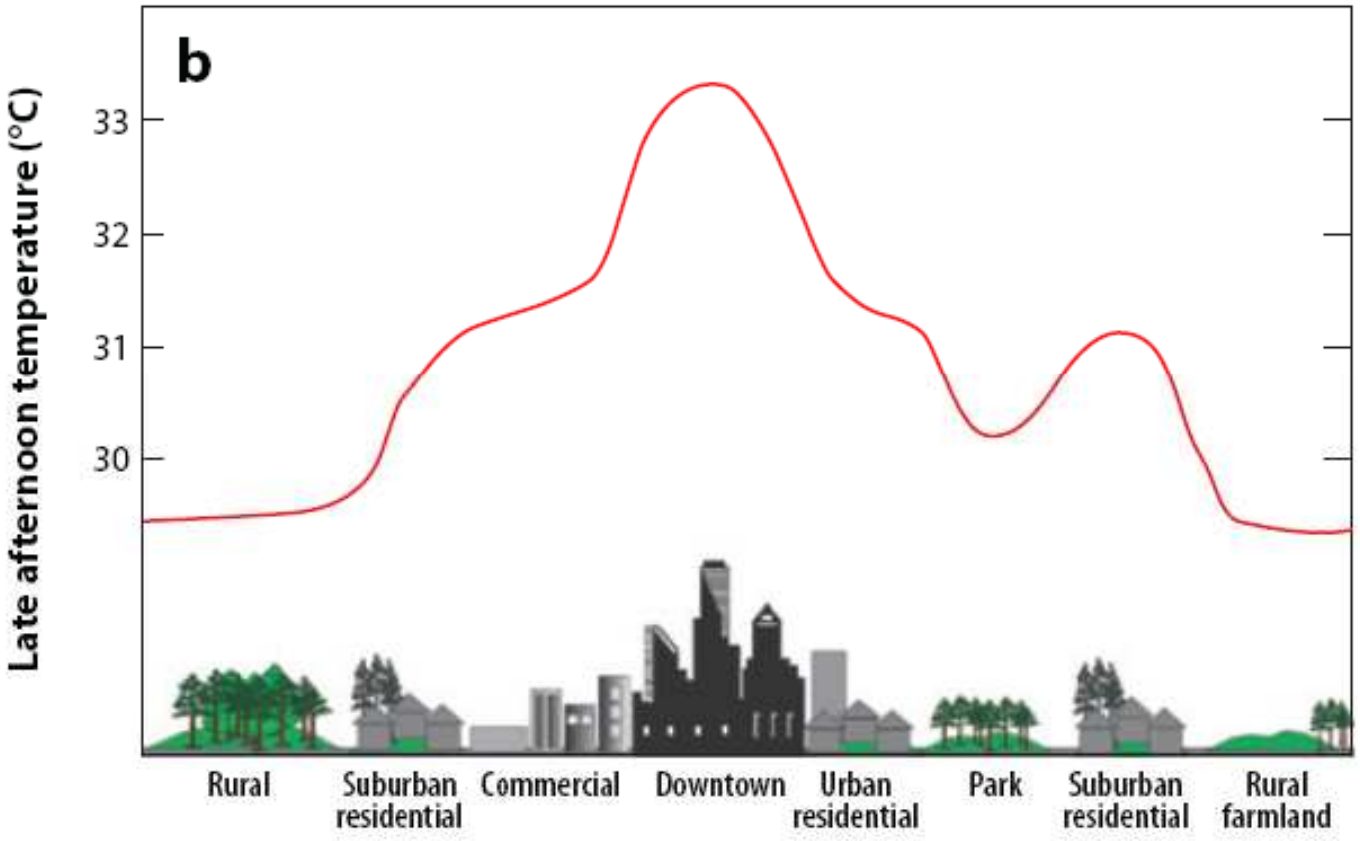
Air Force Army Tent City

Tent City

No AC

Land cover → temperature





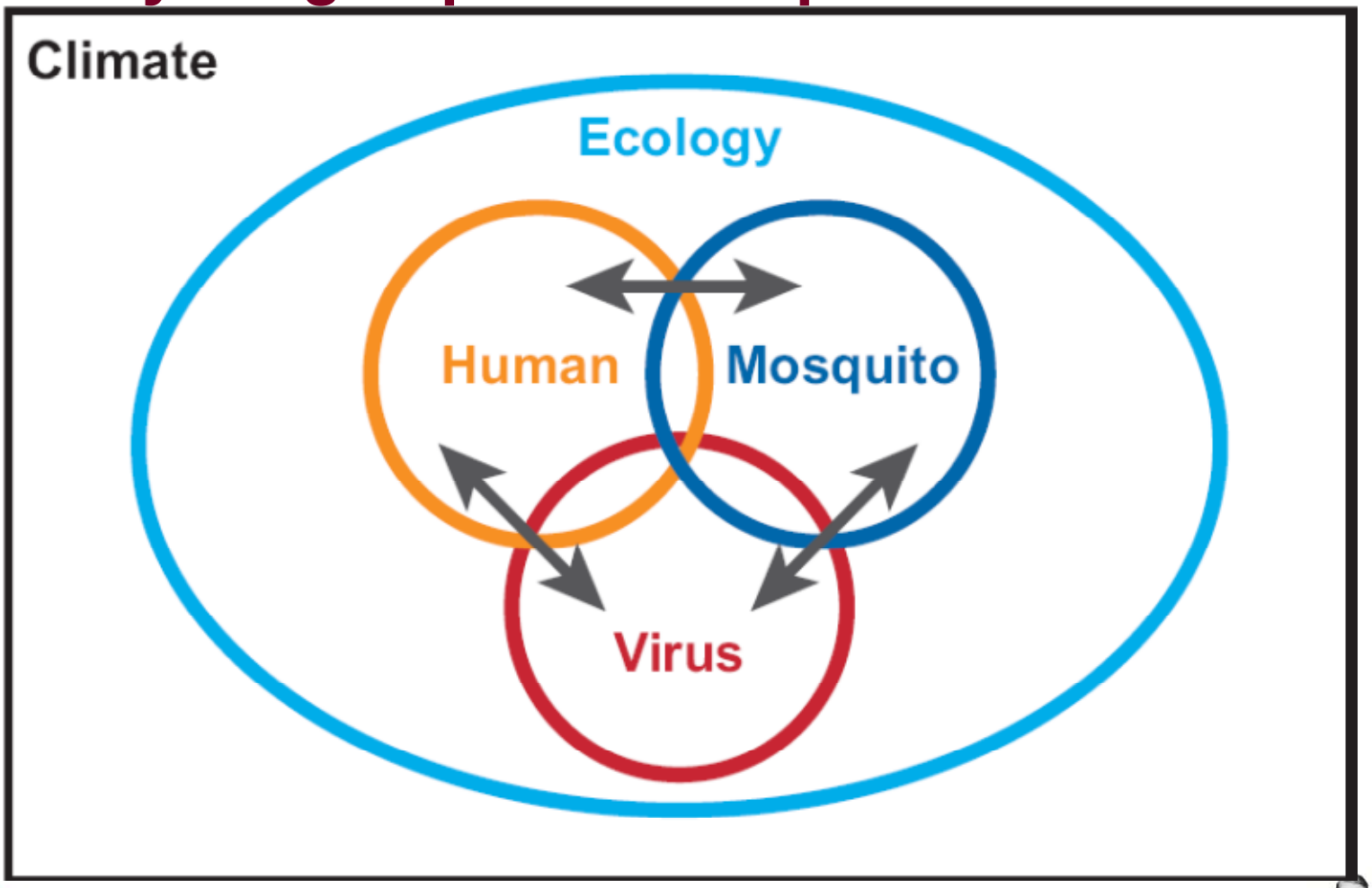
Extremely variable

(Reisen, 2010)

WRAIR
Walter Reed Army Institute of Research
Soldier Health • World Health

Epidemiology of transmission

Everything depends on space and time



Kyle & Harris, 2008

- Model of *P. falciparum*
- No transmission in areas surrounded by high transmission.
- Why?...
- No vectors.

Help in Identifying Priority threats

Entomological Operational Risk Assessments (EORA)

- Provide risk estimates for vector-borne and zoonotic diseases in the country of concern.
- These estimates, prepared by USACHPPM.
- EORAs available for >30 countries.

Infectious Disease Risk Assessment (IDRA)

- AFMIC now NCMI
- Web-based and CD (MEDIC)
- unclassified medical intelligence

WRAIR
Walter Reed Army Institute of Research
Soldier Health • World Health

Resources

Where can you find answers?

- Public Health Command (PHC), Ento Div

  http://chppm-www.apgea.army.mil/ento/default.htm

- AFPMB

  http://www.afpmb.org

- NCMI (MEDIC CD)
- Walter Reed Biosystematics Unit (WRBU)

  http://wrbu.si.edu and http://mosquitomap.nhm.ku.edu/vectormap/

- Command PM assets

WRAIR
Walter Reed Army Institute of Research
Soldier Health • World Health

http://www.afpmb.org

Armed Forces Pest Management Board

recommends policy, provides guidance, and coordinates the exchange of information on all matters related to DoD pest management

Log in/Register

Search AFPMB.org

- Search the AFPMB Website

Questions?

- Send a question to the Board

DoD Topics

- Pesticide & Equipment Lists
- Training & Certification
- DoD Pesticide Hotline

Literature

AFPMB LRS | WRBU LRS

Hosted Sites

WRBU

NAVFAC

Military Entomology

Army | Navy | Air Force

Board Meeting Info

Next Board Meeting:
Oct. 31 - Nov 4, 2011

- Information from last meeting
- Board Minutes & Staff Reports
- Committee Workspaces

Contingency & Deployment Resources

We provide support to DoD personnel on any pest management issue in any situation. We also provide rapid accurate responses to questions regarding all aspects of pest management and maintain the website to meet the needs of our customers. Find a resource now

Literature Retrieval System

Our Literature Retrieval System is an online collection of scientific papers comprising over 100,000 documents in searchable PDF format, drawn from our extensive library of books, journals, reprints, reports, and other sources.
Search our database of over 120,000 PDFs

Deployed War-Fighter Protection (DWFP) Program

The Deployed War-Fighter Protection research program (DWFP) is an initiative to develop and validate novel methods to protect United States Military deployed abroad from threats posed by disease-carrying insects. Read more

Disease Vector Ecology Profiles

Disease Vector Ecology Profiles (DVEPs) summarize unclassified literature on medically important arthropods, vertebrates and plants that may adversely affect troops in specific countries or regions of the world. Read more

Technical Guides

As a unit of the AFPMB, ISD (Information Services Division) collects, stores and disseminates published and unpublished information on arthropod vectors and pests, natural resources, and environmental biology important to the DoD.
Read more

Living Hazards Database

The Living Hazards Database (LHD) is a comprehensive compilation of more than 500 species worldwide, which are reported to cause serious injury or death of humans. Read more

What's New

- Audrey Perich and Brian Zeichner receive award for development of lethal ovitrap
- Report of the 6th Annual Meeting of the Roll Back Malaria Partnership
- Roll Back Malaria Progress & Impact Series
- Archives

Flickr Images

Go to our image database

YouTube Videos

More

Follow Us:

REGIONAL RISK

DVEPS

- Provide risk estimates for vector-borne and zoonotic diseases in the regions of concern.
- Prepared by AFPMB.

Office of the Deputy Under Secretary of Defense for Installations & Environment

Regional Disease Vector Ecology Profile

South Central Asia

Defense Pest Management Information Analysis Center
Armed Forces Pest Management Board
Forest Glen Section
Walter Reed Army Medical Center
Washington, DC 20307-5001

Homepage: http://www.afpmb.org

September 2001

The Walter Reed Biosystematics Unit

WRBU
Walter Reed Biosystematics Unit
Know the vector, know the threat

HOME | VECTOR ID | WHO WE ARE | STAFF | WHAT WE DO | FAQS | FORUM

The Walter Reed Biosystematics Unit (WRBU) is a unique national resource. Its mission is to conduct systematics research on medically important arthropods and to maintain the U.S. mosquito collection. The WRBU is just one part of the U.S. Government's entomological research system, which includes the U.S. Department of Agriculture (USDA) and the Smithsonian Institution (SI). Historically, mosquito identification was managed by USDA and the SI, but in 1972 this responsibility was transferred from USDA to the U.S. Army for research on medically important arthropods. Located at the Museum Support Center of the Smithsonian Institution in Suitland, Maryland, the WRBU's physical space is provided by the Smithsonian Institution in return for curation of the collection and specimen identification... ***(more)***

What's New?

Mosquito Classification 2010

Discussion Forum

New mosquito identification keys

See new WRBU staff publications

VectorMap
MosquitoMap.org
SandflyMap.org
TickMap.org

Vector Identification Resources

to medically important arthropods and WRBU's Vector Identification Service

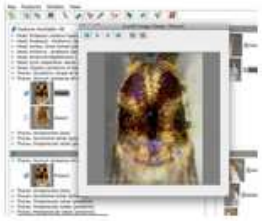
Mosquito Resources

Culicidae Catalog
www.mosquitocatalog.org

Mosquito Genera

Mosquito Literature

Medically Important Mosquitoes



Mosquito Species
Identification Keys

Other Vectors

Sand Flies

Ticks

Scorpions

Fleas

WRAIR ENTOMOLOGY

AFPMB

http://wrbu.si.edu/

VectorMap

- Comprised of MosquitoMap, SandflyMap and TickMap
- Geospatially referenced clearinghouses for arthropod disease vector species collection records and distribution models.
- Users can pan and zoom to anywhere in the world to view the locations of:
  - past **vector collections** and
  - the **results of modeling that predicts the geographic extent of individual species.**

http://mosquitomap.nhm.ku.edu/vectormap/

VectorMap is new and still in the test phase.

Requires you to download Silver Light freeware from Microsoft.

WRAIR

Walter Reed Army Institute of Research

Soldier Health • World Health

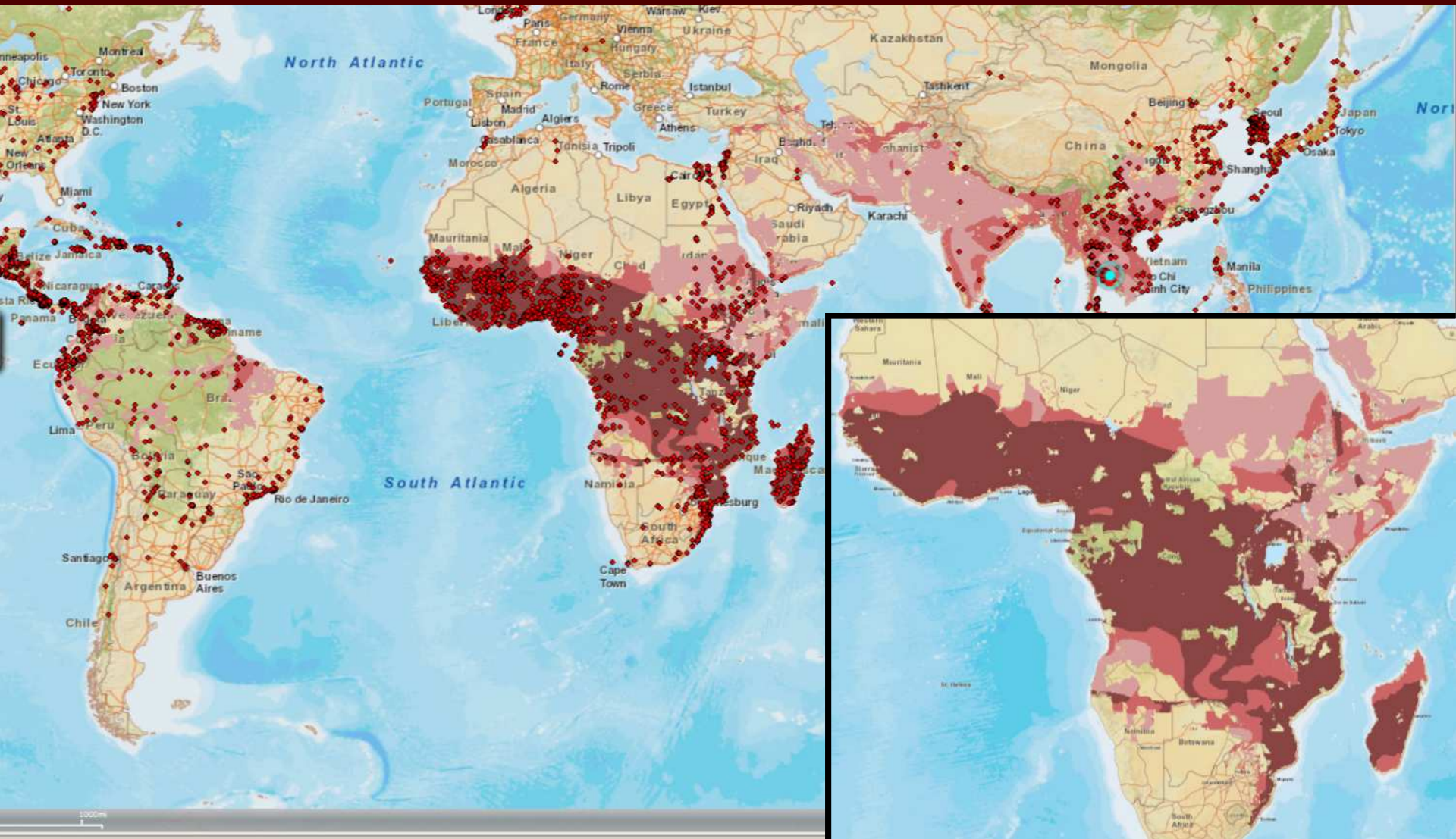
Model of *Plasmodium falciparum* in 2005 from the Malaria Atlas Project http://www.map.ox.ac.uk/index.htm.

Hypoendemic, Mesoendemic and Hyper-holoendemic

Several sources of information on malaria risk (notably international travel health guidelines on malaria chemoprophylaxis, altitude limits for dominant vectors, climate limits for malaria transmission and human population density thresholds) have been combined in a GIS to generate this map. See Guerra et al. (2006) Advances in Parasitology 62: 157 – 179 and Guerra et al. (2006) Trends in Parasitology 22: 353 – 358 for details.

The method for defining the endemic levels within these limits can be found in Snow et al. (2005) Nature 434: 214 – 217.

Anopheles collection records show up as red dots



Tick collection records

Major Vectorborne Disease Threats

- Malaria
- Dengue
- Leishmaniasis
- Other arboviruses
  - (e.g., chikungunya, JEV, WNV)
- Rickettsioses
  - (e.g. African tick bite fever, scrub typhus)

WRAIR
Walter Reed Army Institute of Research
Soldier Health • World Health

Vectorborne Disease Threats

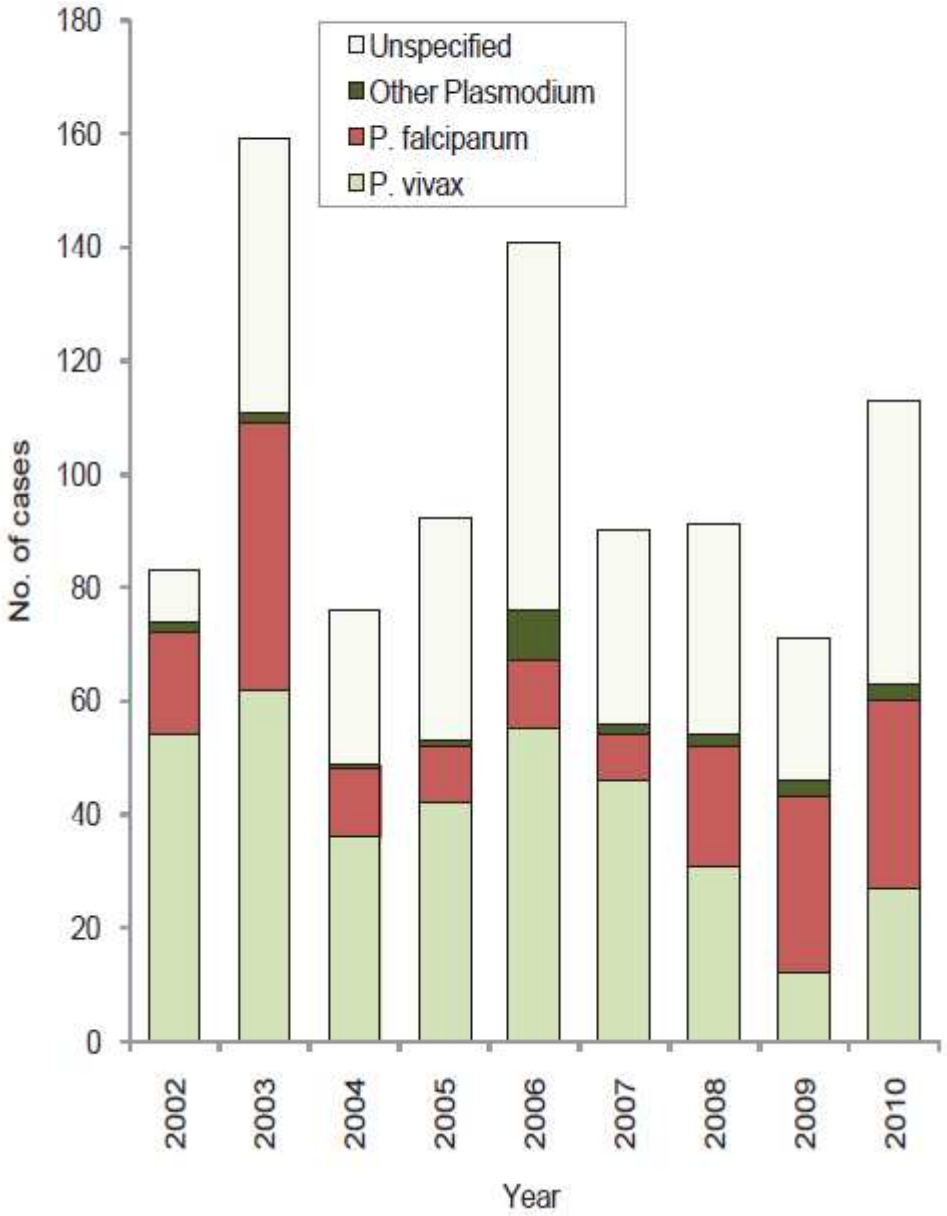
TABLE 1. Past and present impact of vector-borne diseases of military importance among deployed troops

	Past threats	Present threats	Other diseases of less importance
Sandfly-borne diseases	Sandfly fever Old World cutaneous leishmaniasis New World mucocutaneous leishmaniasis Visceral leishmaniasis	Sandfly fever Old World cutaneous leishmaniasis New World mucocutaneous leishmaniasis Visceral leishmaniasis	Oroya fever
Mosquito-borne diseases	Malaria Lymphatic filariasis Yellow fever Japanese B encephalitis Dengue fever Chikungunya disease	Malaria Dengue fever Chikungunya disease Rift Valley fever virus West Nile virus	O'nyong nyong virus, Semliki Forest virus, Sindbi virus, and other mosquito-borne viruses
Flea-borne diseases	Plague Murine typhus	Plague? Murine typhus?	Flea-borne spotted fever
Louse-borne diseases	Typhus Trench fever Louse-borne relapsing fever		
Tick-borne diseases	Rocky mountain spotted fever Mediterranean spotted fever African tick bite fever Other common tick-borne spotted fevers Ehrlichiosis Q-fever* Tularemia* Crimean–Congo hemorrhagic fever Tick-borne encephalitis	Rocky mountain spotted fever Mediterranean spotted fever African tick bite fever Other common tick-borne spotted fevers Ehrlichiosis Q-fever* Tularemia* Crimean–Congo hemorrhagic fever	New pathogenic rickettsiae (*Rickettsia slovaca*, *Rickettsia helvetica*, and *Rickettsia sibirica mongolitimonae*) 'Rickettsia of unknown pathogenicity' Colorado tick fever Kemerovo tick fever Other tick-borne fevers (Dugbe or Banjha virus) Omsk hemorrhagic fever Kyasianur Forest disease Alkhurma virus hemorrhagic fever Human babesiosis
Mite-borne diseases	Scrub typhus	Scrub typhus	
Tsetse fly-borne diseases	Sleeping sickness	Sleeping sickness	
Kissing bug-borne diseases	Chagas disease	Chagas disease	

Pages et al., 2010. The past and present threat of vector-borne diseases in deployed Troops. Clin Microbiol Infect

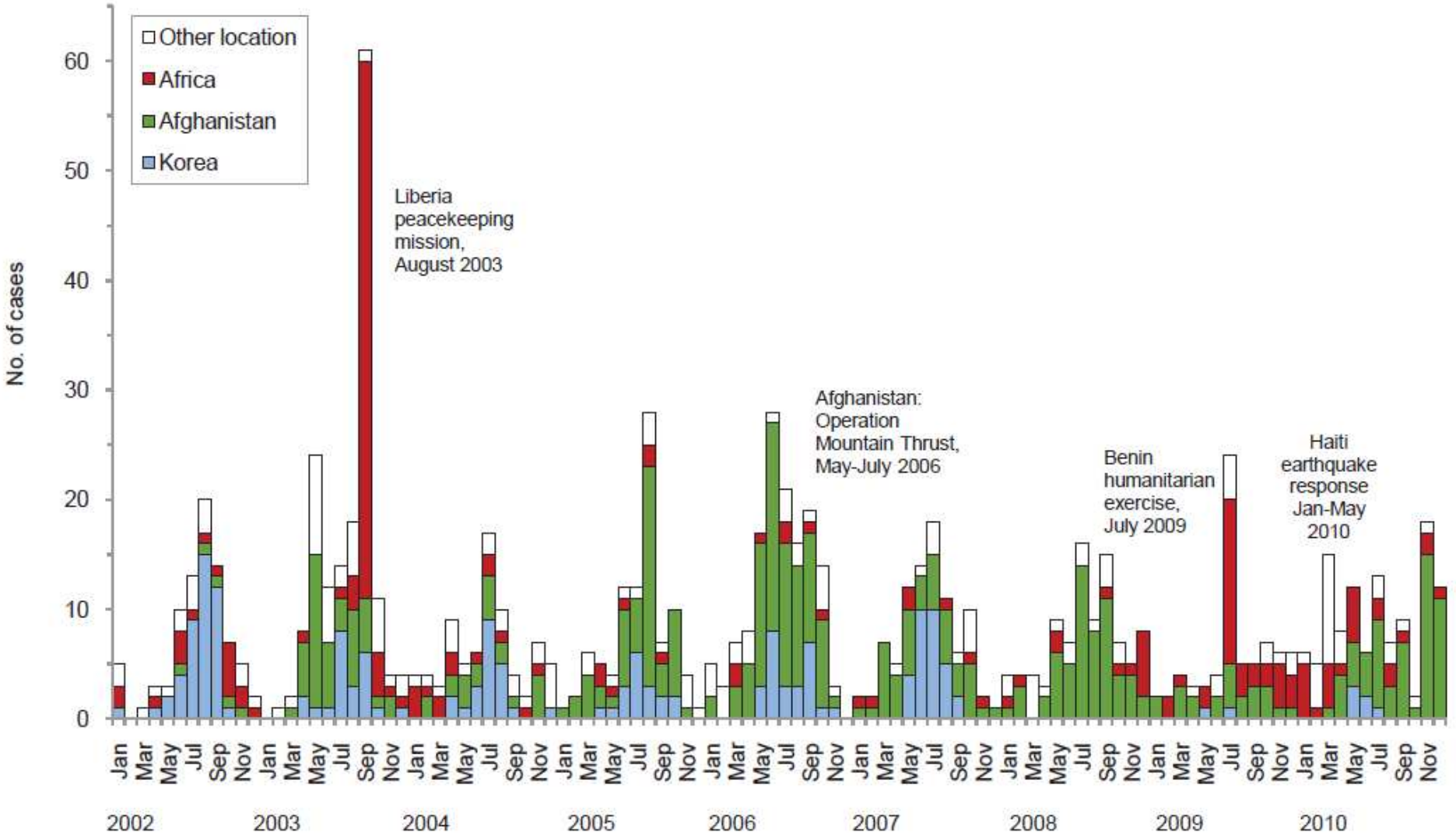
Malaria

Figure 1. Malaria cases among U.S. service members, by *Plasmodium* species and calendar year of diagnosis/report, 2002-2010



Malaria

Figure 2. Malaria among U.S. service members, by estimated location of infection acquisition, 2002-2010



Malaria

Table 2. Number of malaria cases by geographical location of diagnosis or report and presumed location of acquisition, U.S. Armed Forces, 2010

Location of diagnosis/report	Presumed location of infection acquisition					Total	% of total 2010 cases
	Korea	Afghanistan	Africa	Haiti	Unknown		
Bagram/Camp Lacy, Afghanistan	0	24	0	0	0	24	21.2
Landstuhl, Germany	0	6	4	0	0	10	8.8
Fort Bragg, NC	0	1	0	8	0	9	8.0
Portsmouth, VA	0	0	3	1	1	5	4.4
Seoul, Korea	5	0	0	0	0	5	4.4
Fort Wainwright, AK	0	4	0	0	0	4	3.5
Camp Lejeune, NC	0	1	0	3	0	4	3.5
Naval Station Norfolk, VA	0	0	4	0	0	4	3.5
Fort Carson, CO	0	3	0	0	0	3	2.7
Fort Bliss, TX	1	2	0	0	0	3	2.7
Walter Reed Army Medical Center, DC	0	0	0	0	2	2	1.8
Fort Stewart, GA	0	1	0	0	1	2	1.8
Fort Campbell, KY	0	2	0	0	0	2	1.8
Nellis Air Force Base, NV	0	2	0	0	0	2	1.8
Fort Hood, TX	0	0	1	1	0	2	1.8
Naval Mobile Construction Battalion 7 (location unknown)	0	0	2	0	0	2	1.8
Joint Task Force - Horn of Africa	0	0	2	0	0	2	1.8
Other locations (with 1 case each)	0	12	8	1	7	28	24.8
Total (% of total)	6 (5%)	58 (51%)	24 (21%)	14 (12%)	11 (10%)	113 (100%)	100.0

Malaria

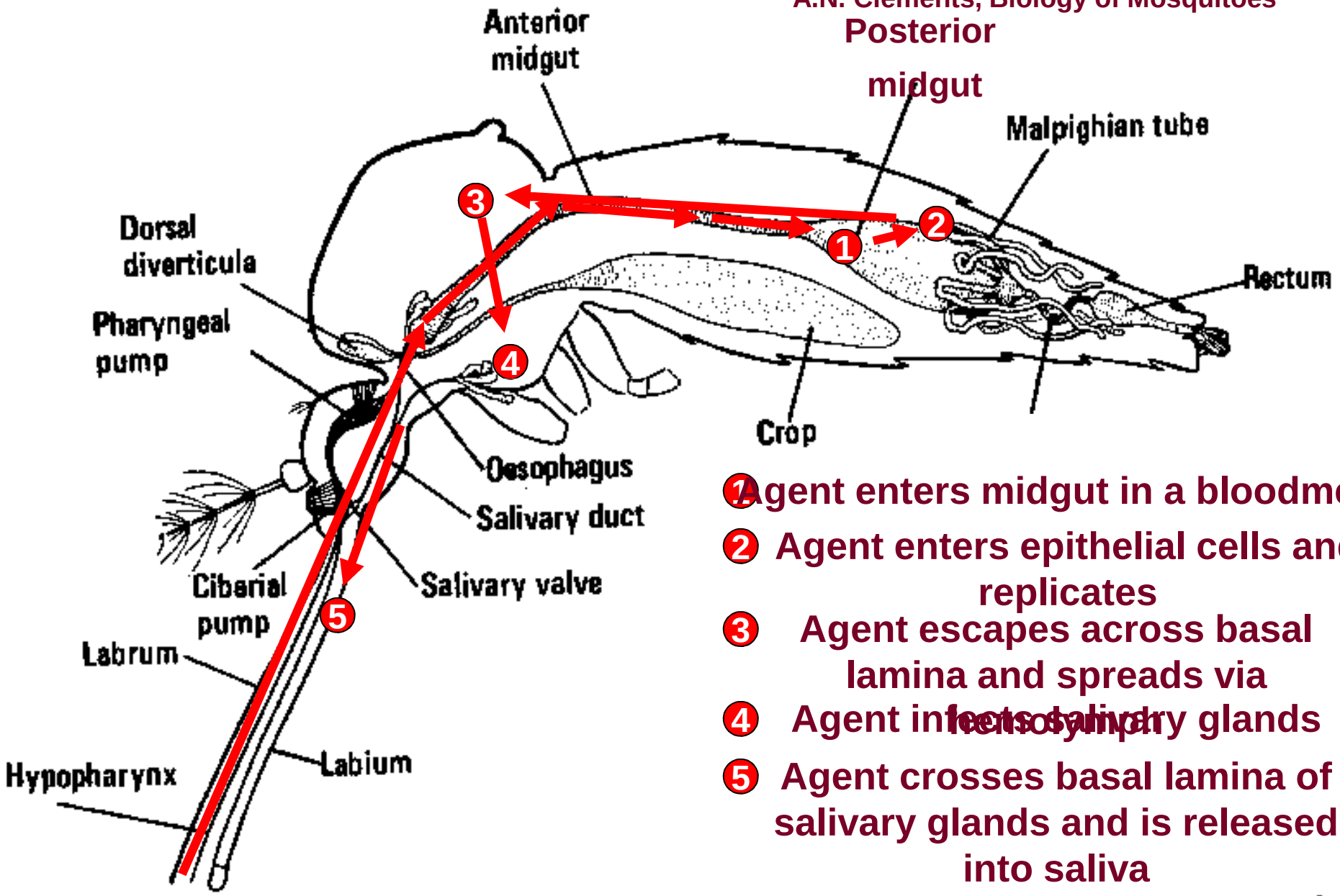
- Risk varies geographically
  - Different species of Anopheles mosquitoes.
- Entomological inoculation rate (EIR).
  - An estimate of exposure to infective mosquitoes,
  - EIRs can exceed 1 infective bite per person per night.

What is a vector?

- An arthropod that becomes infected with a pathogen and is able to transmit it to another host.
- Although an arthropod is able to maintain a parasite alive within its body, transmission depends upon its competence as a vector.

Barriers to Pathogen Transmission

A.N. Clements, Biology of Mosquitoes

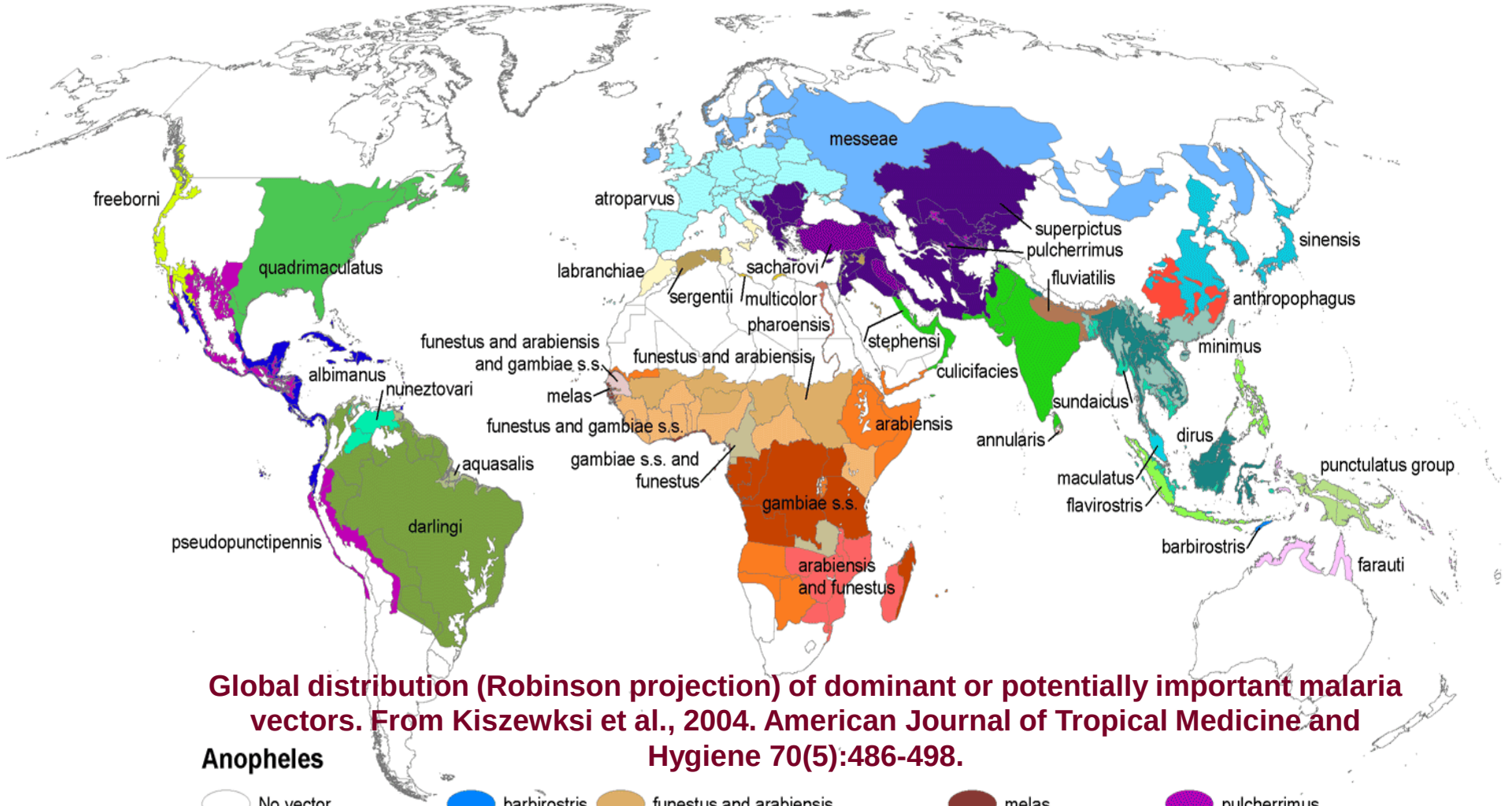


1. Agent enters midgut in a bloodmea
2. Agent enters epithelial cells and replicates
3. Agent escapes across basal lamina and spreads via hemocoel
4. Agent infects salivary glands
5. Agent crosses basal lamina of salivary glands and is released into saliva

Vector potential

- Mosquito species vary in their vector potential because of environmental conditions and factors affecting their **abundance, blood-feeding behavior, survival, and ability to support malaria parasite development.**
- Sporogony is the complex life cycle of the parasite in female mosquitoes.
- Most individual mosquitoes that ingest gametocytes do not support development to the sporozoite stage.

WRAIR
Walter Reed Army Institute of Research
Soldier Health • World Health



Global distribution (Robinson projection) of dominant or potentially important malaria vectors. From Kiszewksi et al., 2004. American Journal of Tropical Medicine and Hygiene 70(5):486-498.

Anopheles

- No vector
- albimanus
- annularis
- anthropophagus
- arabiensis
- arabiensis and funestus
- aquasalis
- atroparvus
- barbirostris
- culicifacies
- darlingi
- dirus
- farauti
- flavirostris
- fluviatilis
- freeborni
- funestus and arabiensis
- funestus, arabiensis and gambiae s.s.
- funestus and gambiae s.s.
- gambiae s.s.
- gambiae s.s. and funestus
- labranchiae
- maculatus
- marajoara
- melas
- messeae
- minimus
- multicolor
- nunez-tovari
- punctulatus group
- pharoahensis
- pseudopunctipennis
- pulcherrimus
- quadrimaculatus
- sacharovi
- sergentii
- sinensis
- stephensi
- sundaicus
- superpictus

Biology of *Anopheles spp.*

Eggs

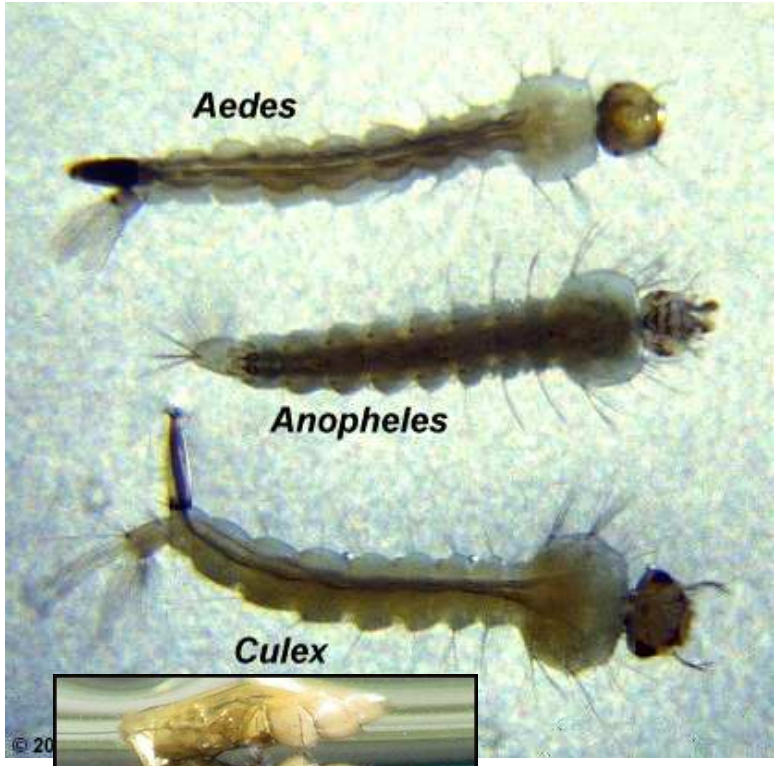
- Eggs are laid individually on the water surface and are kept afloat by air chambers (floats).
- Females lay batches of 75 to 150 eggs.
- The eggs hatch after two or three days at temperatures of 25-30ºC.
- At lower temperatures, this period can be longer, and the eggs can resist total or partial desiccation in moist soil for many days.

WRAIR
Walter Reed Army Institute of Research
Soldier Health • World Health

Biology of *Anopheles spp.*

Larvae

- Characteristic resting position, lying parallel to the water surface.
- Larval development takes around 5 to 7 days.
- Larval habitat varies with species.



Pupae

- Pupae do not eat.
- Metamorphosis of the larva into an adult.
- It lasts from two to three days.

WRAIR
Walter Reed Army Institute of Research
Soldier Health • World Health

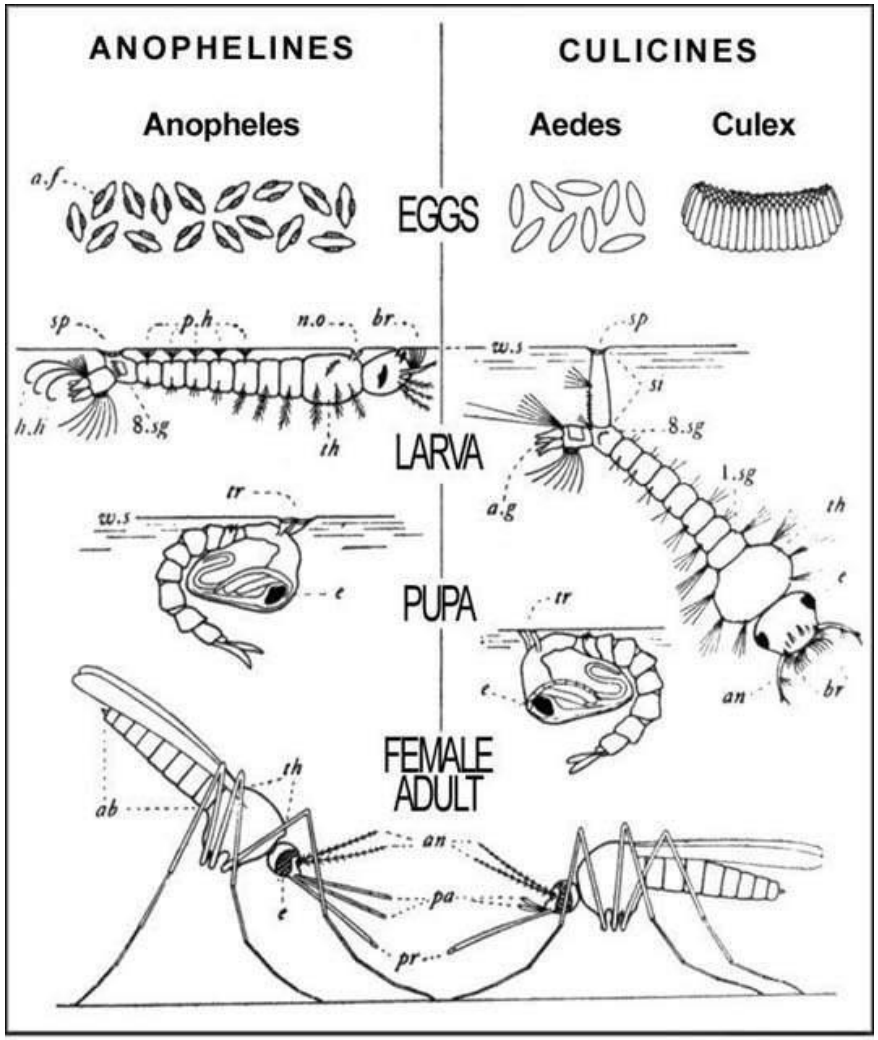
Biology of *Anopheles spp.*

Adult:

- Live from 3 to 4 weeks.
- Feeding occurs at night.
- Host preference varies by species.
- **Indoor vs. outdoor feeding**

Biology of *Anopheles spp.*

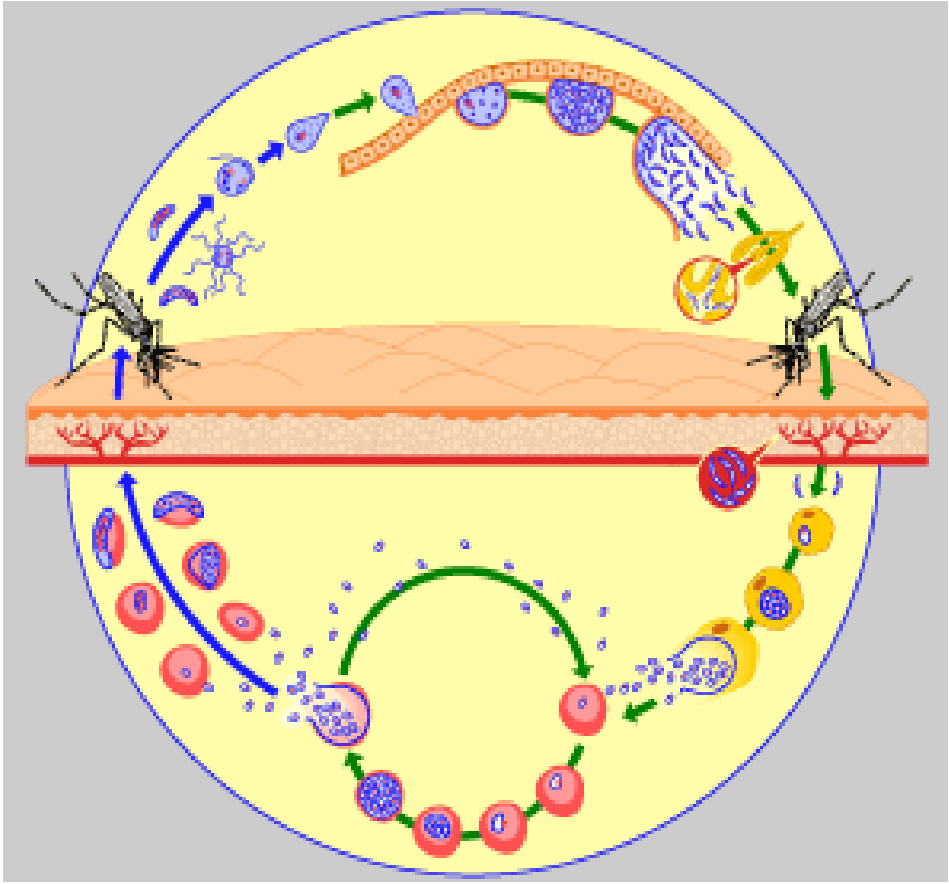
- Larvae lack a siphon
- Larvae rest parallel to water surface
- Adults hold body at an angle of 30º degrees or more with the surface.



Blood required for egg development

Life cycle of *Plasmodium*

- **Mosquito:** Sexual
- **Man:** Asexual

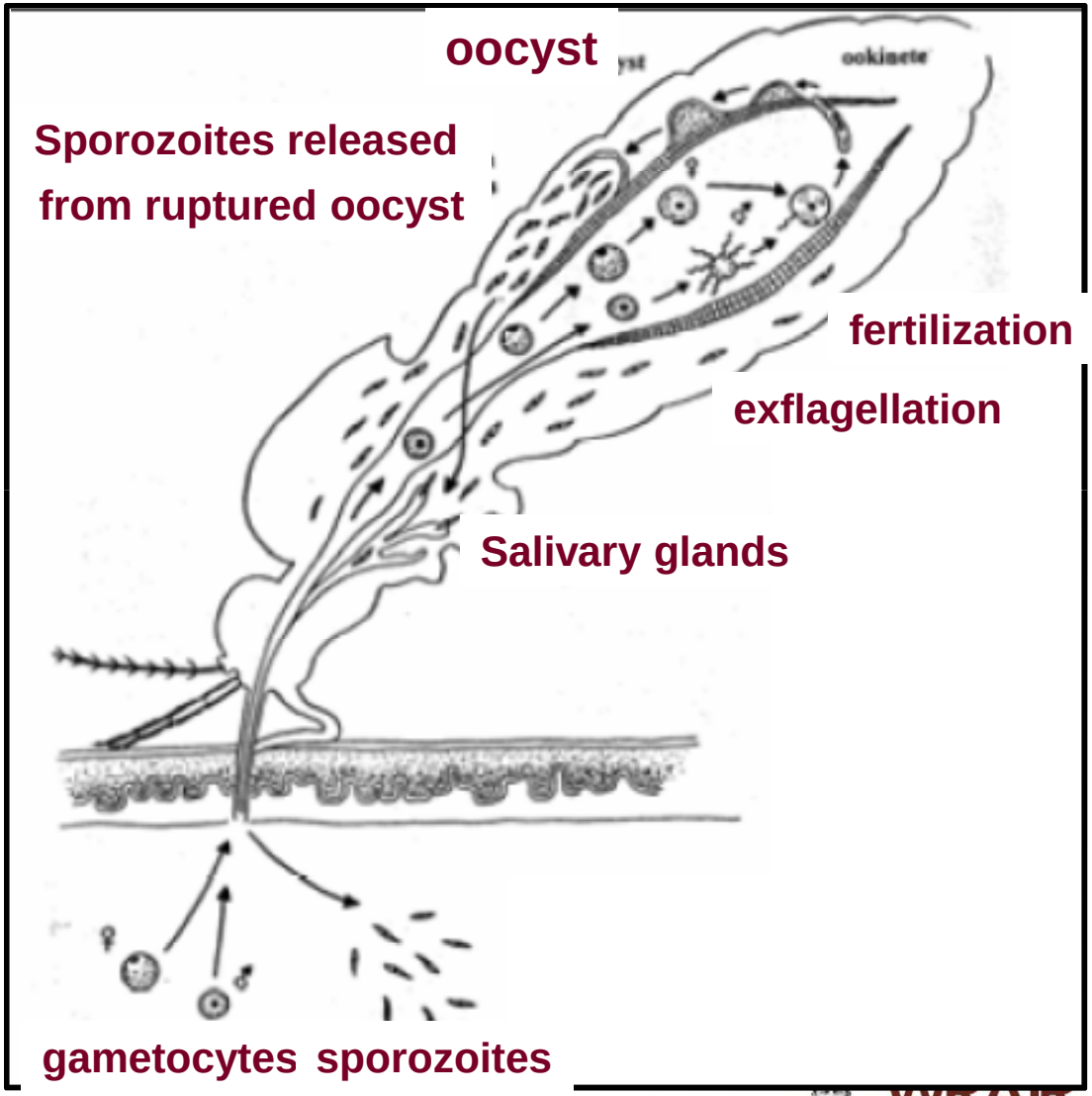


Life cycle of *Plasmodium*

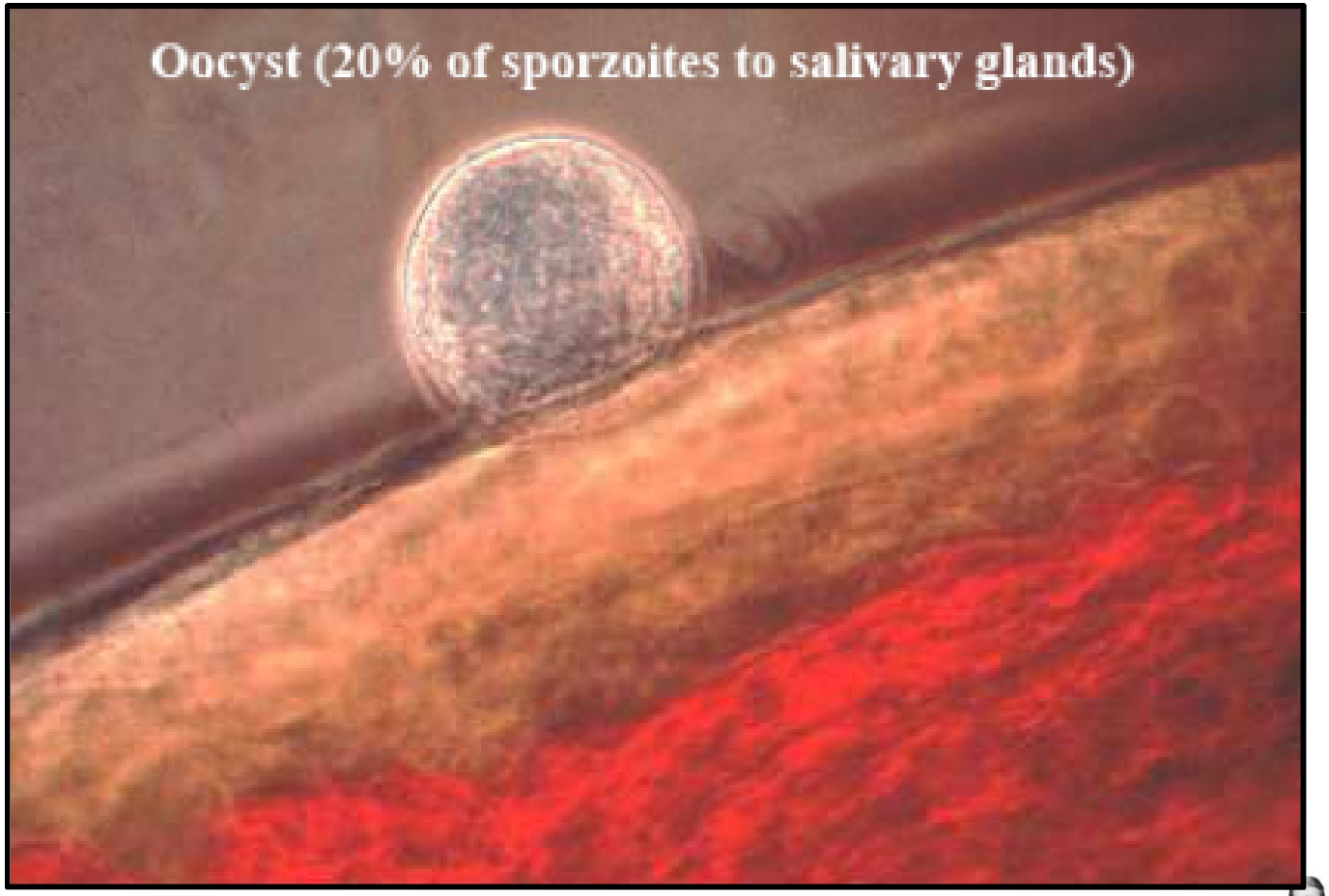
1. Mosquitoes acquire **gametocyte-stage** parasites.

2. The parasites transform to ookinetes, then oocysts, which produce sporozoites.

3. **Sporozoites** invade the salivary glands and are transmitted to new host.



Life cycle - Sexual stage



Dengue virus vectors

Feeding Habits – *Ae. albopictus*

- *Aedes albopictus* prefers to feed and rest outdoors.
- Feeds during daytime (diurnal)
- Feeds on any vertebrate host but prefers humans

Aedes albopictus

WRAIR
Walter Reed Army Institute of Research
Soldier Health • World Health

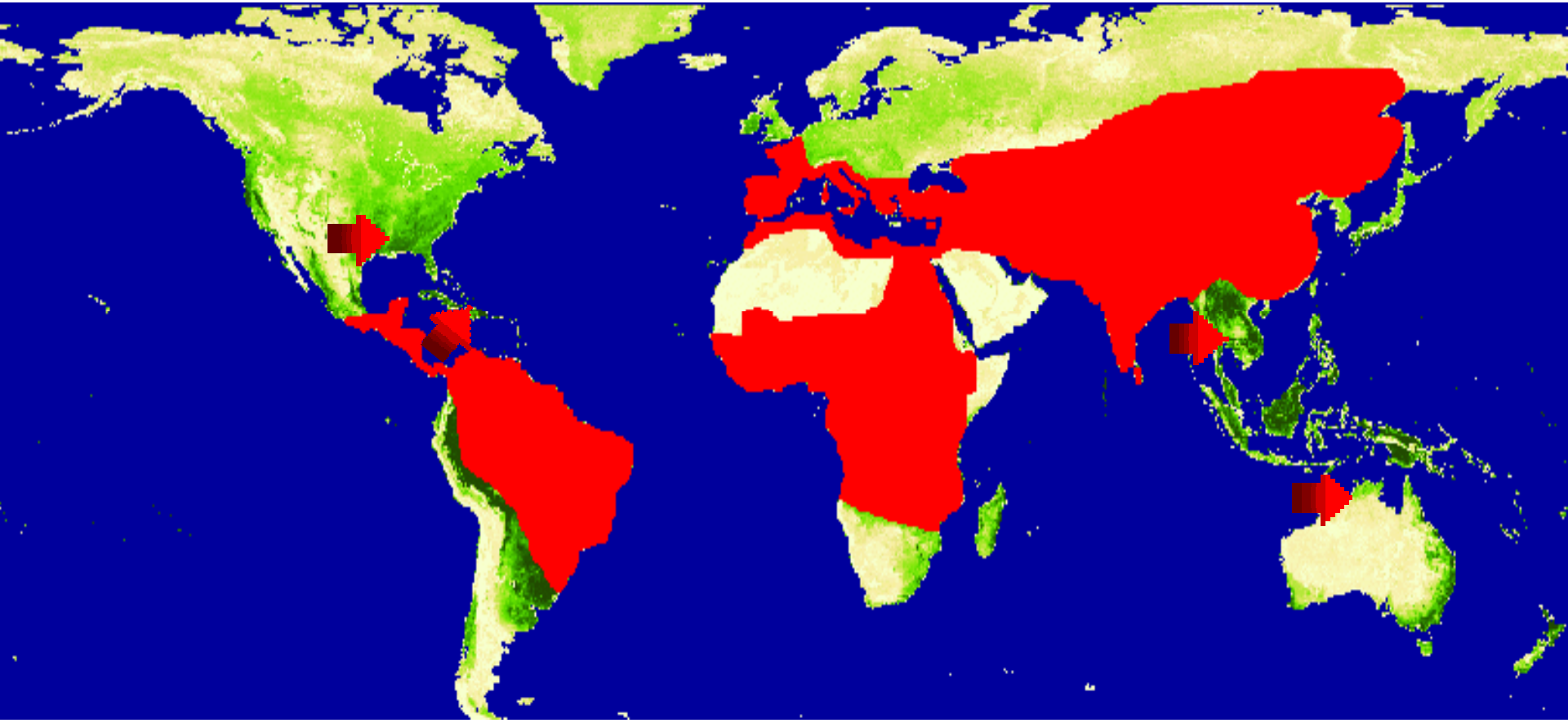
Aedes comparison

	Ae. aegypti	***Ae. albopictus***
Environment	**Urban**	**Sylvatic**
Breed/feed	**Indoors(< 200m)**	**Outdoors**
Container type	**Artificial**	**Natural and artificial**
Biting peak	**Daytime**	**Dusk**
Host	**Human**	**Human/Vertebrates**
Flight Range	**< 200m**	**< 600m**

WRAIR
Walter Reed Army Institute of Research
Soldier Health • World Health

Leishmaniasis

Global distribution of the leishmaniases



The Epidemiological Triangle

Enzootic Cycle

Sand fly

Mammalian Reservoir

Incidental Host

Man and his Activities

WRAIR
Walter Reed Army Institute of Research
Soldier Health • World Health

Psammomys obesus

Chenopods

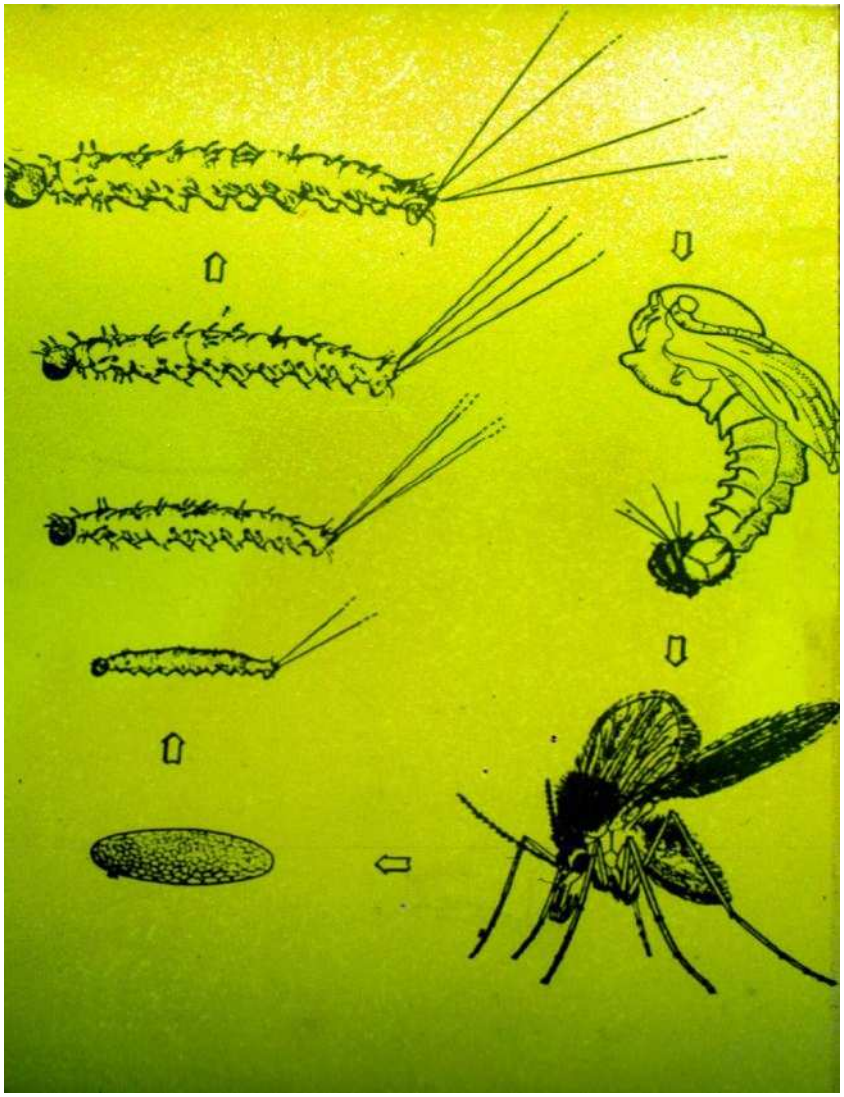
L. major enzootic cycle

Characteristics

- Small (2-3 mm)
- Brown (but appear white when illuminated)
- Wings held in erect V-shape
- Nocturnal
- Do not hover
- Silent
- Painful bite

Life cycle and developmental stages

Fourth instar larvae



Life cycle

Adult male

Eggs

Adult female

Sand flies – vital requirements

- Larvae breed in soil (not aquatic)
- Only females take blood, from a variety of vertebrate species
- Rest during the day in dark, humid microhabitats
- Both sexes require sugar as an energy source

Sand flies resting on wall of a chicken house

Rain Forest, desert, mountains, cities

Tick-borne Diseases

African tick-bite fever (ATBF)

- an emerging infectious disease endemic in sub-Saharan Africa
- the most commonly encountered rickettsiosis in travel medicine.
- *Rickettisia africae*
- *Amblyomma variegatum*

1. Ndip et al., 2011. Risk Factors for African Tick-Bite Fever in Rural Central Africa. *Am. J. Trop. Med. Hyg.*

2. Raoult et al., 2001. *Rickettsia africae , a tick-borne pathogen in travelers* to sub-Saharan Africa . *N Engl J Med*

WRAIR
Walter Reed Army Institute of Research
Soldier Health • World Health

Prevention

WRAIR
Walter Reed Army Institute of Research
Soldier Health • World Health

WHAT CAN YOU DO TO MINIMIZE RISK?

- Find out what the priority risks are in your area before you deploy.
- Understand the vectors so you can avoid them.
- Modify behaviors to minimize contact
  - Use **repellents**
  - Sleep under insecticide treated netting
  - Wear permethrin treated uniforms
- Take malaria chemo (if warranted)
- Call for help:
  - AFPMB (CLO) : afpmb-webmaster@osd.mil: subject CLO question
  - PHC, Ento Division

WRAIR
Walter Reed Army Institute of Research
Soldier Health • World Health

Standard Military DEET Skin Repellent

Commercial

Military

33% Controlled-Release DEET Lotion: NSN 6840-01-284-3982

Highest rated skin repellent available (Consumer Reports, May 2003)

WRAIR
Walter Reed Army Institute of Research
Soldier Health • World Health

CDC recommended repellents

- Of the active ingredients registered with the EPA, products containing these active ingredients typically provide longer-lasting protection than others:

DEET, Picaridin, and IR3535

- The three non-DEET compounds work as well as or nearly as well as DEET when they are used at higher concentrations (~20%).

http://www.cdc.gov/ncidod/dvbid/westnile/repellentupdates.htm

http://www.epa.gov/pesticides/health/mosquitoes/ai_insectrp.htm

http://www.entomology.wisc.edu/mosquitosite/topicalrepel.html

WRAIR
Walter Reed Army Institute of Research
Soldier Health • World Health

Picaridin

- Natrapel, 20%, 3.5-oz. Pump Spray
- Cutter Advanced, 7%, 6-oz. Pump Spray
- Off Skintastic, 5%, 6-oz. Pump Spray

Picaridin

- Picaridin is a colorless, nearly odorless liquid active ingredient that is recommended by the CDC as an alternative to DEET.
- Lab and field studies of products containing picaridin (10-20%) indicate good protection.
- 7.5% products are not as effective.

IR3535

- IR3535 is recommended by the CDC as an alternative to DEET.
- IR3535 is a synthetic insect repellent structurally similar to a natural amino acid, beta-alanine and is classified as a biopesticide by the EPA.
- This compound has been used as a mosquito repellent in Europe and Asia for 10-20 years
- Approved by the U.S. EPA in 1999.
- IR3535 is currently available in the Avon Skin-so-soft Bug Guard 7.5%

Treated Uniforms

- A new training briefing on permethrin-treated Flame-Resistant Army Combat Uniforms (FR ACUs) has been released –CAC REQUIRED
- https://www.us.army.mil/suite/doc/28282876
- https://peosoldier.army.mil/newpeo/ContactUs/faqs/fracu.asp

Bed nets

Enhanced BedNet System 3740-01-546-4354

Improved Bed Net System 3740-01-543-5652

Bed net, Pop-up, self-supporting

Coyote Brown 3740-01-518-7310

OD Green (Camo) 3740-01-516-4415

The pop-up bed net is factory-treated with permethrin and has much finer mesh than the standard military bed net.

WRAIR

Walter Reed Army Institute of Research

Soldier Health • World Health

Myth Busters

- No evidence that eating garlic or taking vitamin B tablets reduces mosquito bites.
- Dark clothing is usually more attractive than light colored clothing.
- Drinking alcohol may increase your attractiveness to mosquitoes.

WRAIR
Walter Reed Army Institute of Research
Soldier Health • World Health

Myth Busters

- Some mosquito control devices use repellents to protect a small outdoor area like a patio.
- No products approved by the EPA for indoors.
- Effective devices which use **allethrin** or other **pyrethroids** to repel mosquitoes include:
  - Mosquito coils, and
  - ThermaCell (TM) Mosquito Repellent System.

WRAIR
Walter Reed Army Institute of Research
Soldier Health • World Health

Myth Busters

Myth Busters

- Citronella candles are weak.
- Geraniol candles can provide 1 meter of protection.

Myth Busters

- Sonic and electronic devices do not work.


Soldier Health
World Health