Supplementary material for

Attraction is not diversion: testing rainwater troughs as a measure to reduce wildlife visits to apiaries in Calakmul, Mexico

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Table S1. Species named by beekeepers as visiting their apiaries, as a share of the 48 respondents, and whether each was recorded by camera trapping. Species are ordered by the number of respondents naming them.

Species	Respondents	Share	Recorded by cameras
Nasua narica	40	83%	Yes
Eira barbara	35	73%	Yes
Meleagris ocellata	13	27%	Yes
Tapirus bairdii	12	25%	Yes
Crax rubra	11	23%	Yes
Ortalis vetula	9	19%	Yes
Pecari tajacu	5	10%	Yes
Mazama pandora	4	8%	Yes
Urocyon cinereoargenteus	4	8%	Yes
Ateles geoffroyi	3	6%	No
Panthera onca	2	4%	Yes
Didelphis sp.	1	2%	Yes
Tamandua mexicana	1	2%	Yes

Table S2. Sampling effort and independent events by site type. Events include all 50 species recorded.

Site type	Stations	Camera-trap days	Independent events
Troughs	8	4,371	5,266
Far apiaries	8	2,489	1,512
Near apiaries	8	4,003	1,366
All sites	24	10,863	8,144

Table S3. Independent events recorded for each species at troughs and at Far and Near apiaries (n = 8,144 events; 5,266 at troughs, 1,512 at Far and 1,366 at Near apiaries), and the number of the 24 stations at which each species was recorded. Species are ordered by total events within each class (22 birds and 28 mammals).

Class	Species	Troughs	Far	Near	Total events	Stations
Birds	*Crax rubra*	1,273	69	50	1,392	14
	Meleagris ocellata	507	97	165	769	19
	Rupornis magnirostris	300	7	10	317	17
	Ortalis vetula	225	13	10	248	13
	Ciccaba virgata	239	6	0	245	8
	Penelope purpurascens	198	23	5	226	8
	Ramphastos sulfuratus	152	0	4	156	9
	Micrastur semitorquatus	109	0	3	112	8
	Buteogallus urubitinga	53	4	8	65	9
	Pteroglossus torquatus *	15	4	0	19	4
	Crypturellus cinnamomeus	15	1	1	17	5
	Coragyps atratus *	14	0	2	16	3
	Buteo plagiatus	13	1	0	14	7
	Astur bicolor *	11	0	0	11	3
	Spizaetus ornatus *	8	0	0	8	2
	Cathartes aura *	3	0	4	7	2
	Astur cooperii *	4	0	0	4	1
	Geranospiza caerulescens *	3	0	0	3	2
	Aramides albiventris *	1	0	1	2	2
	Aramus guarauna *	1	0	0	1	1
	Chondrohierax uncinatus *	1	0	0	1	1
	Sarcoramphus papa *	1	0	0	1	1
Mammals	*Nasua narica*	941	201	307	1,449	24
	Urocyon cinereoargenteus	338	564	122	1,024	22
	Didelphis sp.	63	77	322	462	20
	Leopardus pardalis	194	67	99	360	22
	Panthera onca	106	26	53	185	17
	Puma concolor	109	20	46	175	22
	Mazama pandora	75	54	32	161	16
	Dasyprocta punctata	55	77	15	147	14
	Pecari tajacu	70	9	7	86	15
	Spilogale angustifrons	10	30	19	59	9
	Eira barbara	15	26	17	58	14
	Cuniculus paca	29	17	8	54	6
	Procyon lotor	10	32	8	50	9
	Sciurus deppei	4	26	17	47	9
	Tapirus bairdii	18	16	1	35	7
	Sciurus yucatanensis	20	11	0	31	6
	Odocoileus virginianus *	25	0	0	25	2
	Leopardus wiedii	12	10	2	24	10
	Conepatus semistriatus	2	6	11	19	10
	Dasypus novemcinctus	3	5	8	16	6
	Sylvilagus sp. *	1	8	5	14	4
	Philander opossum *	9	1	0	10	2
	Canis latrans *	2	2	1	5	4

Class	Species	Troughs	Far	Near	Total events	Stations
	Bassariscus sumichrasti *	0	0	3	3	3
	Herpailurus yagouaroundi *	2	1	0	3	3
	Tamandua mexicana *	2	1	0	3	3
	Tayassu pecari *	3	0	0	3	1
	Potos flavus *	2	0	0	2	1

* Recorded at fewer than five stations and excluded from all analyses (20 species, 141 events).

Table S4. Camera stations: site type, whether the water provisioned for the colonies was accessible to wildlife (apiaries only), first and last day of operation, camera-trap days and independent events of all species.

Station	Site type	Accessible water	First day	Last day	Camera-trap days	Events	Rainfall analyses
T1	Trough	–	14 Jan 2023	5 May 2026	862	1,070	Yes
T2	Trough	–	14 Jan 2023	7 Feb 2026	885	1,269	Yes
T3	Trough	–	30 Jun 2023	1 May 2026	845	752	Yes
T4	Trough	–	5 May 2024	26 Apr 2026	639	818	Yes
T5	Trough	–	22 Dec 2024	9 Aug 2025	230	226	Yes
T6	Trough	–	18 Jan 2025	12 May 2026	454	818	Yes
T7	Trough	–	8 Jun 2025	1 May 2026	256	133	Yes
T8	Trough	–	9 Jun 2025	10 Apr 2026	200	180	No
F1	Far	Yes	17 Feb 2023	24 Sep 2025	384	525	Yes
F2	Far	Yes	16 Jan 2025	30 Mar 2026	363	233	No
F3	Far	No	17 Jan 2025	1 May 2026	469	257	Yes
F4	Far	No	17 Jan 2025	10 Feb 2026	325	64	Yes
F5	Far	Yes	18 Jan 2025	29 Apr 2026	369	338	Yes
F6	Far	No	21 Jan 2025	27 Oct 2025	261	39	Yes
F7	Far	No	2 Feb 2025	1 Jul 2025	149	33	Yes
F8	Far	No	2 Apr 2025	3 Nov 2025	169	23	Yes
N1	Near	Yes	20 Feb 2023	28 Feb 2026	993	257	Yes
N2	Near	Yes	22 Jun 2023	1 May 2026	758	133	Yes
N3	Near	No	25 Jun 2023	9 Oct 2023	106	50	Yes
N4	Near	Yes	2 Mar 2024	26 Nov 2025	526	200	Yes
N5	Near	Yes	5 May 2024	1 May 2026	511	121	Yes
N6	Near	Yes	15 Jan 2025	1 Mar 2026	268	307	No
N7	Near	No	18 Jan 2025	1 May 2026	372	45	Yes
N8	Near	Yes	21 Jan 2025	5 May 2026	469	253	Yes

Stations are numbered within each site type by the date on which they were installed. Camera-trap days exclude the periods in which the camera was not operating. The three stations not used in the rainfall analyses are in Unión 20 de Junio, far from the rain gauge.

Table S5. Far/Near contrasts for the 14 species modelled separately. Each cell gives the Far/Near ratio followed, in parentheses, by its p value adjusted across species with the Benjamini–Hochberg procedure. The ratio is a rate ratio for capture frequency, an odds ratio for active days and weeks with records, and a ratio of means for days between visits.

Species	Events, Far	Events, Near	Capture frequency	Active days	Weeks with records	Days between visits
Urocyon cinereoargenteus	564	122	4.04 (0.387)	3.62 (0.709)	3.65 (0.850)	0.36 (0.055)
Nasua narica	201	307	0.90 (0.857)	0.86 (0.780)	0.87 (0.850)	0.79 (0.681)
Didelphis sp.	77	322	0.75 (0.845)	0.74 (0.780)	0.76 (0.850)	2.34 (0.548)
Meleagris ocellata	97	165	0.72 (0.845)	0.68 (0.780)	0.72 (0.850)	0.80 (0.681)
Leopardus pardalis	67	99	0.82 (0.845)	0.81 (0.780)	0.86 (0.850)	0.84 (0.681)
Crax rubra	69	50	4.00 (0.845)	3.66 (0.780)	3.06 (0.850)	0.77 (0.681)
Dasyprocta punctata	77	15	3.32 (0.845)	2.88 (0.780)	2.47 (0.850)	0.47 (0.681)
Mazama pandora	54	32	0.75 (0.845)	0.73 (0.780)	0.73 (0.850)	0.29 (0.055)
Panthera onca	26	53	1.10 (0.916)	1.08 (0.937)	1.06 (0.949)	**2.83 (0.003)**
Puma concolor	20	46	0.69 (0.845)	0.70 (0.780)	0.90 (0.850)	1.22 (0.681)
Spilogale angustifrons	30	19	2.32 (0.845)	2.35 (0.780)	2.45 (0.850)	0.36 (0.521)
Sciurus deppei	26	17	6.60 (0.845)	6.57 (0.780)	6.92 (0.850)	**0.38 (0.019)**
Eira barbara	26	17	2.48 (0.845)	2.29 (0.780)	2.36 (0.850)	–
Procyon lotor	32	8	4.95 (0.845)	4.85 (0.780)	4.37 (0.850)	1.45 (0.738)

Ratios above 1, or below 1 for days between visits, support the prediction that visits are fewer near a trough. Contrasts surviving correction are in bold. The interval model was not fitted for *Eira barbara*, which had fewer than the 30 intervals between visits required.

Table S6. Climate variables compared as predictors of monthly capture frequency. Each model included site type, the standardised variable and their interaction, with log camera-trap days as an offset and station as a random intercept (negative binomial). ΔAIC is calculated against the best model.

Variable	Period	AIC	ΔAIC
Accumulated rainfall	60 days	2698.5	0.0
Accumulated rainfall	90 days	2705.9	7.4
Accumulated rainfall	120 days	2710.0	11.5
Accumulated rainfall	30 days	2724.2	25.7
Accumulated rainfall	15 days	2744.5	46.0
Longest dry spell	60 days	2744.9	46.3
Mean daily maximum temperature	30 days	2747.1	48.5
Accumulated rainfall	7 days	2748.0	49.5
Days since last rain	–	2756.3	57.8
Mean temperature	30 days	2763.7	65.1

Rainfall was recorded by a tipping-bucket gauge (0.254 mm per tip) and summed over the stated number of days before the first day of each month; the dry spell is the longest run of days without rain in the preceding 60 days. Temperatures are means over the preceding 30 days. The three stations in Unión 20 de Junio were excluded.

Table S7. Monthly capture frequency against rainfall accumulated over four windows: likelihood-ratio test of the site type × rainfall interaction (χ^2, 2 df), and the change in monthly capture frequency per 10 mm of rainfall at each site type (%, with 95% confidence interval).

Window (days)	χ^2	p	Troughs	Far	Near
30	9.05	0.011	-5.9 (-7.5, -4.2)	-1.0 (-3.8, 1.9)	-4.1 (-6.2, -1.9)
60	19.21	<0.001	-4.9 (-6.0, -3.8)	-0.6 (-2.3, 1.2)	-2.5 (-3.8, -1.2)
90	21.15	<0.001	-3.4 (-4.1, -2.6)	0.0 (-1.3, 1.2)	-1.6 (-2.6, -0.7)
120	22.21	<0.001	-2.9 (-3.5, -2.2)	0.1 (-1.0, 1.2)	-1.3 (-2.1, -0.5)

The 60-day window, which had the lowest AIC (Table S6), is the one reported in the main text. Consecutive months at a station are correlated (Durbin–Watson statistic on residuals aggregated by month = 0.83) and an autoregressive model did not converge, so the model-based p values are anticonservative. In the 60-day model the interaction was therefore tested by permuting site type among stations, keeping each station's series intact: 1,000 permutations gave p = 0.027 (Monte Carlo SE 0.005), against a model-based p of 6.7×10^{-5}. In a generalised additive model that also included a smooth of calendar time, the response to rainfall remained significant at troughs (p = 0.0008) but not at Near (p = 0.096) or Far apiaries (p = 0.86).



Figure S1. Apiaries and the water provisioned for the colonies in Calakmul. (a) An apiary. (b) Cement trays of water supporting the legs of the hive stands, which keep ants from the hives. (c) An apiary where the water for the colonies is left within reach of wildlife, in an open drum. (d) A drum covered with a wooden grate, which excludes most vertebrates.



Figure S2. Rainwater collection system. (a) Catchment of corrugated metal sheets on wooden posts, with the 5,000-L storage tank beneath it. (b) Drinking trough supplied by the tank, with a log placed so that small animals entering the water can climb out.

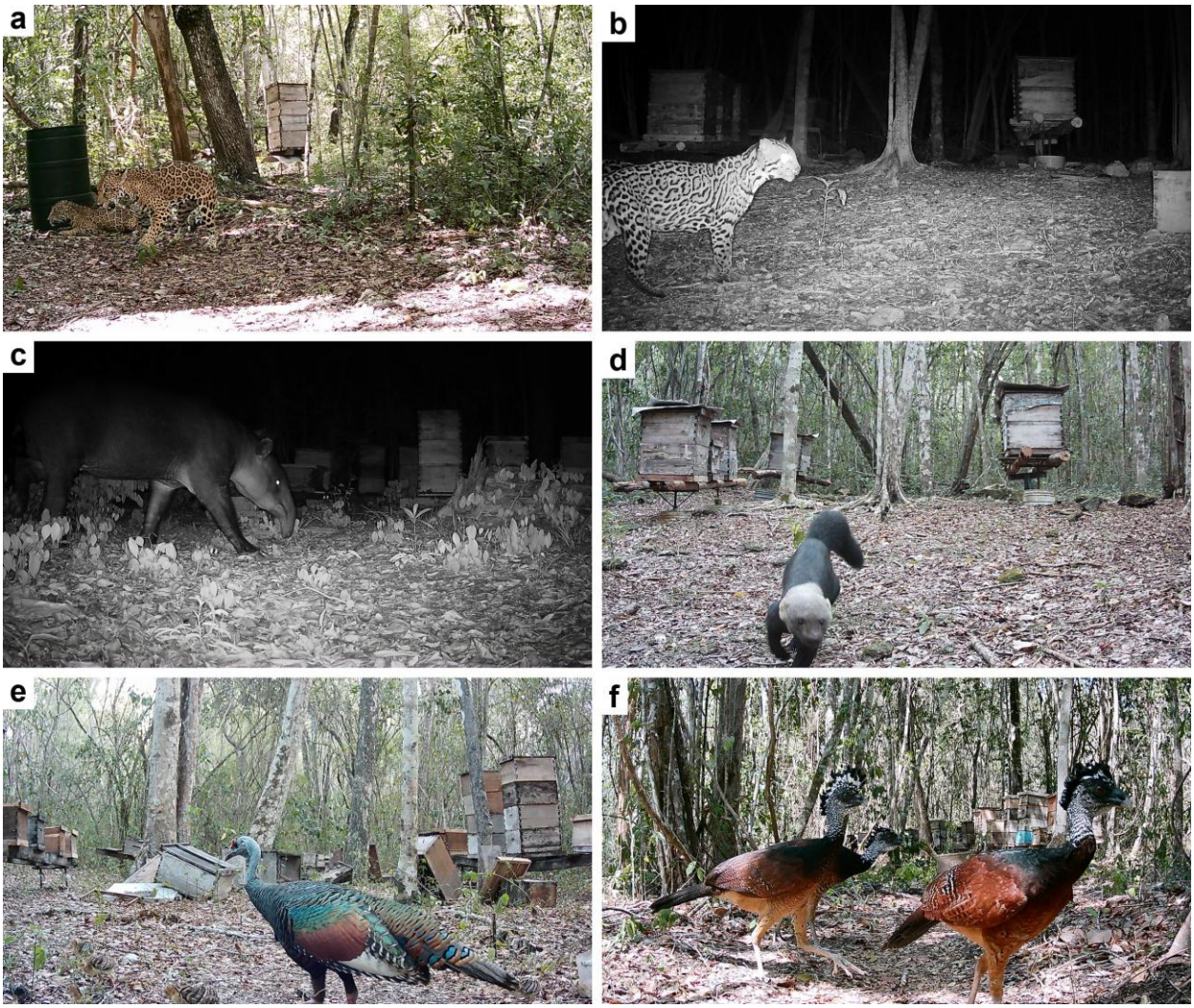

Figure S3. Wildlife recorded by the camera traps at apiaries: (a) jaguar (*Panthera onca*), (b) ocelot (*Leopardus pardalis*), (c) Baird's tapir (*Tapirus bairdii*), (d) tayra (*Eira barbara*), (e) ocellated turkey (*Meleagris ocellata*) and (f) great curassow (*Crax rubra*). All but the ocelot were among the species named by beekeepers as visiting their apiaries (Table S1).

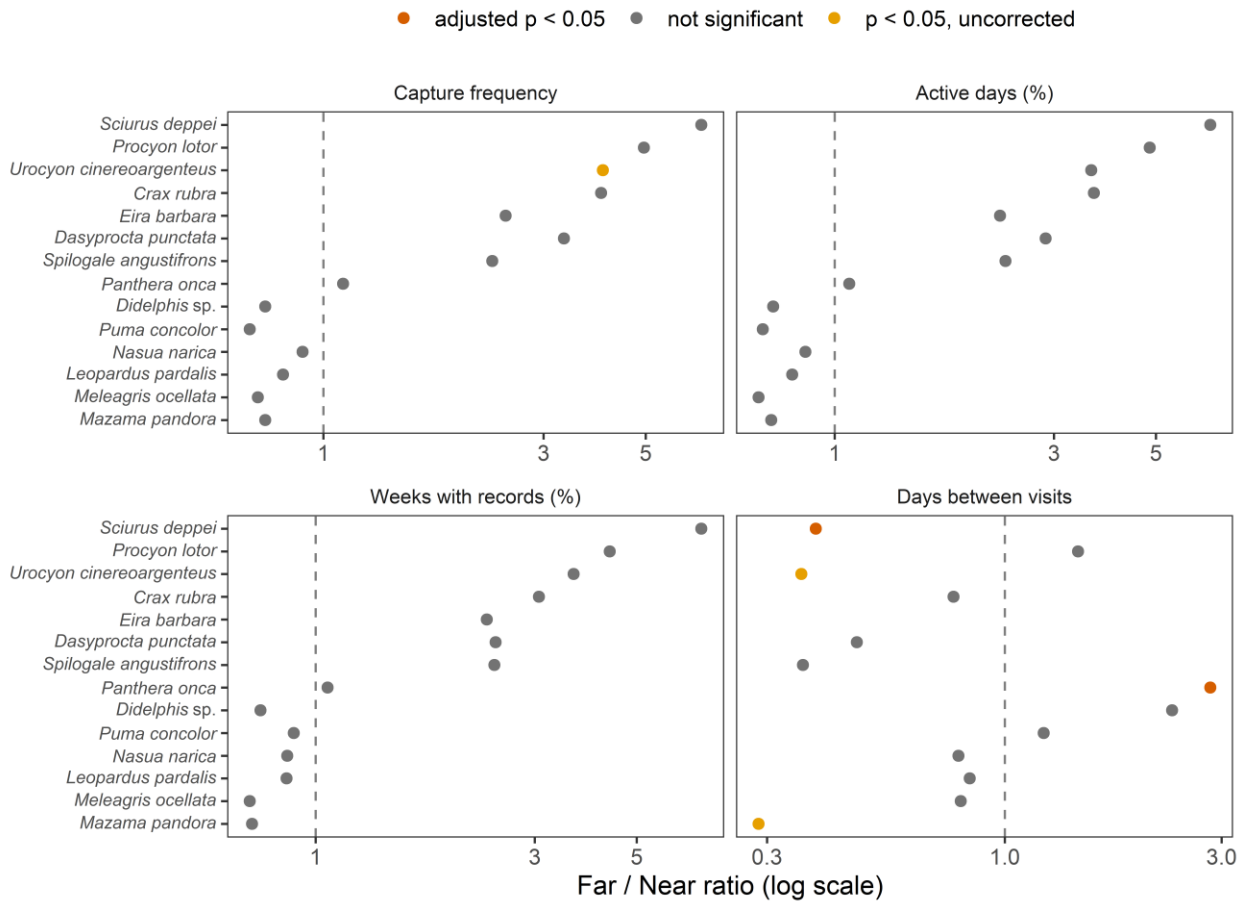

Figure S4. Far/Near contrasts for the 14 species modelled separately on each of the four measures of apiary use (log scale): rate ratio for capture frequency, odds ratios for active days and weeks with records, and ratio of means for days between visits. Values above 1, or below 1 for days between visits, support the prediction. Colours distinguish contrasts significant before and after Benjamini–Hochberg correction across species.

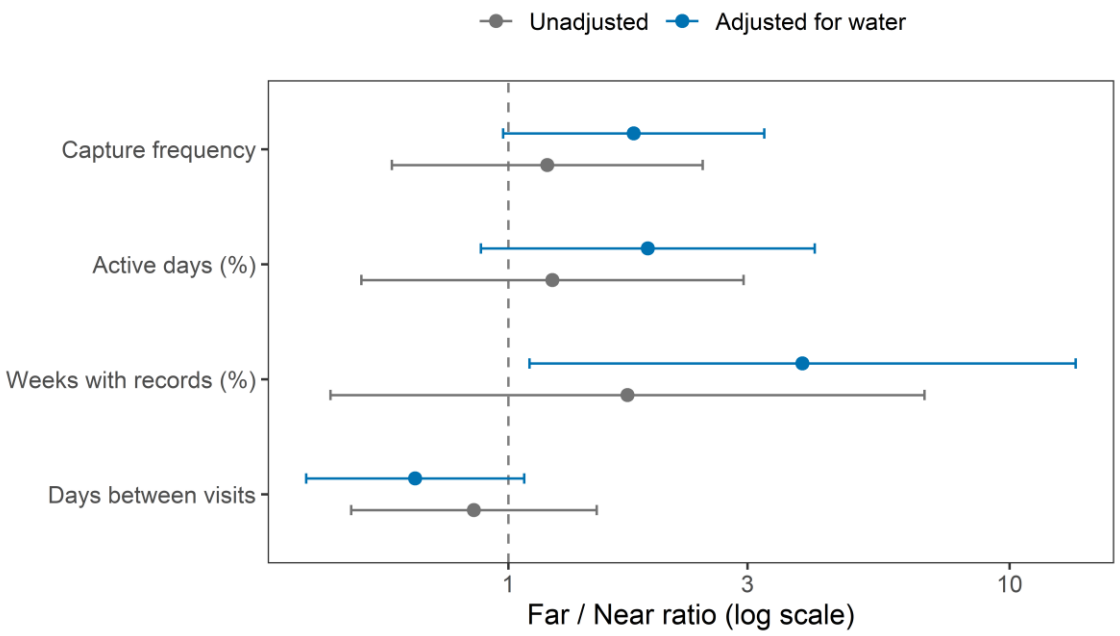

Figure S5. Far/Near contrasts on the four measures of apiary use with and without accessible water as an additive covariate, with 95% confidence intervals (log scale): rate ratio for capture frequency, odds ratios for active days and weeks with records, and ratio of means for days between visits. Adding accessible water improved every model (likelihood-ratio tests, $p = 0.005–0.013$; ΔAIC -6.0 to -4.2).

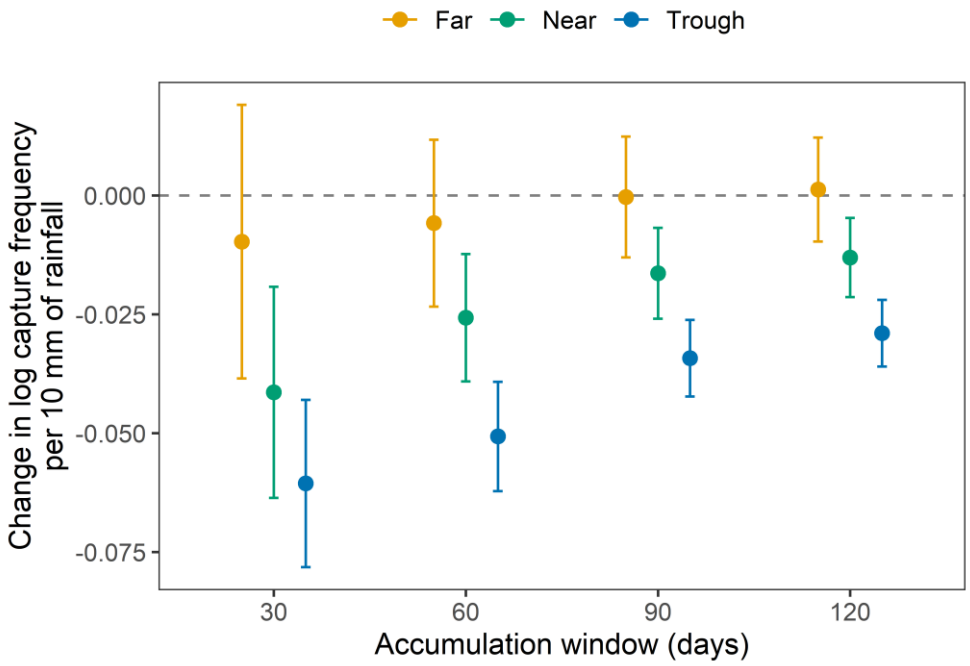

Figure S6. Slope of monthly capture frequency per 10 mm of rainfall accumulated over 30, 60, 90 and 120 days, by site type, with 95% confidence intervals.