Advancing riverine eDNA sampling methodology for monitoring and surveillance of terrestrial pest species

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ZIP ZERO INVASIVE PREDATORS *Enabling a new future*

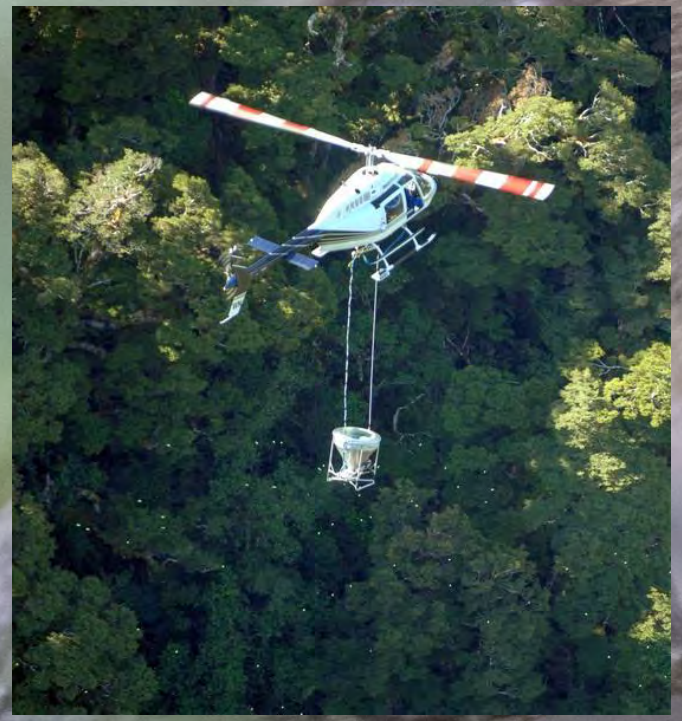
Ōtākou Whakaihu Waka UNIVERSITY OF OTAGO

WILDERLAB Discovery through DNA

Wildlife Services NWRC National Wildlife Research Center

THE UNIVERSITY OF AUCKLAND Te Whare Wānanga o Tāmaki Makaurau NEW ZEALAND


Data SIO, NOAA, U.S. Navy, NGA, GEBCO
Image Landsat / Copernicus
Google Earth



Remotely-reporting AI camera = $5.80 /ha

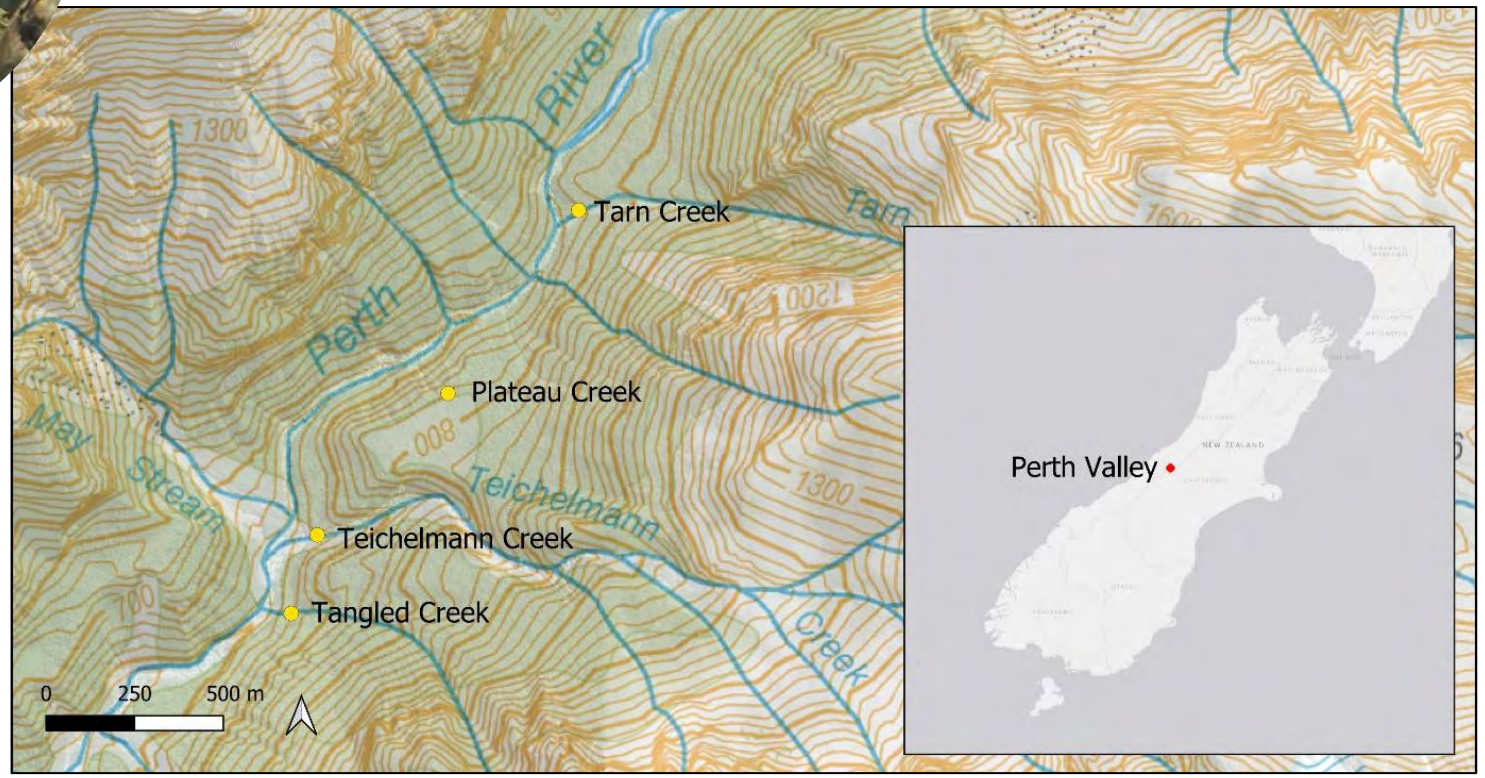
eDNA sampling = ?

'…seeks to use innovative new eDNA technologies to test, develop and establish efficient, sensitive and reliable in-the-field surveys of mammalian pests and native species.'

'…to advance eDNA sampling as technique that is (i) fit for purpose as a pest surveillance tool, and (ii) beats traditional detection techniques on a cost-per-ha basis.'

Syringe sampling vs. Passive sampling

Syringe sampling vs. Passive sampling



Syringe sampling vs. Passive sampling

Site	S1	P1	P2	P3	P Mean	% Passive/ Syringe	Volume (cumecs)	Deployment duration	Flow (m/s)
Teichelmann Creek	**44**	**62**	**58**	**67**	62.33	142%	0.85	28 hours	1.45
Tarn Creek	**47**	**52**	**55**	**50**	52.33	111%	1.01	27 hours	1.10
Plateau Creek	**53**	**47**	**62**	**40**	49.67	94%	0.05	24 hours	0.15
Tangled Creek	**69**	**54**	**62**	**62**	59.33	86%	0.21	22 hours	0.49

Mean AD Syringe = 53.25
Passive = 55.92

Syringe sampling vs. Passive sampling

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Optimal deployment duration

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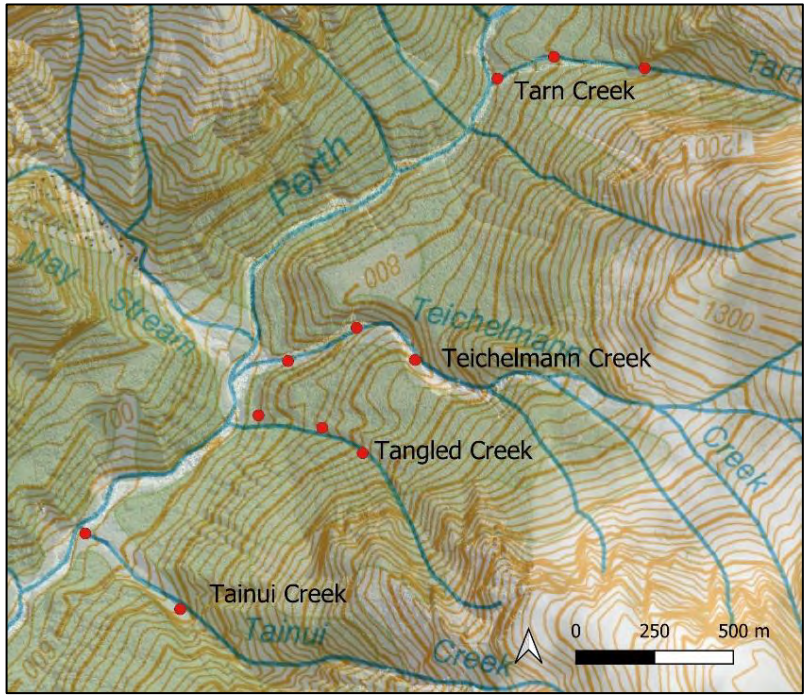
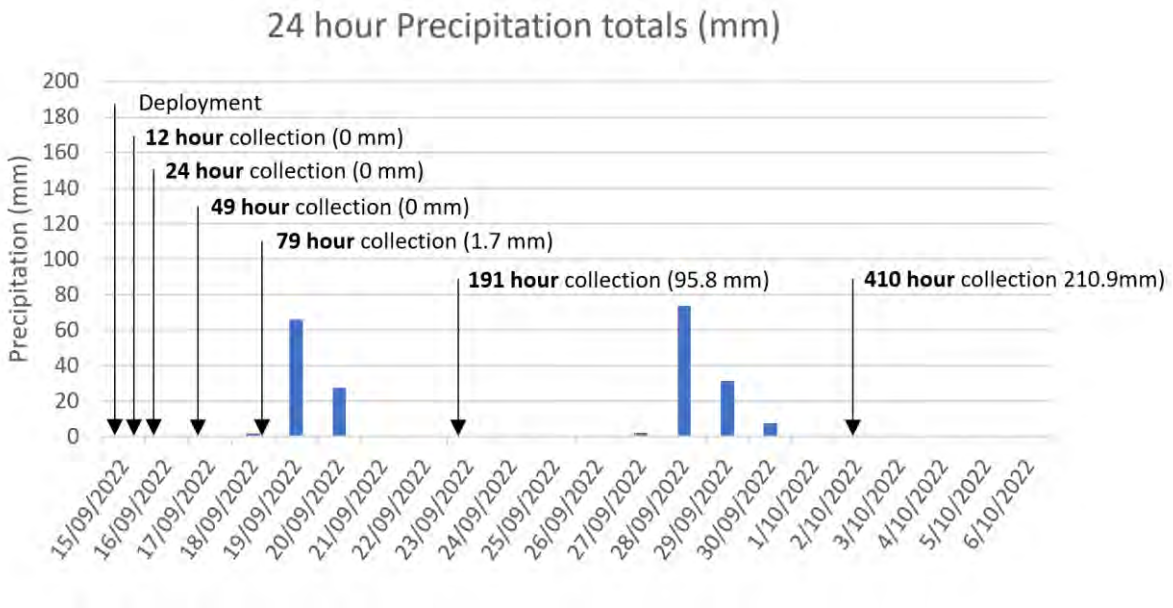
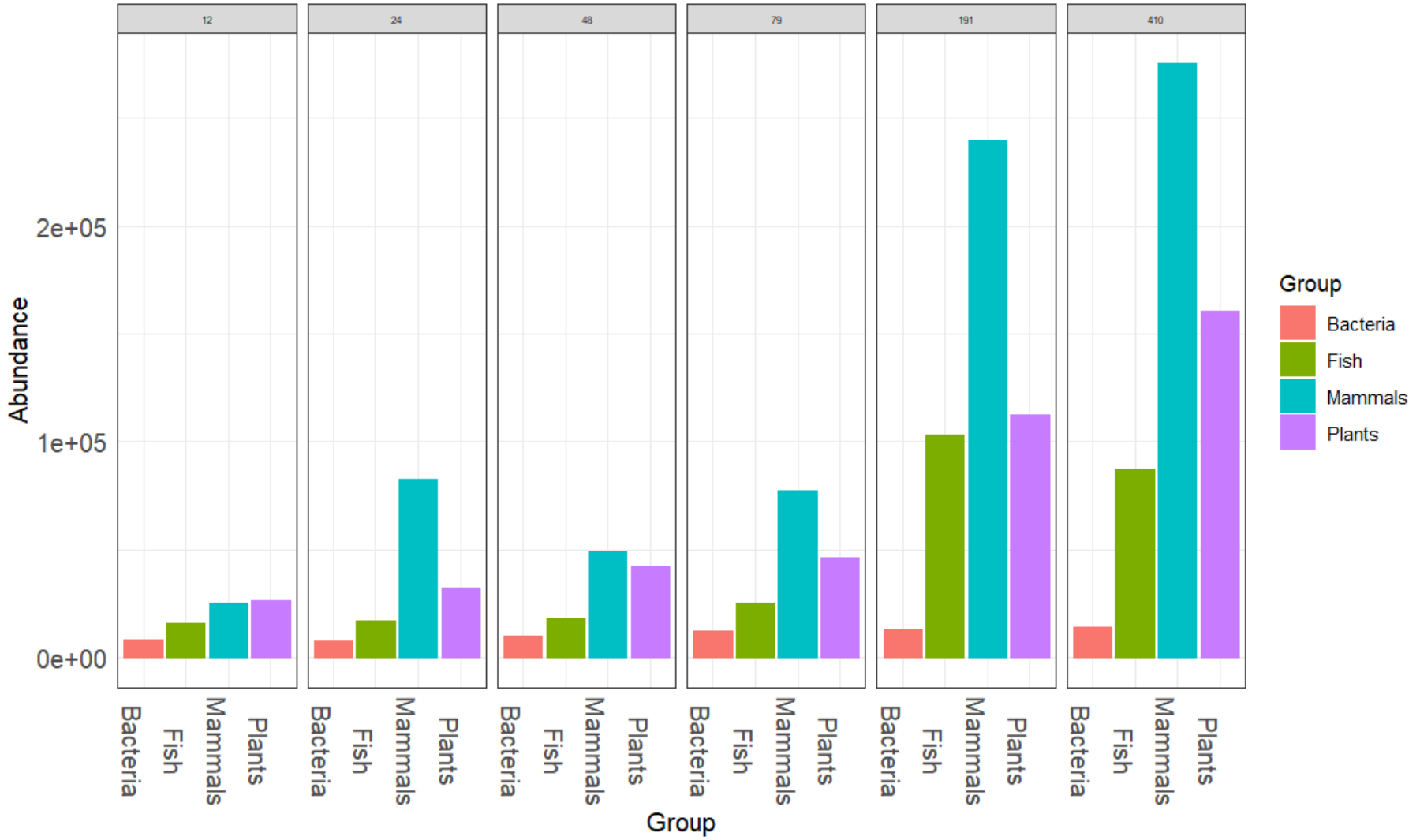




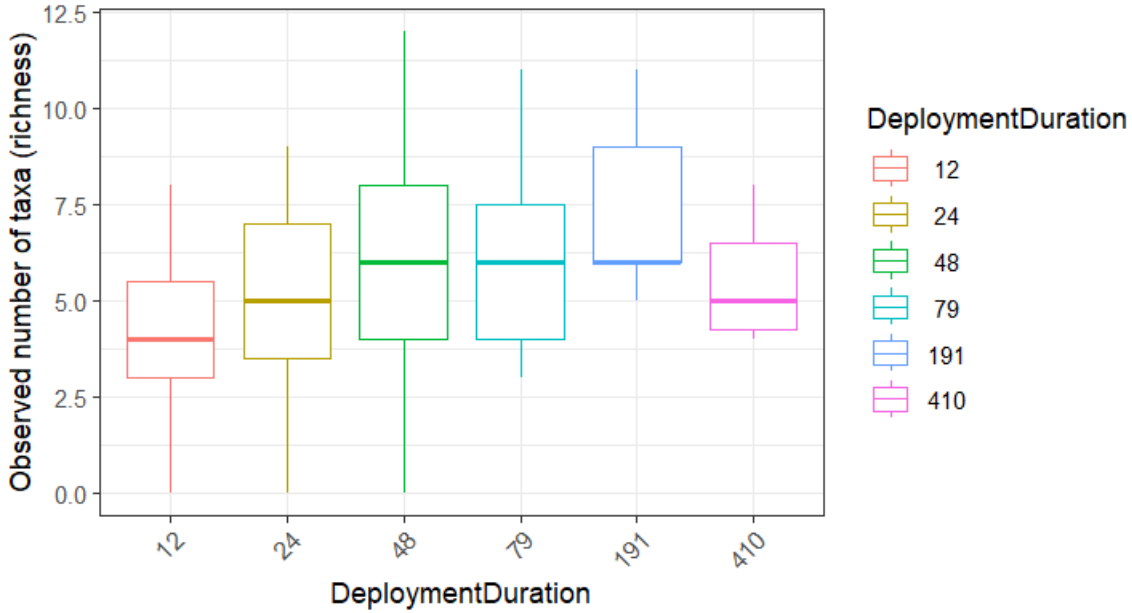
Optimal deployment duration

All taxa (major)

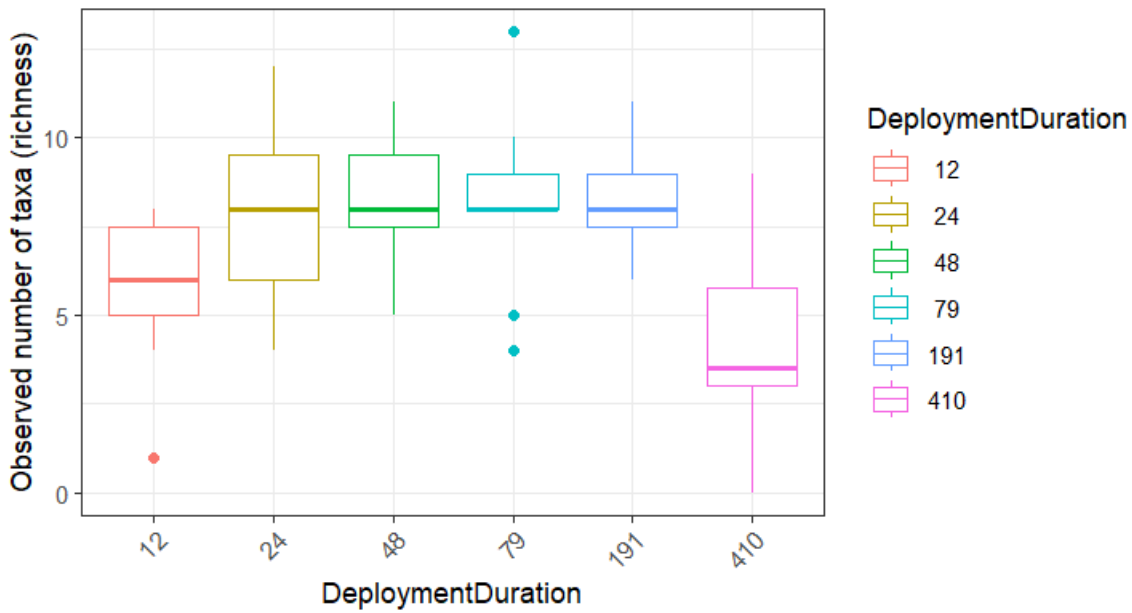


Optimal deployment duration

Terrestrial taxa



Aquatic taxa



Optimal deployment duration

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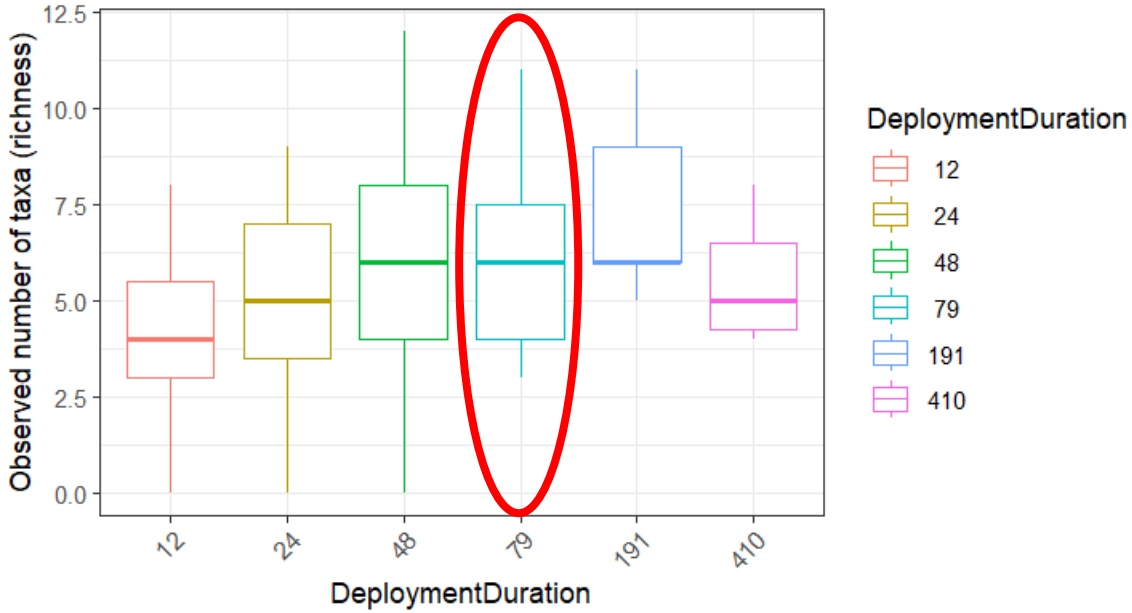
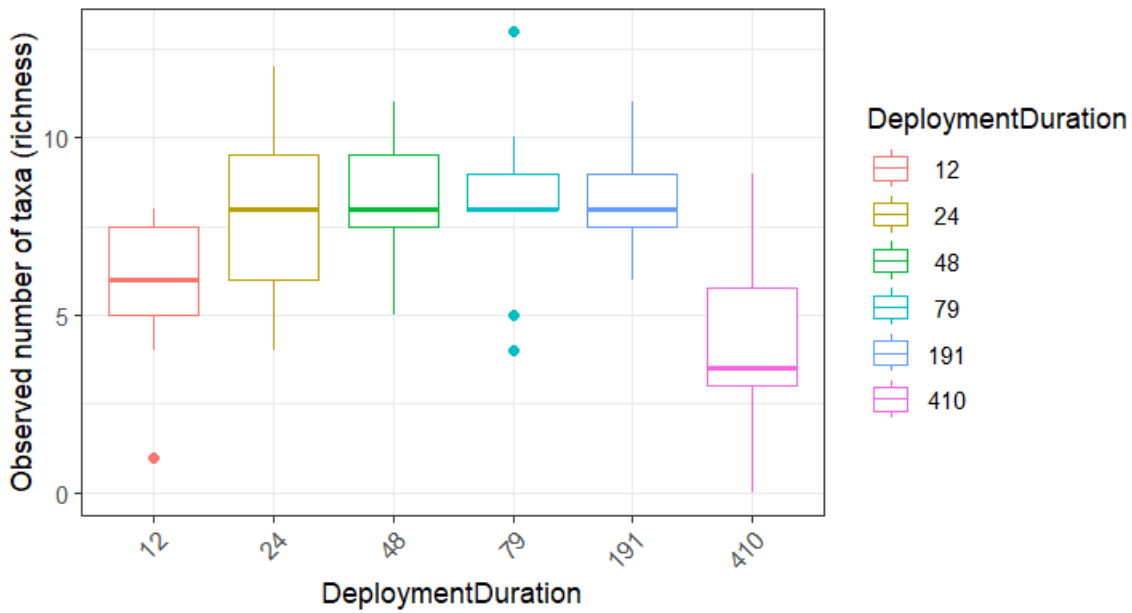


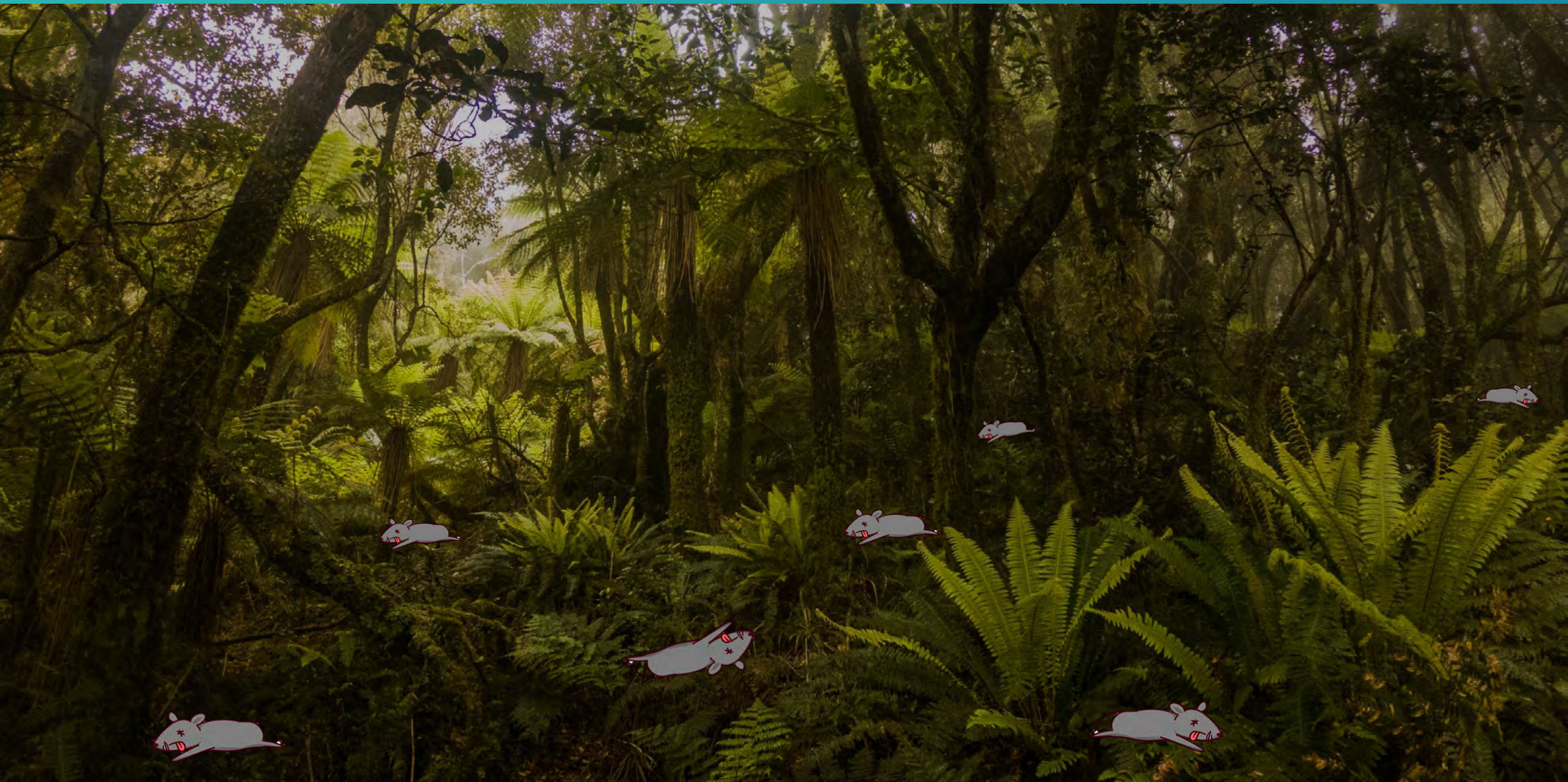
Aquatic taxa



Longer deployments = more terrestrial species detected. Field practicalities: 4-8 days ideal

Read counts strongly influenced by deployment duration: important to standardise if to be used in any quantitative way.

Rat signal decay after an aerial toxin operation



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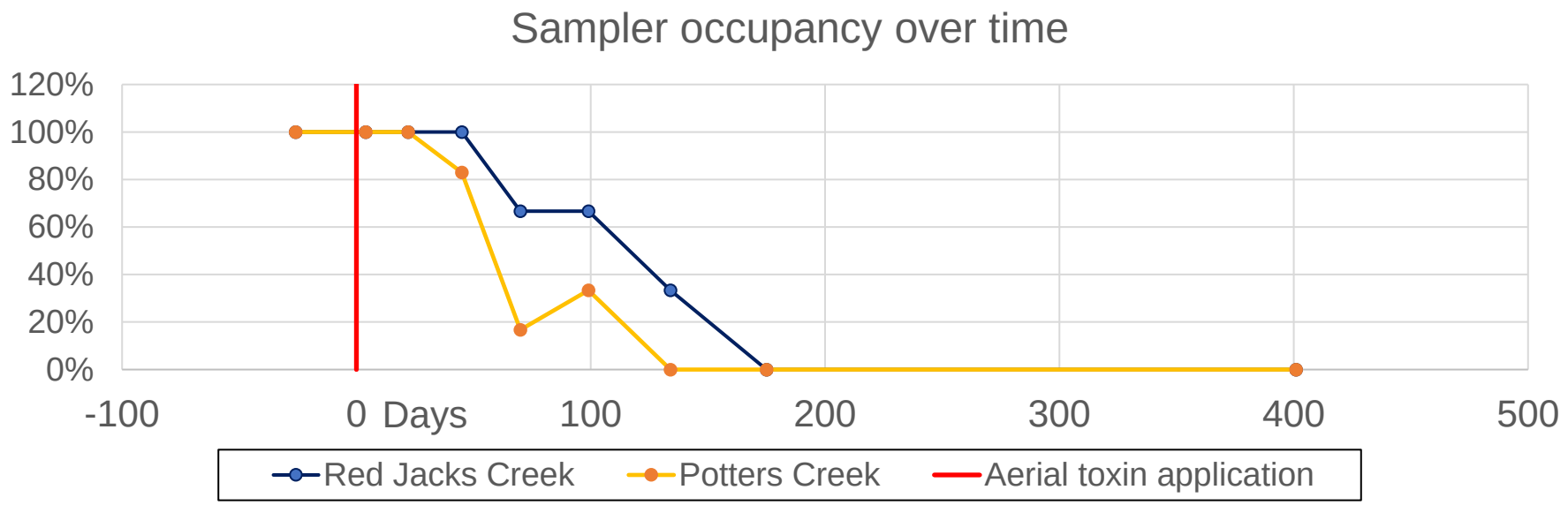

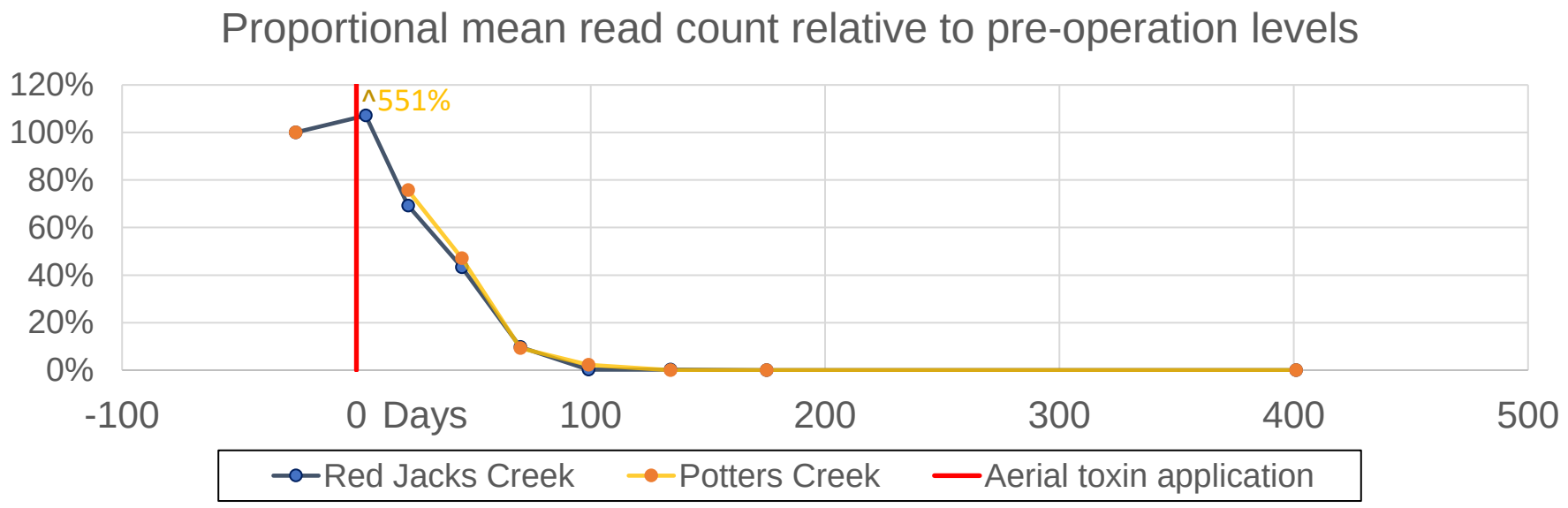

Passive sampling for index of abundance?

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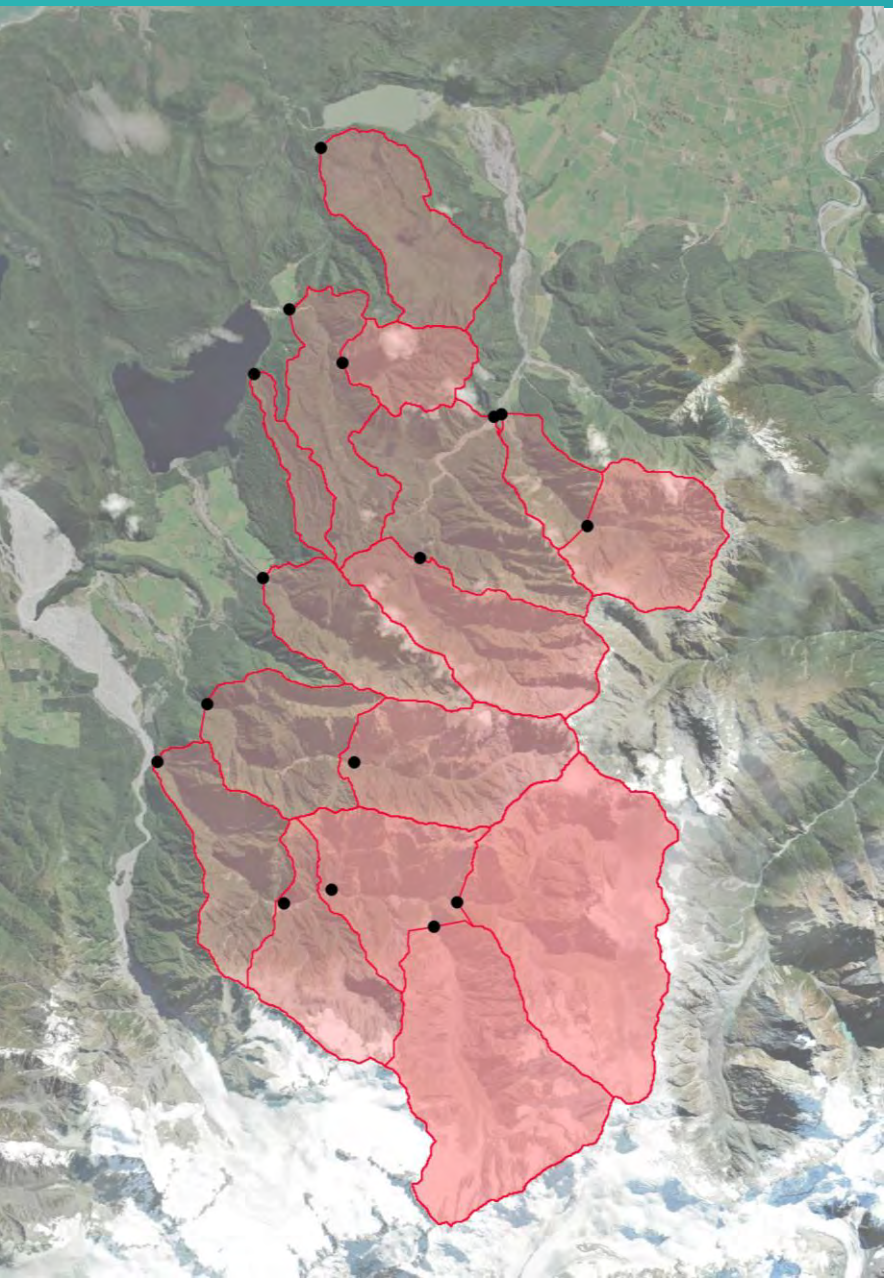

Site name	Density (Rats/ha)	Sampler occupancy (/6)	Mean read count	log mean read count
Zalas Creek	2.12	1.00	47486	4.68
MacDonalds Creek Lower	0.81	1.00	53385	4.73
Red Jacks Creek	0.80	1.00	50997	4.71
MacDonalds Creek Upper	0.71	1.00	27271	4.44
Waitangitahuna Creek Lower	0.56	0.50	6267	3.80
Potters Creek	0.44	1.00	6248	3.80
Darnley Creek Lower	0.30	0.50	66	1.82
Tatare Stream Lower	0.28	1.00	6132	3.79
Waitangitahuna Creek upper	0.24	0.50	2482	3.39
Darnley Creek Upper	0.17	0.83	11234	4.05
Callery River Bridge	0.16	0.33	22	1.33
Tatare Stream Upper	0.13	0.50	5502	3.74
Callery River Gorge	0.12	0.20	42	1.62
Callery River Mid	0.10	0.17	13	1.10
Spencer Creek	0.07	0.17	18	1.26
Callery River Upper	0.05	0.17	12	1.06

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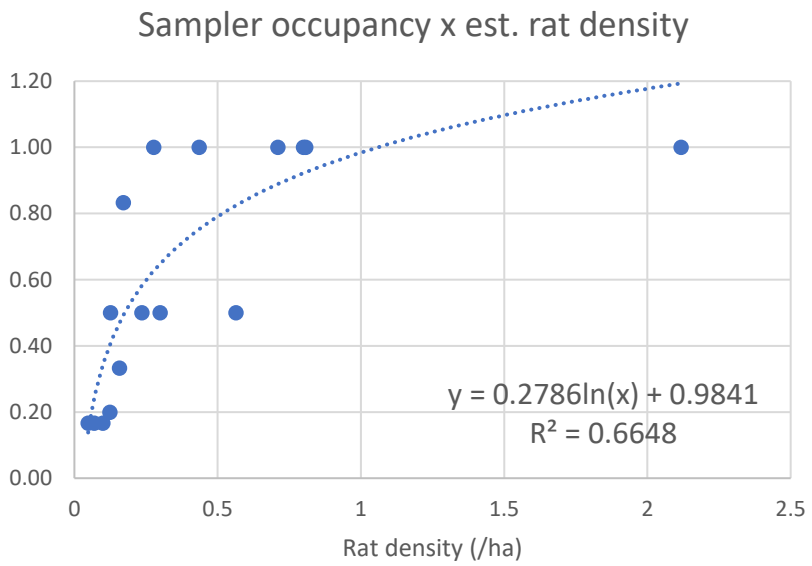

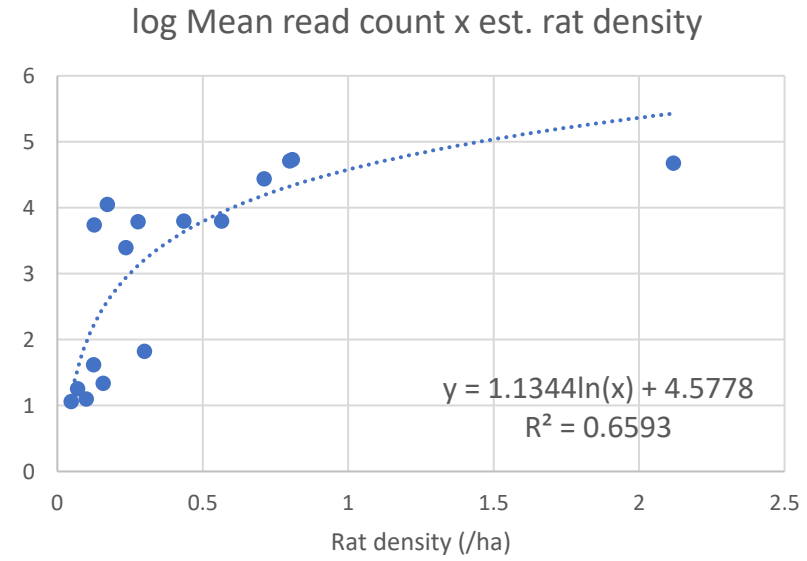

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Estimating sufficient sampling effort for survivor detection

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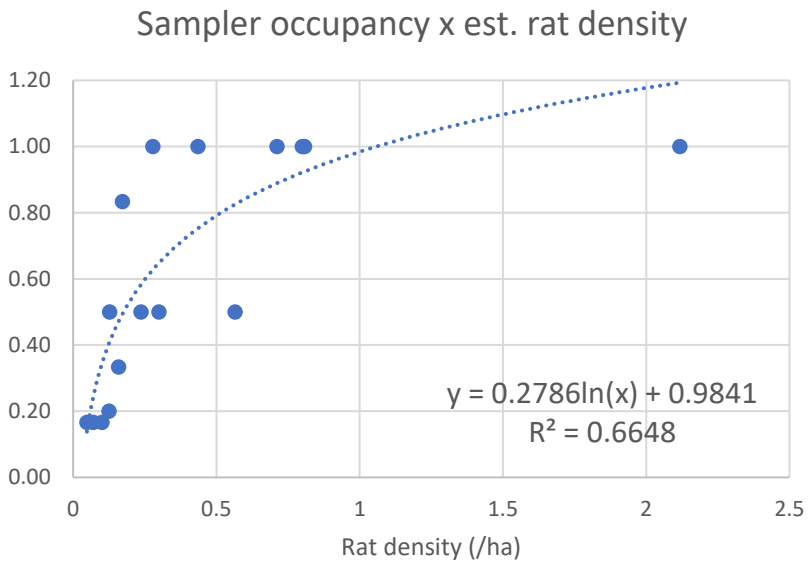

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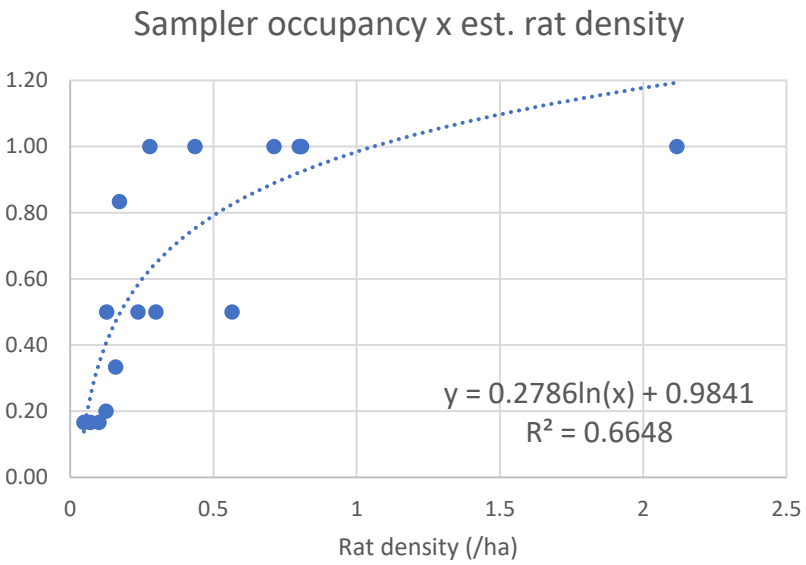

Sampler occupancy x rat density												
2.5	-0.04	0.40	0.60	0.79	0.90	0.98	1.00	1.00	1.00	1.00	1.00	1.00
2	-0.11	0.34	0.54	0.73	0.84	0.92	0.98	1.00	1.00	1.00	1.00	1.00
1.5	-0.19	0.26	0.46	0.65	0.76	0.84	0.90	0.95	1.00	1.00	1.00	1.00
1	-0.30	0.15	0.34	0.54	0.65	0.73	0.79	0.84	0.88	0.92	0.95	0.98
0.5	-0.49	-0.04	0.15	0.34	0.46	0.54	0.60	0.65	0.69	0.73	0.76	0.79
	1%	5%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%

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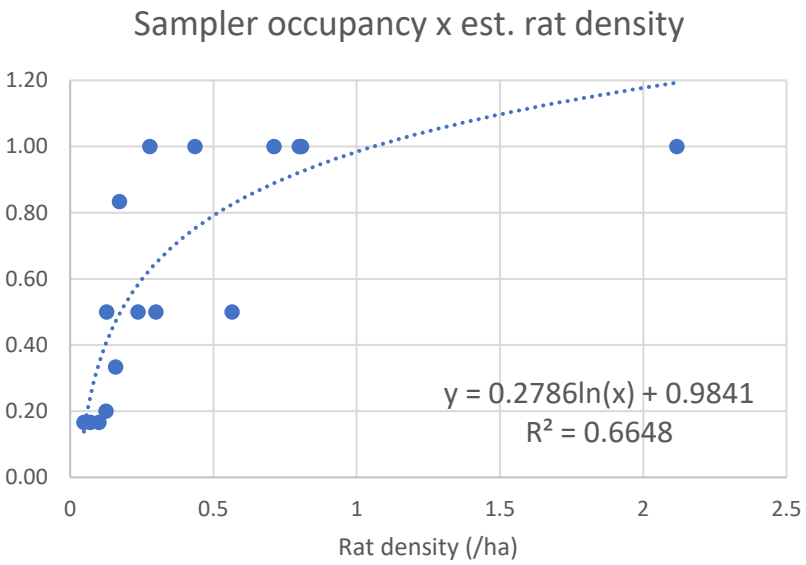

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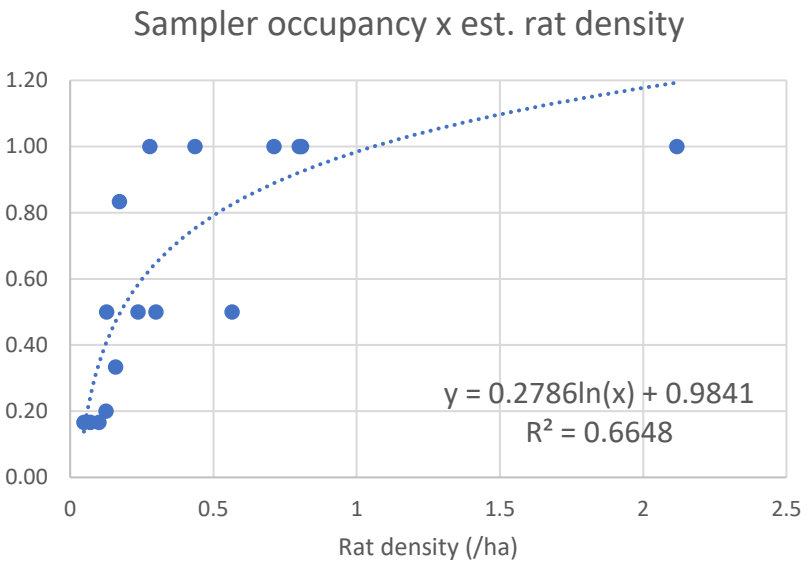
2	-0.11	0.34	0.54	0.73	0.84	0.92	0.98	1.00	1.00	1.00	1.00	1.00
1.5	-0.19	0.26	0.46	0.65	0.76	0.84	0.90	0.95	1.00	1.00	1.00	1.00
1	-0.30	0.15	0.34	0.54	0.65	0.73	0.79	0.84	0.88	0.92	0.95	0.98
0.5	-0.49	-0.04	0.15	0.34	0.46	0.54	0.60	0.65	0.69	0.73	0.76	0.79

samplers required for 95% confidence rat detection x rat density

	1%	5%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
2.5	NA	5.77	3.29	1.91	1.28	0.72	0.26	0.26	0.26	0.26	0.26	0.26
2	NA	7.14	3.90	2.30	1.62	1.17	0.72	0.26	0.26	0.26	0.26	0.26
1.5	NA	9.84	4.93	2.86	2.09	1.62	1.28	0.97	0.49	0.26	0.26	0.26
1	NA	18.50	7.14	3.90	2.86	2.30	1.91	1.62	1.39	1.17	0.97	0.72
0.5	NA	NA	18.50	7.14	4.93	3.90	3.29	2.86	2.55	2.30	2.09	1.91

Estimating sufficient sampling effort for survivor detection



Sampler occupancy x rat density

	1%	5%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
2.5	-0.04	0.40	0.60	0.79	0.90	0.98	1.00	1.00	1.00	1.00	1.00	1.00
2	-0.11	0.34	0.54	0.73	0.84	0.92	0.98	1.00	1.00	1.00	1.00	1.00
1.5	-0.19	0.26	0.46	0.65	0.76	0.84	0.90	0.95	1.00	1.00	1.00	1.00
1	-0.30	0.15	0.34	0.54	0.65	0.73	0.79	0.84	0.88	0.92	0.95	0.98
0.5	-0.49	-0.04	0.15	0.34	0.46	0.54	0.60	0.65	0.69	0.73	0.76	0.79

samplers required for 95% confidence rat detection x rat density

	1%	5%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
2.5	NA	5.77	3.29	1.91	1.28	0.72	0.26	0.26	0.26	0.26	0.26	0.26
2	NA	7.14	3.90	2.30	1.62	1.17	0.72	0.26	0.26	0.26	0.26	0.26
1.5	NA	9.84	4.93	2.86	2.09	1.62	1.28	0.97	0.49	0.26	0.26	0.26
1	NA	18.50	7.14	3.90	2.86	2.30	1.91	1.62	1.39	1.17	0.97	0.72
0.5	NA	NA	18.50	7.14	4.93	3.90	3.29	2.86	2.55	2.30	2.09	1.91

samplers required for 95% confidence rat detection x rat density (rounded up)

	1%	5%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
2.5	NA	6.00	4.00	2.00	2.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
2	NA	8.00	4.00	3.00	2.00	2.00	1.00	1.00	1.00	1.00	1.00	1.00
1.5	NA	10.00	5.00	3.00	3.00	2.00	2.00	1.00	1.00	1.00	1.00	1.00
1	NA	19.00	8.00	4.00	3.00	3.00	2.00	2.00	2.00	2.00	1.00	1.00
0.5	NA	NA	19.00	8.00	5.00	4.00	4.00	3.00	3.00	3.00	3.00	2.00

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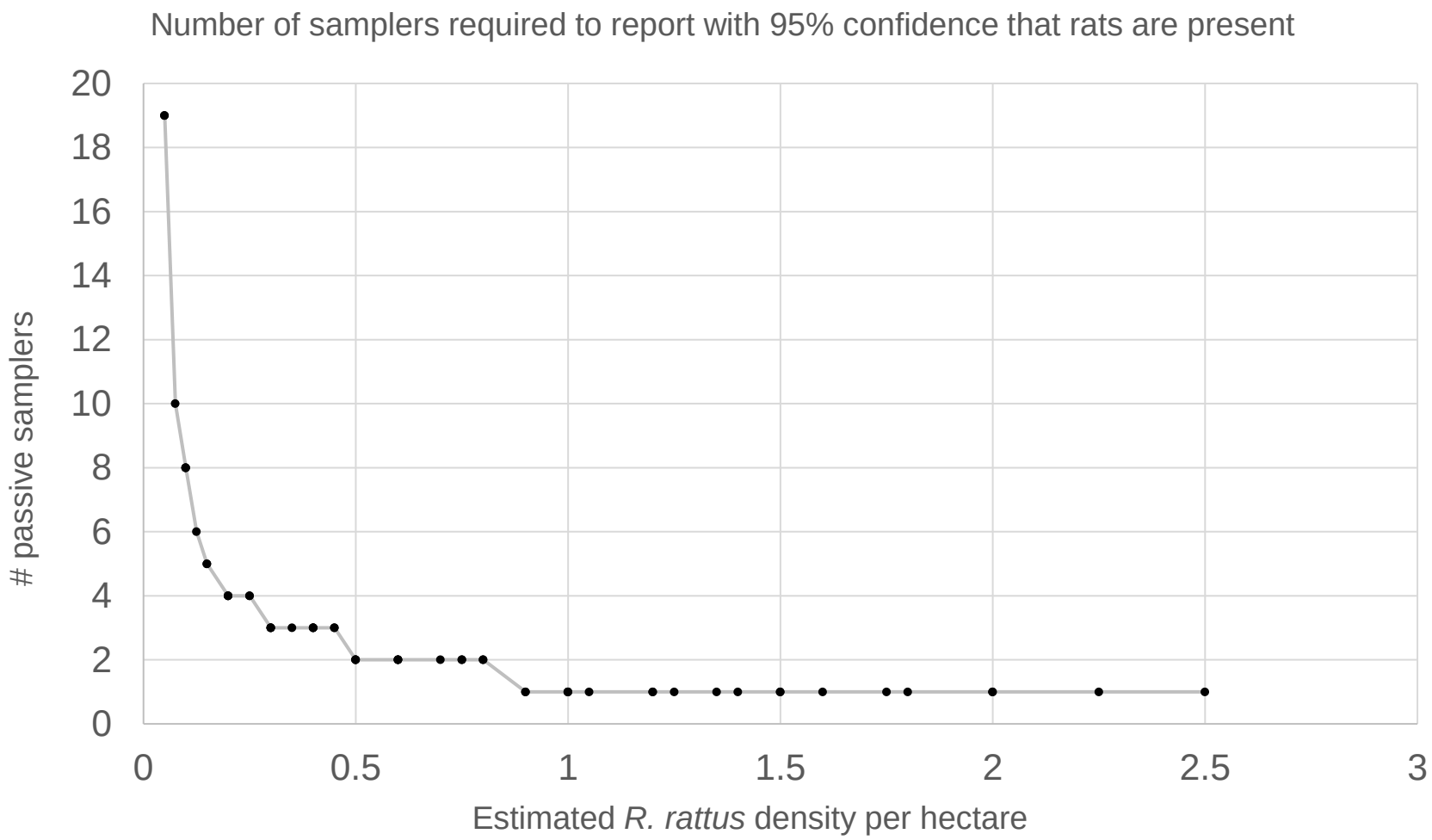

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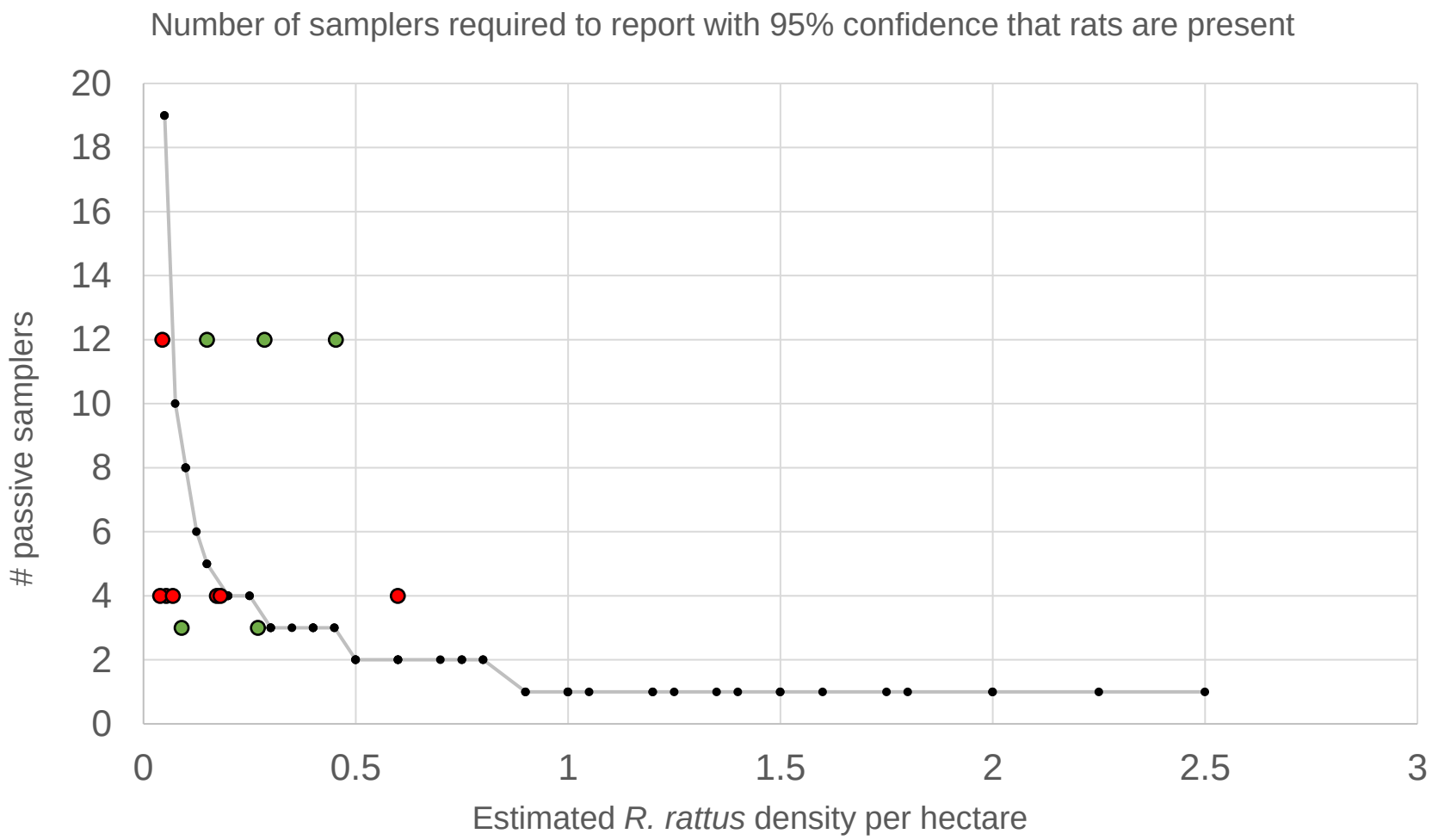
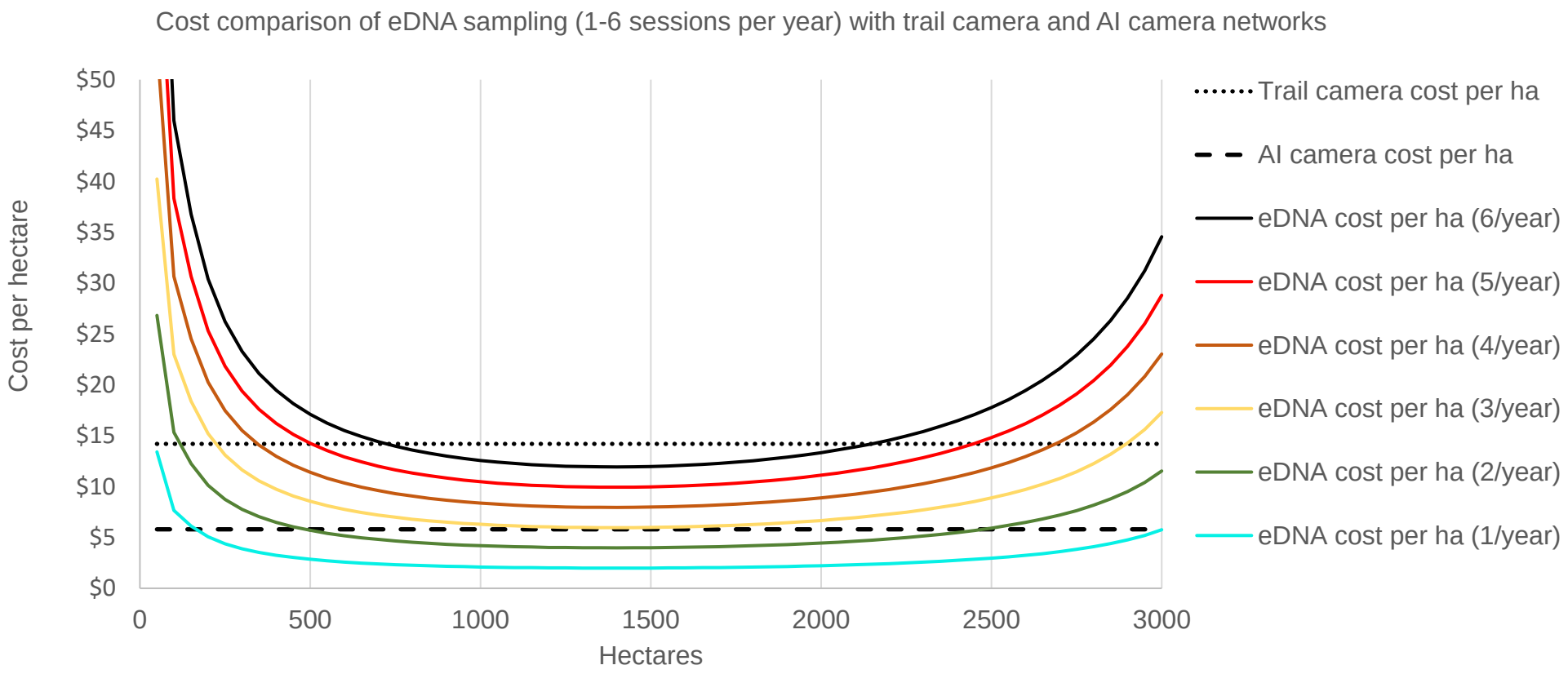


How does eDNA sampling compete with traditional techniques?

Target population size = 100 individuals



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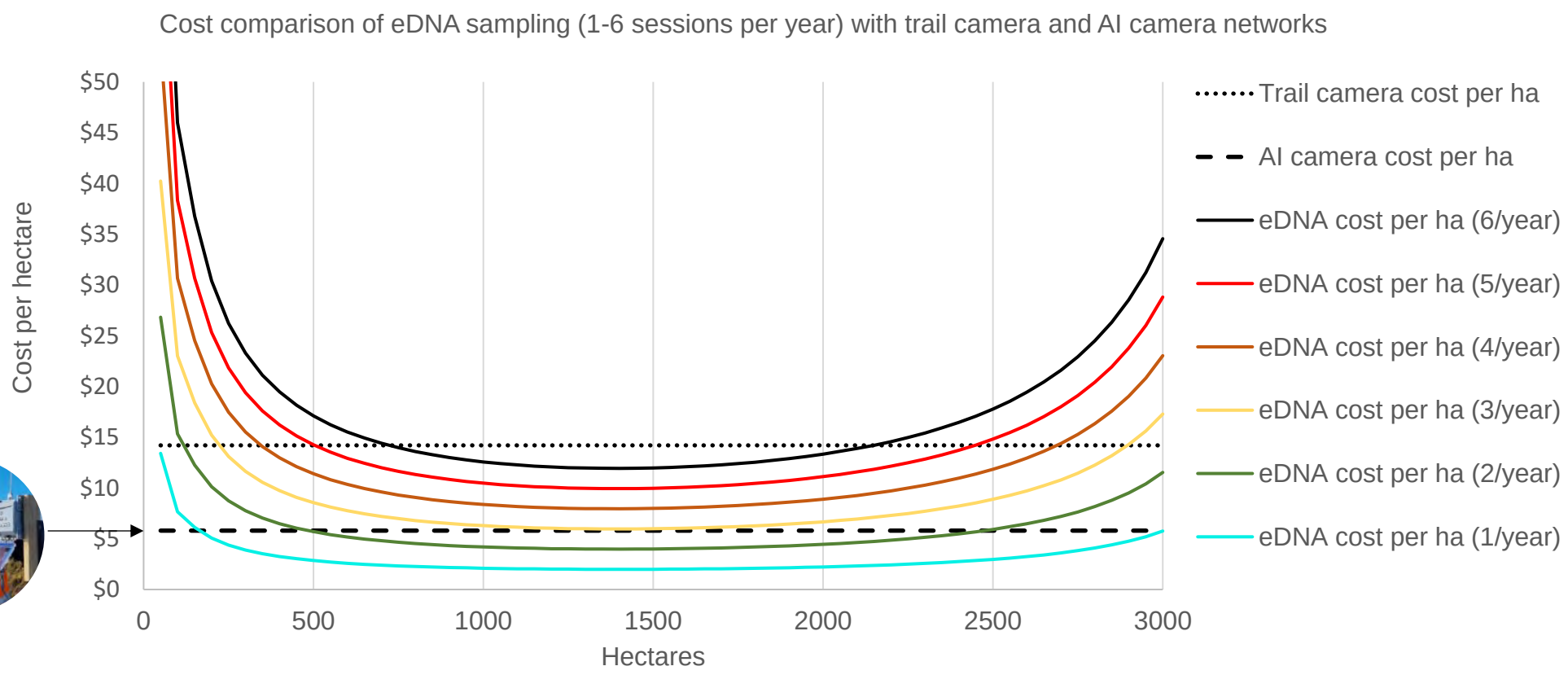

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