Mendel University in Brno

20. 4. 2016, Rivers 2016, Krtiny

Prepared by:

Prof. MVDr. Ivo Pavlik, CSc.

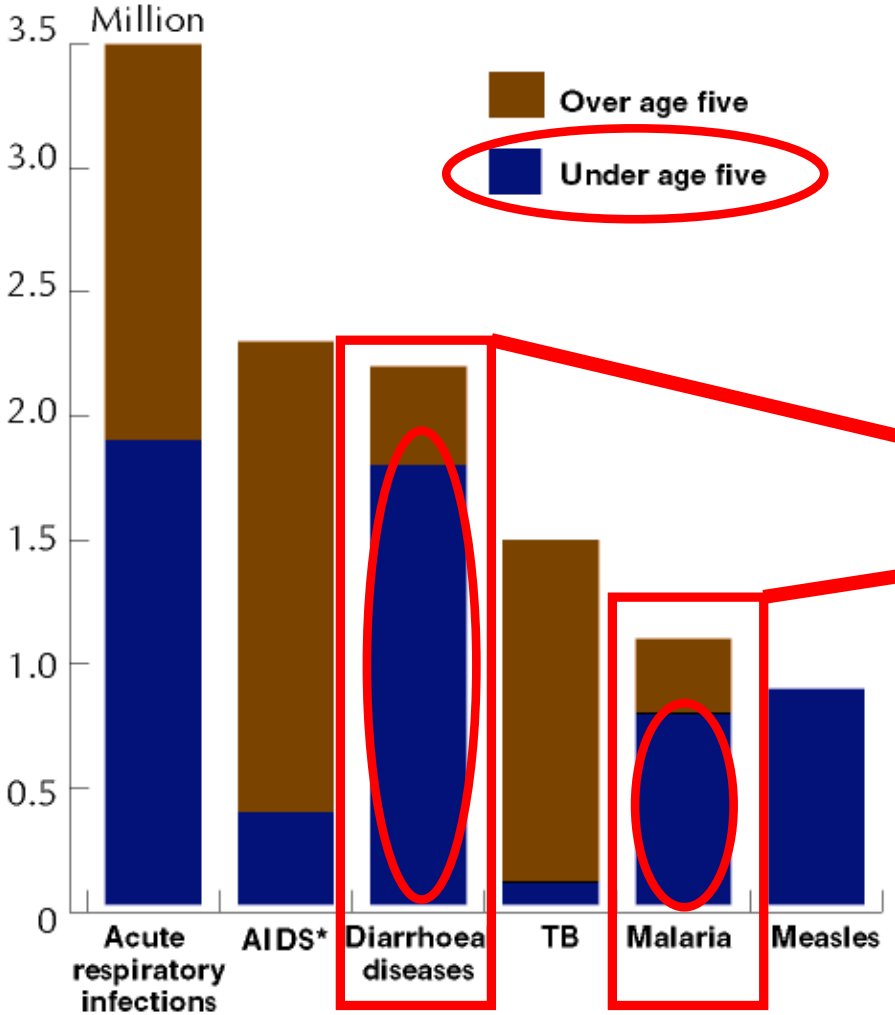
Riverbeds in urban environment and risks of water-related diseases spreading in developing and developed countries

THE ECOSYSTEM SERVICES OF URBAN RIVERS
April 19th – 22th 2016 – Chateau Křtiny, Czech Republic

Not known ecology of the most microorganisms

LEADING INFECTIOUS KILLERS

Six high-burden diseases cause 90% of total disease deaths

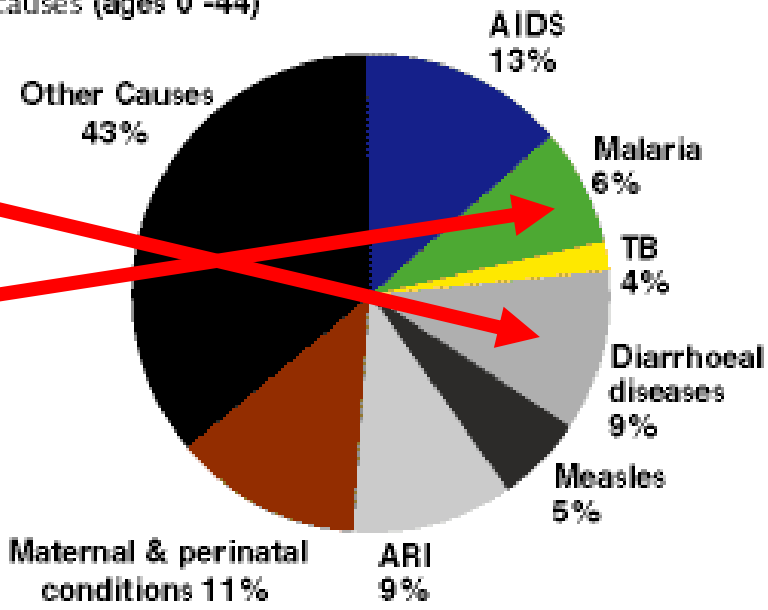


*HIV-positive people who have died with TB have been included among AIDS deaths

Source: World Health Organization/CDS 1999

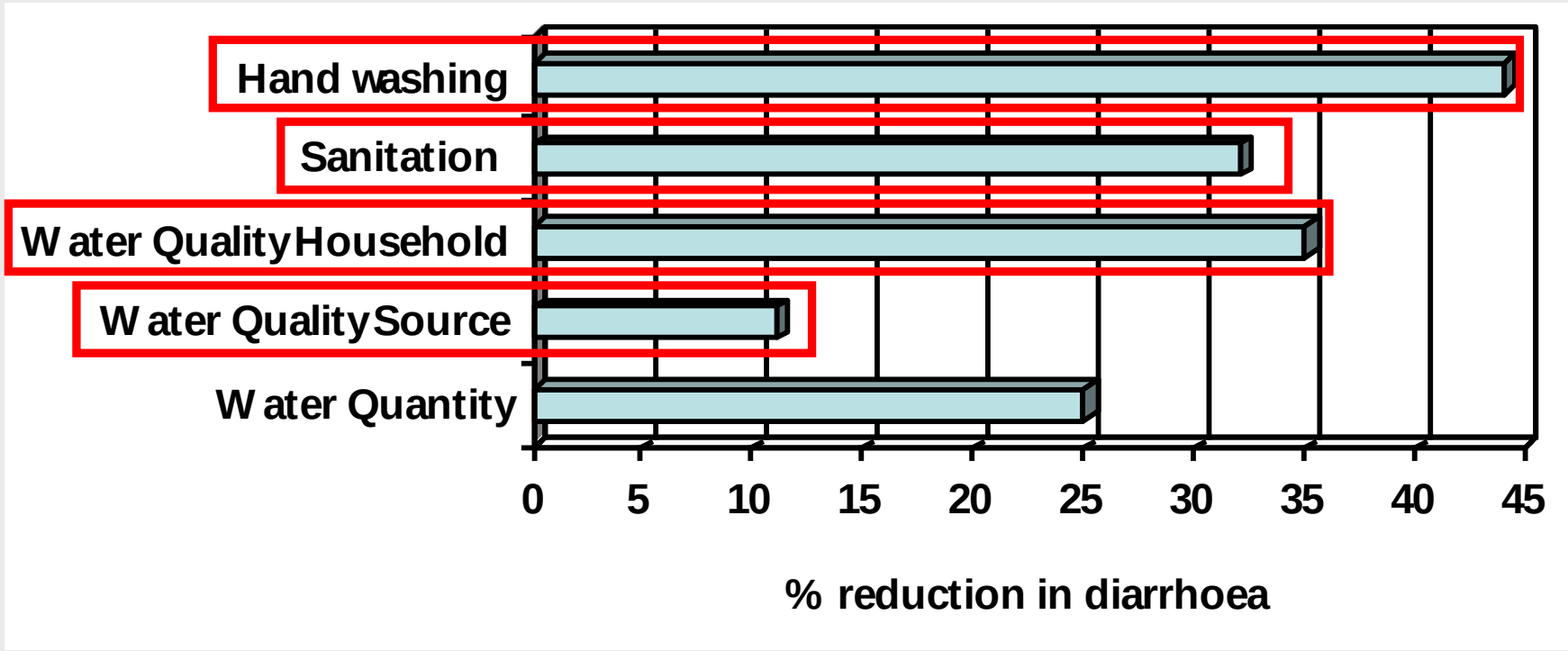
DEATHS IN DEVELOPING COUNTRIES

Two out of three deaths among children and young adults in Africa and Southeast Asia are due to seven causes (ages 0 -44)



Source: World Health Organization/CDS

Water, sanitation, and hygiene interventions to reduce diarrhoea in less developed countries: a systematic review and meta-analysis, Fewtrell et al (2005)



Safe Drinking Water

- Free from pathogenic agents
- Free from harmful chemicals
- Pleasant to taste
- Usable for domestic purposes

Photo Google

Safe Water for International Travelers (SWIT)

1 Drop Countries 

Madagascar, Nepal, Yemen, Angola, Iraq, Laos

2 Drops Countries 

Egypt, Zimbabwe, Morocco, India, Kenya, Dominican Republic

3 Drops Countries 

Turkey, Saudi Arabia, Cuba, Indonesia, Vietnam, South Africa, Tunisia, Thailand

WHO

Safe Water for International Travelers (SWIT)

4 Drops Countries

Slovakia, Bulgaria, Croatia, Hungary, Kuwait

5 Drops Countries

Czech Republic, Austria, USA, Spain, Greek, The Netherlands, Israel

WHO

Water-related diseases

WHO

1. **Water-borne diseases** (microbial contamination of drinking water) – infectious agent ingested

2. **Water-washed (water-scare) diseases** (sufficient water quantities) – person to person

3. **Water-based diseases** (infection through contact with water) – intermediate host in water

4. **Water-associated vector-borne diseases** (ecosystems conducive to vector breeding) – insect breeding or biting near water

1. Water-borne diseases - ECOLOGY

(microbial contamination of drinking water)

- **Developing countries**

Nicaragua

Photo I. Pavlik

Ometepe Lake, Nicaragua

Rivas

Photo I. Pavlik

Ometepe Lake, Nicaragua

Rivas

Photo I. Pavlik

Somoto River, Nicaragua

Photo I. Pavlik

Somoto River, Nicaragua

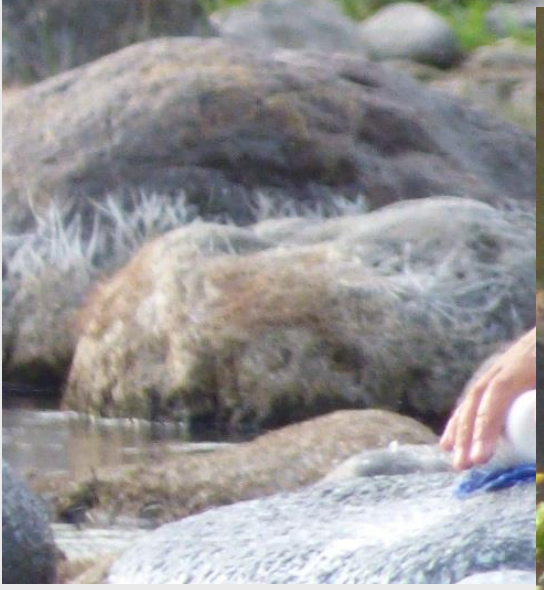


Photo I. Pavlik

Dolores, Nicaragua


Nicaragua
Photo I. Pavlik

Ice represents critical factor (vehiculum)!

Managua, Nicaragua

Photo I. Pavlik

Water contamination, Mexico

Photo I. Pavlik

Water contamination, Brazil

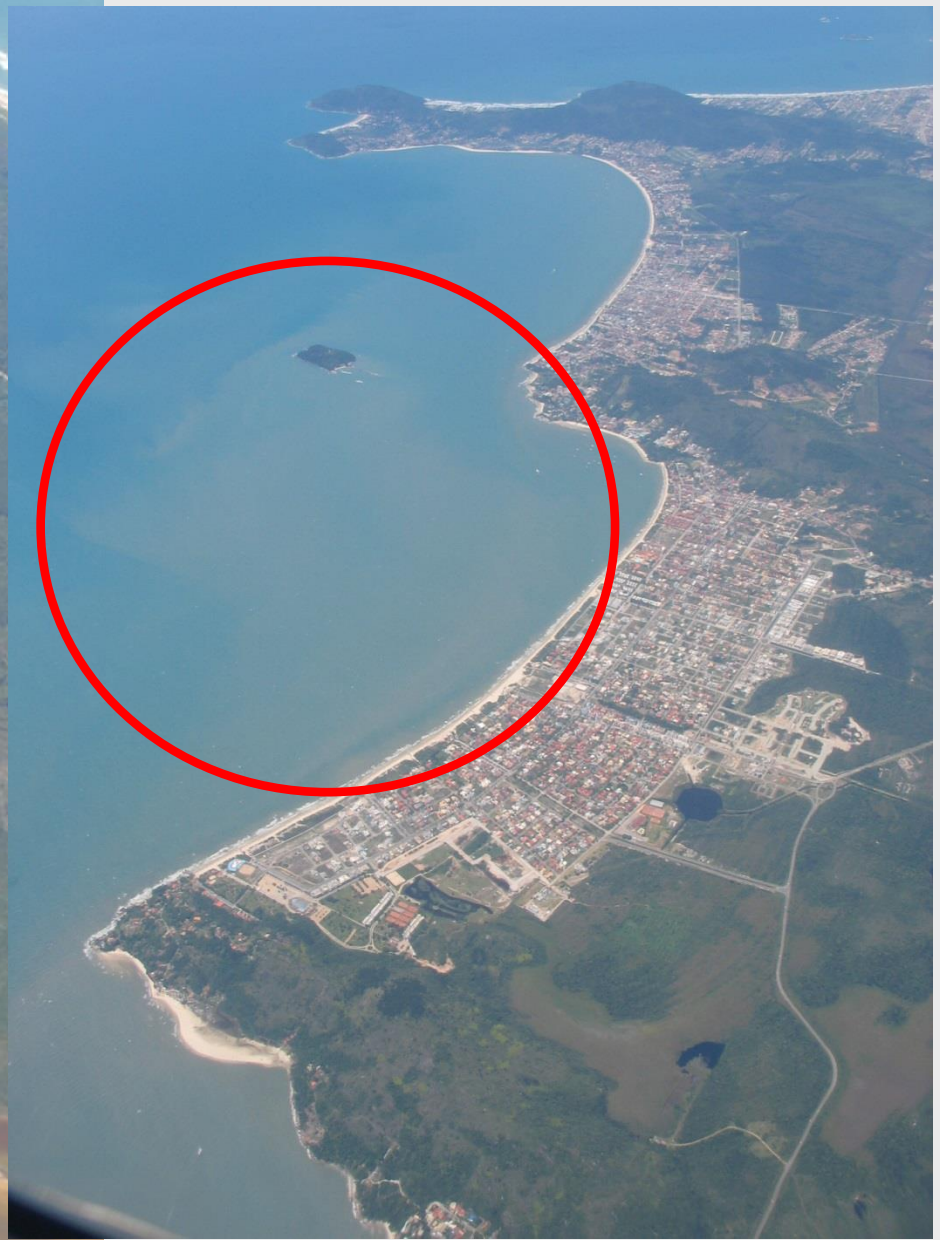


Photo I. Pavlik

1. Water-borne diseases - ingested (microbial contamination of drinking water)

Infectious water-borne diseases

- Water-borne diseases are caused by pathogens that can be directly spread through contaminated water.
- Most cause diarrheal illness spread through the fecal-oral route.
- **Viruses:** Hepatitis A, E, Rotaviruses, noroviruses
- **Bacteria:** Cholera, Shigellosis and Typhoid Fever
- **Protozoa:** Cryptosporidiosis, Giardiasis
- **Helminths:** Guinea Worm, Schistosomiasis (Bilharzia)

Examples from Nicaragua - rotaviruses

Journal of Clinical Virology 46 (2009) 391–393

Contents lists available at ScienceDirect

Journal of Clinical Virology

journal homepage: www.elsevier.com/locate/jcv

Letter to the Editor

Zoonotic bovine rotavirus strain in a diarrheic child, Nicaragua

ther group A rotaviruses representing various genotype speci-
ficities. Using phylogenetic analysis,[7] the most likely ancestors

Ometepe Lake, Nicaragua

Photo I. Pavlik

Rotaviruses – seasonal variations (raining…)

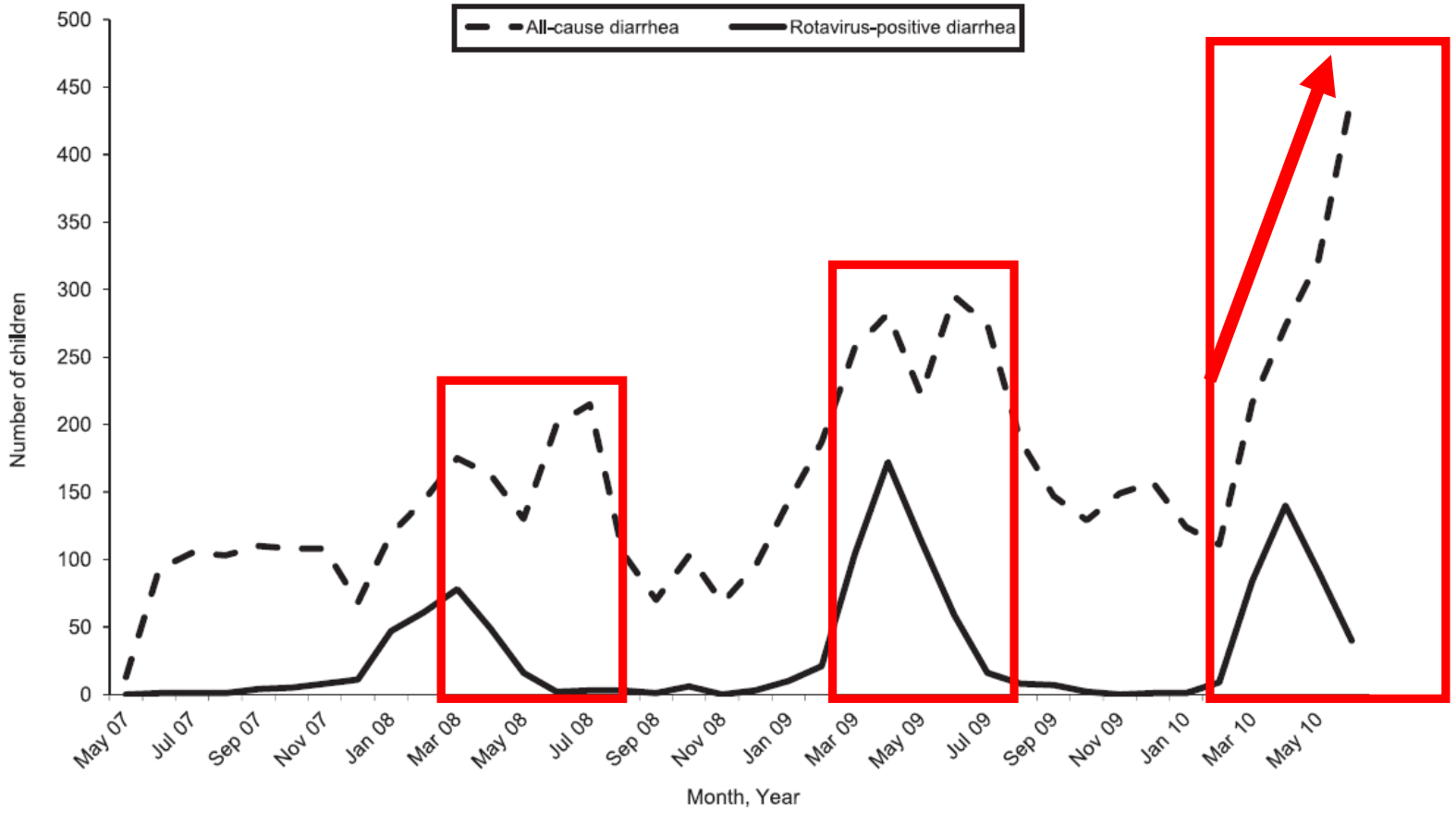


FIGURE 1

Monthly number of vaccine age-eligible children with severe diarrhea and rotavirus positive diarrhea, 4 hospitals, Nicaragua, July 2007 through June 2010.

Am. J. Trop. Med. Hyg., 89(2), 2013, pp. 246–250
doi:10.4269/ajtmh.13-0026

Community Diarrhea Incidence Before and After Rotavirus Vaccine Introduction in Nicaragua

Sylvia Becker-Dreps,* Marlon Meléndez, Lan Liu, Luis Enrique Zambrana, Margarita Paniagua, David J. Weber, Michael G. Hudgens, Mercedes Cáceres, Carina Källestål, Douglas R. Morgan, Félix Espinoza, and Rodolfo Peña

Departme... and F... University of... Nationa... Universi... ...se Control ...tistics, ...ealth (CIDS), ...nomous ...apel Hill,

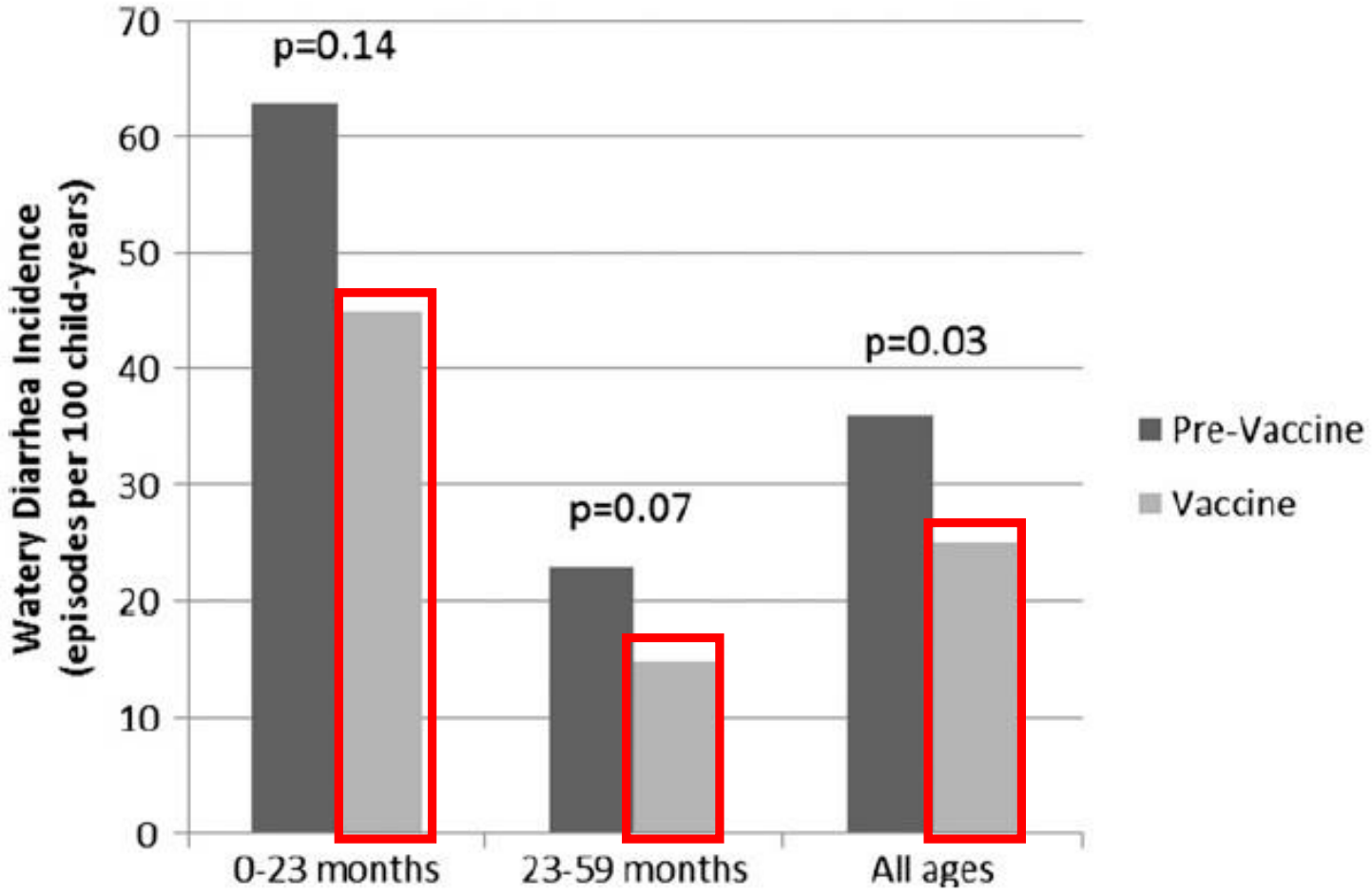


FIGURE 2. Watery diarrhea incidence by age group.

Hepatitis A

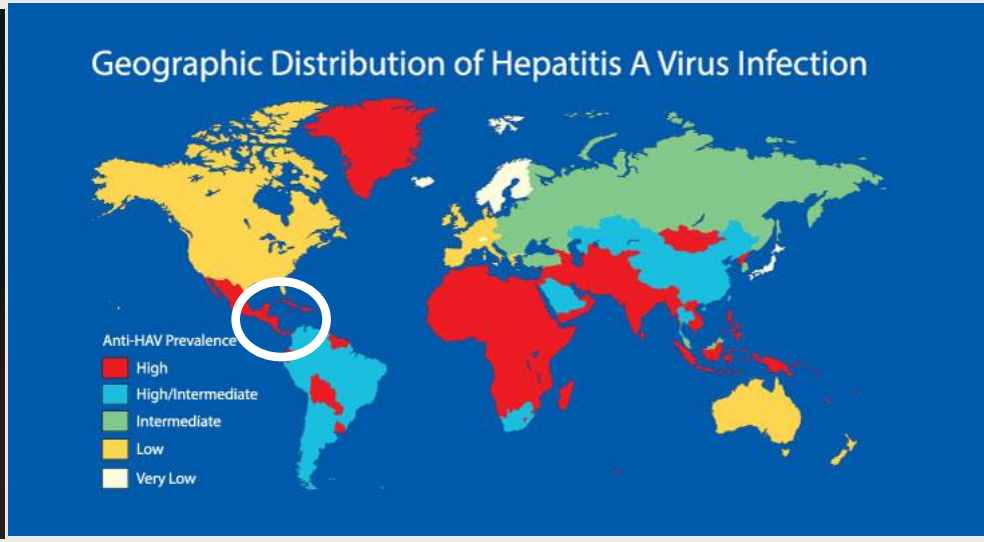
OPEN ACCESS Freely available online

PLOS ONE

Decreasing Risk of Hepatitis A Infection in León, Nicaragua: Evidence from Cross-Sectional and Longitudinal Seroepidemiology Studies

Orlando Mayorga Perez[1], Martin W. G. Brinkhof[2¤a], Matthias Egger[2], Gert Frösner[3], Christian Herzog[4¤b], Marcel Zwahlen[2*]

1 Department of Microbiology and Parasitology, Faculty of Medical Sciences, National Autonomous University, León, Nicaragua, **2** Institute of Social & Preventive Medicine (ISPM), University of Berne, Berne, Switzerland, **3** Max von Pettenkofer Institute, Ludwig-Maximilians University, Munich, Germany, **4** Crucell Switzerland AG, Berne, Switzerland



León – touristic center in Nicaragua

Sewage management…

León

Photo I. Pavlik

Water contaminations

Photo I. Pavlik

Risks of infection (humans‘ expositions)

Photo I. Pavlik

Hepatitis A virus expositions (Nicaragua)

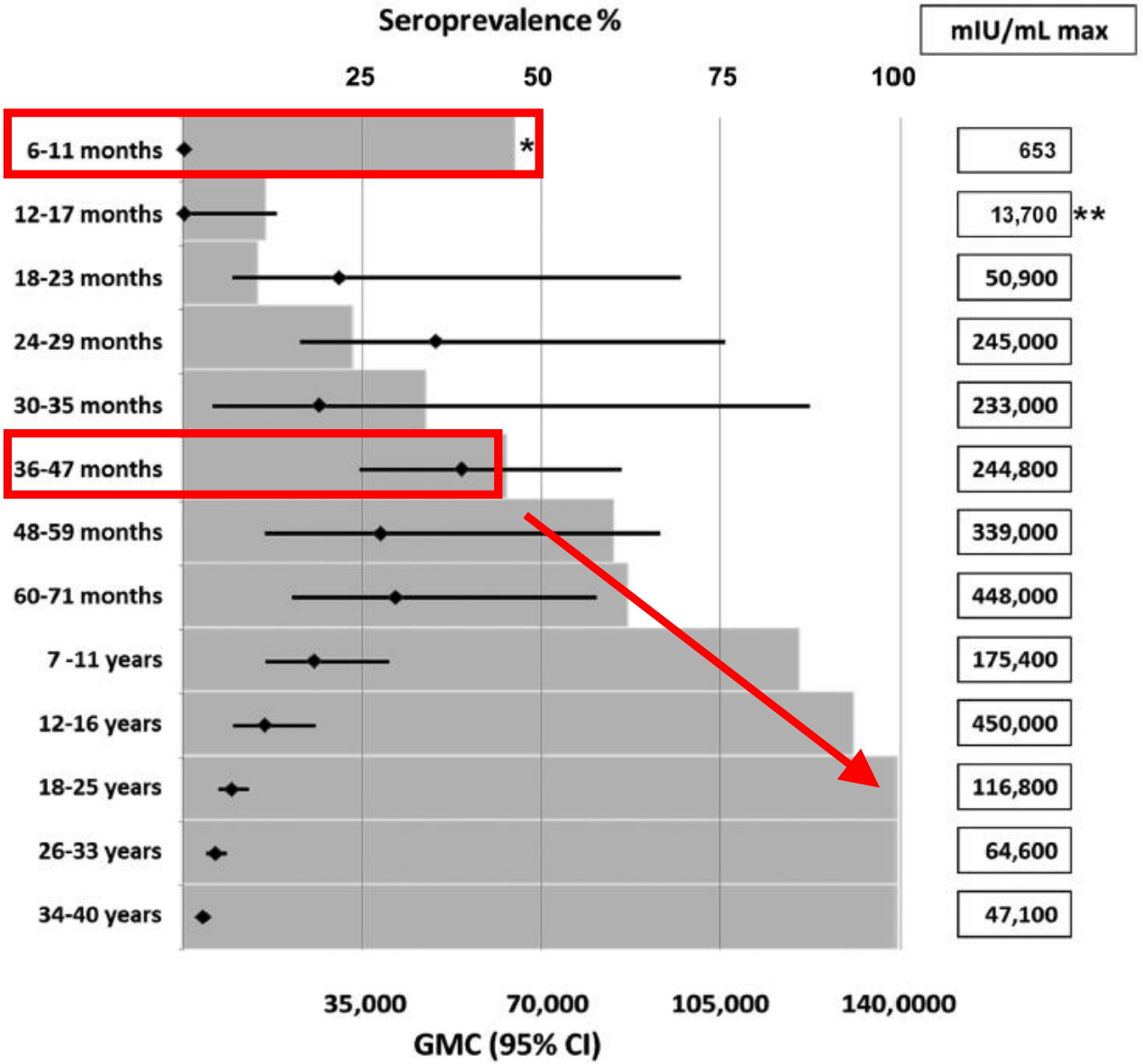


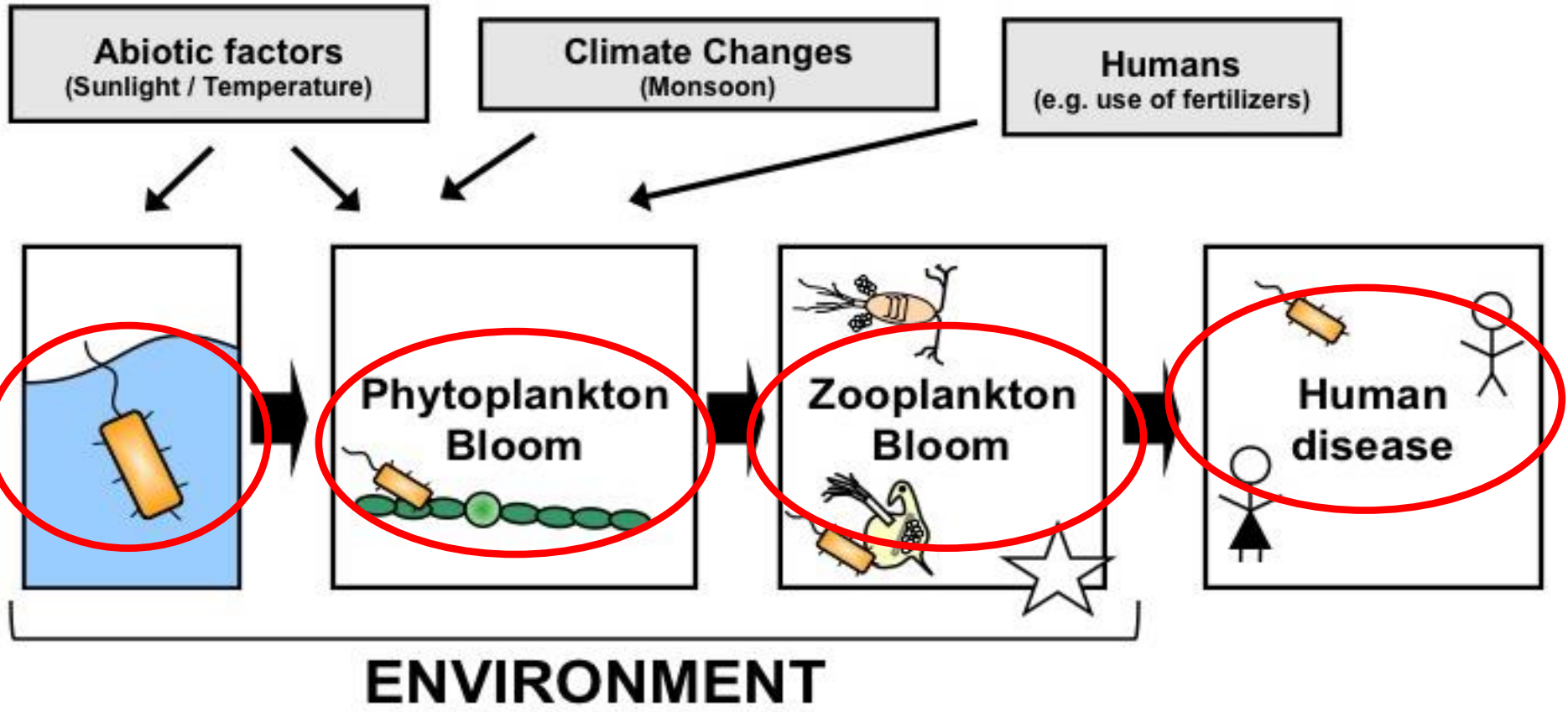
Figure 3. Age-specific seroprevalence, GMC and maximum values of anti-HAV antibodies in the 2003 cross-sectional sample. The shaded bars (upper scale) represent seroprevalence rates; the diamonds (lower scale) indicate GMC with lines representing 95% confidence intervals. * The seroprevalence of the 6–11 months old children is entirely due to maternal anti-HAV antibodies (see Table 2). ** The maximal concentration of 13700 mIU/mL was caused by one recent HAV infection. Three other anti-HAV positive children in this group had maternal anti-HAV with concentrations of 26, 28 and 31 mIU/ml (see Table 2).

doi:10.1371/journal.pone.0087643.g003

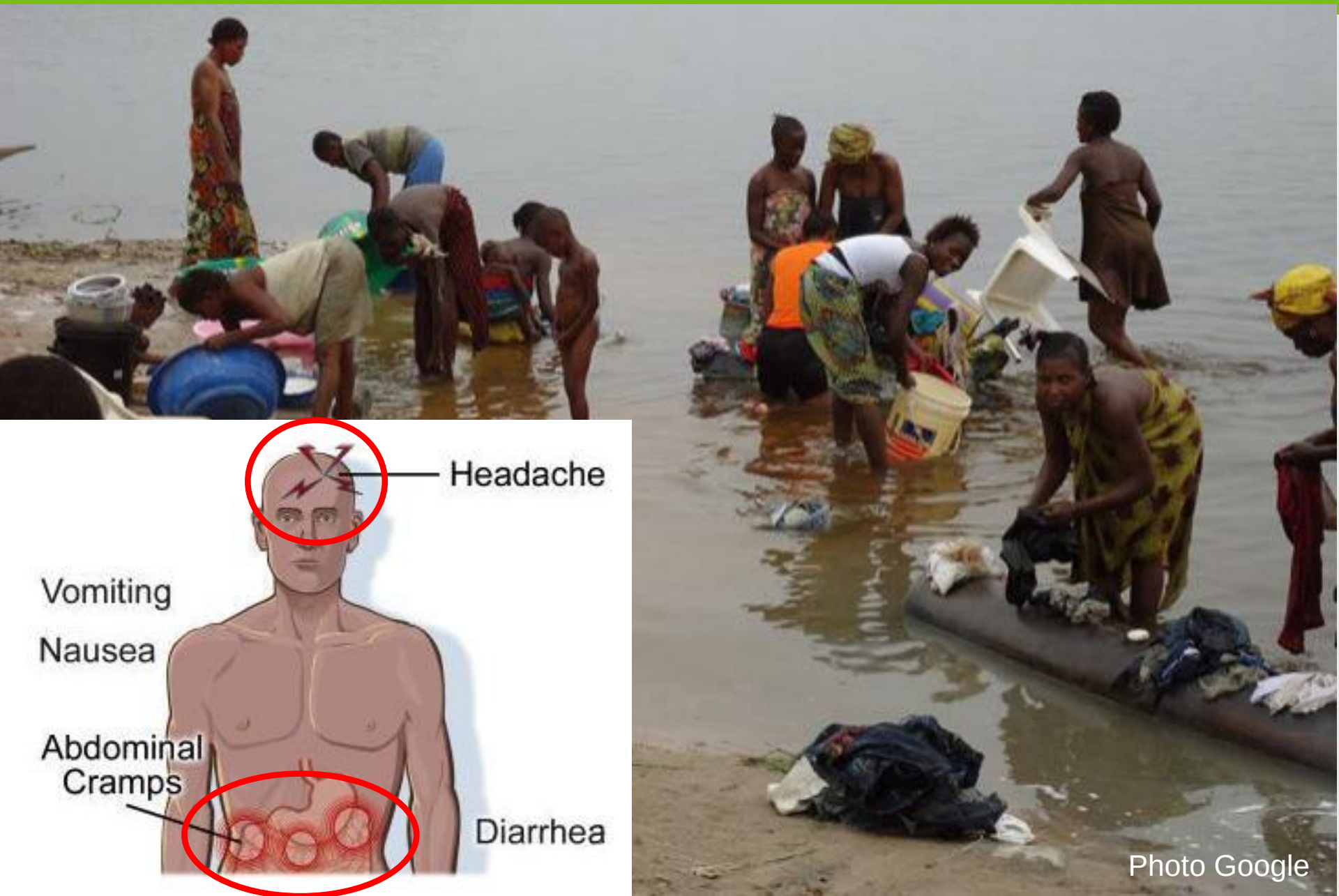
Examples from Nicaragua - bacteria

The Cholera Model –

Effects of Global Climate on Infectious Disease



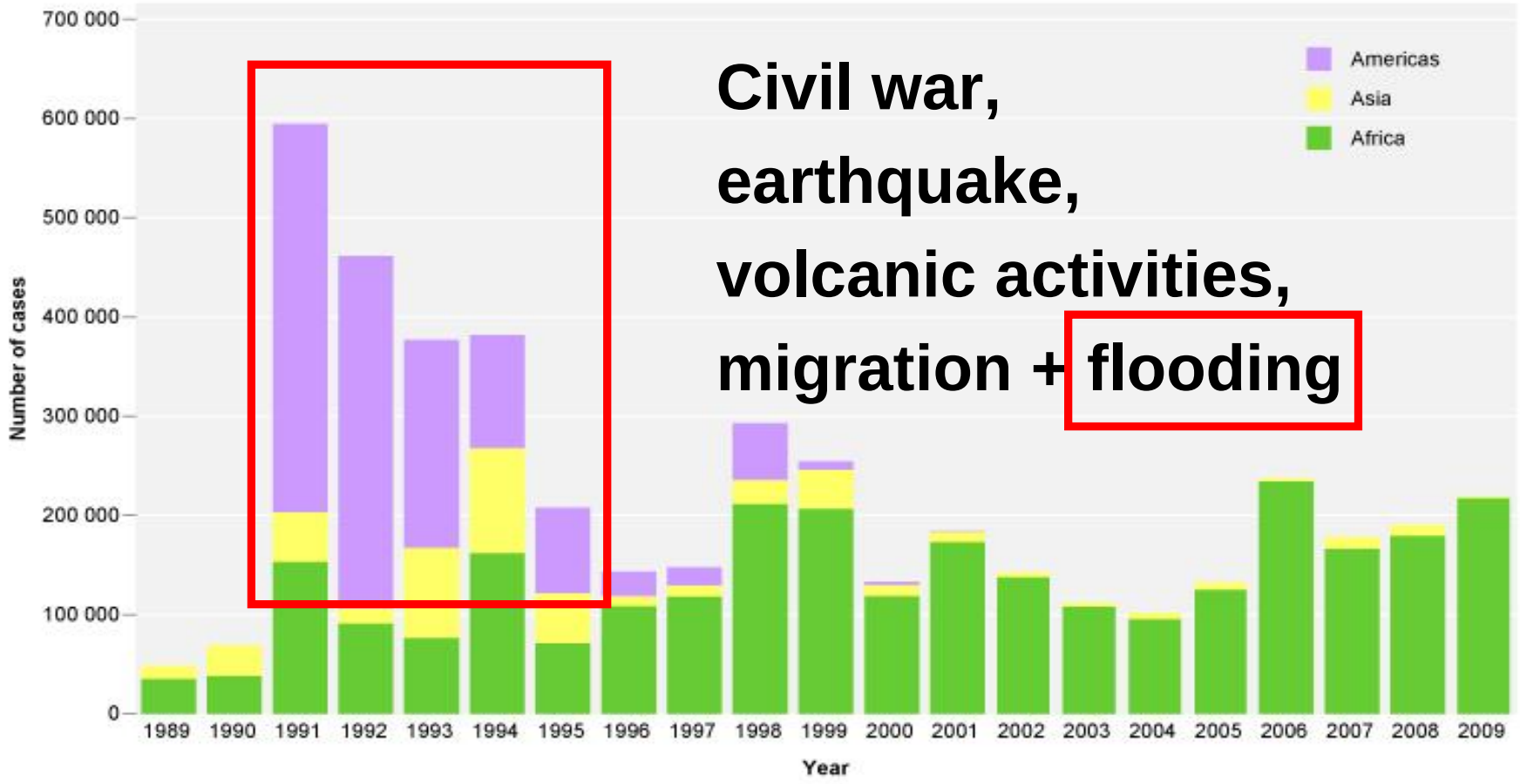
Risks and clinical signs – *Vibrio cholerae*



Notifiable disease – Central America epidemic

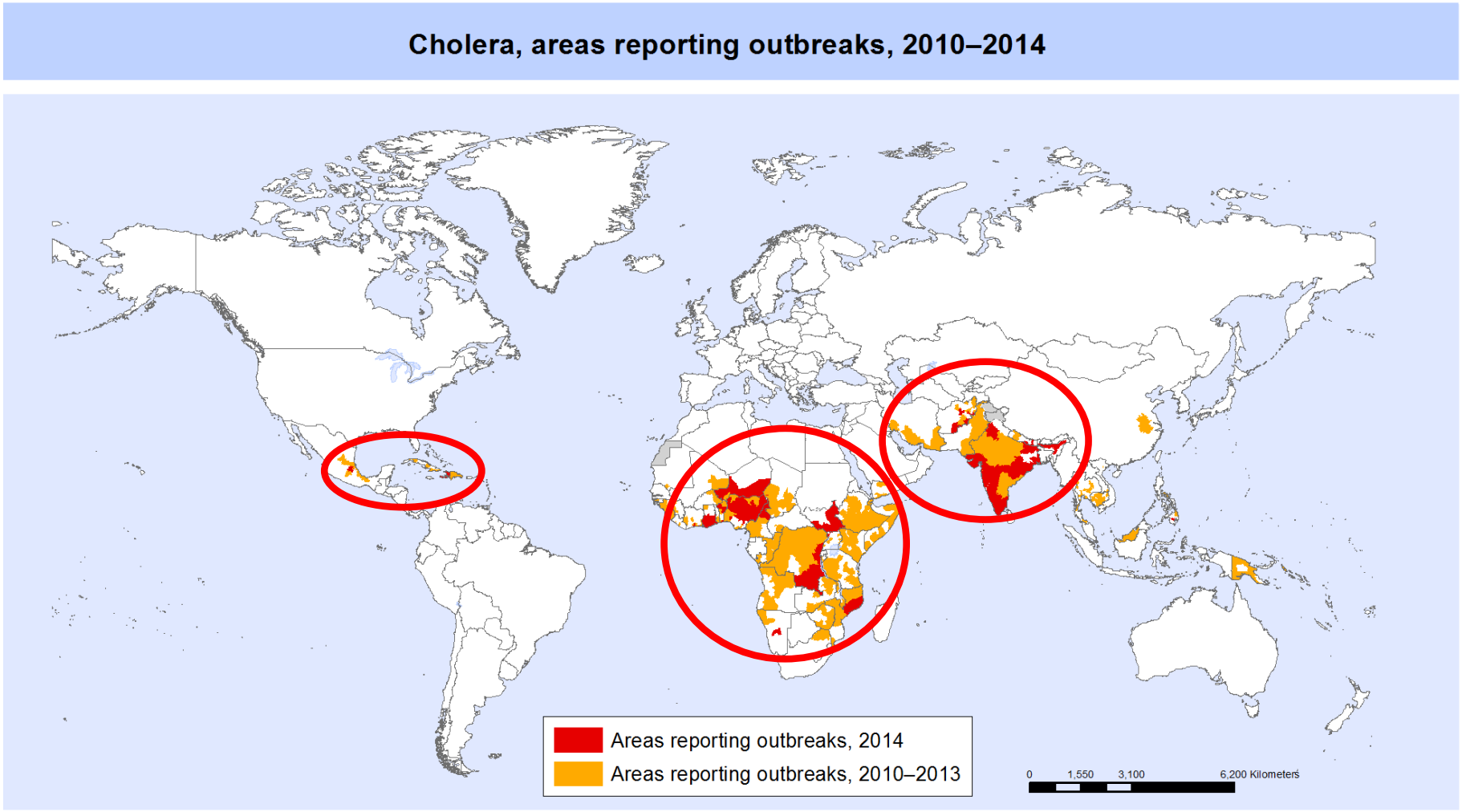
World Health Organization

Cholera cases reported to WHO by year and by continent 1989–2009



Source: WHO Weekly Epidemiological Record no. 31, 2010, 85, 293–308

Current cholera outbreaks, 2010-2014



The boundaries and names shown and the designations used on this map do not imply the expression of any opinion whatsoever on the part of the World Health Organization concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries. Dotted and dashed lines on maps represent approximate border lines for which there may not yet be full agreement.

Data Source: World Health Organization
Map Production: Health Statistics and Information Systems (HSI)
World Health Organization

World Health Organization

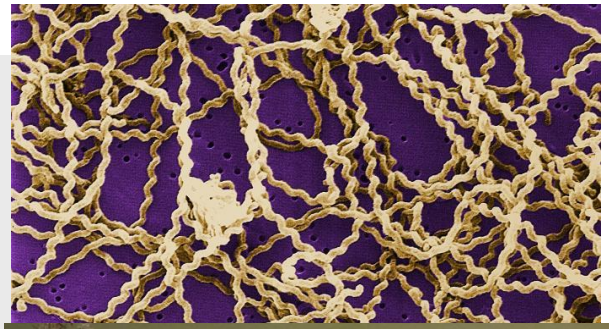
Leptospirosis in Nicaragua – river water

Am. J. Trop. Med. Hyg., 63(5, 6), 2000, pp. 249–254

ASYMPTOMATIC INFECTION AND RISK FACTORS FOR LEPTOSPIROSIS IN NICARAGUA

DAVID A. ASHFORD, ROBYN M. KAISER, RICHARD A. SPIEGEL, BRADLY A. PERKINS, ROBBIN S. WEYANT, SANDRA L. BRAGG, BRIAN PLIKAYTIS, CARLOS JARQUIN, JOSE O. DE LOSE REYES, AND JUAN J. AMADOR

Centers for Disease Control and Prevention, National Center for Infectious Diseases, Division of Bacterial and Mycotic Diseases, Meningitis and Special Pathogens Branch, Atlanta, Georgia; Ministerio de Salud, Complejo Nacional de Salud,



RISK FACTORS FOR LEPTOSPIROSIS IN NICARAGUA

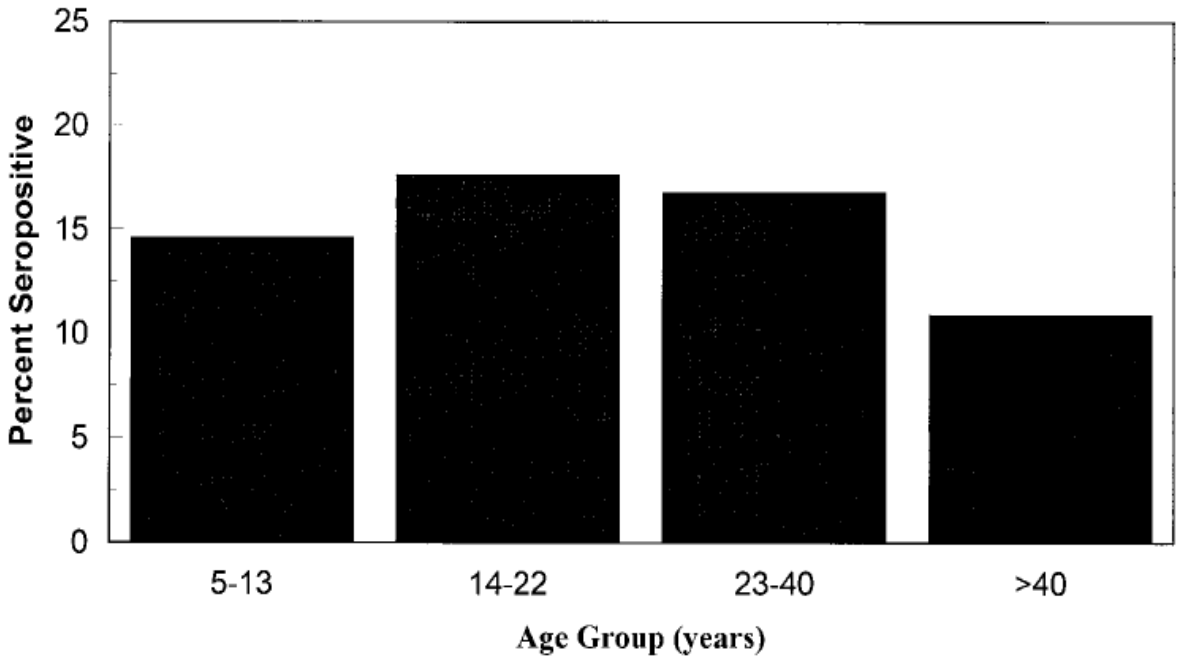


FIGURE 1. Age-specific attack rate for leptospirosis infection in El Sauce, Nicaragua, 1995.

Leptospirosis in Nicaragua – distribution

Int. J. Environ. Res. Public Health **2012**, *9*, 3883-3910; doi:10.3390/ijerph9113883

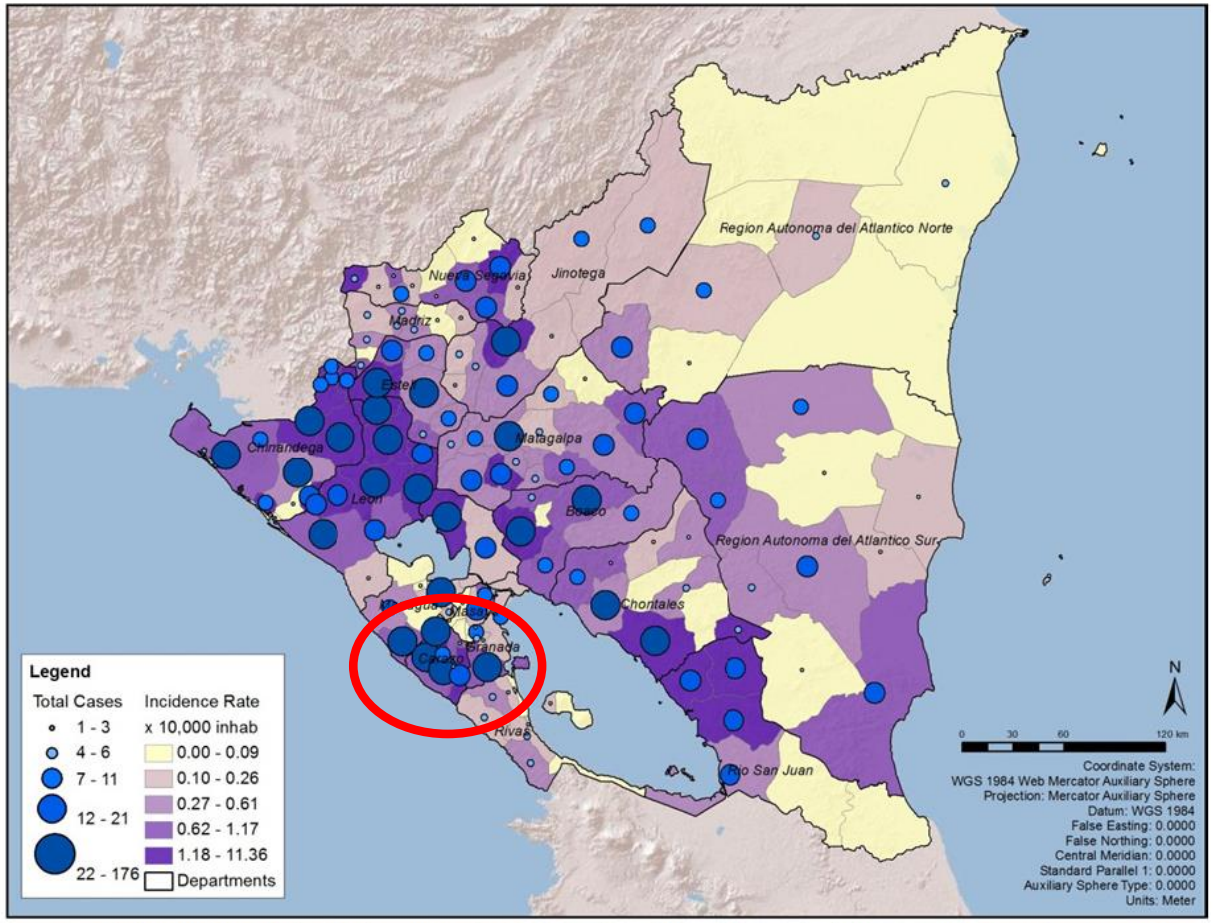
OPEN ACCESS

Article

Leptospirosis Outbreal
Areas and Exploring D

Maria Cristina Schneider [1,*], Patr
Aida Soto [3], Wilmer Marquiño [3], I
Eduardo Jimenez [4], Matthew Moy

Figure 2. Total number of cases of leptospirosis, cumulative incidence rate (10,000 populations), by municipality, Nicaragua, 2004–2010.



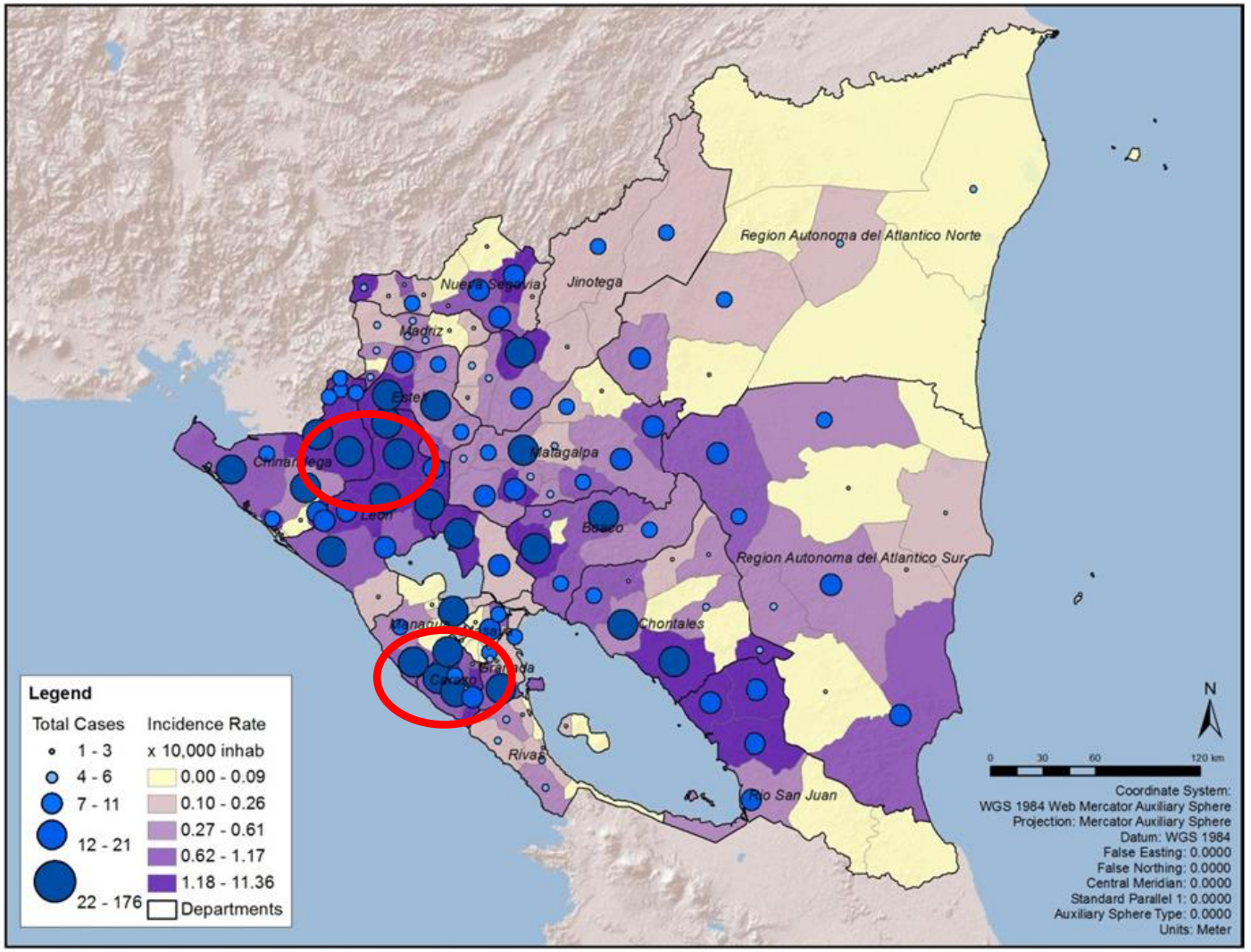
Source: Ministry of Health of Nicaragua [25] and others [26,37]. Analysis was carried out by the authors.

Contaminated surface water „Nicaragua“

Photo I. Pavlik

Irrigation systems: risks in Northern areas

Figure 2. Total number of cases of leptospirosis, cumulative incidence rate (10,000 populations), by municipality, Nicaragua, 2004–2010.

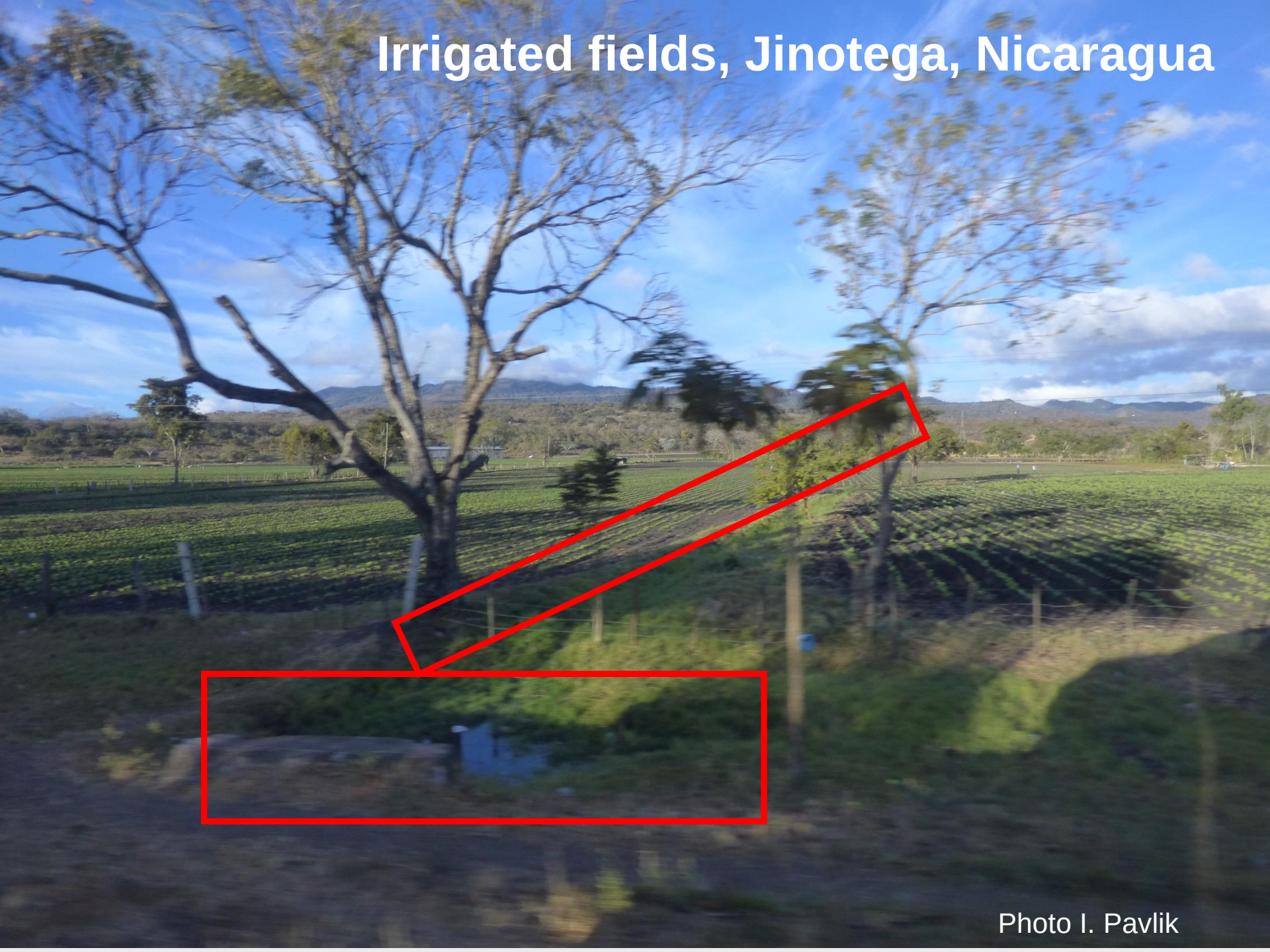


Source: Ministry of Health of Nicaragua [25] and others [26,37]. Analysis was carried out by the authors.

Irrigation systems: vegetable and/or fruit

Nikaragua, León

Google maps;
29.3.2014


Irrigated fields, Jinotega, Nicaragua
Photo I. Pavlik

Cross-contaminated vegetable by water

Photo I. Pavlik

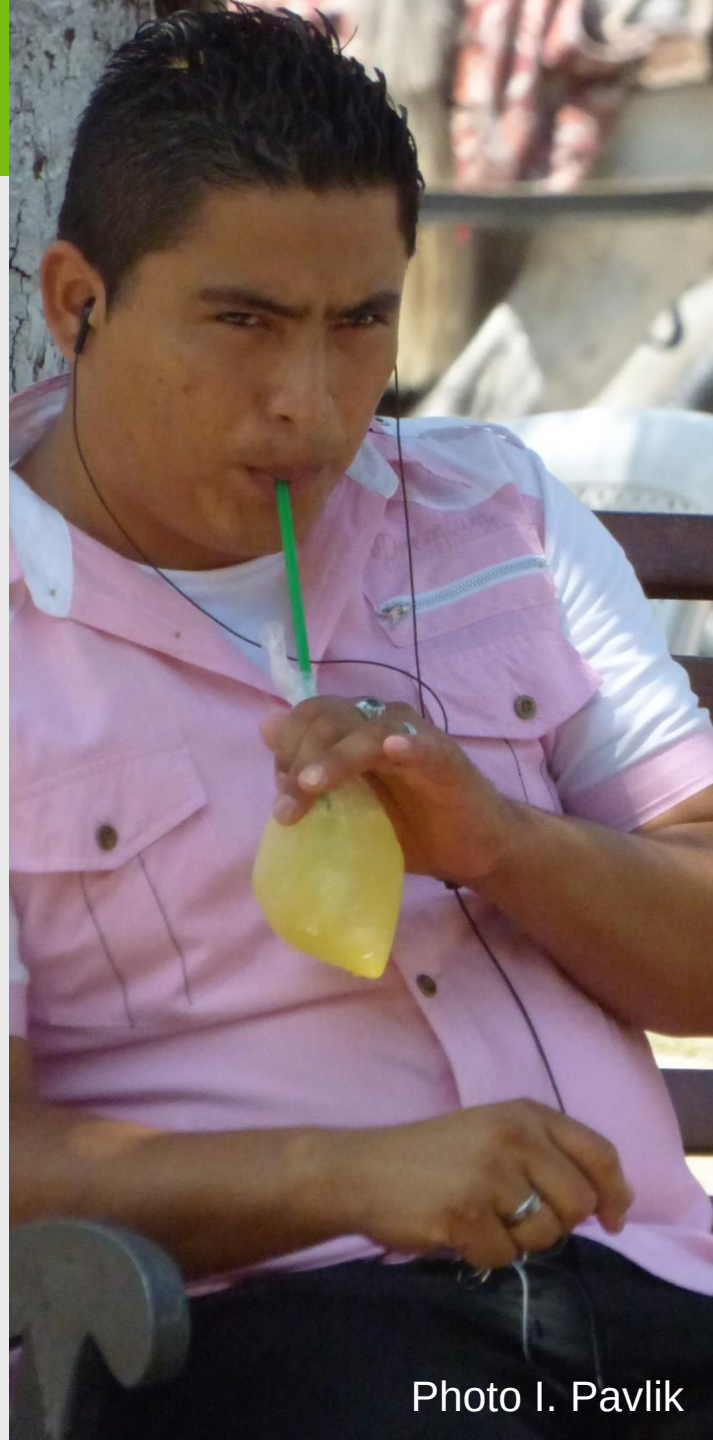


Photo I. Pavlik

Photo I. Pavlik

2. Water-washed diseases – arid areas (Africa)

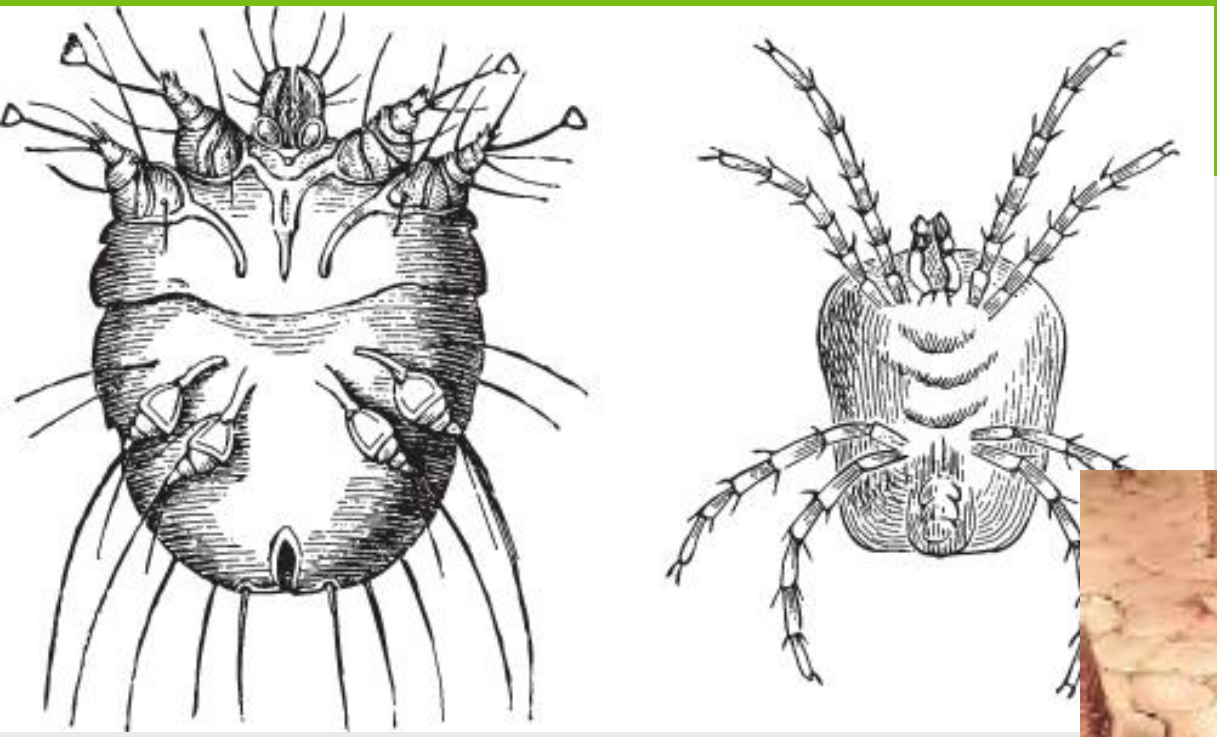
2. Water-washed diseases – person to person

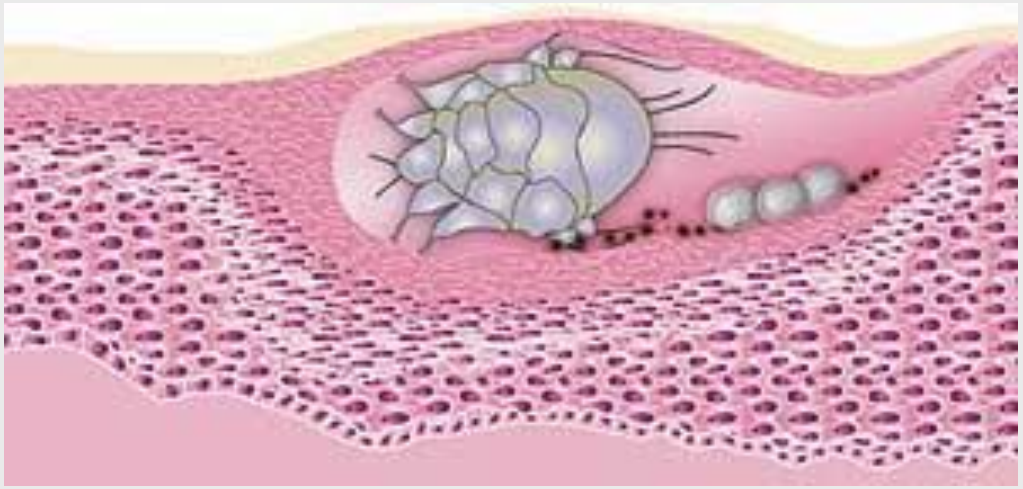
- Scabies
- Flea
- Lice
- Tick-borne diseases

Photo Google

Photo I. Pavlik

Skin infection (not regularly washed)

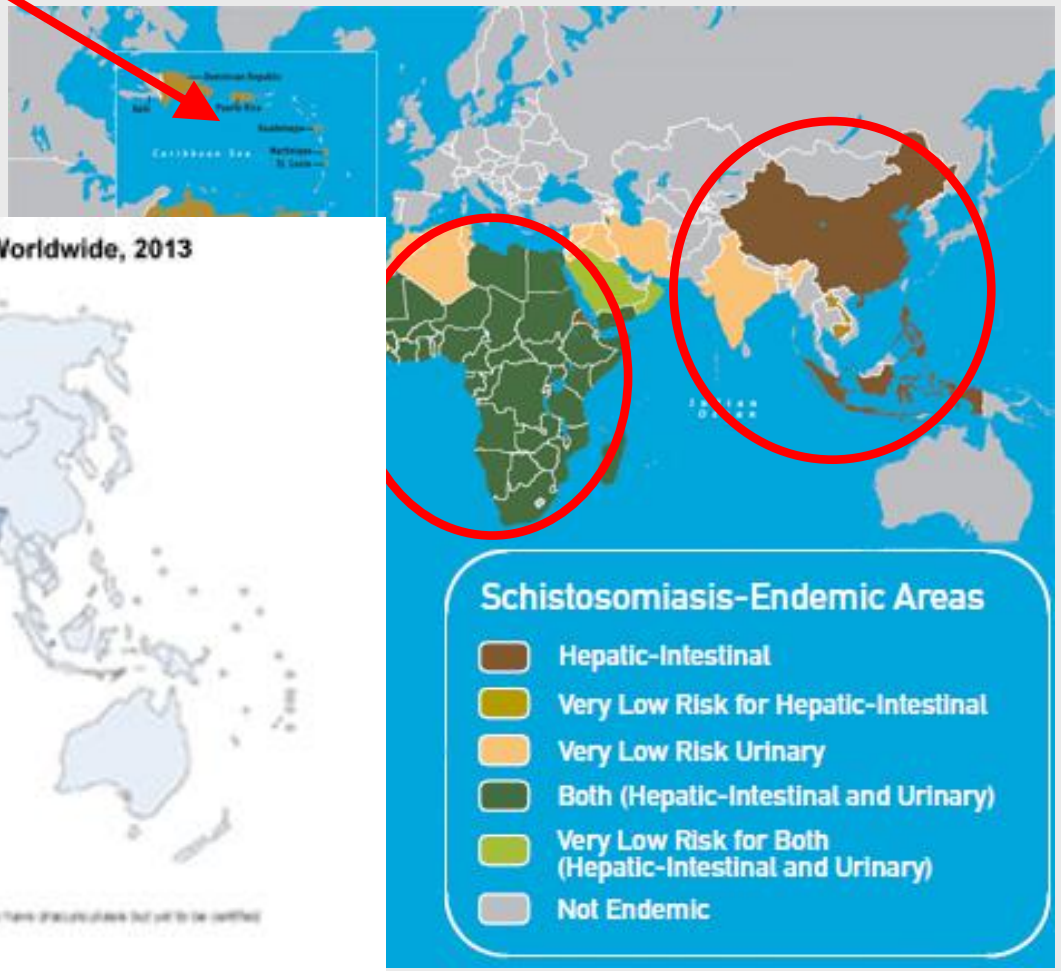




Source: Google

3. Water-based diseases - intermediate host in water

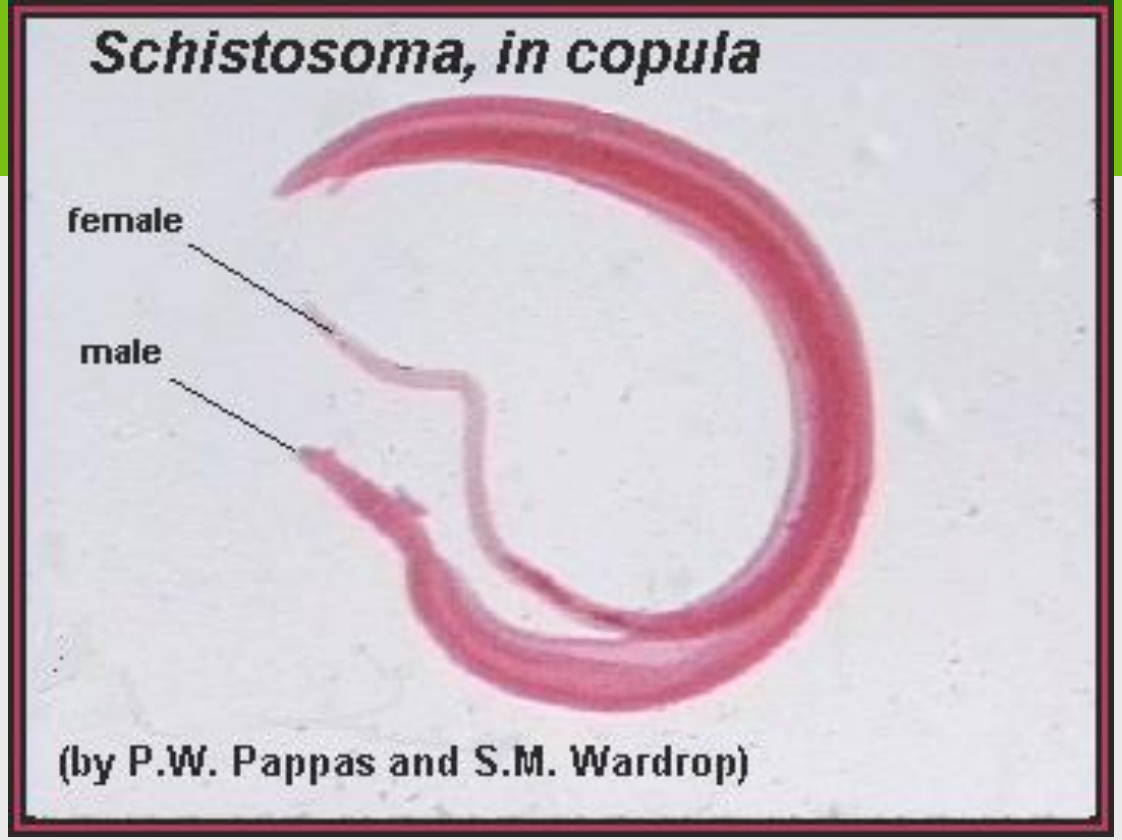
- **Schistosomiasis** (Bilharziasis)
- **Dracunculiasis**



Schistosomiasis

(Bilharziasis)

Photo Google


Schistosoma, in copula
female
male
(by P.W. Pappas and S.M. Wardrop)

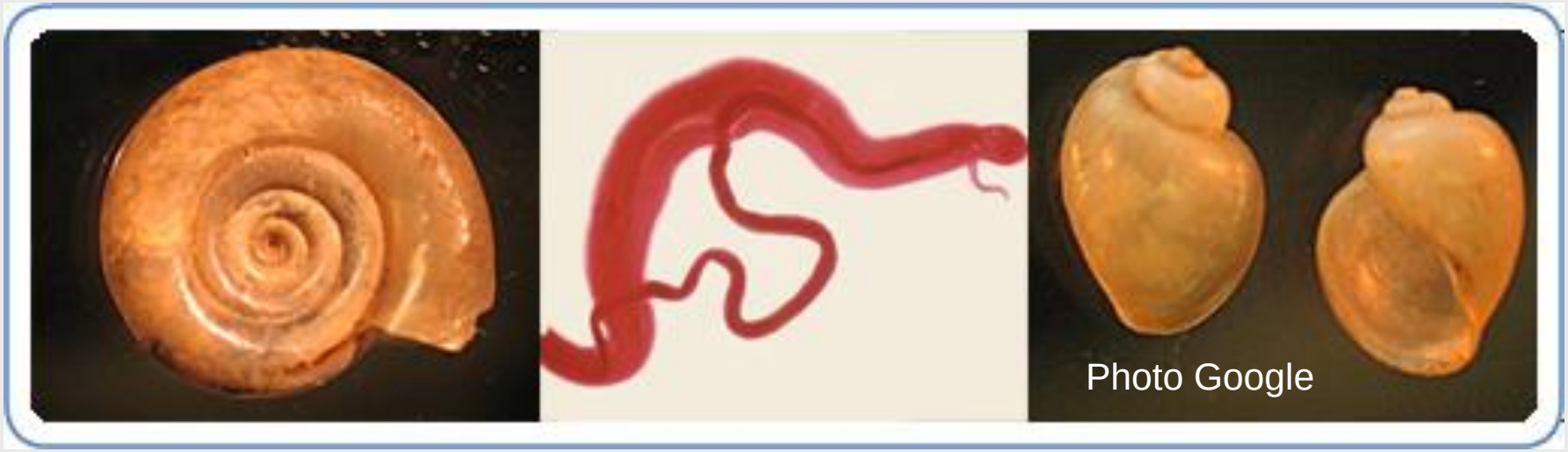
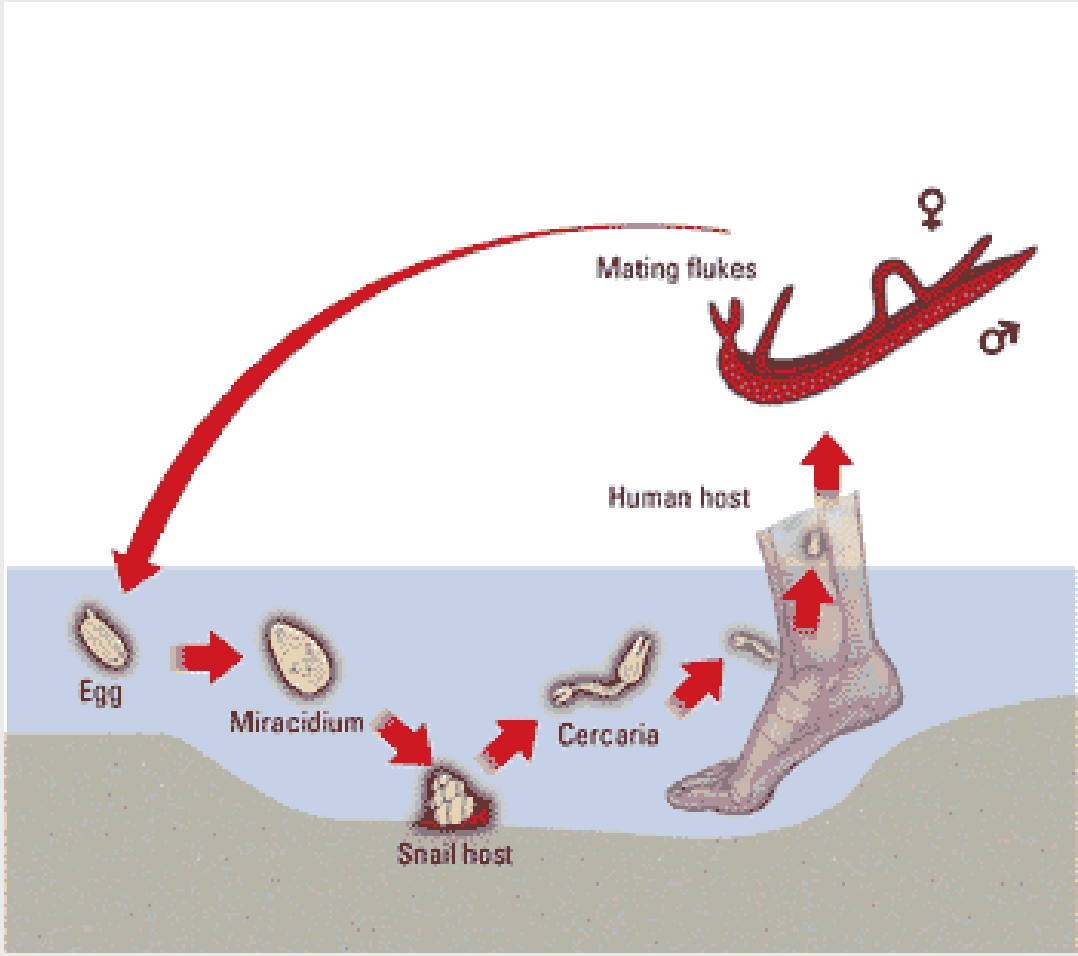


Photo Google

Infection can happen through healthy skin!

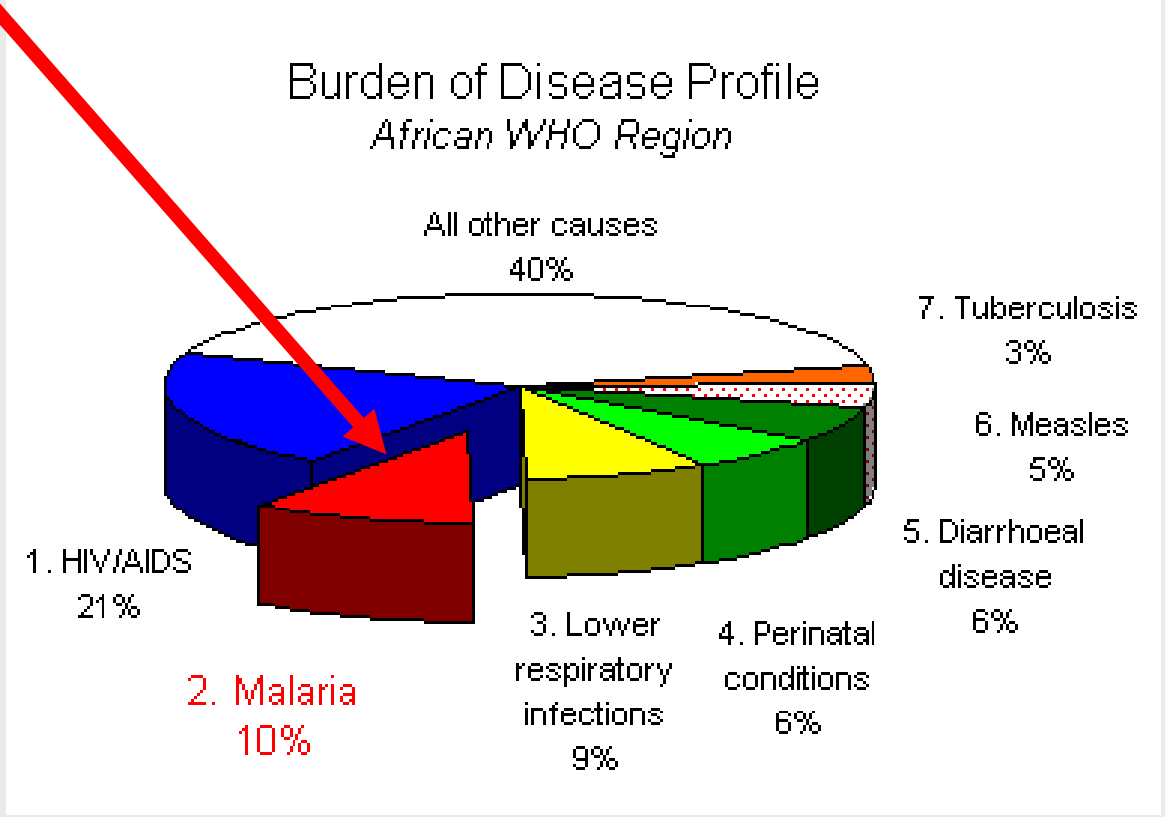


Typical risky behavior

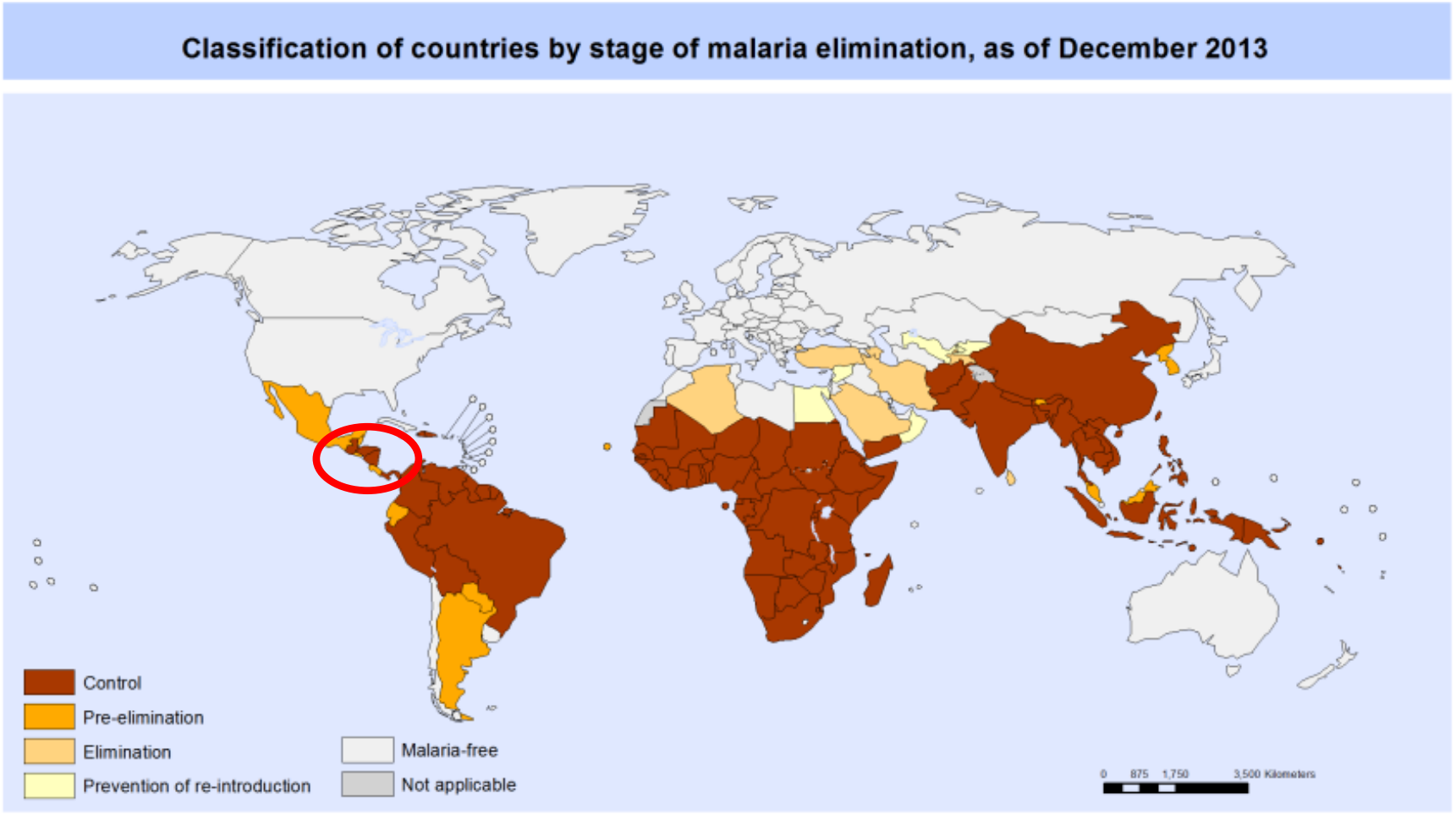
Photo Google

4. Water-associated vector-borne diseases– insect breeding or biting near water

- **Malaria**
- **Filariasis**
- **Onchocerciasis**
- **Trypanosomiasis**
- **Yellow fever**



Malaria–protozoal infection (Central America)



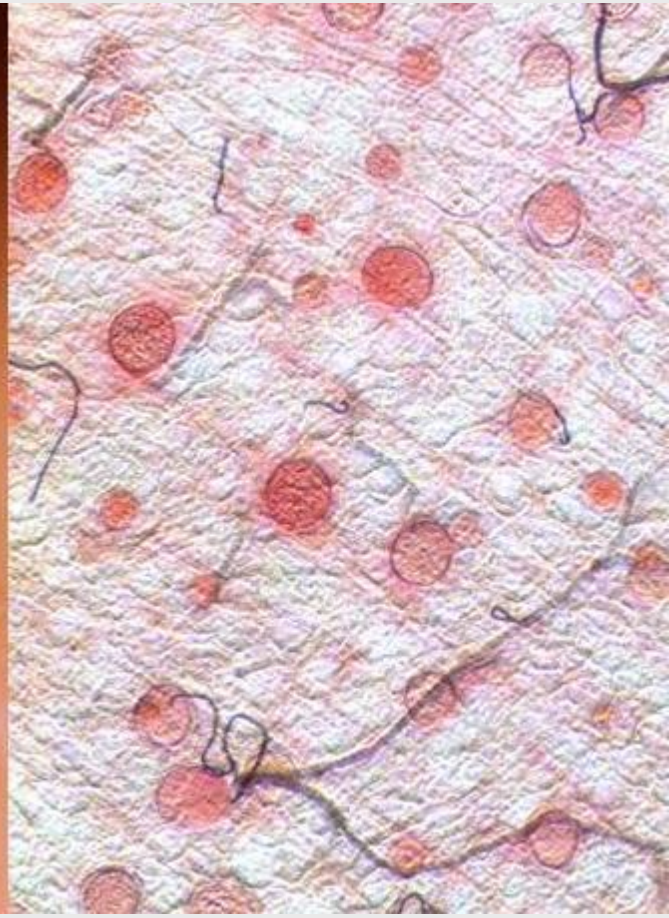
Somoto River, Nicaragua

Photo I. Pavlik

Photo I. Pavlik

Malaria

Photo Google



Leishmania

Phlebotomus dubosci, a sand fly
WHO/TDR/Stammers

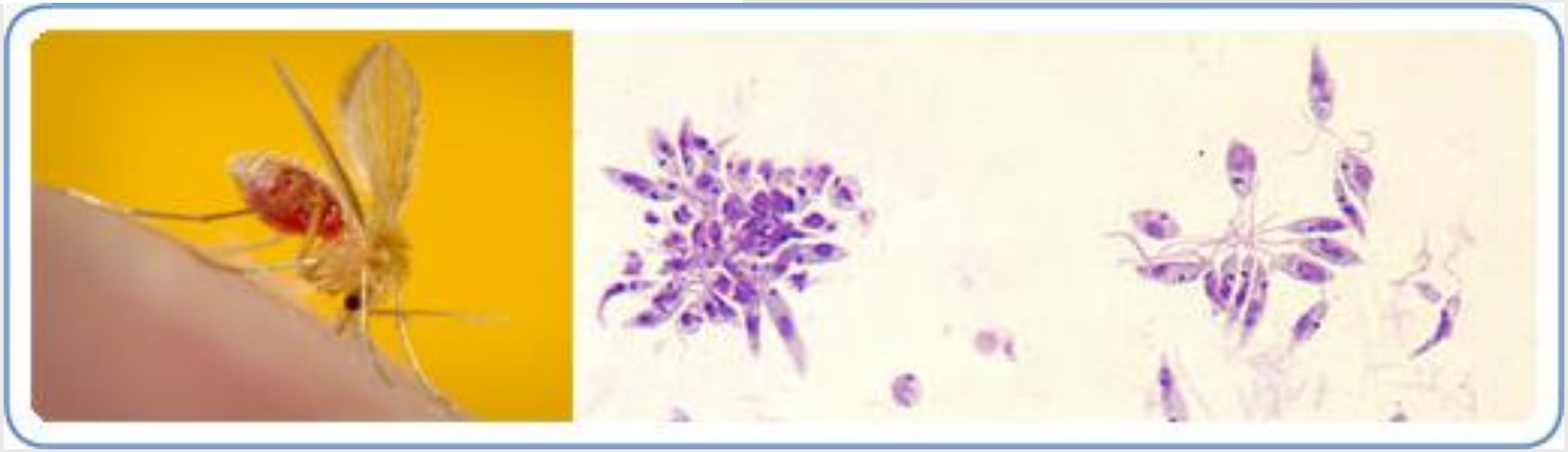


Photo Google

Cutaneous Leishmania

FIGURE 2-1 ■ Distribution of cutaneous leishmaniasis.

Skin lesions in a case of cutaneous leishmaniasis are healed after treatment with herbal extracts.

Photo Google

Ecology of vectors/reservoirs

Leishmania: running water

Malaria: standing water

Photo Google

Mycobacterium ulcerans – Buruli ulcer

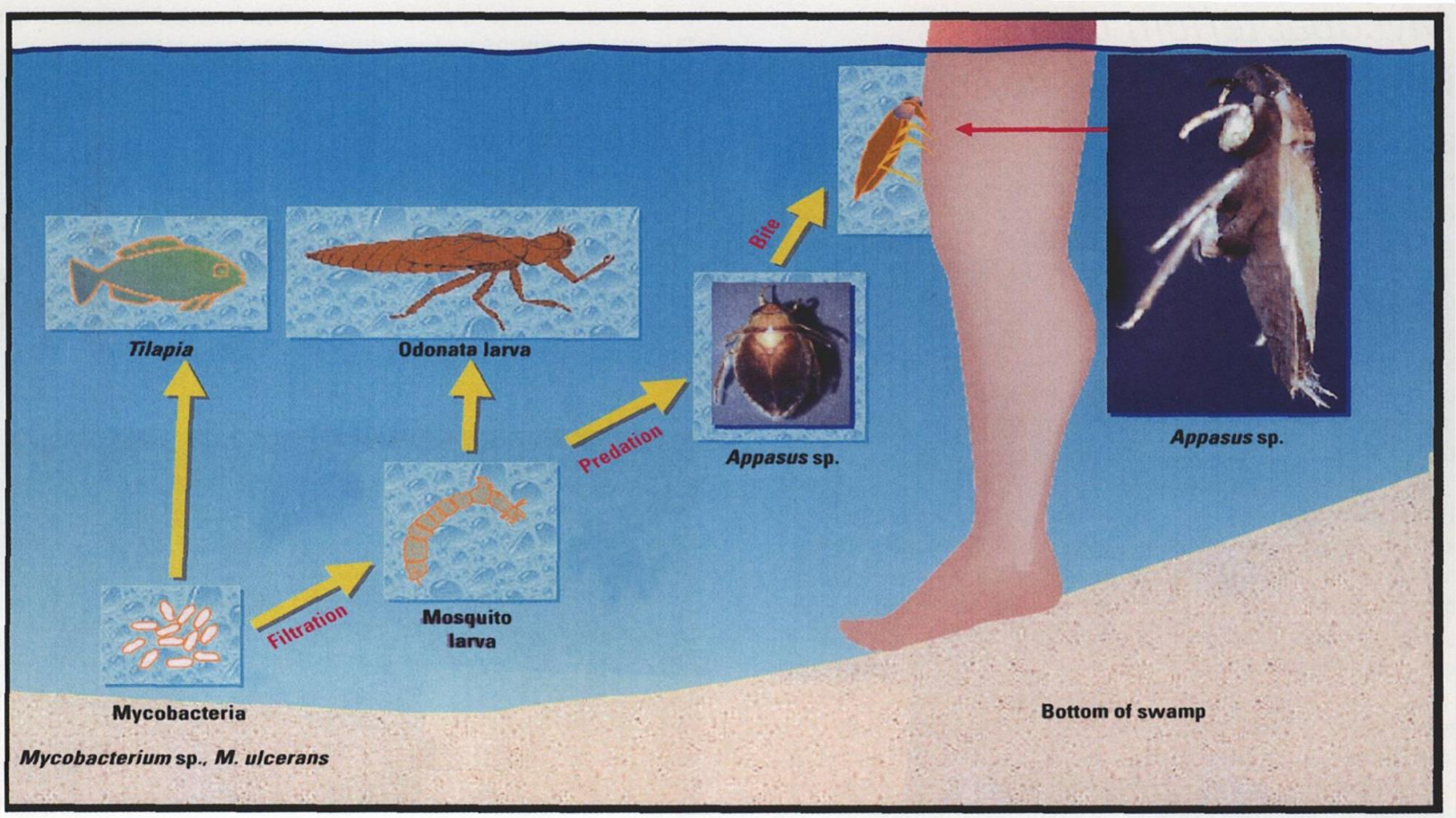


Fig. 3
Environmental sources of *Mycobacterium ulcerans* and possible mode of transmission to animals and humans

Portaels et al., Rev. Sci. Tech. Off. Int. Epiz., 2001, 20, 252-264

An 11 year old girl had extensive arm edema due to M. ulcerans and received 8 weeks of treatment. By the end of therapy, an ulcer has developed.

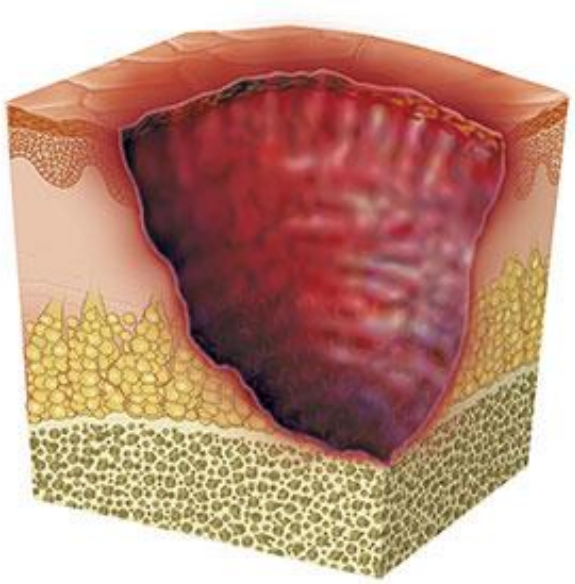


Photo Google

Developed countries – rivers‘ contamination

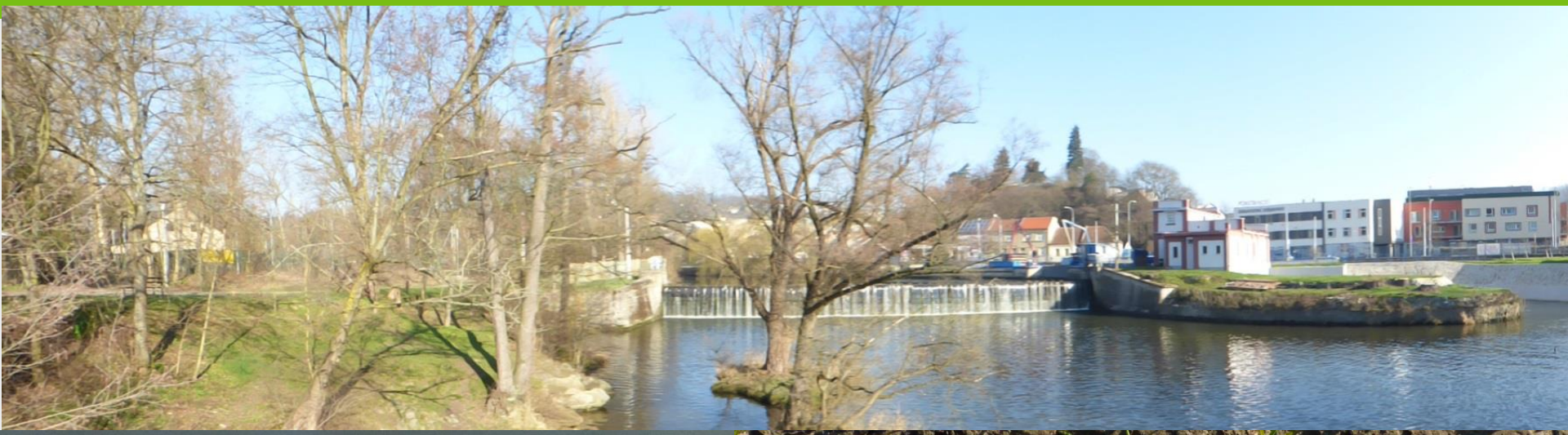


Photo I. Pavlik

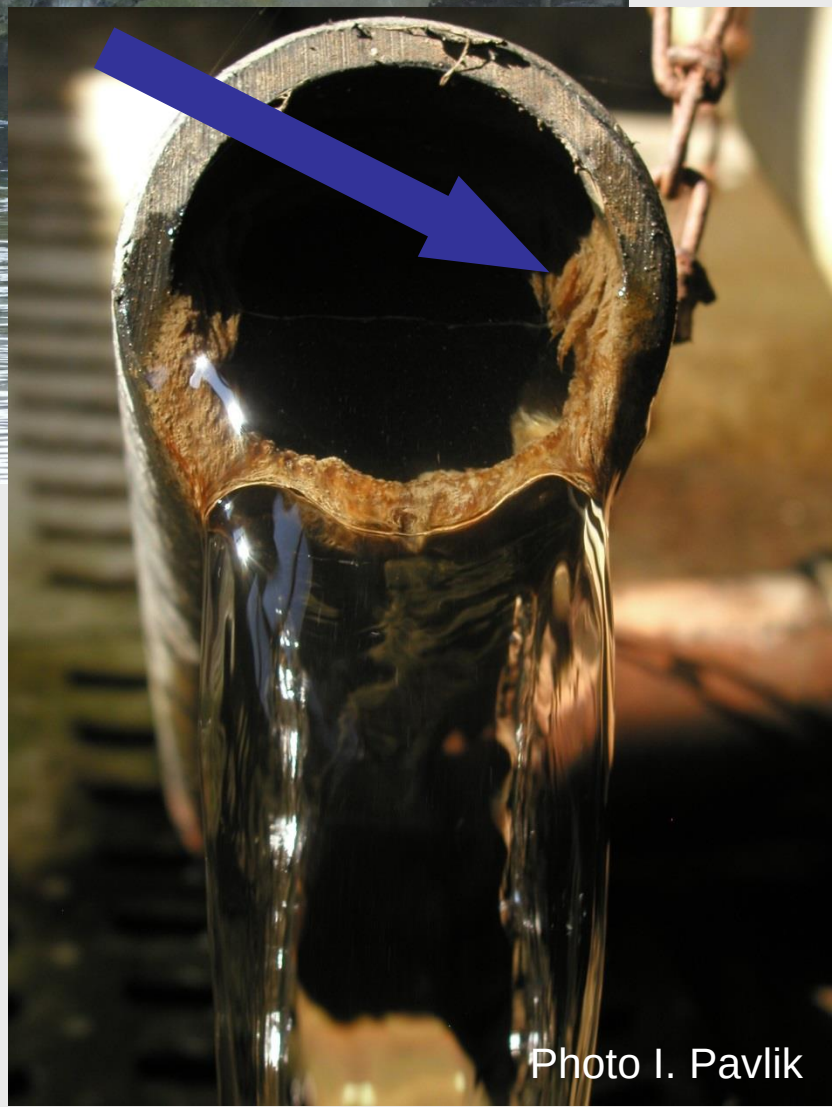
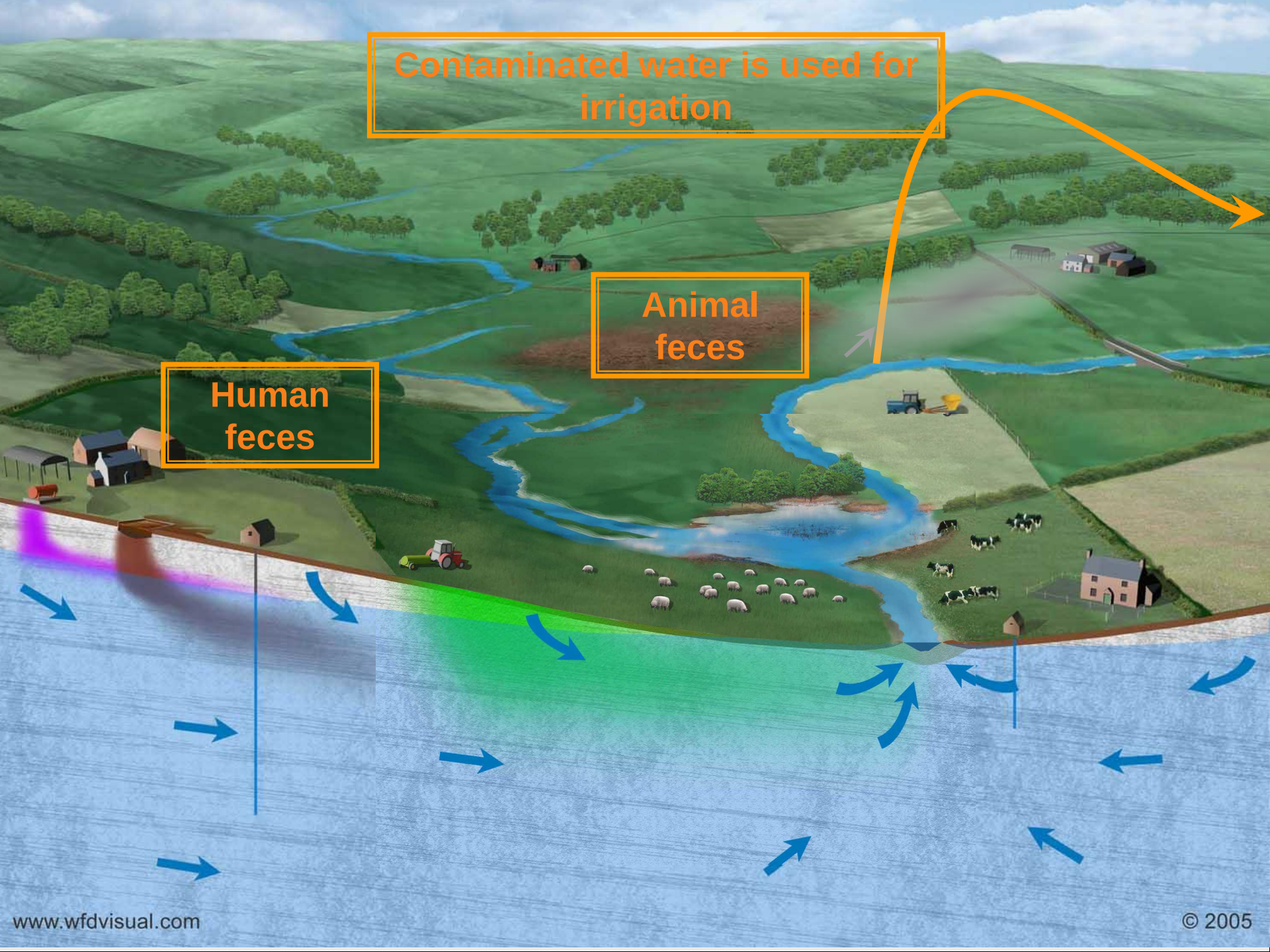


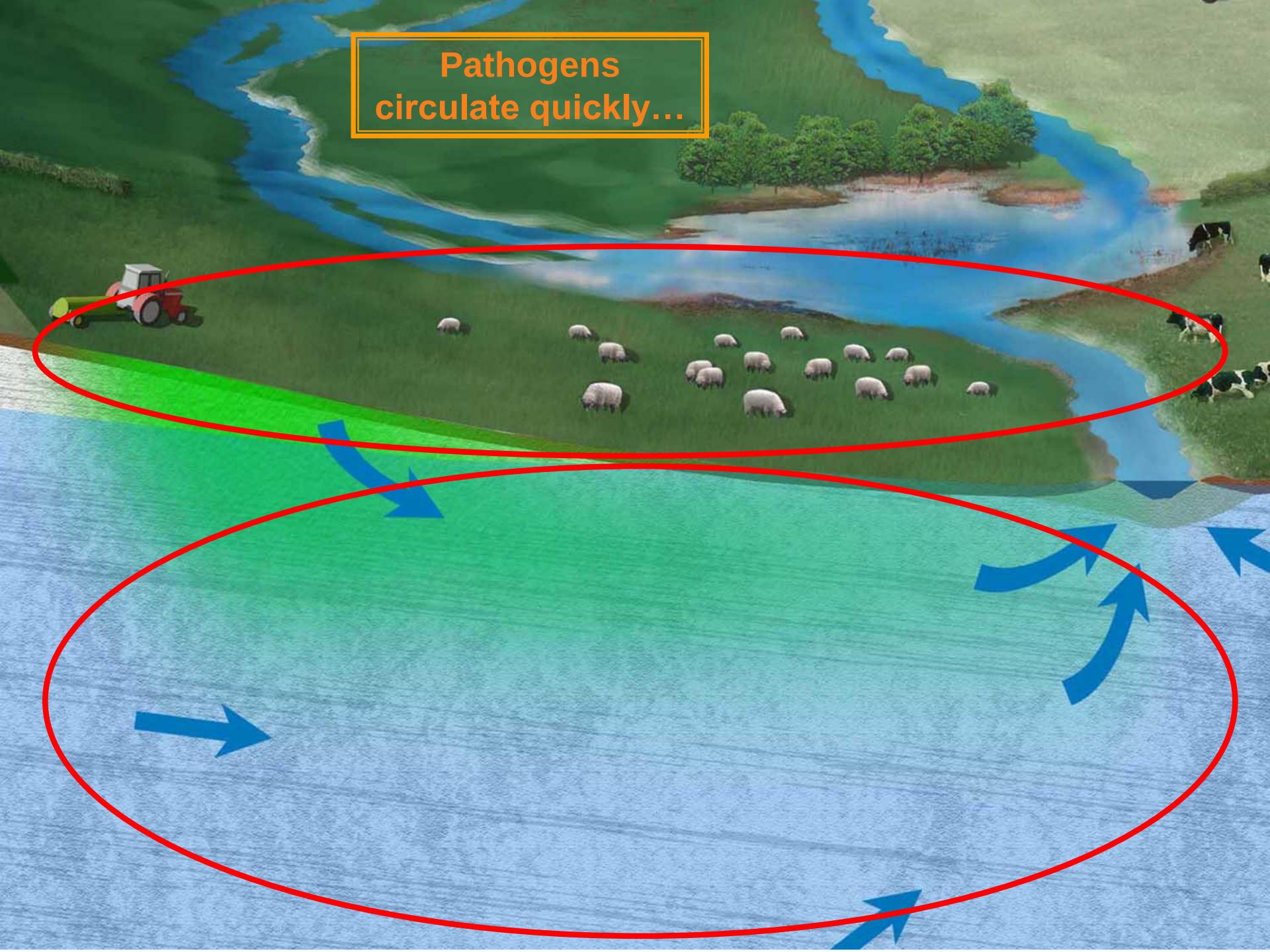
Photo I. Pavlik

Water contamination in villages

Photo I. Pavlik


Photo I. Pavlik


Contaminated water is used for irrigation
Animal feces
Human feces
www.wfdvisual.com
© 2005


Pathogens
circulate quickly…

Examples from USA - protozoa

Cryptosporidiosis

Cause: *cryptosporidium muris* is found in infected water

Prevention: Boiling water for 5-10 minutes will destroy organism

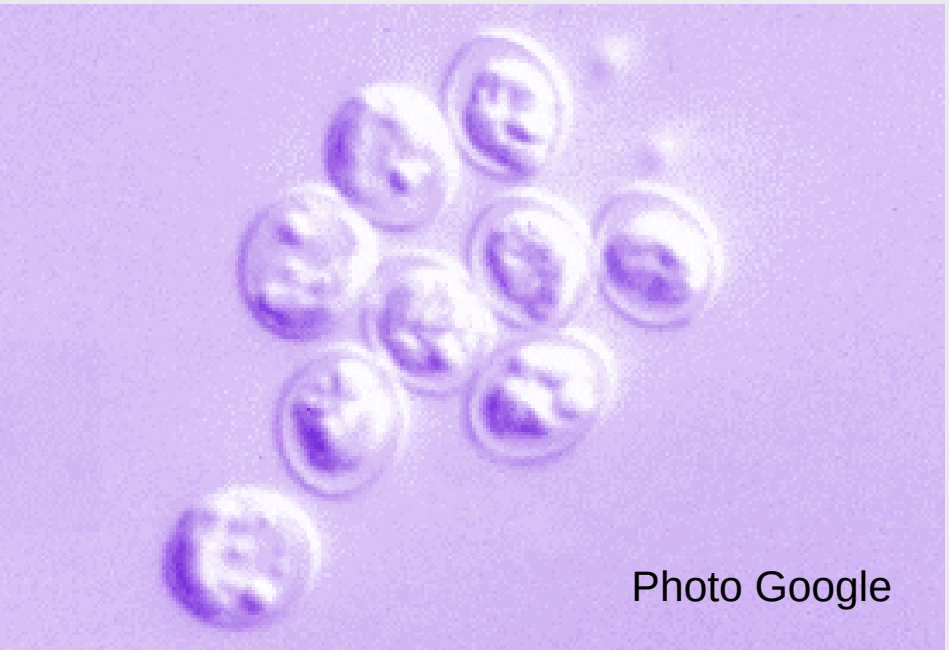
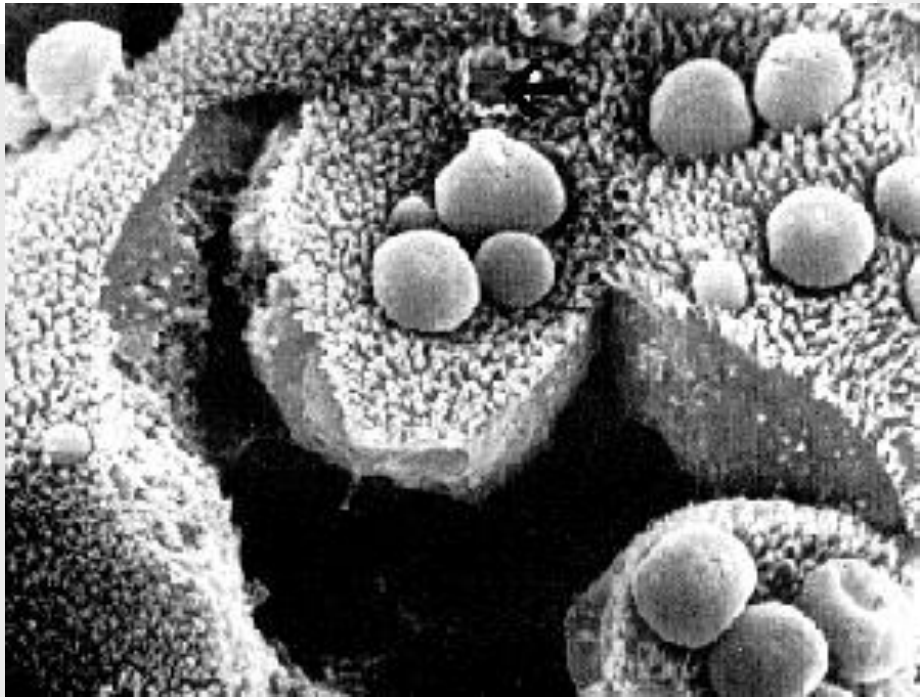
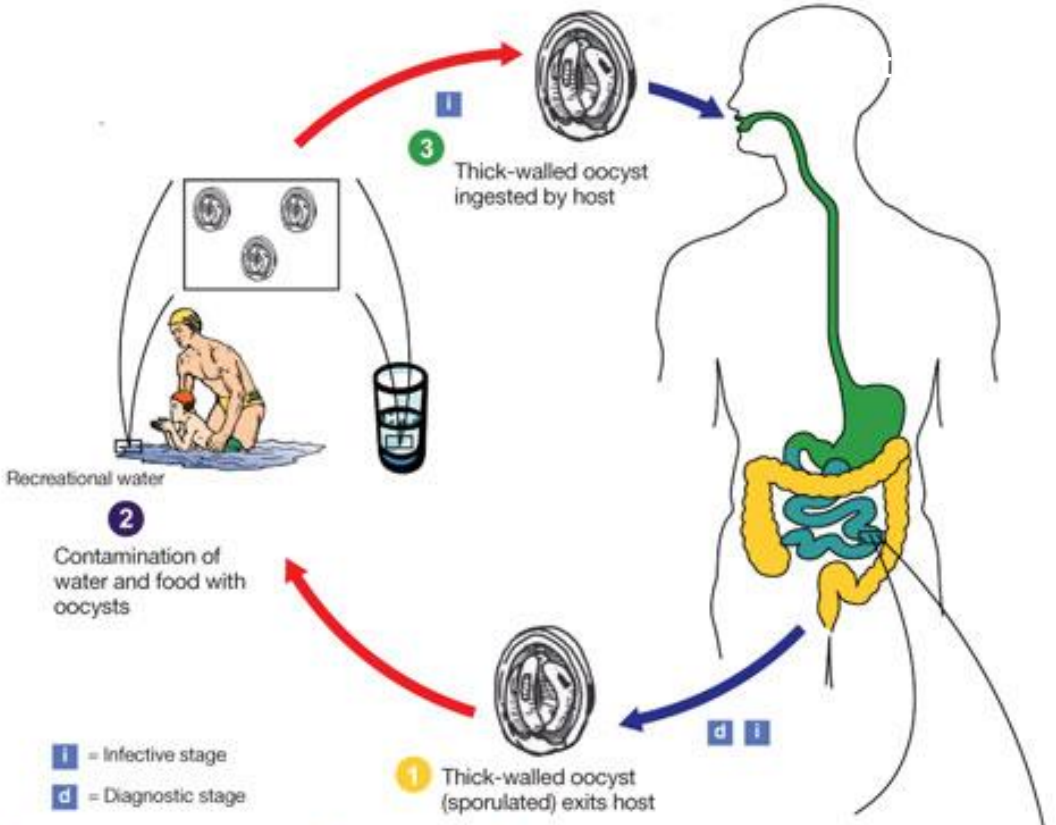


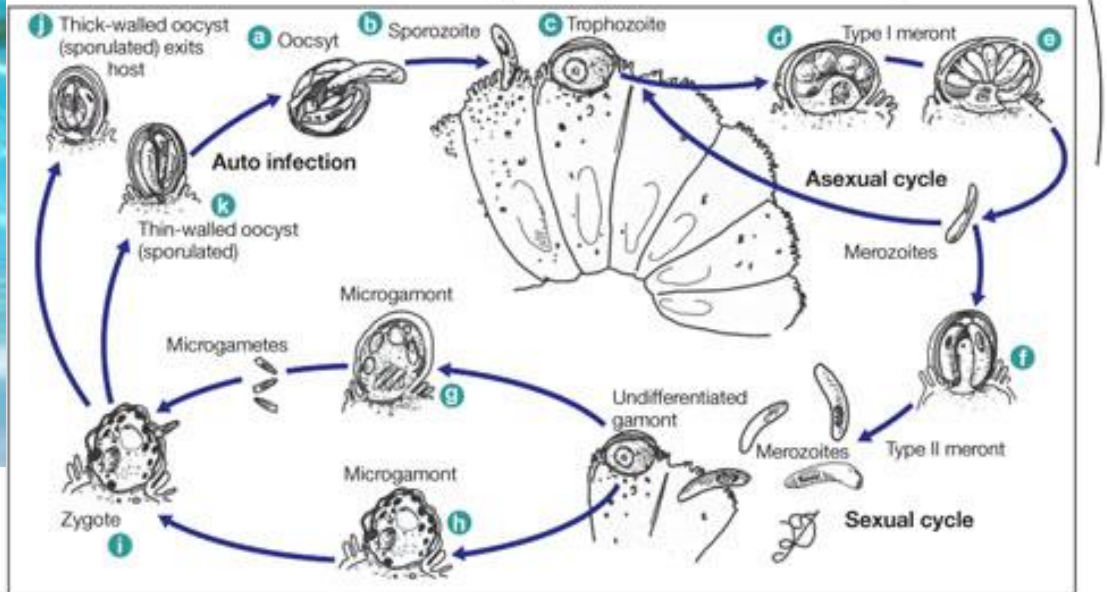
Photo Google



Water contamination!

Photo Google





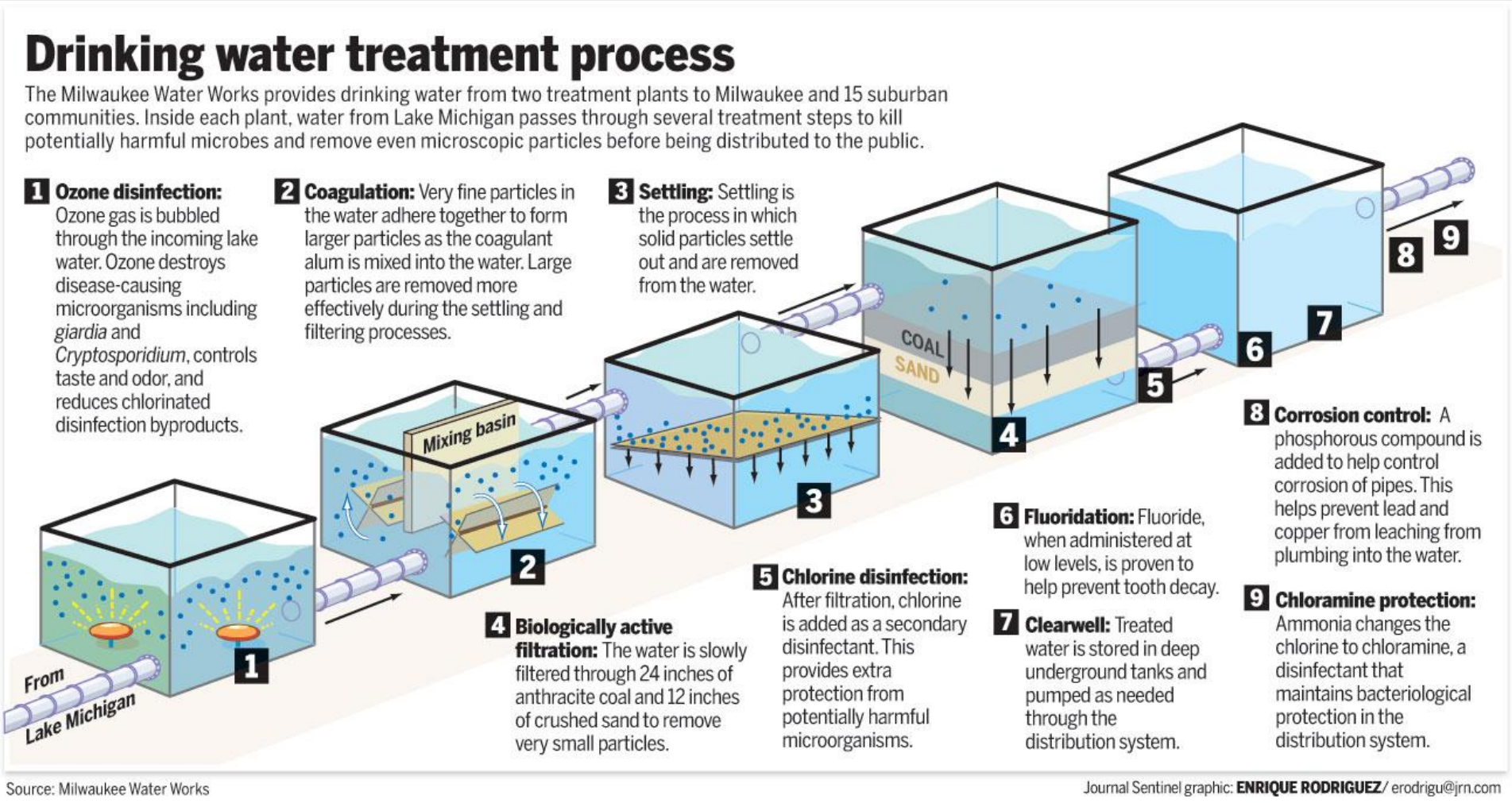
Difficult to treat (toxic drugs are used)

Photo Google

Prevention

- Avoid exposure to **contaminated surface water** (with sewage)
- Do not drink or swallow **water from recreational sources** (lakes, streams, pools etc.)
- **Ice, fountain beverages and water fountain**s are risky (avoid contact with your mucous in mouth)

Key preventive step



Drinking water from Římov, Czech Republic

Photo I. Pavlik

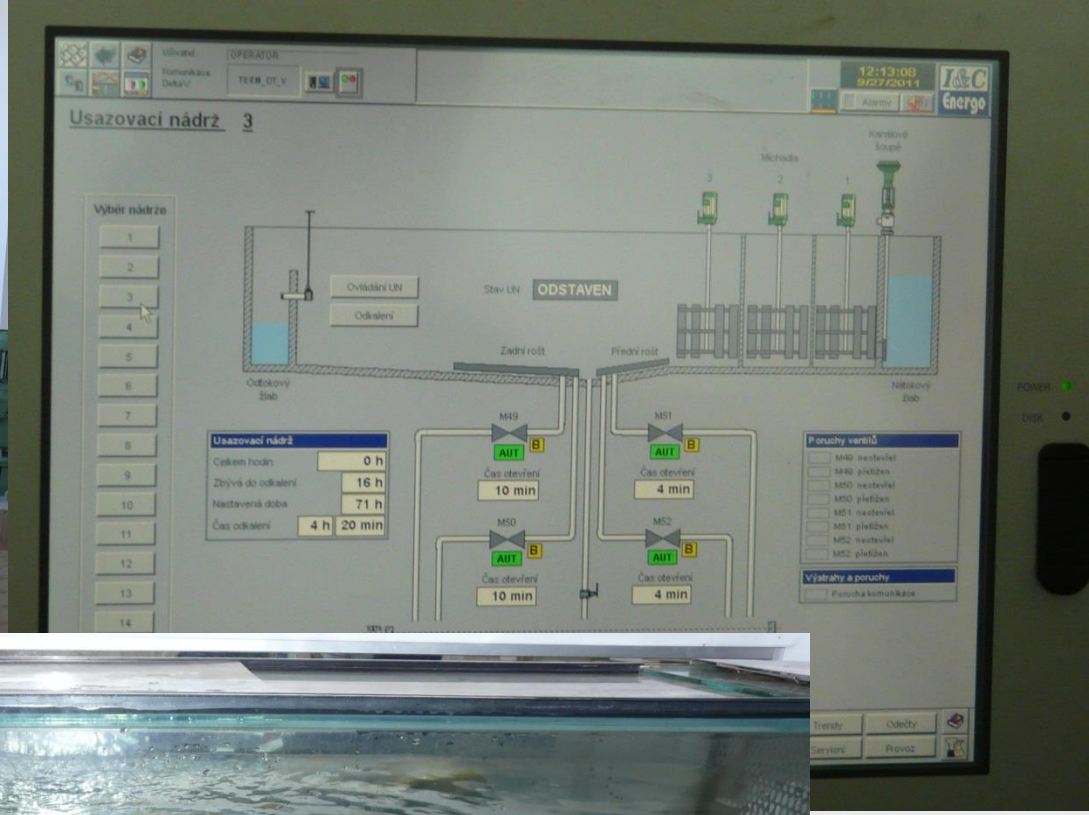

Usazovací nádrž 3
Výběr nádrže
Ovládání UN
Odkalení
Stav UN
ODSTAVEN
Zadní rošt
Přední rošt
Usazovací nádrž
Celkem hodin 0 h
Zbývá do odkalení 16 h
Nastavená doba 71 h
Čas odkalení 4 h 20 min
M49
M51
M50
M52
AUT
Čas otevření
10 min
4 min
Poruchy ventilů
Výstrahy a poruchy
Trendy
Odečty
Servisní
Provoz


Photo I. Pavlik

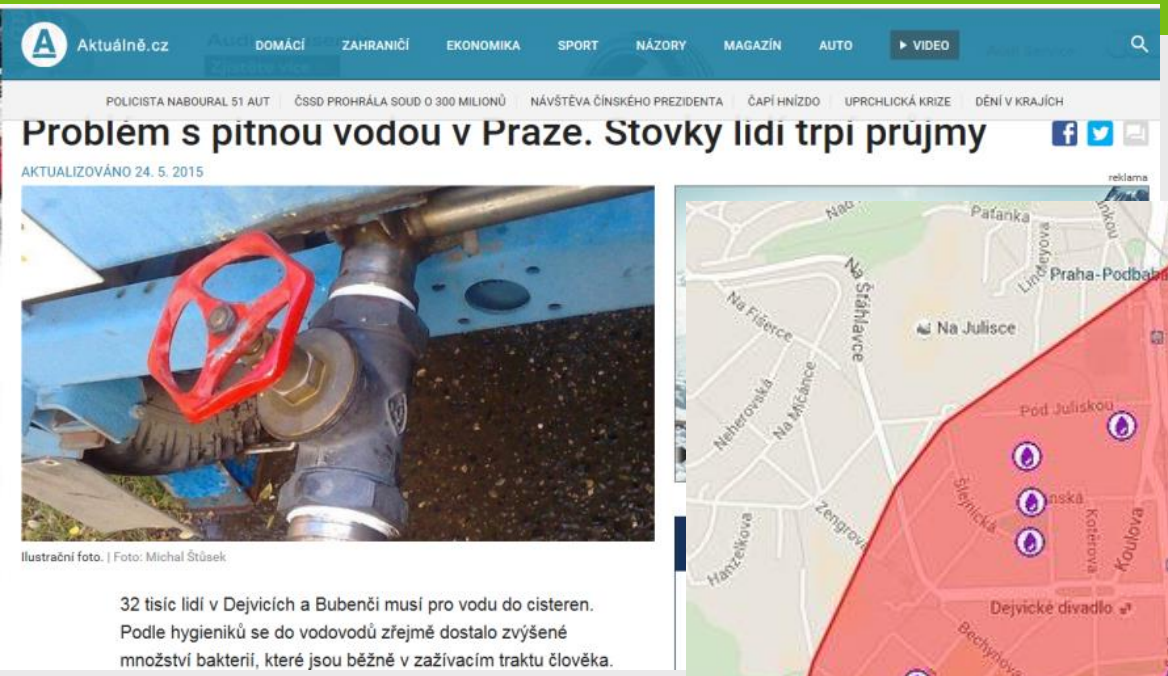
Drinking water distribution system (safety)

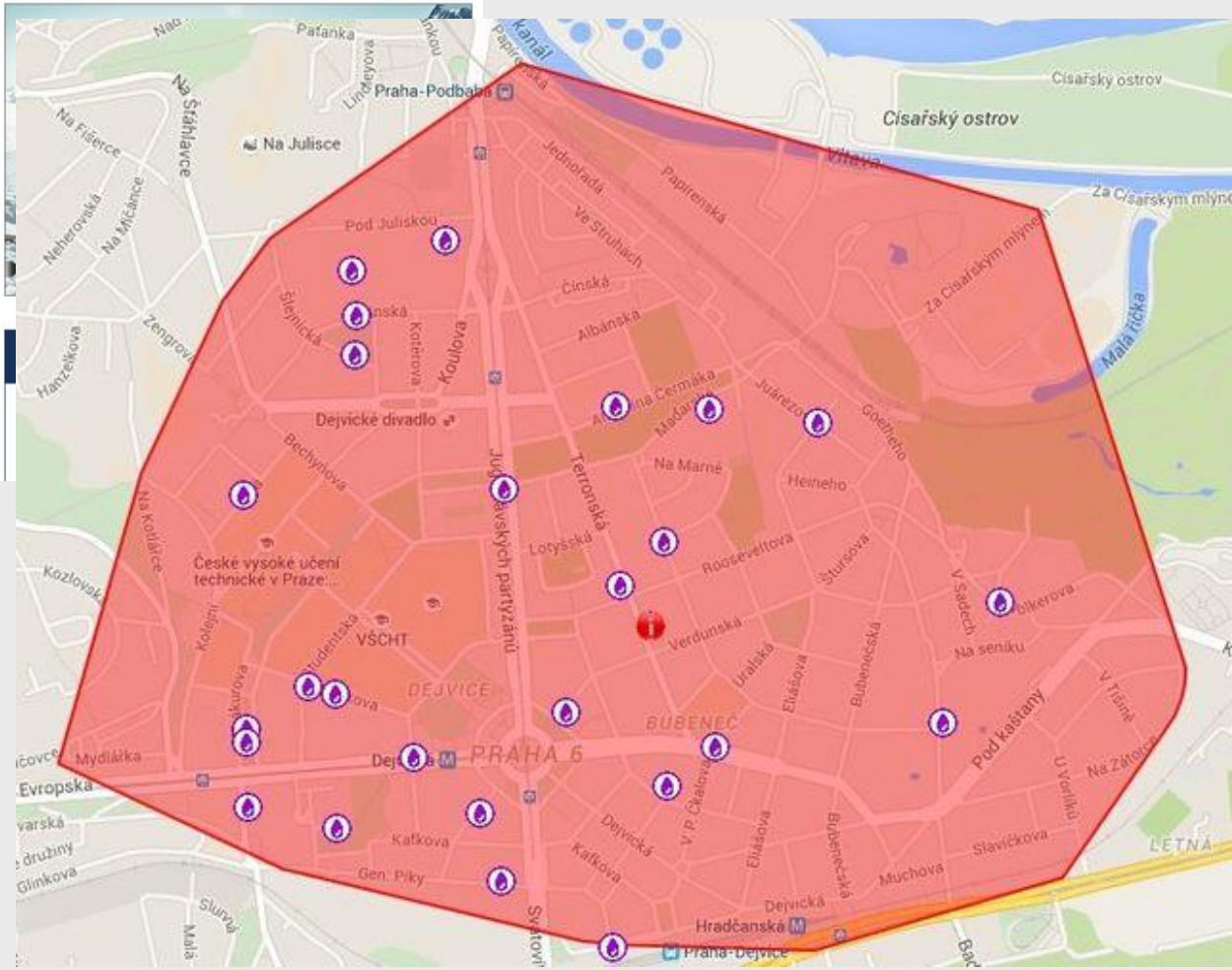
Photo I. Pavlik

Accidents – contamination with sewage

Photo Google

Case from the Czech Republic - 2015

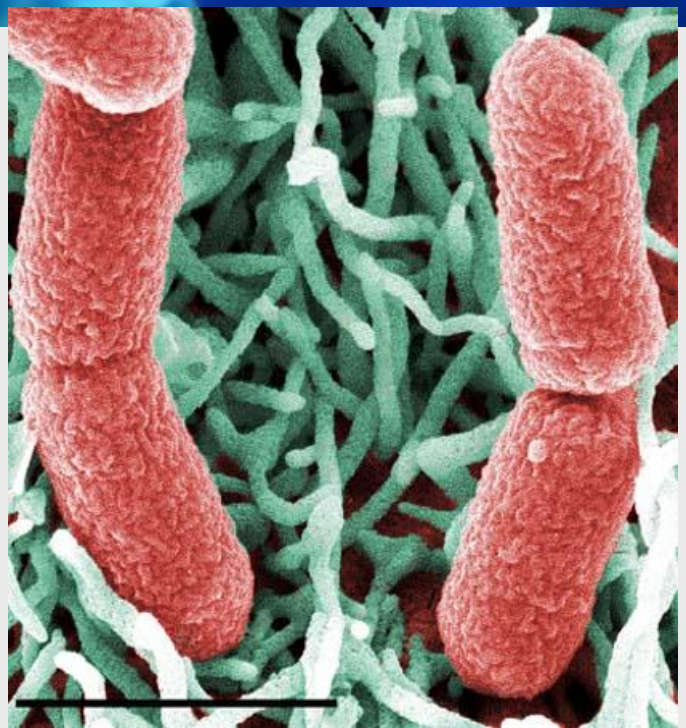


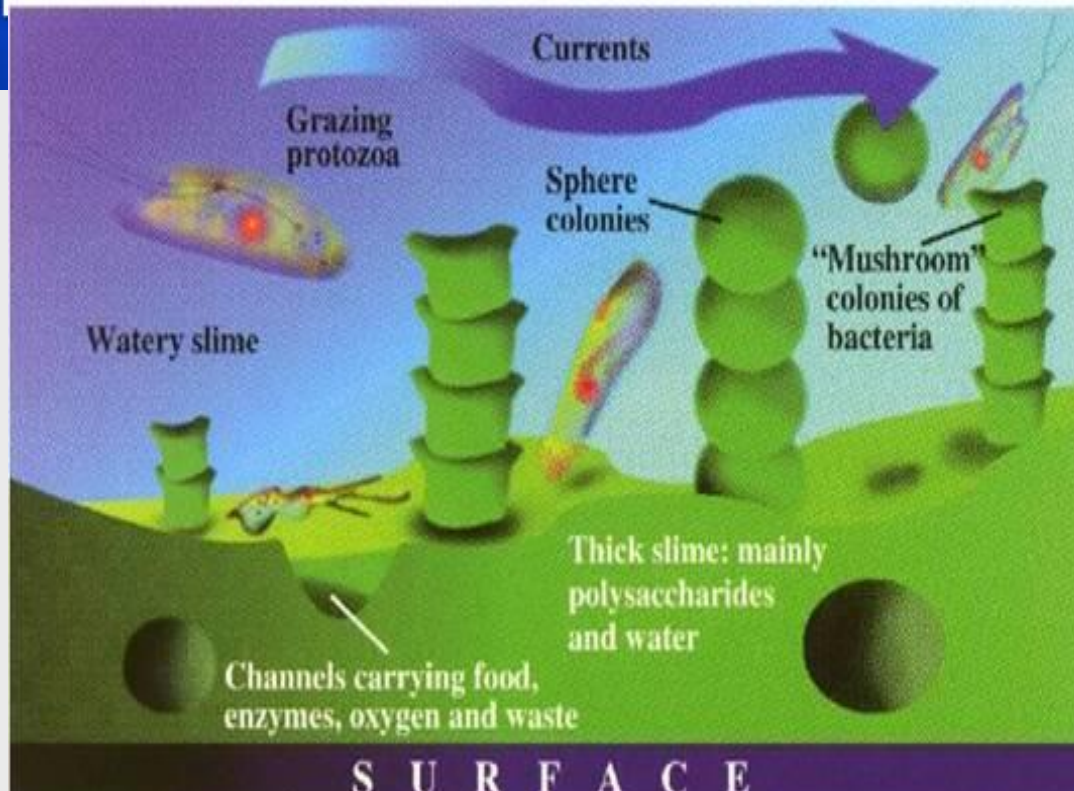


- **32 th. people without pipe water**
- **130 patients hospitalized**
- **550 suspected cases**

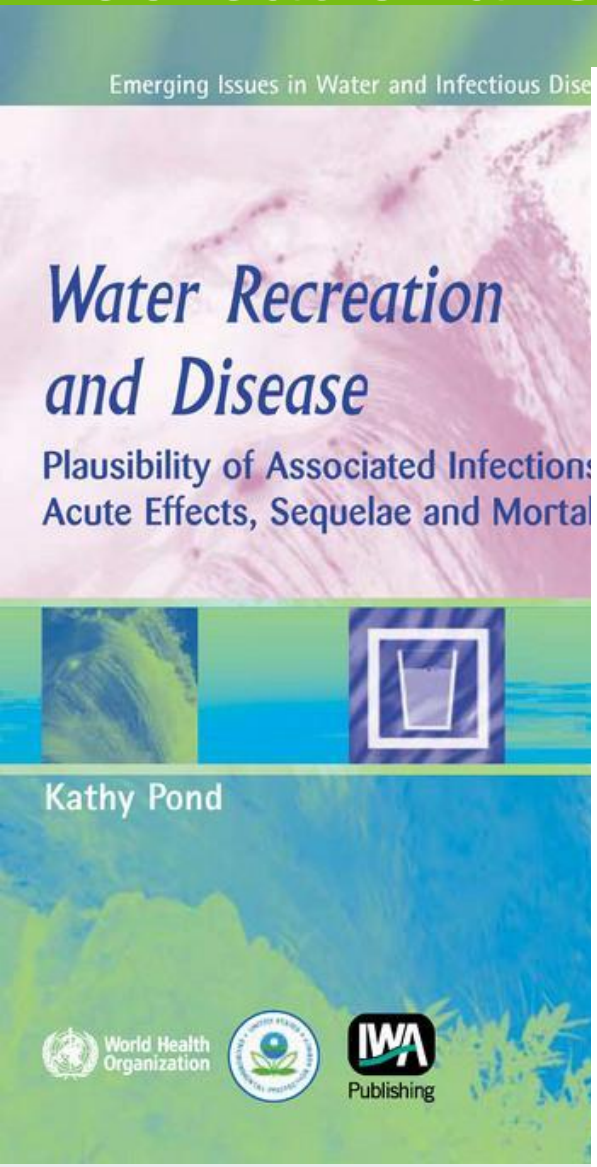
Photo Google

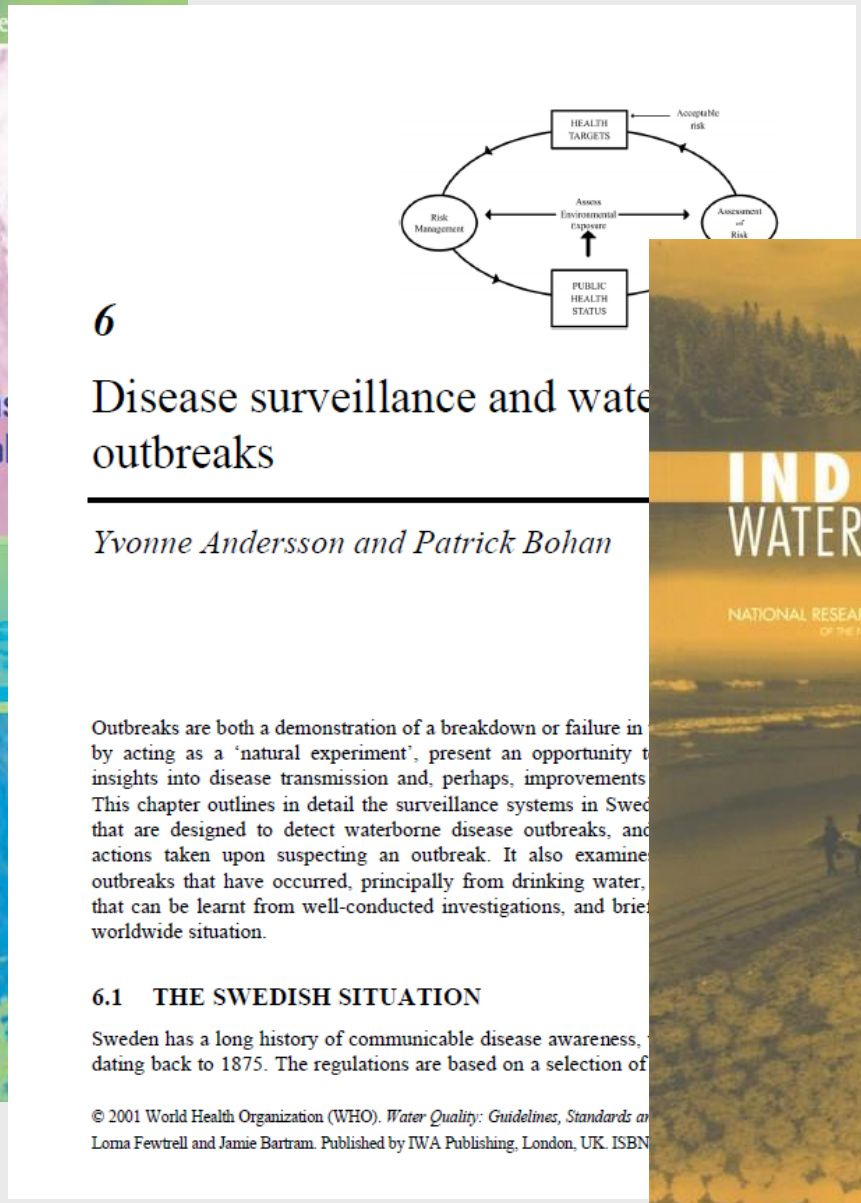
Biophilm – phenomenon in bacterial ecology

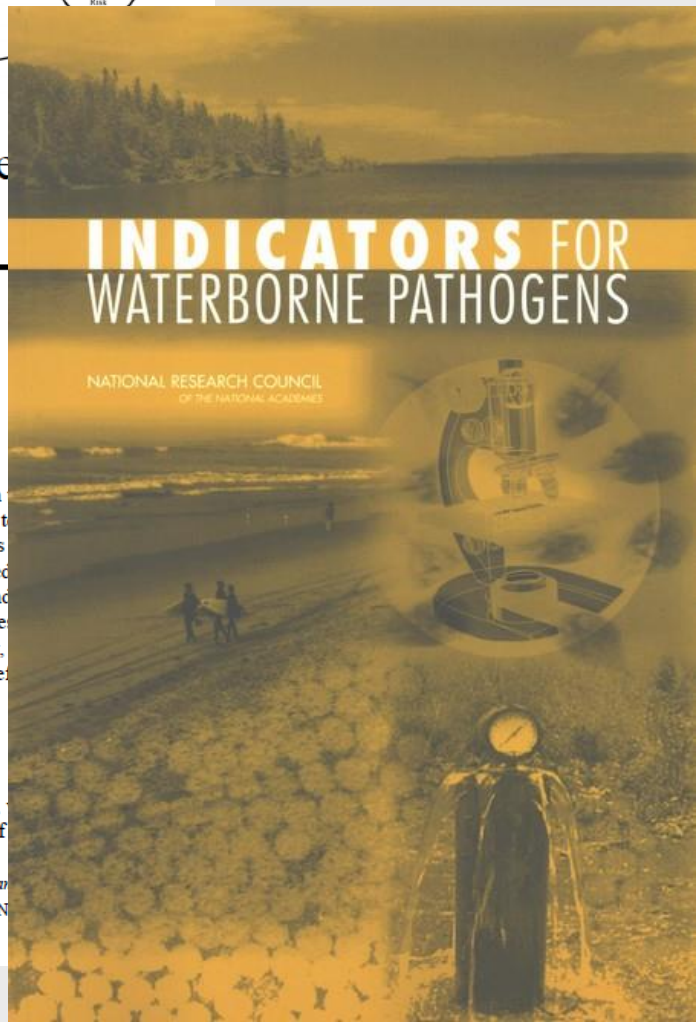




Recreational surface water







Mendel University in Brno

Thank you for your attention!

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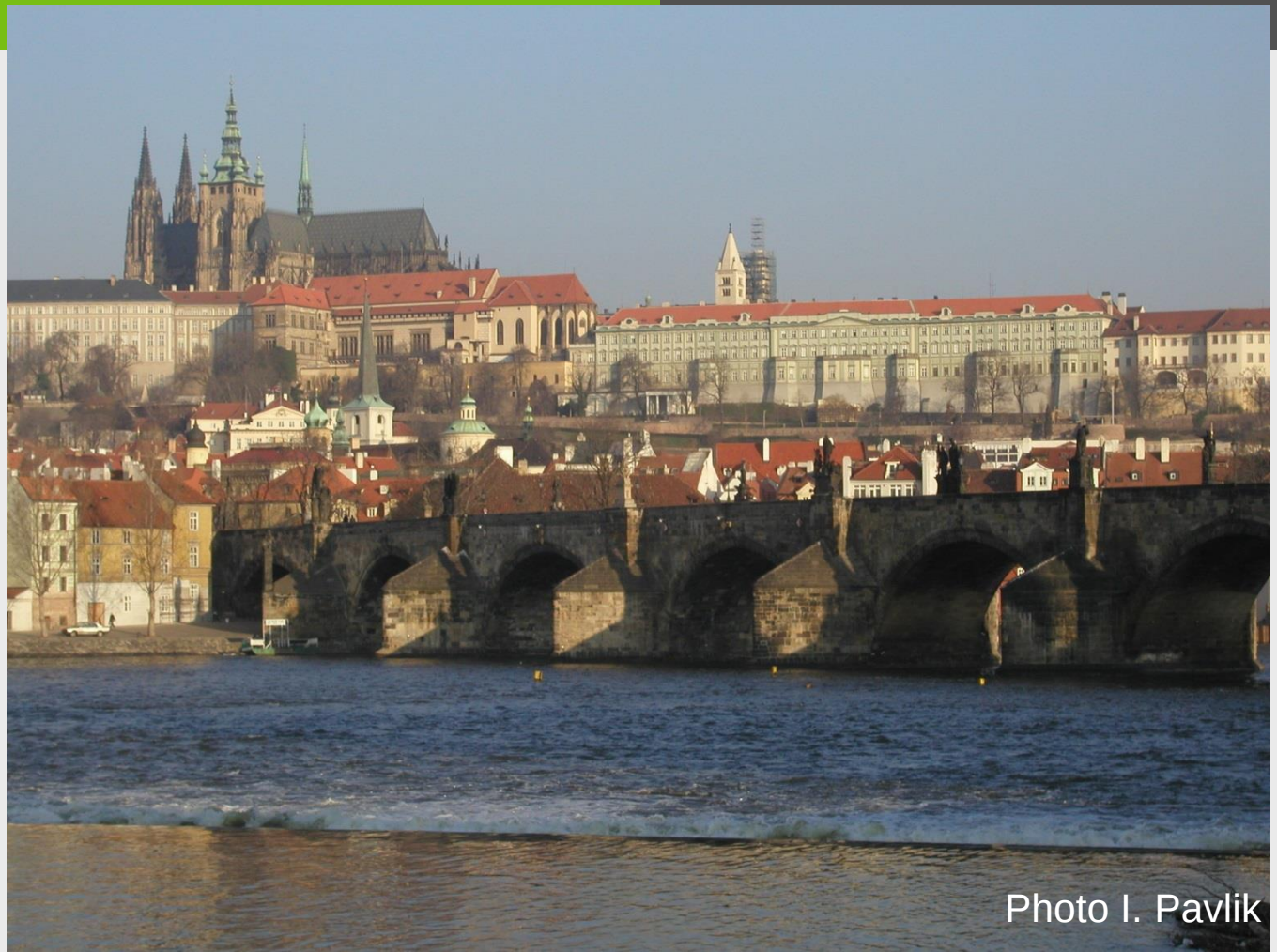

Photo I. Pavlik