URBAN MALARIA GLOBALIZATION

FROM A NEGLECTED DISEASE IN FORESTS TO A URBAN GLOBAL HEALTH CRISIS

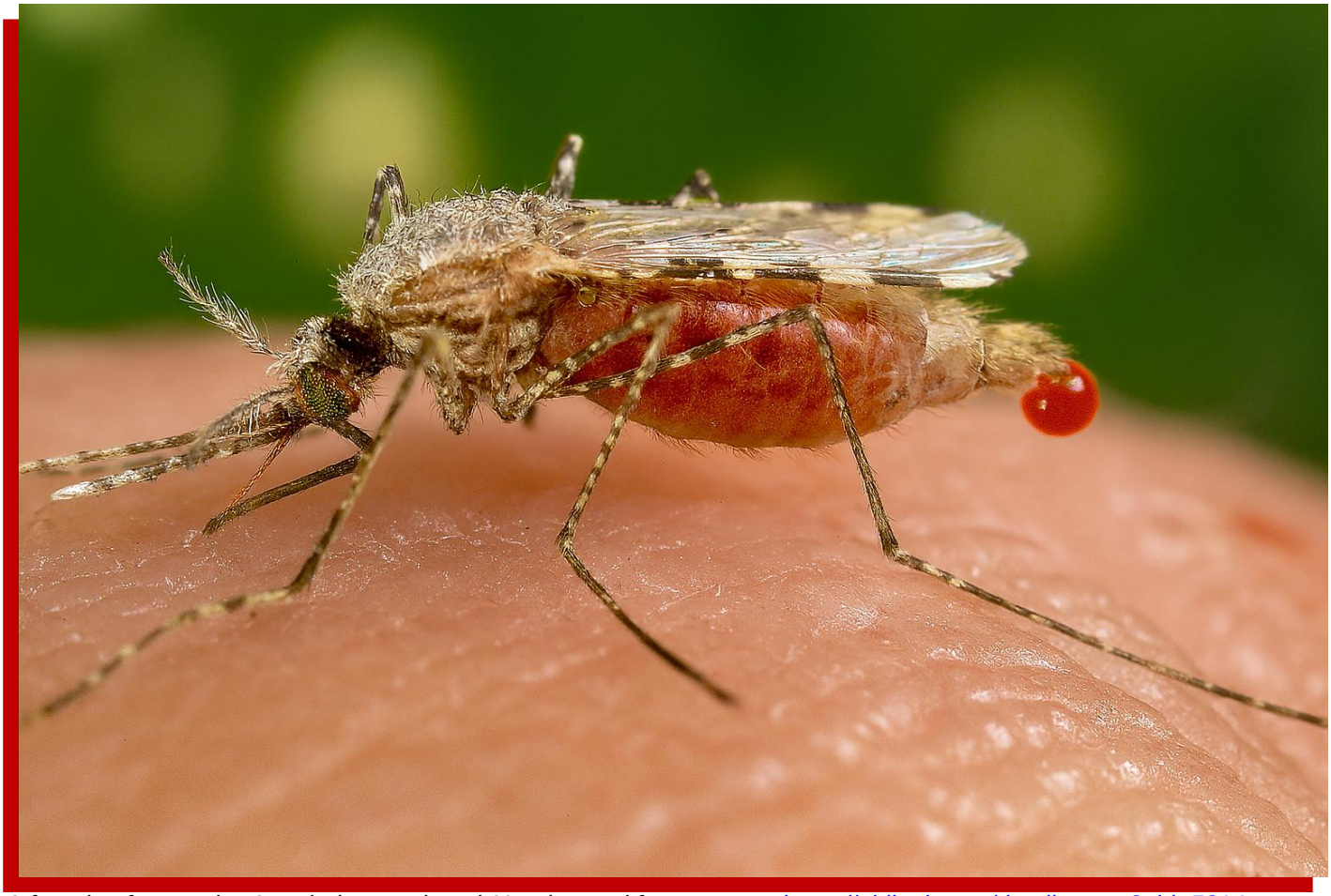
URBANIZATION RISK OF MALARIA GROWS WITH THE INVASION OF ANOPHELES STEPHENSI

Malaria: a new urban threat to global public health

Malaria is a serious infectious disease that can quickly lead to death if not diagnosed and treated in time. Historically, it has been associated with tropical, rural, or forested regions, especially in mining, gold prospecting, or deforestation areas where its traditional mosquito vectors thrive.

However, malaria is now expanding into urban environments. This shift in the transmission pattern is alarming and demands immediate attention from health authorities, public managers, and international organizations. The primary driver of this transformation is an invasive mosquito species, transported and introduced through human activities and favored by climate change: *Anopheles stephensi*.

Previously restricted to some countries in Asia and the Middle East, *Anopheles stephensi* is now spreading to other countries and continents. It has already been detected in densely populated African cities, both in the eastern region and along the Atlantic coast, bringing malaria to urban areas and deeply altering its transmission dynamics.



A female of mosquito *Anopheles stephensi* AI-enhanced from source: https://phil.cdc.gov/details.aspx?pid=5814

Why does this mosquito pose a real threat?

Anopheles stephensi often goes unnoticed by the population due to its resemblance to other common urban mosquitoes. Highly adapted to urban environments, it reproduces easily in any container or place that holds water, such as water tanks, puddles, gutters, garbage, untreated pools, and other artificial human-made environments. Its habits are similar to the well-known *Aedes aegypti*, vector of dengue, Zika, chikungunya, and yellow fever.

This ecological similarity shows that *Anopheles stephensi* can occupy the same environments used by *Aedes aegypti* and benefit from the same urban vulnerabilities, such as lack of sanitation, poor waste management, and unplanned urban growth. This indicates that cities worldwide already provide ideal conditions for the establishment and spread of this new malaria vector.

Worsening the situation, climate change is expanding the areas with favorable conditions for *Anopheles stephensi* survival, including regions where malaria has never been recorded. In addition to being highly adapted to urban environments, this mosquito is resistant to a wide variety of environmental conditions — able to survive in dry, humid, rural, forested, and even polluted areas (such as landfills and water and sewage treatment stations) — which significantly increases its potential for global invasion and spread.

How is it spreading?

The global invasion of *Anopheles stephensi* represents an imminent risk, as the species is silently and rapidly moving through various transport routes, making detection difficult. Its primary means of dispersal are ships, but it can also travel by train, truck, or airplane, hidden in humid environments and objects containing standing water.

Critical points include containers, trucks, and wagons with residual water; drums, tanks, water collectors, and water trucks; water tanks used by crews; puddles formed in metal structures, and the ballast water used to stabilize ships. This form of dispersal hinders its detection in ports, highways, airports, and borders — allowing silent and continuous expansion into new regions.

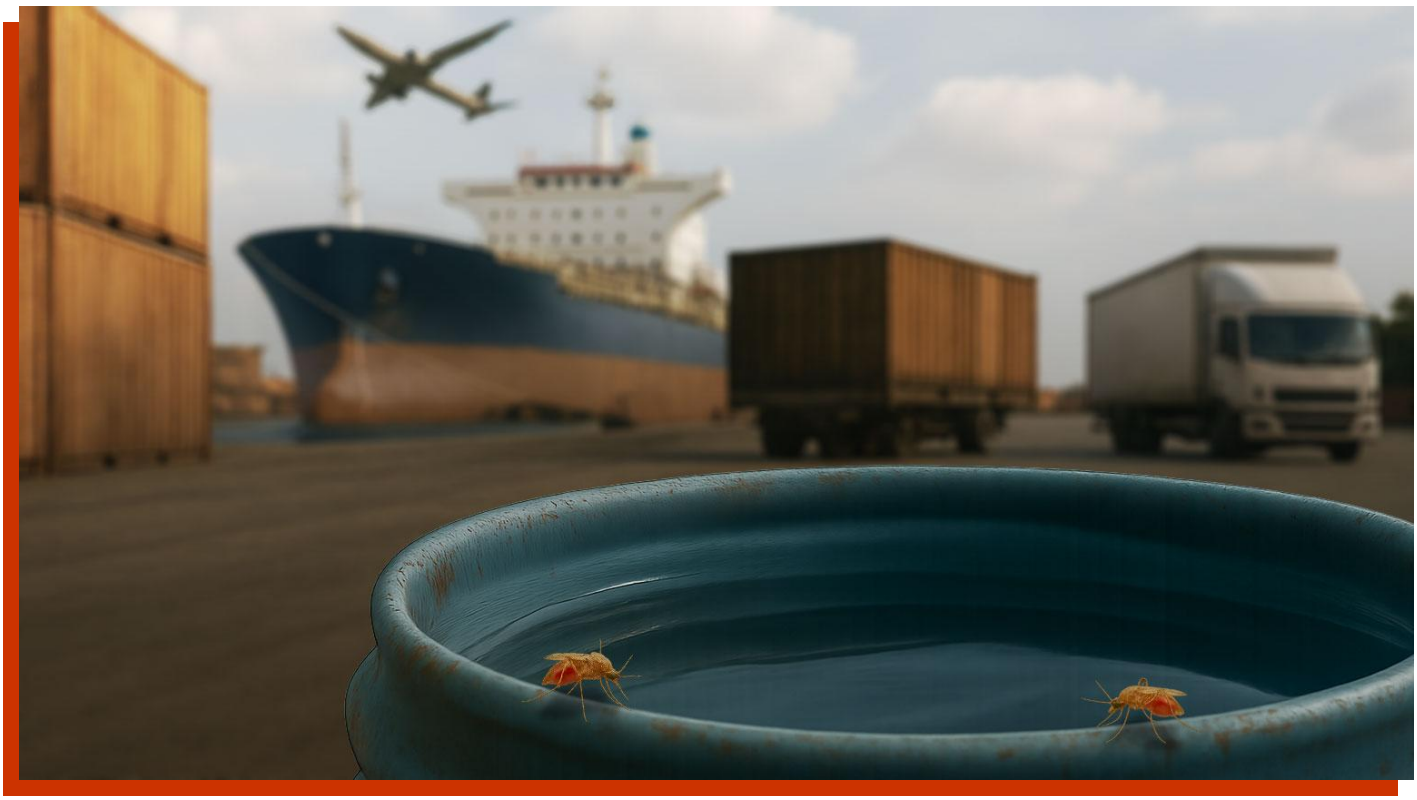


Illustration of hitchhiking mosquitoes arriving at the port. AI-generated image. Mosquito scale has been altered for visual clarity.

Urban expansion of malaria: a growing risk

Like *Aedes aegypti*, the urban malaria vector *Anopheles stephensi* exploits urban failures: lack of sanitation, waste accumulation, improper water storage, and unplanned urban growth.

The presence of *Anopheles stephensi* in urban areas represents a new and serious public health threat, adding malaria to a context already burdened by other mosquito-borne diseases. The coexistence of this vector with species like *Aedes aegypti* and other disease-transmitting mosquitoes increases the strain on health systems already struggling to control insect-borne urban infections.

If urgent measures are not taken, this mosquito could not only increase case numbers in malaria-affected countries but also establish transmission in areas previously considered malaria-free or where local transmission had been eliminated.

Illustration of urban mosquito breeding habitats.AI-generated image. Mosquito scale has been altered for visual clarity.

Global risk map and projections

Currently, about 13% of the Earth's surface has climatic conditions favorable to the survival of *Anopheles stephensi*. This corresponds to about 34% of the world's population, or approximately 2.4 billion people living in areas suitable for this mosquito — especially in India, Pakistan, Nigeria, and China.

In the next 45 years, over half of the global population may be exposed to climates favorable to the presence of the vector. By 2100, between 4.73 and 5.78 billion people could be living in at-risk areas, representing around 56% of the global population.

This silent expansion especially endangers urban populations with precarious infrastructure, children under five, pregnant women, immunocompromised individuals, and people living in countries without a history of malaria — where there is no collective immunity or preparedness in the health systems to handle the disease.

Urgent response to the global urban malaria threat

To contain the growing threat posed by *Anopheles stephensi*, it is essential to adopt coordinated and immediate actions across multiple fronts. The first step is to strengthen entomological surveillance, with systematic monitoring of this mosquito in ports, airports, railways, highways, and logistics centers, as well as border areas. Early detection of its presence, breeding sites, and introduction routes is key to halting its silent spread.

Vector control in urban environments must also be intensified. This includes eliminating standing water in construction sites, gutters, exposed water tanks, various containers, and other breeding spots. Structural investments are urgently needed, such as expanding waste collection, improving basic sanitation, and enhancing urban drainage. In addition, vector control strategies must be tailored to local environmental and socioeconomic realities, based on scientific evidence and considering the impacts of climate change.

An effective response also requires international cooperation. Countries must share real-time data, align surveillance and control strategies, and integrate efforts through the World Health Organization (WHO) and national and global malaria programs.

Simultaneously, it is crucial to prepare urban health systems for this emerging epidemiological reality. This includes training professionals to diagnose and treat malaria cases, even in areas where the disease is not endemic. Access to rapid diagnostic tests, effective medications, and responsive treatment protocols must be guaranteed, especially in regions currently free of transmission but under imminent threat.

Most importantly, the population must be broadly informed about the risks associated with *Anopheles stephensi* and mobilized to demand emergency measures from public managers, health authorities, and political representatives — at all levels, from local to international.

The urgency of this mobilization is unequivocal: *Anopheles stephensi* threatens to reverse decades of progress in the fight against malaria. Its spread could reintroduce the disease into countries where it had been eliminated and establish new transmission hotspots in historically malaria-free regions. We are facing a global — and still silent — emergency, with devastating potential for urban health. The world cannot wait. The response must be immediate, coordinated, and science-driven.

Source or the research: Future global distribution and climatic suitability of *Anopheles stephensi*.
Authors: Acosta, A.L., Castro, M.C., Laporta, G.Z., Conn, J.E., Sallum, M.A.M.
Journal: Scientific Reports - Nature. Volume 15, Article 22268, July 2025
Free access to the research article: https://rdcu.be/ewmwB
Nonprofit public awareness campaign, conducted without the use of government resources.

Spread the word to fight against the urban malaria Spread

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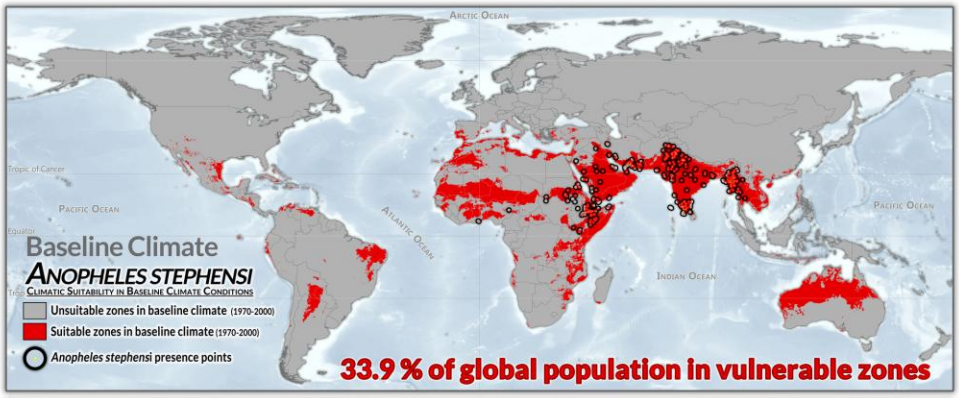
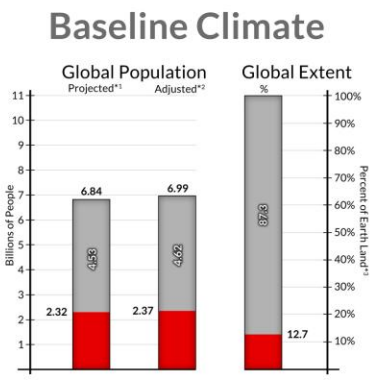
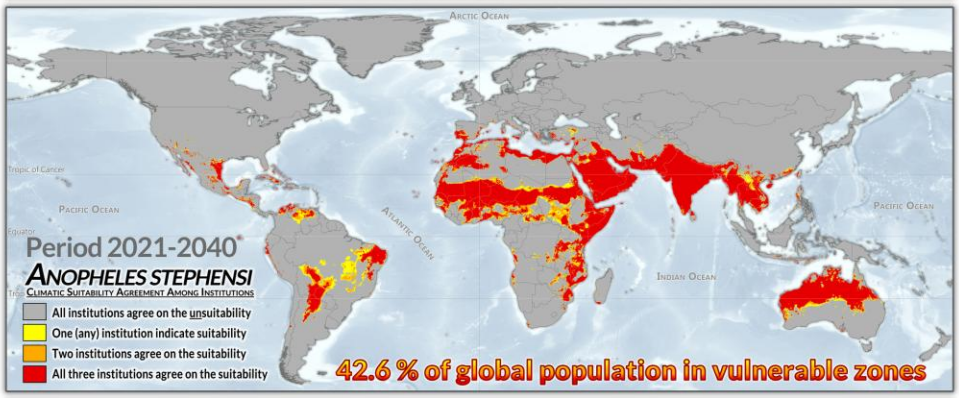
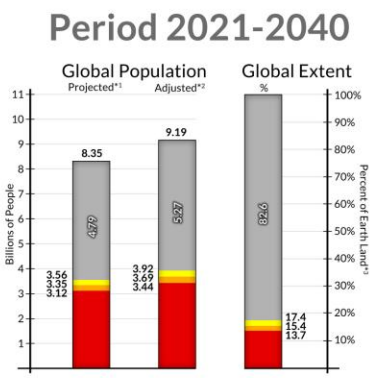
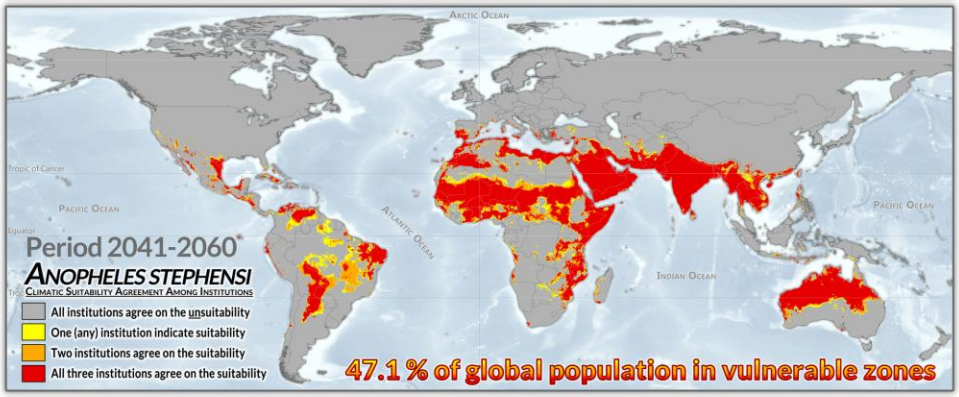
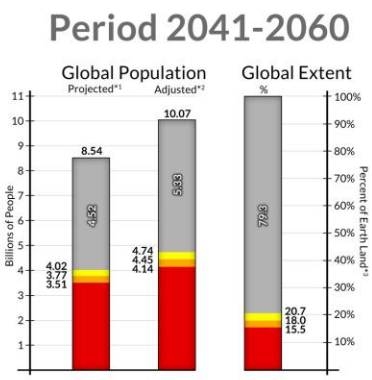

Baseline Climate
ANOPHELES STEPHENSI
CLIMATIC SUITABILITY IN BASELINE CLIMATE CONDITIONS
Unsuitable zones in baseline climate (1970-2000)
Suitable zones in baseline climate (1970-2000)
Anopheles stephensi presence points
33.9 % of global population in vulnerable zones

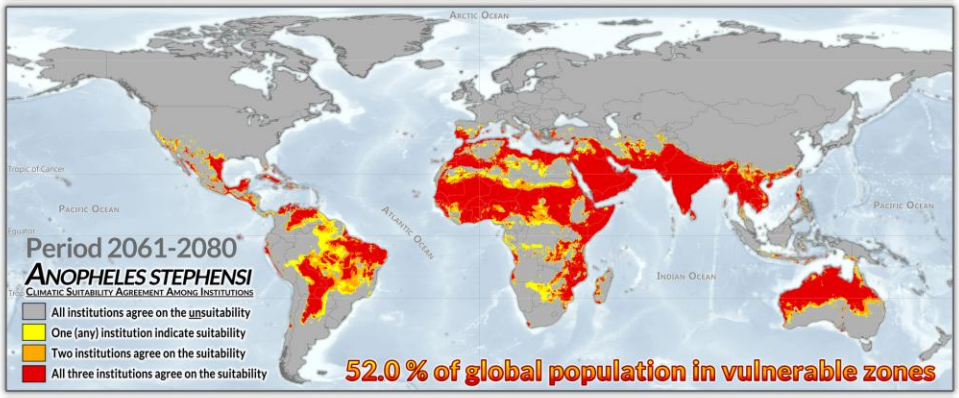

Baseline Climate
Global Population
Projected*1
Adjusted*2
Billions of People
6.84
6.99
4.48
4.62
2.32
2.37
Global Extent
%
Percent of Earth Land*3
33.9
12.7

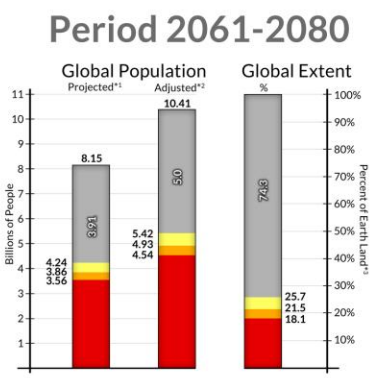

Period 2021-2040
ANOPHELES STEPHENSI
CLIMATIC SUITABILITY AGREEMENT AMONG INSTITUTIONS
All institutions agree on the unsuitability
One (any) institution indicate suitability
Two institutions agree on the suitability
All three institutions agree on the suitability
42.6 % of global population in vulnerable zones

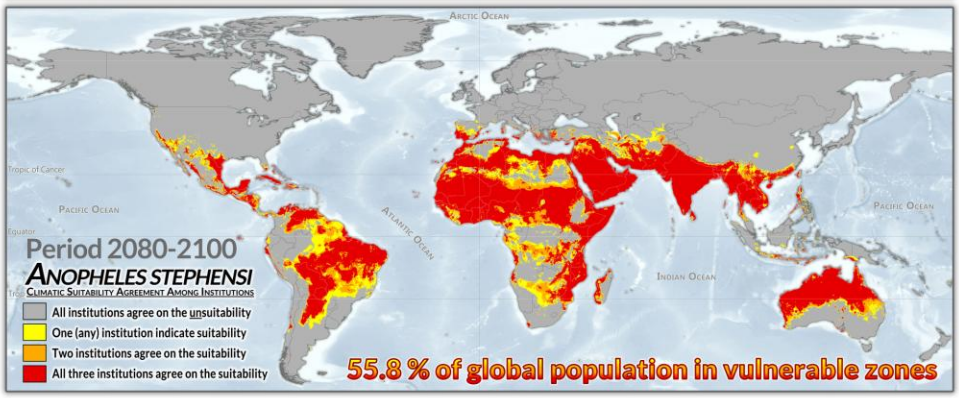

Period 2021-2040
Global Population
Projected*1
Adjusted*2
Billions of People
8.35
9.19
4.97
5.47
3.56
3.35
3.12
3.92
3.69
3.44
Global Extent
%
Percent of Earth Land*3
59.3
17.4
15.4
13.7

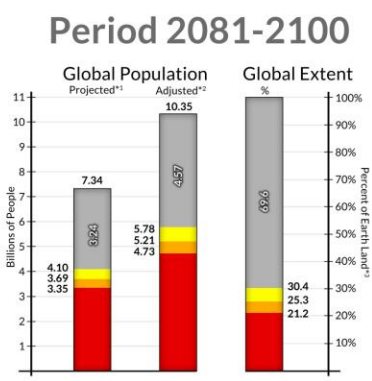

Period 2041-2060
ANOPHELES STEPHENSI
CLIMATIC SUITABILITY AGREEMENT AMONG INSTITUTIONS
All institutions agree on the unsuitability
One (any) institution indicate suitability
Two institutions agree on the suitability
All three institutions agree on the suitability
47.1 % of global population in vulnerable zones


Period 2041-2060
Global Population
Projected*1
Adjusted*2
Billions of People
8.54
10.07
4.92
5.83
4.02
3.77
3.51
4.74
4.45
4.14
Global Extent
%
Percent of Earth Land*3
59.7
20.7
18.0
15.5


Period 2061-2080
ANOPHELES STEPHENSI
CLIMATIC SUITABILITY AGREEMENT AMONG INSTITUTIONS
All institutions agree on the unsuitability
One (any) institution indicate suitability
Two institutions agree on the suitability
All three institutions agree on the suitability
52.0 % of global population in vulnerable zones


Period 2061-2080
Global Population
Projected*1
Adjusted*2
Billions of People
8.15
10.41
4.91
5.0
4.24
3.86
3.56
5.42
4.93
4.54
Global Extent
%
Percent of Earth Land*3
74.8
25.7
21.5
18.1


Period 2080-2100
ANOPHELES STEPHENSI
CLIMATIC SUITABILITY AGREEMENT AMONG INSTITUTIONS
All institutions agree on the unsuitability
One (any) institution indicate suitability
Two institutions agree on the suitability
All three institutions agree on the suitability
55.8 % of global population in vulnerable zones


Period 2081-2100
Global Population
Projected*1
Adjusted*2
Billions of People
7.34
10.35
4.28
5.57
4.10
3.69
3.35
5.78
5.21
4.73
Global Extent
%
Percent of Earth Land*3
69.9
30.4
25.3
21.2