

Zika Mozzie Seeker update:

Innovative citizen science sustains invasive *Aedes* mosquito surveillance

15th MCAA Session 11: 23 Aug 2023

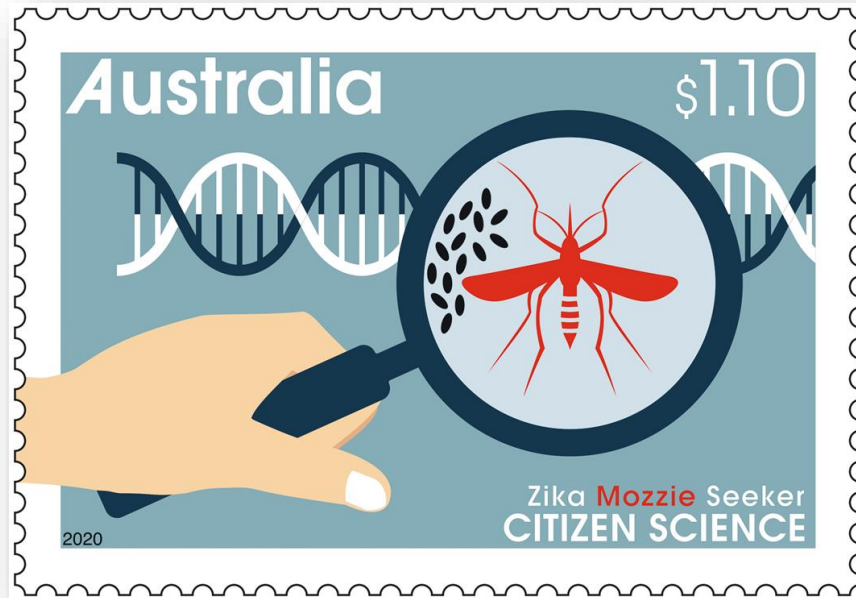
Brian L Montgomery, Jason Christiansen, Jon Cianci, Corinne Collins, Sonja Hall-Mendelin, Jamie McMahon, Ian Mohamad, Phil Rocha, Matt Wessling

ICARE² values



Citizen scientists monitor urban mosquitoes for presence-absence of invasive *Aedes* species

Zika Mozzie Seeker (ZMS): Widely recognized as a good idea



Australia Post stamp – designer Jonathan Chong

Queensland

- Metro South Health Innovation Awards 2017, 2019
- Qld Health Innovation Award 2017
- Case study in *Qld Citizen Science Strategy*
- Mention in *Qld Public Health Review 2023*

Australia

- Australian Museum 'Eureka Awards for Innovation in Citizen Science':
Finalist 2018, 2019
- Australia Post stamp 2020

International

- Case study in OPSI *Embracing Innovation in Government: Global Trends 2019*
- *Wing Beats* AMCA magazine: 'Fall' edition 2020

Are there Zika mozzies in your yard?

Citizen scientists can create sustainable and expansive early warning networks in large cities

ZMS aligns with public health definition: 'promote health, prevent disease and manage risk' (*QPHR Final Report Mar 2023 p.18*)

Citizen Science – Zika Mozzie Seeker Project

Since early 2017, the Metro South PHU innovative Zika Mozzie Seeker project has recruited community members to trap mosquito eggs in their backyards to be tested for exotic diseases such as Zika, dengue or chikungunya. The screening technology was developed by Queensland Health and is a world first for mosquito monitoring.

The project is designed to enhance the ability to detect invasions of *Aedes aegypti* mosquitoes into South East Queensland. The success of the project depends on the high participation of community members to place traps in many locations as the mosquito does not fly more than 500 metres.

QPHR 2023: Excerpt from p. 34

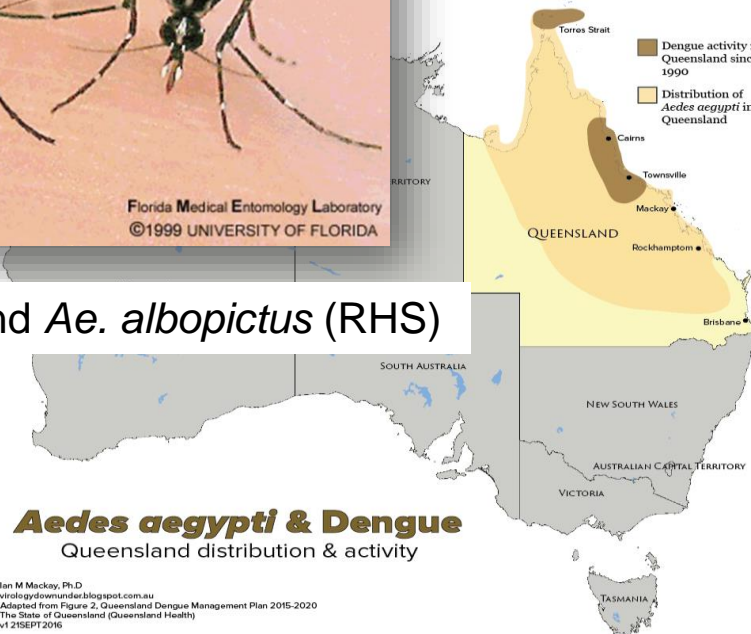


Zika mozzies in SEQ is a public health risk

Early detection may pre-empt cryptic transmission of Zika, dengue or chikungunya viruses

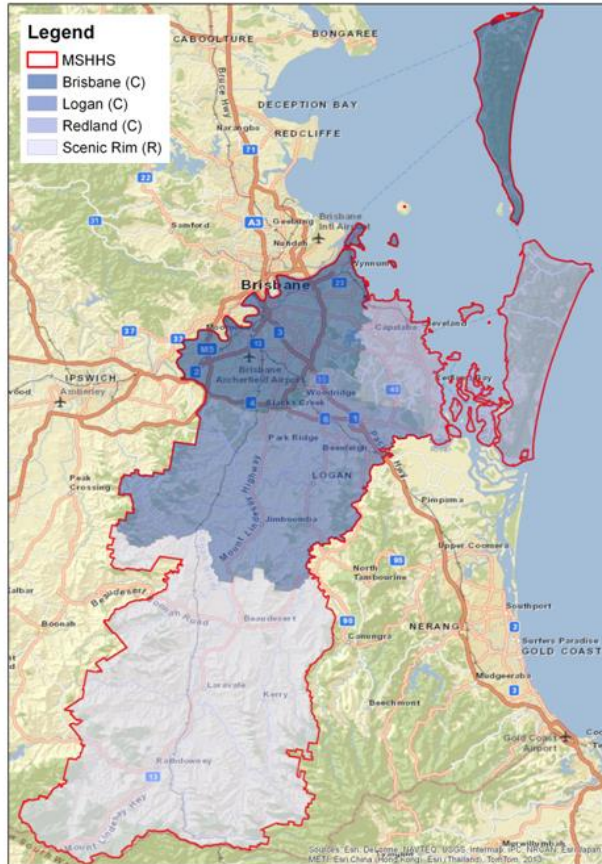


Ae. aegypti (LHS) and *Ae. albopictus* (RHS)



ZMS aim: Detect covert invasion(s) of vectors to pre-empt cryptic disease outbreaks

MSH overlaps four councils; recruitment must target a defined spatial footprint



Council	Pop (ABS 2016)	No. suburbs (3 islands excluded?)	Pop./suburb* (mean)	Area/suburb (mean)
Brisbane (south)	611672	102	6,053.8	4.4
Logan	307193	69	4,452.1	3.3
Redland	146987	22	7,324.8	15.0
Scenic Rim (portion)	13192	33	n/a	n/a
Total	1,079,044	226	4,774.5	

Metro South Health:

Approx. 3,800 km²

Population:

Approx. 1.1 million people

Distribution:

226 suburbs (urban, commercial and rural)

Brisbane Seaport

High risk site for mosquito infestations in overseas freight

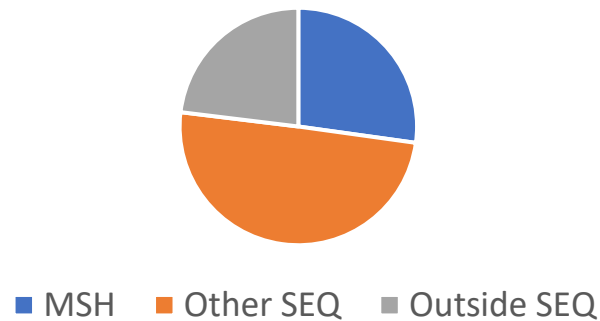
Preventing disease: Exotic viruses arrive annually in Qld

Outbreaks a threat to SEQ if vectors are present

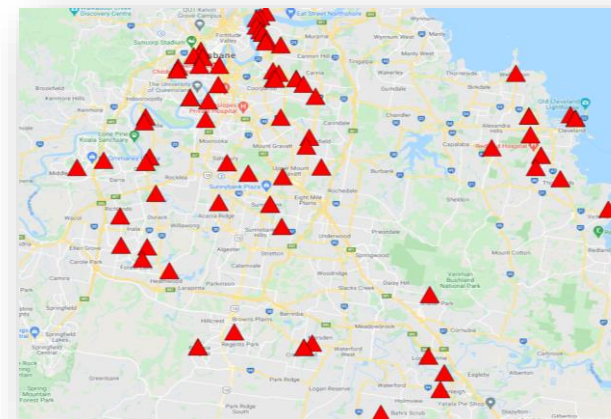
Notifiable virus importations into Queensland: 2018-2023 (*NoCS extract 20 Jul 23*)

Virus	2018	2019	2020	2021	2022	2023	MSH Total	SEQ Total	Qld Total
Chikungunya	2	9	4	0	8	6	15	24	29
Dengue	218	313	53	1	58	76	189	550	717
Yellow Fever	0	0	0	0	0	0	0	0	0
Zika	2	1	0	0	1	0	0	3	4

Notifiable invasive *Aedes* mosquito-borne viruses in Queensland 2018-2023
(*n* = 750)

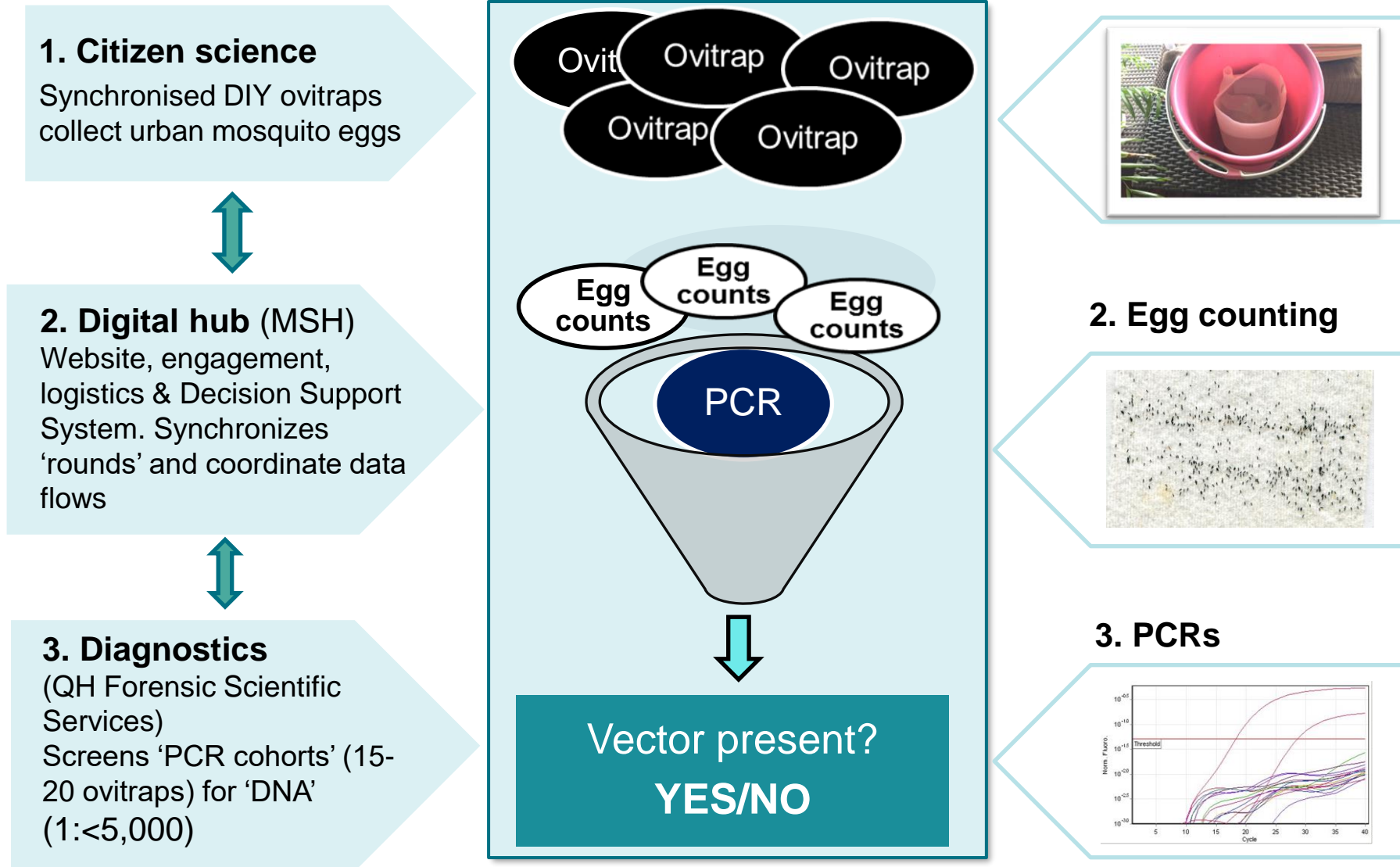


Addresses of infective travellers arriving into MSH (2019)



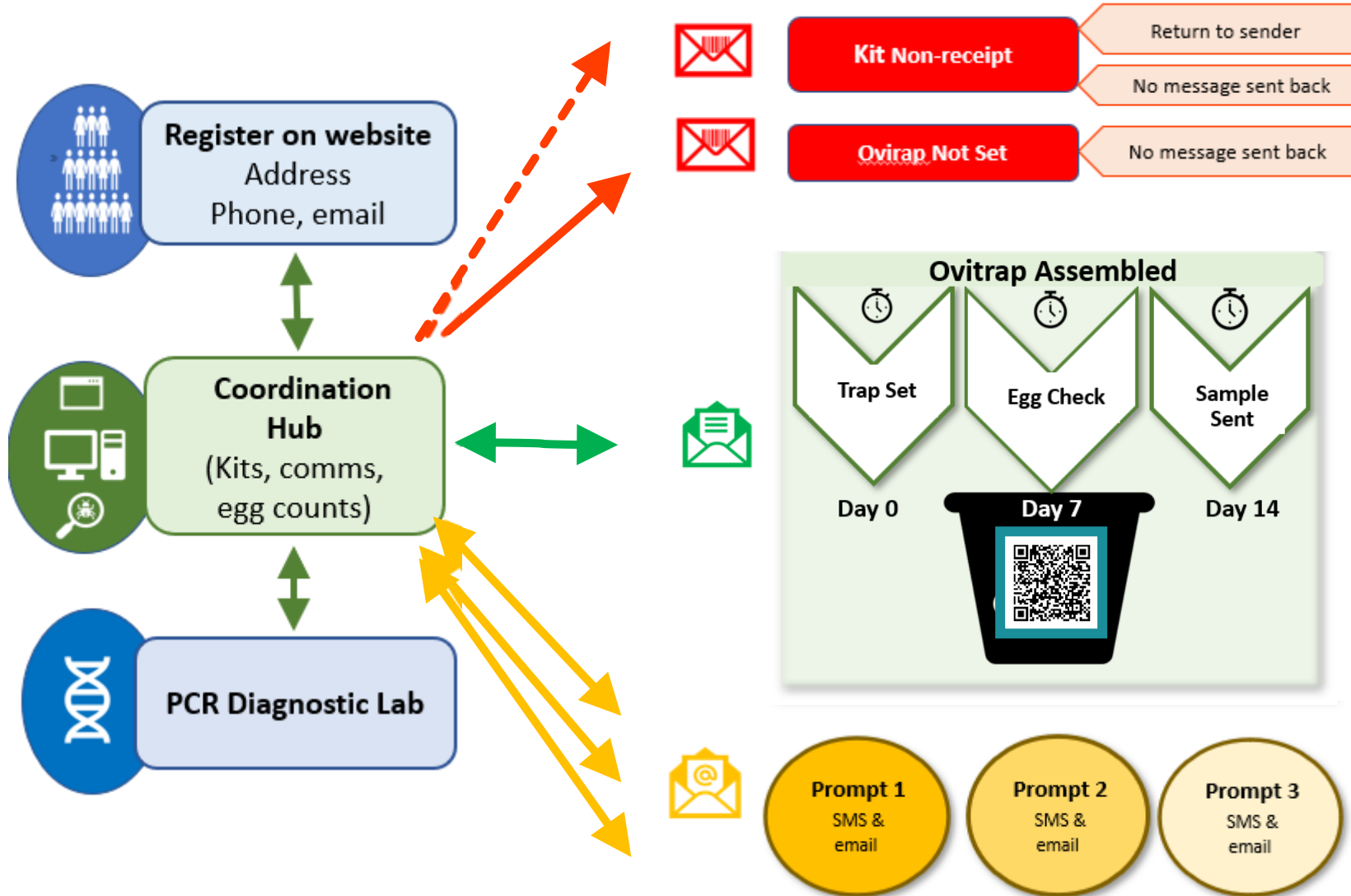
Zika Mozzie Seeker (ZMS)

Integrates three innovative methodologies



How we synchronise DIY ovitrapping

Egg Collection Kits mailout to addresses, and return of ovistrips



New QR code for instructions

Introduced to egg collection kit in March 2023 (Round 12)

A self-help, low carbon-footprint ethos



ASSEMBLING YOUR DIY OVITRAP

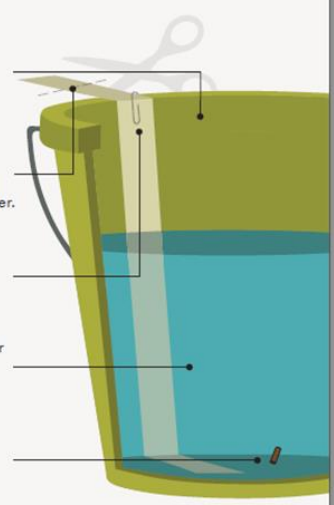
We provide free

- Egg Collection Strip
- Pre-addressed Envelope
- Sealable Bag
- Blotting Paper
- Paperclip
- Lucerne Pellet

You provide

- A large (e.g. 2L) dark container - an ice cream tub or a bucket is ideal.


- 1** Select your container. Rinse the container twice before use.
- 2** Hang the egg collection strip (supplied) in the container so it touches the bottom. Trim off any excess outside the container.
- 3** Fix the egg collection strip in place using a paper clip (supplied).
- 4** Fill the container with tap water (about three-quarters full); enough to last for 2-3 weeks.
- 5** Add the lucerne pellet (supplied) to the water (more than one will spoil the water).



An ideal location for your trap is under cover. Place the trap away from disturbance by pets or children, out of the rain and wind and away from hoses or sprinklers.

Don't worry! We will be sending a series of SMS reminders.
Graphics by Sophie Magee

2 WEEKS LATER



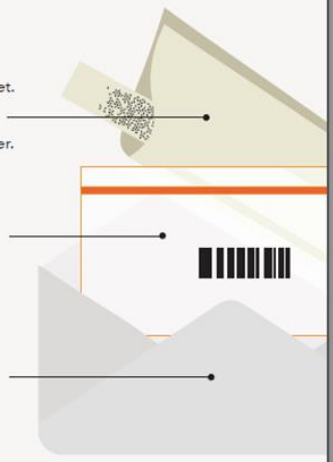
Any female urban mosquitoes visiting your yard will lay their eggs (< 1mm) on the egg collection strip. The eggs need to stay unhatched. Please do not refill the bucket or splash water to prevent eggs hatching. After two weeks, check to see if there are any eggs on the collection strip.

No eggs?
Leave the trap out for one more week; or send us a photo!

I see eggs!
It's time to send them in.

RETURNING THE STRIP

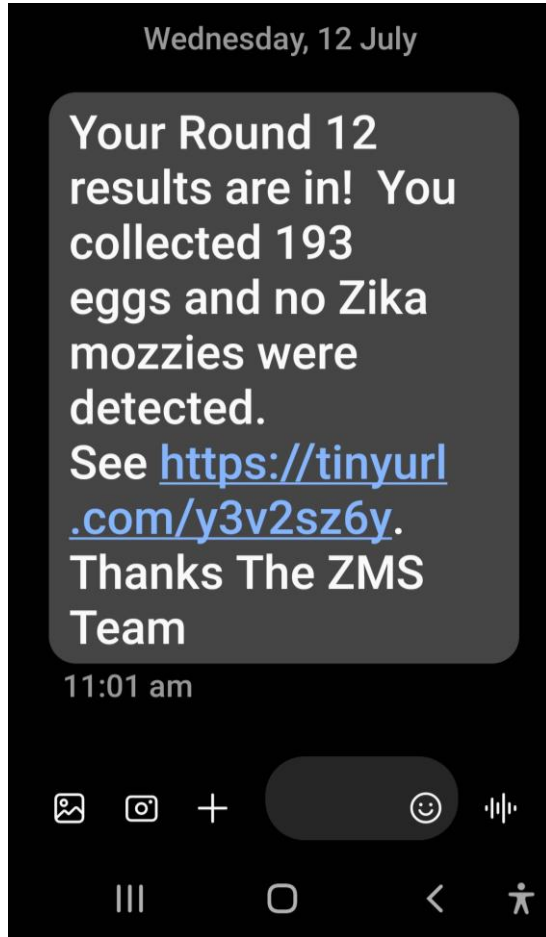
- 1** Remove the strip from the bucket. Mop up excess water using the blotting paper (supplied). Wrap the damp strip in the paper.
- 2** Place it in the barcoded sealable bag (supplied).
- 3** Seal and place the barcoded bag into the postage paid pre-addressed envelope and mail to us.



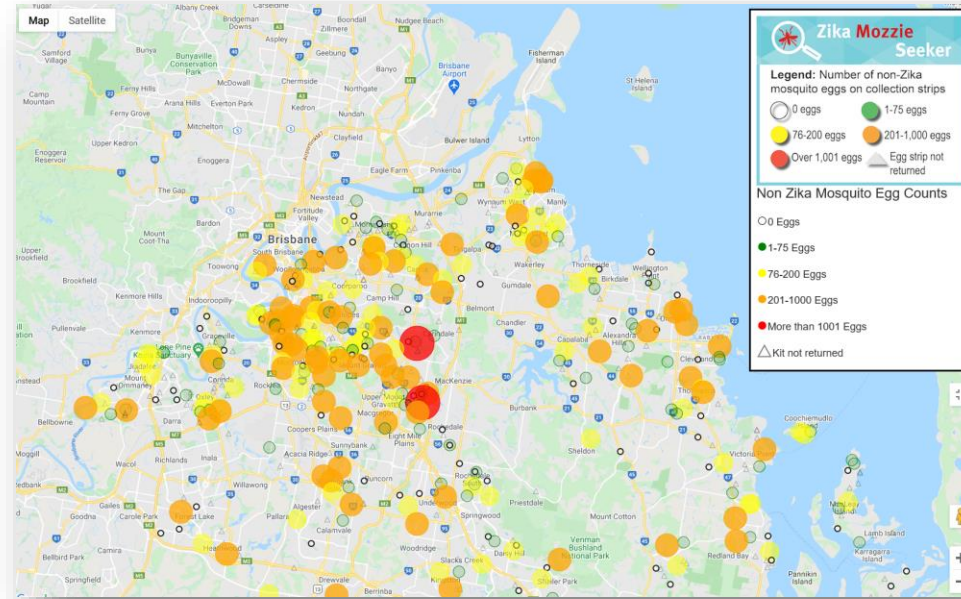
Any questions? Please send an email to MSPHU-Med-Ent@health.gov.au
Graphics by Sophie Magee

Timely and targeted results

Individuals can contextualise by comparing result with community



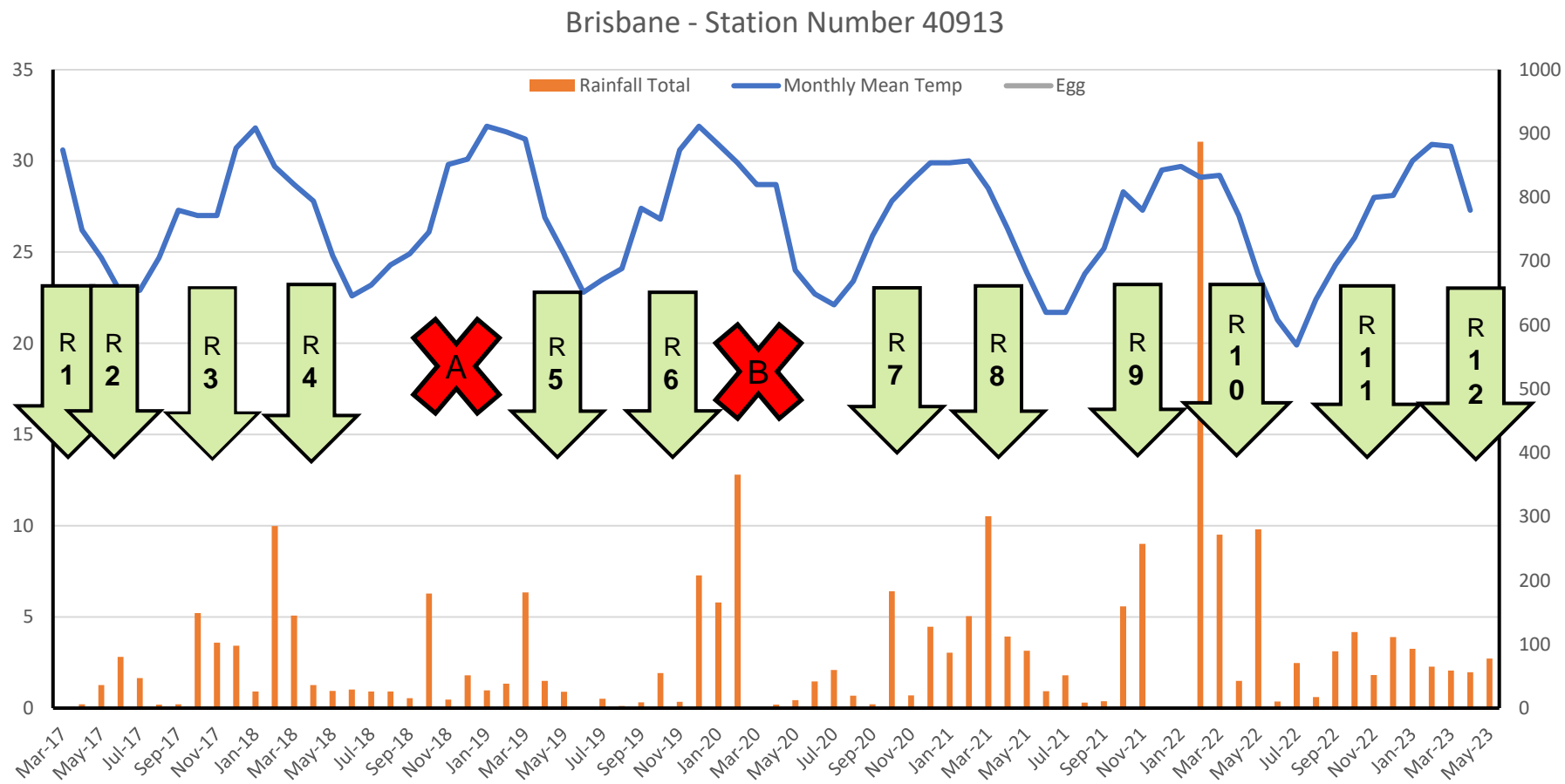
Individual results via SMS.



Community results: Each round egg abundances visualised on ZMS website.

Biannual 'rounds' to overlap mosquito abundance

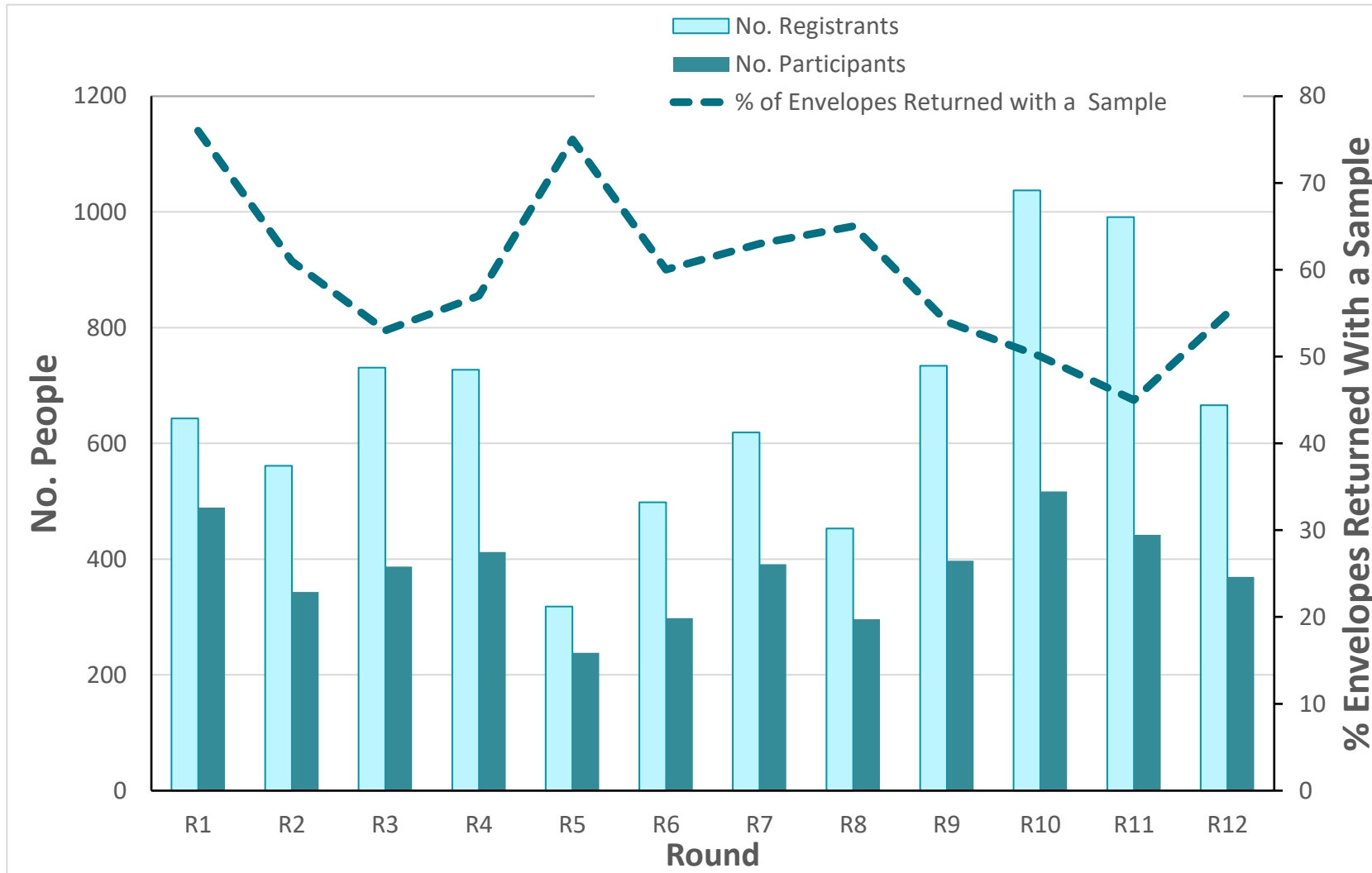
ZMS 2017-2023 Rounds 1-12: chronology



ZMS has proven to be sustainable

Summary of participation (R1-12)

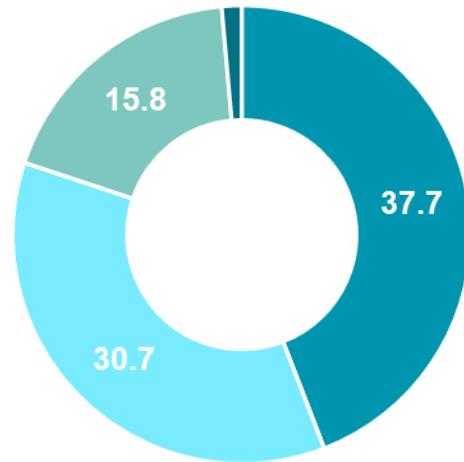
Participants rate is 57.7% (4,601 of 7,975 registrations)



Where did you hear about ZMS and why join?

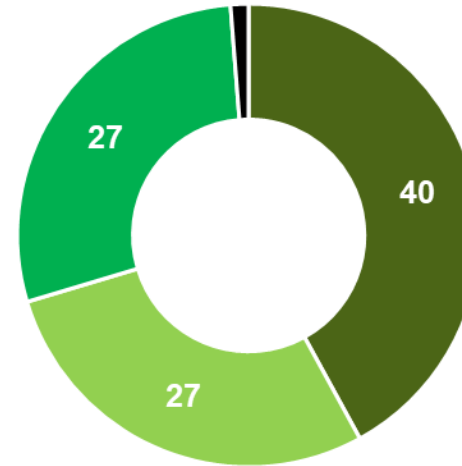
Extract from R12 registration page

Recruitment source ($n = 100$)



- Facebook/twitter post
- Email newsletter
- Word of mouth
- Other

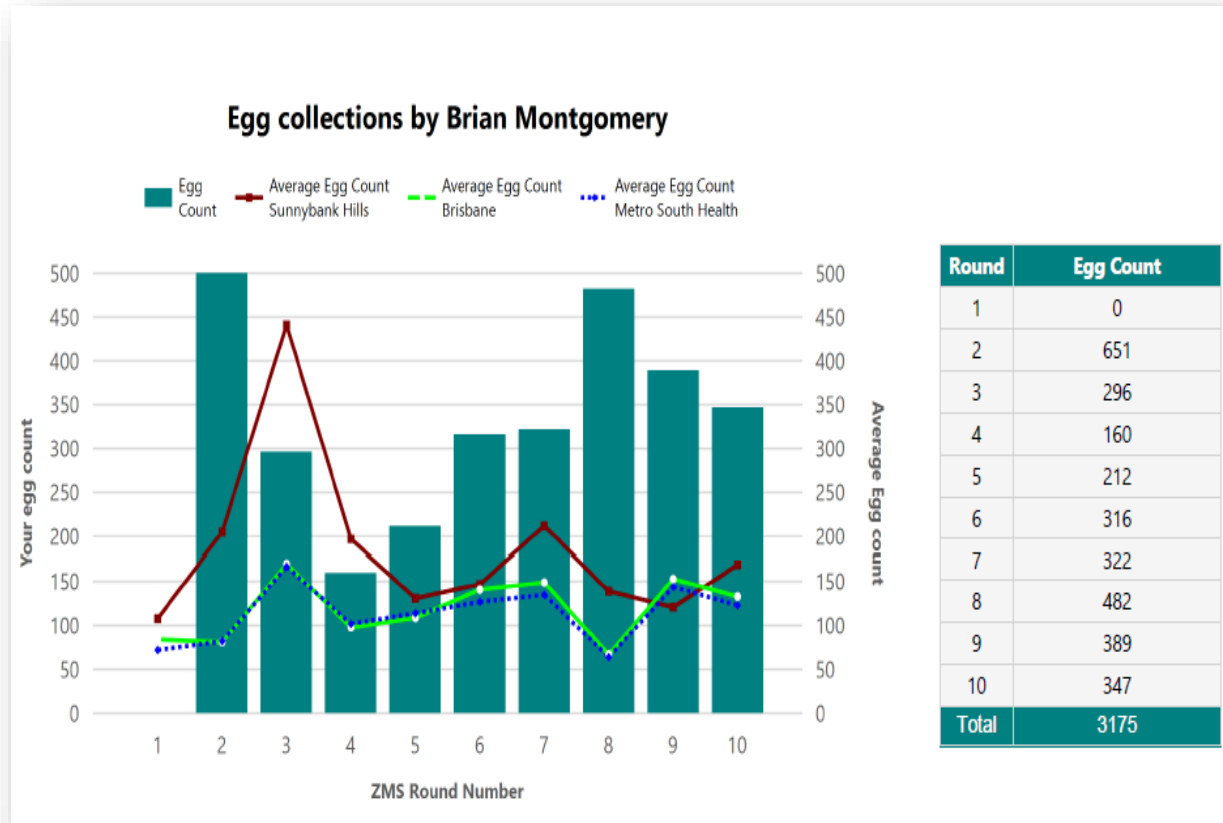
Motivation ($n = 100$)



- Keeping community safe
- Keeping family safe
- Citizen science
- Other

Aspiration: provide automated data history

Certificate of appreciation issued for loyalty (7 of 10 rounds)

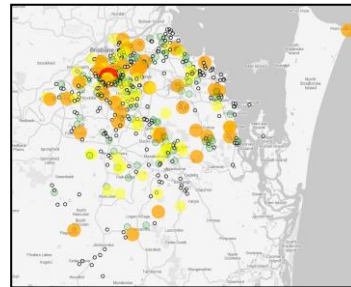
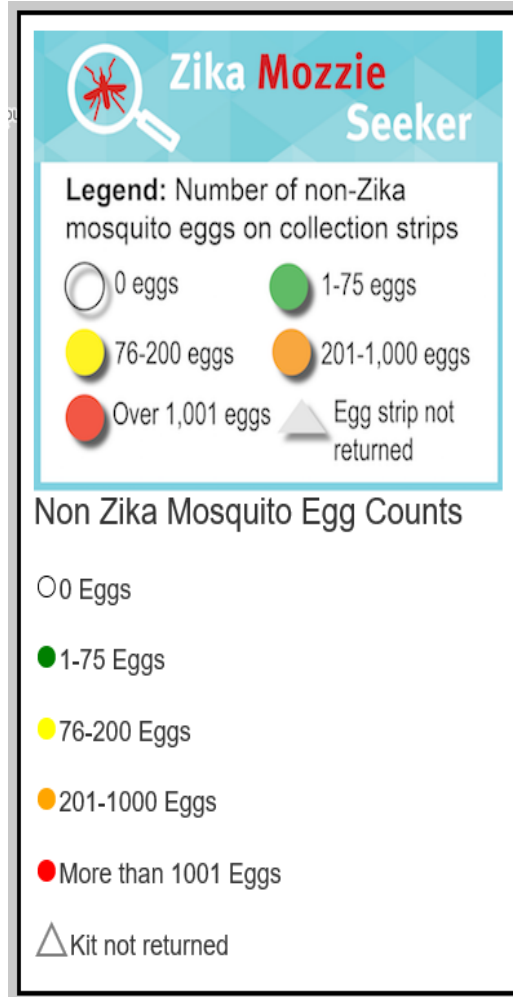


Round	Egg Count
1	0
2	651
3	296
4	160
5	212
6	316
7	322
8	482
9	389
10	347
Total	3175

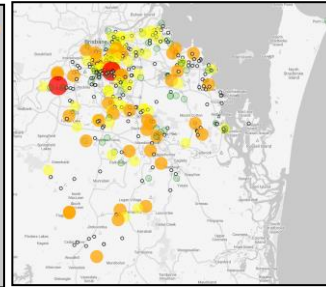


Iteration is key for monitoring invasive species

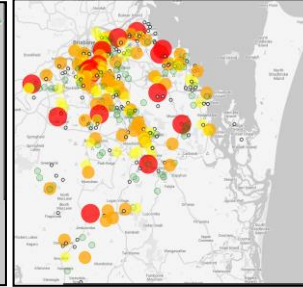
ZMS participation R1-12 ($S = \text{suburbs}$): Total 172 suburbs, mean 125 S/R



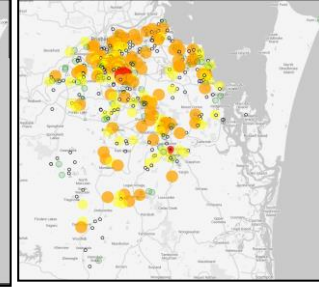
R1 ($S = 129$)



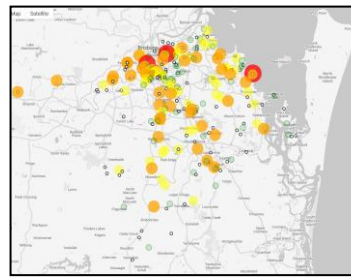
R2 ($S = 119$)



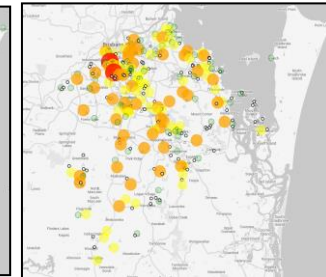
R3 ($S = 123$)



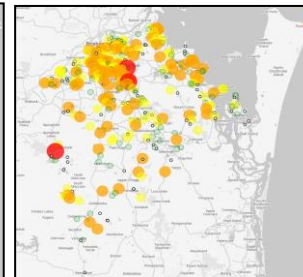
R4 ($S = 126$)



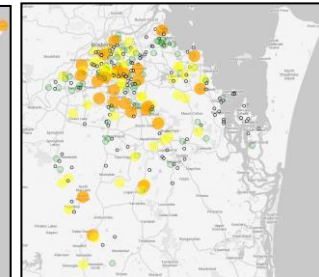
R5 ($S = 99$)



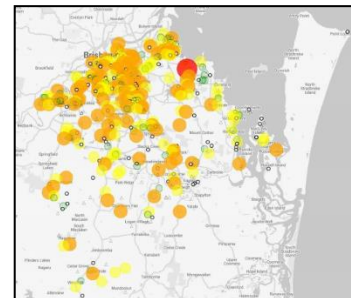
R6 ($S = 117$)



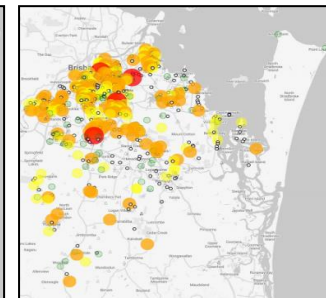
R7 ($S = 124$)



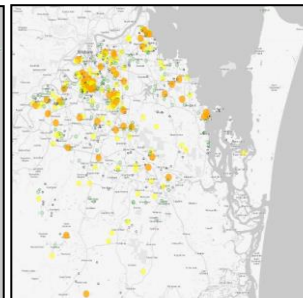
R8 ($S = 116$)



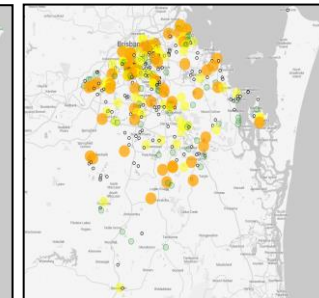
R9 ($S = 132$)



R10 ($S = 143$)



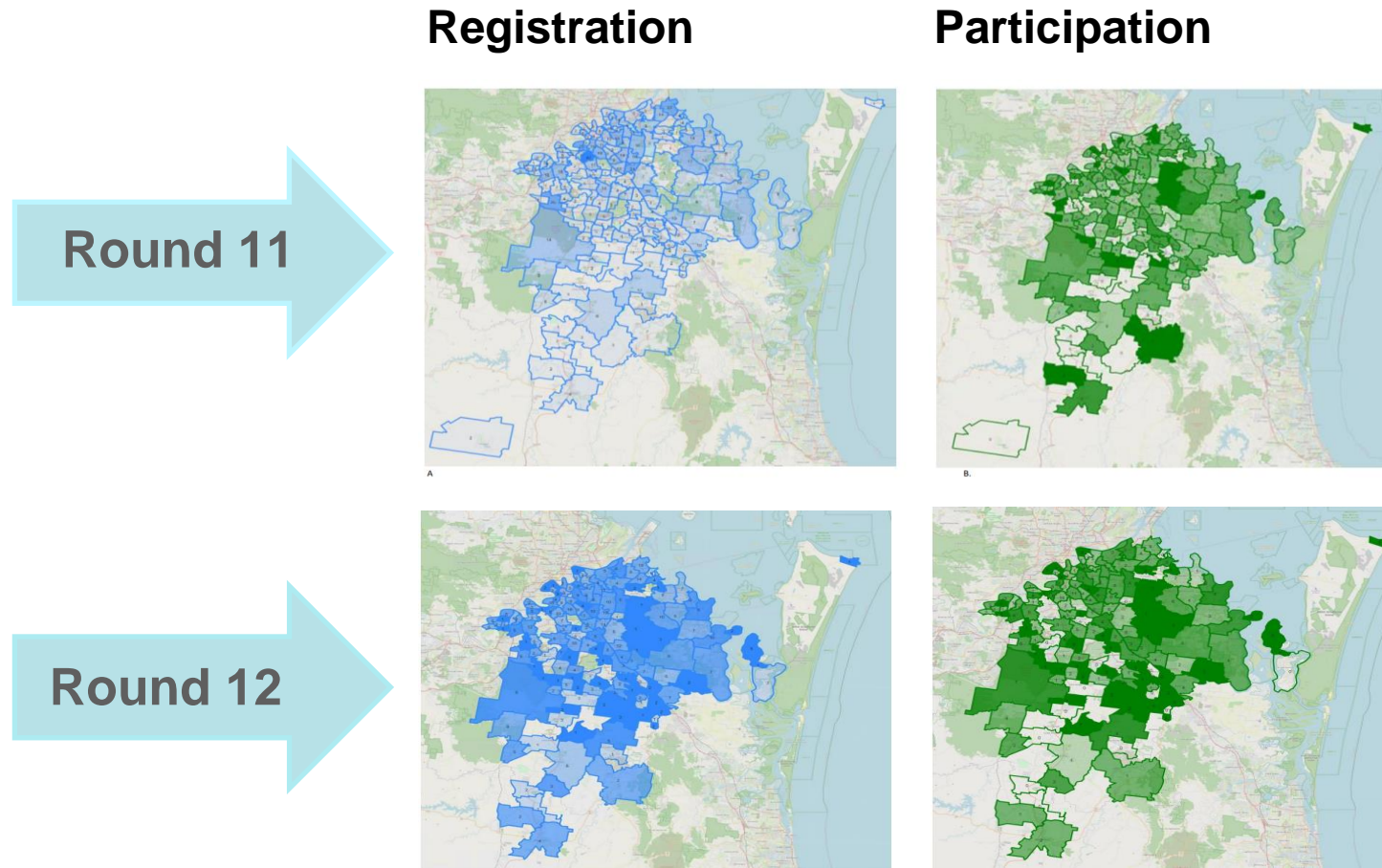
R11 ($S = 134$)



R12 ($S = 137$)

Suburb orientation: Maps introduced in R11-12

A tool for motivation and engagement



Maps of Zika Mozzie Seeker Round 11, showing registrants (A) and participants (B). Darker shades of green (Map B) indicates suburbs with higher a percentage of participation. Participants are defined as the number of people that sent in a sample (zero eggs or eggs). Darker shades of blue (Map A) indicate suburbs with higher numbers of registrations.

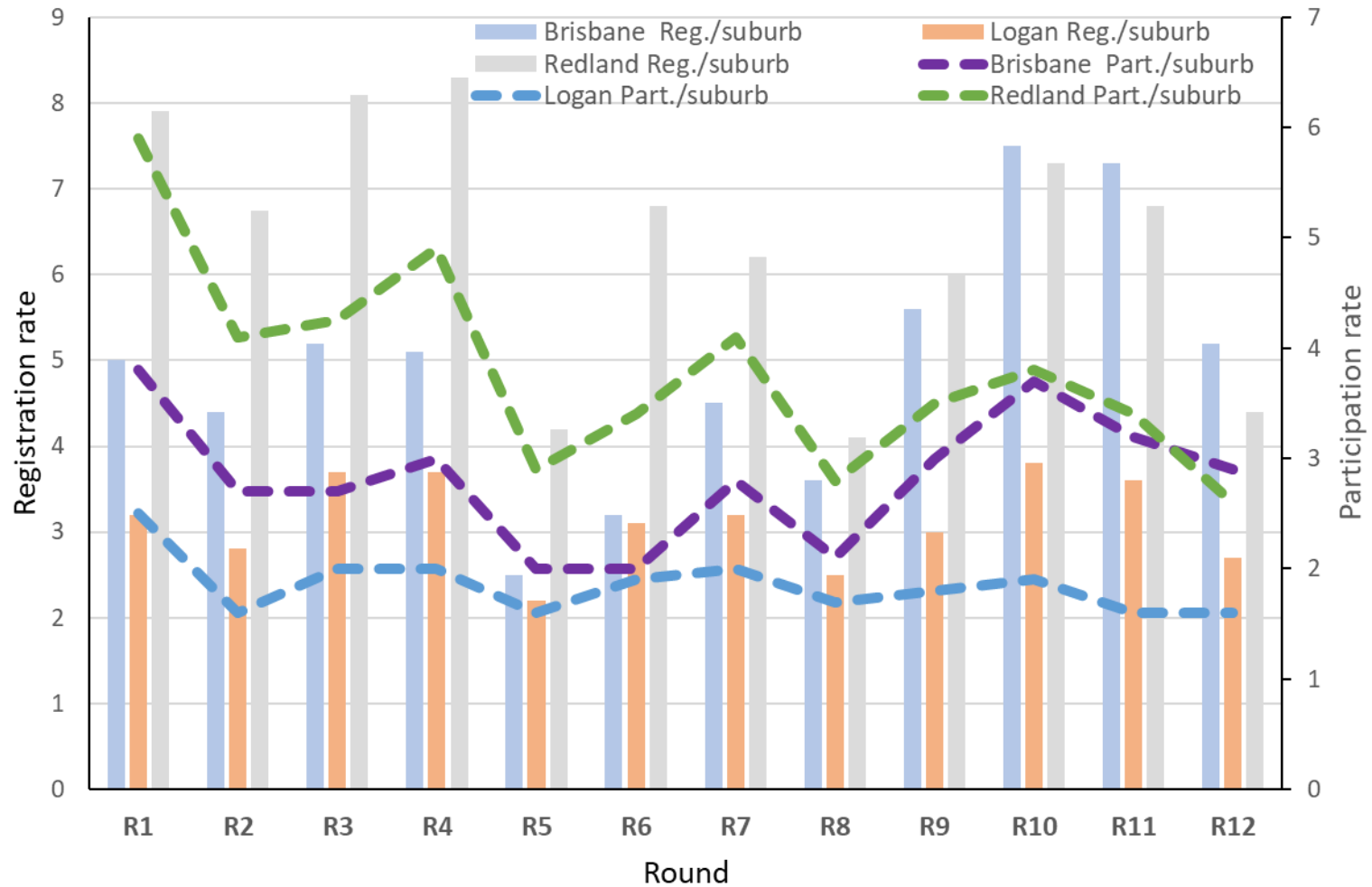
Suburb data provided, with a request to 'phone a friend'

Suburb	Participants	Registrants	Suburb	Participants	Registrants
Acacia Ridge	3	5	Alexandra Hills	4	8
Algerster	4	5	Amity Point	1	1
Annerley	3	8	Bahrs Scrub	1	1
Balmoral	0	2	Bannockburn	2	2
Beaudeisert	2	4	Beenleigh	1	1
Belmont	4	5	Bethania	1	1
Birkdale	1	6	Boronia Heights	1	2
Browns Plains	1	1	Buccan	2	2
Burbank	1	1	Calamvale	5	5
Camp Hill	6	9	Cannon Hill	6	9
Capalaba	6	10	Carbrook	1	1
Carina	7	11	Carina Heights	3	5
Carindale	6	10	Cedar Vale	2	3
Chandler	1	1	Chelmer	1	2
Cleveland	4	5	Coochiemudlo Island	2	2
Coopers Plains	1	2	Coorparoo	7	9
Corinda	1	3	Cornubia	2	6
Crestmead	1	2	Daisy Hill	2	3
Darra	4	5	Doolandella	1	2
Drewvale	2	4	Durack	1	3
Dutton Park	3	3	Eagleby	4	6
East Brisbane	1	3	Edens Landing	1	2
Eight Mile Plains	4	5	Fairfield	3	4
Flagstone	3	5	Forest Lake	7	8
Forestdale	1	1	Gleneagle	1	2
Graceville	1	2	Greenbank	7	9
Greenslopes	4	8	Hawthorne	1	3
Heathwood	1	1	Hemmant	3	4
Heritage Park	2	2	Highgate Hill	1	3
Hillcrest	1	1	Holland Park	4	4
Holland Park West	4	9	Holmview	0	1
Inala	1	1	Jamboree Heights	1	3
Jimboomba	1	5	Jindalee	3	5
Kangaroo Point	1	2	Karragarra Island	1	1
Kuraby	4	4	Logan Reserve	2	2
Logan Village	4	5	Loganholme	2	2
Loganlea	0	1	Lota	3	3
Macgregor	1	2	Mackenzie	0	1
Macleay Island	5	5	Manly	0	1
Manly West	6	13	Mansfield	6	10
Marsden	3	3	Meadowbrook	1	1
Middle Park	1	2	Moorooka	11	29
Morningside	3	9	Mount Cotton	3	5
Mount Gravatt	4	7	Mount Gravatt East	8	10
Mount Ommaney	1	1	Mount Warren Park	2	2

Munruben	1	3	Murarie	2	4
New Beith	4	9	Norman Park	3	4
Ormiston	2	3	Oxley	8	12
Pallara	0	1	Park Ridge	0	3
Park Ridge South	2	2	Parkinson	1	3
Priestdale	1	1	Redland Bay	4	6
Regents Park	2	5	Riverhills	2	6
Robertson	1	1	Rochedale	2	5
Rochedale South	5	11	Runcom	2	4
Russell Island	0	3	Salisbury	1	6
Seven Hills	1	3	Seventeen Mile Rocks	1	2
Shailer Park	4	7	Sheldon	3	3
Sherwood	3	4	Sinnamon Park	1	4
Slacks Creek	2	3	South Brisbane	1	1
South Maclean	0	1	Springwood	2	3
Stockleigh	1	1	Sumner	1	1
Sunnybank	0	3	Sunnybank Hills	5	10
Tamborine	1	2	Tanah Merah	0	3
Tarragindi	10	17	Tennyson	1	1
Thorneside	1	1	Thornlands	3	7
Tingalpa	1	3	Underwood	2	3
Upper Mount Gravatt	3	5	Veresdale	0	1
Victoria Point	7	9	Wakerley	2	2
Waterford	1	1	Waterford West	2	3
Wellington Point	2	6	West End	2	2
Westlake	3	6	Windaroo	0	1
Wishart	6	14	Woodhill	0	2
Woodridge	1	1	Woolloongabba	0	2
Wynnum	8	17	Wynnum West	3	8
Yarrabilba	0	1	Yeerongpilly	4	5
Yeronga	9	14			
Total participants:	379		Total registrants:	663	

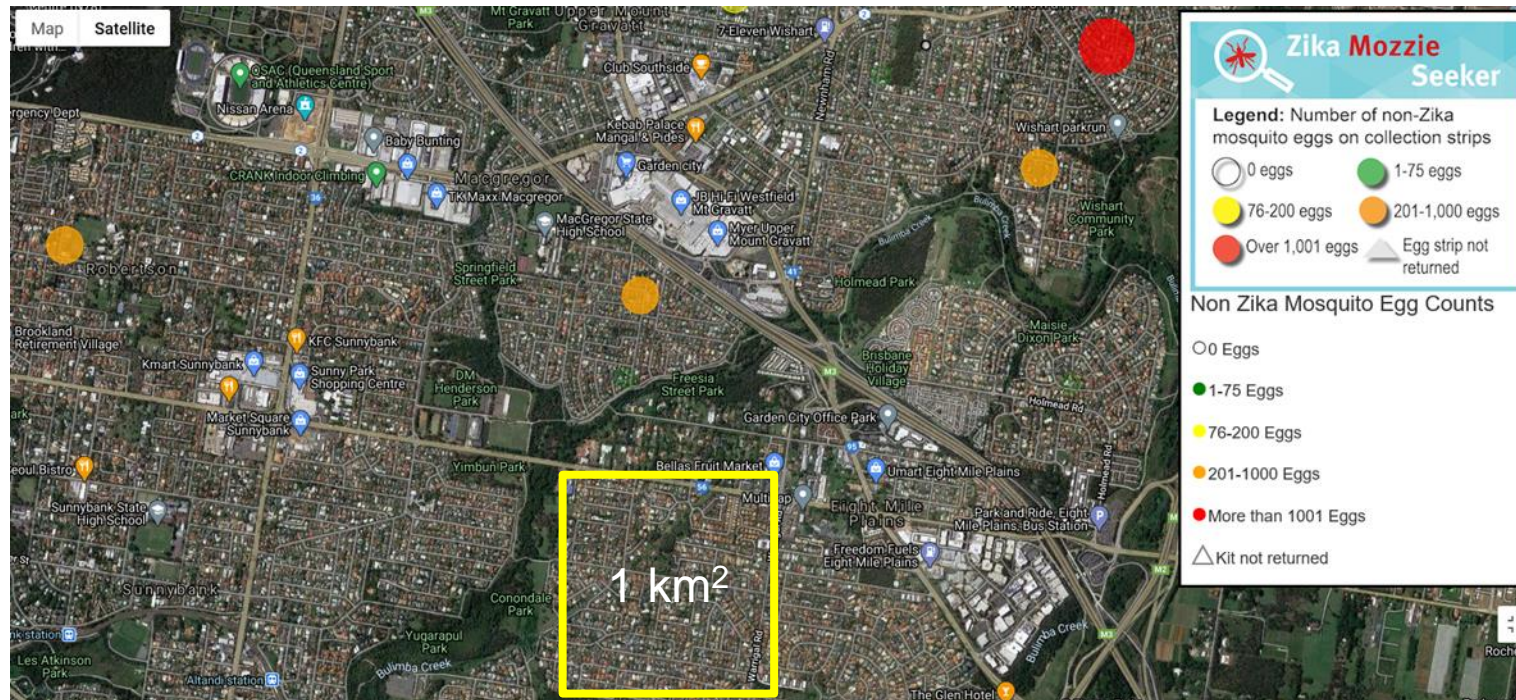
ZMS reports at suburb level

Can also report by council to identify larger engagement targets



All suburbs are NOT equal

Residential, commercial and greenspace. Can we set targets?



Council	No. Suburbs	Mean Area (km ²)/ Suburb	Mean Pop./ Suburb	People/ km ²	Mean No. Dwellings/ suburb	Dwellings/ km ²	People/ home	TARGET A ZMS 2 - 4 Part./ suburb	TARGET B ZMS 1 - 2 Part./ km ²
Brisbane	101	4.4	6,053.8	1,375.8	2,373.3	539.4	2.6	202 - 404	444 - 888
Logan	69	3.3	4,452.1	1,349.1	1,588.5	481.4	2.9	138 - 276	228 - 456
Redland	20	15.0	7,342.8	489.5	2,980.8	198.7	2.6	40 - 80	300 - 600
No. ovitraps								380 - 760	972 - 1,944

Are there holes (R1-12), why are they there?

A. Suburbs without registrants ($n = 29$)

	Council	Suburb	Pop. ABS 2021	Area (km ²)	Descriptor
1	Brisbane	Lytton	6	6.9	commercial
2	Brisbane	Port of Brisbane	0	24.6	commercial
3	Logan	Lyons	39	44.2	undeveloped
4	Redlands	North Stradbroke	181	271.1	National Park,
5	Redlands	Peel Island	0	12.4	National Park
6	Scenic Rim	Barney View	38	36.7	Rural locality
7	Scenic Rim	Birnam	109	20.9	Rural locality
8	Scenic Rim	Bromelton	129	113.8	Rural locality
9	Scenic Rim	Chinghee Creek	35	22.6	Rural locality
10	Scenic Rim	Christmas Creek	88	41.1	Rural locality
11	Scenic Rim	Cryna	134	22.9	Rural locality
12	Scenic Rim	Darlington	98	52.7	Rural locality
13	Scenic Rim	Josephville	172	60.1	Rural locality
14	Scenic Rim	Kerry	306	101.8	Rural locality
15	Scenic Rim	Knapp Creek	59	84.7	Rural locality
16	Scenic Rim	Laravale	185	57.1	Rural locality
17	Scenic Rim	Mount Barney	46	82.6	Rural locality
18	Scenic Rim	Mount Gipps	7	15.7	Rural locality
19	Scenic Rim	Mount Lindsey	14	68.2	Rural locality
20	Scenic Rim	Nindooindah	95	54.8	Rural locality
21	Scenic Rim	Oaky Creek	96	53.1	Rural locality
22	Scenic Rim	Palen Creek	368	100.9	Rural locality
23	Scenic Rim	Running Creek	146	112.3	Rural locality
24	Scenic Rim	Tabooba	57	24.2	Rural locality
25	Scenic Rim	Tabragalba	48	26.5	Rural locality
26	Scenic Rim	Tamrookum	94	19.1	Rural locality
27	Scenic Rim	Tamrookum Creek	35	30.7	Rural locality
28	Scenic Rim	Undullah	24	93.3	Rural locality
29	Scenic Rim	Wyaralong	20	90.1	Rural locality
		Total	2,629	1,745.1	
		mean	90.6	60.2	

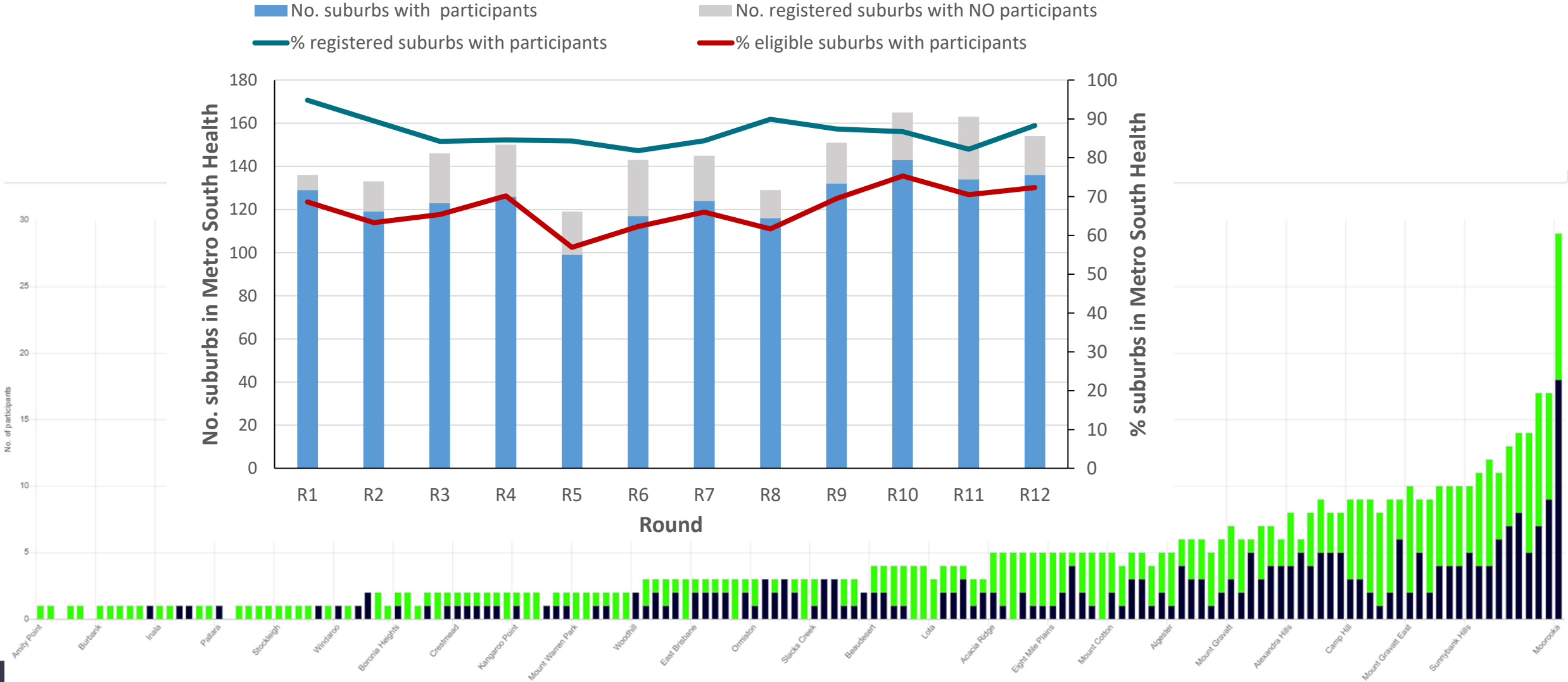
B. Registered suburbs with no participants ($n = 24$)

	Council	Suburb	Pop. ABS 2021	Area (km ²)	Descriptor
1	Brisbane	Bulwer	59	0.4	Island community
2	Brisbane	Karawatha	337	8.6	Undeveloped, park
3	Brisbane	Koorinal	43	0.2	Island community
4	Brisbane	Larapinta	0	6	New urban development
5	Brisbane	Richlands	5,621	5	Urban development
6	Brisbane	Stones Corner	2,336	0.6	Urban development
7	Brisbane	Wacol	4,253	18.2	Urban development
8	Brisbane	Willawong	145	26.7	Commercial
9	Logan	Belivah	515	3.3	Green space, rural
10	Logan	Cedar Creek	861	38.7	Rural community
11	Logan	Flinders Lakes	0	11.9	Development corridor
12	Logan	Glenlogan	1,122	6.7	Rural, development corridor
13	Logan	Monach Glen	0	9.7	Rural community
14	Logan	North Maclean	1,581	20.5	Rural community
15	Logan	Riverbend	661	16	Rural community
16	Logan	Silverbark Ridge	0	5.3	Urban development
17	Logan	Wolfdene	266	11.1	Rural community
18	Redland	Cowan Cowan	27	0.1	Island community
19	Redland	Kagaru	19	29	Island community
20	Scenic Rim	Allenview	209	43.6	Rural community
21	Scenic Rim	Biddadabba	171	42.3	Rural community
22	Scenic Rim	Hillview	76	19	Rural community
23	Scenic Rim	Lamington	89	58.2	Rural community
24	Scenic Rim	Rathdowney	320	72.2	Rural community
		Total	18,711	453.3	
		mean	779.6	18.9	

ZMS is expansive across urbanised suburbs

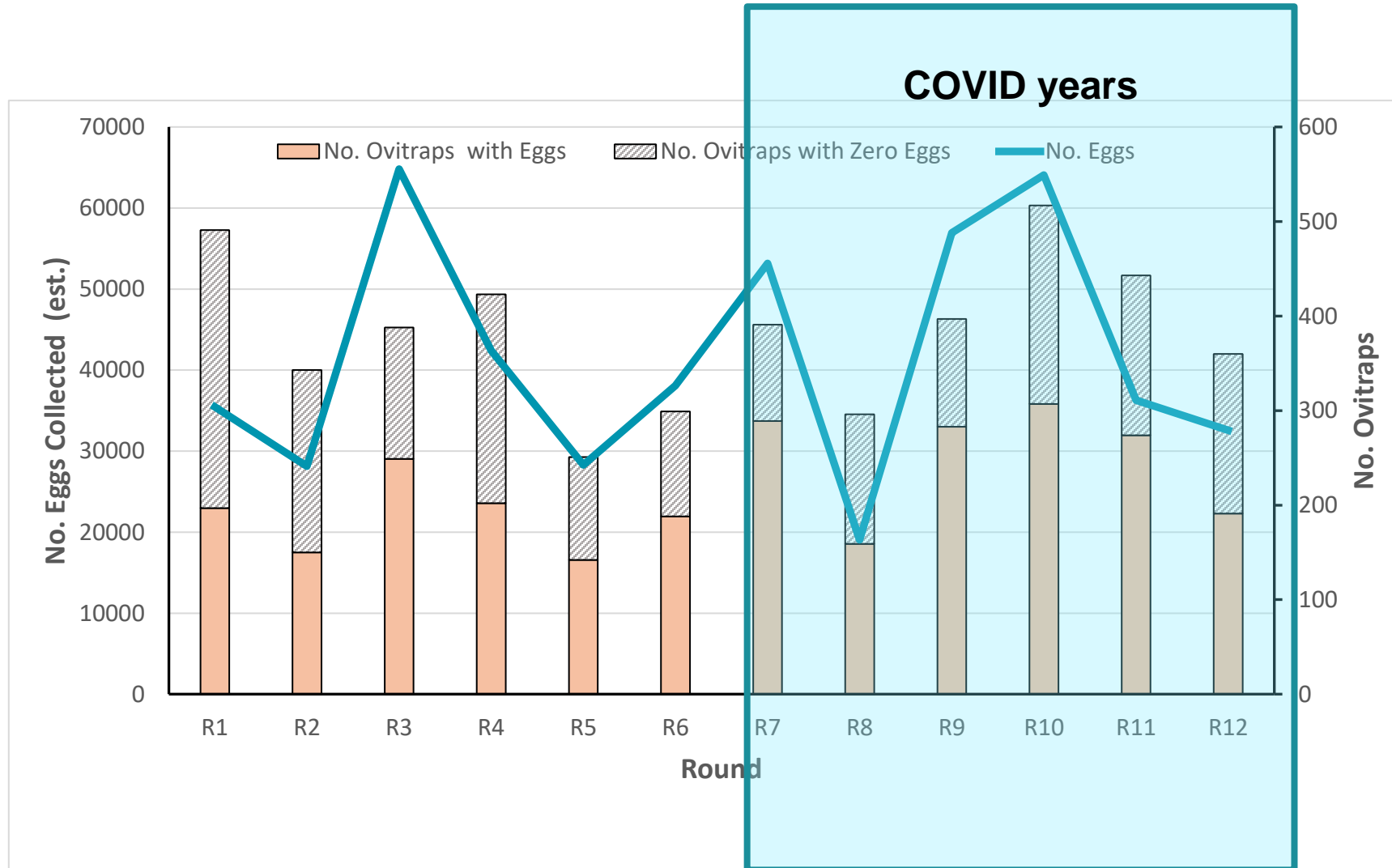
Spatial footprint via suburb: R1-12 ($n = 172$ participatory suburbs)

'Eligible suburb' arbitrarily defined as >50 households



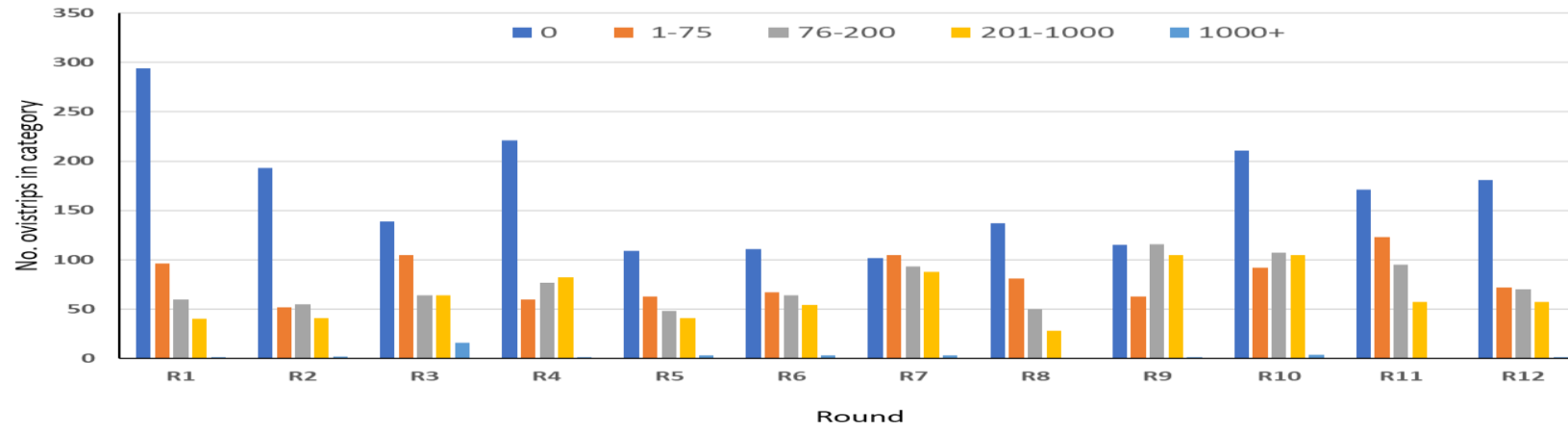
No 'Zika mozzies' detected 2017-2023

502,855 eggs ($n = 153$ PCRs) collected by 4,601 ovitraps

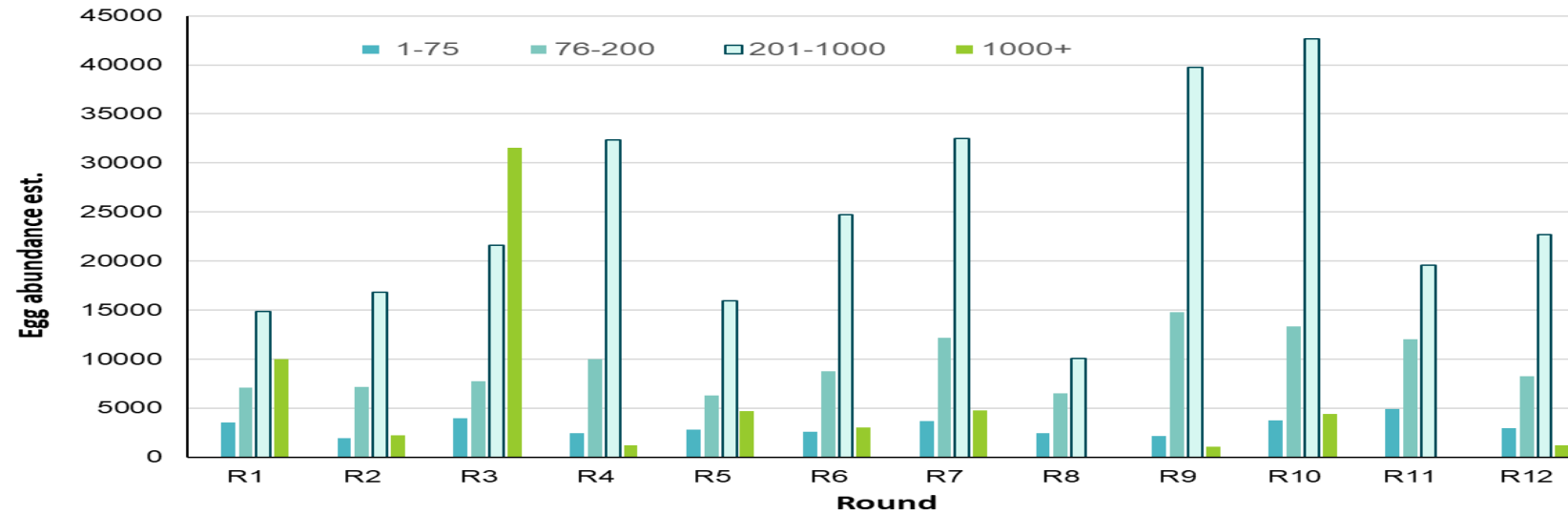


Eggs on ovistrips (R1-12)

A. Number of ovistrips per category

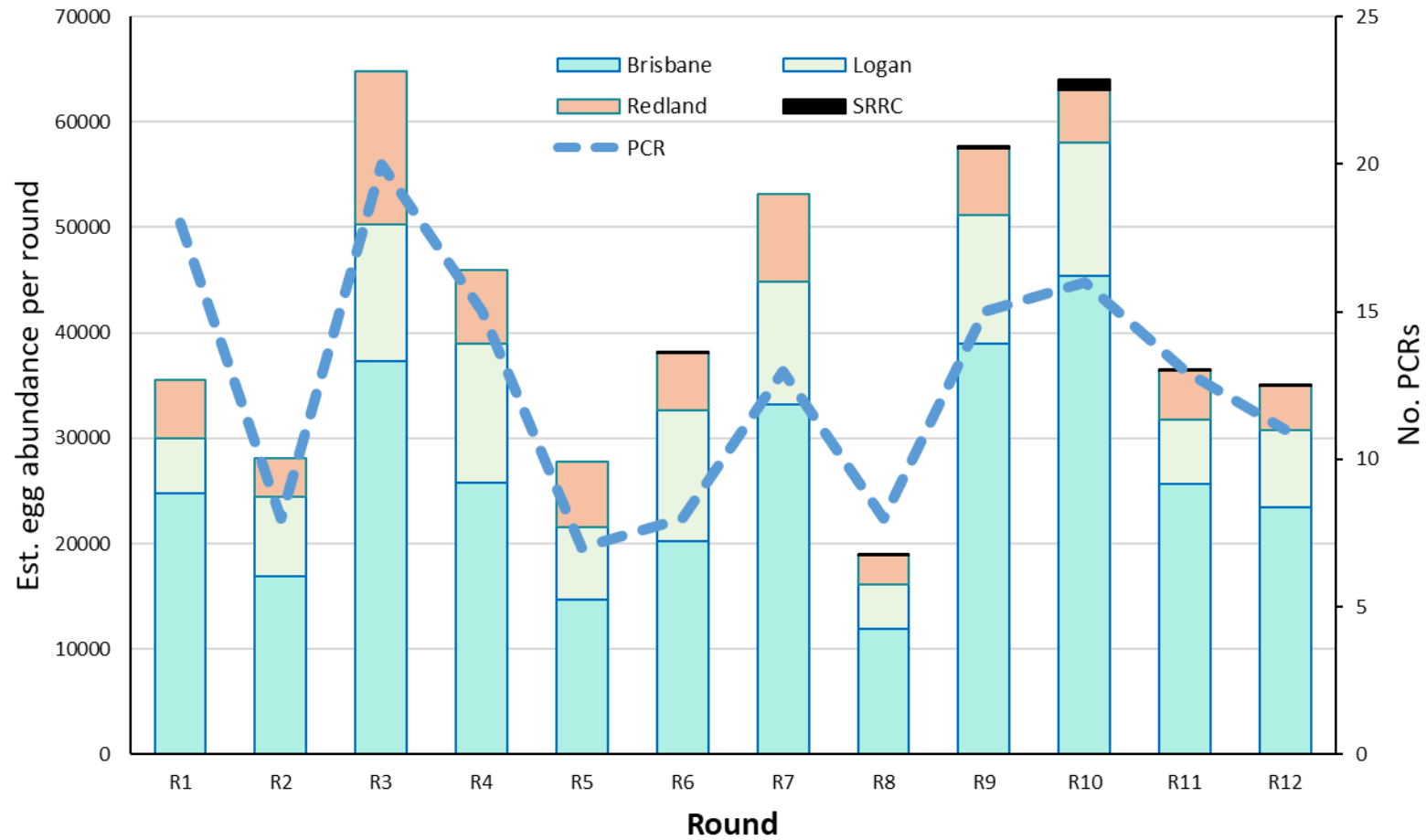


B. Egg abundance estimates per category



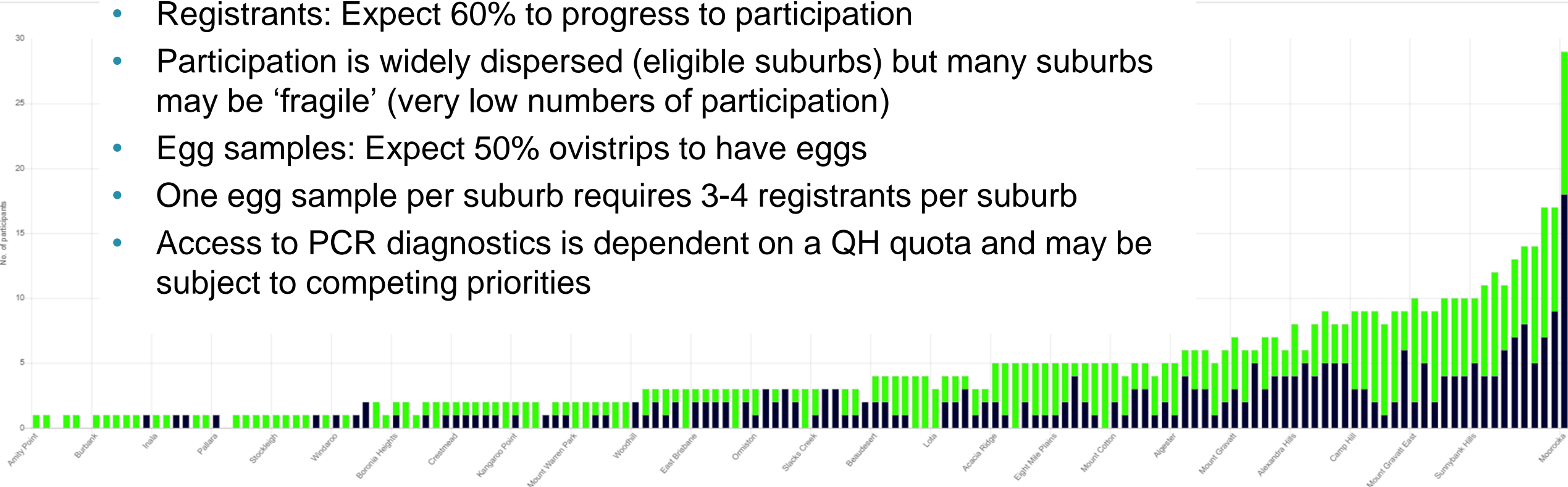
PCR is very efficient

502,855 eggs from 2,648 ovitraps processed by 153 PCRs
mean 3,287 eggs/PCR (mean 12.7 PCRs/Round, range 7-20)



Considerations for a blueprint for expansion

- Community engagement is needed to recruit and manage attrition and focus on target suburbs
- Registration and participation is highly variable, both casual and loyal participants are important
- Registrants: Expect 60% to progress to participation
- Participation is widely dispersed (eligible suburbs) but many suburbs may be 'fragile' (very low numbers of participation)
- Egg samples: Expect 50% ovistrips to have eggs
- One egg sample per suburb requires 3-4 registrants per suburb
- Access to PCR diagnostics is dependent on a QH quota and may be subject to competing priorities

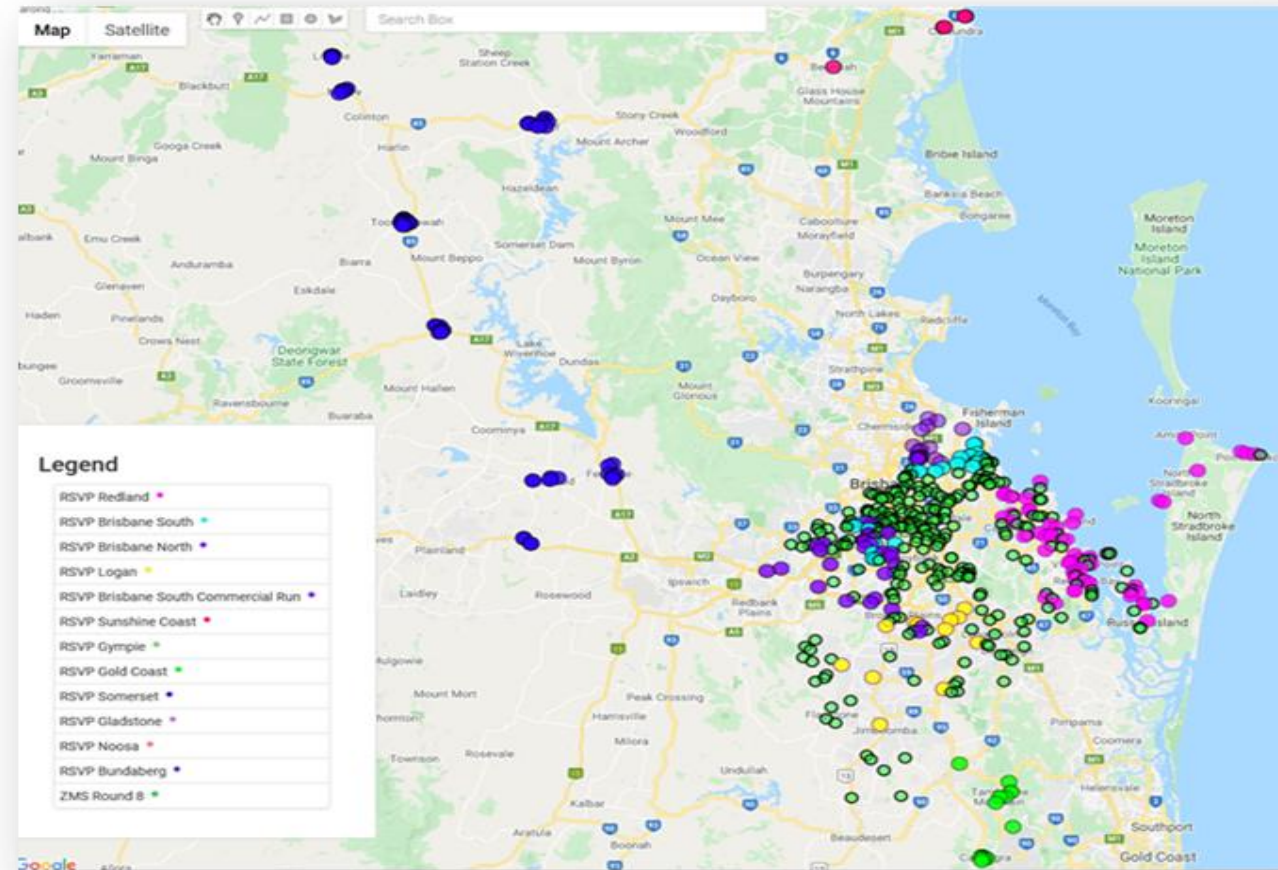


ZMS is now 'business-as-usual' in MSH

- Biannual rounds refresh confidence that Zika mozzies are absent in lead up to Brisbane Olympics 2032
- Sustainable and scalable. Data management efficiencies will continue to evolve
- Complements other CS platforms (e.g. *Mozzie Monitors*, *STEM champions*) to increase options for participation
- A LAMP-based colorimetric diagnostic is being optimised in a collaboration with QIMRB (Dr Brian Johnson) via a MARC grant as an alternative to sustain, enhance, or expand ZMS
- Genomic study of *Ae. notoscriptus* – partnered with QIMRB (Dr Gordana Rasic) to explore grant opportunities
- Integration ZMS with *Rapid Surveillance for Vector Presence Program* (commercial premises focus) provides a 'best-practice' surveillance strategy



Thanks to our citizen scientists and all others involved!



Example of SEQ ovitrap sites: Combined ZMS and RSVP program