

MODELING MALARIA

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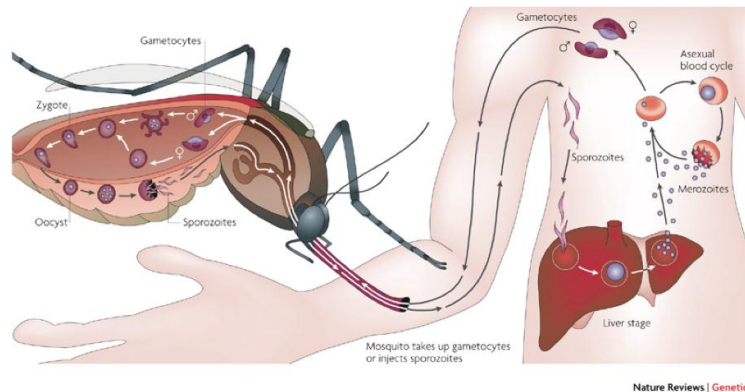
Johns Hopkins Bloomberg School of Public Health

& Center for Disease Dynamics Economics & Policy, Washington, DC

Why model malaria?



- Understand
- Investigate
- Synthesize
- Contextualize
- Predict
- Analyze
- Optimize
- Prioritize research
- Establish thresholds
- Rational strategies



How long does a person remain infectious?

How many times a day is a person bitten by potential vectors?

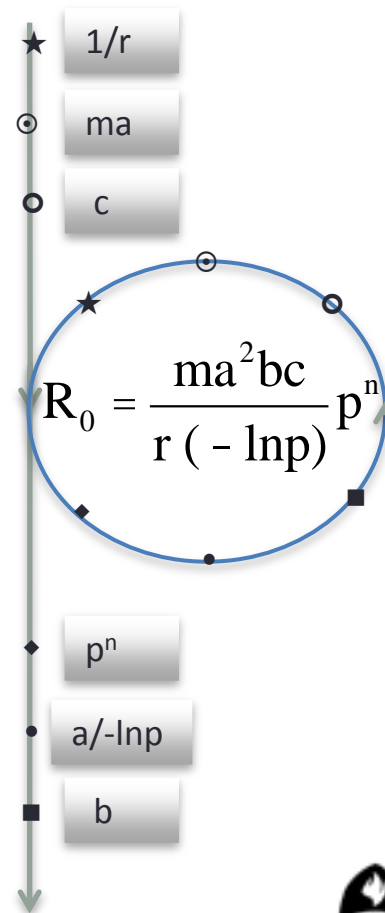
What fraction of bites on infectious humans infect a mosquito?

m – ratio of mosquitoes to humans
p – probability a mosquito survives one day
n – number of days required for sporogony
a – number of human bites, per mosquito, per day

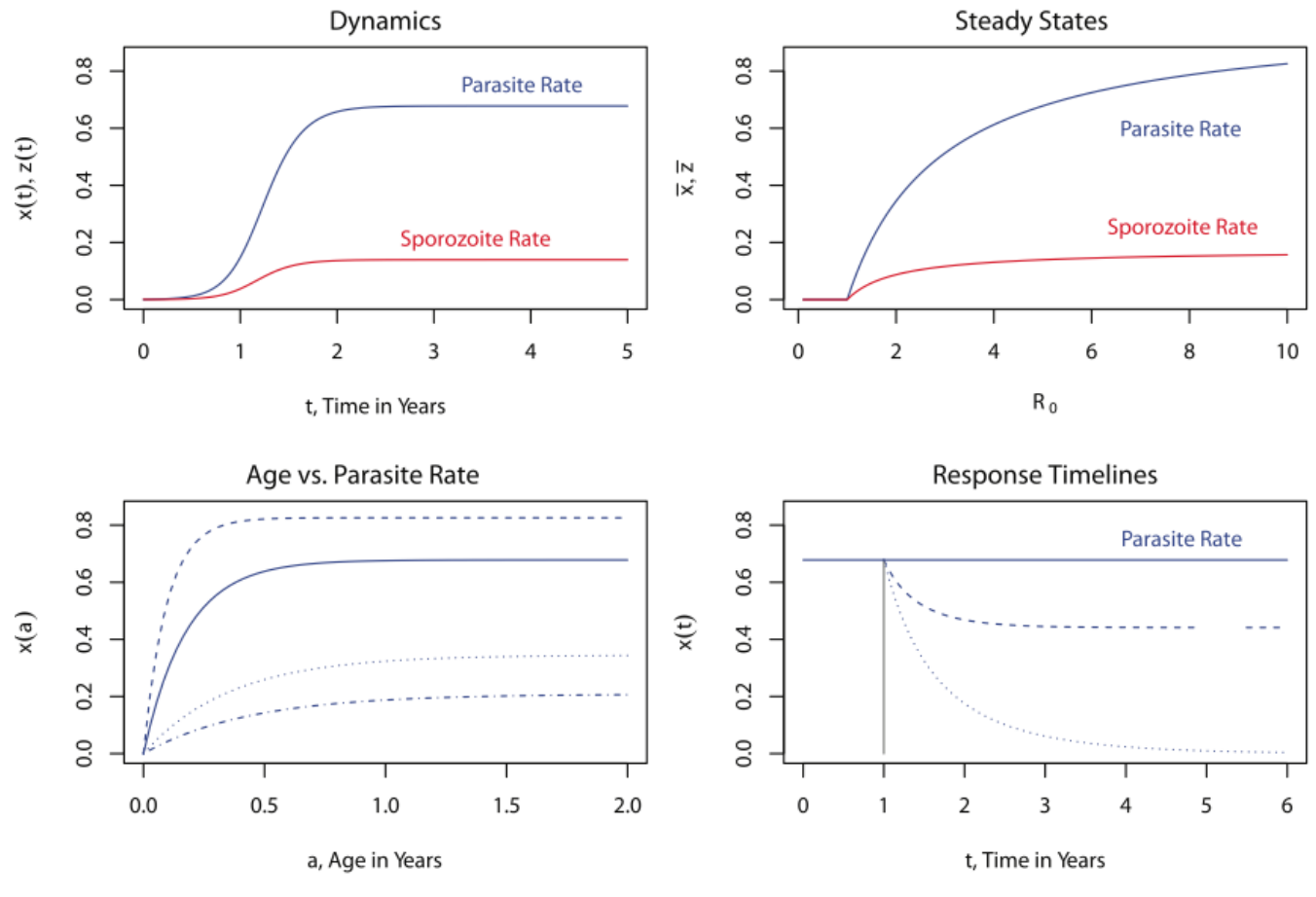
What fraction of mosquitoes survive sporogony?

How many human bloodmeals does a vector take over its lifetime?

What fraction of infectious bites infect a human?

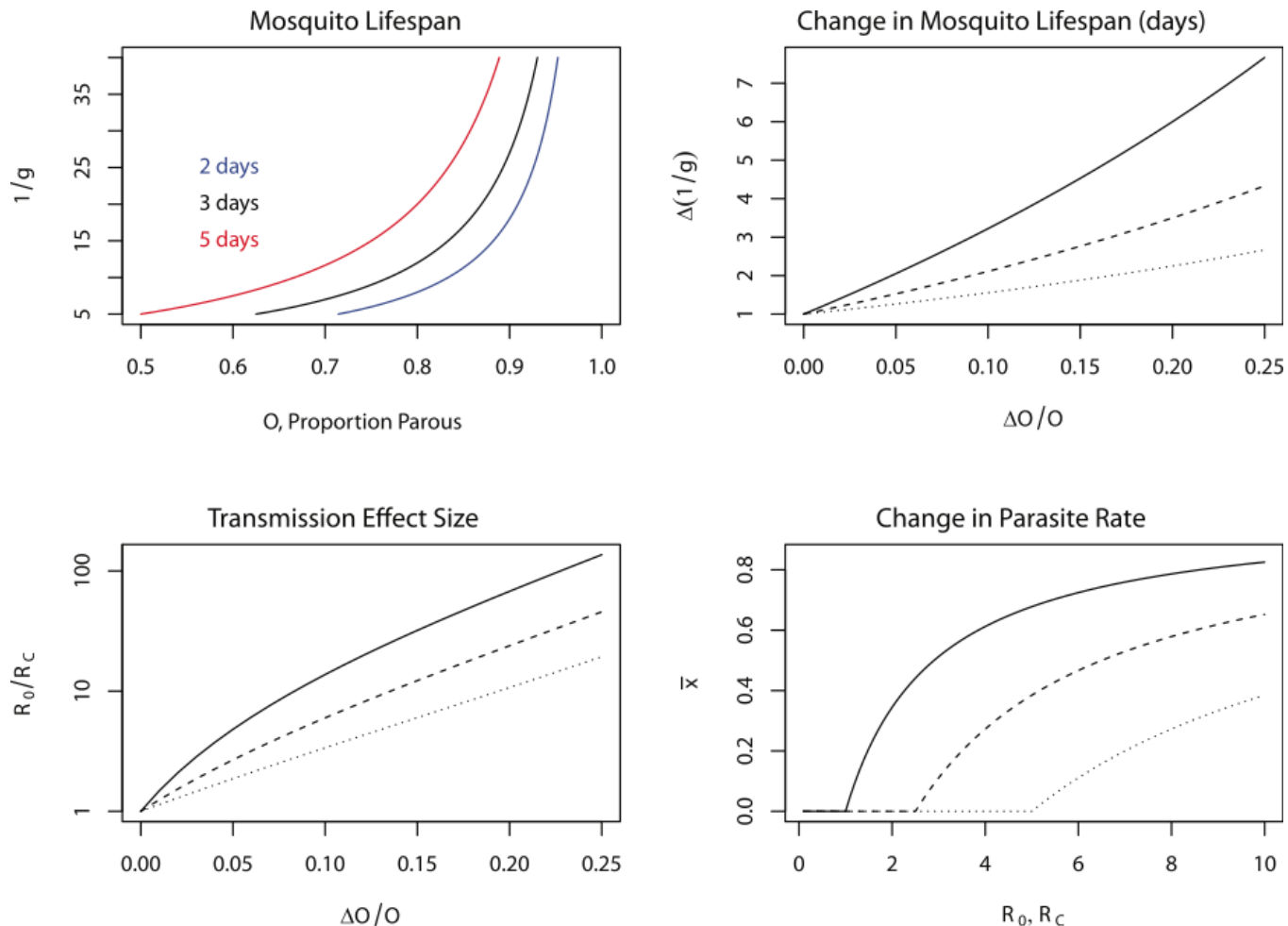


The Ross-Macdonald Model (1904-1969)



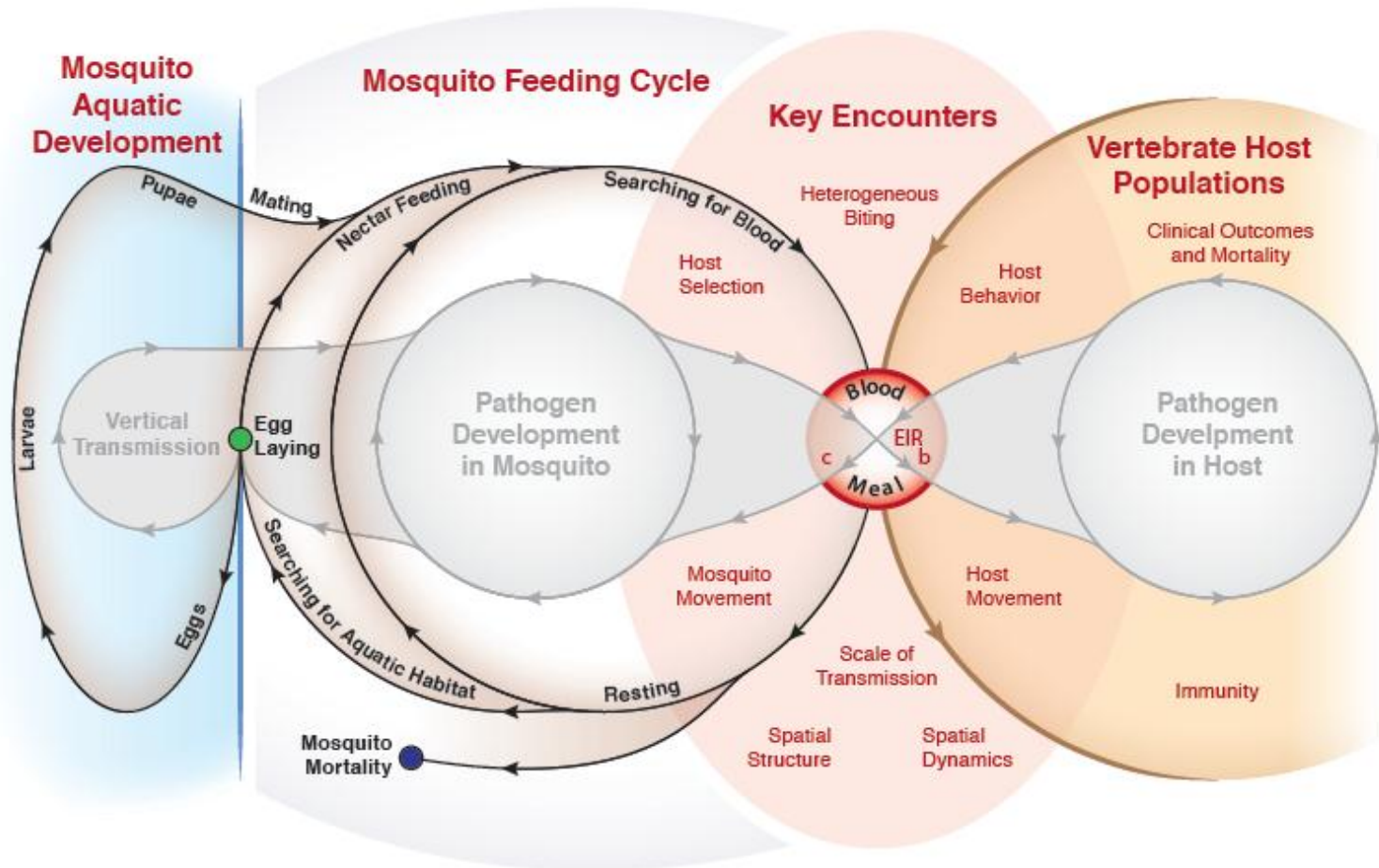
To appear: PLoS Pathogens, on Apr 5, 2012

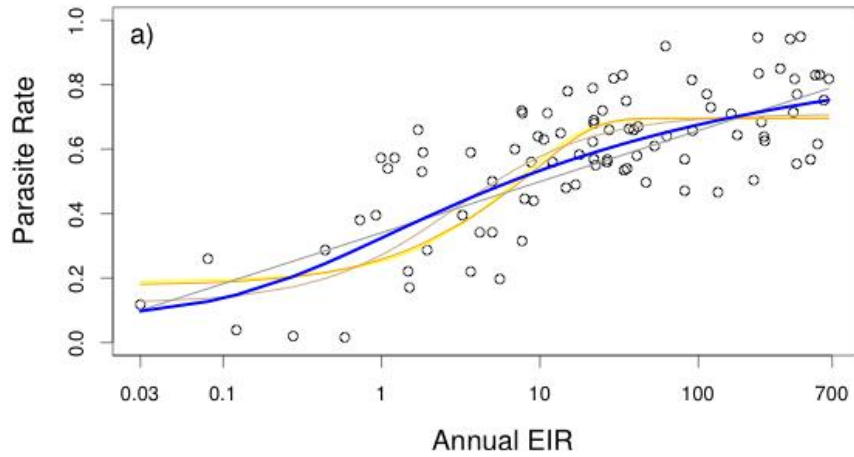
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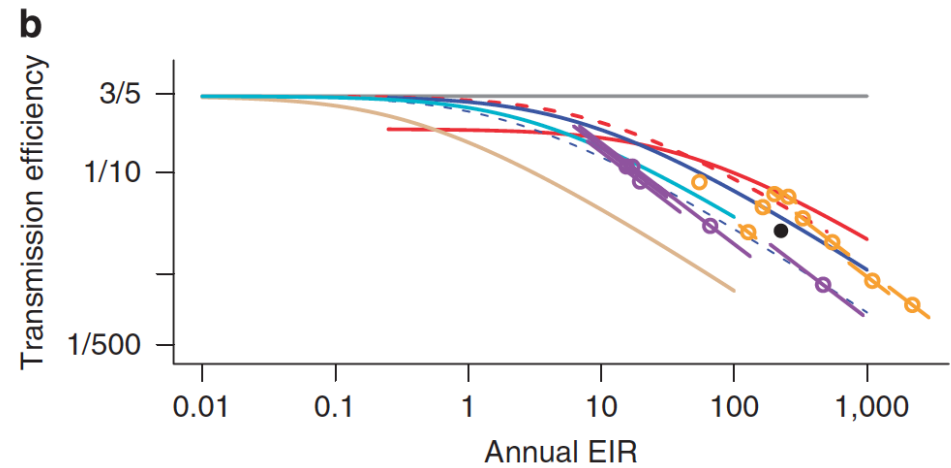
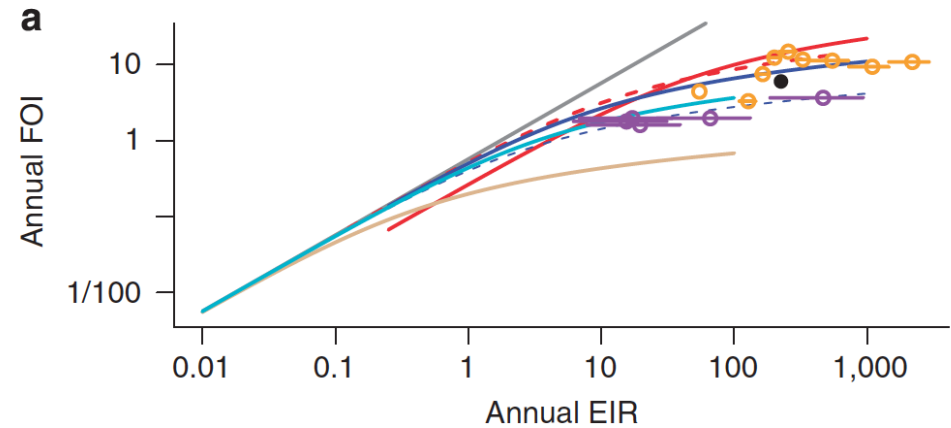
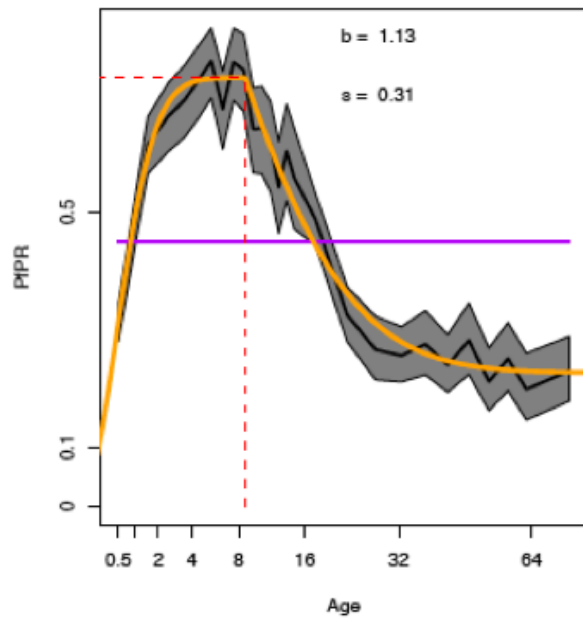
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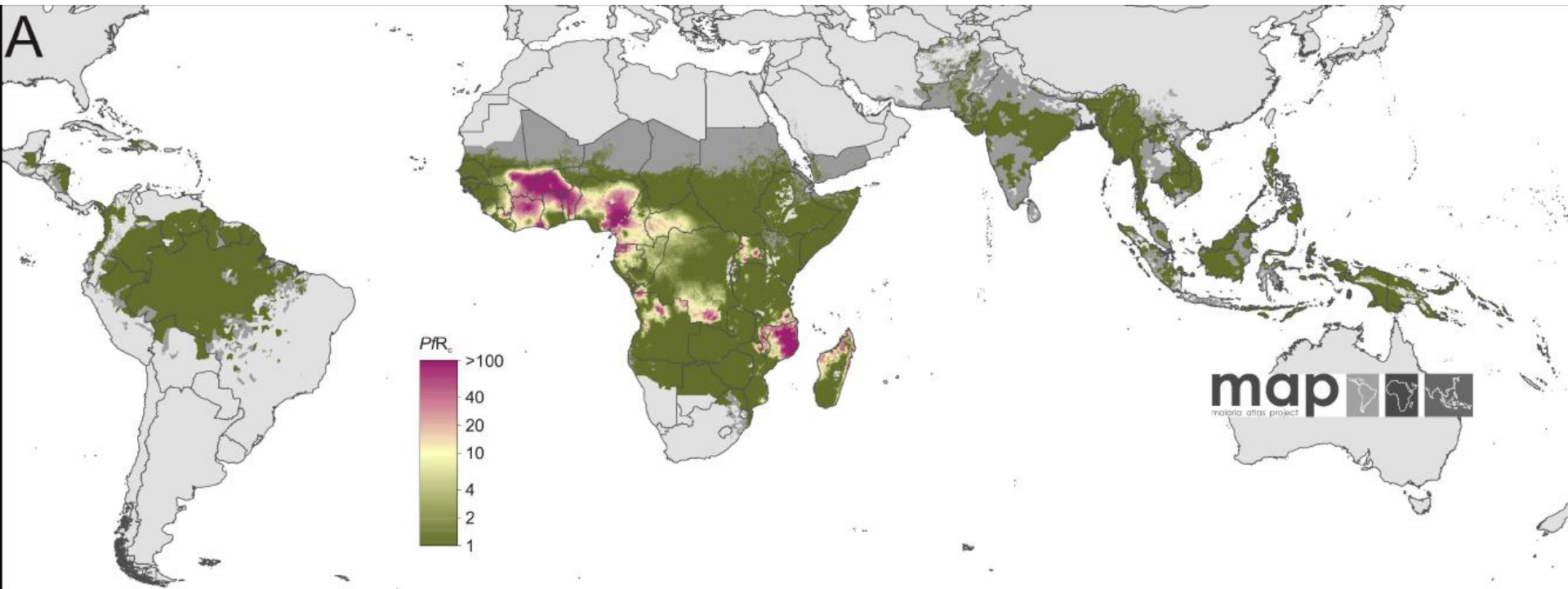
Mosquito-borne pathogen models (1970-2010)





Navrongo





Gething *et al. Malaria Journal* 2011, **10**:378
<http://www.malariajournal.com/content/10/1/378>



RESEARCH

Open Access

A new world malaria map: *Plasmodium falciparum* endemicity in 2010

Peter W Gething^{1†}, Anand P Patil^{1†}, David L Smith^{2,3†}, Carlos A Guerra¹, Iqbal RF Elyazar⁴, Geoffrey L Johnston^{5,6}, Andrew J Tatem^{2,7} and Simon I Hay^{1,2*}



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How can we use models?



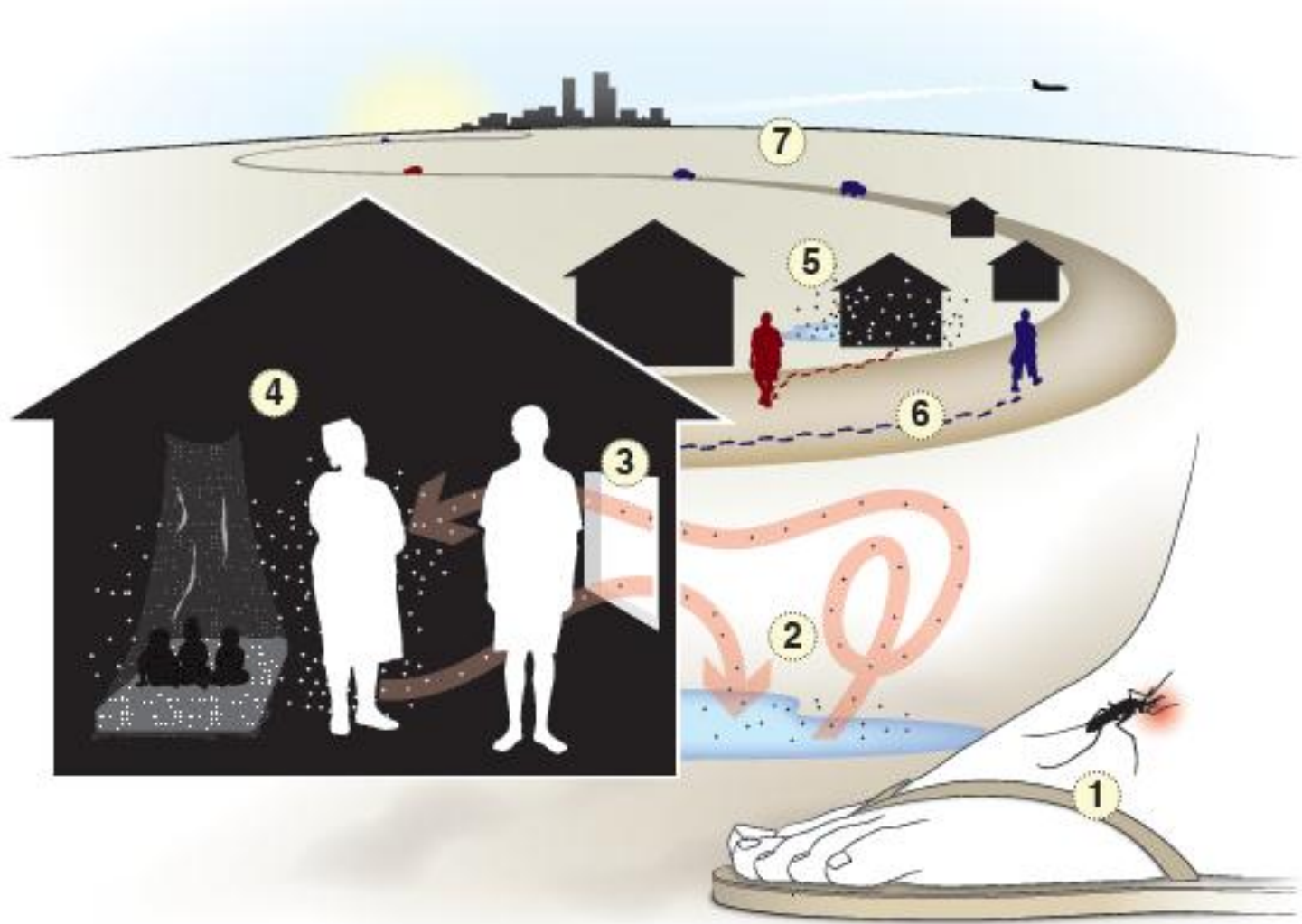
- Strategic planning for the GMEP
- Target intervention coverage levels for elimination
- Timelines for elimination
- Reasonable expectations about the outcome of control

Strategic Planning

- What could be done?
- How long would it take?
- How much would it cost?

Strategic Planning

- Do we know enough about malaria to answer these questions?
- If not, then what kind of study do we need to do?



A. Dry season

Parasite carriage in humans (low to high)



Mosquito exposure (low to high)



B. Wet season



OPEN ACCESS Freely available online

PLOS MEDICINE

Policy Forum

Hitting Hotspots: Spatial Targeting of Malaria for Control and Elimination

Teun Bousema^{1,2,3*}, Jamie T. Griffin⁴, Robert W. Sauerwein², David L. Smith⁵, Thomas S. Churcher⁴, Willem Takken⁶, Azra Ghani⁴, Chris Drakeley¹, Roly Gosling⁷



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Research priorities

- Linking mathematical theory & information systems to simulate malaria transmission in a specific place (e.g. *Zanzibar, Haiti*)
- Understanding low intensity transmission dynamics & control
- Quantifying mosquito and human movement and the spatial and temporal scales of transmission
- Assessing the technical feasibility of malaria elimination and associated operational requirements
- Optimizing the suite of malaria interventions to eliminate or “control” malaria