

Supplementary

Table S1 Sample size calculation based on factors

Article	Variable	Ratio of unexposed to exposed in sample	Percent of unexposed with outcome	Percent of exposed with outcome	OR	Sample size
(37)	Flooding	1.0	5	24.12	6.04	126
(50)	Rainfall	1.0	5	42.02	13.77	50
(42)	Temperature	1.0	5	3.98	0.7869	13658
(49)	Humidity	1.0	5	3	0.58	3082

Table S2 Formulae used in the study

Formula	Equation	Description
Exponential growth model	$P_t = P_0(1 + r)^{t-t_0}$	Where P_t represents the estimated population at year t , P_0 is the population at the base year t_0 , and r is the annual growth rate
Annual growth rate	$r = \left(\frac{P_1}{P_0}\right)^{\frac{1}{n}} - 1$	Where P_1 and P_0 denote population counts at two benchmark years separated by n years
Kernel Density Estimates (KDE)	$\hat{\lambda}(x,y) = \frac{1}{nh^2} \sum K\left(\frac{x-x_i}{h}, \frac{y-y_i}{h}\right)$	Where (x,y) represents the projected coordinate reference system of leptospirosis cases using EPSG:3857. (x_i,y_i) represents the observed coordinates of each case. n is the total number of cases. h represents the fixed bandwidth applied during smoothing. K is the kernel function
Nearest Neighbour Index (NNI)	$NNI = \frac{D(NN)}{D(ran)}$	Where $D(NN)$ is the mean nearest neighbour distance, $D(ran)$ is the expected mean distance for a random distribution
Mean nearest neighbour distance	$D(NN) = \frac{1}{n} \sum \min(d_{ij})$	Where $\min(d_{ij})$ represents the distance between each case and its closest neighbouring case, and n is the number of leptospirosis cases for that year
Expected mean distance for a random distribution	$D(ran) = \frac{1}{2} \sqrt{\frac{A}{n}}$	Where A is the area of the study region defined by the convex hull, and n is the number of cases

Table S3 Comparison of estimates obtained using Rubin’s rules and the averaged pooled dataset

Variable	Rubin β	Pooled dataset β	Rubin IRR (95% CI)	Pooled dataset IRR (95% CI)
Humidity	0.1262	0.1265	1.13 (0.98–1.31)	1.13 (0.99–1.31)
Temperature	−0.1427	−0.1432	0.87 (0.77–0.98)	0.87 (0.77–0.98)
Rainfall	−0.0688	−0.0995	0.93 (0.76–1.14)	0.91 (0.74–1.10)

CI, confidence interval; IRR, incidence rate ratio.

Table S4 Sensitivity analysis between Rubin’s rules model and the averaged pooled dataset model

Metric	Value
Number of coefficients compared	3
Coefficient RMSE	0.0177
Coefficient MAE	0.0105
IRR RMSE	0.0163
IRR MAE	0.0096
Significant associations (Rubin)	1
Significant associations (Pooled dataset)	1

MAE, mean absolute error; RMSE, root mean squared error.

Table S5 Variables used to identify associated factors from GLMM

Variable	Definition	Description (unit)	Reference
Flooding	Annual percentage of flooded area in each state	The percentage of pixels with an MNDWI value greater than or equal to it. The daily percentage was averaged yearly for each state (%)	MOD09A1
Rainfall	Annual total rainfall in each state	The daily total rainfall in each station was averaged yearly for each state (mm)	DID Malaysia
Temperature	Annual average temperature in each state	The daily average temperature in each station was averaged yearly for each state (°C)	DOE Malaysia
Humidity	Annual average relative humidity in each state	The daily average relative humidity in each station was averaged yearly for each state (%)	DOE Malaysia

GLMM, generalised linear mixed model; MNDWI, Modified Normalised Difference Water Index.

Table S6 Residual temporal and spatial dependence from each fitted GLMM model at the state level

Model	Temporal lag residual correlation	Moran’s I statistic	P value*
Flooding	0.46154	−0.09391	0.578
Humidity	0.46160	−0.11296	0.629
Temperature	0.47300	−0.11841	0.644
Rainfall	0.46578	−0.07469	0.523
Final	0.47563	−0.08840	0.562

*, P value for Global Moran’s I statistic. GLMM, generalised linear mixed model.

Table S7 Sociodemographic characteristics of leptospirosis cases in Malaysia, 2012–2022 (N=51564)

Characteristic	2012, n=3691	2013, n=4482	2014, n=7680	2015, n=8286	2016, n=5286	2017, n=4344	2018, n=5094	2019, n=5177	2020, n=2912	2021, n=1737	2022, n=2875	Overall, N=51564
Age	31 (21–45)	30 (20–44)	30 (18–46)	29 (18–46)	29 (17–45)	30 (18–46)	31 (18–49)	30 (17–47)	33 (19–50)	33 (20–49)	31 (19–47)	30 (19–46)
Age group (years)												
<15	379 (10.3)	586 (13.1)	1199 (15.6)	1440 (17.4)	1059 (20)	772 (17.8)	916 (18)	1049 (20.3)	489 (16.8)	225 (13)	482 (16.8)	8596 (16.7)
15–64	3088 (83.7)	3641 (81.2)	5990 (78)	6287 (75.9)	3883 (73.5)	3279 (75.5)	3749 (73.6)	3744 (72.3)	2170 (74.5)	1366 (78.6)	2182 (75.9)	39379 (76.4)
≥65	224 (6.1)	255 (5.7)	491 (6.4)	559 (6.7)	344 (6.5)	293 (6.7)	429 (8.4)	384 (7.4)	253 (8.7)	146 (8.4)	211 (7.3)	3589 (7)
Sex												

Female	1003 (27.2)	1269 (28.3)	2710 (35.3)	2829 (34.1)	1784 (33.7)	1407 (32.4)	1545 (30.3)	1739 (33.6)	855 (29.4)	480 (27.6)	836 (29.1)	16457 (31.9)
Male	2688 (72.8)	3213 (71.7)	4970 (64.7)	5457 (65.9)	3502 (66.3)	2937 (67.6)	3549 (69.7)	3438 (66.4)	2057 (70.6)	1257 (72.4)	2039 (70.9)	35107 (68.1)
Ethnicity												
Chinese	248 (6.7)	344 (7.7)	510 (6.6)	466 (5.6)	320 (6.1)	244 (5.6)	304 (6)	323 (6.2)	153 (5.3)	120 (6.9)	159 (5.5)	3191 (6.2)
Indian	235 (6.4)	258 (5.8)	358 (4.7)	326 (3.9)	218 (4.1)	241 (5.5)	239 (4.7)	221 (4.3)	131 (4.5)	73 (4.2)	133 (4.6)	2433 (4.7)
Malay Bumiputera	2097 (56.8)	2530 (56.4)	4695 (61.1)	5580 (67.3)	3491 (66)	2848 (65.6)	3254 (63.9)	3219 (62.2)	1659 (57)	1024 (59)	1897 (66)	32294 (62.6)
Other Bumiputera	586 (15.9)	653 (14.6)	1299 (16.9)	1144 (13.8)	869 (16.4)	687 (15.8)	933 (18.3)	1048 (20.2)	769 (26.4)	388 (22.3)	451 (15.7)	8827 (17.1)
Others (citizen)	39 (1.1)	55 (1.2)	99 (1.3)	74 (0.9)	38 (0.7)	31 (0.7)	39 (0.8)	34 (0.7)	25 (0.9)	16 (0.9)	41 (1.4)	491 (1)
Others (non-citizen)	486 (13.2)	642 (14.3)	719 (9.4)	696 (8.4)	350 (6.6)	293 (6.7)	325 (6.4)	332 (6.4)	175 (6)	116 (6.7)	194 (6.7)	4328 (8.4)
State												
Johor	71 (1.9)	62 (1.4)	358 (4.7)	309 (3.7)	202 (3.8)	337 (7.8)	558 (11)	247 (4.8)	155 (5.3)	45 (2.6)	143 (5)	2487 (4.8)
Kedah	266 (7.2)	294 (6.6)	693 (9)	761 (9.2)	413 (7.8)	413 (9.5)	521 (10.2)	364 (7)	150 (5.2)	136 (7.8)	243 (8.5)	4254 (8.2)
Kelantan	175 (4.7)	266 (5.9)	1024 (13.3)	1951 (23.5)	865 (16.4)	494 (11.4)	605 (11.9)	846 (16.3)	407 (14)	185 (10.7)	552 (19.2)	7370 (14.3)
Kuala Lumpur	258 (7)	427 (9.5)	336 (4.4)	352 (4.2)	173 (3.3)	161 (3.7)	110 (2.2)	175 (3.4)	77 (2.6)	53 (3.1)	60 (2.1)	2182 (4.2)
Labuan	8 (0.2)	6 (0.1)	25 (0.3)	49 (0.6)	42 (0.8)	22 (0.5)	17 (0.3)	1 (0)		2 (0.1)		172 (0.3)
Melaka	439 (11.9)	106 (2.4)	140 (1.8)	231 (2.8)	228 (4.3)	152 (3.5)	187 (3.7)	265 (5.1)	62 (2.1)	33 (1.9)	57 (2)	1900 (3.7)
Negeri Sembilan	150 (4.1)	181 (4)	295 (3.8)	298 (3.6)	170 (3.2)	218 (5)	314 (6.2)	359 (6.9)	218 (7.5)	225 (13)	179 (6.2)	2607 (5.1)
Pahang	161 (4.4)	280 (6.2)	282 (3.7)	381 (4.6)	238 (4.5)	193 (4.4)	131 (2.6)	162 (3.1)	112 (3.8)	68 (3.9)	108 (3.8)	2116 (4.1)
Perak	286 (7.7)	425 (9.5)	620 (8.1)	501 (6)	342 (6.5)	299 (6.9)	287 (5.6)	341 (6.6)	243 (8.3)	183 (10.5)	285 (9.9)	3812 (7.4)
Perlis	26 (0.7)	11 (0.2)	20 (0.3)	16 (0.2)	9 (0.2)	14 (0.3)	11 (0.2)	22 (0.4)	4 (0.1)	3 (0.2)	23 (0.8)	159 (0.3)
Pulau Pinang	130 (3.5)	95 (2.1)	191 (2.5)	136 (1.6)	42 (0.8)	75 (1.7)	96 (1.9)	54 (1)	45 (1.5)	59 (3.4)	88 (3.1)	1011 (2)
Putrajaya	1 (0)	2 (0)	14 (0.2)	23 (0.3)	11 (0.2)	4 (0.1)	3 (0.1)	3 (0.1)	4 (0.1)	4 (0.2)	5 (0.2)	74 (0.1)
Sabah	415 (11.2)	365 (8.1)	921 (12)	474 (5.7)	172 (3.3)	147 (3.4)	189 (3.7)	54 (1)	55 (1.9)	81 (4.7)	94 (3.3)	2967 (5.8)
Sarawak	297 (8)	435 (9.7)	613 (8)	791 (9.5)	840 (15.9)	629 (14.5)	882 (17.3)	1260 (24.3)	798 (27.4)	348 (20)	430 (15)	7323 (14.2)
Selangor	880 (23.8)	1355 (30.2)	1780 (23.2)	1225 (14.8)	847 (16)	685 (15.8)	677 (13.3)	666 (12.9)	405 (13.9)	227 (13.1)	460 (16)	9207 (17.9)
Terengganu	128 (3.5)	172 (3.8)	368 (4.8)	788 (9.5)	692 (13.1)	501 (11.5)	506 (9.9)	358 (6.9)	177 (6.1)	85 (4.9)	148 (5.1)	3923 (7.6)

Data are presented as median (interquartile range) or n (%).

Table S8 Incidence of notified leptospirosis cases in Malaysia according to state and district

State	District	Incidence of leptospirosis (per 100,000 population)											Average incidence (per 100,000 population)
		2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	
Johor	Batu Pahat	3.61	4.26	39.53	16.45	1.8	3.75	2.38	1.49	1.25	1.03	0.81	6.94
Johor	Johor Bahru	2.1	0.34	2.66	5.95	4.71	4.77	6.45	2.11	0.57	0.2	2.32	2.93
Johor	Kluang	2.03	1	1.32	3.26	2.89	12.71	27.62	11.78	6.13	1.51	3.29	6.69
Johor	Kota Tinggi	1.05	4.2	5.26	11.05	6.85	14.76	37.98	10.56	15.85	1.59	8.99	10.74
Johor	Kulaijaya	0.76	1.82	2.79	14.7	7.36	16.56	23.51	1.13	2.7	0.26	2.73	6.76
Johor	Mersing	5.81	1.45	7.23	14.44	11.53	25.88	30.13	12.88	10	1.43	4.27	11.37
Johor	Muar	0.41	3.65	11.21	4.35	5.86	8.87	11.04	12.03	6.68	2.2	1.09	6.13
Johor	Pontian	1.31	1.31	5.21	11.02	6.45	14.78	35.81	7	7.6	1.89	10.67	9.37
Johor	Segamat	2.18	0	32.53	10.81	16.17	23.65	30.02	34.21	17.06	6.91	13.25	16.98
Johor	Tangkak	3.81	8.3	17.93	6.66	5.86	5.8	21.54	16.35	6.34	2.79	2.76	8.92
Kedah	Baling	23.91	34.16	84.13	160.65	85.3	72.47	56.18	41.52	30.59	26.87	45.69	60.13
Kedah	Bandar Baharu	9.23	2.29	22.62	13.43	8.86	10.97	13.03	12.89	0	12.63	6.25	10.2
Kedah	Kota Setar	11.29	17.4	24.96	21.46	9.15	11.88	20.65	10.57	2.48	5.15	7.26	12.93
Kedah	Kuala Muda	4.07	6.25	13.81	13.84	7.51	7.87	10.95	19.91	4.85	1.35	3.78	8.56
Kedah	Kubang Pasu	17.3	10.77	25.22	32.71	17.2	16.53	36.76	16.06	4.47	4.8	16.18	18
Kedah	Kulim	5.86	6.27	15.38	9.58	5.31	8.33	6.21	3.73	2.87	2.31	3.99	6.35
Kedah	Langkawi	10.35	10.06	29.33	20.05	13.33	10.96	16.47	12.24	7.32	10.67	25.05	15.08
Kedah	Padang Terap	55.53	44.26	95.15	89.67	50.28	57.07	75.29	31.52	8.51	8.42	12.49	48.02
Kedah	Pendang	29.94	18.5	38.88	53.97	21.29	22.2	21.09	12	6.97	8.92	8.88	22.06
Kedah	Pokok Sena	23.57	23.16	37.95	35.44	31.16	16.22	15.94	15.67	3.42	10.09	9.92	20.23
Kedah	Sik	26.75	49.98	173.03	117.94	93.9	76	109.99	42.69	27.25	9.43	8	66.81
Kedah	Yan	15.44	10.73	50.25	66.54	12.01	22.37	8.89	7.35	4.38	1.45	5.76	18.65
Kelantan	Bachok	7.03	10	23.51	67.28	25.79	26.15	25.06	28.93	11.83	0	4.73	20.94
Kelantan	Gua Musang	30.81	55.7	142.31	272.08	70.42	40.71	118.08	105.97	50.53	49.83	160.83	99.75
Kelantan	Jeli	41.76	41.4	92.37	333.26	65.58	15.01	34.72	36.88	82.88	45.92	103.05	81.17
Kelantan	Kecil Lojing	27.74	45.59	62.94	132.99	61.2	25.86	59.51	108.98	74.4	65.21	136.64	72.82
Kelantan	Kota Bharu	9.64	11.76	40.59	53.13	45.99	31.72	26.27	25.66	7.56	2.9	7.5	23.88
Kelantan	Kuala Krai	14.08	37.08	185.79	150	81.19	14.09	46.97	80.72	88.18	37.67	119.02	77.71
Kelantan	Machang	8.79	10.84	75.9	148.71	81.15	37.98	19.24	31.97	39.42	11.67	43.16	46.26
Kelantan	Pasir Mas	9.08	22.2	106.14	214.65	83.4	50.11	57.58	39.13	13.23	3.88	12.47	55.62
Kelantan	Pasir Puteh	10.59	11.38	35.6	74.93	29.9	13.56	20.17	30	20.67	6.56	12.2	24.14
Kelantan	Tanah Merah	11.88	2.51	27.28	169.68	41.86	30.98	51.74	223.59	40.47	12.81	25.28	58.01
Kelantan	Tumpat	7.48	15.46	56.43	138.41	55.73	28.17	20.87	11.87	8.03	4.88	21.09	33.49
Kuala Lumpur	Kuala Lumpur	15.58	25.27	19.48	20	9.63	8.78	5.88	9.16	3.95	2.66	2.96	11.21
Labuan	Labuan	11.02	8.13	33.3	64.17	54.08	27.85	21.16	1.22	0	2.37	0	20.3
Melaka	Alor Gajah	74.56	24.37	17.54	41.68	35.68	16.65	27.79	28.86	6.15	6.41	6.66	26.03
Melaka	Jasin	82.67	16.97	19.98	16.79	34.04	31.26	37.31	49.1	15.36	5.18	5.61	28.57

Melaka	Melaka Tengah	37.32	6.96	14.49	22.54	18.38	11.81	11.33	19.76	3.53	1.4	4.71	13.84
Negeri Sembilan	Jelevu	17.71	20.17	15.07	70.07	42.39	154.04	111.39	135.65	164.63	283.98	129.26	104.03
Negeri Sembilan	Jempol	29.57	16.8	14.15	23.82	6.74	5.83	17.68	25.79	23.05	11.13	18.4	17.54
Negeri Sembilan	Kuala Pilah	35.74	28.27	22.3	25.25	17.8	8.89	23.69	19.23	14.77	23.61	22.11	21.97
Negeri Sembilan	Port Dickson	39.2	43.54	74	35.92	31.27	37.33	30.06	44.86	14	8.71	6.06	33.18
Negeri Sembilan	Rembau	6.79	8.94	22.04	56.53	27.88	12.7	56.36	70.01	16.25	26.05	45.46	31.73
Negeri Sembilan	Seremban	3	12.27	25.23	24.08	10.33	11.04	21.06	21.34	10.39	6.65	6.43	13.8
Negeri Sembilan	Tampin	29.87	14.84	17.2	13.43	23.05	26.52	33.54	32.14	20.11	9.4	14.01	21.28
Pahang	Bentong	5.72	8.03	9.48	7.76	3.05	9	0	2.9	2.14	1.4	1.38	4.62
Pahang	Bera	3.02	8.9	6.79	8.57	7.47	11	7.2	7.94	6.93	3.4	5.84	7.01
Pahang	Cameron Highlands	18.41	25.6	22.42	14.54	11.79	2.29	13.39	10.86	6.34	10.28	2	12.54
Pahang	Jerantut	32.88	45.63	64.62	34.16	21.17	30.43	16.64	20.62	17.38	17.23	12.05	28.44
Pahang	Kuantan	7.61	6.78	8.47	36.67	25.14	14.36	5.79	7.83	3.02	2.94	3.04	11.06
Pahang	Lipis	33.56	27.52	8.67	18.12	11.54	11.35	14.21	17.98	6.88	0.97	17.13	15.27
Pahang	Maran	10.96	38.41	36.62	22.92	10.1	7.35	5.52	11.05	6.46	3.69	5.55	14.42
Pahang	Pekan	12.26	27.13	40.84	30.4	20.11	9.98	15.3	14.29	8.86	5.27	10.47	17.72
Pahang	Raub	8.41	19.68	6.13	18.12	13.89	15.65	0.96	8.55	7.49	0.92	1.82	9.24
Pahang	Rompin	9.03	9.85	24.9	36.19	7.89	7.83	17.27	13.71	19.57	5.07	10.06	14.67
Pahang	Temerloh	3.68	30.84	16.08	4.69	3.47	5.12	6.72	5.52	4.89	2.68	9.49	8.47
Perak	Bagan Datuk	7.16	11.38	7.07	5.63	4.19	2.78	1.38	1.37	6.83	2.71	10.79	5.57
Perak	Batang Padang	41.31	44.97	61.9	91.54	74.8	58.51	52.95	95.05	70.66	25.74	20.16	57.96
Perak	Hilir Perak	5.9	16.85	12.38	10.86	5.04	5.72	2.84	6.36	4.92	2.79	7.63	7.39
Perak	Hulu Perak	47.26	69.22	68.63	82.7	31.13	23.67	12.24	14.16	25.07	14.91	7.89	36.08
Perak	Kampar	12.84	18.45	22.91	7.51	12	6.35	8.03	3.51	8.62	7.63	6.67	10.41
Perak	Kerian	2.76	9.78	6.96	12.13	10.91	8.19	10.08	19.38	3.92	1.93	4.75	8.25
Perak	Kinta	5.19	15.29	24.26	12.64	8.43	5.32	3.48	2.85	3.02	6.15	8.94	8.69
Perak	Kuala Kangsar	22.21	27.55	34.62	20.49	16.74	13.64	23.54	8.76	6.95	11.49	15.96	18.36
Perak	Larut Dan Matang	9.37	9.21	10.99	10.79	12.17	13.18	22.58	24.26	9.3	7.43	20.77	13.64
Perak	Manjung	8.43	9.16	24	15.17	7.04	6.51	6.4	3.54	1.55	0.38	3.73	7.81
Perak	Muallim	43.78	13.87	47.11	22.47	13.29	14.56	7.18	7.07	4.18	4.13	4.07	16.52
Perak	Perak Tengah	8.31	14.48	35.52	28.74	9.4	20.95	2.47	4.84	5.54	5.43	5.33	12.82
Perak	Selama	7.6	0	24.45	14.42	4.72	18.56	11.4	22.41	24.22	4.33	17.01	13.56
Perlis	Perlis	11.34	4.73	8.5	6.71	3.73	5.72	4.44	8.76	1.57	1.16	8.81	5.95
Pulau Pinang	Barat Daya	17.93	11.03	8.84	7.21	5.17	5.06	10.81	4.85	1.73	1.27	7.03	7.36
Pulau Pinang	Seberang Perai Selatan	2.88	2.22	8.06	6.23	1.5	2.42	6.55	2.71	0.44	0.42	1.22	3.15
Pulau Pinang	Seberang Perai Tengah	9.59	8.35	25.3	13.26	2.7	9.6	6.81	2.53	3.83	6.84	4.54	8.49
Pulau Pinang	Seberang Perai Utara	3.49	3.78	8.78	6.31	1.63	3.21	2.84	3.72	3.96	5.4	7.66	4.62
Pulau Pinang	Timur Laut	8.58	4.96	6.17	6.78	2.15	1.58	3.45	2.36	1.65	0.97	3.33	3.82
Putrajaya	Putrajaya	1.44	2.79	18.8	29.79	13.74	4.81	3.48	3.35	4.31	4.15	5	8.33
Sabah	Beaufort	4.04	2.6	84.3	65.68	14.11	12.5	15.38	1.06	2.05	1.98	0.96	18.61
Sabah	Beluran	32.9	16.54	27.05	13.08	5.75	6.66	3.22	1.04	0	5.82	0	10.19
Sabah	Kalabakan	1.13	0.73	2.1	1.36	0.98	0.32	0.61	0.3	0	0	0.27	0.71
Sabah	Keningau	3.3	1.59	6.16	28.8	11.04	2.78	4.93	1.3	0	0.41	1.57	5.63
Sabah	Kinabatangan	16.02	13.42	11.47	1.93	0	0.9	3.48	0	0.81	1.97	2.28	4.75
Sabah	Kota Belud	55.29	17.47	44.71	15.37	14.85	9.87	11.28	1.68	3.24	7.05	4.54	16.85
Sabah	Kota Kinabalu	11.46	7.78	11.62	2.2	4.04	4.73	5.57	1.15	1.12	1.26	2.43	4.85
Sabah	Kota Marudu	22.26	10.76	50.71	8.8	3.64	3.52	6.81	6.58	0	2.05	3.96	10.83
Sabah	Kuala Penyu	64.63	31.24	60.39	38.92	9.41	4.55	0	0	0	7.94	3.84	20.08
Sabah	Kudat	15.57	12.74	16.79	6.49	6.28	9.1	5.86	0.94	0	0.88	4.27	7.17
Sabah	Kunak	5.75	6.94	12.08	2.59	0	0	4.69	0	2.19	1.06	0	3.21
Sabah	Lahad Datu	7.63	34.57	26.29	6.03	1.67	2.41	1.95	0.75	2.54	1.76	1.7	7.94
Sabah	Nabawan	0	4.35	16.82	12.2	11.79	5.7	11.01	1.77	1.71	1.66	0	6.09
Sabah	Papar	16.89	8.79	32.8	8.81	2.27	2.75	3.19	1.03	2.48	0	0.93	7.27
Sabah	Penampang	18.45	14.96	22.25	2.15	4.16	1.51	1.46	0.47	1.82	1.75	1.27	6.39
Sabah	Pitas	17.61	9.73	49.36	20.45	4.39	8.49	4.1	3.97	5.75	11.12	5.38	12.76
Sabah	Putatan	33.49	30.33	54.66	10.2	9.9	5.76	3.73	1.81	3.51	1.7	0	14.1
Sabah	Ranau	18.5	15.2	53.58	44.28	5.65	5.46	9.81	2.92	4.94	2.73	7.91	15.54
Sabah	Sandakan	9.04	7.24	4.59	6.77	1.35	0.87	0.84	0.41	0.2	0.57	0.92	2.98
Sabah	Semporna	3.08	4.46	13.65	5.56	1.34	0	1.25	0	0	0.57	0.55	2.77
Sabah	Sipitang	13.74	15.94	320.96	116.65	21.59	6.96	15.69	2.17	0	4.05	3.91	47.42
Sabah	Tambunan	5	12.08	42.02	45.14	15.27	14.76	4.08	0	5.71	14.73	8.9	15.24
Sabah	Tawau	8.77	13.04	46.65	15.23	4.71	4.55	9.91	2.13	1.54	3.48	3.84	10.35
Sabah	Telupid	37.55	29.04	14.04	3.39	0	6.34	3.06	8.88	5.73	0	2.67	10.06
Sabah	Tenom	9.51	5.51	46.2	79.01	9.96	9.63	9.31	6	0	0	1.35	16.04
Sabah	Tongod	6.81	2.2	10.61	8.21	3.97	0	1.85	1.79	0	1.67	1.62	3.52
Sabah	Tuaran	11.33	8.21	52.91	6.82	5.77	10.36	12.32	3.72	0.72	1.39	2.02	10.51
Sarawak	Asajaya	2.47	0	9.66	16.71	11.8	4.66	18.43	13.66	4.5	2.22	10.98	8.64

Sarawak	Bau	18.12	16.46	22.29	30.28	29.62	27.82	30.61	28.84	23.87	10.61	5.19	22.16
Sarawak	Belaga	22.71	43.55	101.8	15.02	19.2	27.61	11.03	55	22.31	48.6	26.09	35.72
Sarawak	Beluru	0	14.44	14.6	22.15	29.85	22.62	22.86	38.51	54.47	31.45	39.71	26.42
Sarawak	Betong	9.36	6.96	16.11	73	79.16	51.57	93.37	125.62	72.1	45.49	57.99	57.34
Sarawak	Bintulu	12.37	34.89	56.18	16.51	18.27	10.23	9.43	28.02	6.44	6.75	18.28	19.76
Sarawak	Bukit Mabong	16.82	6.3	6.29	31.36	22.95	12.48	62.25	39.31	28.87	12.33	28.67	24.33
Sarawak	Dalat	5.52	11.29	0	53.06	36.14	12.31	18.87	38.55	13.13	13.41	27.4	20.88
Sarawak	Daro	3.33	6.48	3.15	3.07	26.83	17.39	11.27	32.84	10.64	2.58	0	10.69
Sarawak	Julau	10.31	66.95	20.59	56.59	51.41	30.82	87.26	205.16	76.87	40.96	25.58	61.14
Sarawak	Kabong	24.6	19.54	9.7	0	0	18.98	14.13	37.41	9.28	4.61	0	12.57
Sarawak	Kanowit	10.71	31.98	21.22	63.38	108.68	83.76	93.81	231.75	120.53	37.71	30.72	75.84
Sarawak	Kapit	307.61	58.26	224.98	775.75	759.83	401.17	803.08	1004.72	804.44	335.44	310.51	525.98
Sarawak	Kuching	13.08	9.13	15.63	19.62	19.24	15.82	15.51	22.3	9.32	4.16	3.42	13.38
Sarawak	Lawas	2.32	25.16	24.78	46.61	48.1	49.53	31.81	43.87	55.55	12.16	15.96	32.35
Sarawak	Limbang	54.56	25.77	27.46	29.1	28.63	18.11	75.22	91.53	55.56	33.93	44.51	44.03
Sarawak	Lubok Antu	31.08	32.69	50.37	59.6	72.47	42.49	41.9	54.45	49.99	14.6	28.8	43.49
Sarawak	Lundu	7.88	20.64	22.79	59.68	51.27	52.73	51.77	43.89	40.82	26.71	28.41	36.96
Sarawak	Maradong	13.62	77.07	9.06	22.61	27.1	13.53	13.52	45	53.93	35.9	17.93	29.93
Sarawak	Marudi	10.95	44.37	117.99	91.08	92.27	87.64	171.66	137.93	78.98	43.09	74.83	86.44
Sarawak	Matu	0	2.21	1.08	4.26	4.17	6.14	7.03	3.94	3.86	0.95	2.78	3.31
Sarawak	Miri	5.12	18.82	20.96	21.16	18.13	16.63	24.64	37.49	29.16	3.75	6.99	18.44
Sarawak	Mukah	0	10.37	13.06	44.74	42.42	56.1	59.22	65.09	30.06	16.52	27.74	33.21
Sarawak	Pakan	33.12	79.74	26.66	33.43	20.12	26.91	33.73	67.67	88.24	54.47	20.49	44.05
Sarawak	Pusa	19.75	19.58	0	14.43	19.08	14.18	14.06	37.17	18.43	9.13	45.27	19.19
Sarawak	Samarahan	10.46	11.86	12.14	22.92	18.31	7.07	14.84	9.8	4.63	0	3.53	10.51
Sarawak	Saratok	14.72	14.63	18.16	28.87	14.34	28.49	31.85	35.15	45.4	10.41	3.45	22.32
Sarawak	Sarikei	9.64	26.26	4.73	9.36	11.58	9.17	13.62	6.74	20.03	4.41	0	10.5
Sarawak	Sebauh	3.38	13.17	54.43	9.34	3.03	11.79	5.73	16.73	0	13.19	15.39	13.29
Sarawak	Selangau	4.05	3.98	15.68	50.16	34.18	14.95	44.14	72.39	49.86	24.53	17.24	30.11
Sarawak	Serian	3.61	7.1	9.78	10.31	22.3	24.58	20.91	23.13	21.47	3.72	4.27	13.74
Sarawak	Sibu	3.63	3.58	11.79	41.3	60.26	26.62	46.94	75.54	27.75	12.35	14.3	29.46
Sarawak	Simunjan	5.24	10.44	23.41	25.92	59.43	38.63	33.36	76.74	81.57	25.4	45.57	38.7
Sarawak	Song	14.24	18.9	9.41	51.54	88.63	88.25	110.98	147.33	123.77	22.82	54.53	66.4
Sarawak	Sri Aman	31.99	48.51	54.22	55.67	48.93	32.25	75.74	39.42	19.49	15.41	9.53	39.2
Sarawak	Subis	1.79	20.88	28.79	36.27	24.07	20.3	25.84	42.91	28.8	8.41	13.64	22.88
Sarawak	Tanjung Manis	3.8	0	3.66	39.51	7.05	0	6.78	6.65	0	0	0	6.13
Sarawak	Tatau	0	49.08	86.81	37.98	19.96	5.57	24.44	34.46	20.7	22.72	34.5	30.57
Sarawak	Tebedu	6.76	6.67	26.37	13.02	9.65	9.53	9.42	27.91	15.31	15.13	11.95	13.79
Sarawak	Telang Usan	5.85	23.72	48.07	12.17	6.17	31.24	6.33	89.75	51.95	13.16	26.66	28.64
Selangor	Gombak	13.39	20	35.32	15.29	14.61	12.96	13.1	8.89	5.59	4.15	4.45	13.43
Selangor	Klang	23.53	8.28	10.17	8.8	1.9	5.54	4.49	4.37	2.92	1.38	11.59	7.54
Selangor	Kuala Langat	16.2	12.03	17.64	24.88	17.71	8.98	14.81	14.65	10.35	12.29	10.95	14.59
Selangor	Kuala Selangor	9.5	9.71	20.67	10.09	20.92	9.61	19.53	14.11	10.79	4.72	11.34	12.82
Selangor	Petaling	10.63	26.23	28.79	14.03	9.71	8.84	8.24	7.1	3.85	1.7	3.04	11.11
Selangor	Sabak Bernam	28.02	24.22	31.56	29.77	3.11	11.49	10.53	11.68	9.64	4.32	11.99	16.03
Selangor	Sepang	2.53	19.44	26.89	16.34	10.89	7.19	8.38	7.71	6.28	2.87	3.25	10.16
Selangor	Ulu Langat	16.1	33.3	38.17	39.66	24.56	15.87	11.54	16.4	8.01	4	5.84	19.4
Selangor	Ulu Selangor	47.71	40.01	64.01	26.58	17.39	9.08	12.46	7.43	5.71	2.22	9.38	22
Terengganu	Besut	17.1	43.61	89.58	104.91	60.93	46.12	120.12	45.61	17.37	8.26	6.9	50.96
Terengganu	Dungun	9.94	18.28	69.44	190.61	157.79	152.95	108.9	76.86	35.21	13.29	17.08	77.3
Terengganu	Hulu Terengganu	18.92	8	21.07	57.22	89.87	51.97	23.78	19.77	24.4	14.45	38.05	33.41
Terengganu	Kemaman	28.53	27.41	23.58	41.41	32.16	24.81	16.22	24.35	12.18	4.78	7.96	22.13
Terengganu	Kuala Nerus	0.7	4.84	9.57	18.22	14	9.88	9.75	23.77	3.17	1.88	3.09	8.99
Terengganu	Kuala Terengganu	0.51	4.07	12.05	23.32	15.68	8.23	11.47	7.08	1.87	1.38	2.27	7.99
Terengganu	Marang	12	1.97	18.5	46.12	23.7	16.84	23.07	9.11	9.88	1.77	2.62	15.05
Terengganu	Setiu	19.68	17.74	26.4	158.84	242.39	75.56	49.4	54.06	41.9	31.58	74.19	71.98

Table S9 Mortality of notified leptospirosis cases in Malaysia according to state and district

State	District	Mortality of leptospirosis (per 100,000 population)											Average mortality (per 100,000 population)
		2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	
Johor	Batu Pahat	0	0.24	1.63	0.46	0	0.22	0.87	0.21	0	0.21	0	0.35
Johor	Johor Bahru	0	0	0	0.38	0.72	0.41	0.45	0.22	0.26	0	0.15	0.24
Johor	Kluang	0	0	0.33	0.33	0.32	0.32	0.94	0.31	0.31	0	0.3	0.29
Johor	Kota Tinggi	0	0.53	0	0.53	0.53	1.05	1.06	0.53	1.06	0	1.59	0.63
Johor	Kulaijaya	0	0	0	1	0.96	0	0.88	0	0	0	0.5	0.3
Johor	Mersing	1.45	0	0	1.44	0	0	0	2.86	1.43	0	0	0.65
Johor	Muar	0	0	0.4	1.19	0.39	0.39	0	0	1.11	0.37	0	0.35

Johor	Pontian	0	0	0.65	0.65	0	1.93	2.56	0	0	0	0.63	0.58
Johor	Segamat	0	0	0	0.54	0.54	0.54	0.54	0	0	0	1.06	0.29
Johor	Tangkak	0	0.75	1.49	2.22	0.73	0	0	0	0	0	0	0.47
Kedah	Baling	0	0	0	0	0	0	0	0	0	0	1.41	0.13
Kedah	Bandar Baharu	0	0	2.26	0	0	0	0	0	0	0	0	0.21
Kedah	Kota Setar	0.83	1.09	1.07	0.26	0	0	0.51	0.5	0	0	0	0.39
Kedah	Kuala Muda	0	0.63	0	0.2	0.58	0.19	0	0.36	0	0	0	0.18
Kedah	Kubang Pasu	1.82	0.9	0	1.74	1.29	0.85	0.42	0.82	0.41	0	0	0.75
Kedah	Kulim	0	0	0.3	0	0.56	0.27	0	0	0.24	0	0.22	0.14
Kedah	Langkawi	2.3	0	2.17	0	0	0	0	0	0	0.89	0	0.49
Kedah	Padang Terap	0	4.58	1.51	1.49	0	0	0	1.43	0	0	0	0.82
Kedah	Pendang	1.03	1.03	1.02	0	2.03	0	3.01	0	0	1.98	0	0.92
Kedah	Pokok Sena	0	0	0	0	1.83	1.8	0	0	0	1.68	0	0.48
Kedah	Sik	0	0	1.45	1.44	1.42	0	0	0	0	0	0	0.39
Kedah	Yan	1.54	0	0	1.51	0	1.49	0	0	0	0	0	0.41
Kelantan	Bachok	0	0.77	0.76	0	0	0	0	0	0	0	0.68	0.2
Kelantan	Gua Musang	0	2.53	0	3.69	0	0	0	0	2.3	1.13	2.23	1.08
Kelantan	Jeli	0	0	7.7	0	0	0	0	0	2.44	0	0	0.92
Kelantan	Kecil Lojing	0	0	0	0	0	0	0	0	0	8.15	0	0.74
Kelantan	Kota Bharu	0.21	0.82	0.81	0.4	0.2	0	0	0	0	0	0	0.22
Kelantan	Kuala Krai	0	1.85	3.66	0	0.89	0	0	1.72	3.39	0	4.96	1.5
Kelantan	Machang	0	0	2.14	0	0	0	0	0	0.99	0.97	3.84	0.72
Kelantan	Pasir Mas	0.53	0.53	0.52	2.07	1.53	0	0	0	0	0	0.96	0.56
Kelantan	Pasir Puteh	0.88	0	1.74	1.72	1.71	0	0	0	0.83	0	1.63	0.77
Kelantan	Tanah Merah	0.85	0.84	2.48	1.63	0	0	0	0	0	1.51	0.74	0.73
Kelantan	Tumpat	0	0	0.66	3.28	1.3	0	0	0	0	0	0	0.48
Kuala Lumpur	Kuala Lumpur	0.12	0.18	0.23	0.34	0.39	0.16	0.16	0.47	0.21	0	0.1	0.21
Labuan	Labuan	1.38	0	1.33	0	0	2.53	0	0	0	0	0	0.48
Melaka	Alor Gajah	0	0	0	0	0.49	0	0	0	0	0	0	0.04
Melaka	Jasin	0.73	0	0	0.67	0.65	0	0	0	0	0	0	0.19
Melaka	Melaka Tengah	0.4	0.19	0	0	0.71	0.17	0	0	0.16	0.31	0	0.18
Negeri Sembilan	Jelevu	0	2.52	0	0	0	4.97	0	0	0	2.45	2.44	1.13
Negeri Sembilan	Jempol	0.92	1.87	1.89	0.95	0	0	0	0.99	0	0	0	0.6
Negeri Sembilan	Kuala Pilah	0	2.98	1.49	1.49	0	1.48	0	0	0	0	1.47	0.81
Negeri Sembilan	Port Dickson	0	0	0.9	0.9	0	0	0	0	0	0	0	0.16
Negeri Sembilan	Rembau	0	0	4.41	4.35	0	0	2.09	2.06	0	0	0	1.17
Negeri Sembilan	Seremban	0.18	0.51	1.32	0.8	0.62	0.45	0.43	0.84	0.13	0.13	0.25	0.51
Negeri Sembilan	Tampin	2.49	2.47	2.46	1.22	0	0	0	0	1.18	1.18	0	1
Pahang	Bentong	0	0.8	0.79	0.78	0	0	0	0	0	0	0	0.22
Pahang	Bera	0	0.99	0	0	0.93	0	0	0	0.87	0	0.83	0.33
Pahang	Cameron Highlands	0	0	0	0	0	0	0	0	2.11	0	0	0.19
Pahang	Jerantut	0	0	0	0	1.06	0	0	0	0	0	0	0.1
Pahang	Kuantan	0	0.42	0.83	2.22	0.59	0.77	0.56	0.18	0.18	0.17	0.17	0.55
Pahang	Lipis	0	0	0	0	0	0	0	1	0	0	0	0.09
Pahang	Maran	0	0	0	0.92	0.92	0.92	0	0	0	0	0	0.25
Pahang	Pekan	0	0.94	1.86	0.92	0	0	0	0	0	0	1.74	0.5
Pahang	Raub	0	0	0	1.01	0	0	0	0	0	0	0	0.09
Pahang	Rompin	0.9	0	0	2.65	0	0.87	0.86	0.86	1.7	0	0	0.71
Pahang	Temerloh	0	0	0	0	0	0	0	0	0.54	0	0.53	0.1
Perak	Bagan Datuk	0	0	0	0	0	0	0	1.37	1.37	0	1.35	0.37
Perak	Batang Padang	0	0	0.84	0.82	0.81	0	1.58	2.34	0.77	0.76	0.75	0.79
Perak	Hilir Perak	0	0.73	0	2.17	1.44	0.72	0	0	0.7	0	0.69	0.59
Perak	Hulu Perak	2.15	1.06	3.17	1.05	0	2.06	2.04	0	2.01	0	0.99	1.32
Perak	Kampar	0	1.94	0	0	0	0	0	0	0	0	0.83	0.25
Perak	Kerian	0	0	2.14	1.05	0.52	0	0.5	1.99	0	0	0.95	0.65
Perak	Kinta	0	0.13	0.5	0.49	0.24	0.12	0	0.11	0.34	0.33	0.22	0.23
Perak	Kuala Kangsar	0.62	0.61	1.82	0	0.6	0	0	0	0	0.57	0.57	0.44
Perak	Larut Dan Matang	0.33	0	0.65	1.59	1.87	0	0.3	0.3	0.29	0.29	1.68	0.66
Perak	Manjung	0.44	0	0.43	0.42	0.41	0.41	0.4	0.39	0.39	0	0	0.3
Perak	Muallim	0	0	1.52	1.5	0	0	0	0	1.39	0	0	0.4
Perak	Perak Tengah	0.92	0.91	5.33	0.87	0	0	0	0	0.79	0	0	0.8
Perak	Selama	0	0	2.45	0	0	2.32	0	0	0	0	0	0.43
Perlis	Perlis	0.87	0	0.42	0	0	0	0.81	1.19	0	0.39	0.38	0.37
Pulau Pinang	Barat Daya	0	0	0	0	0	0.46	0	0.44	0	0	0	0.08
Pulau Pinang	Seberang Perai Selatan	0	0	0.54	0.52	0	0	0.47	0	0	0	0	0.14
Pulau Pinang	Seberang Perai Tengah	1.33	0.26	0	0.25	0	0	0	0	0	0	0	0.17
Pulau Pinang	Seberang Perai Utara	0	0.69	1.69	0.66	0	0	0	0.31	0	0	0	0.3

Pulau Pinang	Timur Laut	0.39	0	0.56	0	0.18	0	0.17	0.17	0	0	0.16	0.15
Putrajaya	Putrajaya	0	0	1.34	0	0	0	0	0	1.08	0	0	0.22
Sabah	Beaufort	0	0	2.52	3.65	1.18	0	1.1	0	0	0	0	0.77
Sabah	Beluran	3.95	0	0	0	1.15	0	0	0	0	0	0	0.46
Sabah	Kalabakan	0	0	0.7	0	0	0	0	0	0	0	0	0.06
Sabah	Keningau	0	0	0	0.5	0	0	0	0	0	0	0.39	0.08
Sabah	Kinabatangan	0	0.52	0	0	0	0	0.44	0	0	0.39	0	0.12
Sabah	Kota Belud	1.06	1.03	3.97	0	0.93	0	0	0	0	0	0	0.64
Sabah	Kota Kinabalu	0	0.71	1.14	0	0.21	0.41	0	0	0	0	0	0.22
Sabah	Kota Marudu	0	0	0	0	0	0	1.14	0	0	0	0	0.1
Sabah	Kuala Penyu	0	0	15.1	0	4.7	0	0	0	0	0	3.84	2.15
Sabah	Kudat	1.2	0	0	0	0	0	0	0	0	0	0	0.11
Sabah	Kunak	0	0	0	0	0	0	2.34	0	0	1.06	0	0.31
Sabah	Lahad Datu	1.43	0	0.45	0	0.42	0.4	0	0	0	0.35	0	0.28
Sabah	Nabawan	0	0	0	0	0	0	0	0	0	0	0	0
Sabah	Papar	0	0	0	1.17	0.57	0.55	0	0	0	0	0	0.21
Sabah	Penampang	0	0.58	2.22	0	0	0	0	0	0	0	0.42	0.29
Sabah	Pitas	0	0	0	0	0	0	0	0	0	0	0	0
Sabah	Putatan	2.23	4.33	4.2	0	0	0	0	0	0	0	0	0.98
Sabah	Ranau	0	0	2.59	0.84	0.81	0.78	0	0	0	0.68	0	0.52
Sabah	Sandakan	0	0	0.24	0.23	0	0	0.21	0	0	0.19	0	0.08
Sabah	Semporna	0	0	0	0	0	0	0	0	0	0	0	0
Sabah	Sipitang	0	0	5.14	0	0	0	0	0	0	0	0	0.47
Sabah	Tambunan	0	0	0	0	0	0	0	0	0	0	0	0
Sabah	Tawau	0	0	0	0	0.59	0.57	0.55	0	0	0.5	0	0.2
Sabah	Telupid	3.76	3.63	0	0	0	0	0	0	0	0	0	0.67
Sabah	Tenom	0	1.84	1.78	0	0	0	0	0	0	0	0	0.33
Sabah	Tongod	2.27	0	2.12	0	0	0	0	0	0	0	0	0.4
Sabah	Tuaran	0.94	0.91	0	0	0.82	0	0	0.74	0	0	0	0.31
Sarawak	Asajaya	0	0	0	2.39	0	0	0	0	0	0	0	0.22
Sarawak	Bau	1.29	2.53	0	0	0	0	1.13	0	1.08	0	0	0.55
Sarawak	Belaga	2.84	0	2.61	0	0	0	0	0	0	0	0	0.5
Sarawak	Beluru	0	0	0	0	7.46	0	0	0	0	0	0	0.68
Sarawak	Betong	0	0	0	4.56	0	4.48	2.22	4.41	2.18	2.17	0	1.82
Sarawak	Bintulu	0	1.2	2.34	0	0	0.54	0	0	0	0	0	0.37
Sarawak	Bukit Mabong	0	0	0	0	0	0	0	0	0	0	0	0
Sarawak	Dalat	0	0	0	0	0	0	0	0	0	0	0	0
Sarawak	Daro	3.33	0	0	0	2.98	0	0	5.47	0	0	0	1.07
Sarawak	Julau	0	15.45	0	0	0	0	0	0	0	0	0	1.4
Sarawak	Kabong	0	0	4.85	0	0	4.74	0	0	4.64	0	0	1.29
Sarawak	Kanowit	3.57	0	0	0	0	0	0	3.46	3.44	0	0	0.95
Sarawak	Kapit	0	16.65	8.33	8.34	16.7	0	8.37	0	0	0	0	5.31
Sarawak	Kuching	0.4	0.39	0.38	0	0	0.36	0	1.21	0.17	0	0.16	0.28
Sarawak	Lawas	0	0	0	0	2.19	4.31	6.36	4.18	0	0	2	1.73
Sarawak	Limbang	2.18	0	2.11	4.16	0	4.02	1.98	0	3.83	0	0	1.66
Sarawak	Lubok Antu	4.14	2.04	0	0	0	0	0	1.88	0	0	0	0.73
Sarawak	Lundu	0	5.16	0	2.49	2.44	0	2.35	0	2.27	0	2.19	1.54
Sarawak	Maradong	0	4.53	0	4.52	9.03	0	4.51	0	0	4.49	0	2.46
Sarawak	Marudi	0	5.55	0	5.69	0	0	5.92	0	0	0	12.47	2.69
Sarawak	Matu	0	0	0	0	0	0	0	0.98	0	0	0	0.09
Sarawak	Miri	0	1.54	0.37	1.09	1.07	0.35	0.68	1.32	0.64	0.31	0.3	0.7
Sarawak	Mukah	0	2.59	2.61	2.63	0	5.34	2.69	0	2.73	0	0	1.69
Sarawak	Pakan	6.62	0	6.67	0	0	0	0	0	0	0	6.83	1.83
Sarawak	Pusa	0	0	0	0	0	0	0	0	0	0	0	0
Sarawak	Samarahan	0	0	0	1.76	0.83	0	0	0.7	0	0	0	0.3
Sarawak	Saratok	0	0	7.27	0	0	0	0	3.52	0	0	0	0.98
Sarawak	Sarikei	0	0	0	0	0	0	0	0	0	0	0	0
Sarawak	Sebauh	0	0	0	0	0	0	0	0	0	0	2.57	0.23
Sarawak	Selangau	0	0	0	0	0	0	0	3.62	0	0	0	0.33
Sarawak	Serian	0	0	0.7	0	0.68	0	0	0.64	0	0	0	0.18
Sarawak	Sibu	0	0.6	0	1.75	0	0	0	1.65	1.09	0.54	0.53	0.56
Sarawak	Simunjan	0	0	0	0	2.58	7.73	0	2.56	2.55	0	2.53	1.63
Sarawak	Song	0	0	0	0	0	0	4.62	9.21	4.58	0	0	1.67
Sarawak	Sri Aman	0	0	4.17	0	4.08	4.03	0	0	0	0	0	1.12
Sarawak	Subis	0	1.74	1.69	0	4.81	0	0	1.48	1.44	0	0	1.01
Sarawak	Tanjung Manis	0	0	0	3.59	0	0	0	0	0	0	0	0.33
Sarawak	Tatau	0	3.07	2.99	0	0	0	0	0	0	0	0	0.55

Sarawak	Tebedu	0	3.34	6.59	0	0	0	0	0	0	0	0	0.9
Sarawak	Telang Usan	0	0	6.01	0	0	6.25	0	0	0	0	0	1.11
Selangor	Gombak	0	0.24	0.24	0.35	1.59	0.78	0.65	0.42	0.1	0.1	0.3	0.43
Selangor	Klang	0.24	0.11	0	0	0	0.21	0.5	0.29	0.09	0	0.18	0.15
Selangor	Kuala Langat	0.45	0	0	0.44	0.86	0	0	0.84	0	0.82	0.41	0.35
Selangor	Kuala Selangor	0	0.88	0	0	1.64	0	1.56	0.76	2.98	0.36	0	0.74
Selangor	Petaling	0.05	0.36	0.3	0.34	0.18	0.18	0.3	0.41	0.16	0.19	0.11	0.23
Selangor	Sabak Bernam	1	3.03	0	1.03	0	1.04	0	1.06	2.14	0	1.09	0.94
Selangor	Sepang	0	0.9	0.57	0.27	0.25	0	0	0.64	0.2	0.19	0	0.27
Selangor	Ulu Langat	0.18	1.03	0.67	0.73	0.79	0.31	0.22	0.22	0.43	0	0	0.42
Selangor	Ulu Selangor	0.47	0	0.45	0.44	0.85	0.41	2.01	0.39	0.38	0	0.36	0.52
Terengganu	Besut	0	0	0.69	1.37	0	0	0.66	0.65	0.64	0	1.25	0.48
Terengganu	Dungun	0.66	0.65	0	0	0	0	1.21	2.38	0.59	0.58	0	0.55
Terengganu	Hulu Terengganu	1.35	0	1.32	0	0	0	0	0	0	0	3.57	0.57
Terengganu	Kemaman	0.57	1.12	0	0	1.05	0.52	0	0.5	0	0	0	0.34
Terengganu	Kuala Nerus	0.7	0.69	0.68	0.67	0	1.32	0	0	0	0	0.62	0.43
Terengganu	Kuala Terengganu	0	0.51	1	0.99	0.49	0.48	0	0.47	0	0	0	0.36
Terengganu	Marang	0	0	0.97	0.96	0	0.94	0	0	0.9	0	0	0.34
Terengganu	Setiu	0	0	0	3.49	0	0	1.7	0	0	0	1.65	0.62

Table S10 Univariable analysis at the state level

Variables	IRR (95% CI)	P value	SE	df residual
Temperature*	0.87 (0.77–0.98)	0.021	0.0619	171
Rainfall	0.91 (0.74–1.10)	0.322	0.1005	171
Humidity	1.13 (0.99–1.31)	0.077	0.0717	171
Flooding	0.94 (0.78–1.13)	0.511	0.0956	171

*, significant variable. CI, confidence interval; df, degrees of freedom; IRR, incidence rate ratio; SE, standard error.

Table S11 Set of generalised linear mixed model selections at the state level.

Flooding*	Humidity*	Rainfall*	Temperature*	df	LL	AIC	ΔAIC
–	0.0928	–	–0.1242	6	–1032.82	2077.63	0
–	–	–0.1133	–0.1477	6	–1032.93	2077.86	0.23
–	0.0902 [†]	–0.1084 [†]	–0.1289 [†]	7 [†]	–1032.18 [†]	2078.37 [†]	0.74 [†]
–0.0655	–	–	–0.1437	6	–1033.36	2078.71	1.08
–0.0753	0.0979	–	–0.1237	7	–1032.49	2078.97	1.34
–0.0421	–	–0.1020	–0.1477	7	–1032.84	2079.67	2.04
–0.0541	0.0944	–0.0942	–0.1280	8	–1032.03	2080.06	2.42
–	0.1255	–0.0960	–	6	–1034.31	2080.62	2.99
–0.0773	0.1318	–	–	6	–1034.45	2080.91	3.27
–0.0593	0.1298	–0.0805	–	7	–1034.13	2082.25	4.62
–0.0424	–	–0.0880	–	6	–1035.72	2083.44	5.81

*, coefficient; [†], the model selected. AIC, Akaike information criterion; LL, log likelihood.

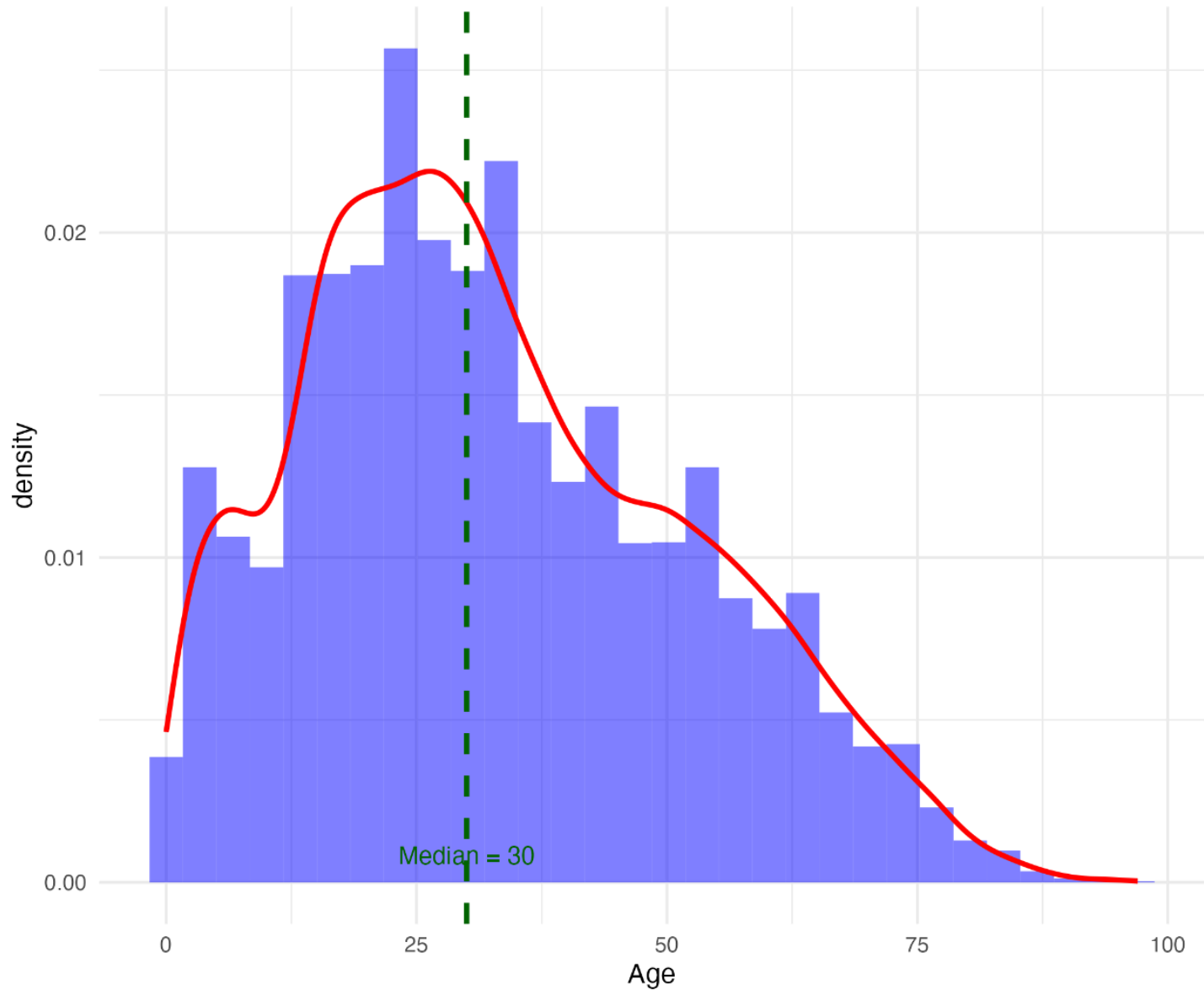


Figure S1 Distribution of age.

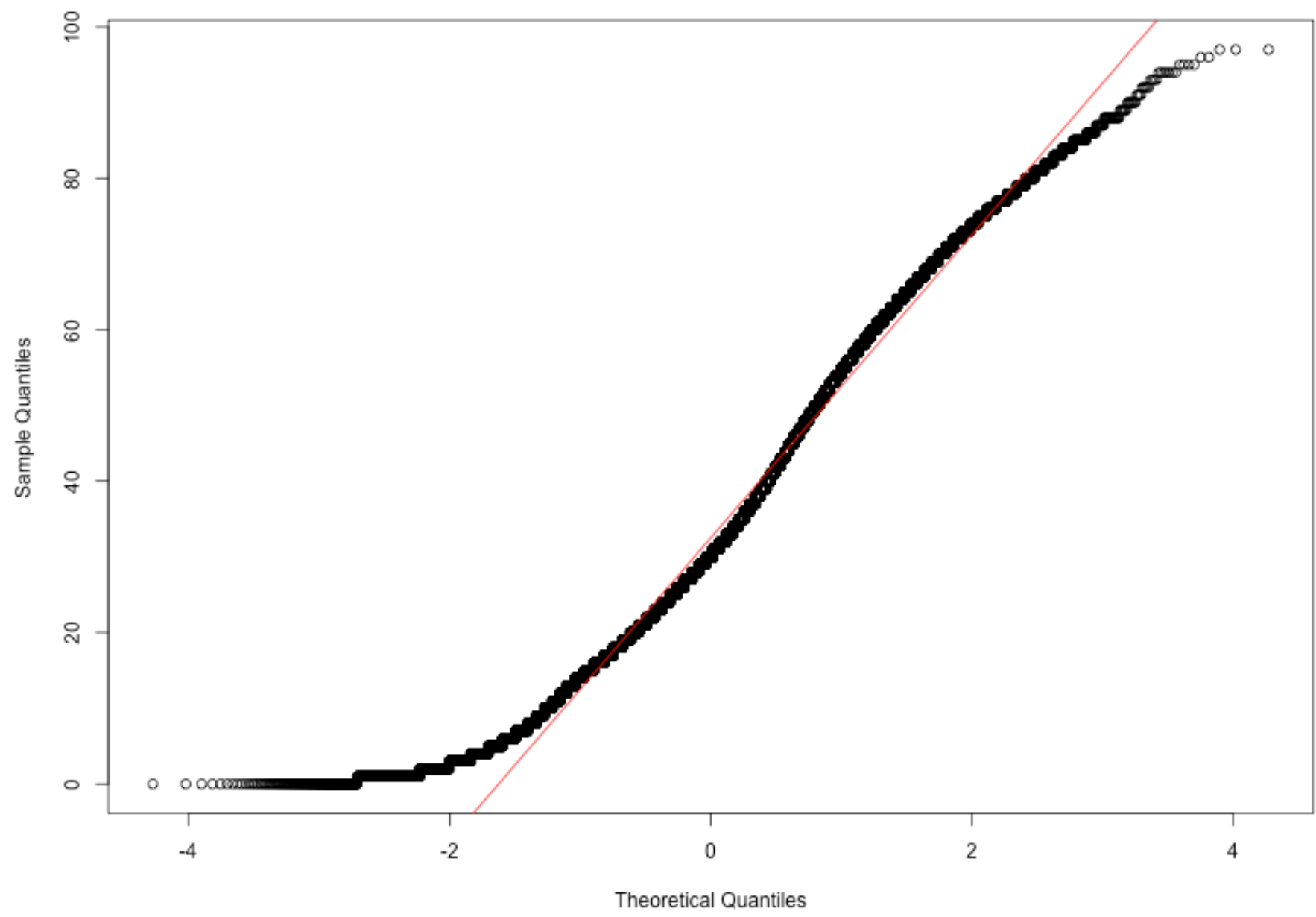


Figure S2 Q-Q plot of age.

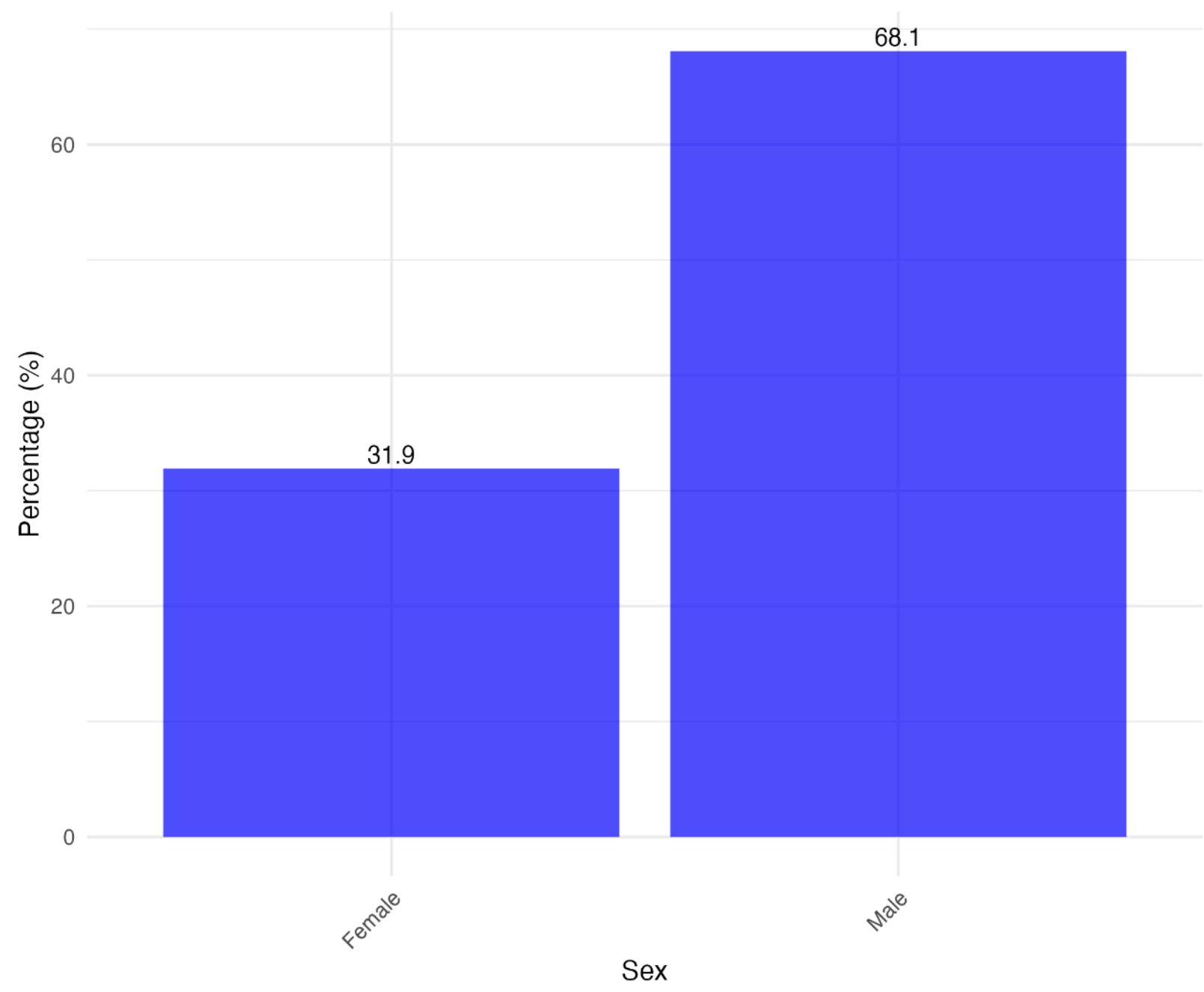


Figure S3 Distribution of sex.

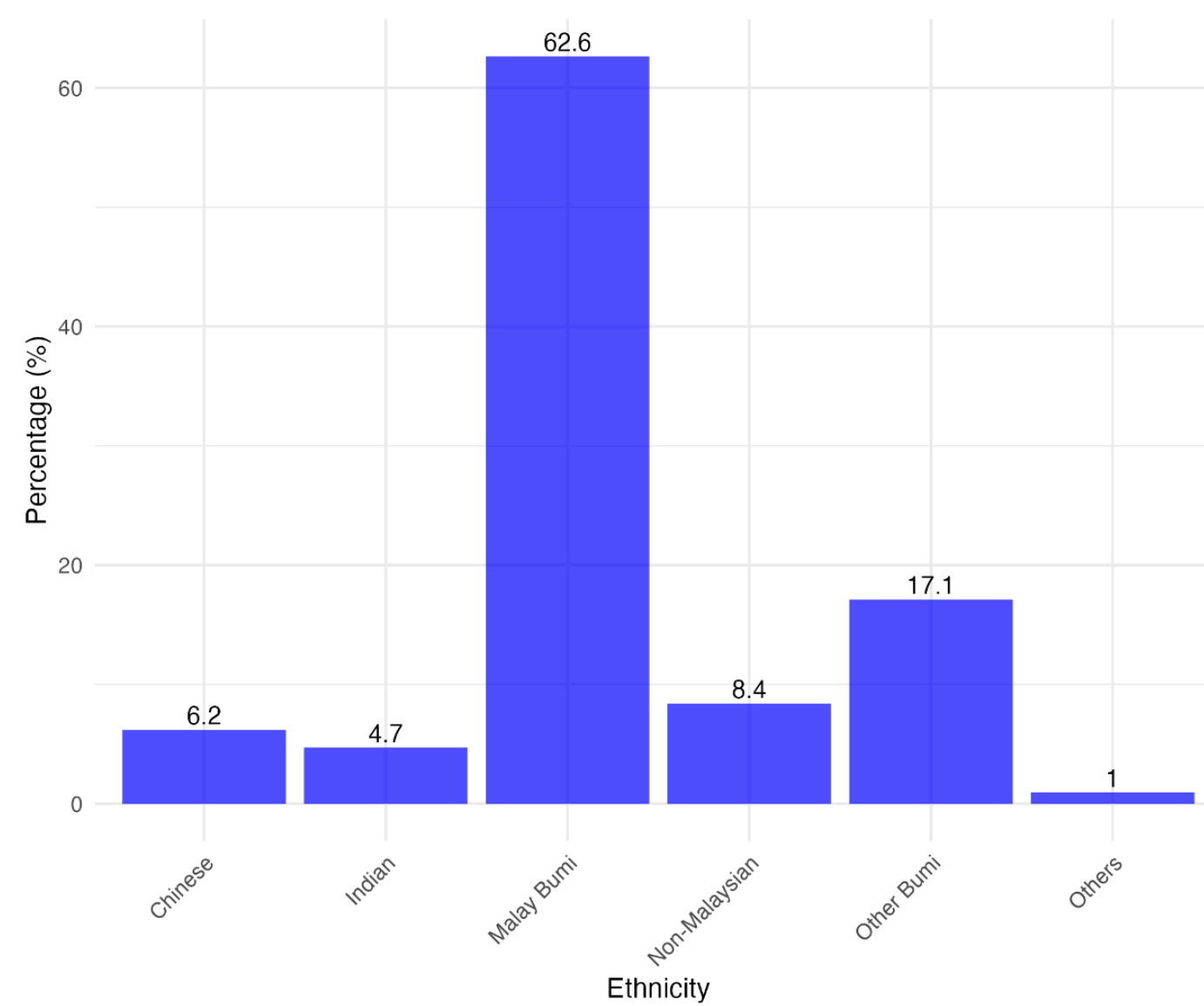


Figure S4 Distribution of ethnicity.

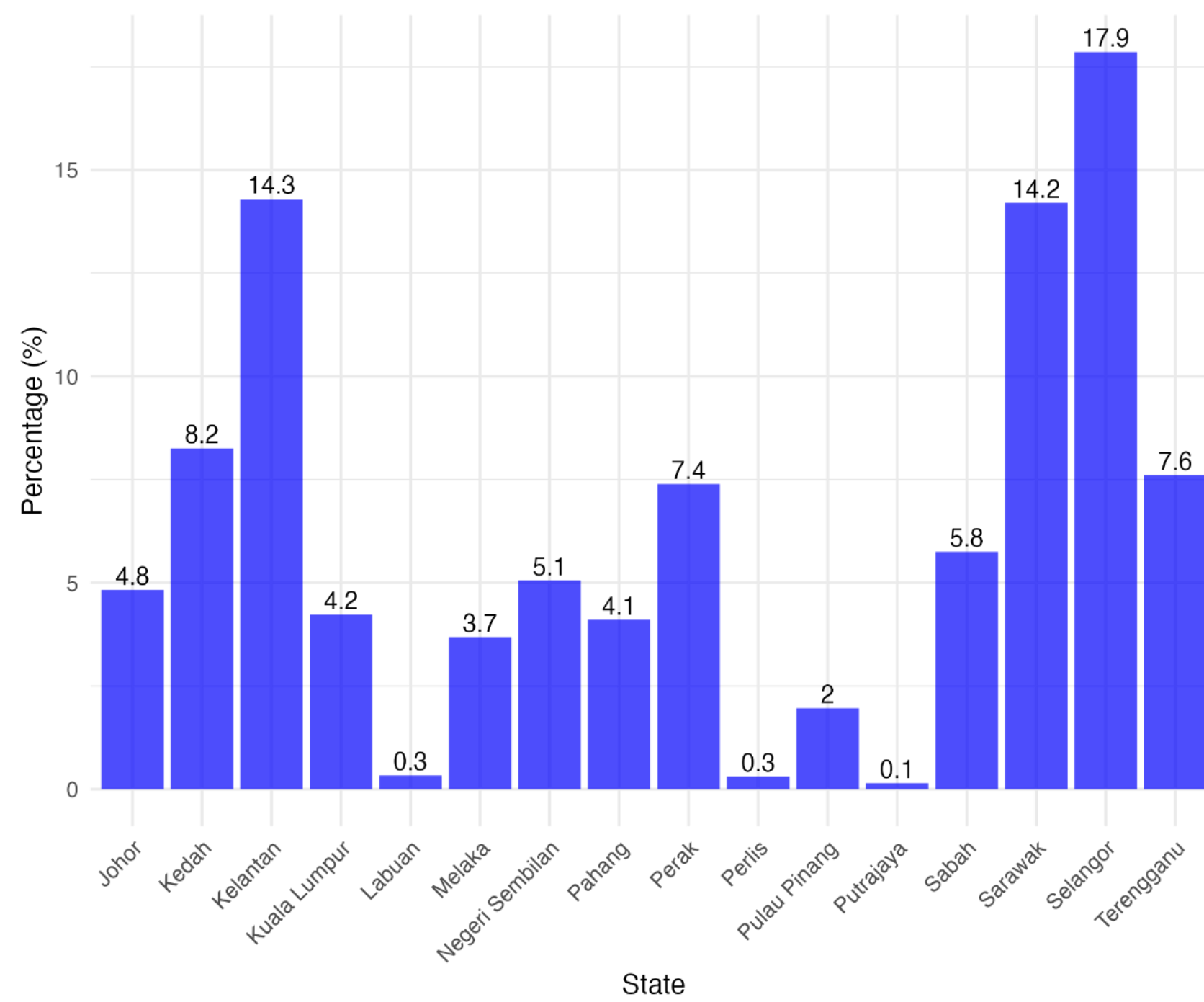


Figure S5 Distribution of state.

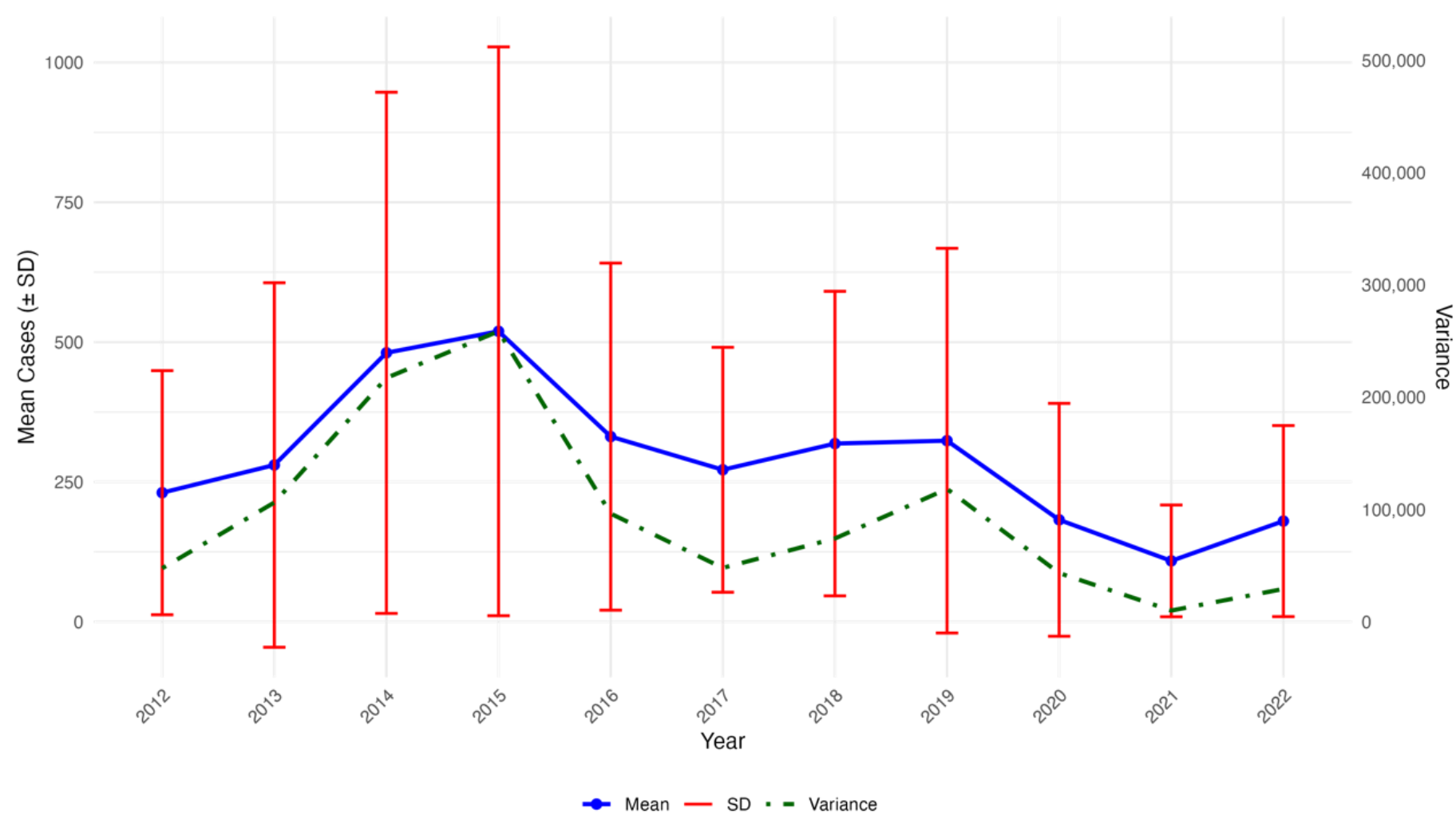


Figure S6 Mean, SD, and variance of leptospirosis cases at the state level. SD, standard deviation.

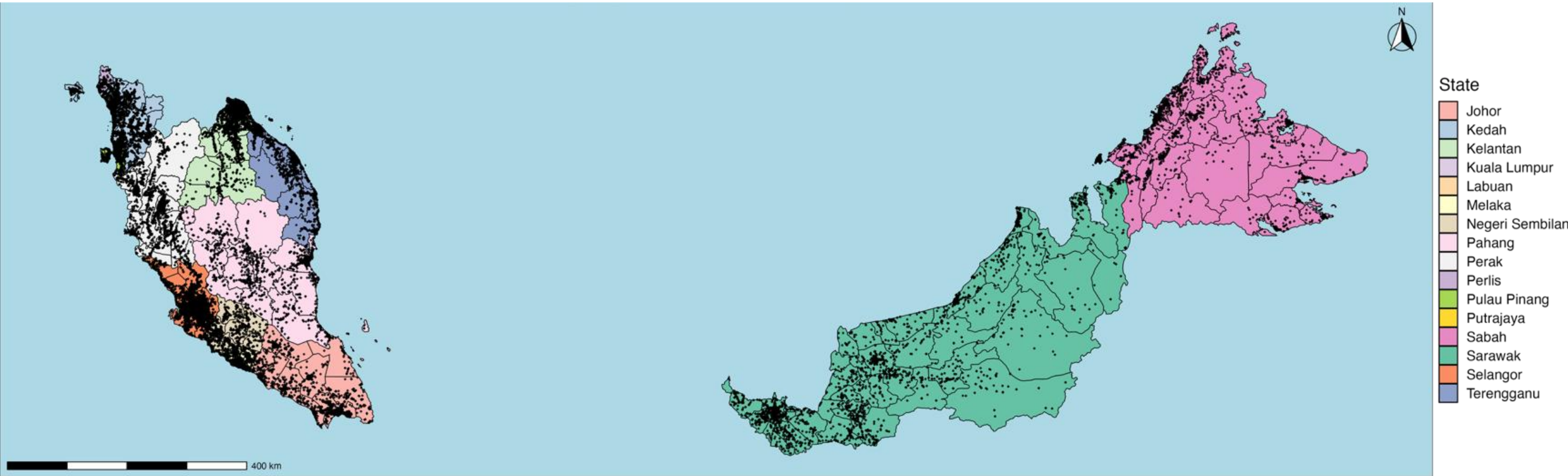


Figure S7 Overall distribution of leptospirosis cases in Malaysia between 2012 and 2022.

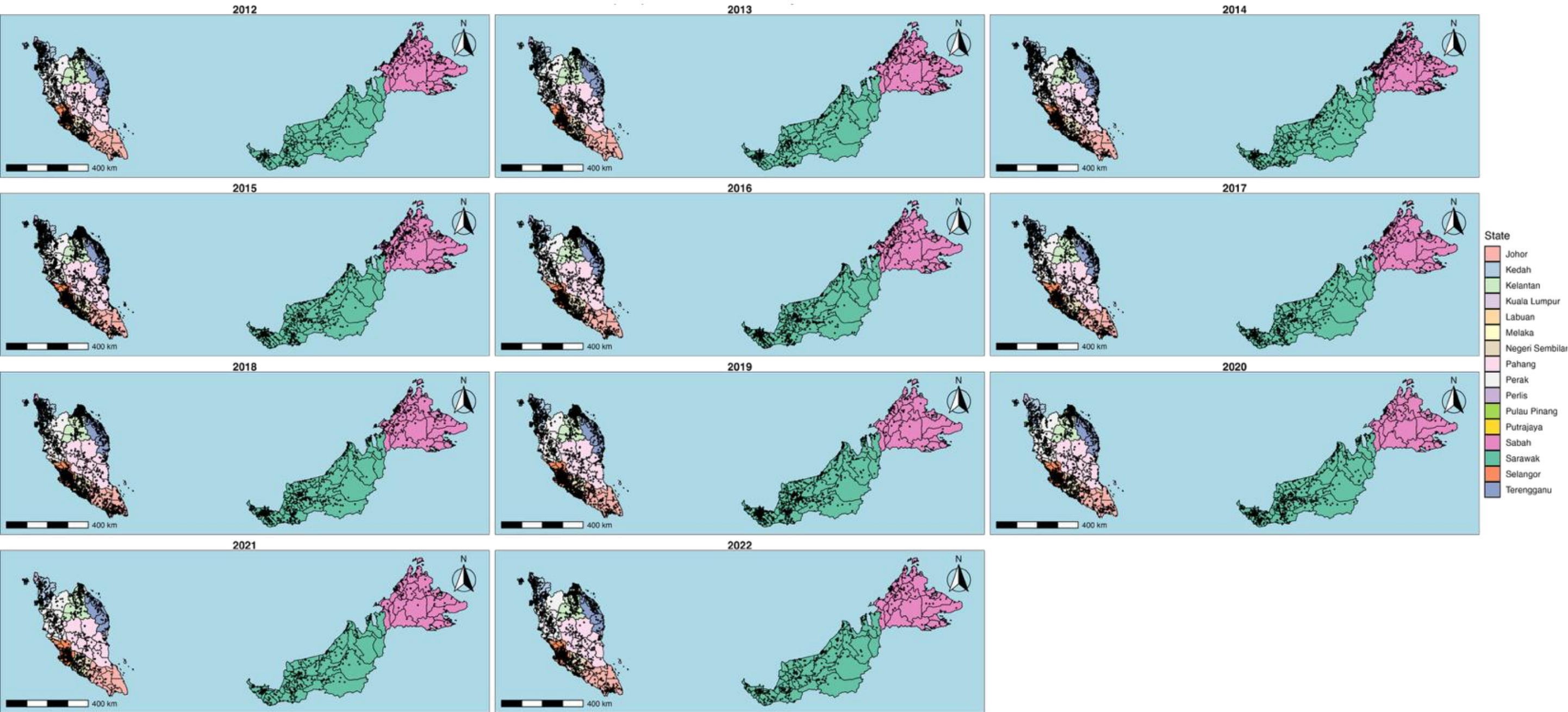


Figure S8 Yearly distribution of leptospirosis cases in Malaysia between 2012 and 2022

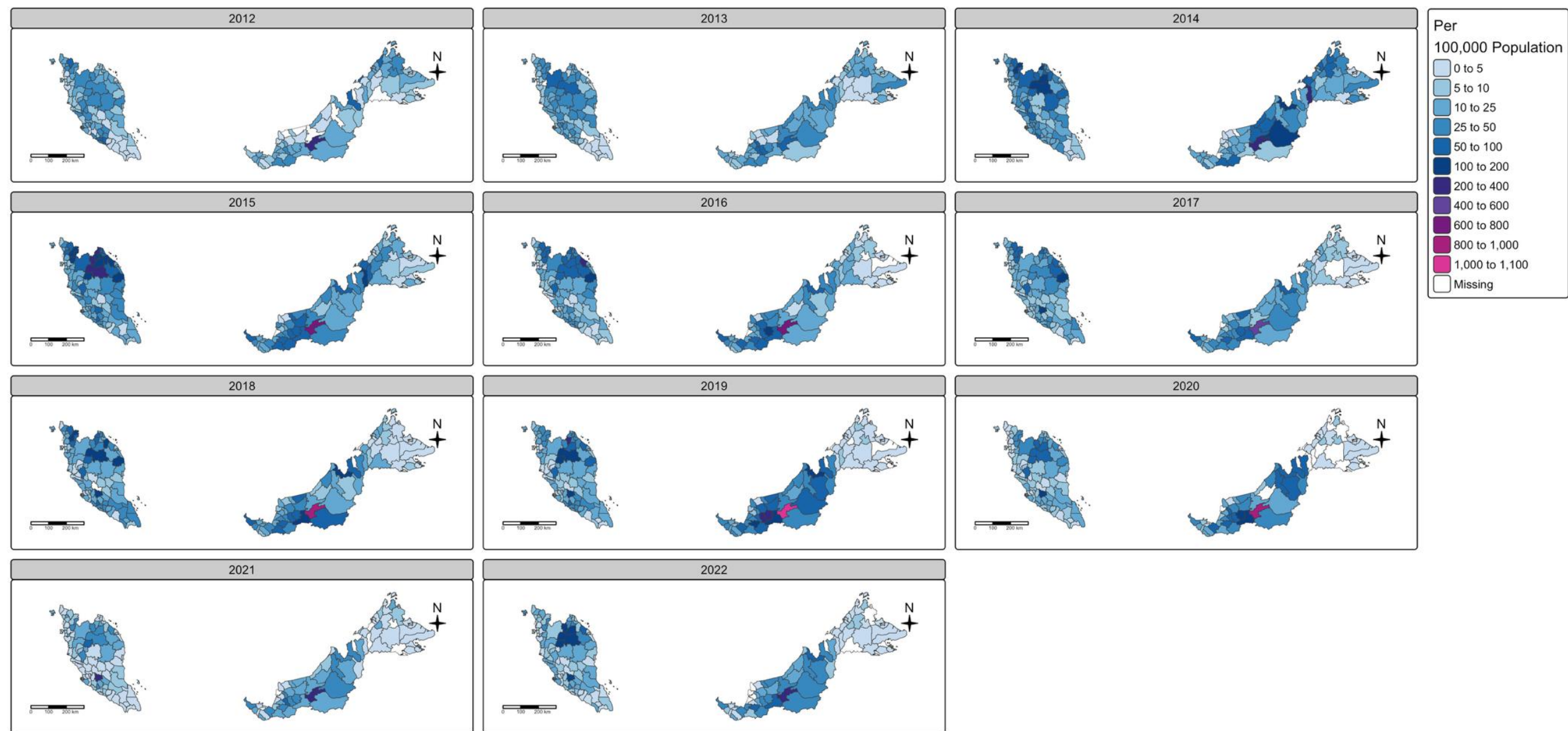


Figure S9 Yearly incidence of leptospirosis cases according to district in Malaysia.

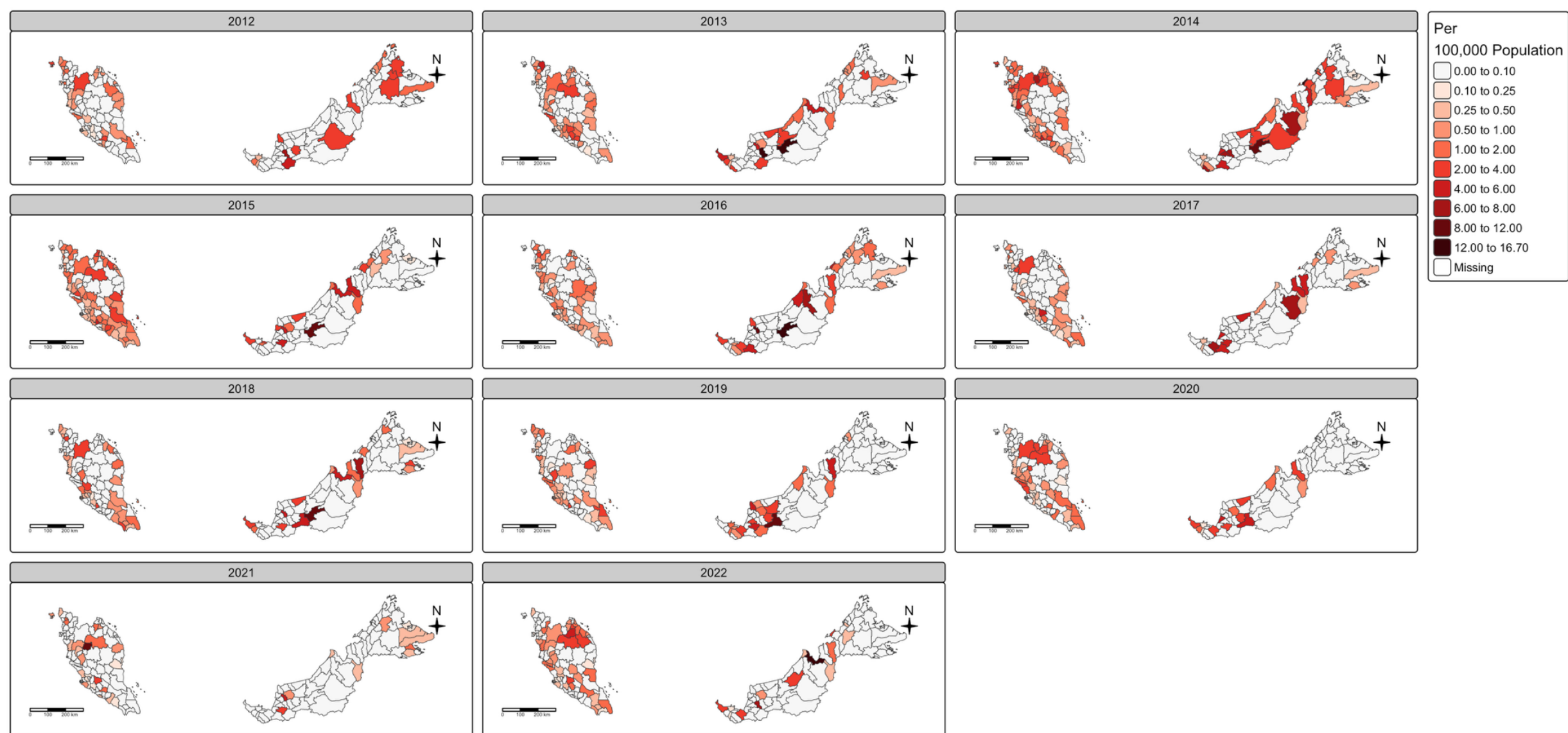


Figure S10 Yearly mortality of leptospirosis cases according to district in Malaysia.

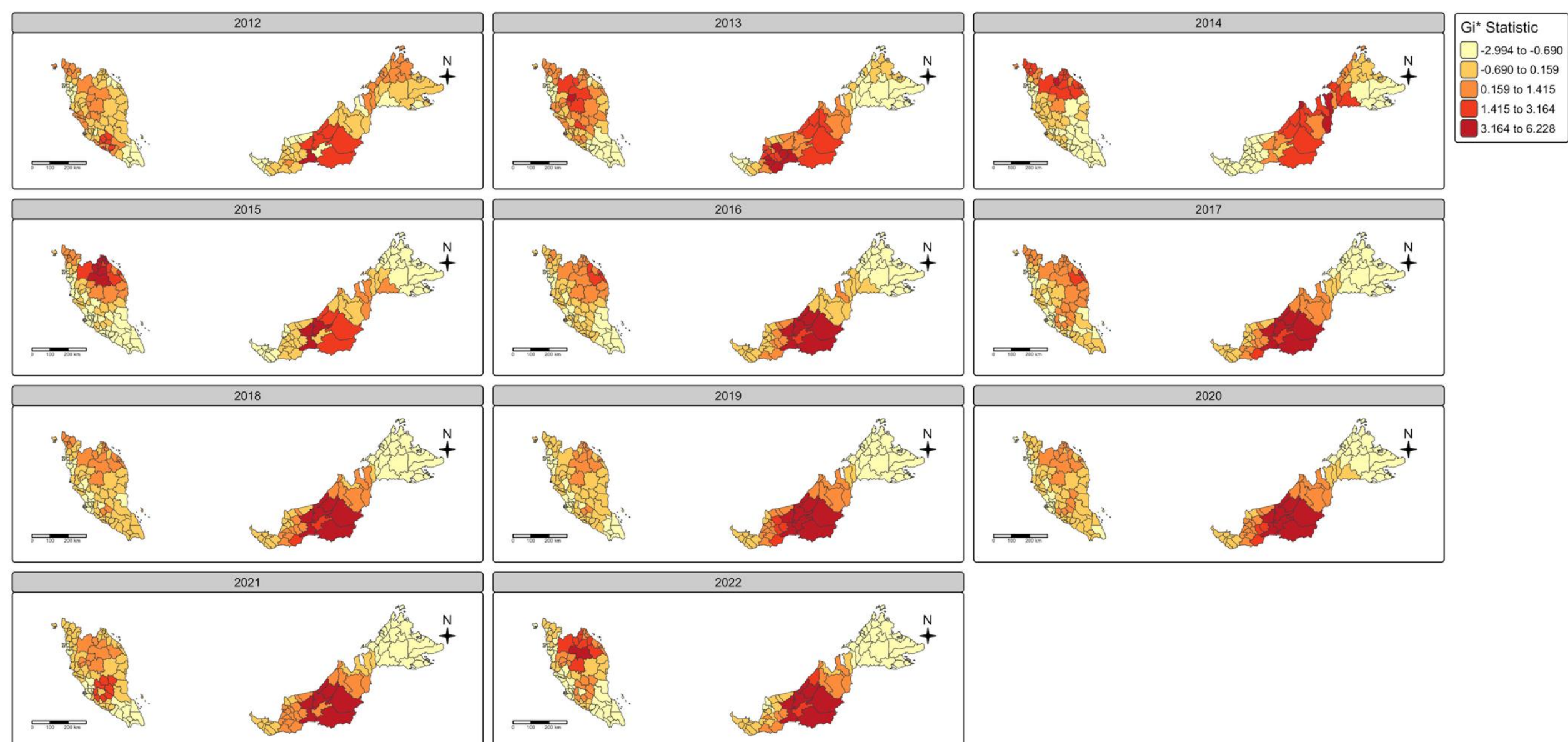


Figure S11 Getis-Ord Gi* statistic for leptospirosis cases in Malaysia at district level.

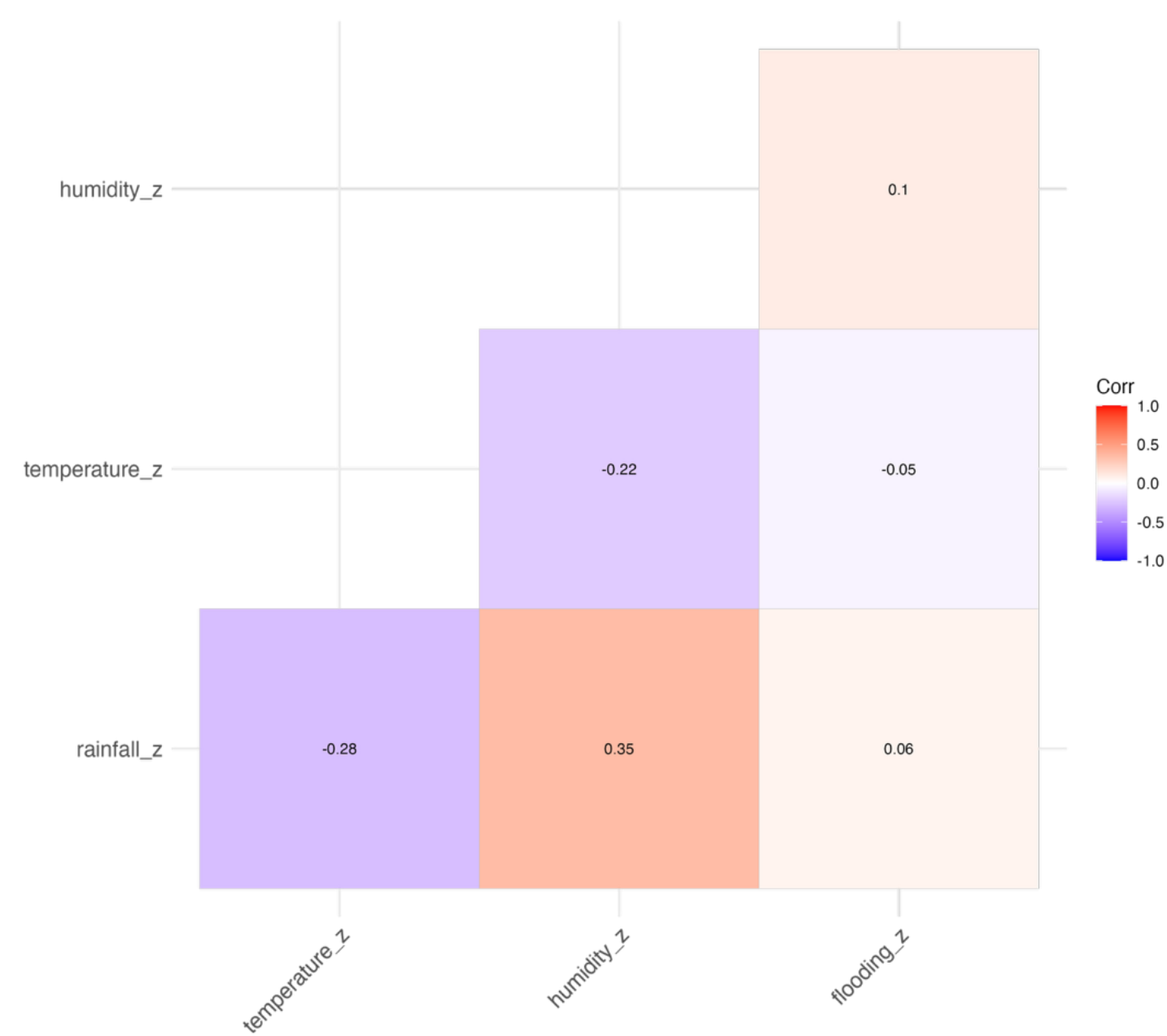


Figure S12 Cross-correlation of the climatic variables at the state level.

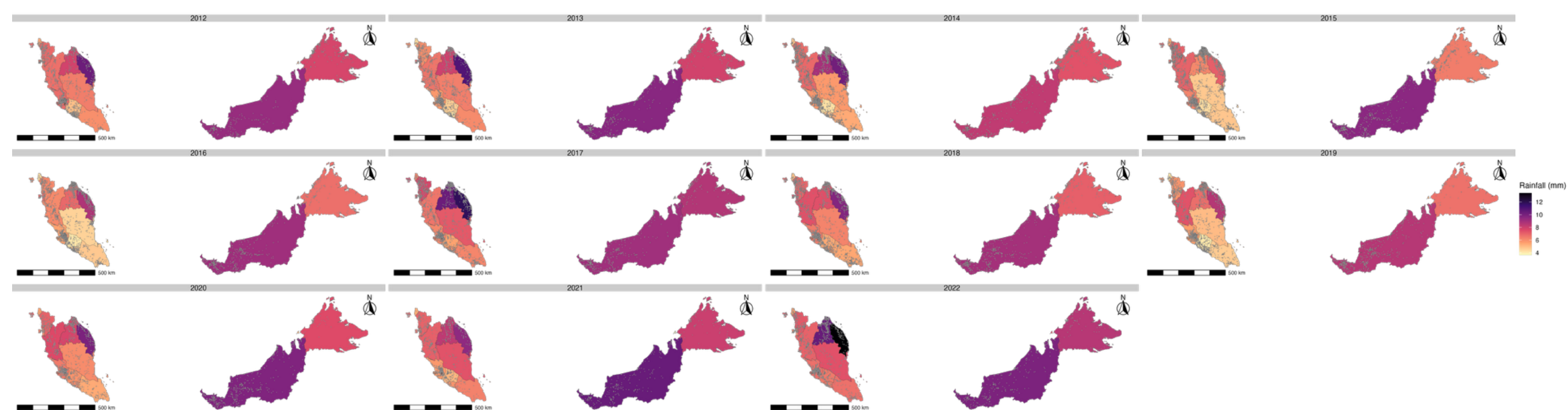


Figure S13 Yearly total rainfall (mm) with leptospirosis cases.

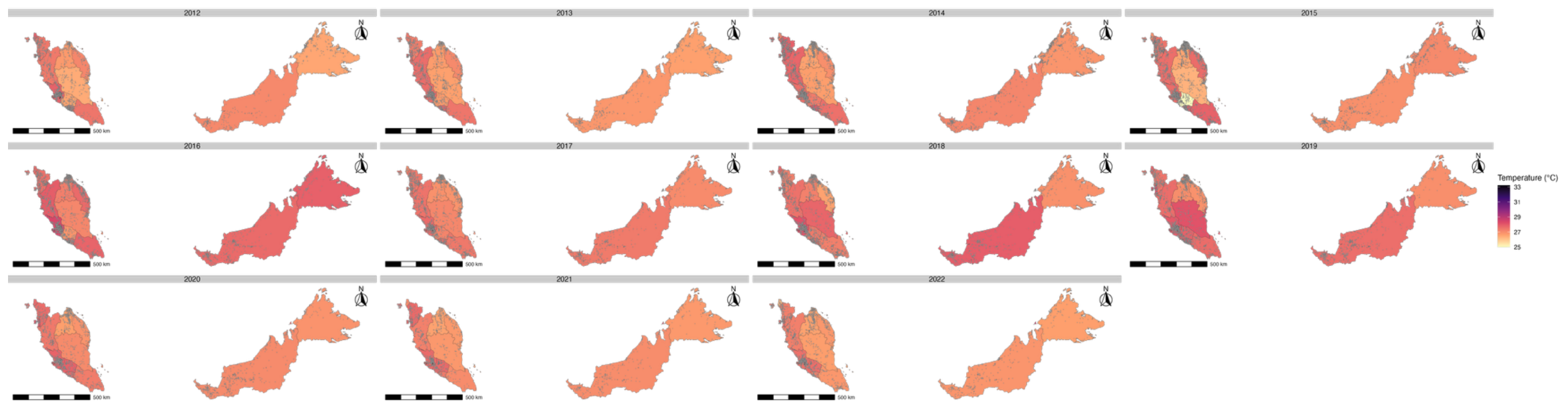


Figure S14 Yearly average temperature (°C) with leptospirosis cases.

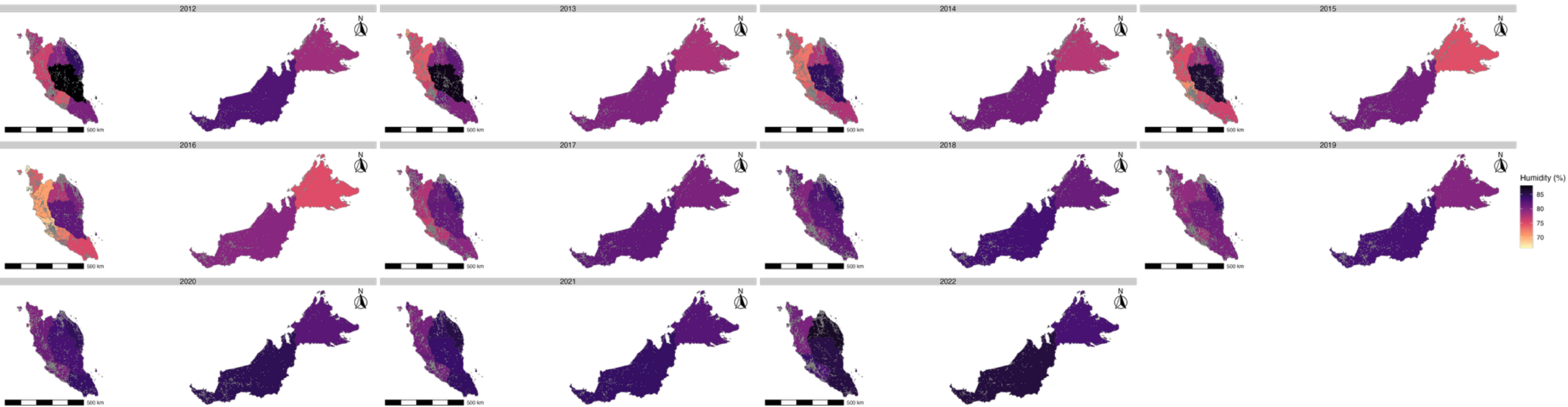


Figure S15 Yearly average relative humidity (%) with leptospirosis cases.

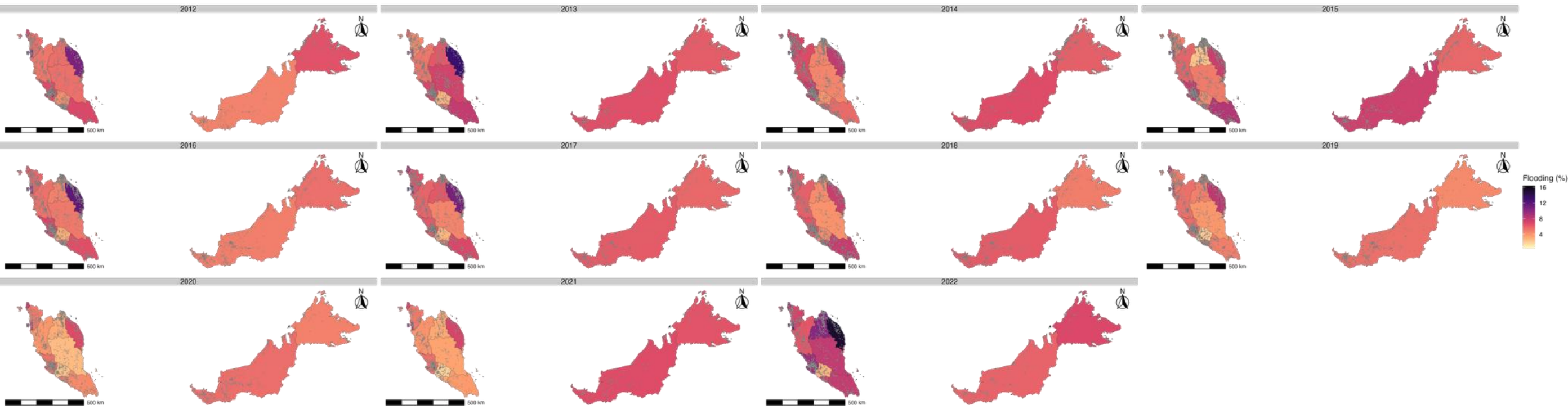


Figure S16 Yearly percentage of flooding (%) with leptospirosis cases.