

# **MOZZIE MONITORS**

## Mozzie Month Technical Report

Mozzie Month 1st edition Feb-Mar 2021



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**Partners** 



Government of Western Australia Department of Health

University of South Australia



## **Executive Summary**

Mozzie Monitors is the first citizen science program globally that engages the public in adult mosquito monitoring using fixed-point mosquito trapping (BG-GAT traps). The program was launched in 2018 in South Australia and is gradually upscaling to other states. The Mozzie Month intervention aimed to upscale the local trials and establish an annual, national and sustainable mosquito surveillance program through a citizen science approach. This first intervention recruited 102 participants from five states, resulting in 148 photo submissions of 1025 mosquitoes. Eight species were identified and no invasive species detected. First outcomes reveal that Mozzie Month contributed to Aedes notoscriptus and Culex quinquefasciatus population data mainly - these species comprised 46% of total mosquitoes collected. Other species identified combined Aedes vigilax, Aedes camptorryhchus, Anopheles annulipes, Culex annulirostris, Culex sitiens and Toxorynchites speciosus. Still, 51% of the catches collected included non-identified species belonging to the genus Aedes and Culex, males and indeterminate. Mozzie Month provided an opportunity to greatly expand the geographic coverage of Mozzie Monitors. In addition, the use of accessible technology, such as smartphones, allowed remote participation.





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## **MOZZIE MONITORS**

Mozzie Month is a national citizen science initiative to monitor mosquitoes across Australia from February to March.



Aedes notoscriptus



Culex quinquefasciatus Toxorrhynchites speciosus



Ants, wasps, midges, spiders.

Mozzie Monitors acknowledges our partners:





Government of Western Australia Department of Health

Ae vigilax

- Citizen scientists can capture mosquitoes and assist researchers from their backvards
  - remotely and at a low cost
  - Mosquitoes of ecological and medical importance
- No invasive species were detected in the first trial!

MORE INFO ON MOZZIEMONITORS.COM



## **Citizen Science Mosquito Surveillance**

Citizen science projects applied to surveillance of vector mosquitoes are still recent and have been growing in different countries. These programs could assist local authorities in monitoring the abundance and diversity of endemic mosquitoes and detecting exotic mosquitoes (Palmer et al., 2017).

Mozzie Monitors is the first citizen science program in the world that engages public participation in mosquito monitoring using fixed-point mosquito trapping. The program was launched in 2018 in South Australia, aiming to increase scientific knowledge on mosquito populations in Australia, raise awareness of mosquito-borne diseases, and answer specific questions regarding the feasibility of citizen science mosquito surveillance (Braz Sousa et al., 2020).

Since its establishing year, Mozzie Monitors has proven comparable to traditional professional methods to monitor mosquitoes, in terms of abundance and species diversity. The program has collected over 14,000 mosquitoes from 15 different species so far and engaged more than 200 people in Australia.

As a citizen science initiative, it benefits researchers and the community and overcomes logistical and spatial barriers. This way, the Mozzie Monitors program could have the potential to assist local health authorities in Australia to monitor mosquitoes of medical importance.

## Mosquito fauna and mosquitoes of medical importance

There are over 3,500 mosquito species described with about 300 species known to occur in Australia. Besides being associated with infectious diseases, they also play crucial ecological roles. Mosquitoes provide essential biomass in the food chain and feeding



invertebrate predators, birds, reptiles and amphibians. They also play a role as pollinators of some plants. Some species hunt other mosquito's larvae, acting as biological control of vector species.

In terms of public health impact, mosquitoes can play a role in transmitting a variety of pathogens, including either parasites or viruses. These mosquitoes are referred to as vectors, as they transmit pathogens from one infected animal or person to others. Dengue, malaria, chikungunya fever, Zika virus fever, yellow fever, West Nile fever, and Japanese encephalitis are among the most common and well-known mosquito-borne diseases globally. These diseases affect millions of people every year. Malaria is responsible for almost half a million deaths annually, and most of the deaths are among children under the age of 5. Dengue is the most prevalent disease globally, where it is estimated that about 4 billion people are at risk of contracting the disease. Also, over 100 million are infected every year.

In Australia, the most common infectionss transmitted by mosquitoes are Ross River Virus and Barmah Forest Virus. Dengue is transmitted in central and far north Queensland, and the mosquito *Aedes aegypti*, which transmits the virus from one infected person to others through bites, is established in the top end of the state. *Aedes albopictus*, which is also a vector of dengue fever, is present in the Torres Strait Islands.

Mosquito-borne diseases are preventable by controlling and/or eradicating the vector mosquitoes. in an effort to gather more surveillance information, several programs are utilizing citizen science as a tool to monitor mosquitoes and mobilise communities at the same time. Mosquito Alert in Spain, Muckenatlas in Germany and Globe Observer in the US are some examples of well-established citizen science programs where participants share observations of mosquitoes and help researcher identify the occurrence of species and breeding sites.



In Australia, Zika Mozzie Seeker (ZMS) and Mozzie Monitors are emerging and growing citizen science mosquito monitoring initiatives. ZMS focuses on mosquito egg collection, whereas Mozzie Monitors focuses on adult mosquitoes. Both programs have been successful in monitoring mosquito distribution through partnership with citizen scientists.

## Citizen Science and the Global Vector Control Response

The World Health Organisation has set some goals to tackle vector-borne diseases.

That is a strategic plan, named the Global Vector Control Response, to be implemented from

2017-30. This response prioritises 4 pillars of action:

- Strengthen inter- and intra-sectoral action and collaboration
- Mobilise communities
- Enhance vector surveillance, and monitoring and evaluation of interventions



• Scale up and integrate tools and approaches

Figure 1. Framework showing the 4 pillars of action to reduce mortality caused by vectorborne diseases.



As a citizen science program, Mozzie Monitors goals align with the Global Vector Control Response. The program focuses on strengthening partnerships with other citizen science and vector control programs in Australia, engaging communities in active mosquito surveillance, enhancing program capacity and innovation and finally scaling up. Mozzie Monitors has proven effective to engage communities in mosquito monitoring through a hands-on approach in local areas. In this new phase, the program is upscaling the network of citizen scientists to a national approach. To address the four pillars of actions stated by the World Health Organisation, the Mozzie Month initiative was launched, aiming to support the development of methods and resources to enhance the existing Mozzie Monitors program.

## **Mozzie Month**

Aiming to assess the likelihood of upscaling Mozzie Monitors from local trials to a national implementation, the UniSA team organised the first edition of Mozzie Month. As a first approach, the intervention was developed in 5 different regions in Australia simultaneously, during the peak season of mosquitoes in February/March. Mozzie Month aimed to answer questions about feasibility, sustainability, biosecurity, and governance. It was a six-week intensive citizen science mosquito surveillance initiative using the BG-GAT trap.

### **Objectives**

The *Mozzie Month* intervention aims to identify the feasibility of launching a citizen science mosquito surveillance program as a national strategy for monitoring vector mosquitoes.

The program specifically aims to:



- Identify the possibility of upscaling and sustainability of the existing *Mozzie Monitors* trials as a regular and large-scale program;
- Identify participants interests, involvement, reliability in a citizen science mosquito surveillance program;
- Identify the challenges and opportunities in developing a national plan for effective community engagement and mobilisation in mosquito monitoring;
- Assess the likelihood of building on existing collaboration across different sectors, including members of the community, researchers, public health agents and authorities, and policy makers;
- Evaluate if the increased data on mosquito populations can be translatable to improved public health policy and practice;
- Assess the feasibility of collecting *Ae. aegypti* and *Ae. albopictus* in established places in Australia;
- Identify challenges to establish an annual program from intervention to implementation.

## Methods

Citizen scientists participated from New South Wales, Northern Territory, Queensland, South Australia, and Western Australia. Recruitment was made through social media (Facebook, Instagram and Twitter) and mainstream media campaigns (radio interviews), as well as through local partners in the respective states. Partners included the Australian citizen science program Zika Mozzie Seeker, the HOT North program (NHMRC funded and led by Menzies School of Health Research), and individual partners as Grace



Maglio in north WA, Cameron Webb in NSW, Adam Craig in NSW. These partners contacted their local network and circulated invitational emails in their institutions. The interested people registered through a link and were provided with an information sheet and consent form, as this trial was approved by the University of South Australia Human Research Ethics Committee (Ethics approval [202266]).

The participants were given a mozzie kit, containing a BG-GAT trap, instructions to assemble the trap, a laminated blue card to place the mosquitoes and take the photos (the 'Tip Card'), an informative brochure and guidelines on how to participate, and the 10 principles of citizen science, adopted by the Australian Citizen Science Association. The BG-GAT trap was chosen for this trial as it was proved effective in collecting container breeding mosquitoes in previous trials (Bazin & Williams, 2018; Braz Sousa et al., 2020), it is a low-cost trap compared to others, it is easily operated, and it does not need a power supply. This passive trap attracts female mosquitoes that are seeking a place to lay their eggs; it imitates a breeding site (https://eu.biogents.com/bg-gat/).

One hundred citizen scientists registered to participate in this intervention. The mozzie kits were shipped to their preferred addresses; participants were asked to set up the traps and to collect the mosquitoes every fortnight, on a specific "Tip Day", over six weeks. A reminder was sent before each Tip Day, comprising three sets of data collection.

During Mozzie Month, participants followed the below steps (Figure 2):

- 1. Set up the BG-GAT trap in their backyards (between 12<sup>th</sup> and 24<sup>th</sup> February\*);
- 2. Managed the trap once every fortnight, during the "Tip Days";
- 3. Collected the trapped mosquitoes;
- 4. Placed them on the laminated tip card;



- 5. Used the pattern within the circle to focus their shot;
- 6. Emailed the photos to the researchers at the UniSA, for counting and identification (between 27<sup>th</sup> March and 18<sup>th</sup> April\*). People were instructed to report 'no mosquitoes', if there was no catch in that specific period.

\* start and end dates varied in up two weeks depending on the locations and delays regarded mosquito kit shipping.



Figure 2. Steps 1-6 illustrating the methods during Mozzie Month.

## **Placing the traps**

Participants received advice to place the traps in a shaded place in their backyards,

protected from extreme wind and sun exposure. Example locations are shown in Figure 3.



Figure 3. BG-GAT traps placed in the Mozzie Monitors' backyards.



South Australia

#### **Results**

From February 21st to April 18th, Mozzie Monitors collected 1,025 mosquitoes resulting in 148 photo submissions. Researchers at UniSA counted and identified the species through digital images, and eight species were identified through the photos submitted, including species of ecological and medical importance. Typical examples of collection photographs are shown in Figure 5.

Amongst the 100 registered participants, 69 people actively participated throughout the six-week period, submitting at least one photo (or reporting 'no mosquitos'). Overall, 21 people contributed with one submission each, 23 people contributed with two submissions and 25 people contributed with three (Figure 4).



Participants submissions over six weeks

Figure 4. Graph showing number of people contributing with 1, 2 and 3 submissions over the period of data collection.

The most common species captured were Aedes notoscritpus and Culex quinquefasciatus, representing 46% of total mosquitoes collected (Figure 5). They are both common urban mosquitoes and occur in every state in Australia. Ae. notoscriptus can play a role in the transmission of Ross River Virus, Barmah Forest and Dog Heartworm.



Although *Cx. quinquefasciatus* is able to carry the Murray Valley encephalitis virus, this mosquito is not an effective vector of diseases in Australia, but it is a significant nuisance pest.

Other species identified combined *Aedes vigilax*, *Aedes camptorryhchus*, *Anopheles annulipes*, *Culex annulirostris*, *Culex sitiens* and *Toxorynchites speciosus*. Still, 51% of the catches collected included non-identified species belonging to the genus *Aedes* and *Culex*, males and indeterminate.

In terms of biosecurity, no exotic species were detected in this first intervention, including *Aedes aegypti* and *Aedes albopictus*. Participants also observed a few other invertebrates attracted to the BG-GAT traps. Citizen scientists were able to monitor mosquitoes of ecological and medical importance from their backyards, remotely and at a low cost.



Figure 5. Species collected during Mozzie Month using the BG-GAT trap. A) *Aedes notoscriptus* and B) *Culex quinquefasciatus* were the most abundant species in all states. C) *Toxorhynchites speciosus* and D) *Aedes vigilax* were also present, but less abundant.



## Mosquitoes collected per location

A list of mosquitoes collected per state is presented below (Tables 2-6). Mosquitoes collected are showed per trap ID number. Data collection took place during summertime and early autumn in Australia. Number of submissions and mosquitoes collected varied per state (Table 1 and Figure 6). The diversity of mosquitoes collected is showed in Figure 7.

	Total	Total	%	%	Average mosquitoes per
State	submissions	Mosquitoes	Submissions	Mosquitoes	submission
NSW	25	105	16.89	10.26	4
NT	21	207	14.19	20.23	10
QLD	54	141	36.49	13.78	3
SA	45	451	30.41	44.09	10
WA	3	117	2.03	11.44	39

Table 1. Total submissions and mosquitoes collected per state.



Figure 6. Map shows the percentage of contribution of mosquitoes collected per state.







Figure 7. Examples of photo submissions received. Mosquitoes caught were placed on the laminated blue Tip Card, as per instructions. Photos show different abundance and diversity of species collected.

## **New South Wales**

Date	ID Number	suburb	postcode	total mosquitoes	Aedes notoscriptus	Aedes vigilax	Aedes camptorhynchus	Culex quinquefasciatus	Aedes aegypti	Anopheles	Culex annulirostris	Culex sitiens	Toxorhynchites speciosus	Aedes albopictus	Aedes	Culex	males	indeterminate
00/00/0001		a	21.15	_	0	0	0		0	0	0	0	0	0	0	0		
02/03/2021	200112	Seven Hills	2147	5	0	0	0	2	0	0	0	0	0	0	0	0	1	2
21/02/2021	200128	Northmead	2152	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1
18/03/2021	200131	Mudgee	2850	2	0	0	0	0	0	0	0	0	0	0	0	0	0	2
28/03/2021	200131	Mudgee	2850	9	5	0	0	0	0	0	0	0	0	0	0	0	1	3
04/04/2021	200131	Mudgee	2850	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
05/04/2021	200132	Mudgee	2850	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
27/02/2021	200133	Canada Bay	2145	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0
16/03/2021	200133	Canada Bay	2145	5	1	0	0	4	0	0	0	0	0	0	0	0	0	0
06/04/2021	200133	Canada Bay	2145	4	3	0	0	1	0	0	0	0	0	0	0	0	0	0
27/02/2021	200134	Parramata	2150	4	1	1	0	2	0	0	0	0	0	0	0	0	0	0
16/03/2021	200134	Parramata	2150	5	1	1	0	1	0		0	1	0	0	0	0	0	1
06/04/2021	200134	Parramata	2150	5	1	0	0	3	0	0	1	0	0	0	0	0	0	0
27/02/2021	200136	Hurlstone Park	2193	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0
13/03/2021	200136	Hurlstone Park	2193	5	3	0	0	0	0	0	0	0	1	0	0	0	1	0
11/04/2021	200136	Hurlstone	2103	2	1	0	0	0	0	0	0	0	0	0	0	0	0	1
06/04/2021	200130	Rolmoin	2195	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0
00/04/2021	200137	Daimain	2041	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0
04/04/2021	200139	Wombarra	2515	5	2	0	0	0	0	0	0	0	0	0	0	0	0	3
28/02/2021	200142	Eastlakes	2018	2	2	0	0	0	0	0	0	0	0	0	0	0	0	0
02/04/2021	200142	Eastlakes	2018	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
27/02/2021	200144	Sydenham	2044	15	11	0	0	0	0	0	0	0	0	0	0	3	1	0
28/03/2021	200144	Sydenham	2044	3	0	3	0	0	0	0	0	0	0	0	0	0	0	0

27/02/2021	200159 Rydalmere	2116	12	10	0	0	1	0	0	0	0	0	0	0	1	0	0
14/03/2021	200159 Rydalmere	2116	16	9	0	0	0	0	0	0	0	0	0	0	0	0	7
02/03/2021	200160 Rydalmere	2116	2	2	0	0	0	0	0	0	0	0	0	0	0	0	0
15/03/2021	200160 Rydalmere	2116	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

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<u> *Mozzie*</u> Monitors University of South Australia

## Northern Territory

Date	ID Number	suburb	postcode	total mosquitoes	Aedes notoscriptus	Aedes vigilax	Aedes camptorhynchus	Culex quinquefasciatus	Aedes aegypti	Anopheles	Culex annulirostris	Culex sitiens	Toxorhynchites speciosus	Aedes albopictus	Aedes	Culex	males	indeterminate	
1 < 100 1000 1	200146	<b>.</b>	0.00		0	0	0	0	0	0	0	0	0	0	0		0	11	
16/03/2021	200146	Larrakeyah	820	15	0	0	0	0	0	0	0	0	0	0	0	4	0	11	
00/02/2021	200147	Rapid Creek	<b>Q10</b>	2	1	0	0	0	0	0	0	0	0	0	0	0	1	1	
25/03/2021	200147	Karama	810 812	5	1	0	0	0	0	0	0	0	0	0	0	0	1	1	
07/03/2021	200142	Karama	813	7	1	0	0	1	0	0	0	0	0	0	0	0	0	5	
23/03/2021	200152	Karama	813	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	
05/04/2021	200152	Karama	813	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	
13/03/2021	200153	Malak	812	7	6	0	0	0	0	0	0	0	0	0	0	0	0	1	
31/03/2021	200153	Malak	812	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	
28/02/2021	200154	Anula	812	22	20	0	0	0	0	0	0	0	0	0	0	0	0	2	
16/03/2021	200154	Anula	812	14	0	0	0	0	0	0	0	0	0	0	0	0	0	14	
29/03/2021	200154	Anula	812	4	1	0	0	0	0	0	0	0	0	0	0	0	0	3	
06/03/2021	200165	Wagaman	810	2	2	0	0	0	0	0	0	0	0	0	0	0	0	0	
		The																	
27/02/2021	200166	Narrows	820	10	8	0	0	1	0	0	0	0	0	0	0	1	0	0	
		The																	
18/03/2021	200166	Narrows	820	15	3	0	0	0	0	0	0	0	0	0	0	0	0	12	
13/03/2021	200168	Malak	812	5	5	0	0	0	0	0	0	0	0	0	0	0	0	0	
31/03/2021	200168	Malak	812	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
20/04/2021	200168	Malak	812	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	





18/03/202	21 <b>2001</b>	69 Larrakey	ah 82	20	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1
01/04/202	21 <b>2001</b>	69 Larrakey	ah 82	20	7	1	0	0	0	0	0	0	0	0	0	0	0	3	3
01/03/202	21 <b>2001</b> '	71 Palmerste	on 8.	31	36	3	1	0	1	0	0	0	0	0	0	0	3	8	20
19/03/202	21 <b>2001</b>	71 Palmerst	on 8.	31	56	0	0	0	51	0	0	0	0	0	0	0	0	3	2
Q	ueensland	qunqns	postcode	total mosquitoes	Aedes notoscriptus	Aedes vigilax	Aedes camptorhynchus	Culex quinquefasciatus	Aedes aegypti	Anopheles	Culex annulirostris	Culex sitiens	Toxorhynchites speciosus	Aedes albopictus	Aedes	Culex	males	indeterminate	
	ID N																		
Date	Number	Sloalsa																	-
28/02/2021	200100	Creek	4127	3	1	0	0	0	0	0	0	0	0	0	0	1	0	1	
28/03/2021	200100	Slacks Creek	4127	1	1	0	0	0	0	0	0	0	0	0	0	0	0	C	)
21/03/2021	200103	Holland Park West	4121	5	5	0	0	0	0	0	0	0	0	0	0	0	0	C	)
02/04/2021	200103	Holland Park West	4121	4	4	0	0	0	0	0	0	0	0	0	0	0	0	C	)
18/03/2021	200104	Alexandra Hills	4161	0	0	0	0	0	0	0	0	0	0	0	0	0	0	C	)
09/04/2021	200104	Alexandra Hills	4161	0	0	0	0	0	0	0	0	0	0	0	0	0	0	C	)
28/02/2021	200105	Greenbank	4124	1	0	0	0	0	0	0	0	0	1	0	0	0	0	C	)
18/03/2021	200105	Greenbank	4124	0	0	0	0	0	0	0	0	0	0	0	0	0	0	C	)
01/04/2021	200105	Greenbank	4124	0	0	0	0	0	0	0	0	0	0	0	0	0	0	C	)
26/02/2021	200106	Camp Hill	4152	4	0	0	0	2	0	0	0	0	0	0	0	2	0	C	)





13/03/2021	200106	Camp Hill	4152	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0
30/03/2021	200106	Camp Hill	4152	6	3	0	0	0	0	0	0	0	0	0	0	0	0	3
24/03/2021	200109	Carindale	4152	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
01/04/2021	200109	Carindale	4152	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
24/02/2021	200110	Hemmant	4174	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
28/03/2021	200110	Hemmant	4174	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
27/02/2021	200113	Rochedale South	4123	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
01/03/2021	200113	Rochedale South	4123	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
14/03/2021	200113	Rochedale South	4123	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
20/02/2021	000110	Rochedale	4100	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
29/03/2021	200113	South	4123	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
17/03/2021	200114	Y eronga	4104	2	0	0	0	0	0	0	0	0	0	0	0	0	0	2
27/02/2021	200116	Jimboomba	4280	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
15/03/2021	200116	Jimboomba	4280	2	1	0	0	1	0	0	0	0	0	0	0	0	0	0
30/03/2021	200116	Jimboomba	4280	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0
27/02/2021	200117	Sherwood Q	4075	4	2	0	0	0	0	0	0	0	0	0	0	0	0	2
12/03/2021	200117	Sherwood Q	4075	4	0	0	0	0	0	0	0	0	0	0	0	1	0	3
26/03/2021	200117	Sherwood	4075	34	6	0	0	0	0	0	0	0	0	0	0	0	0	28
27/02/2021	200117	∝ Kuraby	4112	1	0	1	0	0	0	0	0	0	0	0	0	0	0	20
14/03/2021	200118	Kuraby	4112	2	2	0	0	0	0	0	0	0	0	0	0	0	0	0
27/03/2021	200118	Kuraby	4112	4	4	0	0	0	0	0	0	0	0	0	0	0	0	0
10/04/2021	200118	Kuraby	4112	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1
16/03/2021	200120	Carindale	4152	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30/03/2021	200121	Holland Park West	4121	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0
27/02/2021	200122	Logan Village	4207	3	3	0	0	0	0	0	0	0	0	0	0	0	0	0
14/03/2021	200122	Logan Village	4207	11	9	0	0	0	0	0	0	0	0	0	1	0	0	1
04/04/2021	200122	Logan Village	4207	10	4	0	0	0	0	0	0	0	2	0	0	0	0	4



0 0 0 0 0 0 0 0 0 0 0 0 0 0



14/03/2021	200123	Alexandra Hills	4161	1	1	0	0	0	0	0	0	0	0	0	0	0	0
		Alexandra															
27/03/2021	200123	Hills	4161	0	0	0	0	0	0	0	0	0	0	0	0	0	0
27/03/2021	200124	Capalaba	4157	4	2	0	0	0	0	0	0	0	2	0	0	0	0
09/04/2021	200125	Marsden	4132	0	0	0	0	0	0	0	0	0	0	0	0	0	0
18/03/2021	200126	Moorooka	4105	3	0	0	0	0	0	1	0	0	0	0	0	0	0
10,00,2021	200120			e.	U	Ŭ	Ū	Ū	Ū	-	Ũ	Ū	Ū	Ū	0	Ũ	0
01/04/2021	200126	Moorooka	4105	1	1	0	0	0	0	0	0	0	0	0	0	0	0
18/04/2021	200127	Wellington Point	4160	12	5												
22/02/2021	200130	Holland Park	4121	5	0	0	0	0	0	0	0	0	0	0	0	0	0
12/03/2021	200130	Holland Park	4121	1	1	0	0	0	0	0	0	0	0	0	0	0	0
		Holland		_	-			, in the second s							, in the second		-
31/03/2021	200130	Park	4121	0	0	0	0	0	0	0	0	0	0	0	0	0	0
14/03/2021	200155	Norman Park	4170	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Norman															
06/04/2021	200155	Park	4170	2	0	0	0	0	0	0	0	0	0	0	0	0	0
01/03/2021	200157	West End	4101	4	0	0	0	0	0	0	0	0	0	0	0	0	0
05/04/2021	200157	West End	4101	2	0	0	0	0	0	0	0	0	1	0	0	0	0
16/03/2021	200158	Shailer Park	4128	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30/03/2021	200158	Shailer Park	4128	1	1	0	0	0	0	0	0	0	0	0	0	0	0
55,05,2021	200100	Shailar	1120	•	1	0	0	0	0	0	0	0	0	5	0	0	0
12/04/2021	200158	Park	4128	0													

27/02/2021

200161 Kenmore

Mozzie Monitors

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		suburb	postcode	total mosquitoes	Aedes notoscriptus	Aedes vigilax	Aedes camptorhynchus	Culex quinquefasciatus	Aedes aegypti	Anopheles	Culex annulirostris	Culex sitiens	Toxorhynchites speciosus	Aedes albopictus	Aedes	Culex	males	indeterminate
Date	ID Number	-																
21/02/2021	100013	Lower Mitcham	5062	5	0	0	0	0	0	0	0	0	0	0	0	0	0	5
07/03/2021	100013	Lower Mitcham	5062	4	1	0	0	1	0	0	0	0	0	0	0	0	1	1
20/03/2021	100013	Lower Mitcham	5062	18	0	0	0	0	0	0	0	0	0	0	0	0	0	18
21/02/2021	100033	Eden Hills	5050	19	10	0	0	6	0	0	0	0	0	0	0	0	0	3
07/03/2021	100033	Eden Hills	5050	62	40	1	0	4	0	0	0	0	0	0	0	0	6	11
21/03/2021	100033	Eden Hills	5050	25	12	0	0	0	0	0	0	0	0	0	0	0	2	11
27/02/2021	100064	North Adelaide	5006	10	2	0	0	0	0	0	0	0	0	0	0	6	1	1
14/03/2021	100064	North Adelaide	5006	6	0	0	0	0	0	0	0	0	0	0	0	2	0	4
29/03/2021	100064	North Adelaide	5006	3	1	0	0	0	0	0	0	0	0	0	0	0	0	2
27/02/2021	100100	Freeling	5372	30	0	0	0	26	0	0	0	0	0	0	0	0	4	0
19/03/2021	100100	Freeling	5372	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0
02/04/2021	100100	Freeling	5372	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0
01/03/2021	100115	St Kilda	5110	2	1	0	1	0	0	0	0	0	0	0	0	0	0	0
31/03/2021	100115	St Kilda	5110	2	0	0	0	0	0	0	0	0	0	0	0	0	0	2
27/02/2021	100154	Kensington Park	5068	52	34	0	0	0	0	0	0	0	0	0	0	5	10	3
16/03/2021	100154	Kensington Park	5068	36	7	0	0	0	0	0	0	0	0	0	0	0	7	22
31/03/2021	100154	Kensington Park	5068	38	20	0	0	0	0	0	0	0	0	0	0	0	10	8
28/02/2021	100164	Nangkita/ Mt Compass	5210	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
18/03/2021	100164	Nangkita/ Mt Compass	5210	2	1	0	0	0	0	0	0	0	0	0	0	0	1	0





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0	5/04/2021	100164	Nangkita/ Mt Compass	5210	4	0	0	0	0	0	0	1	0	0	0	0	0	2	1
2	8/02/2021	100165	Mt Compass	5210	4	4	0	0	0	0	0	0	0	0	0	0	0	0	0
1	8/03/2021	100165	Mt Compass	5210	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			Mt																
0	5/04/2021	100165	Compass	5210	3	2	0	0	0	0	0	0	0	0	0	0	0	0	1
0	3/03/2021	100166	Angaston	5353	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	8/03/2021	100166	Angaston	5353	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	4/03/2021	100166	Angaston	5353	13	5	0	0	0	0	0	0	0	0	0	0	0	0	8
1	8/03/2021	100166	Angaston	5353	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	9/04/2021	100166	Angaston	5353	3	0	0	0	0	0	0	0	0	0	0	0	0	0	3
1	7/03/2021	100184	Semaphore	5019	7	6	0	0	1	0	0	0	0	0	0	0	0	0	0
3	1/03/2021	100184	Semaphore	5019	5	1	0	0	0	0	0	0	0	0	0	2	0	0	2
0	1/03/2021	100188	Norwood	5067	30	19	0	0	0	0	0	0	0	0	0	0	3	0	8
1	6/03/2021	100188	Norwood	5067	22	7	0	0	0	0	0	0	0	0	0	0	0	2	13
0	7/04/2021	100188	Norwood	5067	2	1	0	0	0	0	0	0	0	0	0	0	0	0	1
0	1/03/2021	100191	Kersbrook	5231	3	0	0	0	0	0	0	0	0	0	0	0	1	1	1
3	1/03/2021	100191	Kersbrook	5231	7	3	0	0	0	0	0	0	0	0	0	0	0	1	3
1	6/03/2021	100195	Magill	5072	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	7/02/2021	100197	Riverton	5412	11	1	0	0	2	0	0	0	0	0	0	0	5	1	2
2	0/03/2021	100197	Riverton	5412	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3	1/03/2021	100199	Murray Bridge	5253	2	0	0	0	0	0	0	0	0	0	0	0	0	0	2
2	6/02/2021	100200	Renown Park	5008	2	2	0	0	0	0	0	0	0	0	0	0	0	0	0
1	6/03/2021	100200	Renown Park	5008	5	3	0 (	)	2	0 0	) (	) (	) (	) (	)	0	0	0	0
2	8/03/2021	100200	Renown Park	5008	3	3	0	0	0	0	0	0	0	0	0	0	0	0	0
1	7/03/2021	200173	Queenstown	5014	4	2	0	0	0	0	0	0	0	0	0	0	0	0	2

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Date	ID Number	suburb	postcode	total mosquitoes	Aedes notoscriptus	Aedes vigilax	Aedes camptorhynchus	Culex quinquefasciatus	Aedes aegypti	Anopheles	Culex annulirostris	Culex sitiens	Toxorhynchites speciosus	Aedes albopictus	Aedes	Culex	males	indeterminate
28/02/2021	100305	Broome	6725	106	0	0	0	0	0	0	0	0	0	0	0	0	0	106
14/03/2021	100305	Broome	6725	2	0	0	0	0	0	0	0	0	0	0	0	0	0	2
21/03/2021	200172	White Gum Valley	6162	9	4	0	0	3	0	0	0	0	0	0	0	0	0	2

## Other invertebrates captured in the trap

Apart from mosquitoes, the traps can also attract other invertebrates due to the humidity inside, acting as a refuge, especially on hot and warm days. Other invertebrates captured in the BG-GAT traps included: earwigs, flies, beetles, ants, bugs, centipedes, moths, vinegar flies, orthoptera, spiders, midges.









Figure 8. Examples of non-targeted species collected in the BG-Gat traps.

## **Challenges and opportunities**

Mozzie Month was the first trial of the Mozzie Monitors programs at a national scale. It was only possible due to the mutual efforts of researchers at the UniSA and local partners interstate, including the Zika Mozzie Seeker program, HOT North by Menzies, the WA Department of Health and local partners in NSW and WA. The intervention proved it is possible to run a remote citizen science data collection simultaneously in Australia through shipping traps and online engagement. In addition, the use of accessible technology, such as smartphones, allowed remote participation.

This first trial showed a contribution to common urban mosquitoes' data collection, especially *Aedes notoscriptus* and *Culex quiquefasciatus*. Improving the submission of identifiable photos is one of the main challenges identified. About 40% of the identifications were indeterminate in this first trial due to low photo resolution, focus or desiccated



specimens. However, from previous trials, participants enhanced photo submissions over time. Keeping this network of citizen scientists engaged between data collections could allow more identifiable images for the next editions of Mozzie Month.

This intervention provided an opportunity to greatly expand the geographic coverage of mosquito surveillance initiatives and strengthening partnerships. These first outcomes are aligned with the Global Vector Control Response by the WHO.



## **Mozzie Month - Species list**

During Mozzie Month, citizen scientists collected 1025 mosquitoes of the eight different species below:

1. Aedes notoscriptus



Photo: (c) Kerri-Lee Harris, some rights reserved (CC BY-NC).

This mosquito is widespread in all states and territories in Australia and is often a severe nuisance pest. It is related to the transmission of Ross River and Barmah Forest viruses. It is also one of the main vectors of dog heartworm. It has this noticeable silver to golden lyre pattern shape on its scutum.

## 2. Culex quinquefasciatus



Photo: (c) Geoffrey Cox, some rights reserved (CC BY-NC).

This mosquito of brownish appearance is a major nuisance pest and uses artificial water containers in people's backyards to breed. Generally, it does not play an important role in the transmission of mosquito-borne diseases in Australia.



## 3. Aedes vigilax



Photo: (c) Nick Lambert, some rights reserved (CC BY-NC-SA).

This medium-sized saltmarsh mosquito is a generalist feeder, biting humans and other animals. It's related to the transmission of Ross River and Bamah Forest viruses in coastal areas. Fun fact: Studies suggest that this species can fly over 50km from its larval habitats.

## 4. Aedes camptorhynchus



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This species is also known as Southern Saltmarsh Mosquito as it occurs predominantly in coastal areas, but it can also be present in brackish water in inland regions. It is a major vector of Ross River Virus, and can be a potential vector of Barmah Forest Virus and Murray Valley Encephalitis Virus as well.



## 5. Anopheles annulipes



This medium-sized species is widespread in Australia. Its wings have several patches of scales, dark and pale. It is believed that this mosquito had a historical role in the transmission of malaria in Australia. Its current role as a vector is still unknown.

## 6. Toxorhynchites speciosus



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This large mosquito (about four times the size of a typical mosquito) with a metallic appearance does not feed on blood at all. This species feeds only on nectar and other plant-derived nutrients. This way, they have no role in mosquito-borne disease transmission.



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## 7. Culex annulirostris



(c) Cameron Webb, all rights reserved. Also known as Common Banded Mosquito, this species is widespread in Australia, except in Tasmania. This mosquito is a major nuisance-biting species and has a potential role in transmitting Murray Valley encephalitis, Kunjin, Barmah Forest and Ross River virus (it was proved to be an efficient carrier of these pathogens in laboratory studies). It is also able to carry dog heartworm and is probably a major vector of myxomatosis.

#### 8. Culex sitiens



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This medium-sized species has a darkish appearance with narrow golden scales on its scutum. It is typically more abundant during late summer and autumn. Although it can transmit Ross River Virus, this mosquito presents a low infection rate. So, this species does not play an important role in disease transmission.



Learn more about mosquitoes on this book "A Guide to Mosquitoes of Australia".



## How to protect your house from mosquitoes

- Cleaning the backyards are very effective to remove breeding sites and larvae.
  Mosquitoes can use some places as breeding sites, including pot plants (if they hold water), rainwater tanks, water-holding plants, birdbaths, swimming pools, drains, etc.
  Changing water regularly can help avoid mosquito eggs and larvae;
- protecting doors and windows with mosquito nets;
- applying repellents when outside. The best ones are those with DEET and picaridin;
- avoiding mosquito time when it's possible. Mosquitoes tend to be more active during the late afternoon, dusk, and early evening. Most species are active during the night, with a boost in activity before dawn. Few species are active throughout the day (but most nuisance-biting mosquitoes are active during dusk).
- wearing protective clothing, such as loose, light-coloured, long sleeves and pants where possible;
- mosquito traps help attract female mosquitoes, which is beneficial as only females bite.



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