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School on Modelling Tools and Capacity Building in Climate and Public Health

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Environment and disease discourse in Africa

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Environment and disease discourse in Africa



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Argument:

Development of *Tropical medicine* in late 19th/early 20th century encouraged idea of *geographically restricted infectious diseases* posing a risk to outsiders/other parts of the world

At its outset: *Tropical medicine* focused on *parasitology* and *entomology* – an *essentialist* view of disease

the role of other factors contributing to health (e.g. sanitation, nutrition etc) relatively ignored.

Does modelling of disease impacts of climate change challenge or further support this relatively narrow view of disease (& health)?

Do we really understand *current* environment-disease relationships sufficiently well?

Environment and disease – association or causation?

Disease outcomes are susceptible *inter alia* to environment:

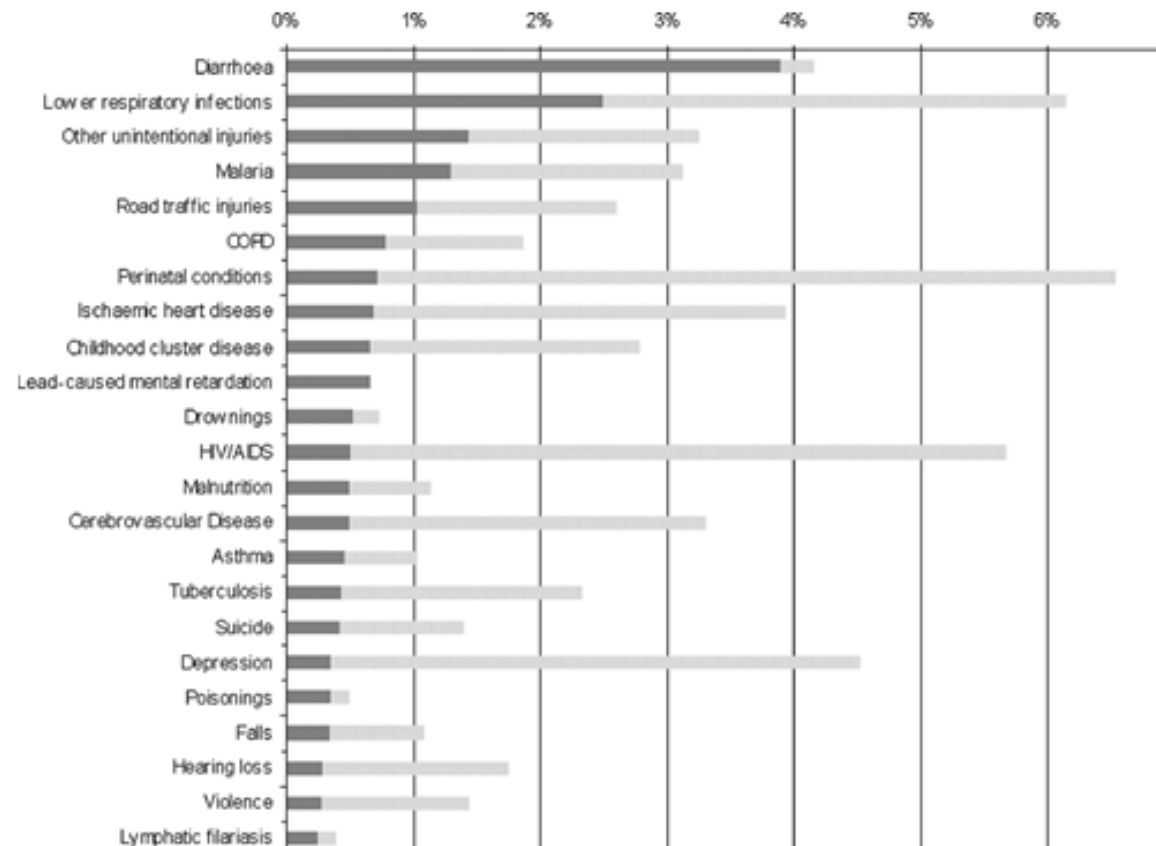
Almost 25% of global disease burden has an environmental component:

94% diarrheal

42% malaria

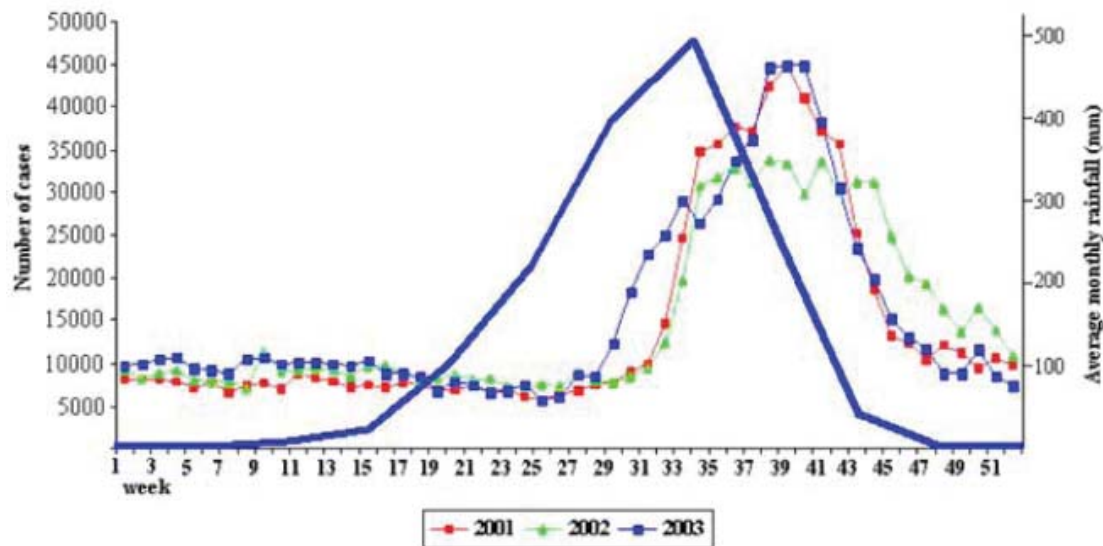
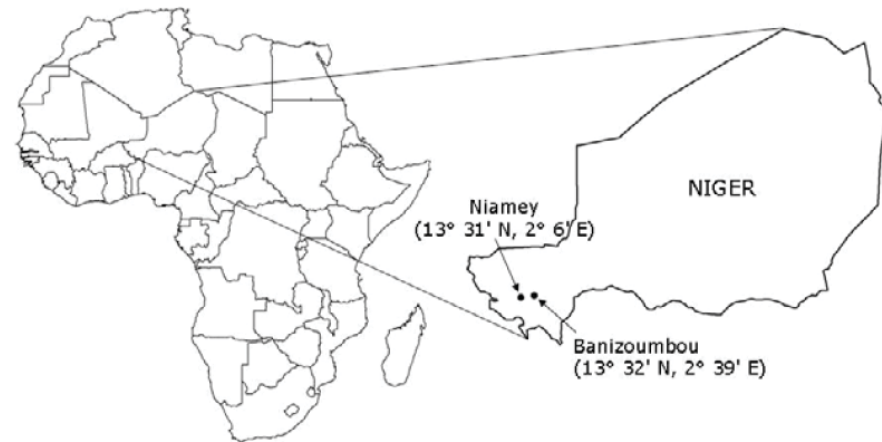
41% lower respiratory

Figure below shows diseases with largest environmental component. For each disease, proportion of total disease burden explained by environment is shown by dark bar; light bar shows proportion explained by non-environment factors



Information from Prüss-Üstün and Corvalán (2007). Data are for 2002

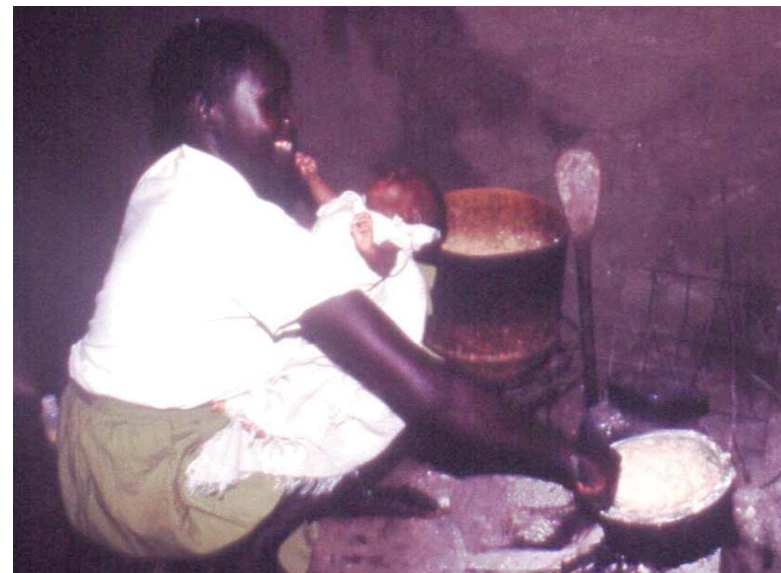
e.g. some infectious (communicable) diseases such as malaria



Weekly malaria incidence in Niamey, Niger, 2001-2003 and GPCP ave monthly precipitation data (from Gianotti *et al.* 2009)

Female *Anopheles* mosquito – vector for malaria in humans

Environment also plays a role in many non-communicable diseases too, e.g. diseases of the respiratory tract



Environment *literally* means *that which surrounds*

[**Nature** is often defined as that which exists independently of human activities (and *wilderness* as landscapes without human impacts)]

We assume that both *environment* and *nature* exist beyond our perception – i.e. they are **real**.

However, environments differ from place to place, time to time and according to the individual/society – the environment(s) of a human can be very different from the environment(s) of a pathogen

What about *disease*? What do we mean by disease and how is disease linked to health?

“There are ... no universally accepted criteria for establishing disease” (Tikkinen *et al.* (2013) *BMJ Open*)

Concept of disease is not fixed, either in place or in time – over last few decades tendency to class certain types of being as consequence of *disease*

e.g. alcoholism, obesity, sexual deviancy, Gulf War syndrome

e.g. homosexuality – variously listed as a disease (e.g. American Psychiatric Association until 1973), moral failing, criminal behaviour punishable by death (Uganda “Kill the Gays Bill”, 2012-) and a legitimate lifestyle choice supported by marriage (NZ, 2013).

Disease as the *cause of illness* – the **Essentialist** (Realist) view.

But what about those illnesses where the cause has not been determined (e.g. some forms of dementia) or where disease is asymptomatic?

Nominalist view: disease (like the soul?) is part of being, and is not separate from it – diseases have no existence apart from patients with them

What about health? Does health simply mean the absence of illness/disease?

The definition of health is culturally specific and varies over time

WHO: *health* = complete physical and mental wellbeing (i.e. *not* merely the absence of disease)

Notions of health have been *strongly* influenced by ideas of statistical normality and by the human body as a finely tuned machine

Increasing emphasis on treatment-oriented health systems:

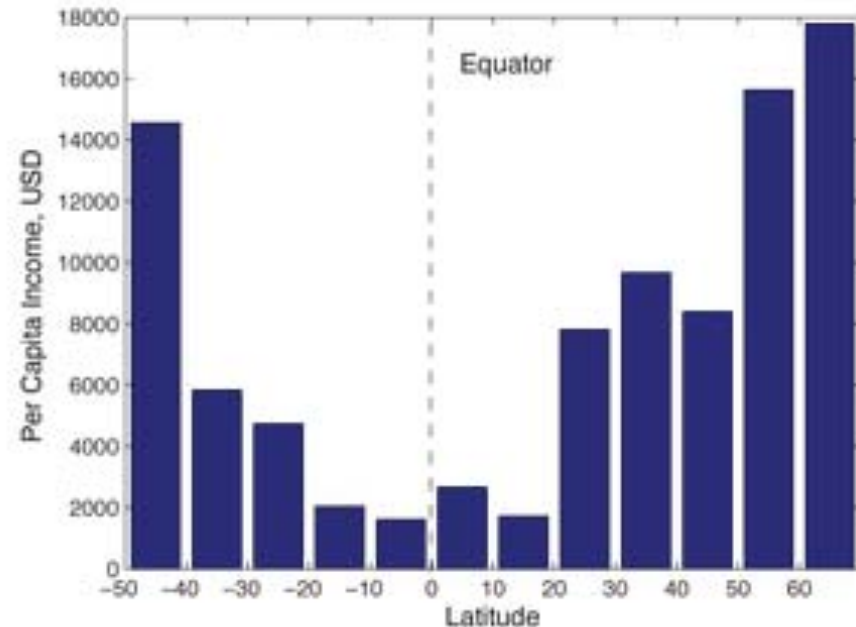
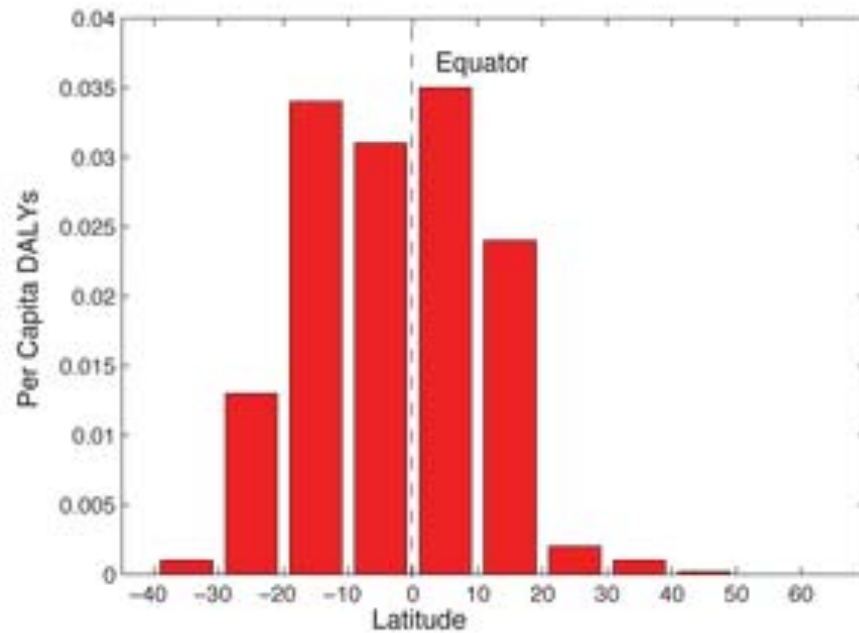
- expensive (medicalisation of society - everyone a patient!)
- unsustainable (e.g. anti-biotic and insecticide resistance, aging societies)
- ignores fact that most of health/longevity gains in last century – especially where no vaccinations available - due to reductions in poverty, improvements in housing, sanitation, nutrition etc.

i.e. transformations in the pathogenic landscape,
rather than medical advances!

Jadad (2011) *BMJ* health is: “the ability to adapt and self-manage”
in the face of “social, physical and emotional challenges”

But there are problems in assuming **association** means a **cause-effect relationship** exists

e.g. is illness a cause or an effect of poverty?



Bonds et al. (2012) Disease Ecology, Biodiversity, and the Latitudinal Gradient in Income. *PLoS Biol* 10(12): e1001456. doi:10.1371/journal.pbio.1001456

(DALY = disability-adjusted life year (combines years of life lost due to premature mortality and to time lived in states of less than full health.))

Situation is complex

Diseases of under-development?

e.g. malaria in Africa?

Disease of the development process?

e.g. African sleeping sickness (trypanosomiasis) outbreak early 20th Century

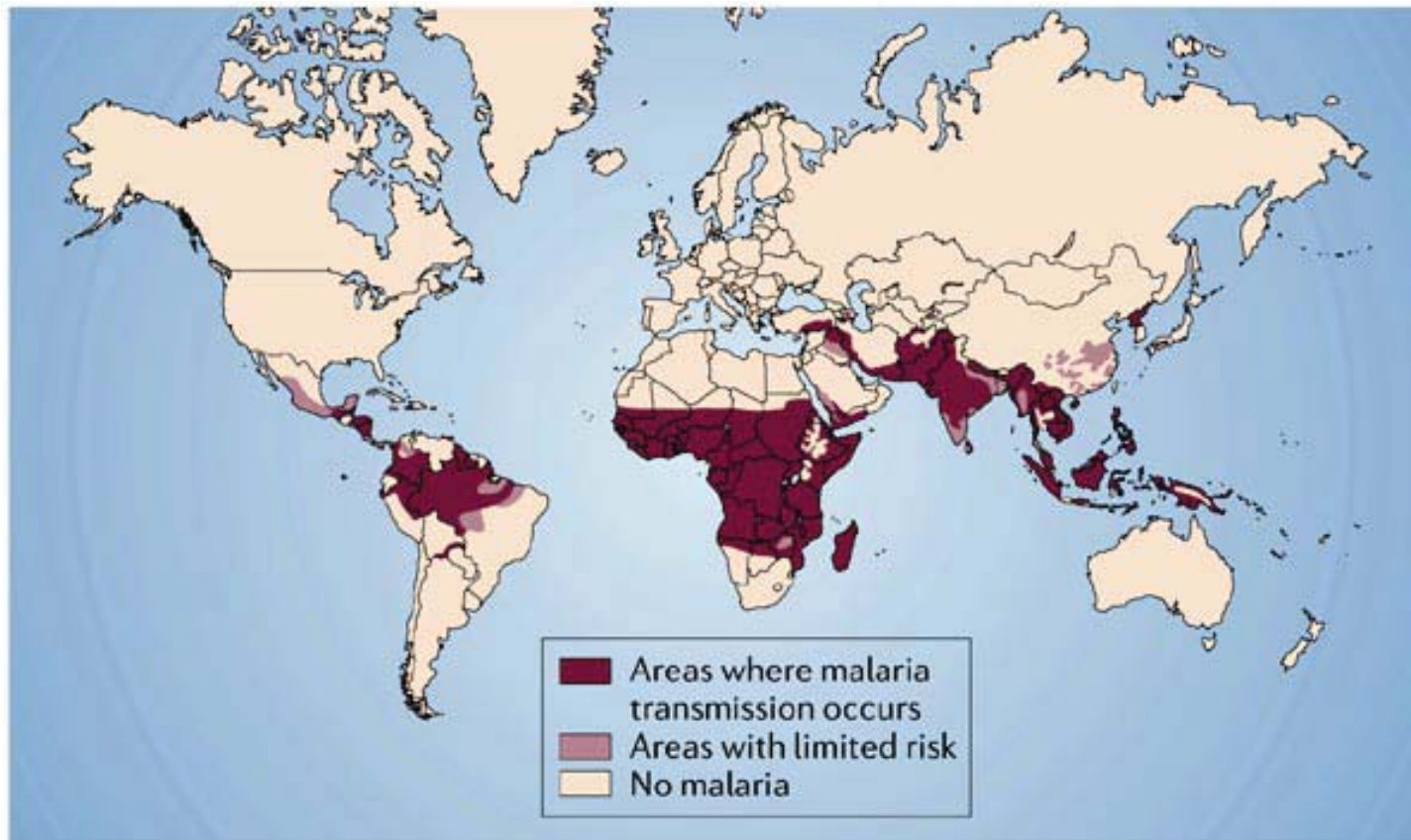
Diseases of development?

e.g. diabetes, obesity, avian flu



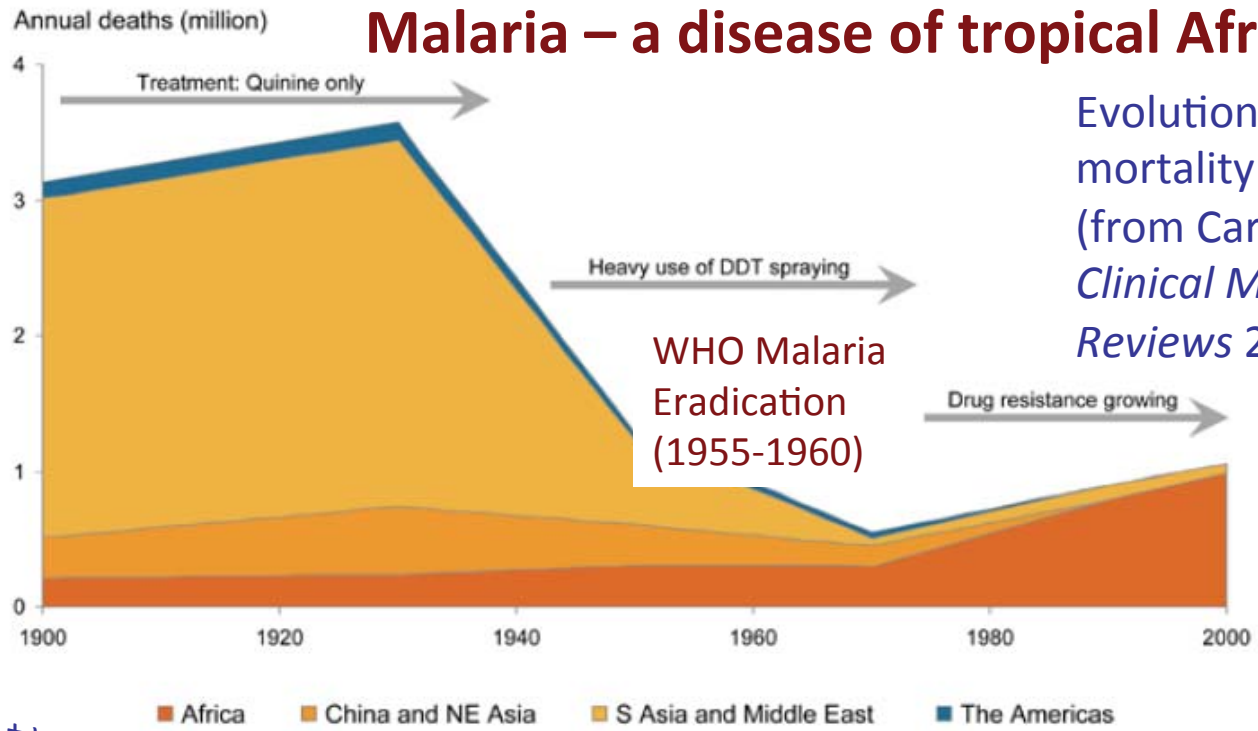
Malaria – the construction of an African tropical disease

Malaria – simply a disease of tropical environment?



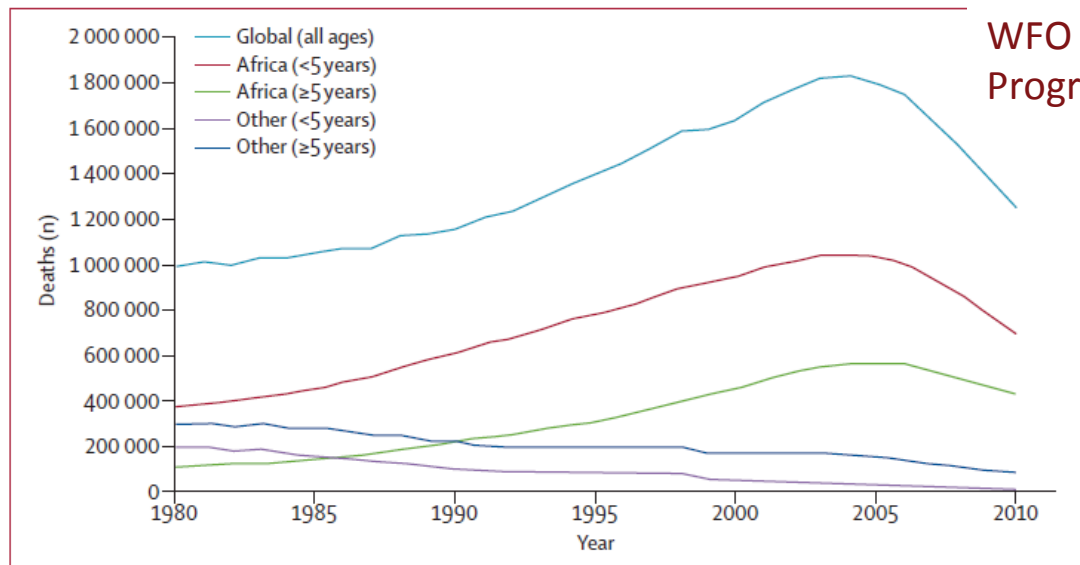
Bell *et al.* *Nature Reviews Microbiology* 4, S7–S20 (September 2006) | doi:10.1038/nrmicro1525

Malaria – a disease of tropical Africa?



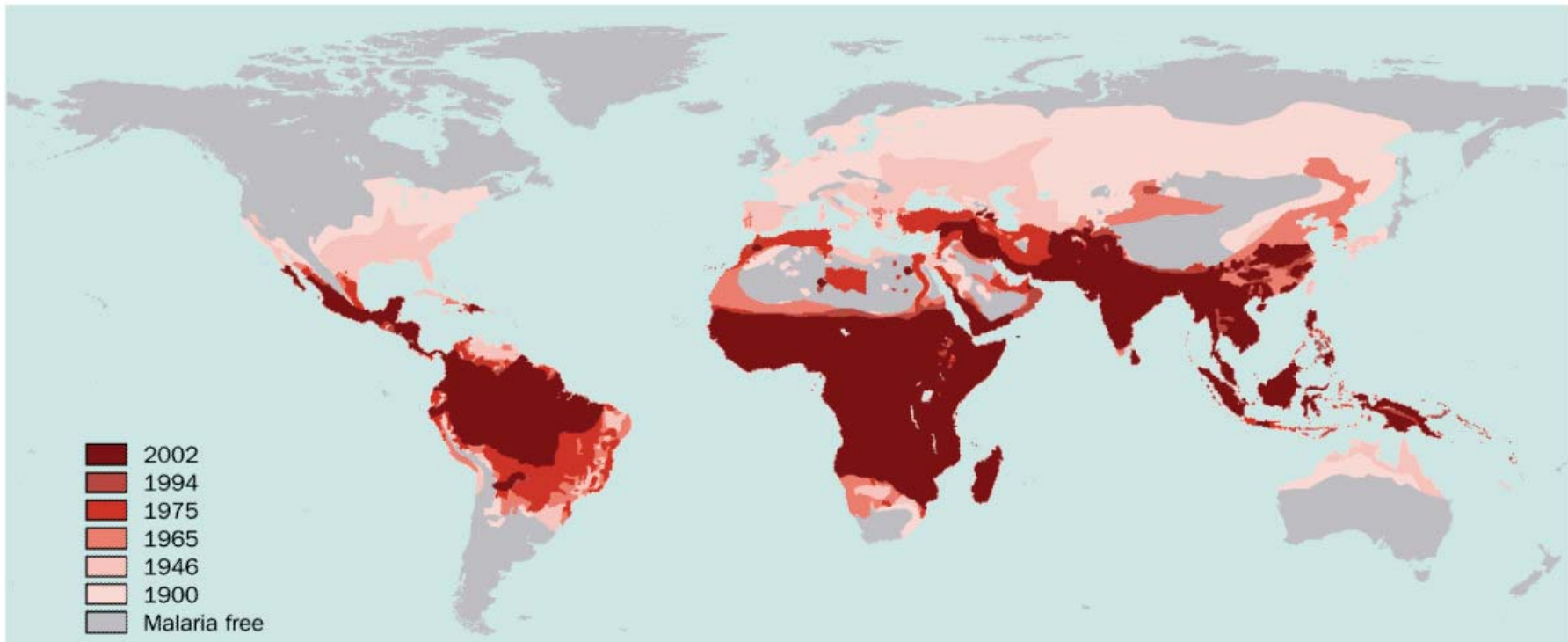
Evolution of malaria mortality 1900-2000 (from Carter & Mendis *Clinical Microbiological Reviews* 2002)

From Murray et al. (2011)
Global malaria mortality *Lancet*



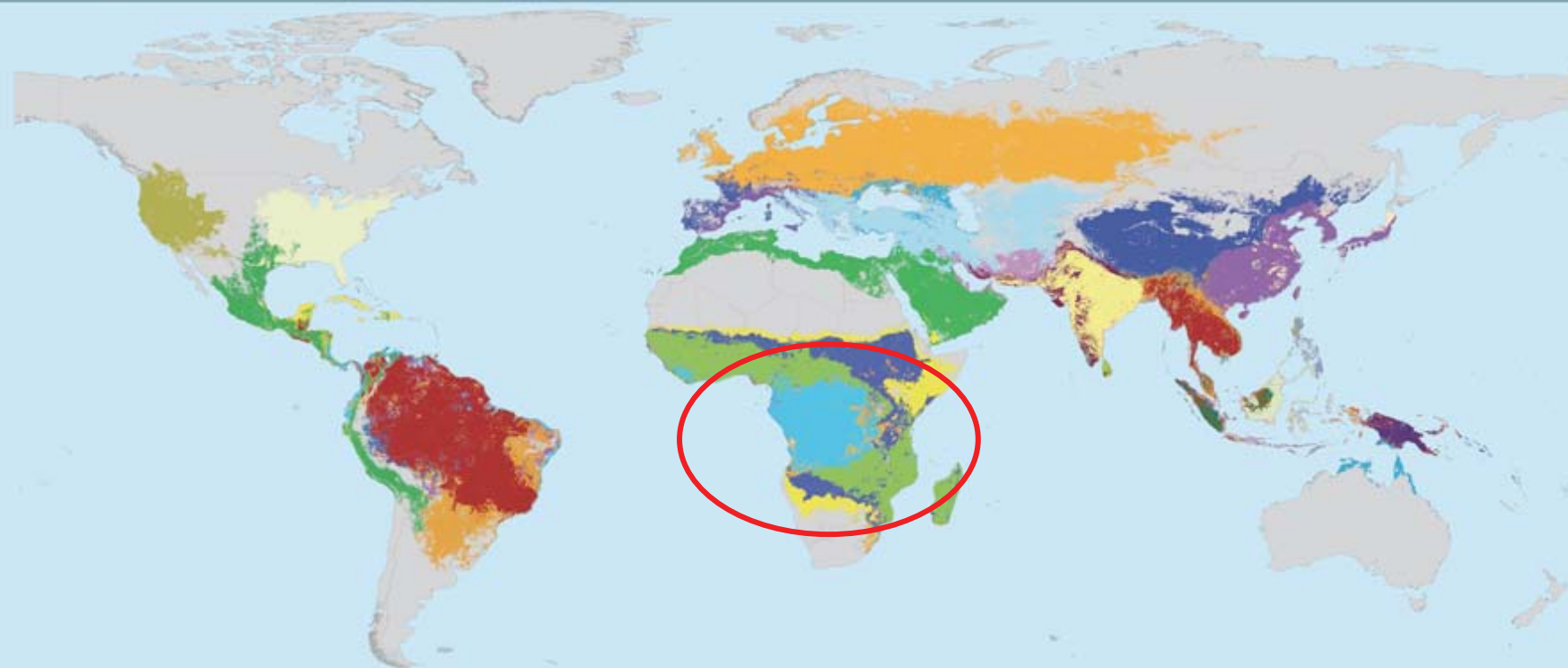
WFO Roll Back Malaria Programme (1998-)

But malaria was a global disease
at the end of the 20th century



Changes in the global distribution of malaria, ~1900-2002
(after Hays et al. (2004) *Lancet Infectious Diseases*)

Geographic distributions of the dominant malaria vectors (*Anopheles* spp.)



The Americas

- *An. darlingi*
- *An. aquasalis*
- *An. albitarsis* s.l.
- *An. marajoara*
- *An. nuneztovari* s.l.
- *An. pseudopunctipennis*
- *An. albimanus*
- *An. quadrimaculatus* s.l.
- *An. freeborni*

Euro. & M.East

- *An. superpictus*
- *An. sergentii*
- *An. sacharovi*
- *An. messeae*
- *An. labranthiae*
- *An. atroparvus*

Africa

- *An. arabiensis*;
- *An. funestus*;
- *An. gambiae*
- *An. arabiensis*;
- *An. funestus*
- *An. funestus*;
- *An. gambiae*
- *An. gambiae*
- *An. funestus*
- *An. arabiensis*

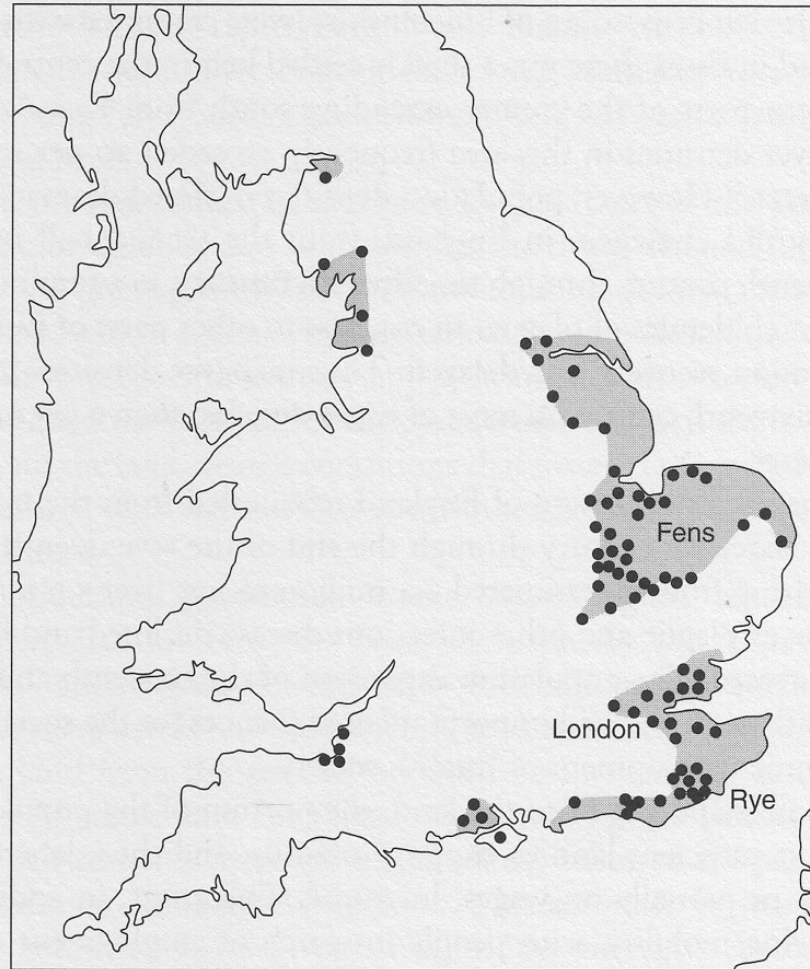
India/Western Asia

- *An. culicifacies* s.l.;
- *An. stephensi*;
- *An. fluviatilis* s.l.
- *An. fluviatilis* s.l.
- *An. stephensi*
- *An. culicifacies* s.l.

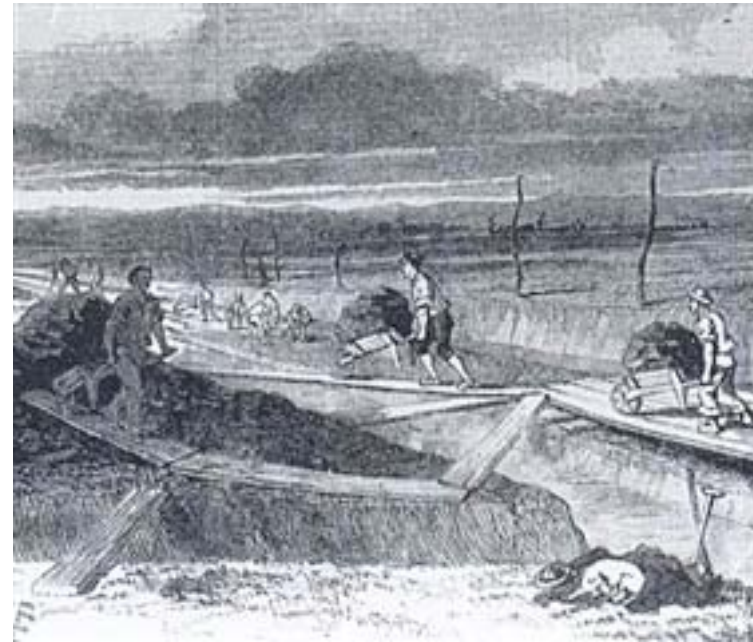
South-East Asia & Pacific

- *An. farauti* s.l.;
- *An. koliensis*;
- *An. punctulatus* s.l.
- *An. dirus* s.l.;
- *An. minimus* s.l.
- *An. lesteri*; *An. sinensis*
- *An. balabacensis*
- *An. barbirostris* s.l.
- *An. dirus* s.l.
- *An. farauti* s.l.
- *An. flavirostris*
- *An. koliensis*
- *An. lesteri*
- *An. leucosphyrus/latens*
- *An. maculatus*
- *An. minimus* s.l.
- *An. punctulatus* s.l.
- *An. sinensis*
- *An. sundaicus* s.l.





Malaria in England, 1860s
After Dobson, M.J. (1997) *Contours of Death and Disease in Early Modern England*



Fen (low-lying wetlands) drainage from 1600s- for agricultural land



Holme Fen, drainage channel

The Pontine Marshes Before Land Reclamation



Generally malaria has been eliminated through combination of vector control, chemotherapy *and* changes in land use, nutrition, well-being

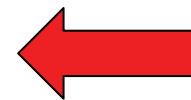
e.g. *bonifica integrale*, Pontine marshes, Italy, 1922-1935





Africa – essentialist view of disease?

Vector control (malaria eradication) programmes



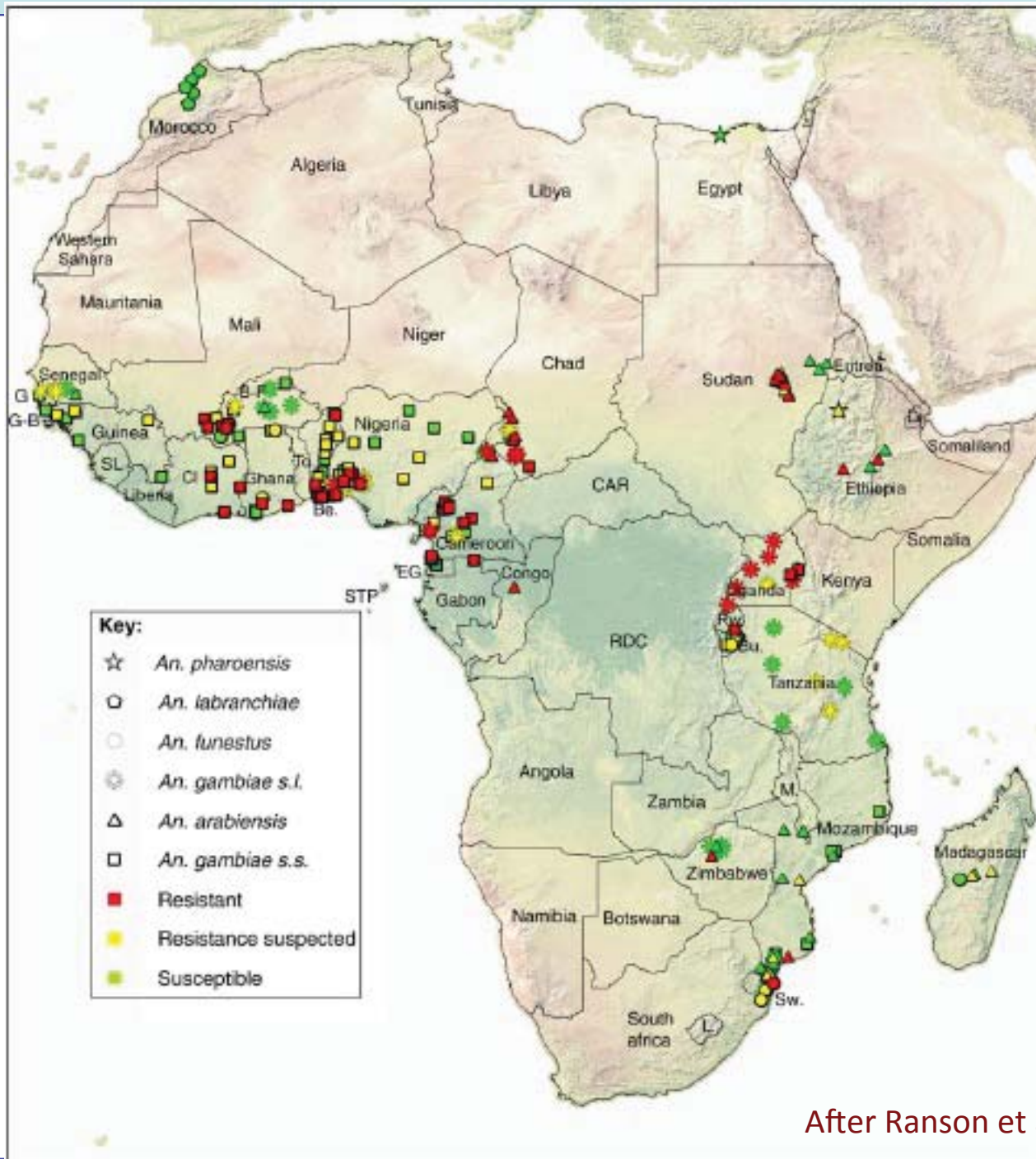
Outdoor spraying of DDT
– 1940s-1960s

“Residual spraying” of pyrethroids
2000s



But only temporarily effective - &
can be counter-productive – if
underlying causes of poor health
are not addressed



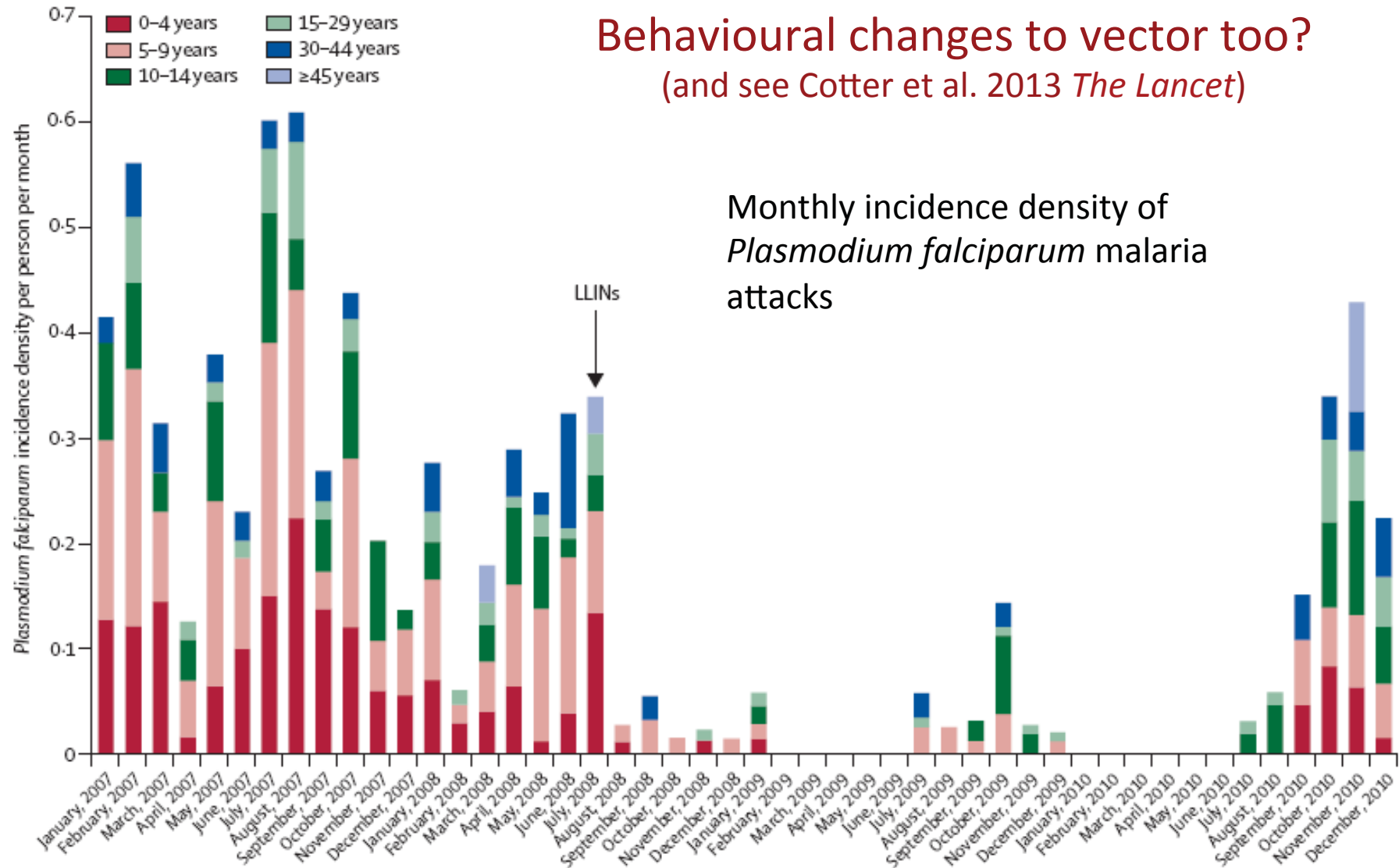


Still dependent basically on same insecticides for 30 years! Evidence that resistance to these is building fast

Pyrethroid resistance in Africa. Note data are incomplete for large parts of the continent. Data from period 2000-2010. Resistance defined according to WHO criteria

After Ranson et al. (2011) *Trends in Parasitology*

Behavioural changes to vector too? (and see Cotter et al. 2013 *The Lancet*)



Dielmo Village, Senegal: Jan 2007-August 2010

After Trape et al. (2011) *Lancet Infectious Diseases*

Underlying causes? Poor & temporary housing, destruction of other sources of blood meals for *Anopheles* mosquitoes (e.g. wild and domesticated animals), creation of breeding sites for mosquitoes, malnutrition etc etc – *pathogenic landscapes!*



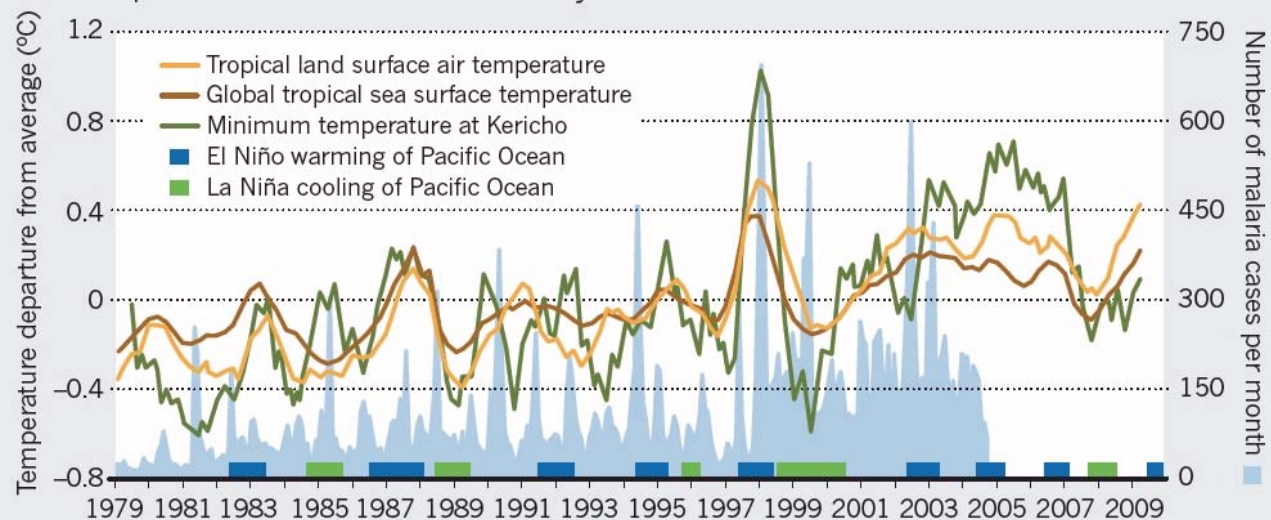
So what?

Climate conditions in Africa are changing – as everywhere else

SOURCES: REF. 7; G. D. SHANKS ET AL. GO.NATURE.COM/CPN7KD

GOING UP

Malaria incidence and temperatures have risen near Kericho in Kenya over the past 30 years; health experts are keen to know whether they are linked.



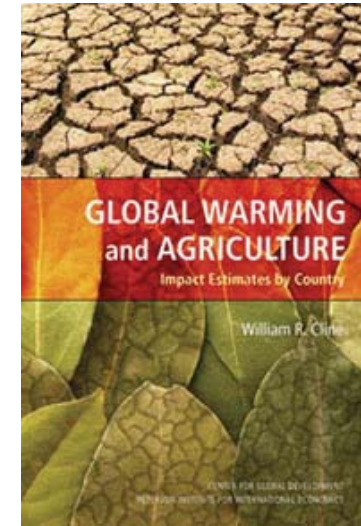
Thomson *et al.*,
(2011) Africa needs
climate data to fight
disease *Nature*

But is a focus on the direct health impacts of climate change – in isolation of other factors that contribute to pathogenic landscapes – helpful? What about the indirect effects – e.g. on food production?

Cline, W. (2007) *Global Warming and Agriculture*

<http://www.cgdev.org/>

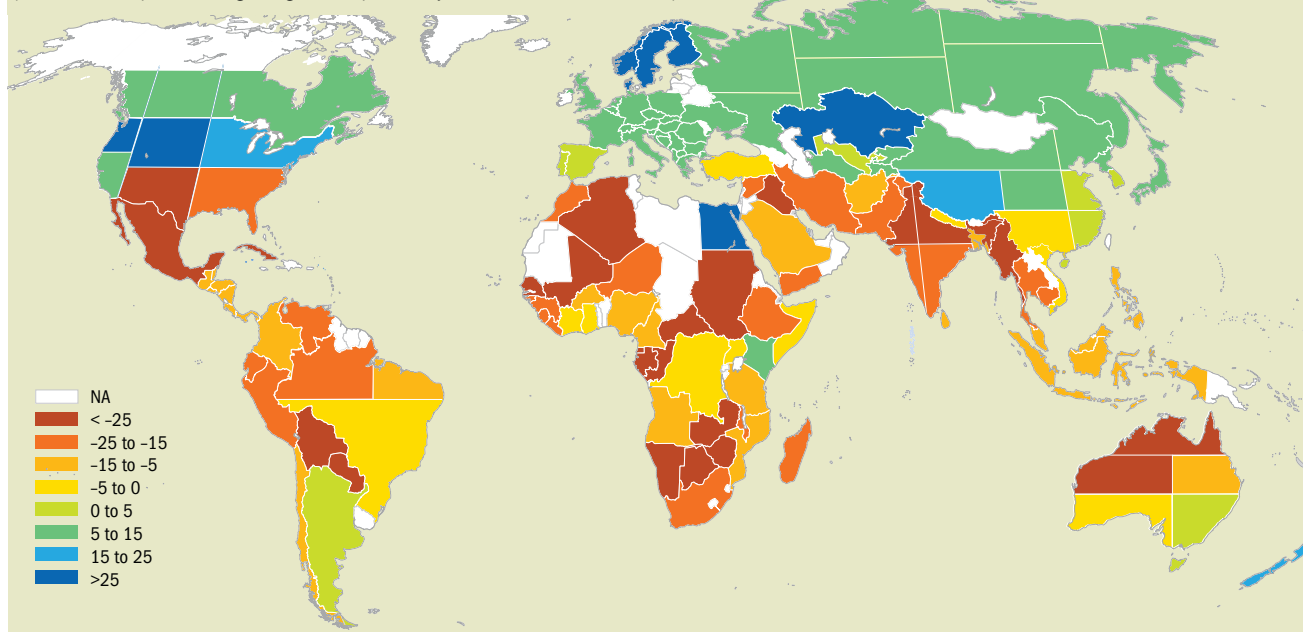
business as usual scenario will reduce agricultural productivity worldwide by c. 16% without CO₂ fertiliser effect, by c. 3% with CO₂ fertiliser effect.



With carbon fertilization

If some crops benefit from increased carbon dioxide, the global impact is less dire and those areas farther from the equator may see some increases in agricultural productivity.

(climate-induced percent change in agricultural productivity between 2003 and the 2080s)



Losses will be **disproportionately concentrated** in developing countries: losses **>20%** in 29 countries and regions, rising to **>50%** in some parts of Africa

Change in pathogenic landscape can interrupt relationship between other environmental variables and disease

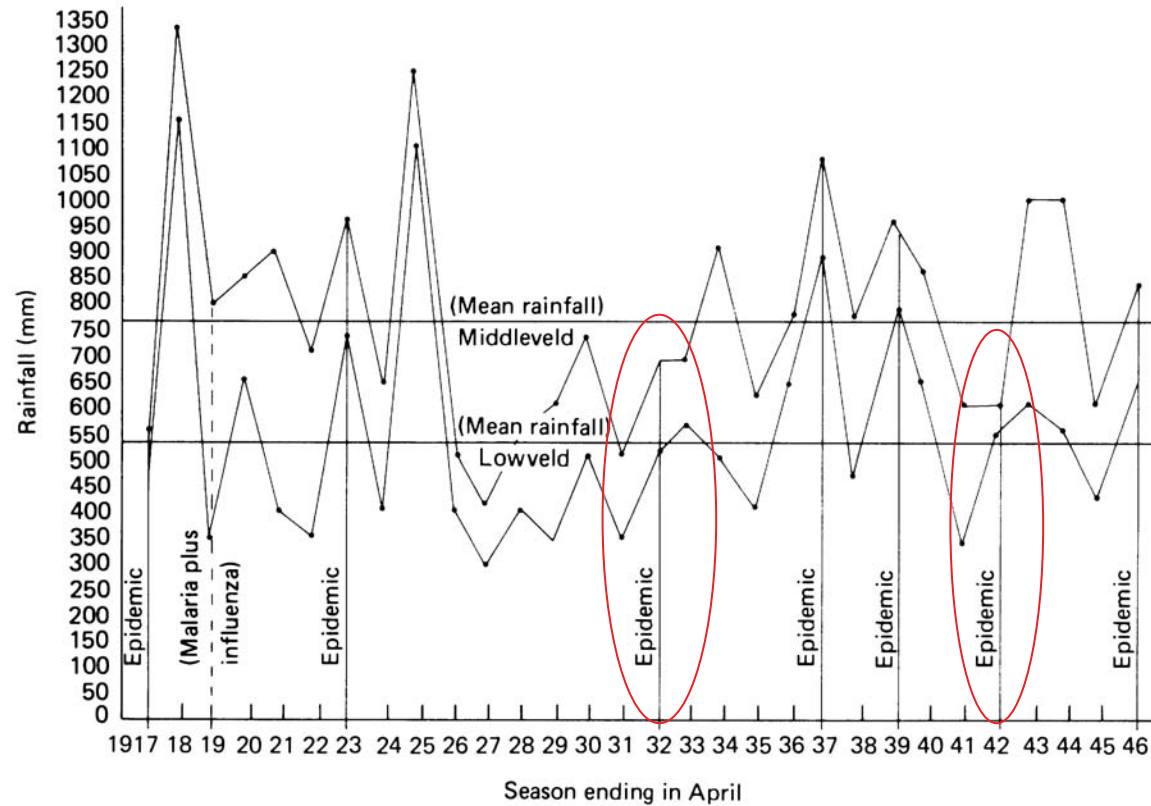
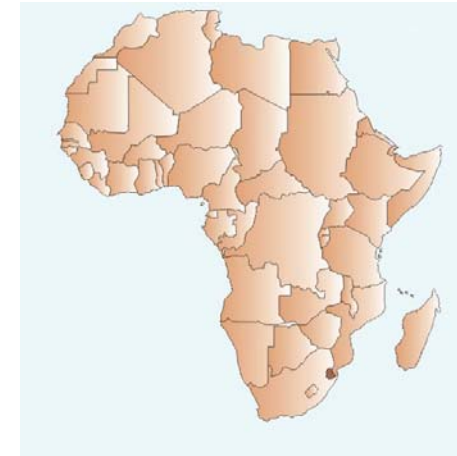


Figure 2. Annual summer rains (November–April) in lowveld (Homestead Station) and Middleveld (Manzini) and regional malaria epidemics.



e.g. effect of famine on malaria in **Swaziland** in the past (Packard, 1984)

HEALTHY FUTURES aims to provide decision support tools to assist in reducing the burden of target vector-borne diseases in East Africa Community Region

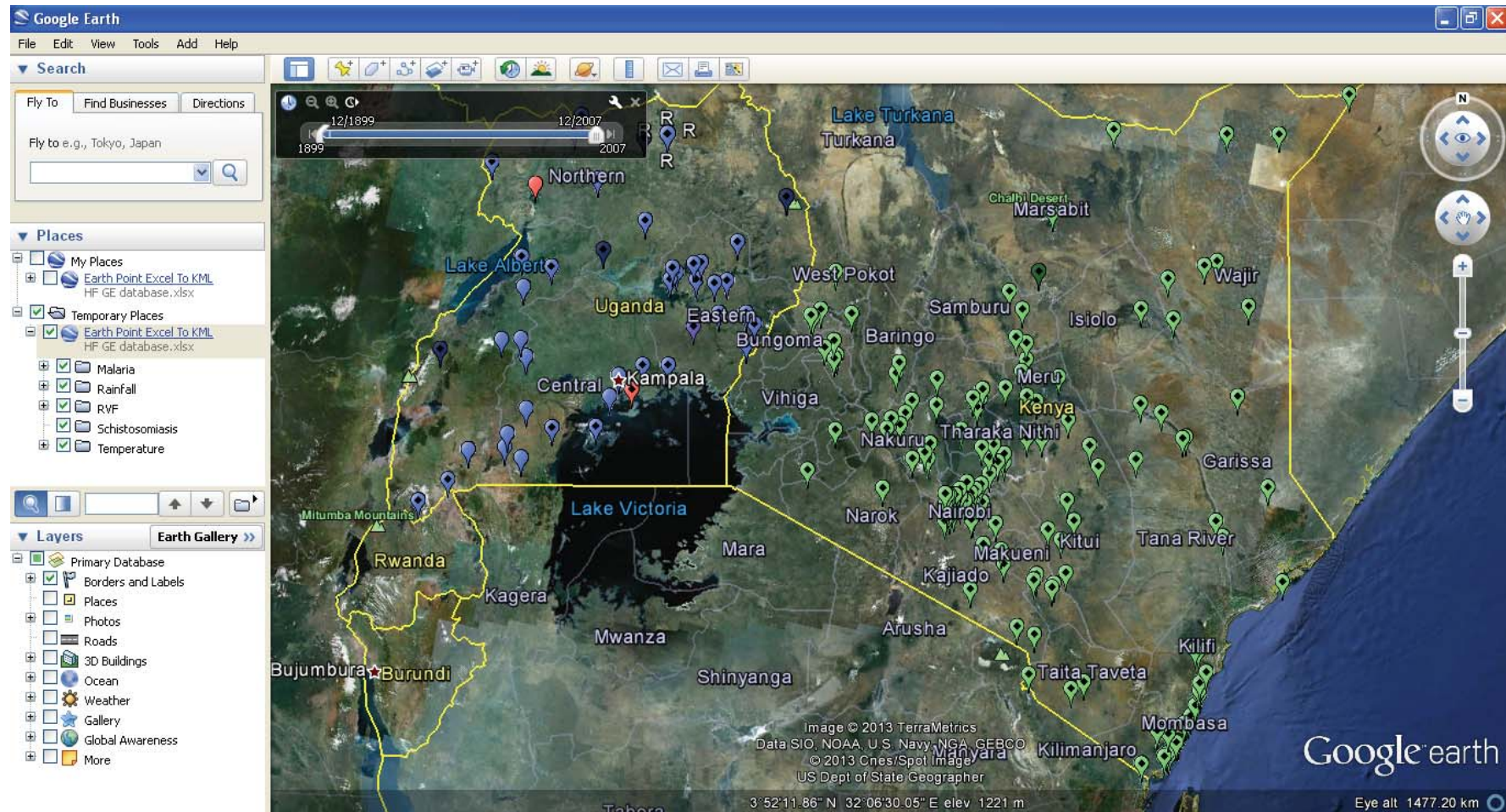


HEALTHY FUTURES 

HEALTH, ENVIRONMENTAL CHANGE AND ADAPTIVE CAPACITY: MAPPING, EXAMINING AND ANTICIPATING FUTURE RISKS OF WATER-RELATED VECTOR-BORNE DISEASES IN EASTERN AFRICA

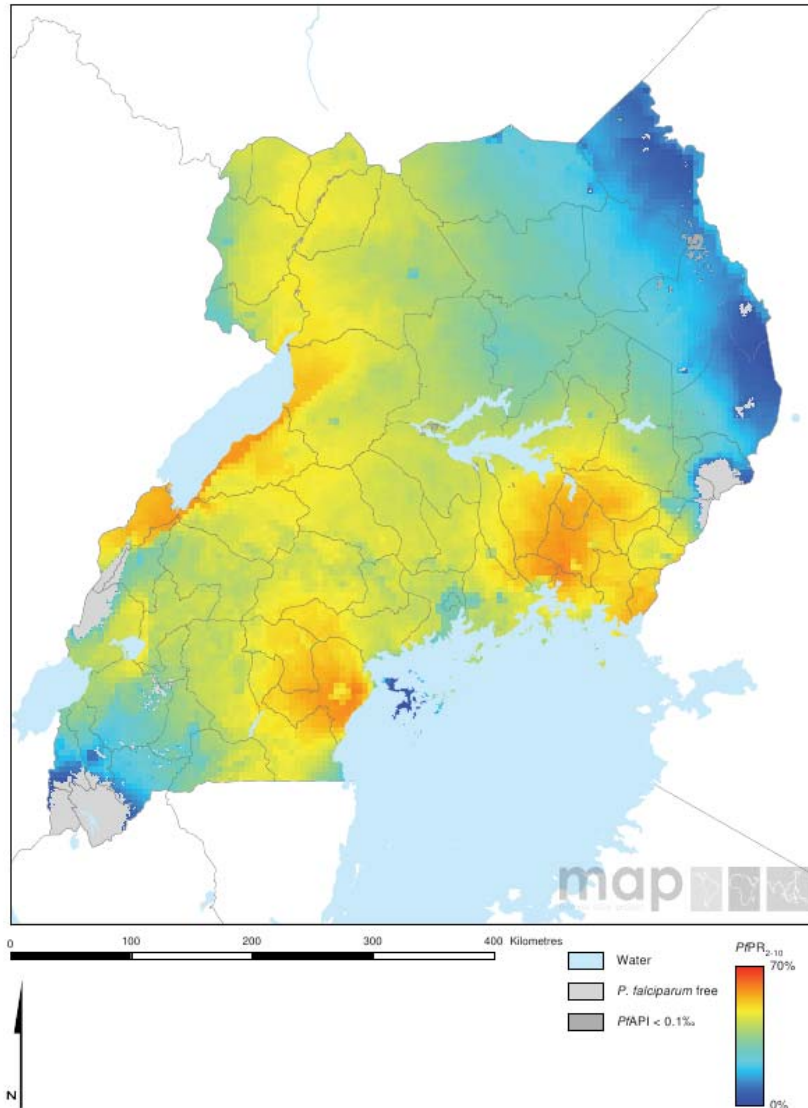
<http://www.healthyfutures.eu>





Screen shot of Google Earth-based historical disease & environmental change database

Malaria in 20th Century Uganda



Estimated levels of *Plasmodium falciparum* malaria endemicity in Uganda (2010).

The mapped variable is the age-standardised *P. falciparum* Parasite Rate ($PfPR_{2-10}$) which describes the estimated proportion of 2-10 year olds in the general population that are infected with *P. falciparum* at any one time, averaged over the 12 months of 2010.

Figure from Malaria Atlas Project

Archival documents for **early 20th C Uganda**: malaria is not mentioned as a major health problem, particularly among the African populations.

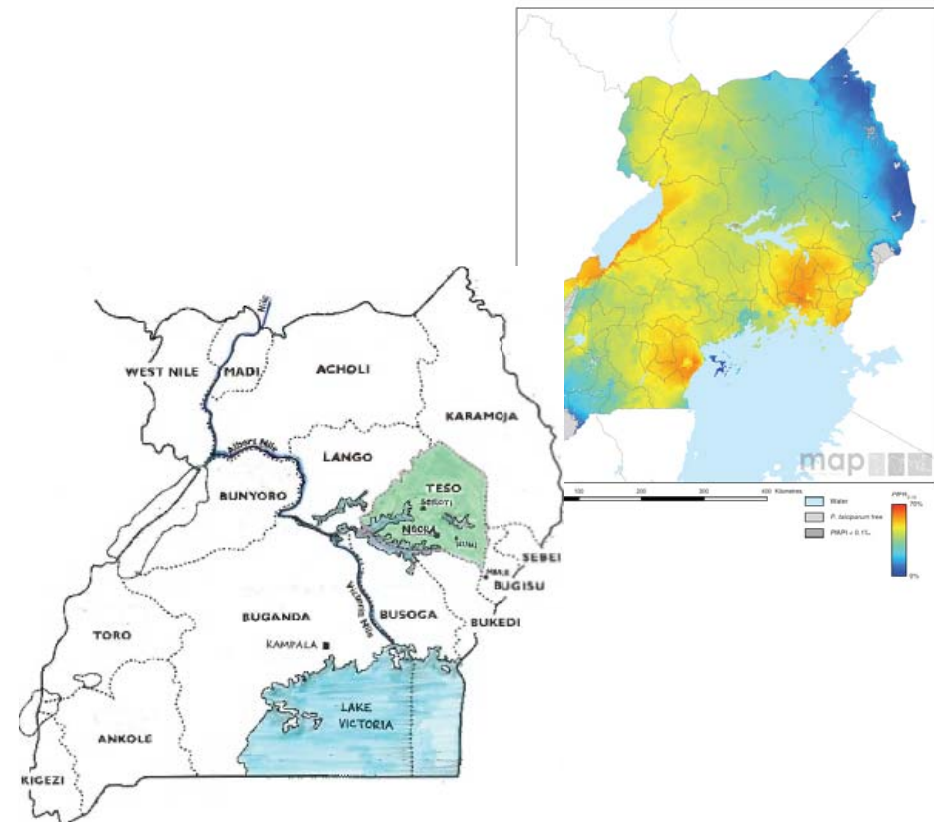
up to 1930s: diseases such as plague, smallpox and sleeping sickness mentioned

Efforts to control malaria targeted at protecting colonial staff.

e.g. 'There is a great amount of disease, much of it apparently curable and preventable, existing among the natives. Of the diseases, plague, small-pox, Leprosy, Cancer, and Syphilis are common and seen in advanced stages. Plague and small-pox are the only diseases of which the extent can be gauged ...'

DC's annual report on **Teso District** for 1914-1915

UNA: PP/Y26: 19



By the 1930s malaria: cause of approximately 25% of 'Epidemic, endemic and infectious diseases' in Ugandan hospitals.

Annual Report on the Social and Economic Progress of the People of the Uganda Protectorate 1935

UNA: Colonial Reports Annual

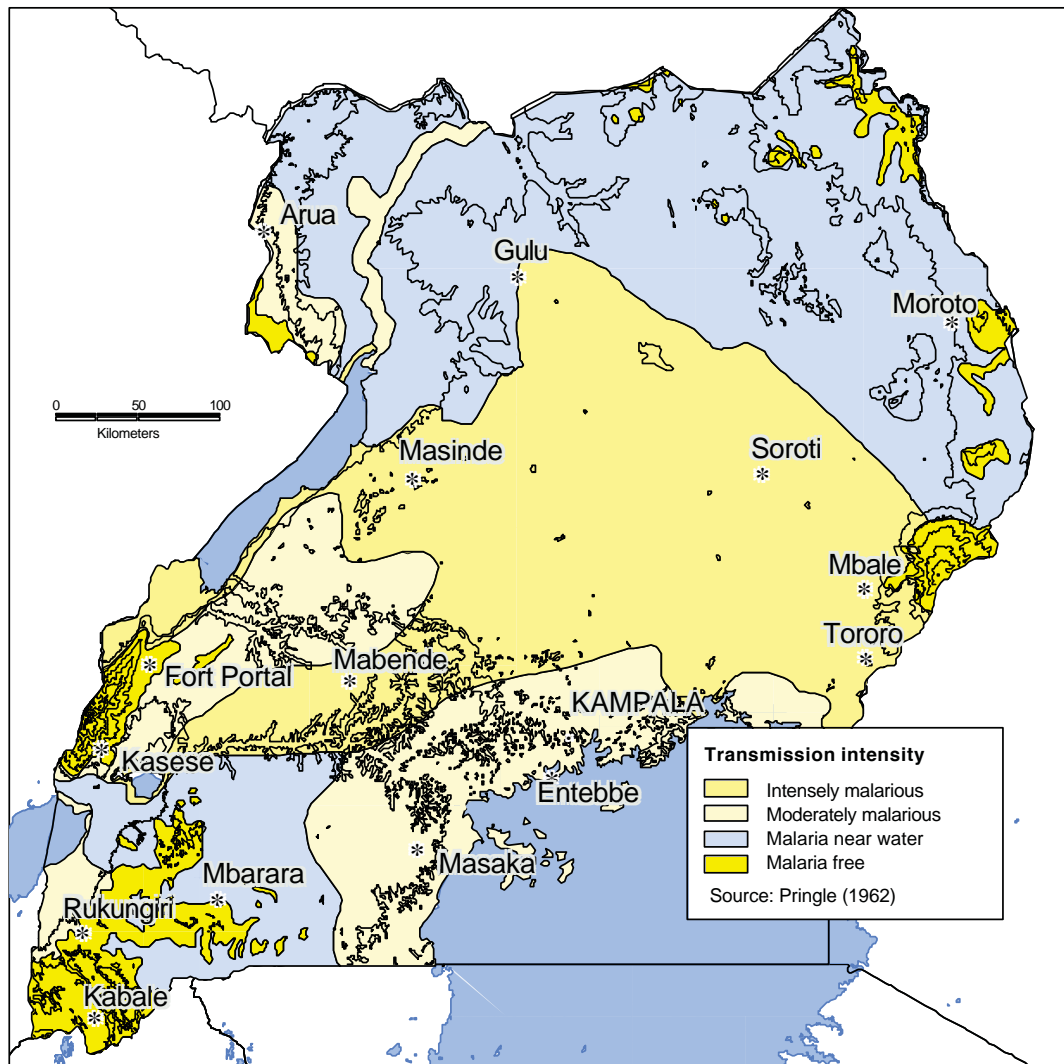
By 1942, malaria was being described as

'the most important of all diseases'

Annual Report of the Medical Department for 1942

UNA: MoH

Map of malaria distribution in Uganda 1962



Map of malaria distribution 1962 obtained from Ministry of Health Uganda, Malaria Control Programme

<http://www.health.go.ug/mcp/m2.pdf>

Was the *apparent change* in importance of malaria in early-mid 20th Century Uganda an effect of:

- reporting differences due to a greater interest in the health of indigenous people
- climate change
- changes in socio-economic factors
- relaxation of earlier interventions
- some combination of factors?