PacMOSSI

Pacific Mosquito Surveillance Strengthening for Impact

ANNUAL REPORT 2022

Dear friends,

Welcome to our 2022 Annual Report.

In the face of the ongoing transmission of mosquito-borne diseases including dengue, malaria, Zika, and Chikungunya across the Pacific, we are proud of the depth and strength of the PacMOSSI consortium. In particular, we are heartened to see all the Pacific Island Countries (PICs) working together to build capacity to address these challenges. Our joint initiatives to mitigate the threat of mosquito-borne diseases across PICs have made important strides this year toward improved vector surveillance and control.

Vector control is an important tool to combat mosquito-borne diseases, but to work well, it must be tailored to suit local conditions. Through PacMOSSI, we are harnessing regional expertise to enable PICs to adapt their available tools to suit their local disease transmission situations. A key aim of PacMOSSI has been to build a successful and holistic program that supports capacity building in vector surveillance and control – from training through to supporting implementation of best practice and translation into policy. At the end of this project, vector control and surveillance officers in participating PICs will be better equipped with surveillance tools and the knowledge to implement recommended best practices.

We are proud of our achievements. To date, 19 countries have participated in the PacMOSSI program. During 2021, 18 countries completed PacMOSSI vector control needs assessments to define their existing capacity and critical gaps. This year, these assessments have directly informed development of national strategic plans for vector surveillance and control in 4 PICs. We have also launched the PacMOSSI online training course in vector surveillance and control. This free, self-paced course has now enrolled more than 300 participants from 19 PICs. To complement the online course, our team brought together Ministry of Health staff from 11 PICs for face-to-face training covering mosquito identification and insecticide resistance testing at QIMR Berghofer Medical Research Institute (QIMRB) in Brisbane. Another key area of work has been to strengthen the use of local vector surveillance data to improve decision making on vector control. Working in collaboration with Beyond Essential Systems (BES), we are supporting PICs to adopt digital data collection with purpose-built apps in Tupaia. In addition, pilot studies to explore the value of citizen science to inform vector surveillance have commenced in 1 country, and applications to conduct operational research from 4 PICs are currently being assessed.

We thank all of our supporters that have contributed to a fantastic 2022. Especially, the Australian Government Department of Foreign Affairs and Trade (DFAT) Indo-Pacific Centre for Health Security, the Agence Francaise de Developpement (AFD), the European Union (EU) and all of the institutions and individuals that have contributed to making PacMOSSI a success. The collaborative partnerships developed through the PacMOSSI program provide a strong foundation for continuing to enhance vector surveillance and control in the Pacific, and ultimately, improving the health of Pacific Islanders.

Warm regards,

PacMOSSI management team

Image credit: WHO/Jason Chute

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Program overview

Introduction

The PacMOSSI project is a regional partnership between Pacific Island countries and areas (PICs) and multiple international institutions working to combat mosquito-borne diseases throughout the Pacific. We focus on preventing current and emerging arboviral and parasitic diseases transmitted by *Aedes* and anopheline mosquitoes in PICs such as dengue, chikungunya, Zika virus disease and malaria. The project comprises a series of initiatives jointly coordinated by James Cook University (JCU), the World Health Organization (WHO) and the Pacific Community (SPC), with funding from the Australian and Fre nch governments and the European Union.

OUR PHILOSOHY is to empower Pacific Islanders to do more with their existing resources.

OUR GOAL is to support Pacific Island countries to strengthen vector surveillance and control to prevent, contain and control mosquito-borne diseases and to improve the health and well-being of Pacific communities.

THE ANTICIPATED OUTCOME is a reduction of vector-borne disease outbreaks and their burden throughout the Pacific through sustainable increased local capacity for informed prevention, containment and effective responses.

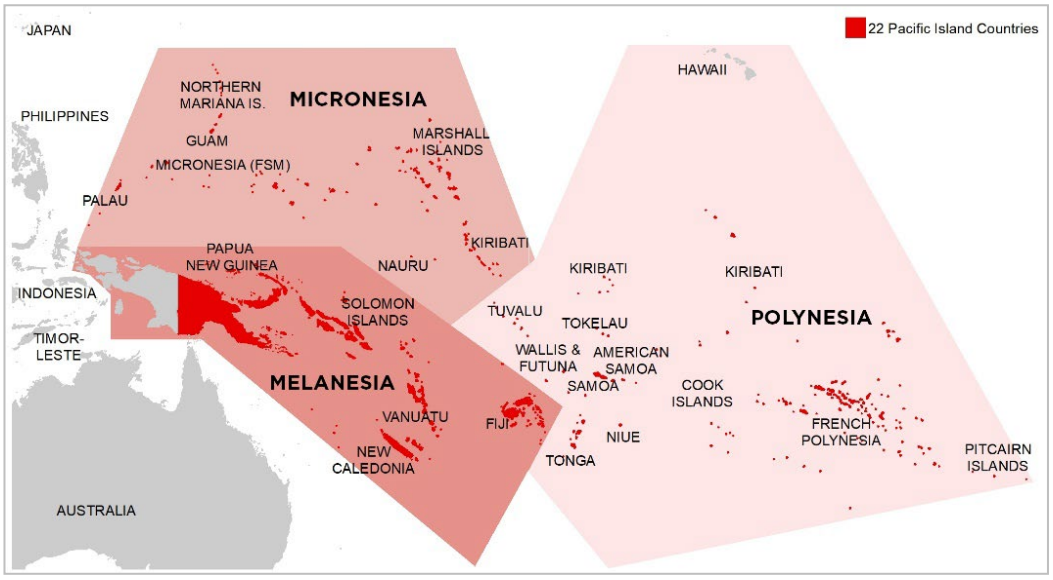
This annual report summarises the achievements of PacMOSSI during 2022. PacMOSSI was initiated in 2020, when the COVID-19 pandemic necessitated a radical shift in program implementation to produce a highly successful program that is tackling the limited capacity in vector surveillance and control throughout the region.

Image credits: Top: Adobe stock; Middle: Dr Tanya Russell; Bottom: WHO/Ranjith de Alwis

The problem of vector borne disease across Pacific Island Countries

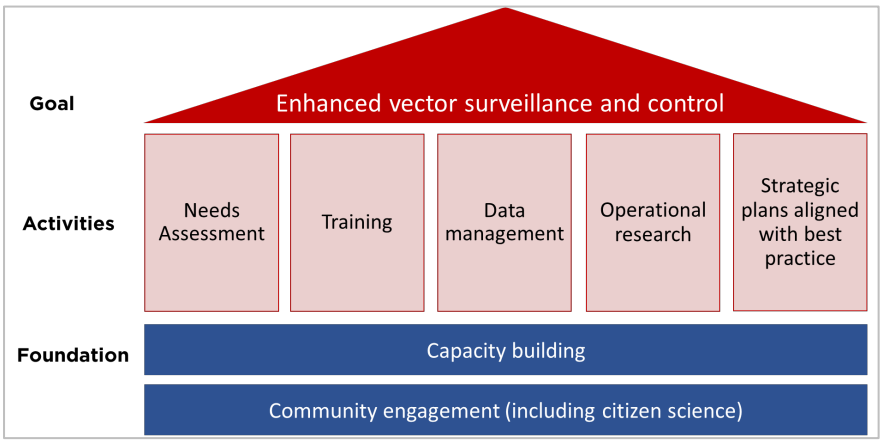
The Pacific is home to 11.4 million people residing in 22 countries and territories. Recently, the Pacific has experienced unprecedented outbreaks of dengue, chikungunya and Zika virus alongside ongoing malaria and lymphatic filariasis transmission with direct effects on morbidity and mortality. Further, there is likely ongoing Ross River virus circulation in many Pacific countries and Japanese encephalitis is endemic in Papua New Guinea. The ongoing transmission of mosquito-borne diseases places a heavy toll on already fragile health systems with flow-on economic and social repercussions.

Vector control interventions have one of the highest returns on investment in public health and are the primary method for controlling malaria and *Aedes*-borne arboviruses. Integrated vector and disease programs seek to ensure the limited resources prevent and control both the mosquito vectors and the pathogens. For vector control to be effective, surveillance and control of mosquitoes needs to be adapted to local conditions, aligned with best practices and implemented by well-trained staff with sufficient equipment and resources to ensure efficient preparedness, prevention, response and control of mosquito-borne disease threats.



PacMOSSI activities

The activities of PacMOSSI are designed to comprehensively build capacity across all aspects of vector surveillance and control to address the greatest needs of PICs. The PacMOSSI activities have been designed to all contribute to achieving the PacMOSSI program overarching goal.



The capacity of PIC vector-borne disease control programs

During 2021, the PacMOSSI consortium developed and deployed a Vector Control Needs Assessment (VCNA) specifically for PICs to identify focus areas in which to build capacity for mosquito surveillance and control. Eighteen countries completed VCNAs.

Across the region, substantial variation in the capacity and capability of vector surveillance and control programs was found. A common underlying programmatic limitation was the absence of up-to-date strategic plans for vector surveillance as a framework for decision-making. There was a wide variation in the surveillance and control activities being implemented by PICs, ranging from ad hoc activities employing traditional vector control approaches to use of more advanced technologies such as *Wolbachia*-based biocontrol for *Aedes*.

Across the region, countries also reported lacking well-trained staff, equipment, supplies, effective data management, and operational research. However, one strength that was identified across several countries was the regular engagement of the community in vector surveillance and control activities. This represents an opportunity to leverage community participation to upscale existing and new approaches to strengthen surveillance and control.

During 2022, the findings of these VCNAs were used to inform new or updated strategies to strengthen vector surveillance and control approaches, discussed further on page 12. A detailed report summarising broad regional trends identified through the VCNAs is also in preparation.

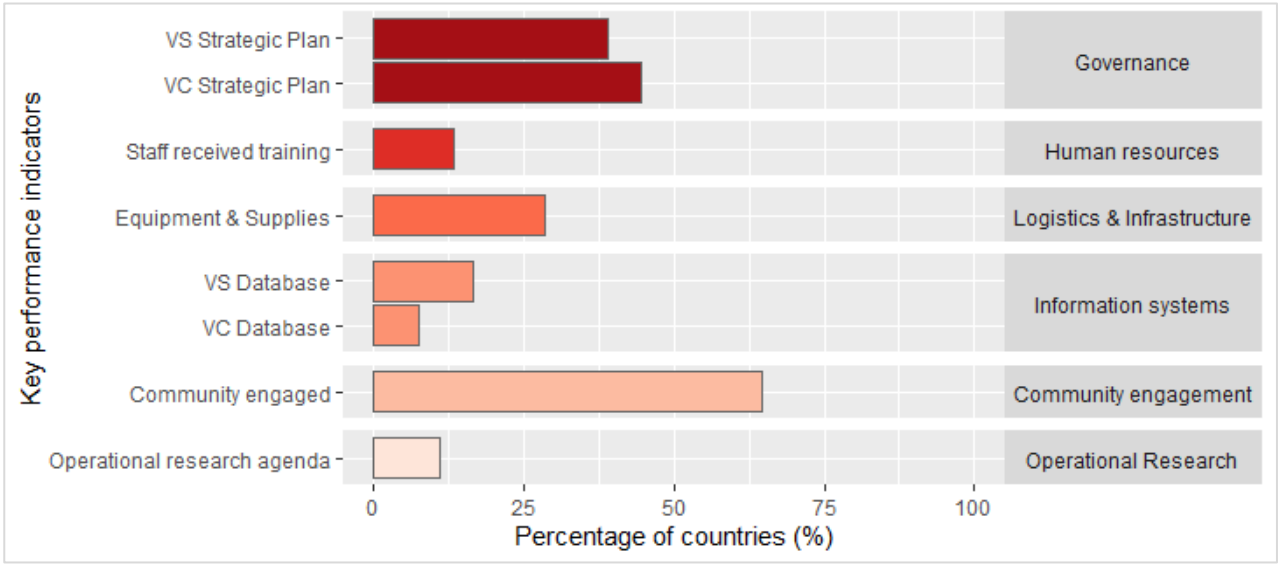


Figure: The capacity of vector surveillance and control programs targeting *Aedes* species assessed against key performance indicators for program health. Percentages were calculated using the number of countries that reported against the indicator as the denominator and the percentage of countries with sufficient capacity as the numerator.

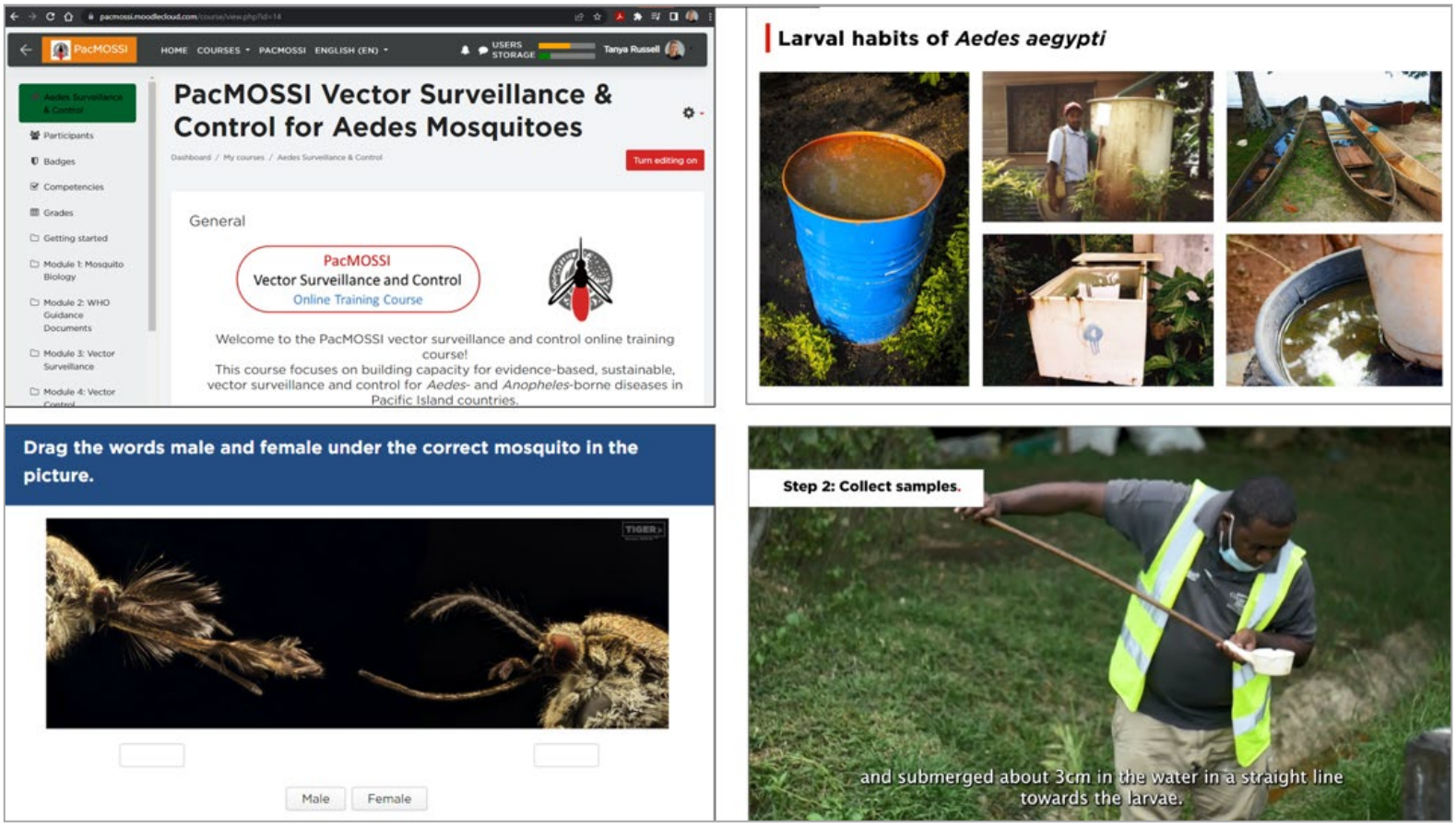
Training programs for vector surveillance and control staff

Online training course

The PacMOSSI online training course in vector surveillance and control was successfully launched in 2022. The course is comprised of 8 fully online, self-paced learning modules (7 of which are completed and available). The training course is tailored to suit the job role and training needs of each participant. Enrolment is freely available to everyone.

The training modules are highly innovative and visual and include case studies, readings, quizzes, videos and animations to help students achieve the learning outcomes (examples shown below). The modules are published online in the Moodle learning management system (LMS) administered by the PacMOSSI management committee. Once enrolled, students have ongoing access to the course to participate in forums and to access reference materials.

The primary audience for the course is Ministry of Health (MoH) operational and managerial staff in PICs; however, the training is also being accessed by other individuals seeking to upskill in vector surveillance and control. Since March 2022, 416 participants from Oceania, Africa, Americas, Asia, Europe, and Middle East enrolled.



Images: Examples of the online vector surveillance and control training course.

Practical training workshops

A face-to-face vector surveillance workshop was held for two groups of students in the Mosquito Control Laboratory at QIMR Berghofer Medical Research Institute (QIMRB) in Brisbane – in September and October 2022. The content covered procedures to test mosquitoes for insecticide resistance, to assess vector control product efficacy and to identify mosquitoes by microscopy. Specifically, participants learned how to perform:

1. Basics of *Ae. aegypti* colony maintenance
2. Insecticide resistance assays on adult mosquitoes (e.g., WHO Tube Test and CDC Bottle Bioassay)
3. Insecticide resistance assays on mosquito larvae (e.g., larval bioassays)
4. Product efficacy test on adults (e.g., cone test for residual efficacy of insecticides)
5. Reporting and analysis of assay results (use of Abbots correction factor, etc)
6. A basic introduction to the taxonomic identification of mosquitoes

The course brought together participants from 11 Pacific Island Countries, and instructors from QIMRB and Queensland Health. Consortium members from SPC and WHO also attended.

Images: Photographs taken during the practical training workshops.

Enhancing responses to vector-borne disease outbreaks

To directly support capacity building for outbreak responses, a regional stockpile of emergency supplies for vector-borne disease outbreaks has been established in Suva, Fiji. The regional stockpile includes items such as insecticides and personal protective equipment (PPE) for vector control and aims to facilitate more timely dispersal of vector control products in the event of an outbreak. The stockpile is managed by the World Health Organization, Division of Pacific Technical Support.

The strength of this approach was demonstrated when stocks were deployed to the Cook Islands in response to the 2021 dengue outbreak (shown below). Rapid diagnostic test kits for dengue were also provided to both Cook Islands and Vanuatu in 2021, and an additional supply was also sent to Vanuatu during 2022. Following the recent in-person training on insecticide resistance testing, WHO has also procured insecticide resistance test kits for all PICs – to be delivered to countries in early 2023.

Photo: The Acting Australian High Commissioner to the Cook Islands, Jane Edquist hands over PPE gear to Te Marae Ora Secretary of Health, Bob Williams and Public Health staff (Source: Cook Island New).

Citizen science

During 2022, pilot studies have commenced exploring the feasibility of a community participation-based model of *Aedes* mosquito surveillance known as 'citizen science'. The citizen science model engages members of the public to make and set simple mosquito traps and then send the gathered information to health authorities to be analysed. This work package has been developed by collaborators at University of New South Wales (UNSW) and the University of Queensland (UQ). A *PacMOSSI Ovitrap Analysis* digital data collection form was drafted to capture key components of this Citizen Science activity that includes mosquito egg trapping, larvae rearing, and mosquito identification, and was programmed into Tupaia by BES.

The citizen science demonstration has successfully commenced in the Solomon Islands being led by the Ministry of Health and Medical Services (MHMS) and the Solomon Islands National University. High school students were engaged as citizen scientists as part of their capstone projects, and there are plans to integrate this into the ongoing high school curriculum. As a result, data will be sustainably collected every six months from sites across the country.

Plans are underway to roll out citizen science to both Fiji and Tuvalu, and implementation plans have been developed. In Fiji, the MHMS will collaborate with a Non-Government Organization to pilot school- and health-centre based citizen science. A launch event to promote the project was held on World Mosquito Day in August 2022. In Tuvalu, the MOH will collaborate with the Red Cross to undertake surveillance of vector presence/absence on remote outer islands.

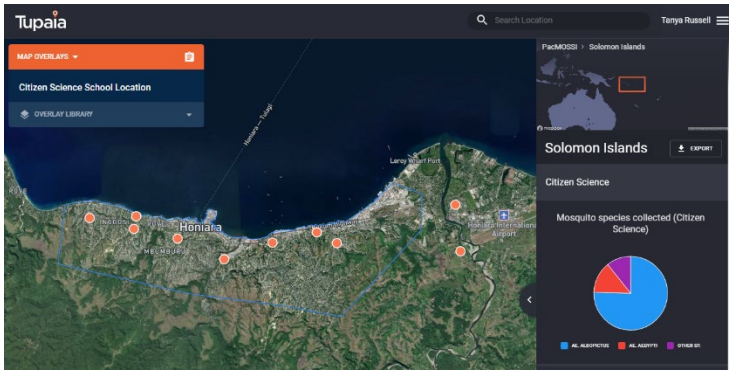


Image sources: Top left: Hugo Bugoro, Solomon Islands National University; Top right: WHO/Jason Chute; Bottom: Tupaia citizen science dashboard.

Improved data management and use

One of the key opportunities to improve vector control is through support for information communication technologies to record, analyse and present essential data for program management decisions. In collaboration with BES, the capacity of MoHs to manage and analyse data is being directly improved, with the establishment of a national entomological database and integration of vector surveillance systems into broader health information systems.

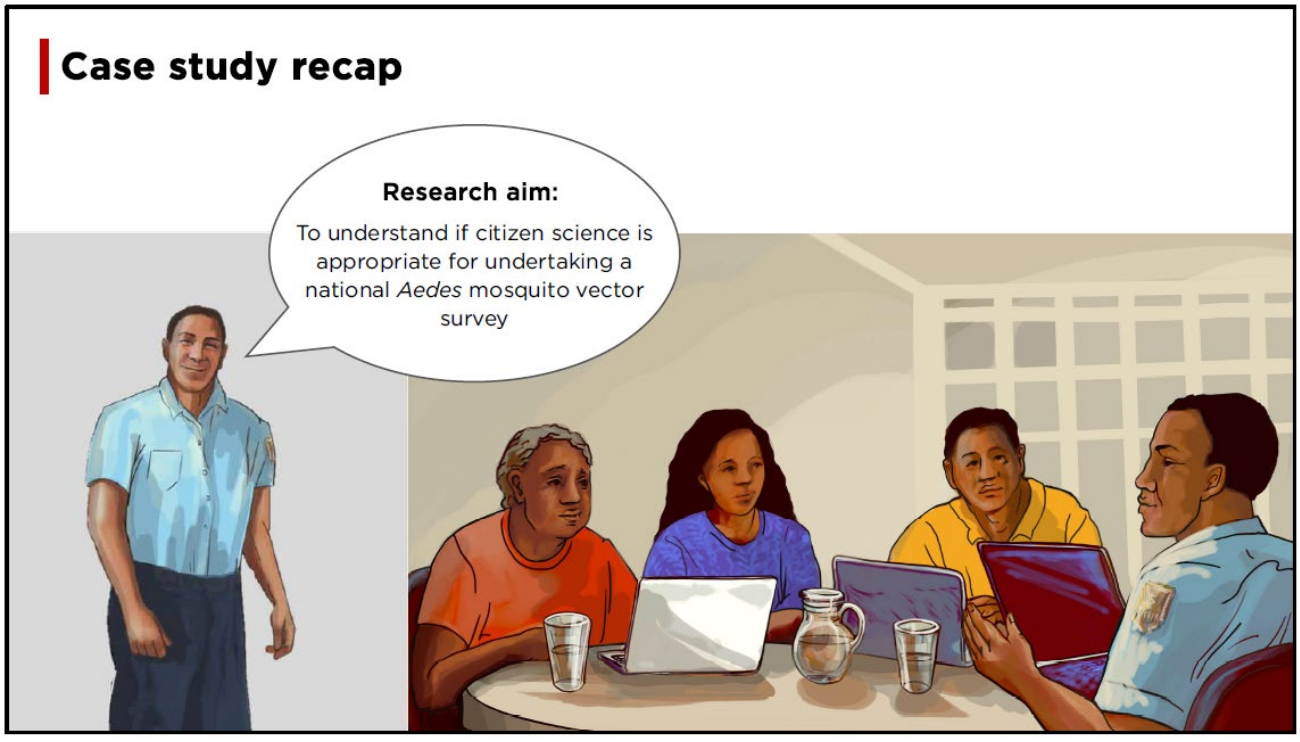
BES have developed a standardised set of vector surveillance digital data collection forms within the Tupaia Meditrak platform. With input from in-country vector surveillance personnel, BES tailors the fields included in the data collection forms to suit each countries' needs. The forms allow collection of data on adult mosquito and larval surveillance, as well as data generated from assays to rest insecticide resistance of mosquitoes and monitoring of insecticide product efficacy. Face-to-face training sessions on data collection with Tupaia Meditrak were conducted in Palau and Samoa in the first quarter of 2022, and an online training session was provided to Fiji Ministry of Health staff in Q3 of 2022. The electronic data management tools have been successfully deployed in these three countries, with discussions underway with additional countries who have expressed interest.

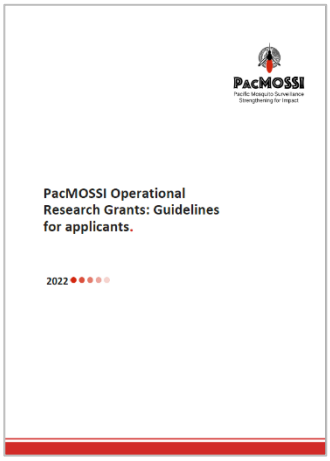
Image source: Tupaia vector surveillance dashboard.

Supporting country-led operational research

PacMOSSI has launched an operational research scheme with the aim of strengthening the operational research capacity of PICs – and gathering data to address priority information gaps. The goal is to facilitate research in response to national operational and implementation challenges to the effective and efficient delivery of mosquito-borne disease surveillance and control programs.

Resources to roll out the Operational Research Small Grants Scheme were developed and launched during 2022, including downloadable guidelines for PacMOSSI Operational Research Small Grant applicants and a portal for proposal submission. The applications for the first round of funding have closed, and we are assessing 4 exciting country-led proposals. A call for an additional round of proposals will open in the first quarter of 2023.





Images: Top: Examples of the case study developed for the training material on operational research. Bottom: Guidelines for applicants to apply for operational research grants.

Alignment of country strategic plans with best practice

To ensure that countries are best equipped to tackle mosquito-borne disease threats, national strategic plans are required to provide a framework for effective vector surveillance and control. The PacMOSSI Strategic Planning consultancy team based at JCU is working directly with interested countries to review existing strategic plans or develop new plans, to ensure alignment with recommended WHO best practice. This activity will directly support implementation of best practices for vector surveillance and control, and may result in policy uptake by governments of PICs.

In April 2022, the PacMOSSI team held a regional virtual Strategic Planning workshop was held with PIC representatives to give an overview of the process to review and develop national vector surveillance and control plans, and the support available through PacMOSSI. Representatives of 14 PICs attended the workshop. The workshop familiarized participants with the latest regional guidance to support strategic planning, including the *Framework for national surveillance and control plans for Aedes vectors in the Pacific* (soon to be released by WHO) and the *Manual for surveillance and control of Aedes vectors in the Pacific* (Pacific Community, WHO Division of Pacific Technical Support, 2020). An overview of key considerations for strategic planning were presented and discussed in break out sessions. The discussion was also informed by common issues identified in the vector control needs assessments.

Following the workshop, individualised technical support for national planning has been provided to Samoa, American Samoa, Tonga, Vanuatu, Papua New Guinea and Fiji. The level of support provided was based on country request, with more intensive support provided to countries who wished to develop new strategies from scratch. As part of this work, in-country visits by JCU and/or WHO in Samoa, Tonga and Fiji have been completed. For Samoa, an initial draft strategic plan has been completed. In the other countries, discussions to further refine these national strategies, and tailor them to specific needs of each country are underway, with updated drafts of national plans expected to be completed in the first half of 2023.

Image: In country visit by PacMOSSI to Samoa to meet with the Ministry of Health.

Sustainability of our approach

One of the greatest challenges underpinning vector surveillance and control across the Pacific is a lack of vector control capacity and capability. PacMOSSI is focused on providing a form of capacity building that is sustainable, ongoing and with long lasting impacts through a multilayered and multidisciplinary approach. Traditional capacity building covers a range of topics irrespective of the experience or needs of the country. PacMOSSI has engaged with the PICs to understand capacity gaps and allowed the program to flexibly respond to their identified needs – whether those needs be related to training, strategic planning and/or provision of supplies and equipment. Further, the VCNA tool used has been carefully developed to enable the tracking of progress over years to come.

PacMOSSI takes a regional approach to address the needs of PICs, which aligns with the relatively limited capacity and small populations served in many small island nations. PacMOSSI has also catalysed the establishment of a network of vector surveillance and control officers across the region that will facilitate opportunities for regional information exchange. In addition, through support from PacMOSSI, WHO has launched a regional stockpile of insecticides and PPE to enable preparedness to rapidly respond to outbreaks that may occur in future.

Prior to the implementation of PacMOSSI, the MoH vector control staff from PICs did not have access to standardised, quality vector control training. Opportunities for face-to-face training were often cost prohibitive or irregular. The development of the online training course has provided a sustainable alternative to reach a large number of participants across the region,and enables staff to complete the training at their own pace, around work commitments. All of the training resources are open access, meaning that they are free of charge to the participants, and can be reused or adapted for future training programs, as well as supporting the face-to-face workshops.

Vector surveillance across the PICs is limited by the need for intensive human resources and expensive travel in remote locations. PacMOSSI is piloting an innovative solution by engaging the community to directly support vector surveillance activities through its citizen science approach. For example, the Solomon Islands have demonstrated the potential of embedding citizen science in the curriculum of high school students, enabling sustainable and ongoing collection of vector distributions each year.

A huge inefficacy in vector surveillance occurs when the data is not analysed and reported in a timely manner for decision makers. To this end, BES has developed software that integrates with the existing health information systems, without the development of a parallel system. This approach is more sustainable as capacity to utilise the data management system is built up across the MoH and data can be easily shared within departments, with a long-term view to continuing use of the system.

The sustainability of our approach is embedded in supporting countries to lead the development of their own long-term strategic plans that outline the key priorities and activities for vector surveillance and control. A country-led vector surveillance and control plan will enable proactive steps to minimize transmission risk, to prevent or contain incursions of introduced mosquitoes, to engage the community to transition from a vertical to a more horizontal program, and to enable effective planning and response based on local data. This will ensure deep and lasting transformations are made through strategic planning that will facilitate policy reform.

Achievements

Meetings and presentations

The PacMOSSI Inception meeting was held on 23 March, 2022. The virtual meeting provided opportunities for interactive feedback and discussions. The meeting brought together staff working in vector surveillance and control across the Pacific region.

A paper on PacMOSSI was presented at the American Society of Tropical Health and Medicine in Seattle, in October 2022.

Needs assessment

The needs assessment was successfully deployed and individual country reports were returned by 18 countries. These reports identified critical areas on which annual work plans for each country should focus, and also informed regional priorities for training and capacity building.

Training programs for vector surveillance and control staff

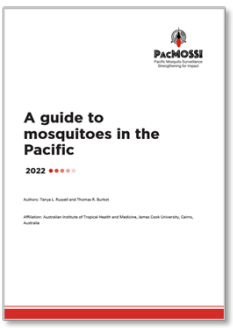
An innovative and engaging online training course in vector surveillance and control was developed, and launched with 7 of 8 learning modules. Over 300 participants from Oceania (including Australia) have enrolled. Since March 2022, 416 participants from Oceania, Africa, Americas, Asia, Europe, and Middle East enrolled. The required suite of learning content is available for some of the streams and 22 participants have completed the course.

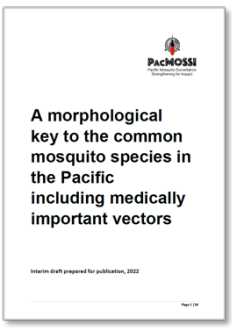
A face-to-face vector surveillance workshop covering insecticide resistance, product efficacy and mosquito identification was held in the Mosquito Laboratory at QIMR Berghofer Medical Research, Institute (QIMRB) in Brisbane. The course brought together participants from 11 Pacific Island Countries, and instructors from QIMRB and Queensland Health.

A series standard operating procedures were developed to support vector surveillance and control operations in PICs. All standard operating procedures are openly available via the PacMOSSI website.

Other key resources that have been drafted are:

- A guide to mosquitoes in the Pacific
- A morphological key to the common mosquito species in the Pacific including medically important vectors





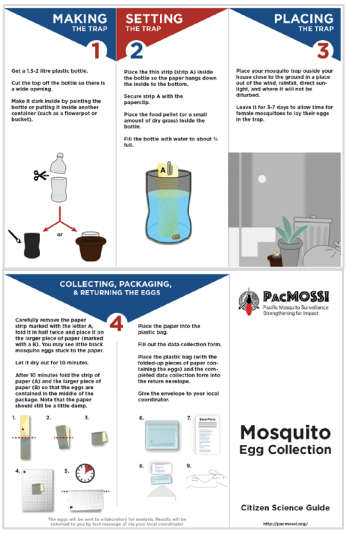
Enhancing responses to vector disease outbreaks

Supplies to enable rapid response to vector-borne disease outbreaks in PICs are now available in a stockpile maintained by WHO in Fiji.

Citizen science

The citizen science pilot study has successfully commenced in the Solomon Islands. By embedding the project in the high school curriculum data will be sustainably collected every six months from sites across the country. Fiji is in the early stages of launching its own citizen science project, focusing on engaging primary schools and health centres to expand mosquito surveillance and raise community awareness.

To support the citizen science project a series of handouts, an explanatory video and a data collection app in Tupaia were developed.



Data management

Development of a standardised set of Tupaia Meditrak PacMOSSI vector surveillance digital data collection forms, covering adult mosquito collection, larval surveillance, testing insecticide resistance and monitoring product efficacy.

The Tupaia Meditrak forms have been successfully deployed to Palau and Samoa for vector surveillance, and to the Solomon Islands and for citizen science.

Operational Research

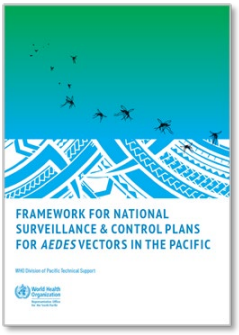
Resources for the development of operational research grants were developed and the first call for country-led applications was launched. Applications were received from 4 countries outlining exciting operational research projects that will directly address the identified needs of the country.

Country strategic plans

The *Framework for national surveillance and control plans for Aedes vectors in the Pacific* was developed, and is a key resource supporting the updating of strategic planning.

A regional strategic planning workshop was conducted with representatives of 14 PICs during April 2022.

For Samoa, an initial draft strategic plan has been completed. This involved extensive consultation with multiple partners across a series of zoom calls and an in-country visit. The Samoan MoH aim to launch the updated strategic plan in February 2023.



Individualised technical support has also been provided to Tonga, Vanuatu, Papua New Guinea and Fiji. Including face-to-face meetings in Tonga and Fiji. Drafting of the strategic plans will continue into 2023.

Project implementation

Pacific Island Countries

American Samoa | Cook Islands | Fiji | French Polynesia | Guam

Kiribati | Marshall Island | Federated States of Micronesia | Nauru | New Caledonia

Niue | Northern Mariana Islands | Palau | Papua New Guinea | Samoa

Solomon Islands | Tokelau | Tonga | Tuvalu | Vanuatu

Wallis & Futuna

Institutional partners

James Cook University Australia

World Health Organization

Pacific Community Communauté du Pacifique

Beyond Essential Systems

QIMR Berghofer Medical Research Institute

APMEN asia pacific malaria elimination network

Queensland Government Queensland Health

the power of humanity – Australian Red Cross

Australian Defence Force Malaria and Infectious Disease Institute

Burnet Institute Medical Research. Practical Action.

UNSW Australia

The University of Newcastle Australia

PNGIMR Papua New Guinea Institute of Medical Research

The University Of Queensland Australia

Donors

Australian Government | Indo-Pacific Centre for Health Security

AFD Agence Française de Développement

European Union

Cross-cutting issues

Gender

Participants undertaking the PacMOSSI training course includes individuals that manage vector programmes, technical vector control specialists, data management officers and health communication officers. The transition from face-to-face instruction to virtual and interactive online learning makes access to training more expansive and accessible to all, regardless of gender, disability status or position/responsibility in vector surveillance and control programs. Overall, 59% of registrants from the Pacific region were female. Of 241 trainees who have completed Modules 1, 2 and 3, 161 are female (66.8%).

The vector surveillance face to face training course held at QIMRB in September and October called for one nomination from each Pacific Island country, with the objective of that person returning to their respective country and sharing the knowledge they gained from the training. Of the 12 trainees, seven were female and five were male. There remains a relatively equal gender balance amongst the project staff.

Disability Inclusion

Vision and hearing impared – all online resources are "accessible". Accessible documents can be read by screen readers. Further, the narration and slide content are available in a large font size. Training is available to physically disabled people.

Inclusion for data management apps – low contrast colours are used during app design. The data collection apps are available for use by physically disabled people.

Strategic plans – gender and disability inclusion are integral cross-cutting issues included when updating country strategic plans with different pathways for inclusion highlighted in the strategic planning workshops.

Climate Responsiveness

Mosquito borne diseases are impacted by both climate (temperature and rainfall are key drivers of mosquito vector population dynamics) and associated national disasters in which protection from mosquitoes is diminished by housing degradation coupled with mosquito populations often increasing. Climate change increases the frequency and severity of extreme weather events, which may increase the frequency and severity of mosquito borne disease outbreaks. Emergency responses to national disasters inform the core of the operational priorities and vector control modules. The updated country surveillance and control plans being developed includes guidance on vector surveillance and control in response to climate change and natural disasters.

PacMOSSI

Pacific Mosquito Surveillance Strengthening for Impact

www.pacmossi.org