2022.12.01, Kisumu
Africa Symposium

SATREPS

Science and Technology Research Partnership
for Sustainable Development Program

2020-2025

Interdisciplinary research for an integrated community-directed strategy for sustainable freedom from malaria

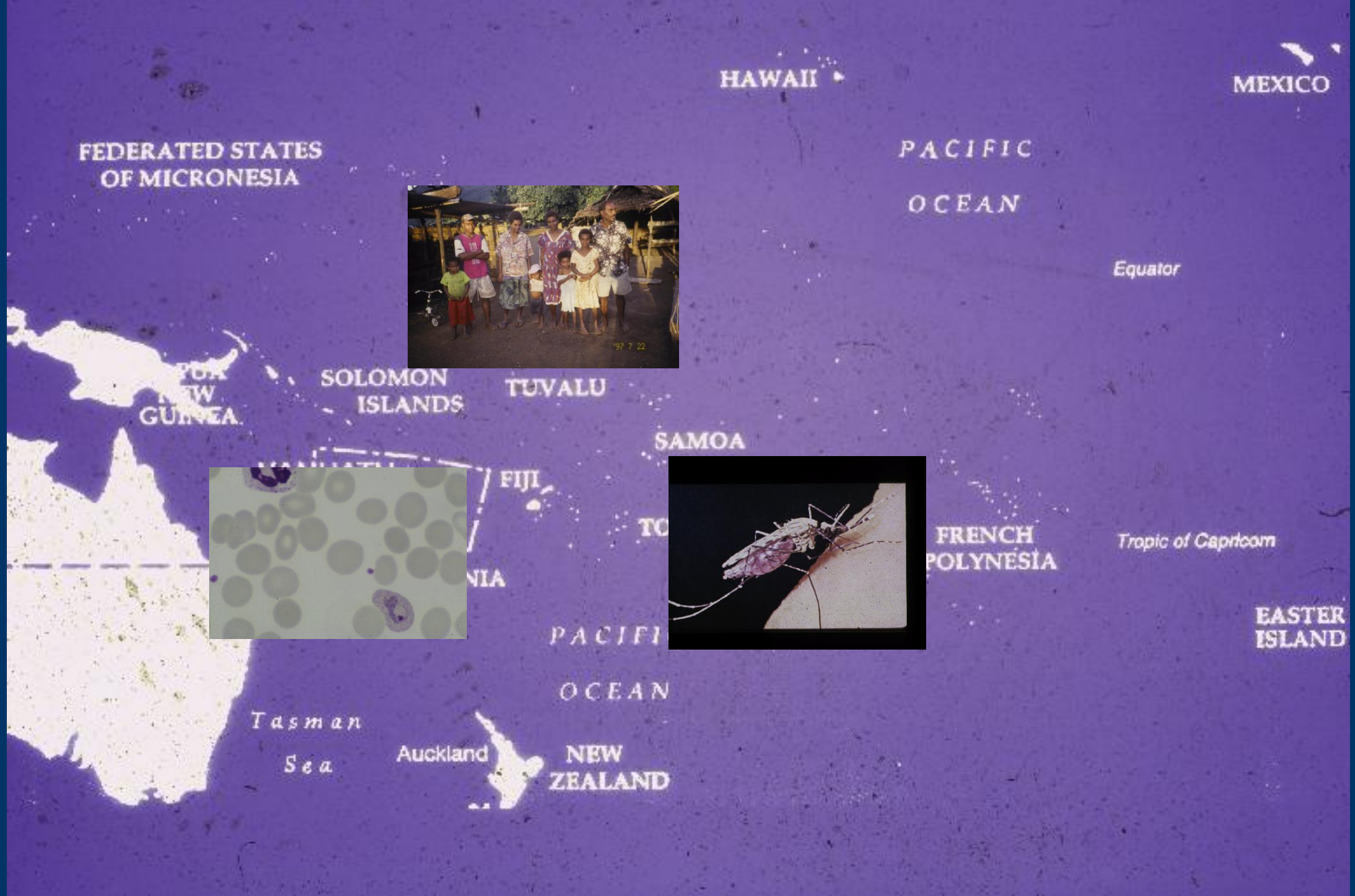
Akira Kaneko, MD, PhD
Professor

Osaka Metropolitan University

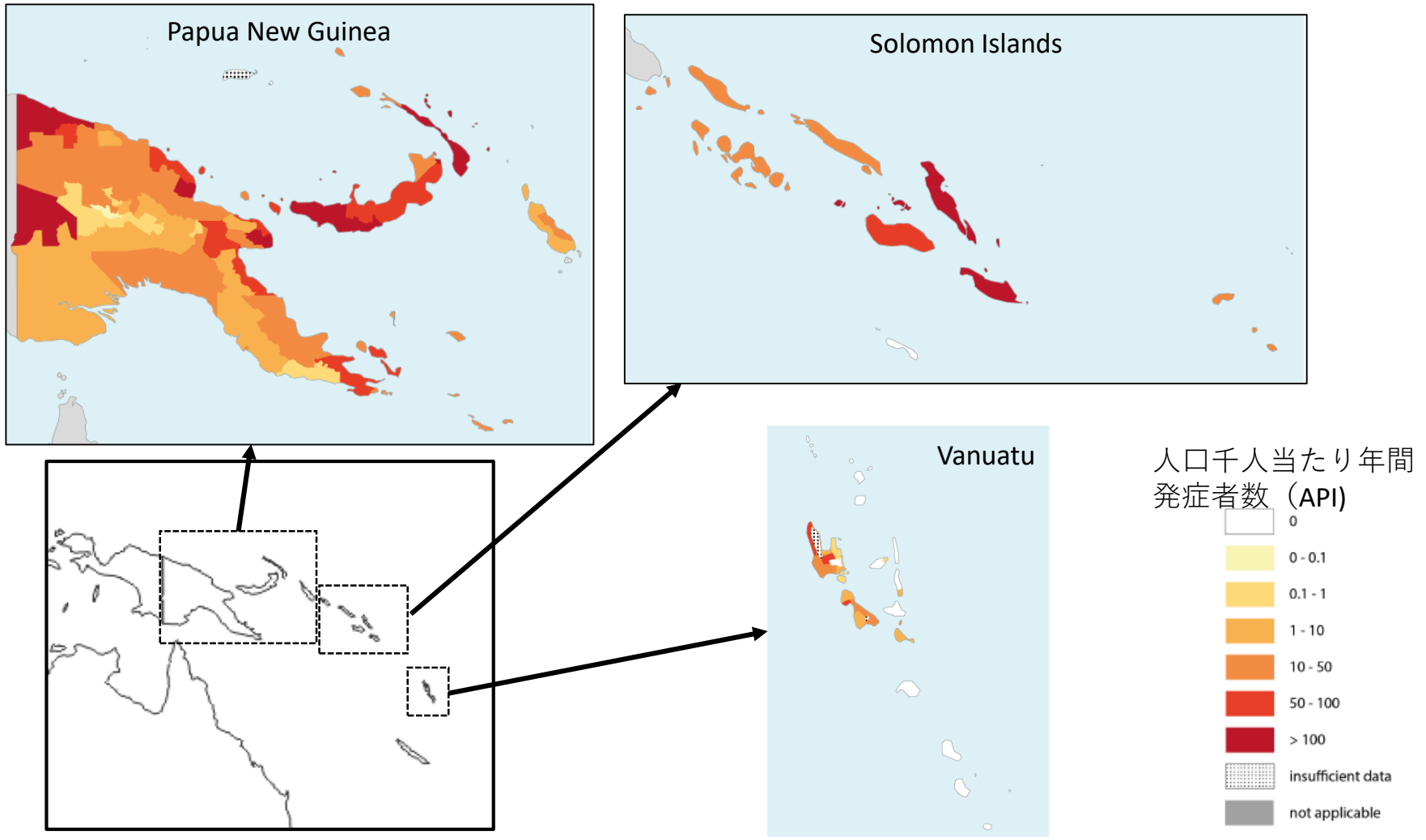
Karolinska Institutet

Prologue

From Vanuatu since 1987

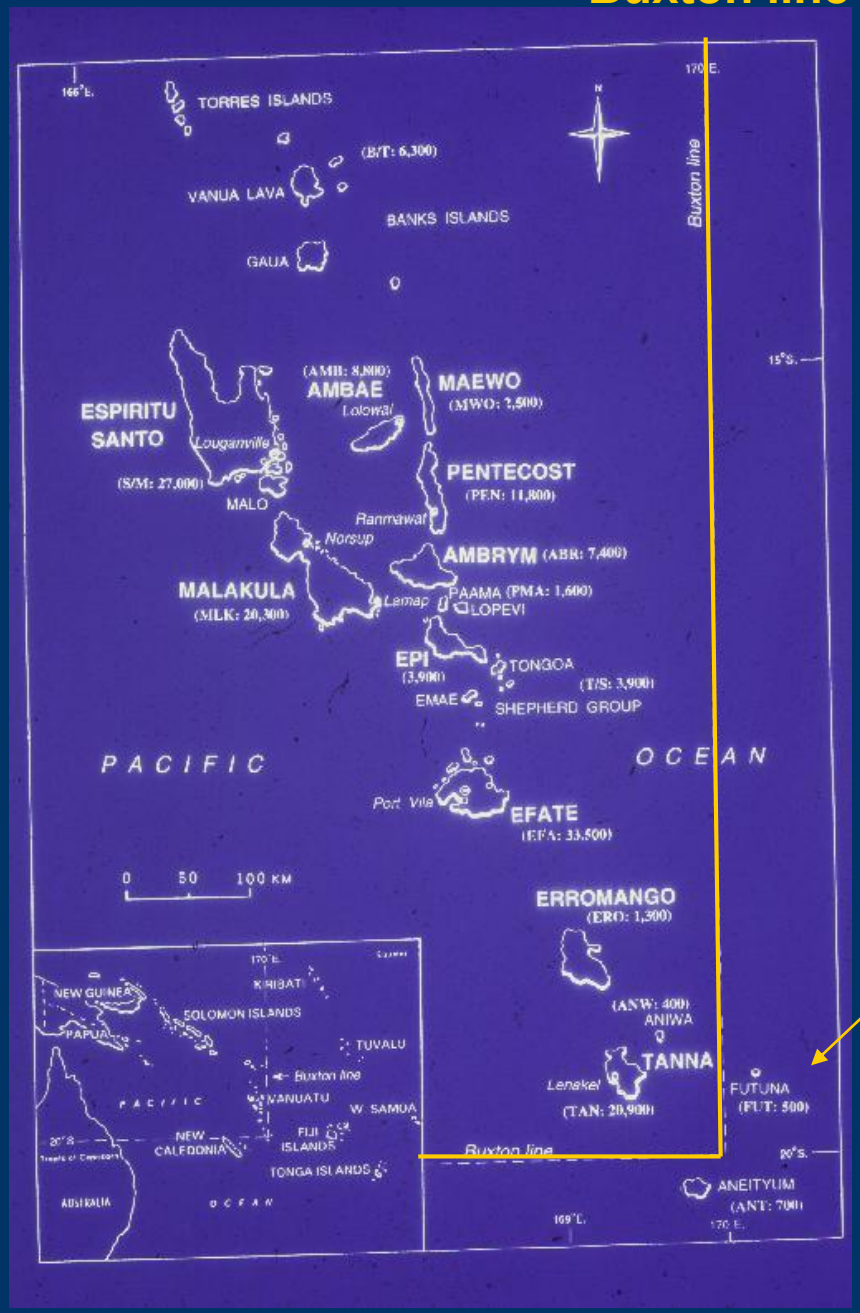

HAWAII
MEXICO
FEDERATED STATES
OF MICRONESIA
PACIFIC
OCEAN
Equator
SOLOMON
ISLANDS
TUVALU
SAMOA
FIJI
FRENCH
POLYNESIA
Tropic of Capricorn
EASTER
ISLAND
PACIFIC
OCEAN
Tasman
Sea
Auckland
NEW
ZEALAND

Malaria in Oceania (2019)



Endemic disease

The Vanuatu Archipelago



200,000 population
120 languages
68 inhabited islands

Limit of Anopheles mosquito and malaria in the Southwest Pacific (Buxton 1926)

Island life and community in Vanuatu

Agricultural products in Vanuatu islands

Malaria infection and disease in Vanuatu

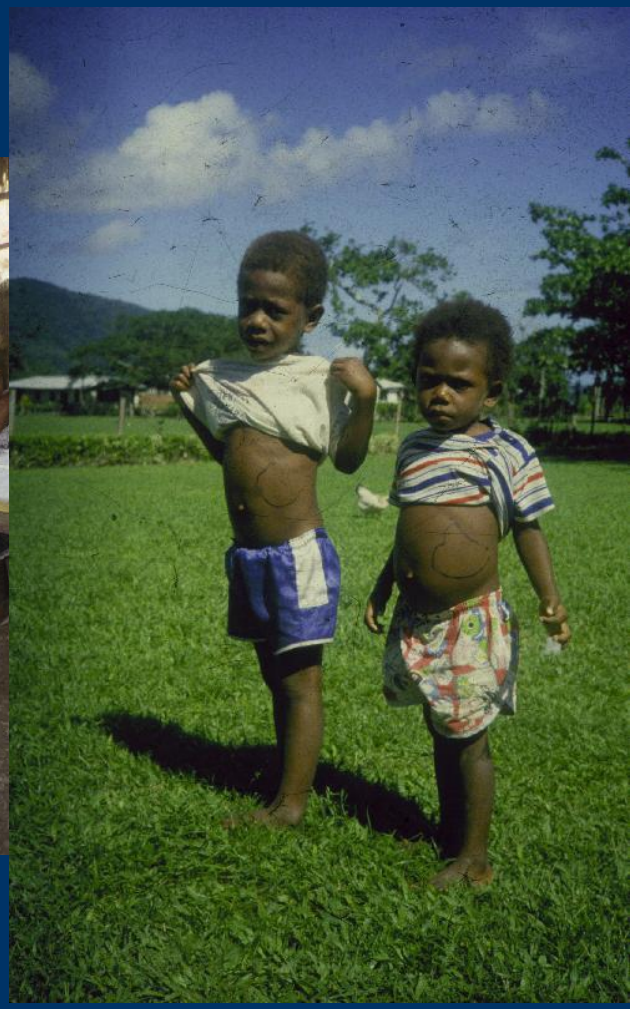
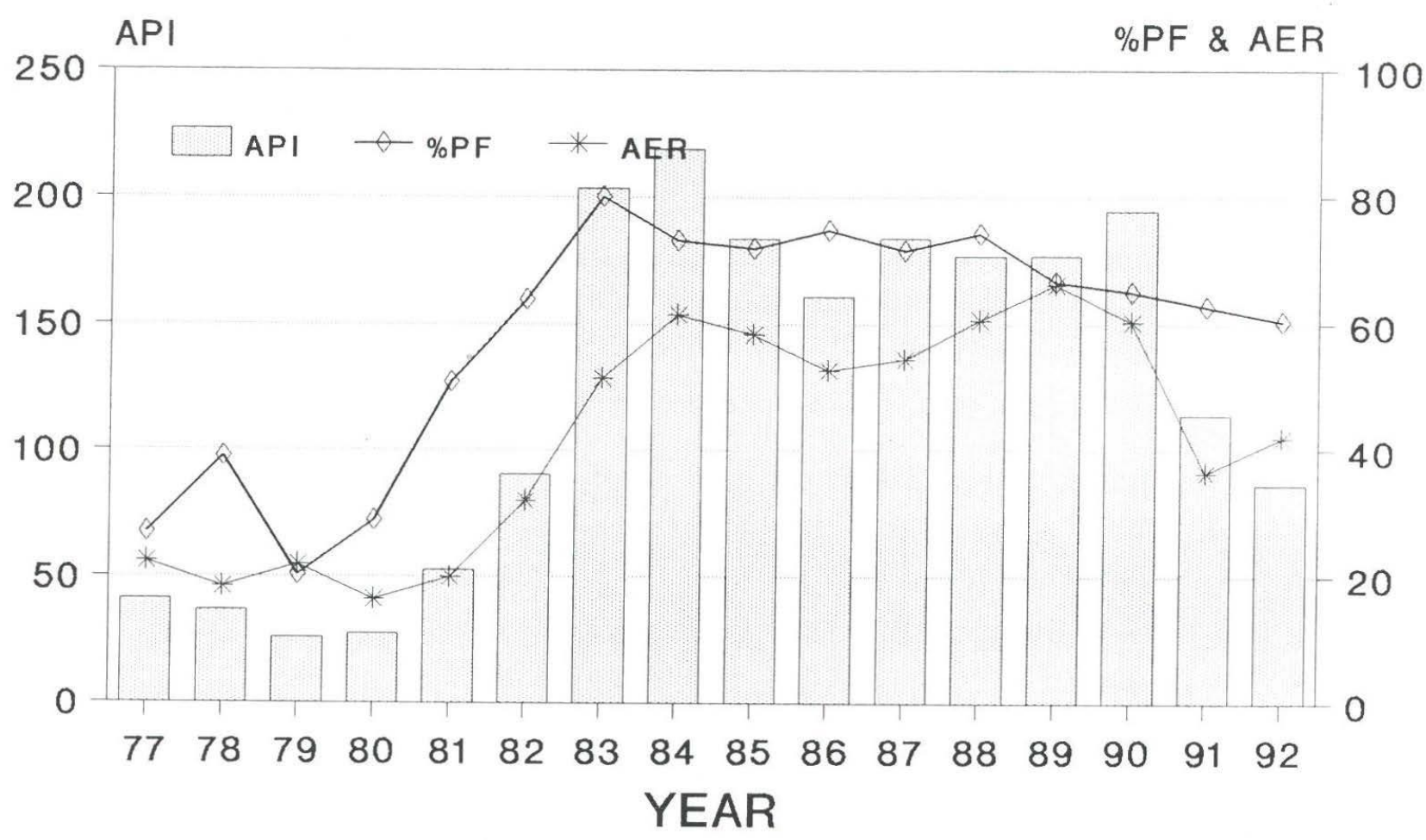


FIG. 1 MALARIA TREND IN VANUATU 1977-1992



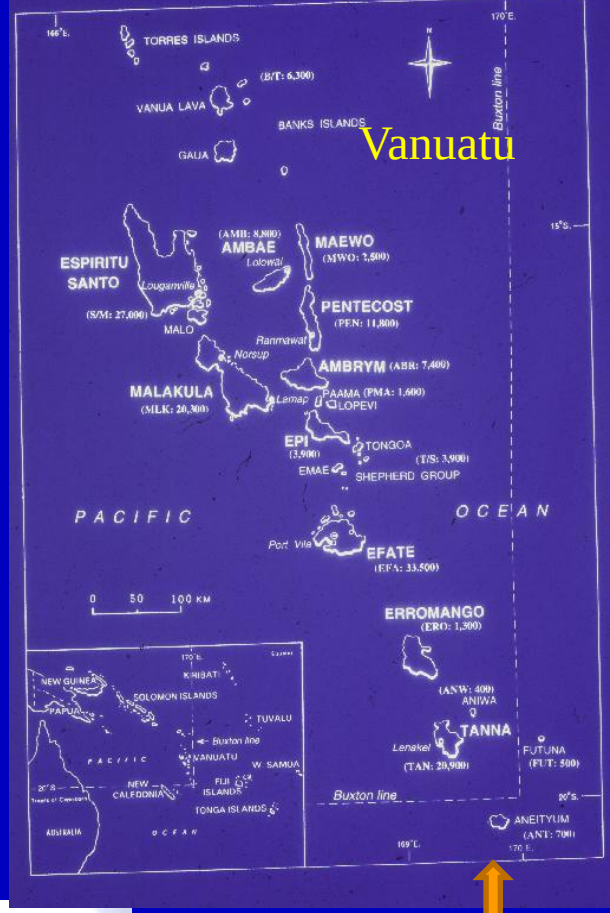
%PF:Percentage of Pf in positive slides
AER:Annual Examination Rate
API:Annual Parasite Incidence/1000 pop.

Malaria eradication on islands

Lancet 2000; 356: 1560–64

Akira Kaneko, George Taleo, Morris Kalkoa, Sam Yamar, Takatoshi Kobayakawa, Anders Björkman

1955-1969 Global Malaria Eradication Program
Heavily reliant on DDT spray
No magic bullet!
No plan to fit for all!



Aneityum project since 1991

- Well-adapted short-term MDA
- Sustained vector control
- High degree of community participation

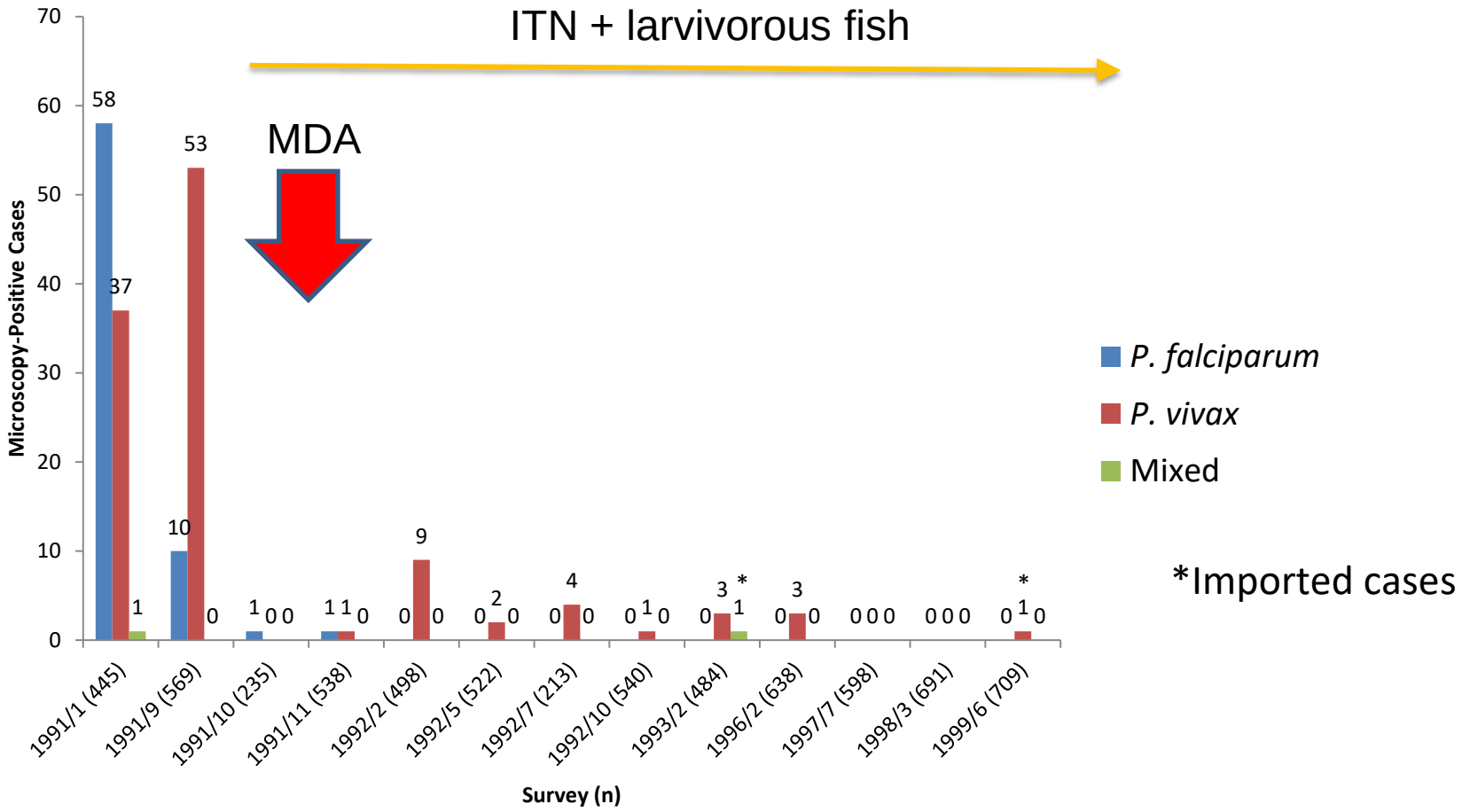
Aneityum Island

2000- New international commitment to GMEP
The proof-of-concept from Aneityum island

Sustainable freedom from malaria for 30 years

Daily monitoring and recording adverse events

Annual cross sectional surveys on Aneityum, 1991-1999

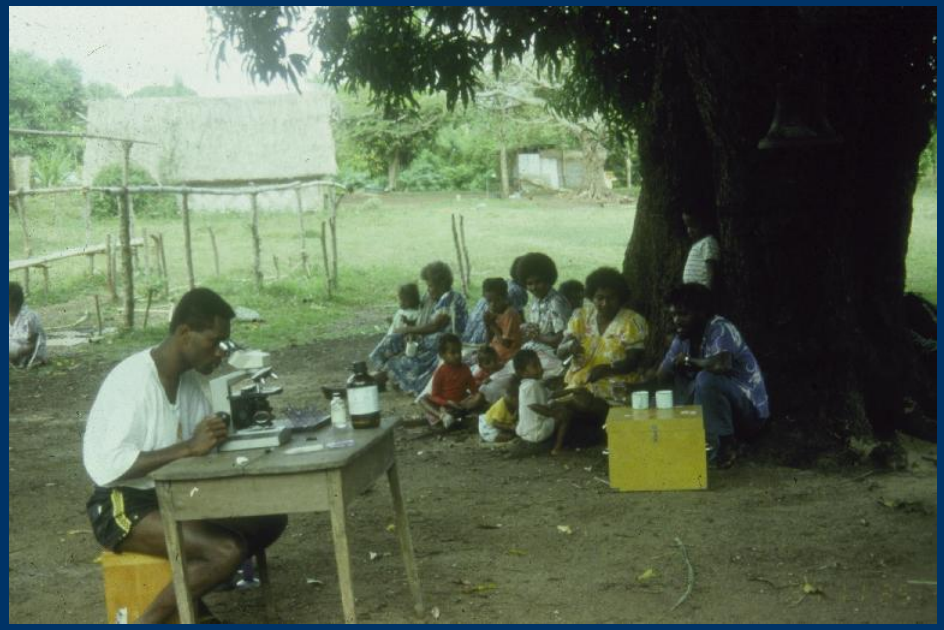


(Kaneko A et al. 2000)

Risk of malaria importation to Aneityum

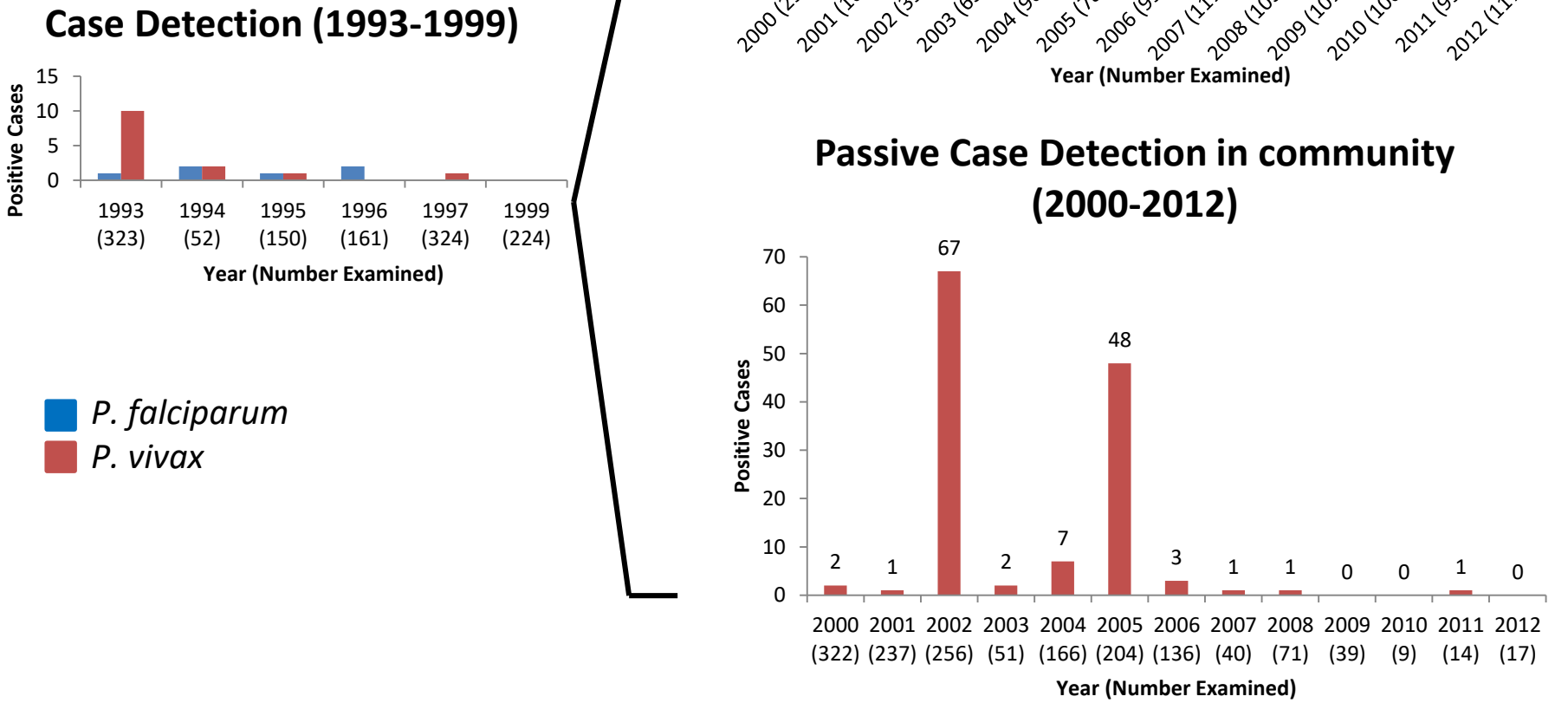
Surveillance by community microscopist on Aneityum since 1993

Active case detection for all arriving passengers



Passive case detection for fever cases in community

Surveillance by community microscopist on Aneityum

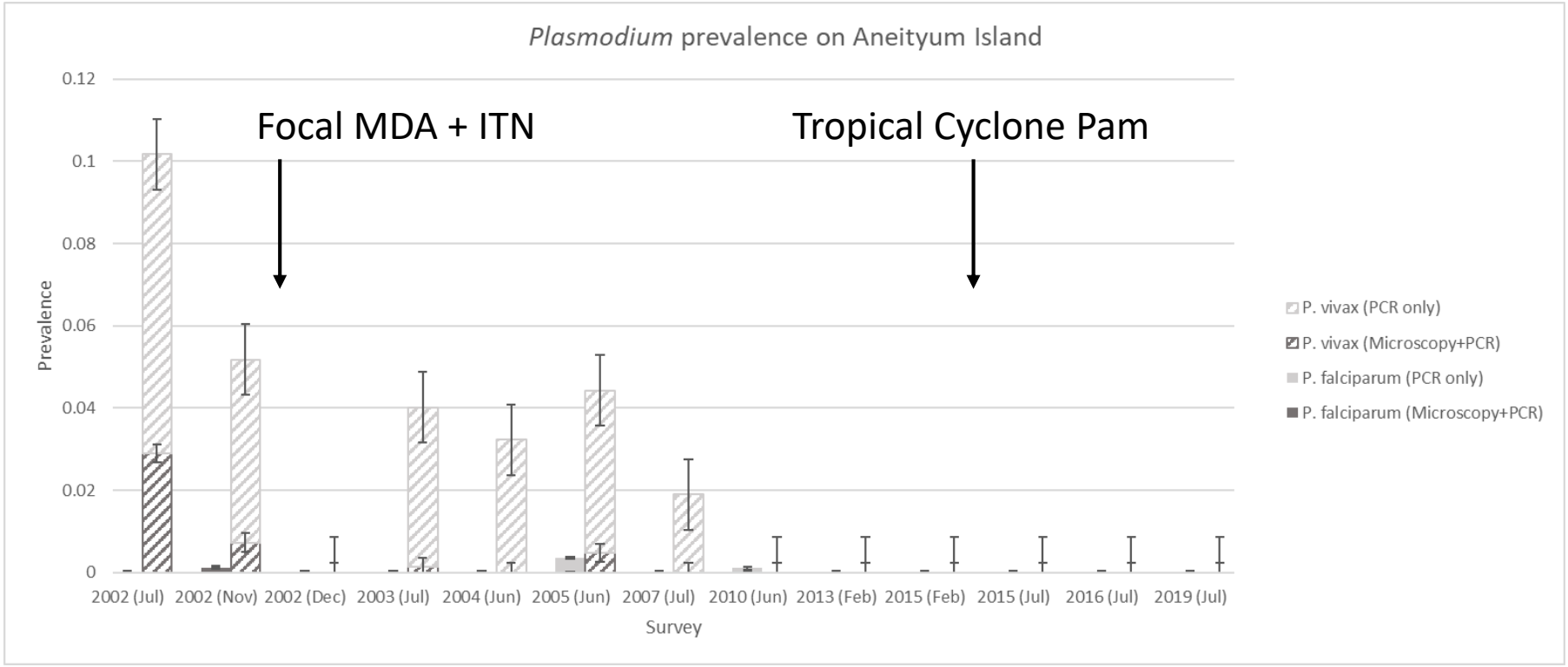


The 2nd MDA on Aneityum island, November 2002

- to contain the *P. vivax* resurgence
- targeting the population <20 years old, based on the microscopy results
- with chloroquine and primaquine (daily 0.25 mg/kg for 14 days)
- with the high ITN provision (0.94 nets per person)

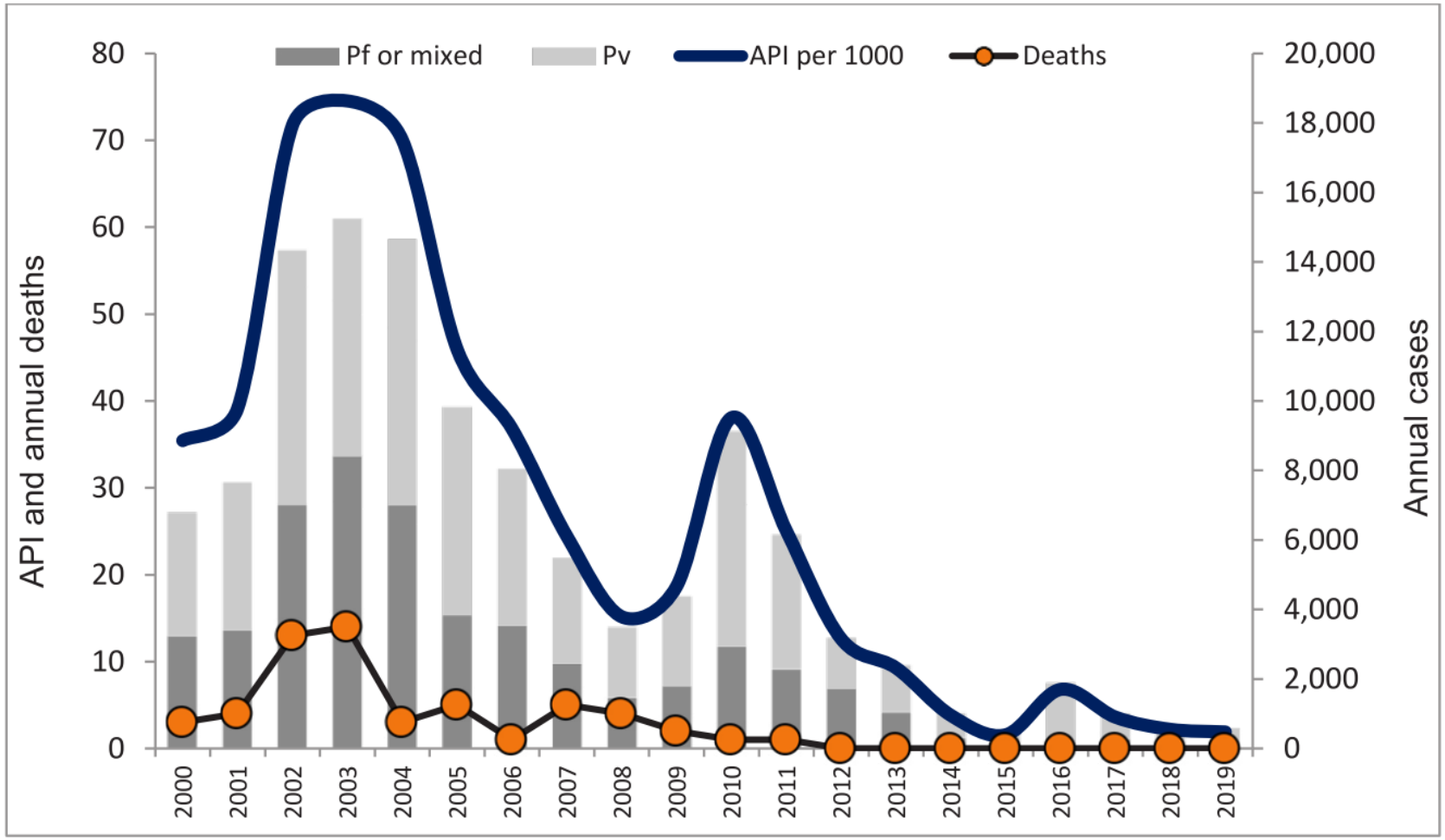
Aneityum (2002-2019)

- Focal MDA (20 years and under) and strengthened ITN
- No *Plasmodium* infections since 2010



Sustainable use of ITNs on Aneityum island, 2014

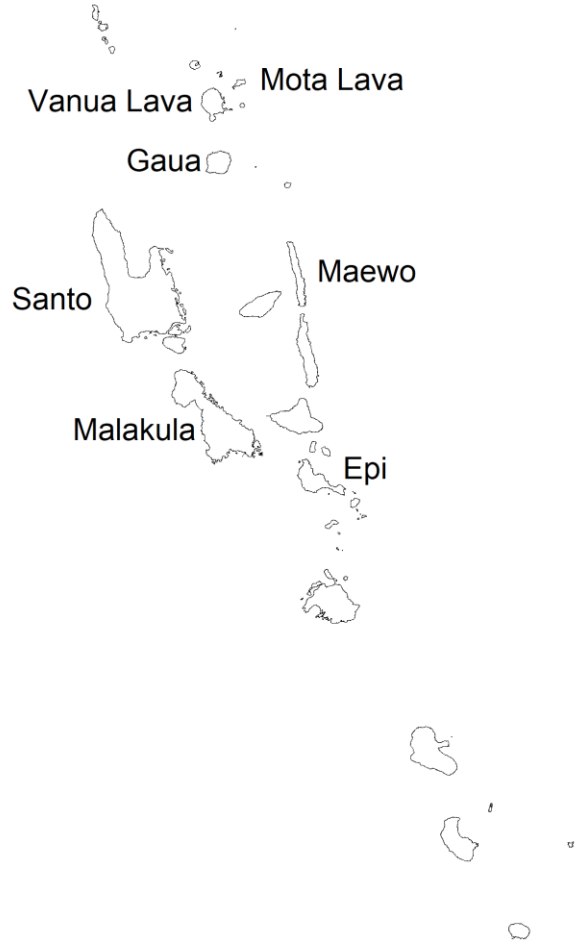
National API (2000 to 2019)



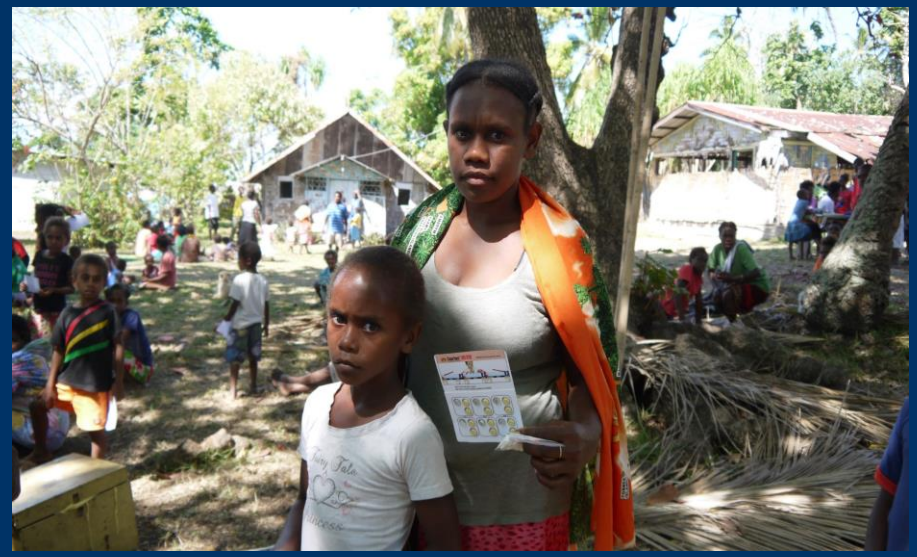
Vanuatu Ministry of Health (2020)

P. vivax infection rate (%) by RDT/PCR

Province	Island	2017 (N)	2018 (N)	2019 (N)	% Submicro
Torba	Mota Lava			0.0/0.0 (200)	n/d
	Vanua Lava			0.4/1.2 (486)	66.7
	Gaua	0.0/0.0 (603)			n/d
Sanma	Santo	0.4/9.3 (926)	1.4/2.1 (712)		86.1
Penama	Maewo			0.0/0.3 (803)	100
Malampa	Malakula	0.1/5.3 (1357)	0.4/4.2 (1061)		94.8
Shefa	Epi		1.3/4.2 (798)		76.5

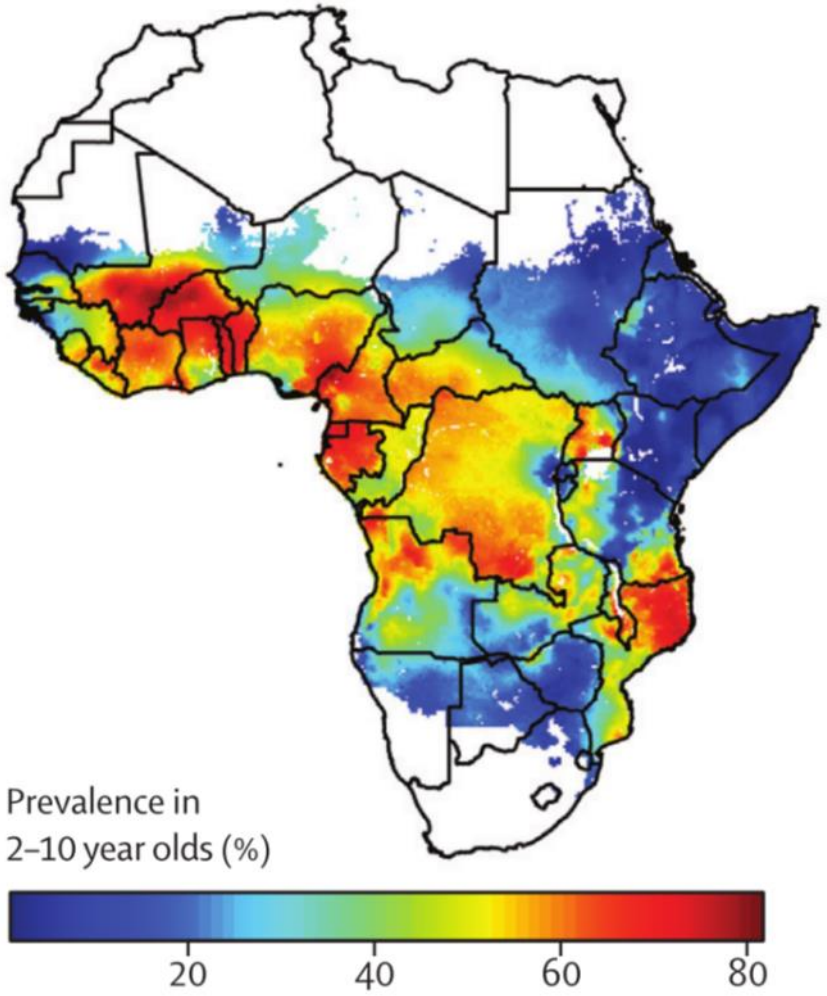


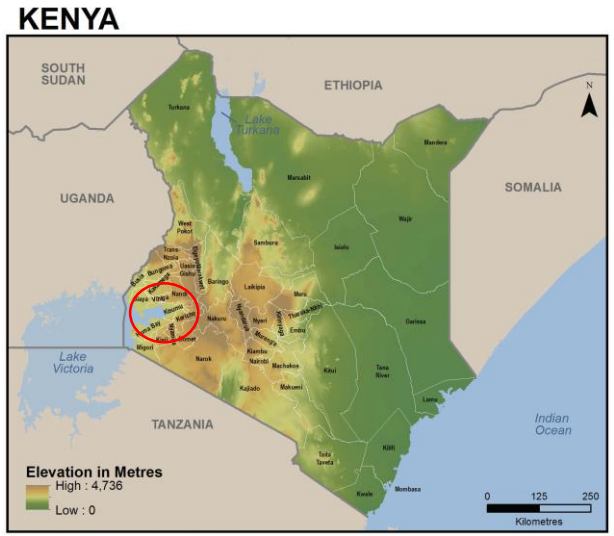
The power of community is key for sustainable malaria elimination



Vanuatu islands

Towards a malaria-free continent





Tropical diseases need attention, too

- What if the world had tackled malaria with the energy now dedicated to the coronavirus?”

[Ntoumi F. 2020. Nature 2020; 587: 331.]

Accelerate malaria elimination in tropical Africa beyond the COVID-19 pandemic!

Available malaria control tools

- LLIN: long-lasting insecticide-treated bed nets
- IRS: indoor residual spray
- RDT: rapid diagnostic test
- ACT: artemisinin-based combination therapy
- IPTp: intermittent prophylactic treatment for pregnant woman

Why dose high malaria transmission continue?

Residual transmission for malaria elimination

Asymptomatic/submicroscopic cases

=>neither seek the treatment, nor are detected

=> maintain the transmission

Pyrethroid-resistance, early biting, and exophagic vectors; *An gambiae => An arabiensis*

=> resistant to available vector control methods such as LLIN and IRS

Multi-purpose human behaviors

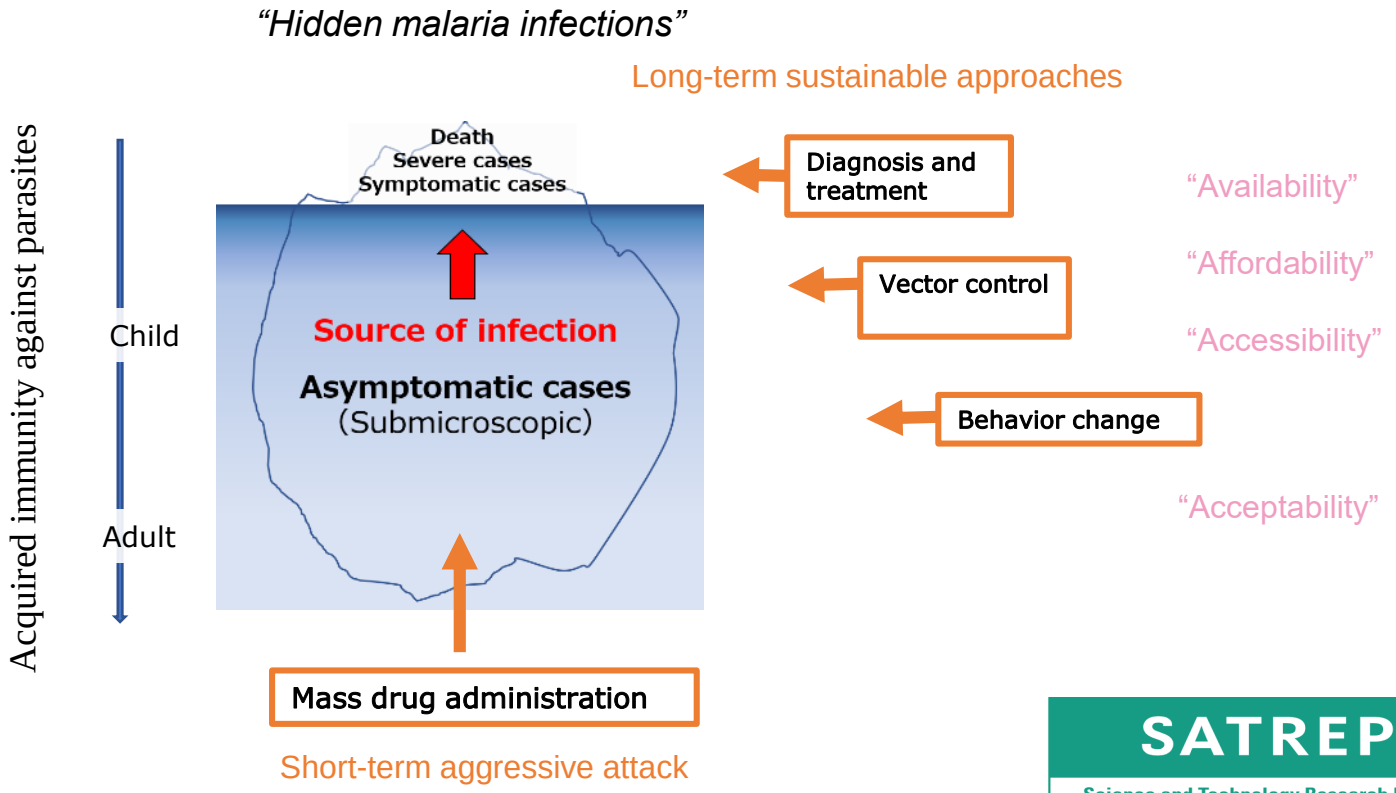
=>alternative use of bed nets

=>delayed diagnosis and treatment

=>lack of ownership of the program

=> Need alternative and innovative approaches

Develop an integrated strategy for sustainable malaria elimination



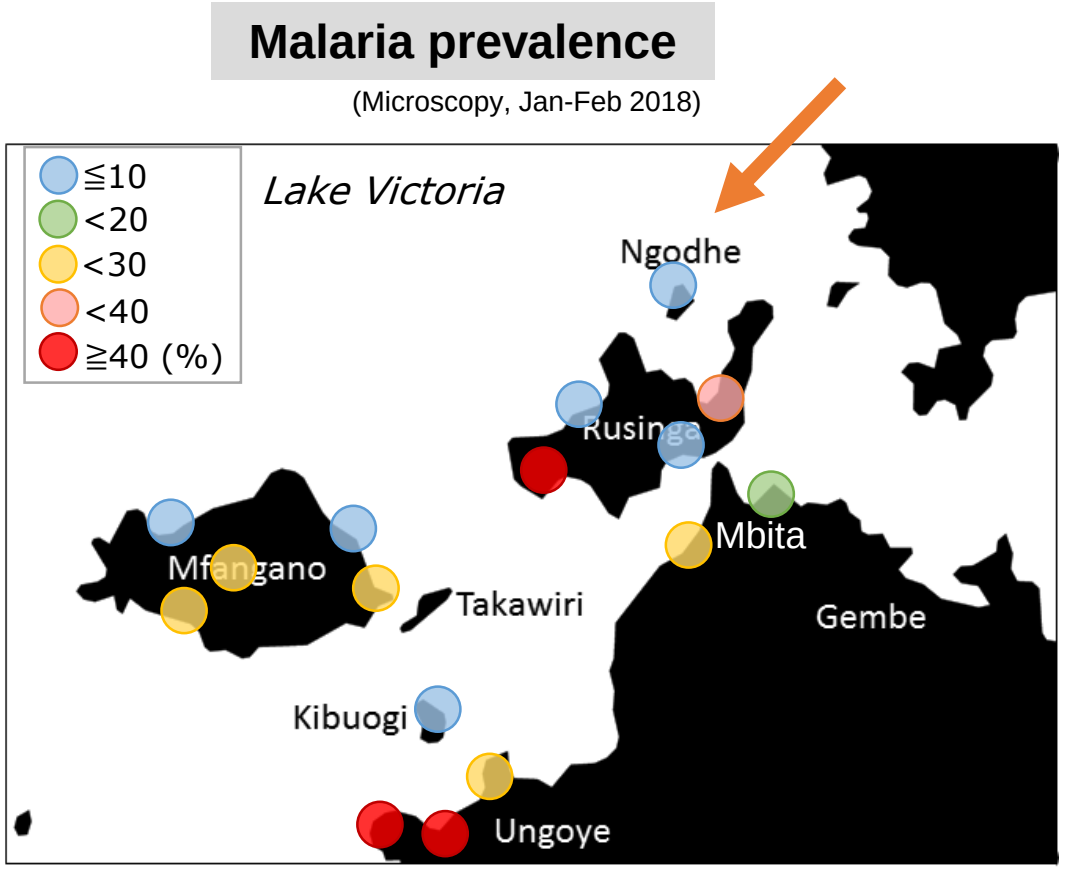
SATREPS

Science and Technology Research Partnership for Sustainable Development Program

2020-2025

A pilot MDA study on Ngodhe Island (Jan 2016~)

- Low endemic area located close to moderate/high endemic area
- ~600 population
- 3km away from the nearest island
- 2 beach points to access



Mass drug administration targeting the whole population on Ngodhe Island, 2016

“Community-directed approaches”

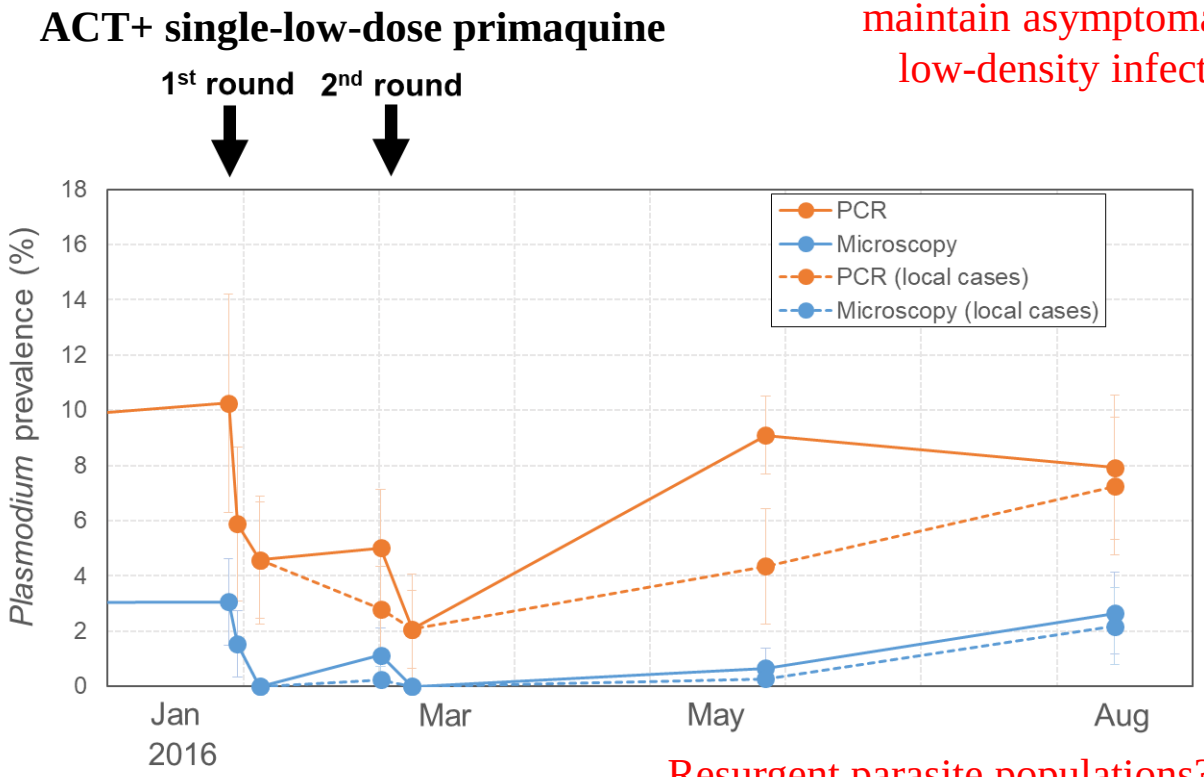
A pilot MDA study on Ngodhe Island (2016)

Malaria resurgence after elimination

Safety and efficacy?

How to transmit and maintain asymptomatic and low-density infections?

Primaquin (mg/kg)
0.75
>0.25
>>0.15



Resurgent parasite populations?
Imported>Local
Residual>New

[Kagaya et al. 2019]

USAID
FROM THE AMERICAN PEOPLE

U.S. PRESIDENT'S MALARIA INITIATIVE

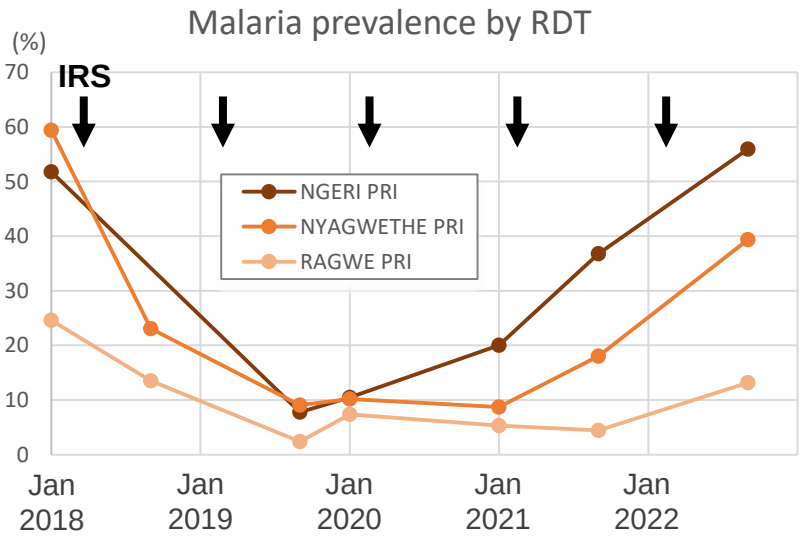
CDC

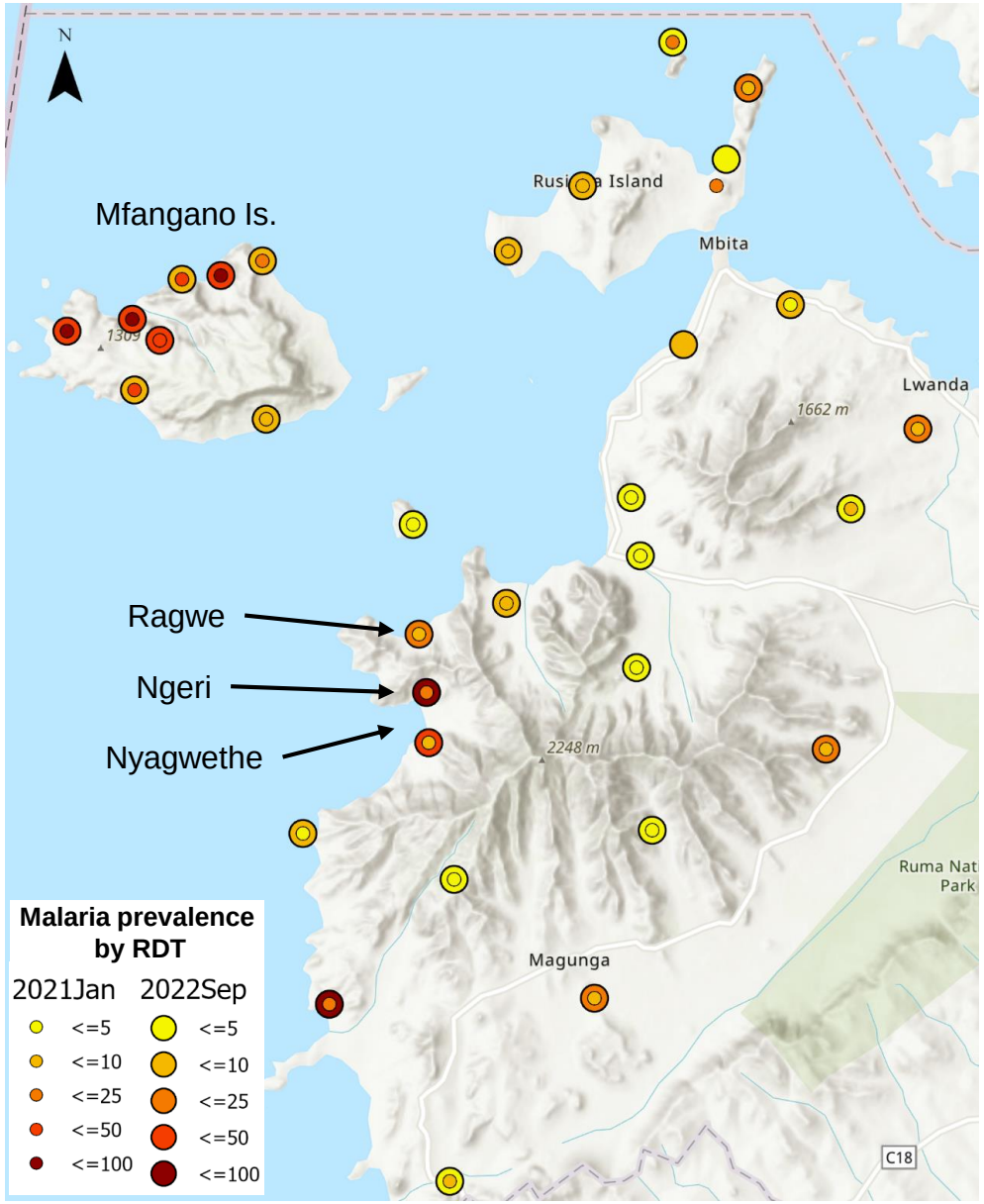
2018 PMI AIRS KENYA
END OF SPRAY REPORT

SPRAY CAMPAIGN: FEBRUARY 12 - MARCH 24, 2018

Epidemiology in the study area

- 2021Jan: low prevalence due to the IRS campaign (except islands)
- 2022 Sep: resurgence in some spots (suppression in Mfangano due to the ceiling net trial)
- Resurgence are mostly observed in historically high transmission spots





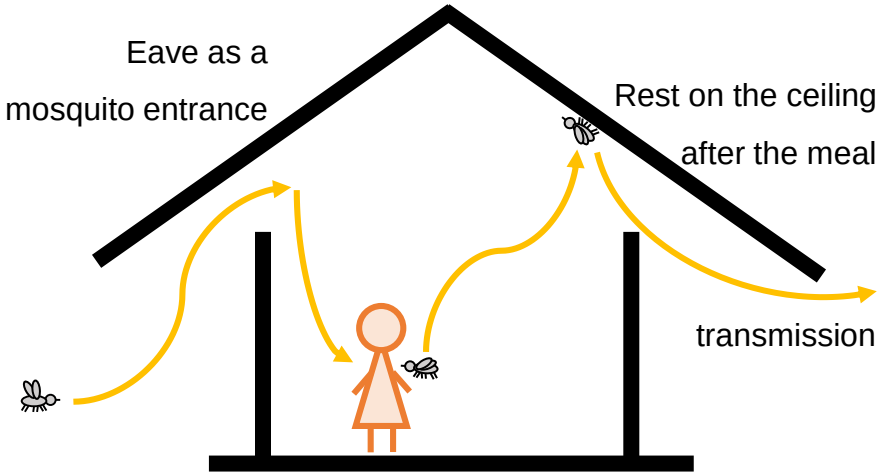
*Data for Mfangano are 2021Jan and 2022May.

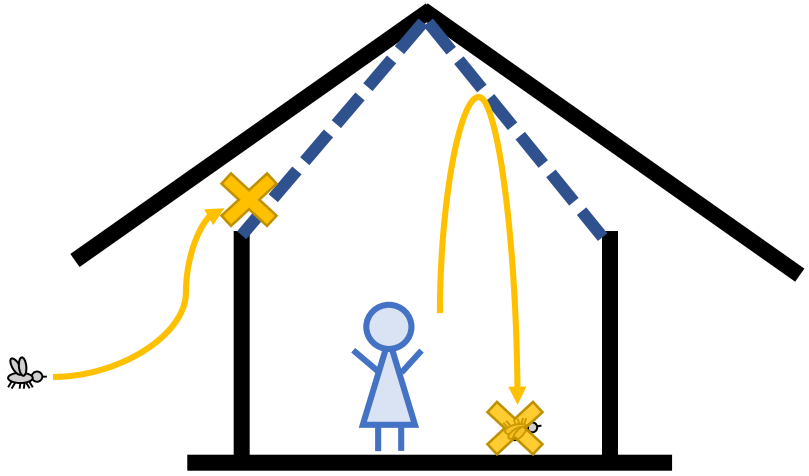
[Kagaya et al., unpublished]

Novel vector control: Olyset®Plus ceiling net

With
Minakawa-lab
Nekken

- A pilot study of ceiling nets on Ngodhe and Kibuogi Island (2019.9~)
- Proof the effectiveness of Olyset®Plus (Sumitomo Chem Co.) with pyrethroid+piperonylbutoxide (PBO) to counter pyrethroid resistant mosquitoes (Minakawa et al. 2021)
- On the top of the LLIN use distributed by NMC





- Protect (1) those who do not have/use nets
  (2) from early biting mosquito
- Stop the transmission

RCT of Olyset®Plus ceiling net on Mufangano Island

In Session 3
Wataru
Prof. Minakawa

Community engagement

Strategies aiming at behavioral changes to promote preventive measures

With
Matsumoto-lab
(Otaru Univ of Com.)
Nagi/Iwashita-lab
(Tokyo Women Med Univ)

Economic intervention (households)

- Knowledge enhancement on proper prevention measures
  - Modifying long-term cost recognition of malaria
- A conditional award if non-infection is proved
  - Incentive scheme to compensate the cost of prevention action

"Nudge to better self-protection"

Citizen science approach (communities)

- Cultivate a social capital in the communities
  - Positive peer effect = community prevention
  - Activate Community Health Volunteers (CHV)

Economic Intervention

- Incentivization for malaria prevention and early treatment
  - Conditional Cash Transfer (CCT): giving each individual Ksh 200 reward for those having the RDT negative in the follow-up
  - Lottery Incentive Scheme (LIS): giving each individual a lottery with a 10 % chance to win Ksh 2,000 reward for those with the RDT negative in the follow-up

Economic intervention in Suba south

In Session 4
Prof. Matsumoto

Community health volunteer (CHV)

Monitoring of the impacts of interventions

Cohorts in Mufangano and Suba south

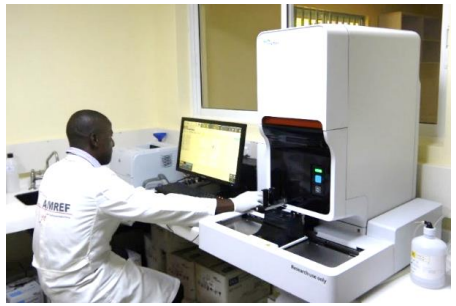
Center for Malaria Elimination
Homa Bay Hospital

- A field sample processing center has established
  - Malaria diagnosis with microscopy, PCR, Sysmex XN-31p
  - PBMC, iRBC, plasma, RNA isolation
  - Sample storage (4C, -20C, -80C, Liquid nitrogen)
- With 2 lab techs, power backup, stable water supply
- Accumulated the know-how on establishing the molecular biology grade lab in the limited setting
- Plan seminars to immense the knowledge of molecular biology to local staffs

Novel malaria diagnostics: Sysmex XN-31

- Evaluate the test performance in Homa Bay County Hospital
  - Finger-tip sampling from malaria-suspected patients
  - Compare with microscopy, RDT, and PCR
  - Stability with storage period and temperature

[Kagaya W, et al. 2020]



  - Applicability of the system on school mass survey
  - Build and test the sample transport and measurement system
  - Detect asymptomatic infections

- A potential tool for fever management in the clinical settings towards malaria elimination

Research Center for Malaria Elimination
Mount Kenya Univ.

In Session 4
Dr. Kanoi

- Advanced analysis of field samples
  - Genetics (Next Generation Sequence)
  - Serology (Multiplex)
- Omics study
- Field to bench, bench to field

- Platform for MSc/PhD students in Kenya to learn advanced skills in the lab

Jesse Gitaka
(PI in Kenya)
PhD in Nagasaki
>Head in MKU

Bernard Kanoi
PhD in Ehime
>PostDoc in Ehime
>EDCTP (EU grant)

Caroline Kijogi
PhD in Nagasaki
>EDCTP
>Tohoku Univ.

Mtakai Ngara
PhD in Karolinska Inst.
>VR (Swedish grant)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Community members
All staff and students
SATREPS
Kakenhi
VR
Hitachi Fund Support
Nikkei FT Communicable
Diseases Conference