MESA

MESA FORUM | VIRTUAL

RESPONDING TO THE THREAT OF ANOPHELES STEPHENSI INVASION IN AFRICA

21 February, 2023

2-3:30 PM CET

@MESA

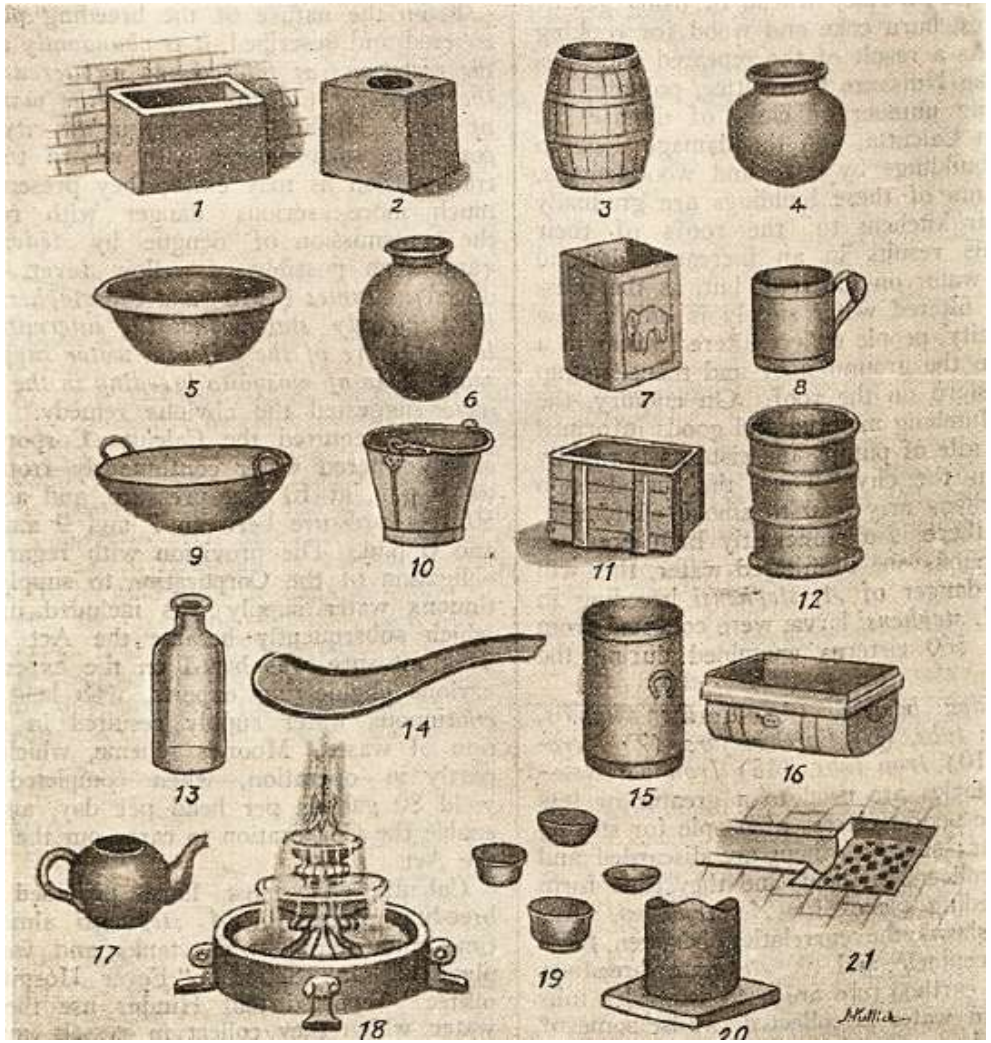
Photo: Lauren Holden

Overview, relevance, and the current status of *An. stephensi*'s geographical spread: WHO Threats Map

Seth Irish, Technical Officer, Vector Control & Insecticide Resistance Unit, Global Malaria Programme, World Health Organization

Anopheles stephensi

- Major malaria vector from south Asia
- First reported finding in Africa in 2012
- Flexibility in larval site choice, especially able to use urban larval sites
- Host preference for cattle/goats
- Good biological vector for *P. falciparum* and *P. vivax*
- Resistant to many insecticides used for public health



WHO initiative

Information exchange

Increasing collaboration

Strengthening surveillance

Prioritizing research

Developing guidance

Vector insecticide resistance

FILTERS REGIONS

Last Updated: 8/30/2022

There are no studies available with the specified criteria

Insecticide class

Insecticide type

Select...

Test type

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Vector species

Select...

Years

010 2015

Malaria Threats Map

Tracking biological challenges to malaria control and elimination

English

Send Feedback

VECTOR INSECTICIDE RESISTANCE

Resistance of malaria mosquitoes to insecticides used in core prevention tools of treated bed nets and indoor residual sprays threatens vector control effectiveness

PARASITE pfhrp2/3 GENE DELETIONS

Gene deletions among some malaria parasites cause false negative diagnostic test results, complicating case management and control

PARASITE DRUG EFFICACY AND RESISTANCE

Resistance of malaria parasites to artemisinin – the core compound of the best available antimalarial medicines – threatens antimalarial drug efficacy

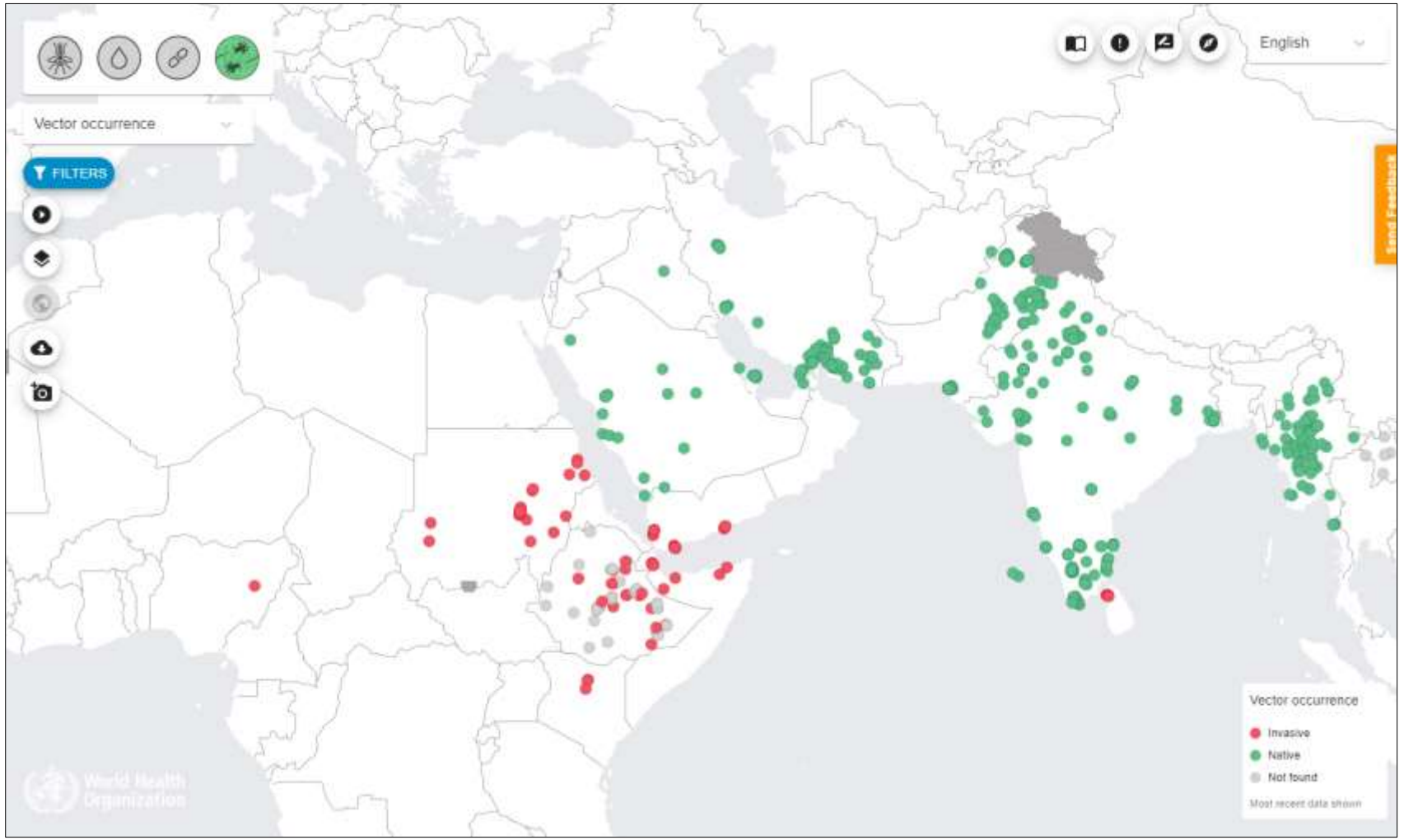
GREATER MEKONG SUBREGION

INVASIVE VECTOR SPECIES

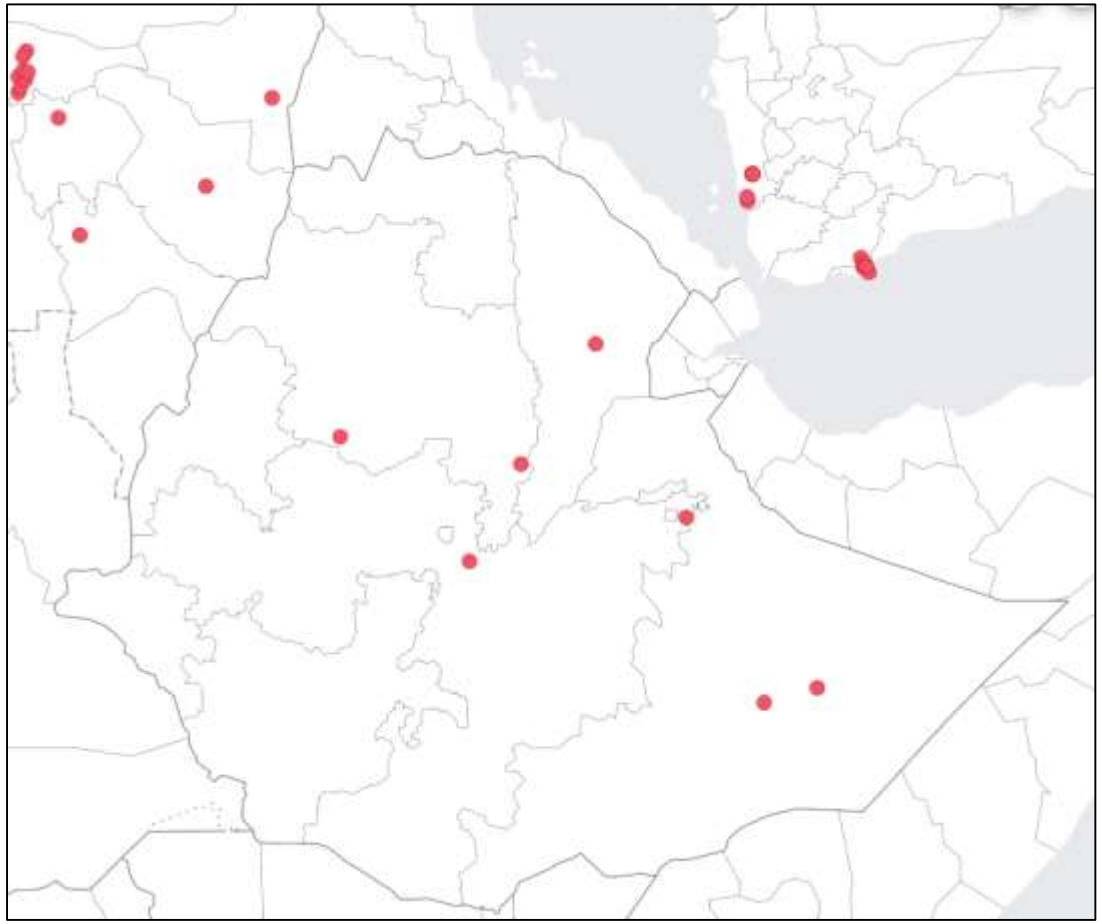
The spread of anopheline mosquito vector species and their establishment in ecosystems to which they are not native poses a potential threat to the control and elimination of malaria

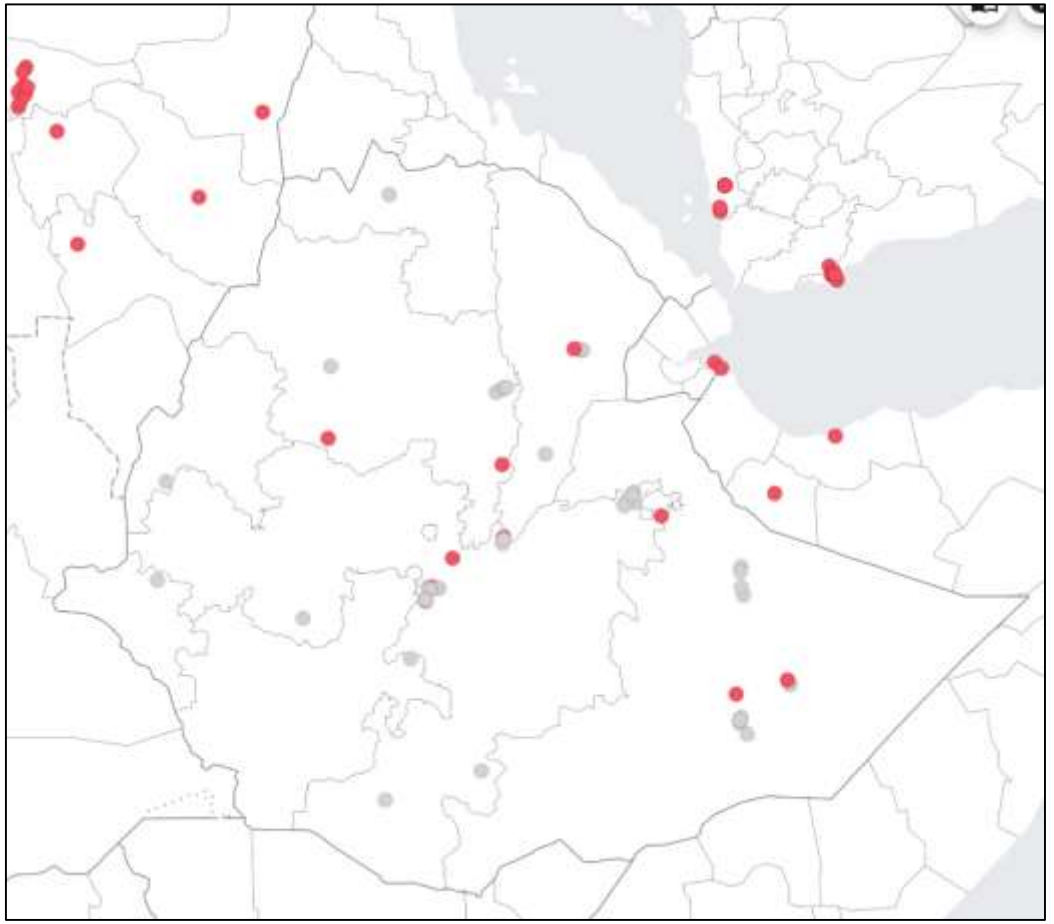
Tracking the spread

- Malaria Threats Map
  - Native occurrences
  - Invasive occurrences
  - Negative findings



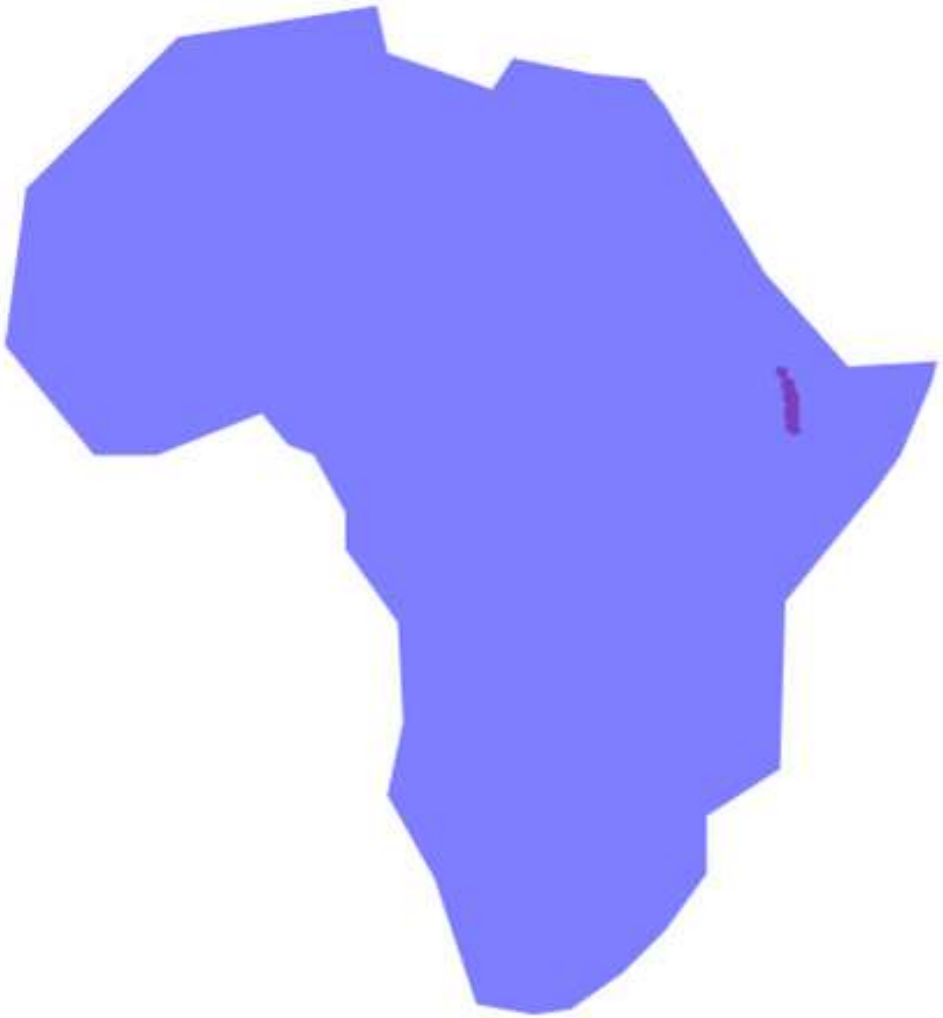
Value of negative findings

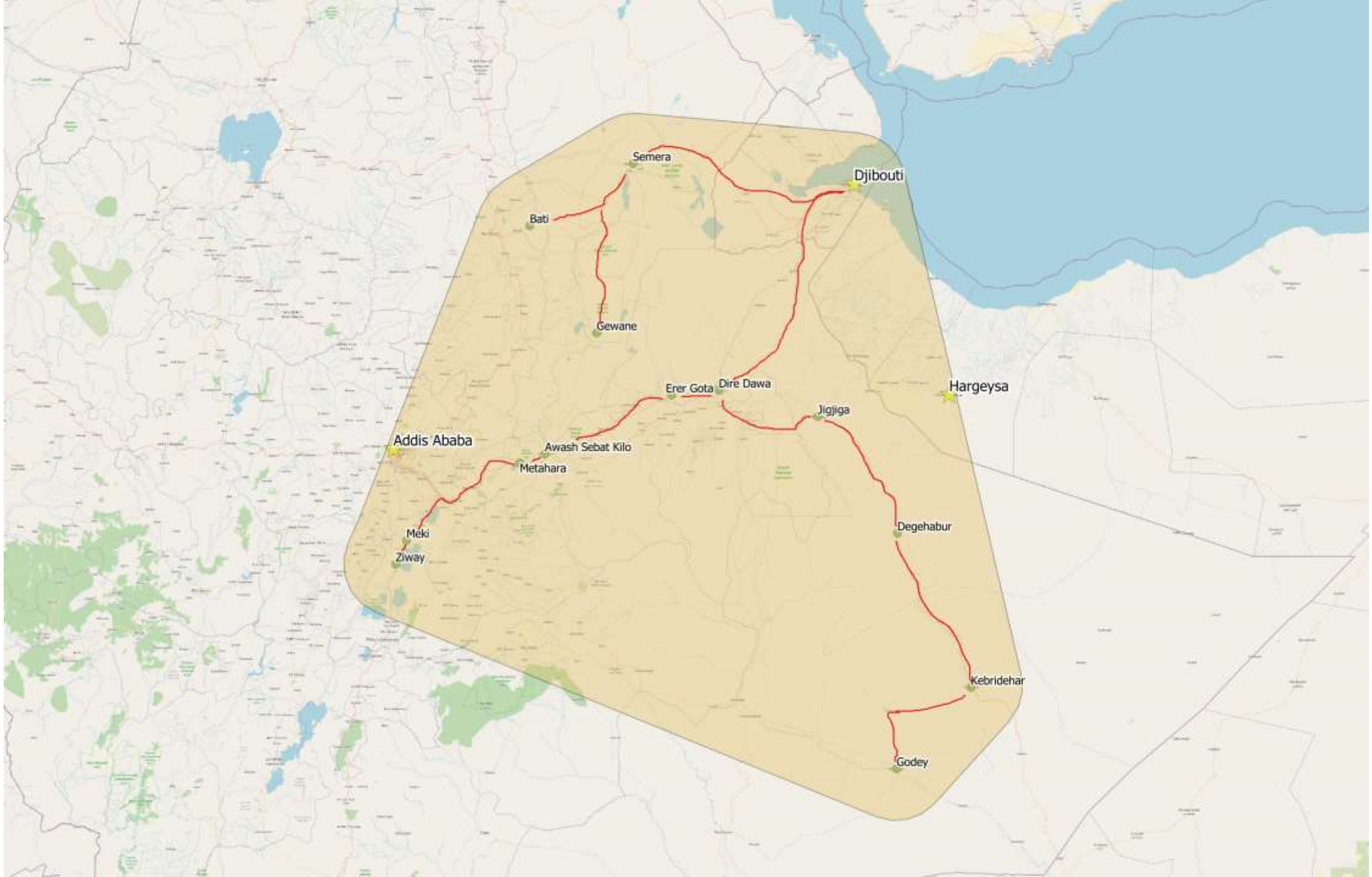




Implications for elimination

- In Brazil, *An. arabiensis* spread to an area of approximately 54,000km^2, just smaller than the area of the country of Togo.
- What area has *An. stephensi* spread to in Africa?

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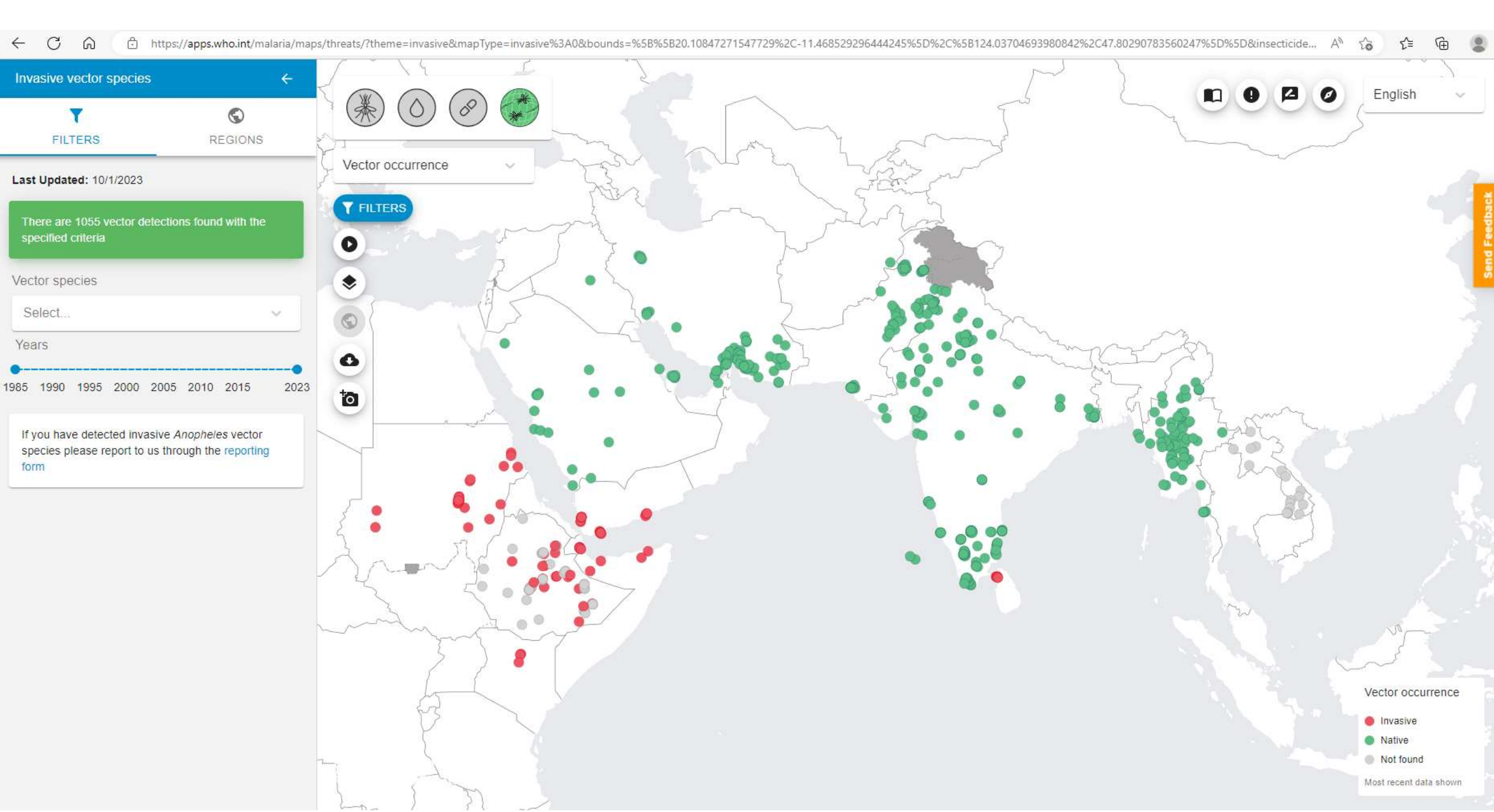
https://apps.who.int/malaria/maps/threats/?theme=invasive&mapType=invasive%3A0&bounds=%5B%5B20.10847271547729%2C-11.468529296444245%5D%2C%5B124.03704693980842%2C47.80290783560247%5D%5D&insecticide...
Invasive vector species
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Last Updated: 10/1/2023
There are 1055 vector detections found with the specified criteria
Vector species
Select...
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1985 1990 1995 2000 2005 2010 2015 2023
If you have detected invasive Anopheles vector species please report to us through the reporting form
Vector occurrence
FILTERS
English
Send Feedback
Vector occurrence
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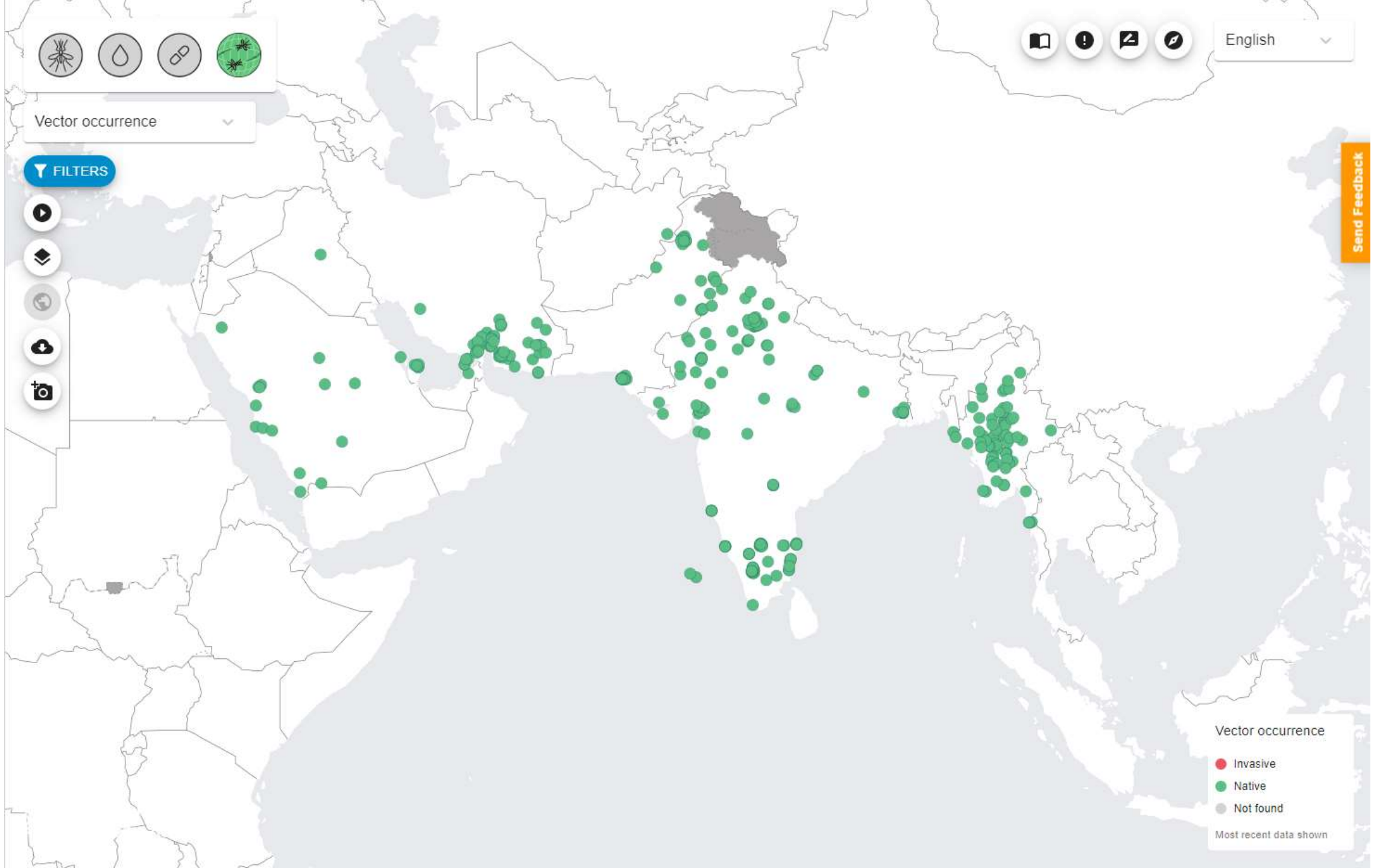
Most recent data shown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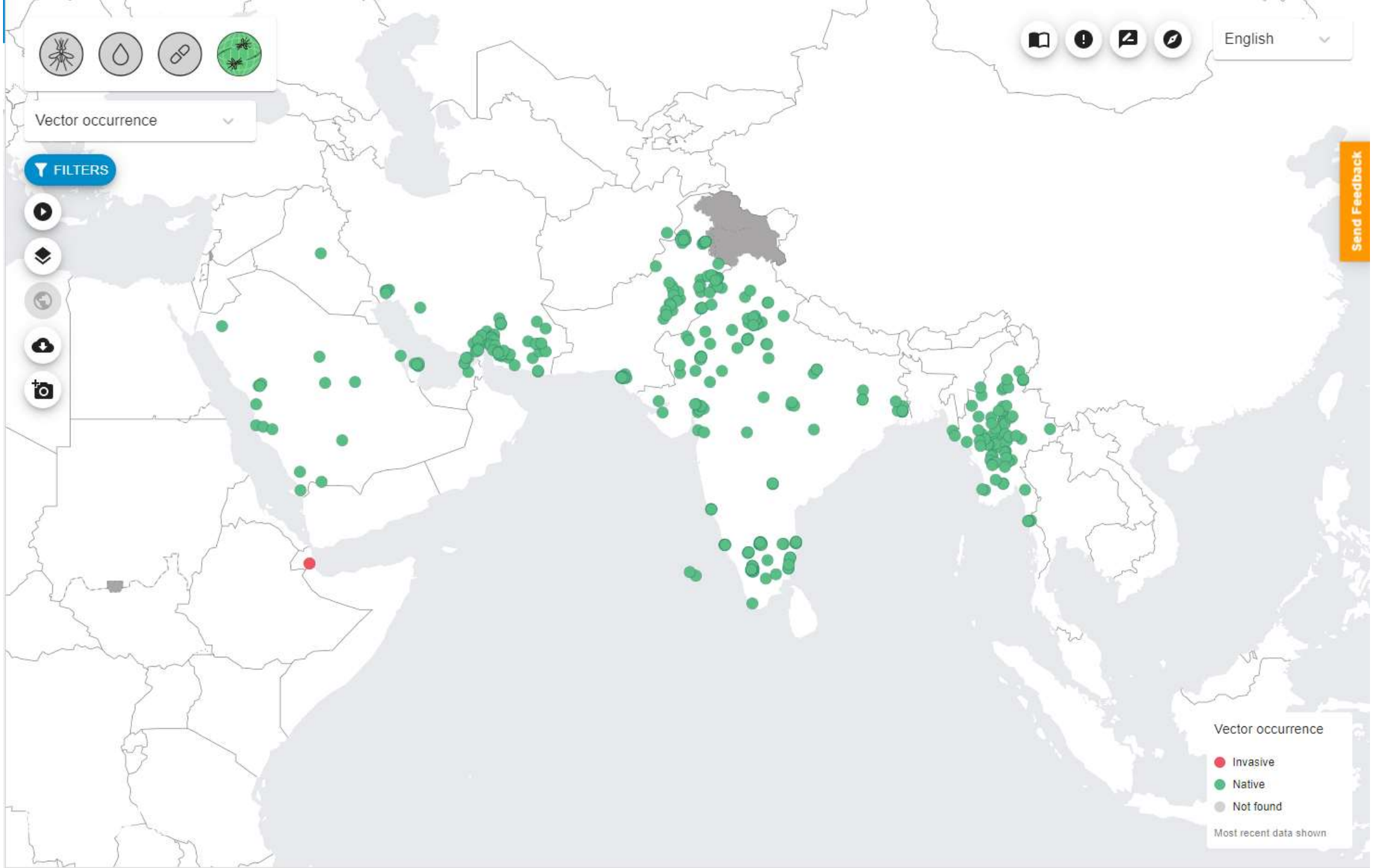
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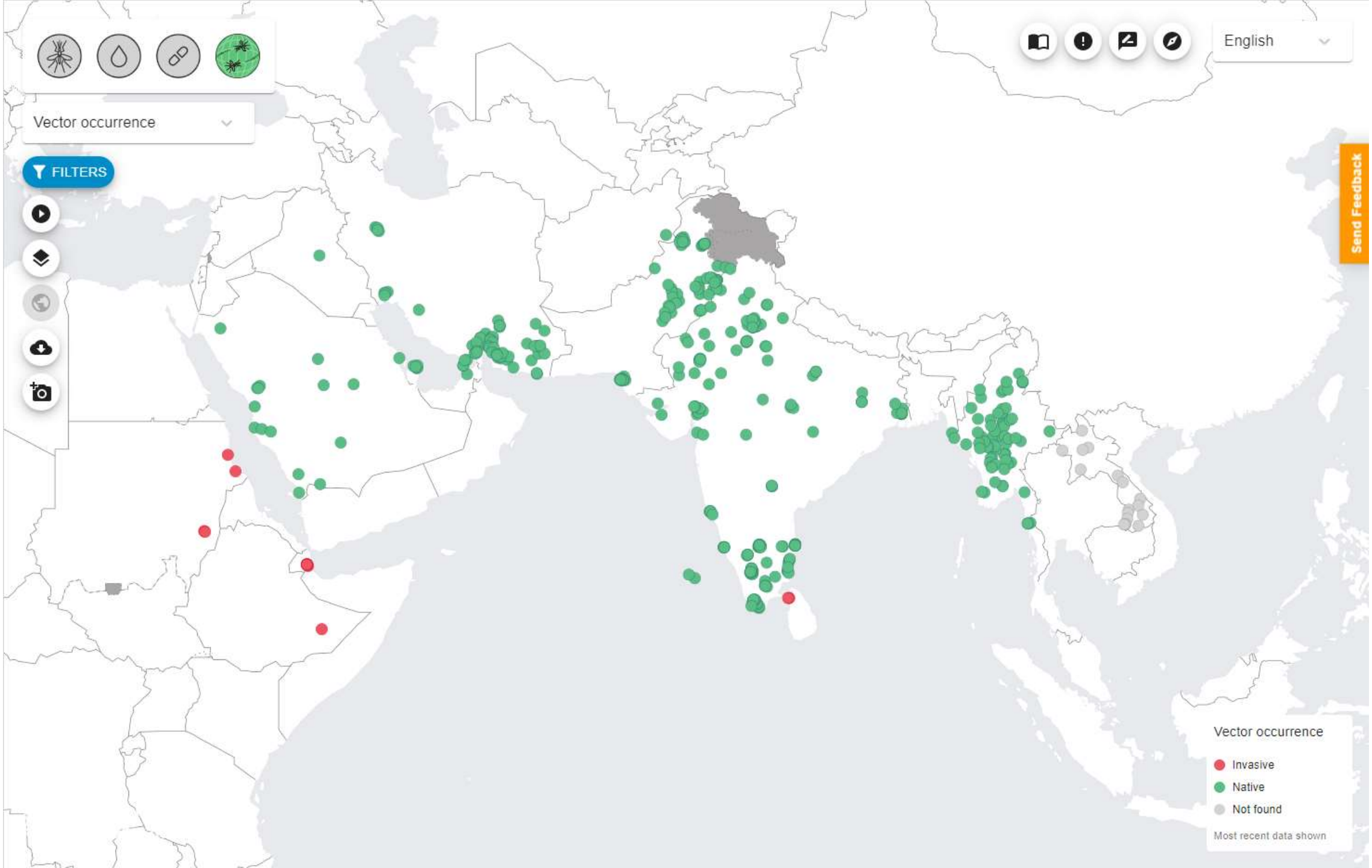
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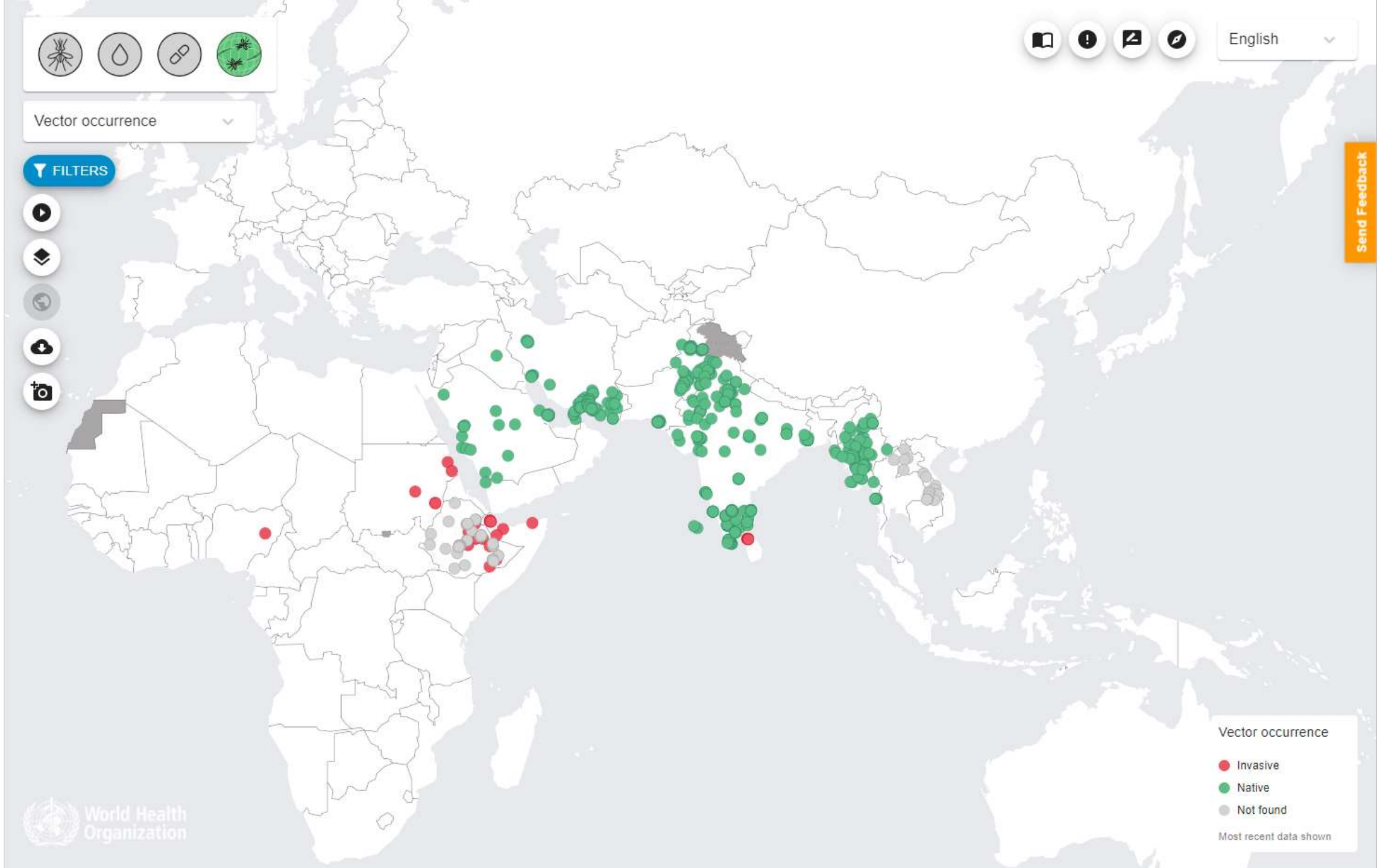
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Vector occurrence
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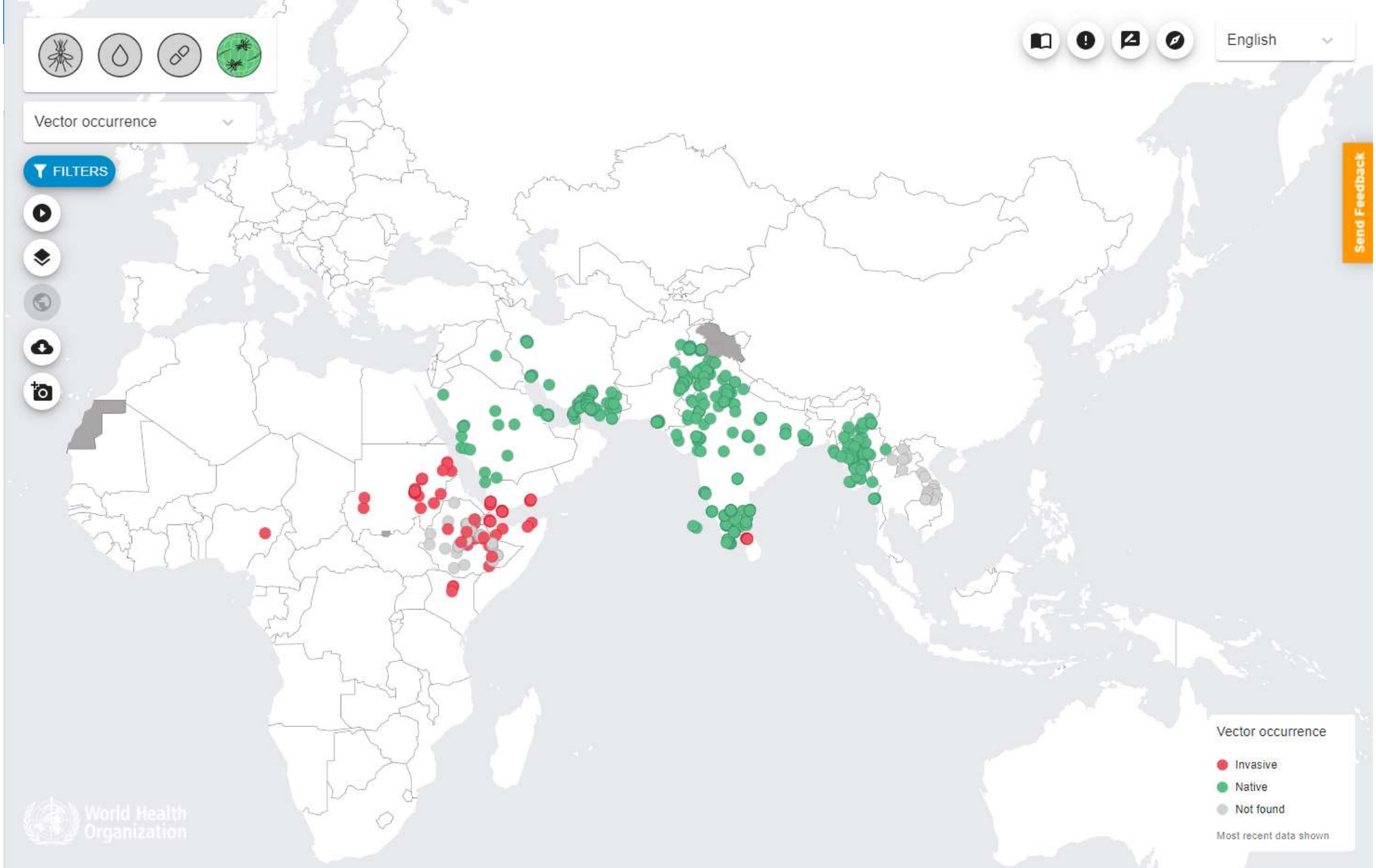
World Health Organization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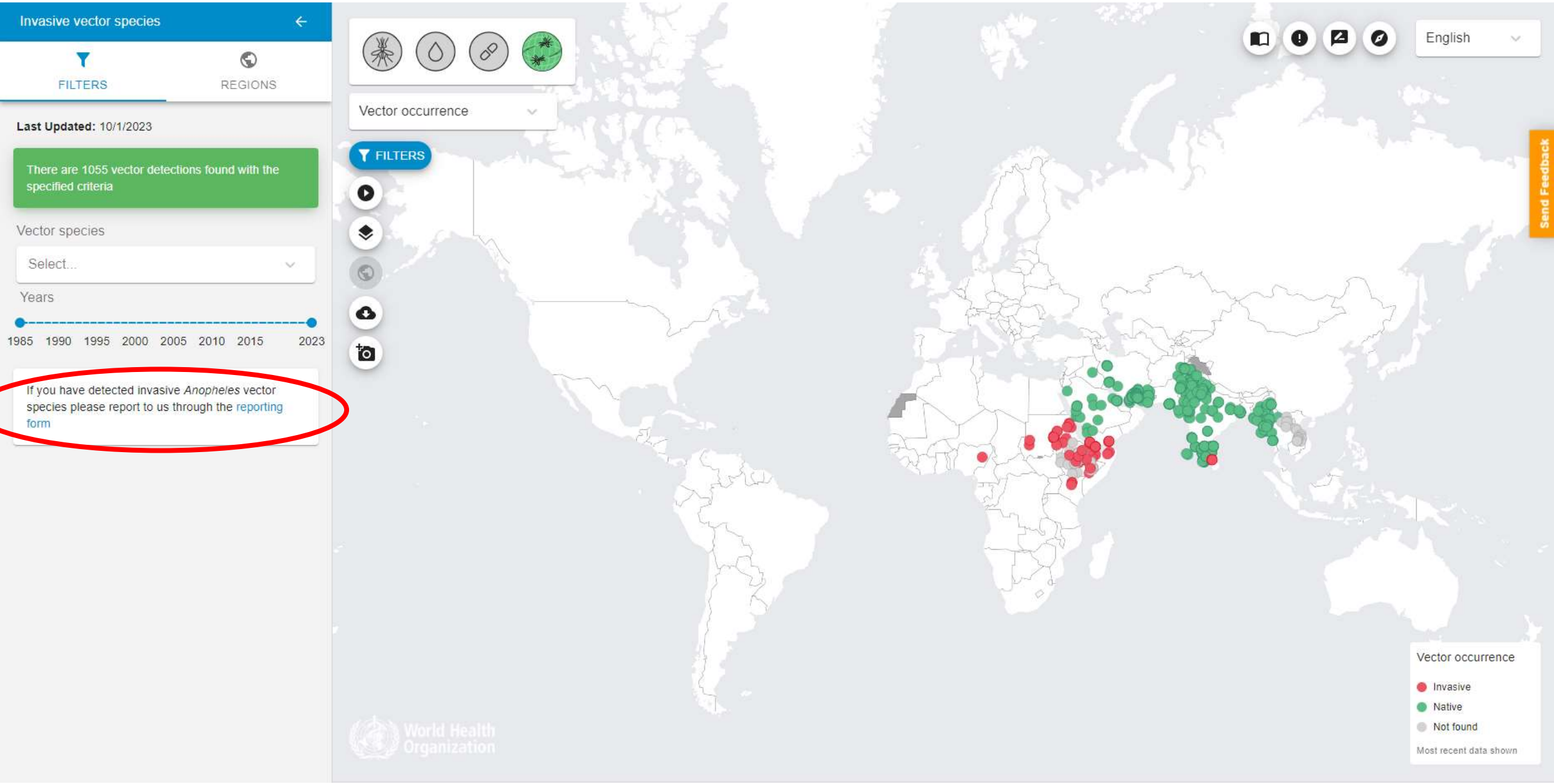
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Not found
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World Health Organization

Excel whogmp-invasive-species-reporting-form - Saved

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Merge General Conditional Formatting Styles Format As Table

C15 District (2nd admin level)

GENERAL INFORMATION	
reporting:	
ata reporting (yyyy-mm-dd):	
erson name:	
erson e-mail:	
erson phone:	
ts:	

World Health Organization

WHO form to report detection of invasive *Anopheles* vector species

Each detection of an invasive species should be reported on a separate row. When the species has been detected through different sar
A detection is considered to be the collection of one or more specimens of an invasive species on a defined day or month in a specific l
Please submit the form to vectorsurveillance@who.int indicating in the subject the name of the country and the vector species detected
If you have any questions please send an e-mail to vectorsurveillance@who.int.

WHO/CDS/GMP/2019.11

Location							*Anopheles* species							
Country	Province/Region/State *(1st admin level)*	District *(2nd admin level)*	City/Village/Commune *(3rd admin level)*	Site name (If the site does not have an specific name, please enter the name of the closest City/Village where it is located)	Latitude X *(in decimal UTM degrees)*	Longitude Y *(in decimal UTM degrees)*	Name of the Anopheles species detected	Type detected	Other *Anopheles* species detected *(i.e. species not listedin the dropdown of the previous column)*	Year of mosquito collection start	Month of mosquito collection start	Year of mosquito collection end	Month of mosquito collection end	

DiscriminatingBioassays

Malaria threats map

- A start, not an end to itself
- Key questions remain:
  - Where is *An. stephensi*?
  - How is it spreading?
  - What is its role in malaria transmission?
  - How to control it?

RESPONDING TO THE THREAT OF ANOPHELES STEPHENSI INVASION IN AFRICA

Ethiopia's Action Plan on *An. stephensi* and recent updates

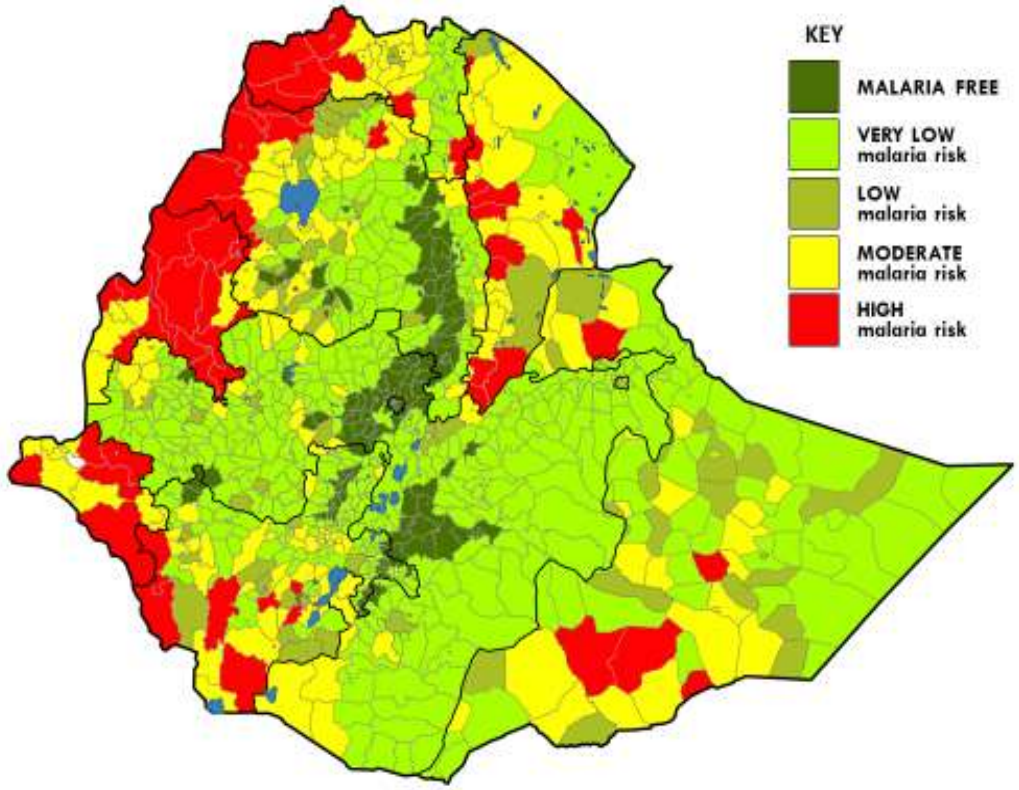
Gudissa Assefa (NMEP Manager)

21 February 2022

Contents

Malaria: Burden & Epidemiology

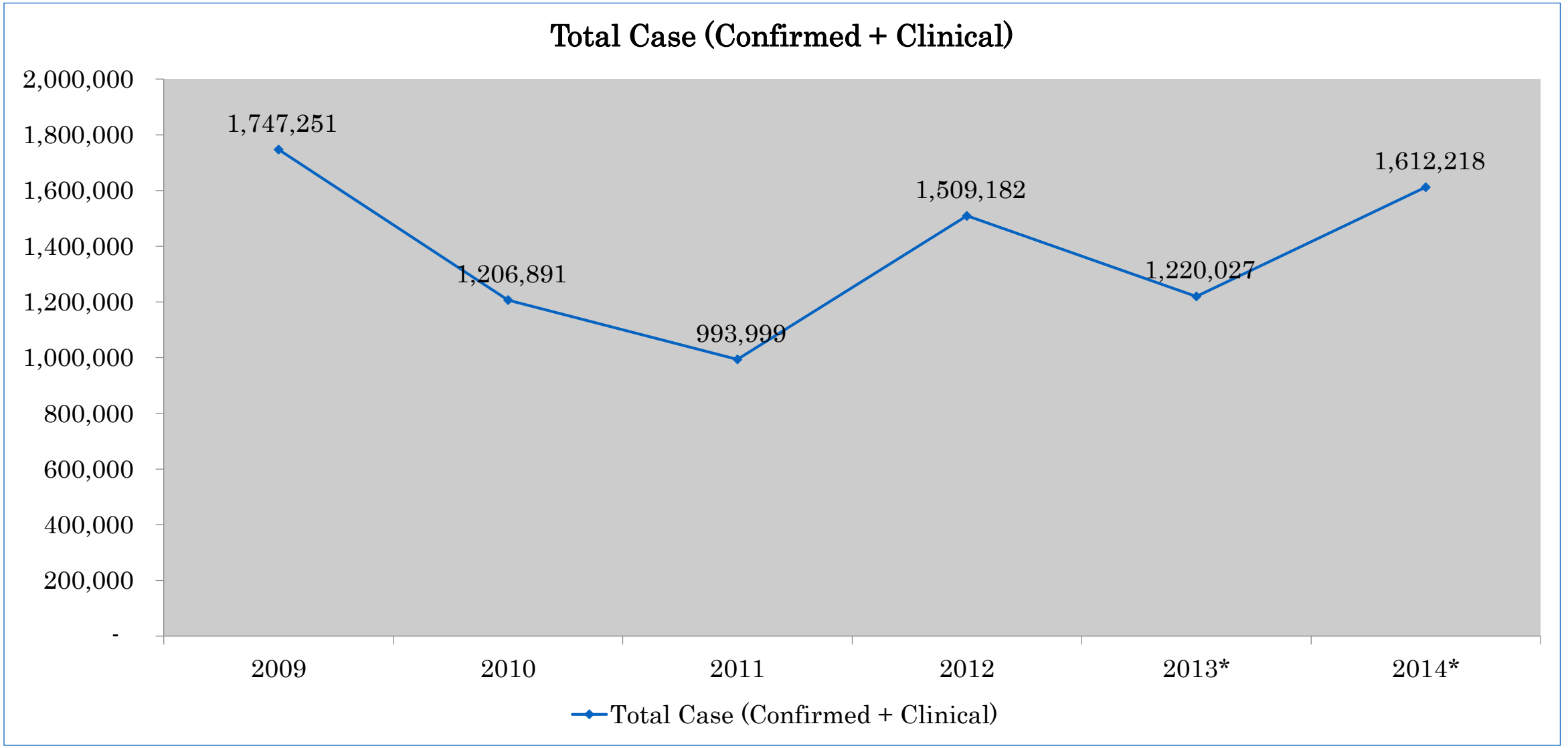
- Malaria burden and epidemiology exhibit a marked variations in the country.



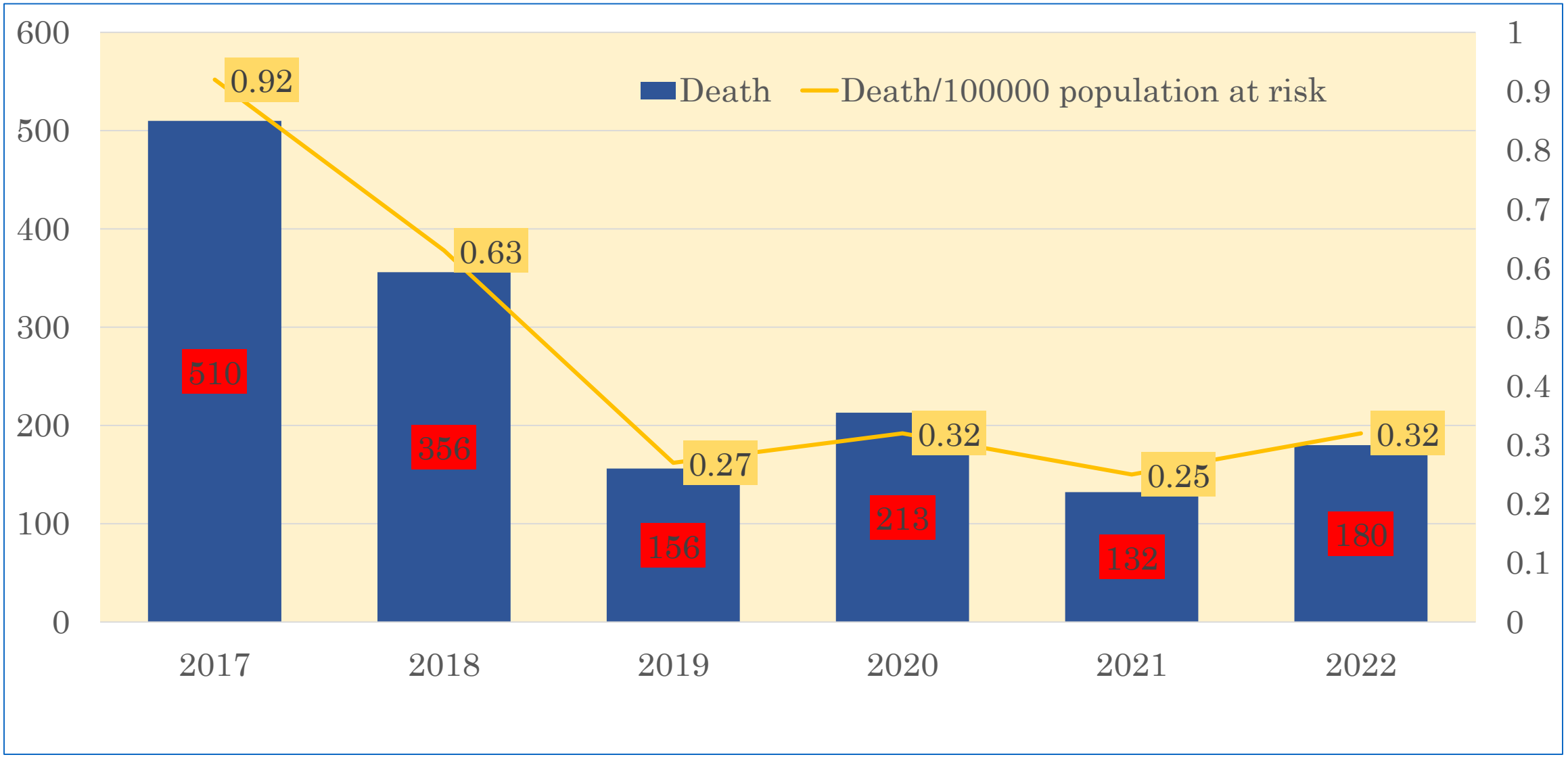
- 3/4th of the area is suitable for malaria transmission;
- Population at risk of malaria infection 52%
- **Determinants:** Altitude & climate (rainfall & temperature)
- Mainly occurs up to 2,000 masl; rare case up to 2,500 masl
- **Transmission:** seasonal & unstable
- **Parasites:** P. f (80.1%) & P. vivax (19.9%) DHIS2 (2020/21)
- **Vector:** *An. Arabiensis & An. Stephensi*

Trend for total malaria and confirmed cases, 209-2014 EFY

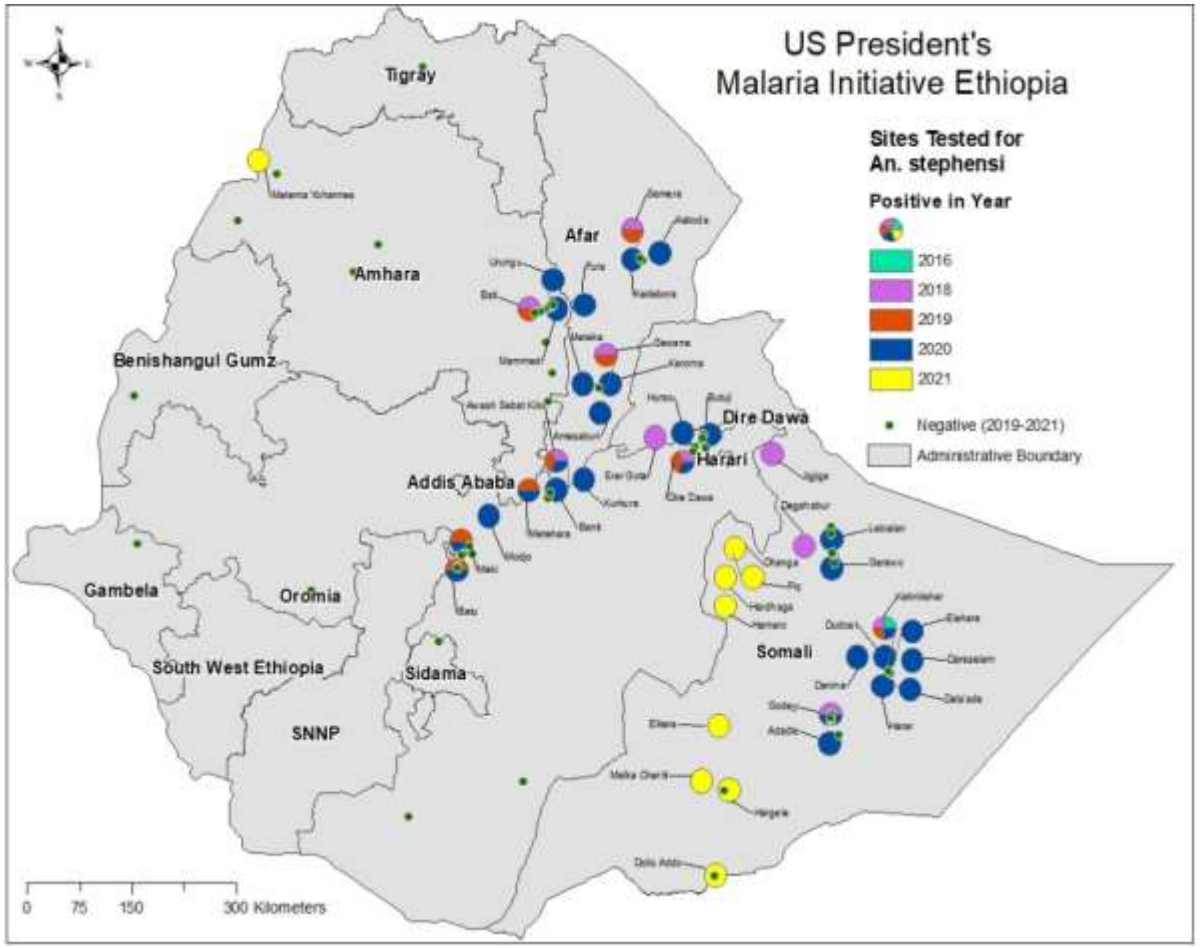
(DHIS-2 Disease report)



Malaria Mortality Rate (2017-2022 DHIS 2)

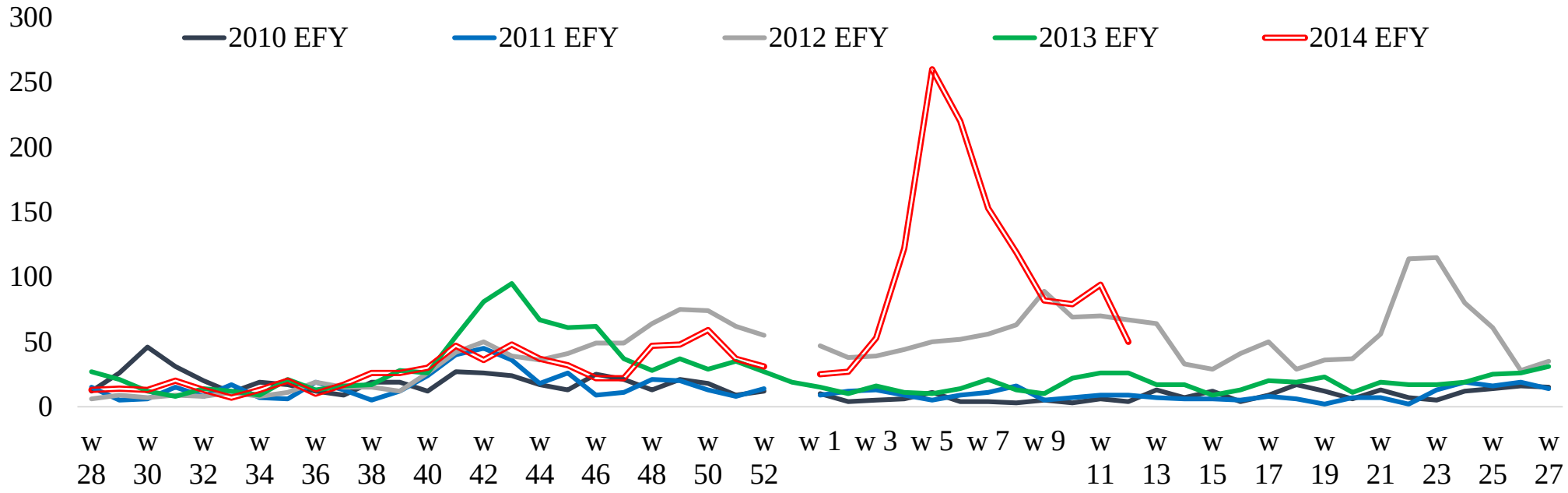


Introduction: An. stephensi



- Detected in Ethiopia in 2016
- In Ethiopia 45 sites found positive for *An. Stephensi*
- *Entomological surveillance monitoring is ongoing (CEASE project)*

Case Trend in Dire Dawa city, Ethiopia



Since WHO epi week 1 to 13/2022, there was outbreak in the city administration. Majority of cases were from Sabian location and Gore health center; and Dire Dawa University (DDU). The reason behind the outbreak are: there is larva positive **water treatment in DDU compound** and **Butuji river** which cross the city more than 9 kilometer is larva positive.


Breeding Habitat at GHC Butiji River
Water treatment pond
Student's cloth washing site
Water seepage from tap running in the ditch
Water pool near moot court

Actionable Plan (2022-2026): Summary

Planning Process

1. Evidence Generation for Planning

- Evidences collected and reviewed – desk review

2. Endorsing the evidences and Organization of Partners

- Sources for relevant evidences (PMI vector link, AHRI, EPHI, Universities and regions,….)
- Formed TWG to develop actionable plan
- Enriching the plan further and finalized
- The final plan was formally launched in the presence of all stakeholders
- Implementation is ongoing as per the plan

Action plan for the Integrated Surveillance and Control of Anopheles Stephensi and Aedes Aegypti,

With a targeted elimination of An. Stephensi in Ethiopia, 2022-2026

Main Objective:

- To eliminate *An. Stephens* from Ethiopia by 2026 and there by control *Ae. aegypti*

Specific Objectives

1. To ***delineate the distribution*** of *An. stephensi* within Ethiopia by outlining and implementing strategies for enhanced surveillance including the evaluation and implementation of integrated surveillance with *Ae. aegypti*
2. ***To control An. stephensi*** and there by *Ae. aegypti* in the already invaded areas by implementing proven vector control measures, monitoring their impact, and evaluating potential new methods and tools
3. Continue control of *An. stephensi* and there by *Ae. aegypti* in areas at risk including the ***use of new methods***
4. To establish an ***Early Warning, Alert and Response System (EWARS)*** to prevent An. stephensi and there by Ae. aegypti from invading any new geographical areas through the combined surveillance and control response outlined
5. To establish a functioning ***inter-sectoral control response*** by assigning clear roles and responsibilities to key partners involved in the response against An. stephensi and there by Ae. Aegypti
6. To provide ***monitoring and evaluation approaches*** to surveillance and intervention

Major Interventions

1.Surveillance

a) Surveillance in areas where presence of An.stephensi is not yet confirmed

b) Surveillance to monitor An.stephensi and *Ae. aegypti* abundance in areas where presence is confirmed

c) Determining insecticide susceptibility of An. stephensi and *Ae. aegypti*

(already started and ongoing by some partners)*

Major Interventions

2. Control of An. stephensi

i. Interventions ready in the short-term

a) Environmental and Larval Source Management

b) Insecticide treated nets and indoor residual spraying (resistance, out door biting/resting behavior) may compromise this part of the intervention

ii. Potential new interventions

a) Interventions available to be tested

b) Interventions being developed

iii. Enact or introduce by-laws to regulate water storage, construction and solid waste management practices and set up system for enforcement

LSM Launching Ceremony @ Dire Dawa

Larva Source Management @ Batu town

Major interventions

3. Cross cutting (Stakeholders, governance, coordination, and leadership of implementation)

- Multi-sectoral engagement
- Community Engagement
- Human resource development (training)
- Advocacy/Communication/SBCC
- Monitoring and evaluation

Cross Cutting (Partnership)

Budget Required for Actionable plan

Detailed Activities Budget has been set for 5 years (2022-2026)

- For surveillance = 4,965,437USD
- For Control/Intervention = 42,173,167USD
- Grand total **47,138,604 USD**
- Budget revision may be necessary in the course of time

What is Next?

- Resource Mobilization
- Implementation based on the endorsed plan of action with no time to waste.
- Existing potentials (Adama new training center lead by AHRI, PMI (vector link, ACIPH, PATH, S4ME, Universities…) being great potentials for the way forward
- Strong collaboration with all stakeholders

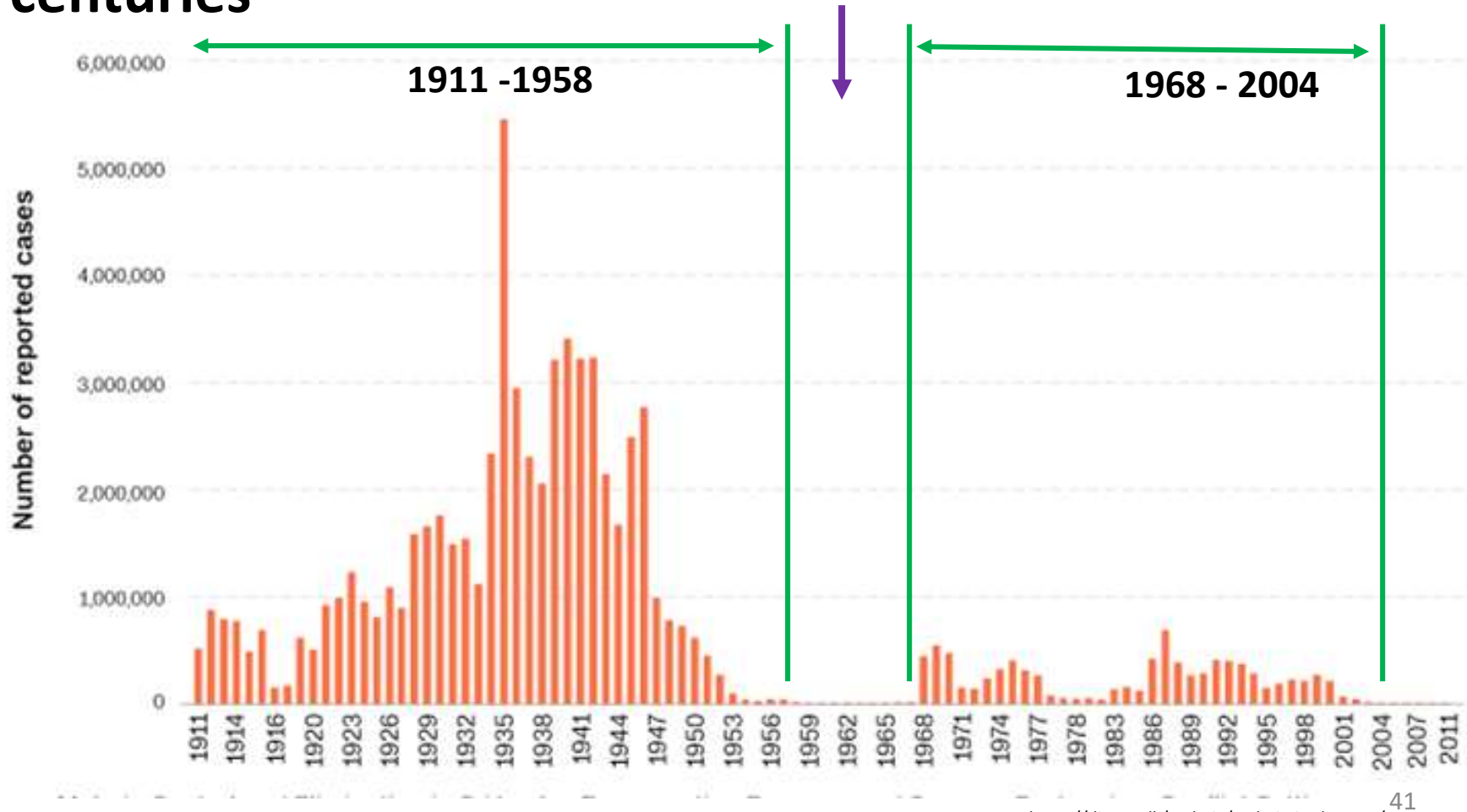
Thank you for your Attention !

Case Study:
Recent range expansion of *Anopheles stephensi* to Sri Lanka and staying malaria free

S.N. Surendran
Department of Zoology
University of Jaffna

Malaria in Sri Lanka

- **Sri Lanka has been endemic for rural malaria for centuries**



https://disease.lk/malaria/malaria-in-the-past/

Malaria in Sri Lanka…….

- **Due to a well-coordinated efforts of the AMC through**
  - **Early diagnosis**
  - **Treatment and**
  - **Vector control**

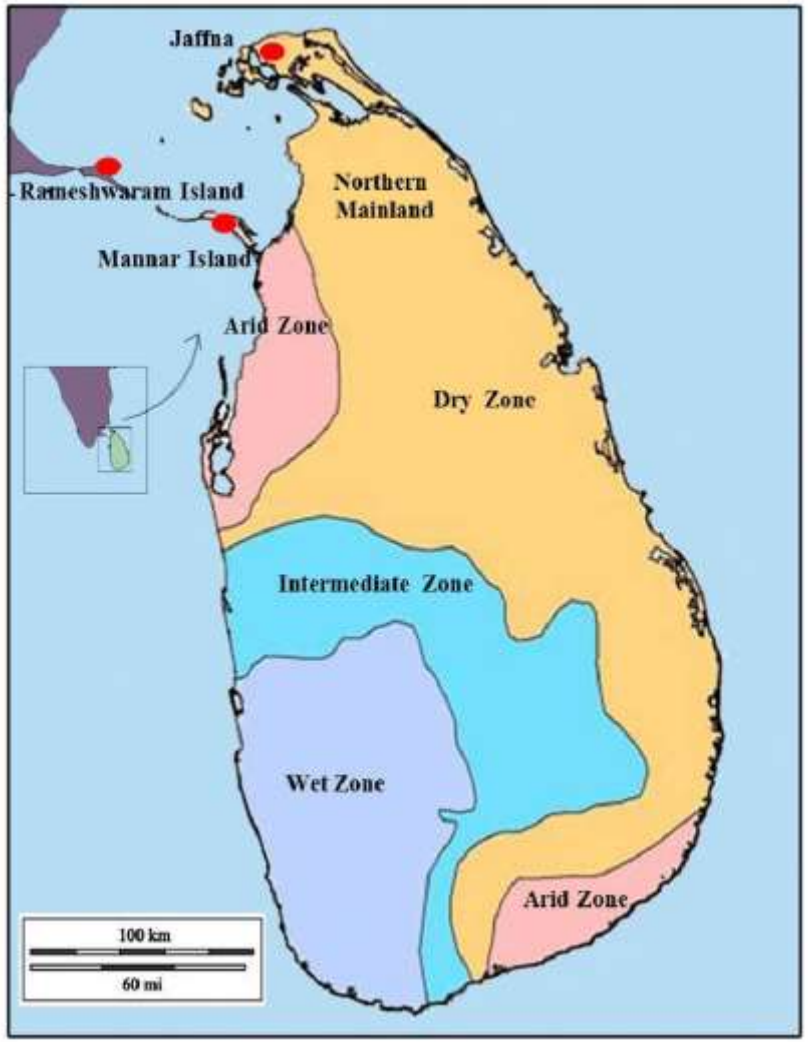
  No indigenous cases reported since 2013
- **Sri Lanka was declared free of any indigenous malaria in 2016**
- **However, imported malaria cases have been reported in the country even after 2016**

Year	No. of Imported cases
2013	95
2014	49
2015	36
2016	41
2017	56
2018	47
2019	53
2021	26
2023 (up to February)	05

http://www.malariacampaign.gov.lk/en/

Malaria Vectors in Sri Lanka

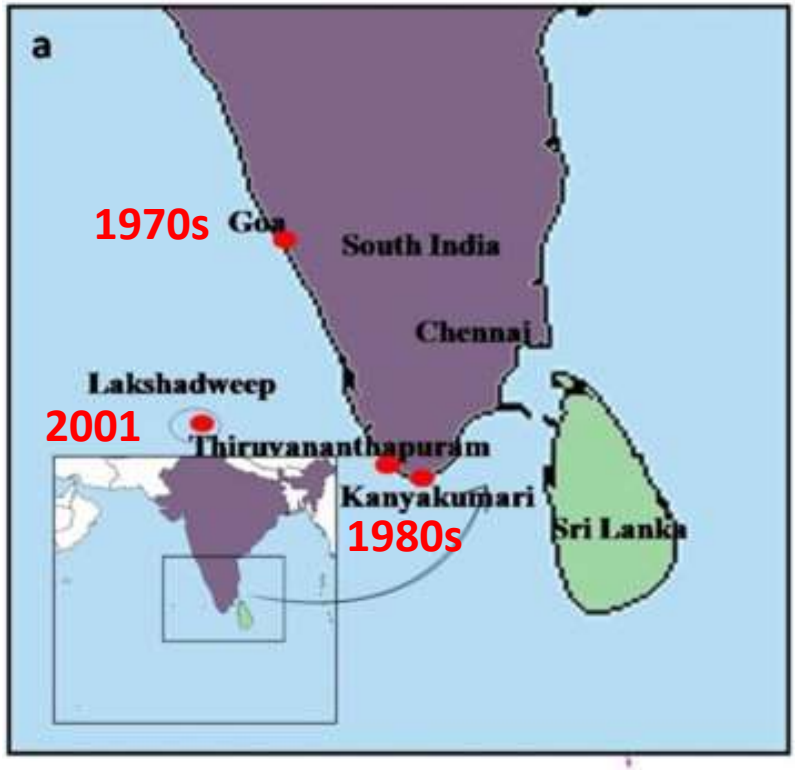
- Malaria has been endemic in the dry and intermediate climatic zones of Sri Lanka
- Out of 24 anophelines mosquitoes, *Anopheles culicifacies* is the major local vector
- *An. subpictus* is the secondary vector
- There are other anopheline species which are able to transmit malaria parasites



Surendran et al, Front Public Health. 2019: 14;7:53.

Invasive *An. stephensi*….

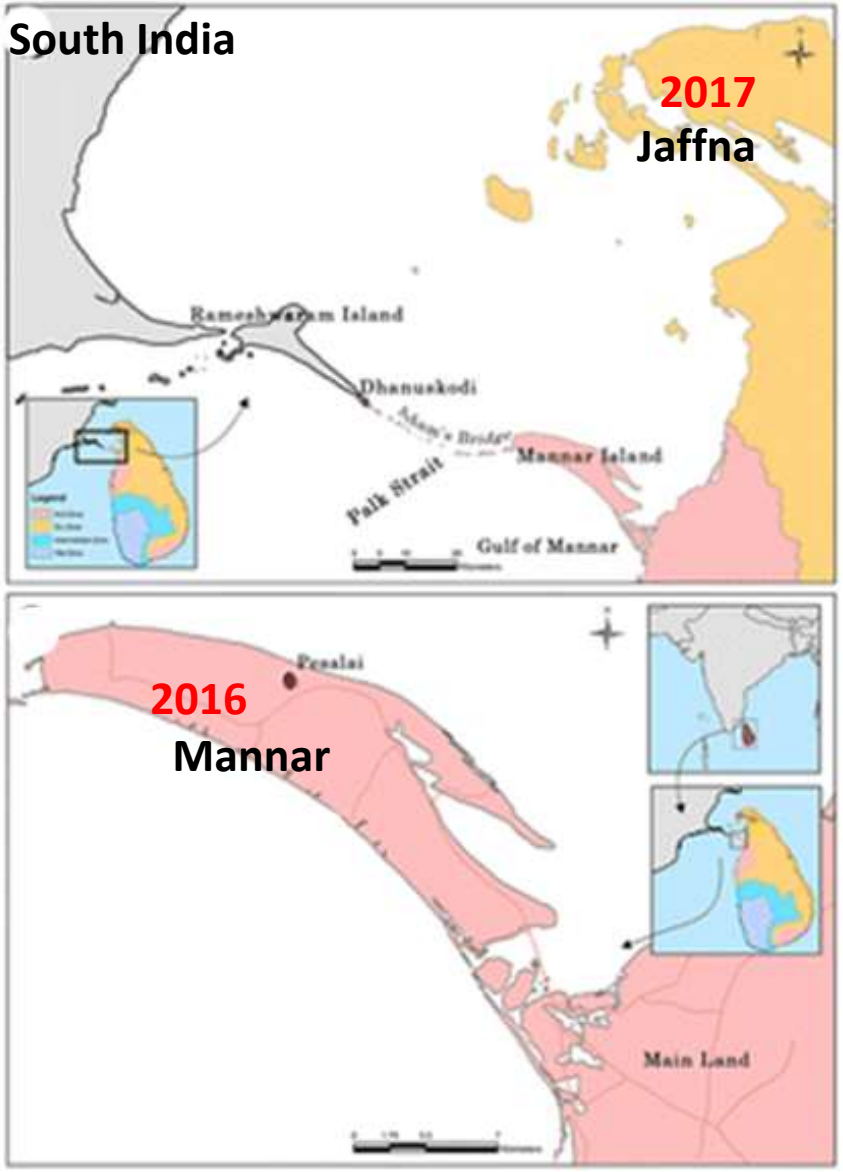
- A southward range expansion of *An. stephensi* was observed in India and attributed to urbanization and associated water storage practices.
- *An. stephensi* reached Goa in the 1970s
- Kanyakumari at the southernmost location of India in the 1980s, and subsequently
- Lakshadweep islands in the Arabian sea in 2001
- It was predicted in 2001 that *An. stephensi* may further expand southwards to invade Sri Lanka and the Maldives



Surendran et al, Front Public Health. 2019: 14;7:53.

Invasion to Sri Lanka

- ***Anopheles stephensi*** **was detected for the first time in Sri Lanka in 2016 in the island of Mannar subsequently in Jaffna in 2017.**
- **The adaptation of *An. stephensi* to undergo preimaginal development in domestic wells and cement water storage tanks has been considered to facilitate range expansion into new territories**



Surendran et al., Parasit Vectors. 2018;11(1):3.

Invasion to Sri Lanka…

- **Arrival:**
  - movement of people across the 64 to 137 km-wide Palk strait that separates south India and Sri Lanka.
  - Wind-borne migration due to SW monsoon???
- **Establishment:**
  - the readily availability of urban domestic wells and cement water storage tanks as habitats to which it was already adapted
- **Spread:**
  - it is therefore likely that *An. stephensi* can utilize similar anthropogenic fresh and brackish water habitats to further extend its range within the Jaffna peninsula and other coastal areas of Sri Lanka.

Surendran et al, 2020: 30;13(1):156

Bionomics of *An. stephensi* in Sri Lanka

- **Undergo preimaginal development in wells and cement water storage tanks**
- **Can lay eggs and undergo preimaginal development in brackish water of up to 3.5 g/L salt proving that *An. stephensi* has euryhaline characteristics.**
- **Highly resistant to 4% DDT, 5% malathion and 0.05% Deltamethrin**
- **It is therefore likely that they can utilize similar habitats to further extend its range within the Jaffna peninsula and other coastal areas of Sri Lanka.**

Insecticide	*An. stephensi*	
	% mortality	95% CI
DDT 4%	$^{R}14 \pm 5$ (100)	12–15
Malathion 5%	$^{R}34 \pm 9$ (110)	3–36
Deltamethrin 0.05%	$^{R}56 \pm 1$ (100)	55–57

Surendran et al., Parasit Vectors. 2020;13(1):156.

Bionomics of *An. stephensi* in Sri Lanka……

- **Based mode of the number of egg ridges on egg-floats type/intermediate/mysorensis forms are present in Jaffna.**
- **Spiracular index revealed presence of type and mysorensis**
- ***AsteObp1* intron-1 region that identified all three biotypes in Iran and Afghanistan failed to differentiate the biotypes in Sri Lanka as in the case of Indian samples.**

```
KJ557465.1 Type         GTGAGCTTGG GTGTCTTCTG GATATTGTTC TAATGTGTTT TCTGTCTATA AGTTTTAAAC ACAAA
KJ557453.1 Mysorensis   .......... .......... .......C.. .......... .TAC....CT T.C...TG.. .G...
KT587049.1 Mysorensis   .......... .......... .......C.. .......... .TAC....CT T.C...TG.. .G...
KJ557452.1 Intermediate .....T.... .......... .......... .......... .......... ......TG.. .....
KT587050.1 Intermediate .....T.... .......... .......... .......... .......... ......TG.. .....
ASJF1                   .......... .......... .......CC. A...T..... .......... .-....TGG. .....
ASJF2                   .....T.... .......... ......A... .......... .......... ......TG.. .....
ASJF3                   .....T.... .......... ......A... .......... ....C..... ......TG.. .....
ASJF4                   .....T.... .......... .......... .......... .......... ......TG.. .....

KJ557465.1 Type         TCTGGACTCT GCATCCTAAA GATAATGTCC TGTCATGCAA TGTCATCACT TTCCAG
KJ557453.1 Mysorensis   ....A.T... .A..GT.... T.....C... .......... .......... ......
KT587049.1 Mysorensis   ....A.T... .A..G..... T.....C... .......... .......... ......
KJ557452.1 Intermediate .......... .......... ......T..- ----...... .......... ......
KT587050.1 Intermediate .......... .......... ......T... .......... .......... ......
ASJF1                   .......... .A........ ......C..A .......... ....G..... ......
ASJF2                   .......... .......... ......T... .......... .......... ......
ASJF3                   .......... .......... ......T... .......... .......... ......
ASJF4                   .......... .......... ......T... .......... .......... ......
```

Surendran et al., Med Vet Entomol.2022: 36(4):496-502

Bionomics of *An. stephensi* in Sri Lanka……

- The results suggested that **numbers of egg ridges**, **spiracular indices** and ***AsteObp1* intron 1** sequences were not useful for differentiating *An. stephensi* biotypes in Jaffna.

- It is proposed that the observed differences between *An. stephensi* mosquitoes in Jaffna now results from normal population variance in the context of rapidly changing bionomics in India and northern Sri Lanka

Surendran et al., Med Vet Entomol.2022: 36(4):496-502

Vector surveillance strategies of Antimalaria Campaign (AMC)

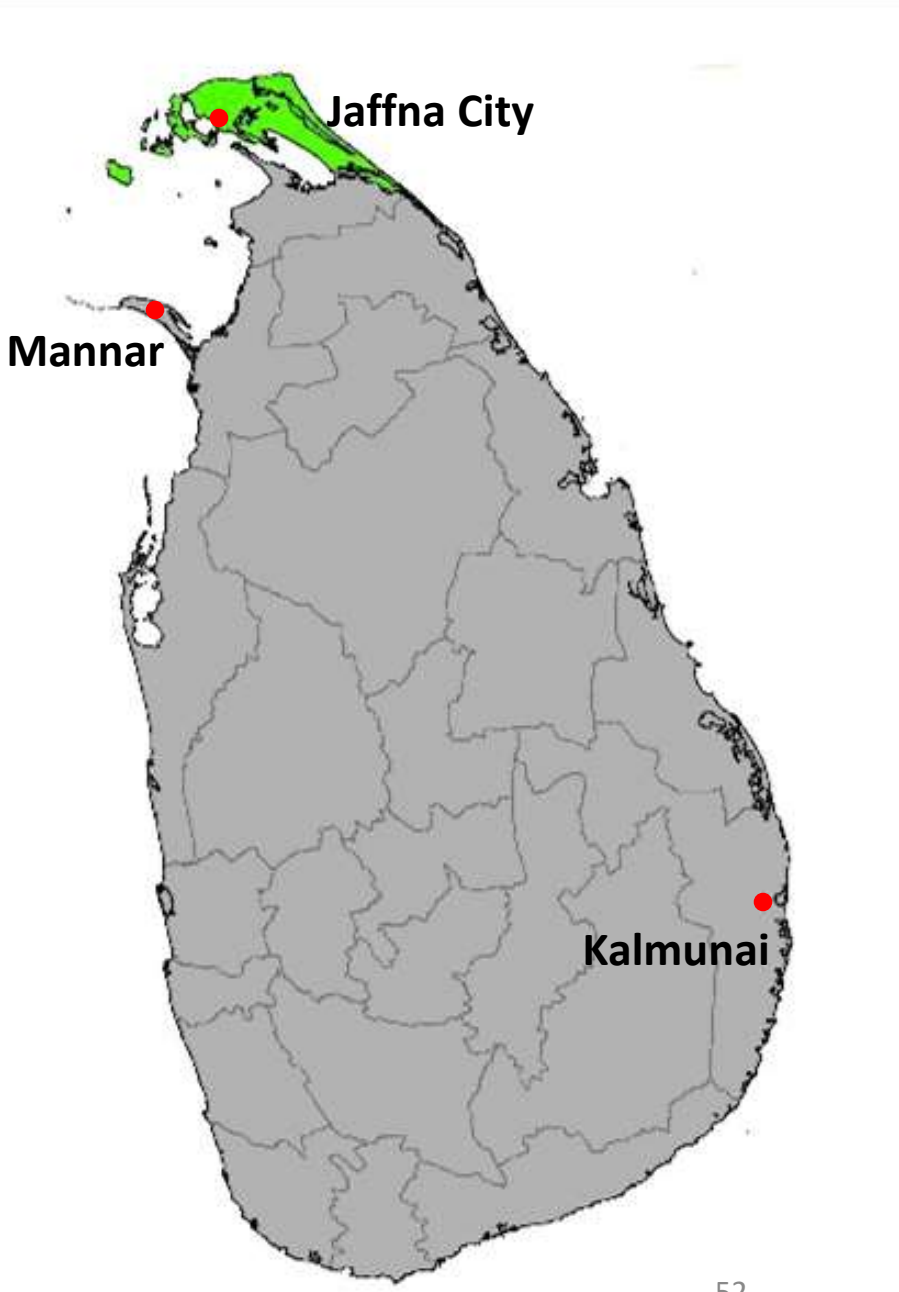
- Two categories of entomological investigations:
  - spot surveys: Spot surveys were carried out as reactive spots when a malaria patient was reported and as proactive spots when vulnerability of a certain area is increased.
  - Sentinel surveys: Sentinel monitoring has been carried out in foci where vulnerability and /or receptivity was moderate to high, on quarterly basis.
- Special entomological surveys are carried out in areas where the *Anopheles stephensi* is found.
- Special larval surveys have been conducted as pre and post intervention larval surveys in areas where invasive Anopheles stephensi has been found.

Control efforts

- The AMC continues **Reactive Spot Vector Surveys in all areas** with reported cases.
- Soon after the detection of *An. stephensi* extensive vector surveys were carried out mainly in the northern Sri Lanka to identify areas invaded by the mosquito.
- All identified preimaginal develop sites and potential sites were treated either with temephos or larvivorous fish or both and covered with mosquito proving nets wherever possible

Control efforts

- Because of the a well-coordinated vector survey and control activities further expansion of *An. stephensi* to mainland of Sri Lanka has been prevented.
- Its presence is now mainly confined to three coastal areas



Challengers in controlling *An. stephensi*

- **Adaptation to undergo preimaginal development in urban environment –transmission of urban malaria**

- **Ability to undergo preimgainal development in brackish waters – transmission of malaria in coastal areas**

- **Resistant to common insecticides – difficulties in control during malaria transmission**

Implications and staying malaria free

- Posing a challenge to prevent re-emergence rural and urban malaria in Sri Lanka due to
  - Imported malaria cases and
  - Presence of local vectors along with invasive urban malaria vector *An. stephensi*

- The recent spread of *An. stephensi* to new territories are also likely to have been caused by anthropogenic and urbanization-associated factors similar to those discussed for Sri Lanka.

- Broad appreciation of the effects of anthropogenic drivers of mosquito vector-adaptation by global health decision-makers, and the development of appropriate mitigating strategies is clearly important.

Thank you

Anopheles stephensi Liston

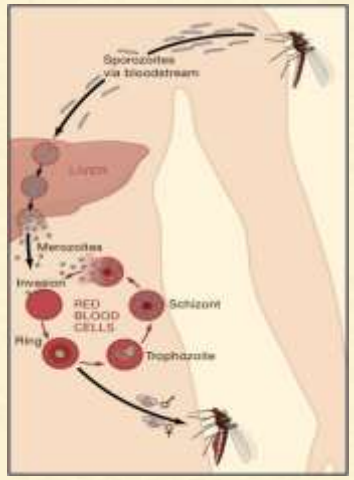
India case study: Lessons learnt from decades fighting the vector

Ashwani Kumar
Director ICMR-Vector Control Research Centre, Puducherry, India


Malvan
मालवण
Gadhinglaj
गडहिंग्लज
Gokak
ಗೋಕಾಕ
Belagavi
ಬೆಳಗಾವಿ
AH47
Mapusa
Calangute
748
67
Panaji
Margao
Dandeli
ದಾಂಡೇಲಿ
52
Karwar
ಕಾರವಾರ
66
Sirsi
ಸಿರ್ಸಿ
Gokarna

Goa

India

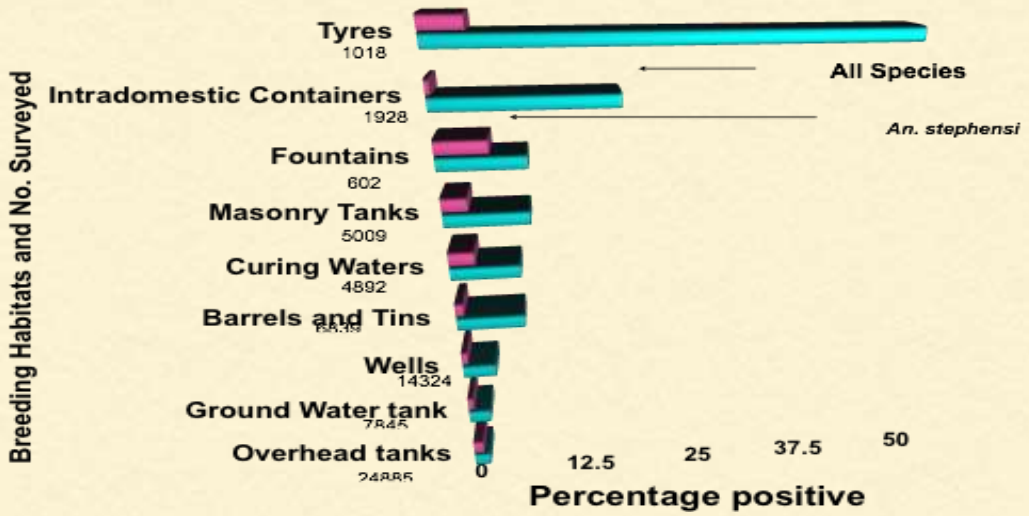


Malaria : Human Plasmodial Infections

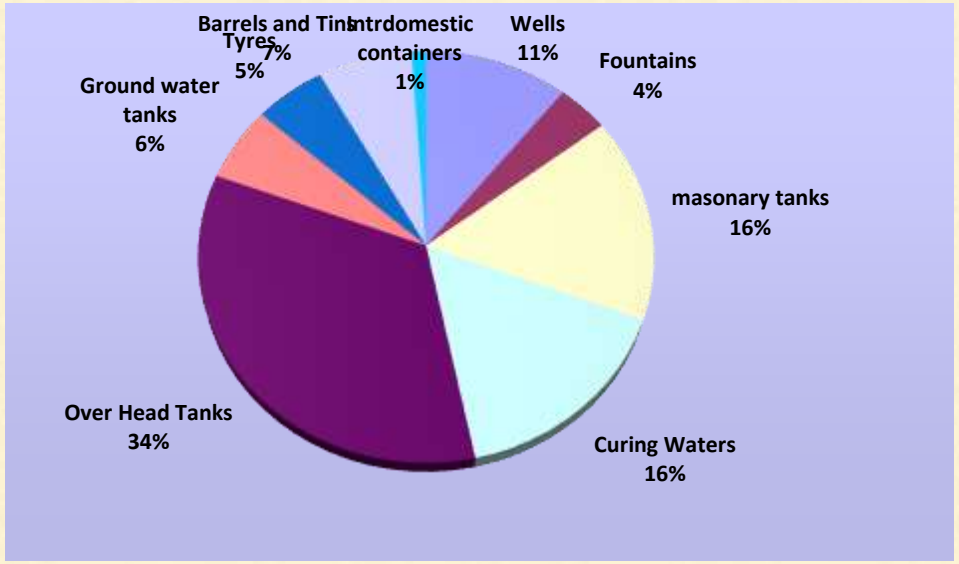
ANOPHELES STEPHENSI TRANSMITTED MALARIA INCIDENCE IN PANAJI, GOA, INDIA FROM 1985-1988

Year	BSE	Total Pos.	*P. vivax*	*P. falciparum*	Pf%	API
1985	***2497***	***5***	***4***	***1***	***20***	***0.12***
1986	***6539***	***352***	***351***	***1***	***0.3***	***8.3***
1987	***21710***	***4416***	***4409***	***7***	***0.2***	***103.6***
1988	***29853***	***5677***	***5435***	***242***	***4.3***	***132.6***

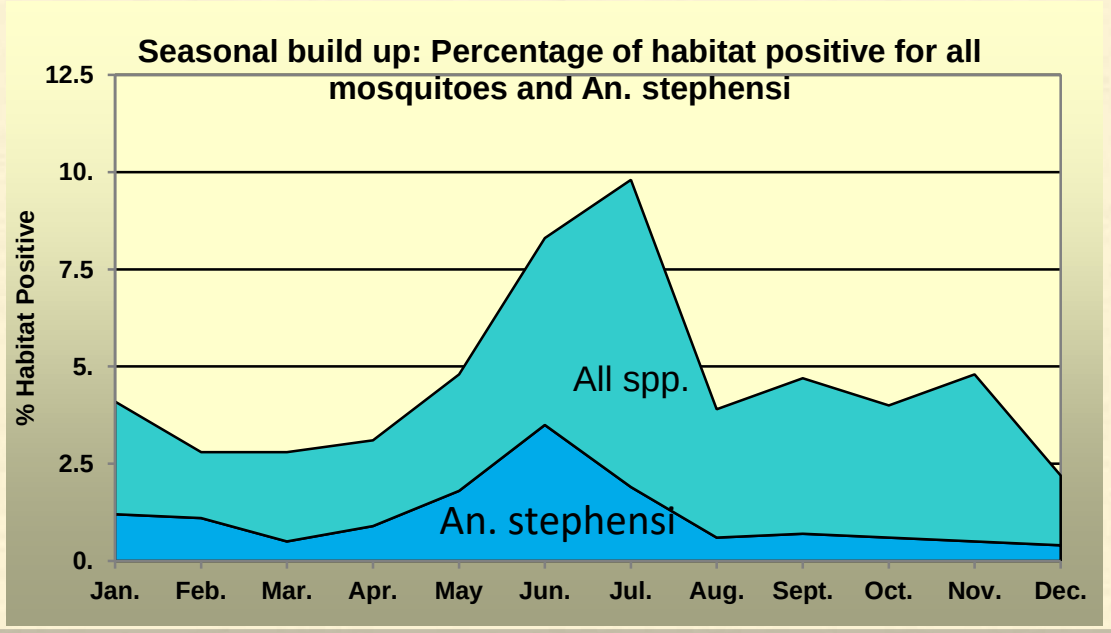
Malaria Problem Delineation

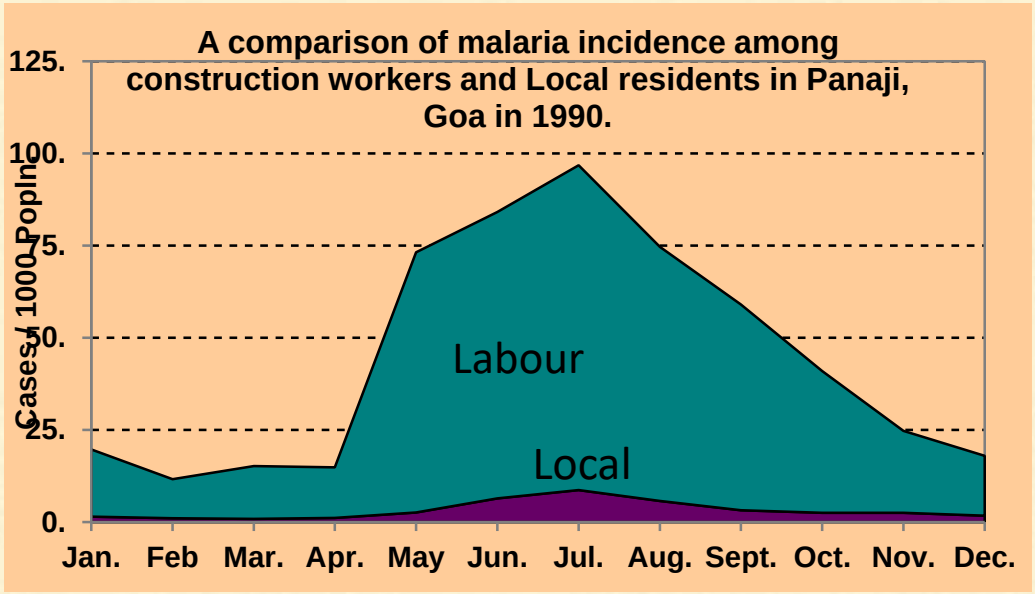


Types and number Breeding sites surveyed and their vector status

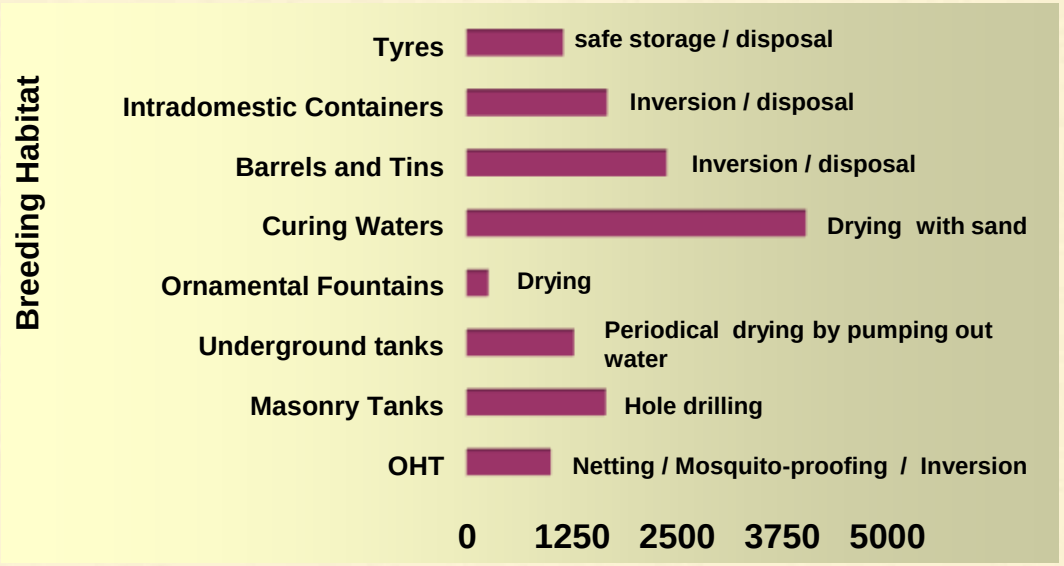


Relative contribution of various breeding habitats to *An. stephensi* breeding in 1990

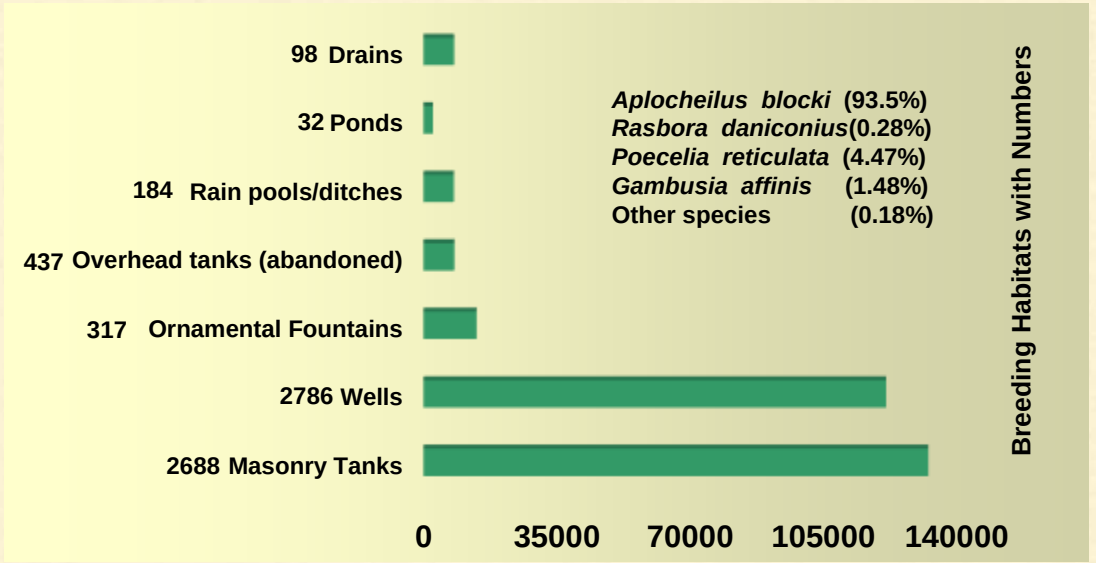




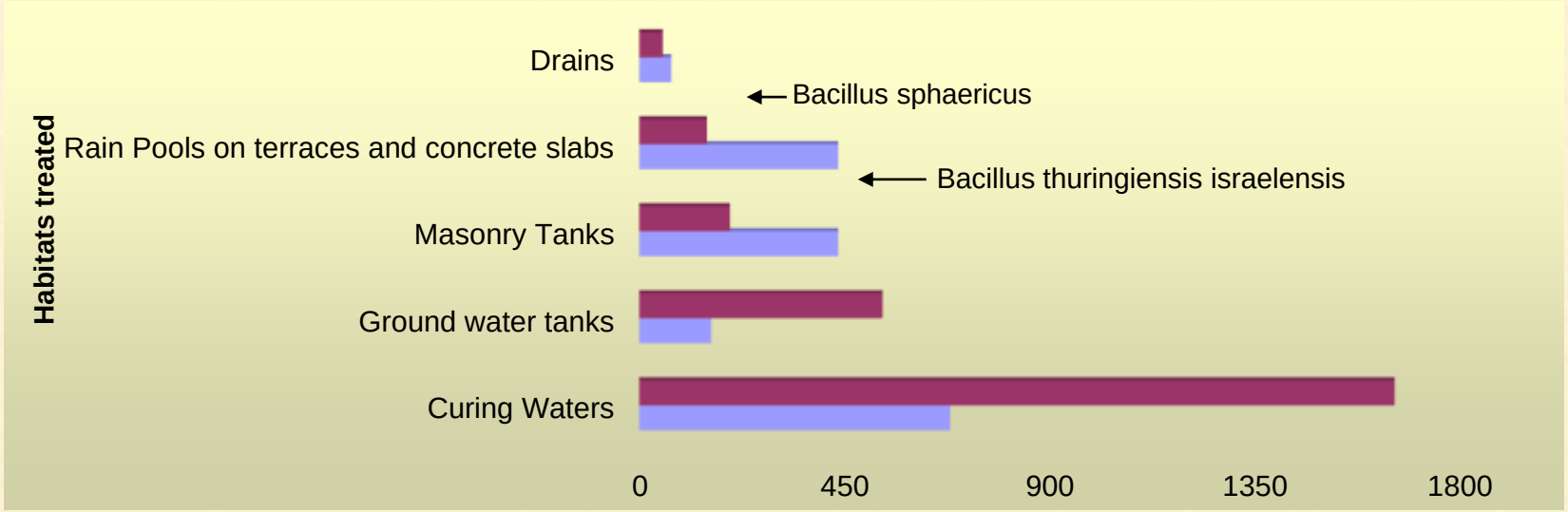
Anopheles stephensi Control Interventions



Bio-environmental intervention against *An. stephensi*:
Breeding Source Reduction / Elimination



Biological control utilizing larvivorous fishes in Panaji, Goa, India (1990-92)



Biological Control of *An. stephensi* with biolarvicides in Panaji from 1990-92







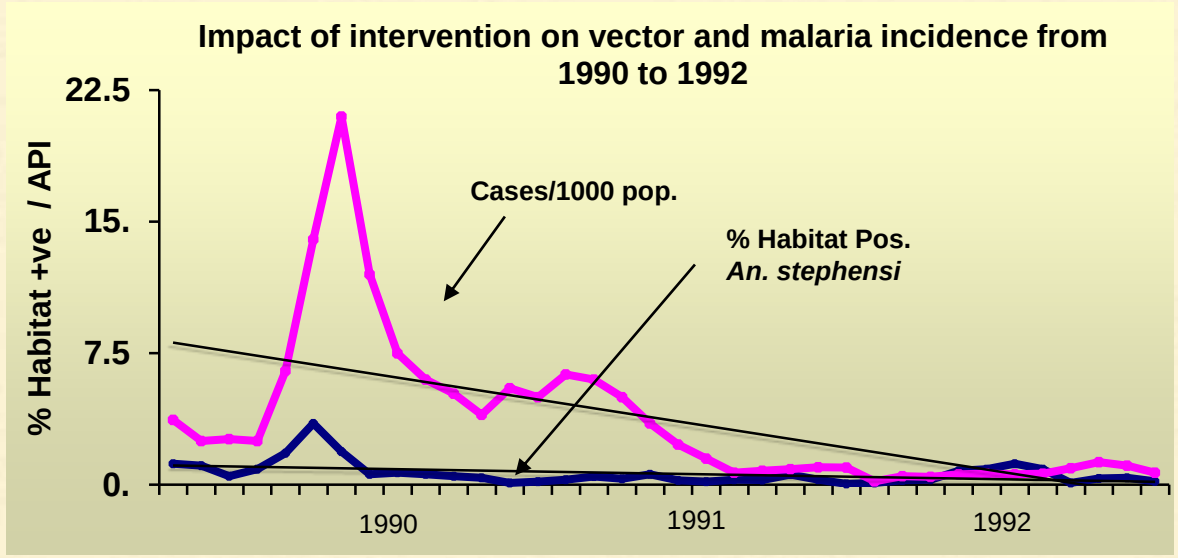


Mosquito-Proofing

Construction sites

Unlined surface drains

Goa Port: *Anopheles stephensi* Breeding Habitats and Interventions


Impact of intervention on vector and malaria incidence from 1990 to 1992
% Habitat +ve / API
22.5
15.
7.5
0.
Cases/1000 pop.
% Habitat Pos.
An. stephensi
1990
1991
1992

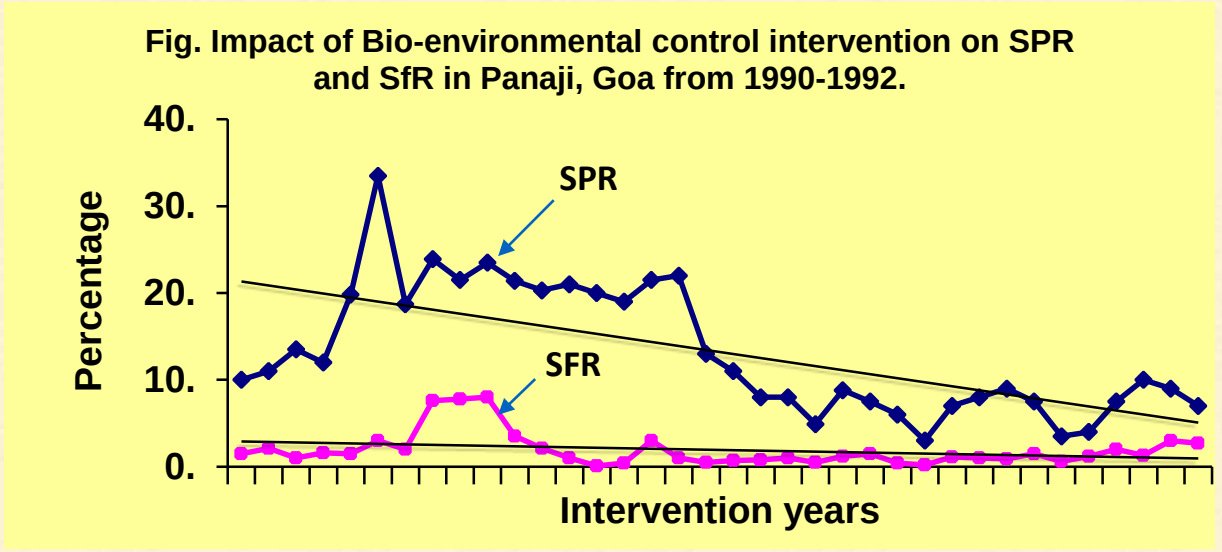
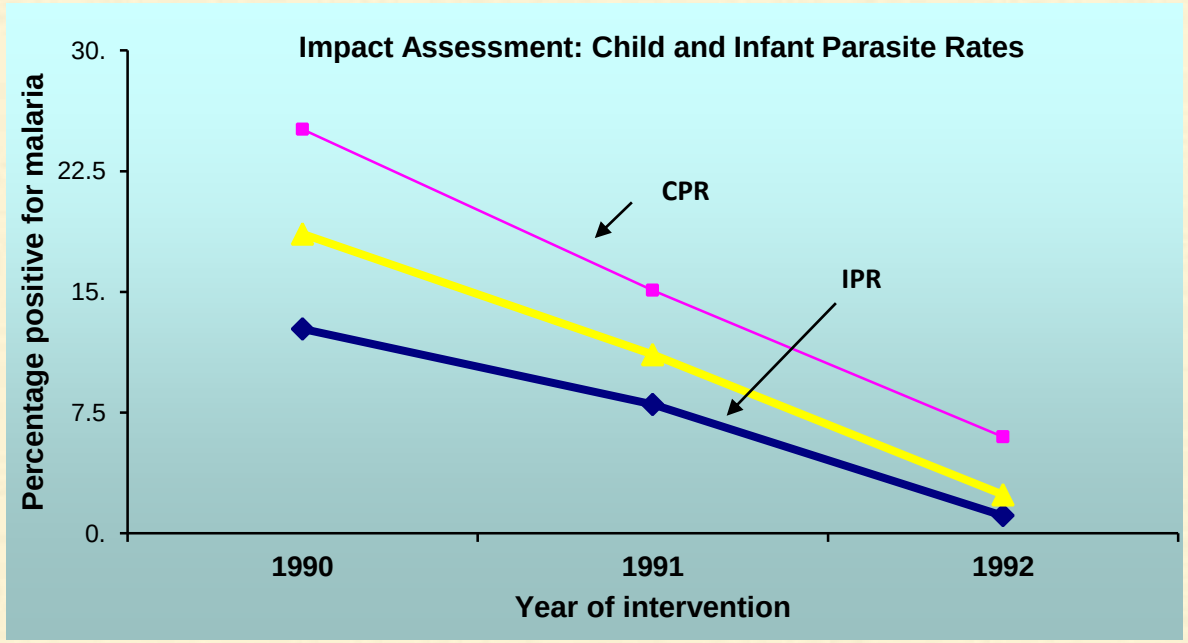


Fig. Impact of Bio-environmental control intervention on SPR and SfR in Panaji, Goa from 1990-1992.
Percentage
40.
30.
20.
10.
0.
SPR
SFR
Intervention years


Impact Assessment: Child and Infant Parasite Rates
Percentage positive for malaria
30.
22.5
15.
7.5
0.
CPR
IPR
1990
1991
1992
Year of intervention

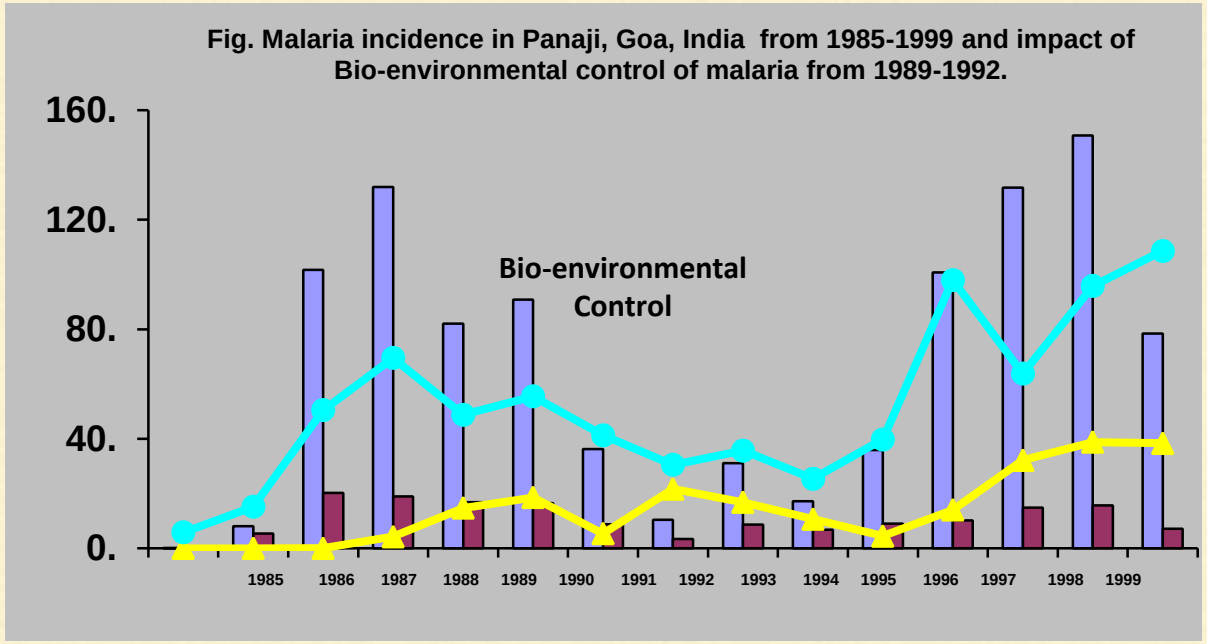


Fig. Malaria incidence in Panaji, Goa, India from 1985-1999 and impact of Bio-environmental control of malaria from 1989-1992.
160.
120.
80.
40.
0.
Bio-environmental Control
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999

Challenge with Adult *Anopheles stephensi* Resting Collection by Hand Catch: Sumodan et al, 2004 JAMCA

Collected 38 mosquitoes resting on 15 different surfaces

CDC Light Trap Deployment, Mosquito collections and Identification: More Effective for Collections/Vector Surveillance




Thank you!

Anopheles stephensi: a catalyst for multi-sectoral action

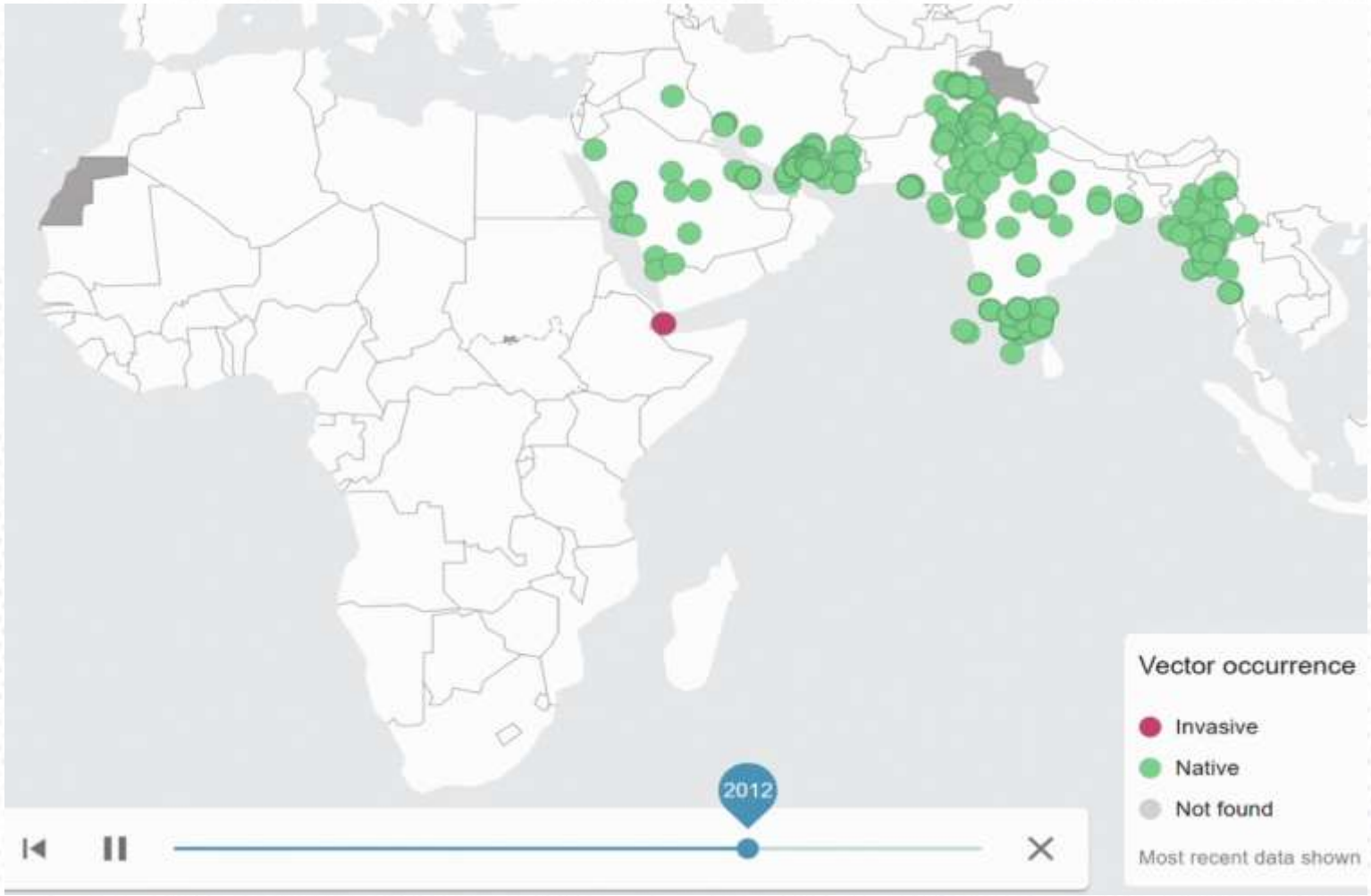
February 2023

OUTLINE

- Unique vector
- What is PMI doing?
- Multi-sectoral opportunities
- Indian Ocean example
- Global engagement and advances in public health entomology

An. stephensi IS STILL SPREADING IN AFRICA

- Djibouti (2012)
- Ethiopia (2016)
- Sudan (2016)
- Somalia (2019)
- Nigeria (2020)
- Kenya (2022)



[WHO threats map]

A UNIQUE VECTOR CREATES ~~CHALLENGES~~ OPPORTUNITIES

- Urban and rural adapted
- Thrives in artificial habitats
  - Shared with dengue mosquito, *Aedes aegypti*
  - Water storage for personal use, agriculture, construction, etc.
- Persists through dry periods
- Often collected in proximity to livestock
- Transmits-*Plasmodium falciparum* and *P. vivax* (Tadesse et al. 2021)

WHAT IS PMI DOING?

- Alignment with WHO initiative

- PMI *An. stephensi* interagency Task Force formed
- USG coordination across **7** agencies
- PMI LSM policy revised for rapid response
- Action plan developed, shared w/ **27** countries, will be online
- Leverage PMI partnerships-**12 PMI** countries began activities
- Supported modeling study on potential impact in Ethiopia
- Surveillance/control needs have identified new partners to engage with surveillance and response capacity

PMI & CDC GLOBAL COORDINATION

- WHO urban malaria technical advisory group
- WHO *An. stephensi* initiative
- WHO EMRO/AFRO
- Roll Back Malaria-Vector Control Working Group
- Global Fund
- Indian Ocean Commission
- Academic partnerships
- West African *Aedes* Surveillance Network
- Pan African Mosquito Control Association

WHAT IS CDC DOING?

- WAASuN trained *Aedes* programs in 18 countries
- PAMCA trainings and response in Djibouti
- Provide support to non-PMI partner countries
- Genomics-identified source populations and reintroductions (Carter et al. 2021)
- Collaboration within CDC- One Health, border health, FETP, geospatial training support opportunities
- CDC BAA call for *An. stephensi* population genomics and control innovation

PMI Action Plan 2.0

Approach

- Mitigation of impacts of *An. stephensi* utilizing enhanced **vector and disease** surveillance, coordinated intervention implementation, and improved monitoring

Geography

- **Scenario 1** *An. stephensi* is established
- **Scenario 2** At risk of invasion

Activities that can be conducted immediately

- Investigate anomalous *Anopheles* spp. from routine collections and IRM
- Align with *Aedes* surveillance
- Strengthen urban and port vector surveillance activities
- Habitat suitability maps provided to guide efforts

Guidance and activities proposed

- Surveillance, monitoring and evaluation
- Vector control
- Social and behavior change (SBC) guidance developed
- Multisectoral coordination-One Health, WASH, trade/commerce, population mobility
- Regulatory needs
- Community engagement

PMI ETHIOPIA

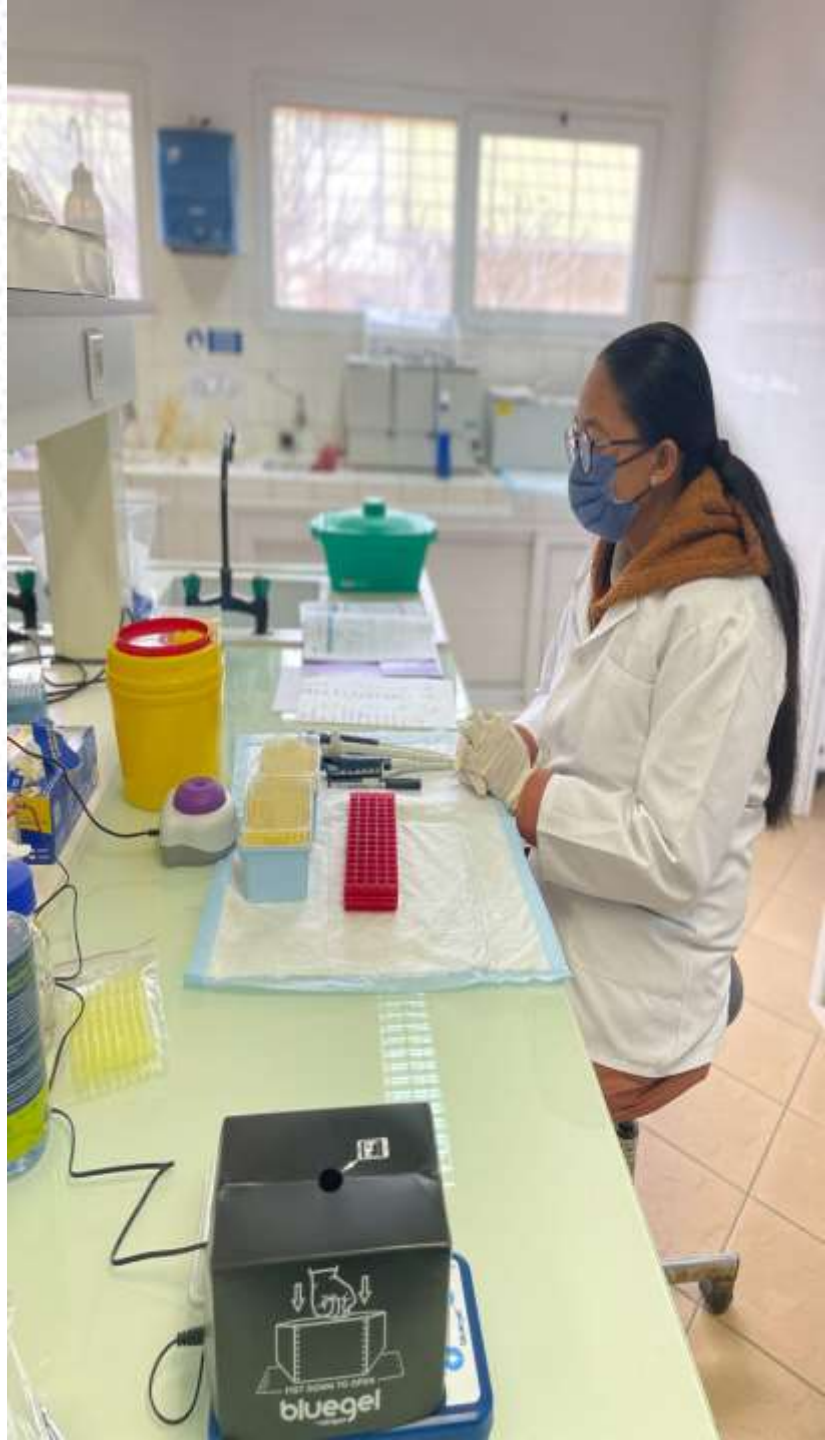
- Invasive *An. stephensi* entomological surveillance and monitoring
  - Insecticide resistance trends
  - 48 detection sites
  - Sporozoite and bloodmeal analysis
- Training support for: Kenya, Benin, Nigeria, Yemen, Sudan, Somalia, Djibouti
- Control launched in eight towns beginning Aug 2022
- Support to investigation of 2022 malaria Dire Dawa outbreak led by AHRI, NMEP
- Support to NMEP and national action plan for *An. stephensi* elimination

OPPORTUNITIES

- Leveraging enhanced surveillance and control monitoring
- Cross-border coordination and collaboration to accelerate response and learning opportunities
- Coordination with non-malaria programs to fill gaps
- Accelerate GVCR and preparedness and response for mosquito borne diseases
- Urban mosquito borne disease surveillance and control
- Enhance public health entomology workforce

SURVEILLANCE

- Improved scientific quality of routine entomological data by reporting and investigating anomalies
- Leverage sequencing capacity
- Negative detections are beneficial for tracking spread
- Understanding urban vector dynamics when not *An. stephensi*
- GVCR accelerated by leveraging *Aedes/*arboviral and *Anopheles/*malaria programs
  - *Aedes* data in Africa enhanced
- WHO urban malaria framework alignment



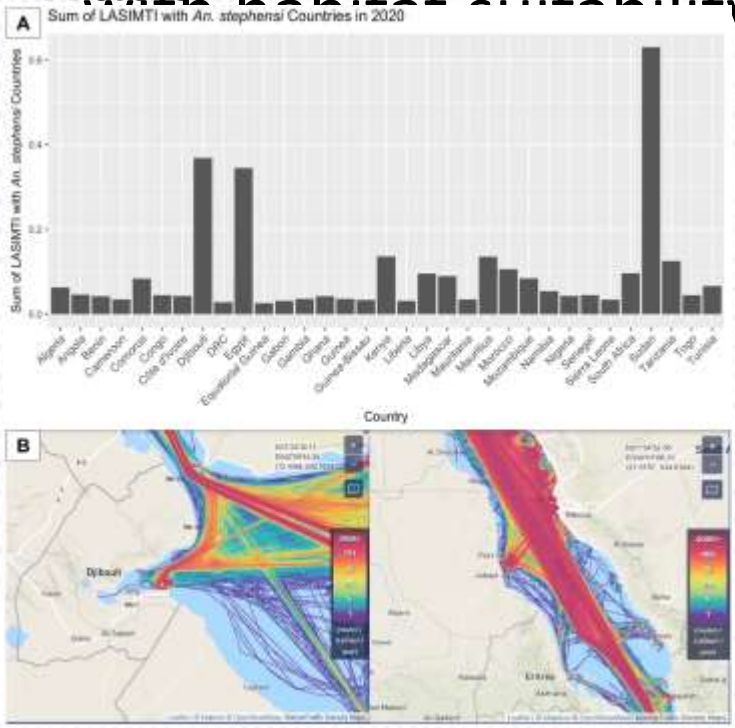
INVASIVE SPECIES

- Opportunities to leverage invasive species efforts and consortia
- US National Invasive Species Council (NISC)
- Biosurveillance, trade, economics, regulations, containment, elimination thresholds
- Invasive mosquitoes often thrive in containers and approaches can be integrated
- Cross-border training to identify species outside of typical keys
- Species distribution models to predict likelihood of introduction/establishment

TRADE/COMMERCE

- 2011 maritime trade data identified **Djibouti** and **Sudan** as countries at greatest risk of introduction (Ahn et al. 2023)
- 2020 marine trade (introduction) data combined with habitat suitability (establishment)

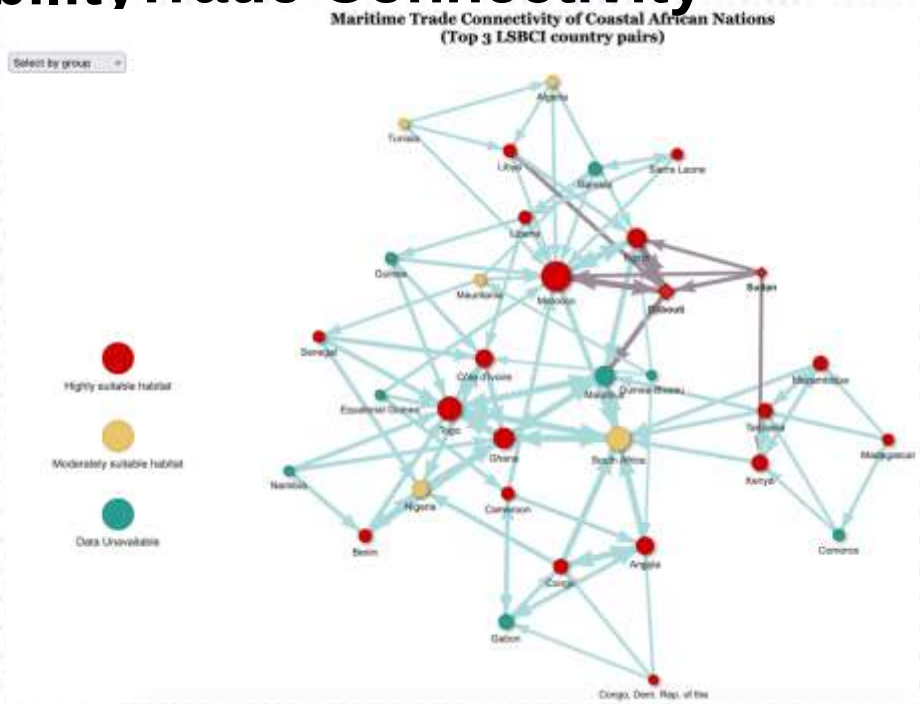
Trade



Trade + habitat suitability

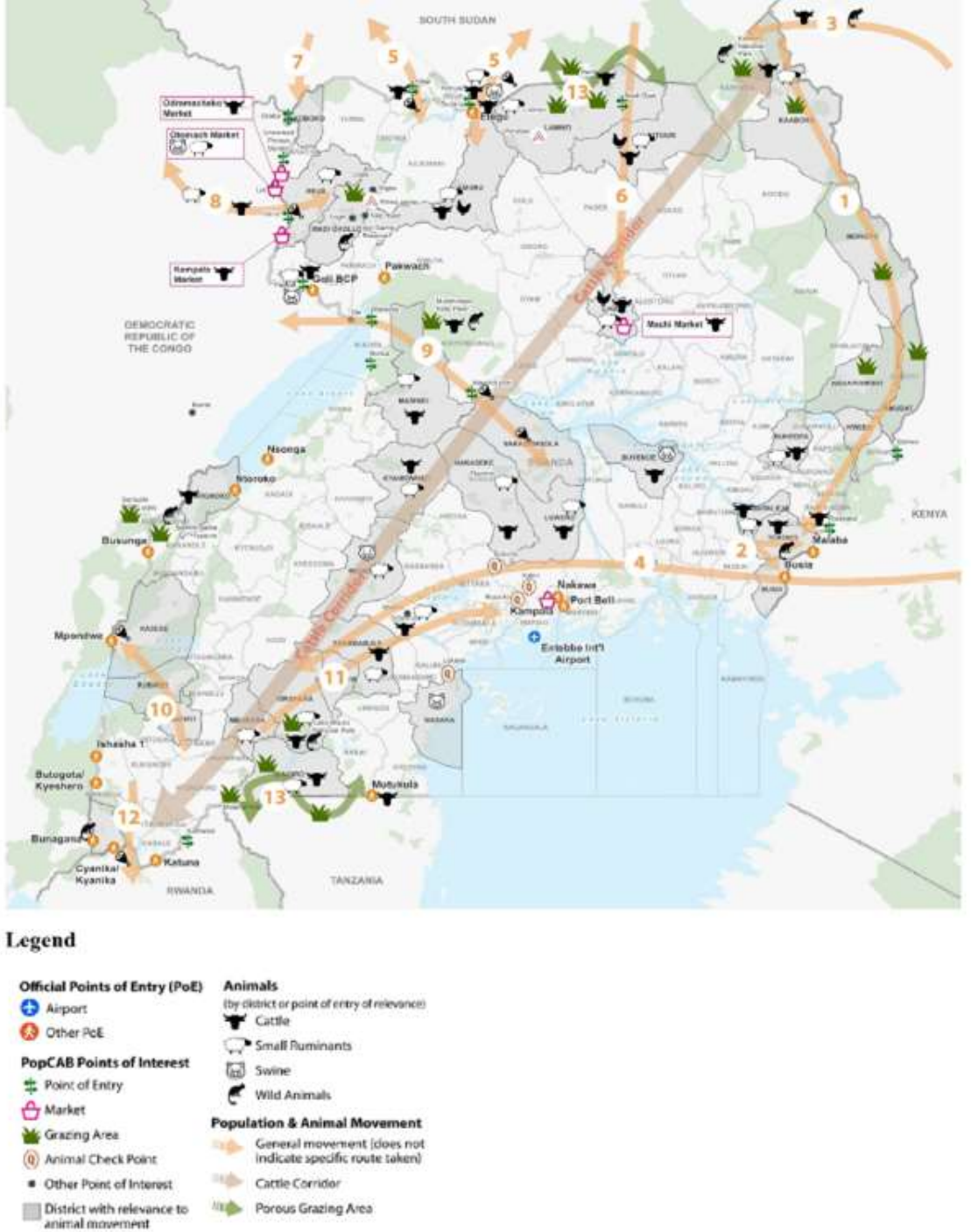
1	Egypt
2	Kenya
3	Tanzania
4	Morocco
5	Libya
6	Madagascar
7	Mozambique
8	Angola
9	Senegal
10	DRC

Trade Connectivity



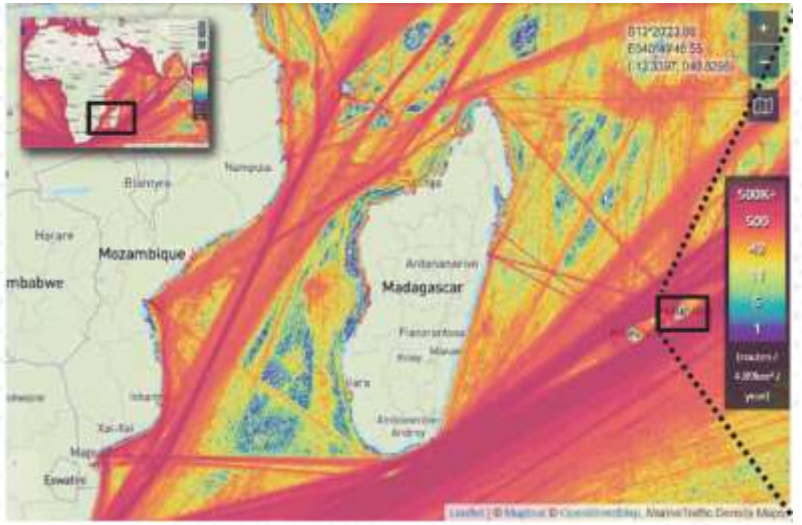
POPULATION MOBILITY

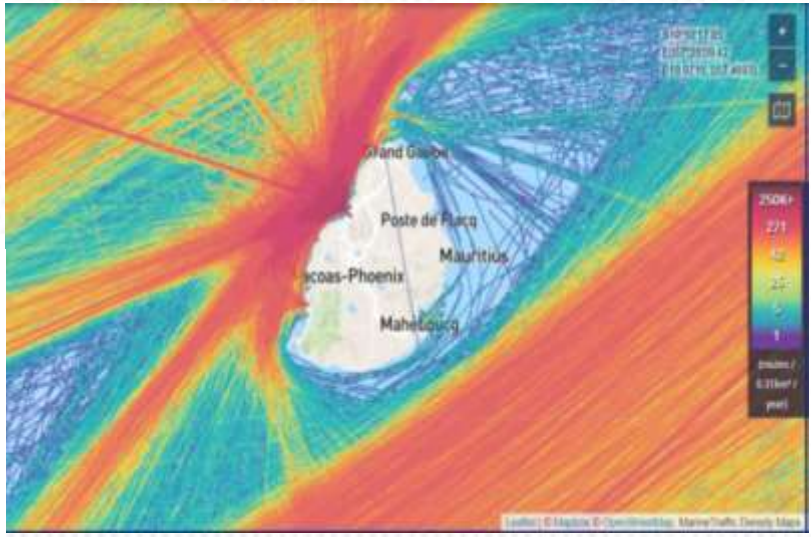
- Identify points of entry/points for control
- Leverage existing data on pinch points from communicable disease (Medley e al. 2021)
- PopCAB Toolkit in PMI Action Plan



INDIAN OCEAN EXAMPLE: *Anopheles* and *Aedes*

- Mauritius connects Asia and Africa through maritime trade
- Strong *Aedes* surveillance program leveraged (Diana Iyaloo)
  - *An. stephensi* surveillance reveals *Anopheles* diversity
- Indian Ocean Commission
- In 1 yr **five island nations** are coordinating vector programs
- Port surveillance in coordination with Port Authorities





WHAT HAVE WE LEARNED?

- Strengths in global partnerships, evidence-informed decision making, and localization initiatives when combined with efforts outside of malaria can accelerate the rate of action
- Cross-cutting engagement can allow for progress in parallel
- Multisectoral engagement can advance initiatives and activities outside of organizational scope
- Gaps and competing resources limit existing surveillance, research, and response capacity
- It is critical to drive more action and address questions around a future with *An. stephensi*

THANK YOU!

MESA FORUM | 21 FEBRUARY 2023, 2 PM CET

RESPONDING TO THE THREAT OF ANOPHELES STEPHENSI INVASION IN AFRICA

MESA

Pre- Forum Questions

1. What is the threat of *An. stephensi* in other regions of Africa, what is the basic step for proximal countries to take and why are most countries more interested with detecting it rather than starting to put strategies to prevent its introduction?
2. Is there any finding that indicates the current malaria transmission by *An. stephensi* and what molecular tools are being used for detection in developed urban areas?
3. Is there any change in the vector control interventions since the detection of *An. stephensi*?
4. There are parallels with *Aedes aegypt*i control and behaviour. What have we learnt from that species?
5. What options are there for action by individuals and organisations in response to the *An. stephensi* rising danger to global eradication?