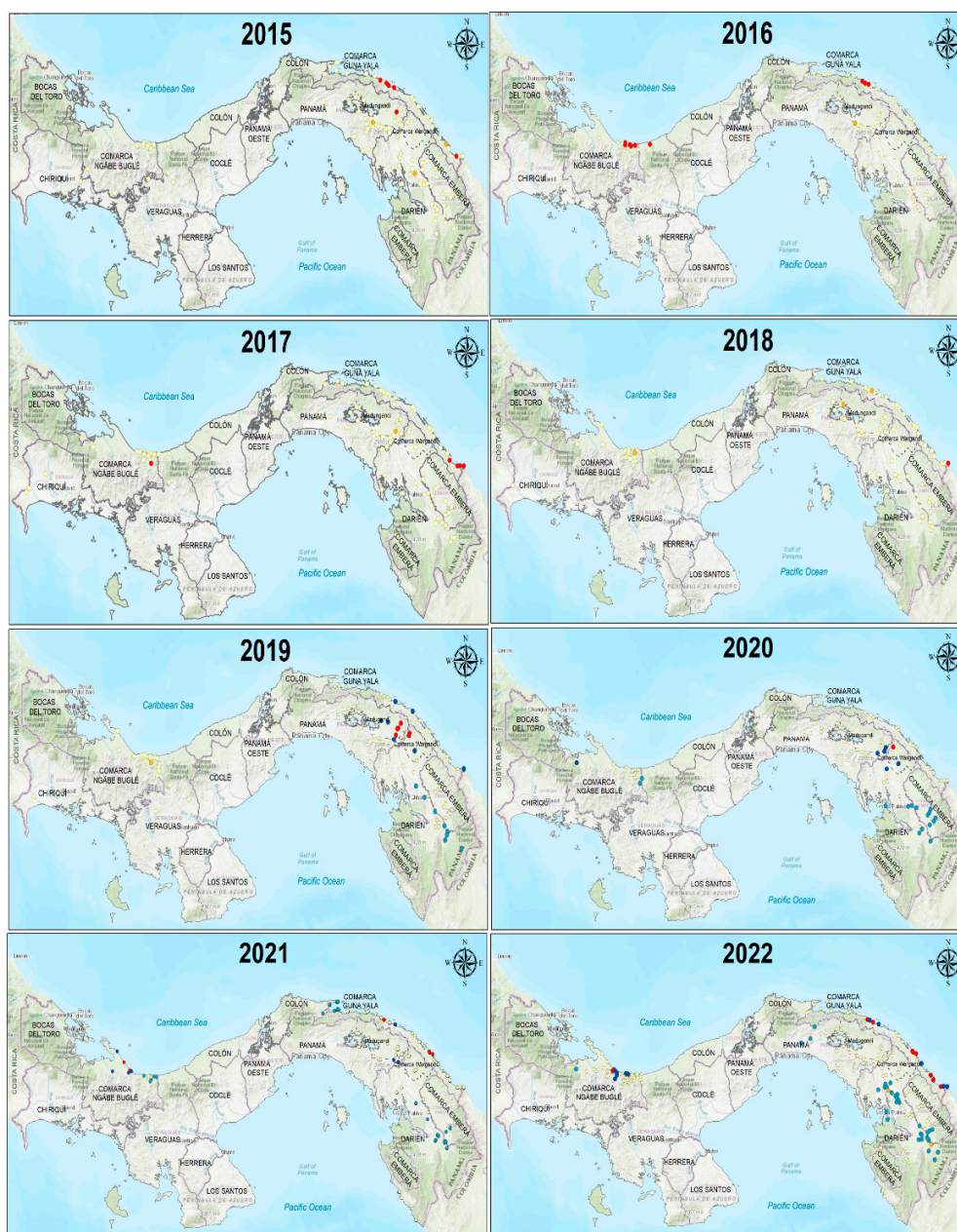


Figure S1. Weekly evolution and monthly distribution of malaria cases in each comarca from Panama, 2015-2022: a) Ngobe Bugle, b) Guna Yala, c) Madungandí, d) Wargandí, e) Emberá Wounáan.



Cluster and Outlier Analysis (Anselin Local Moran's I)

● High-High Cluster
 ● High-Low Outlier
 ● Not Significant
 ● Low-High Outlier
 ● Low-Low Cluster

Service Layer Credits: Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community

Figure S2. Spatial autocorrelation of malaria cases from 2015 to 2022 in Panamá

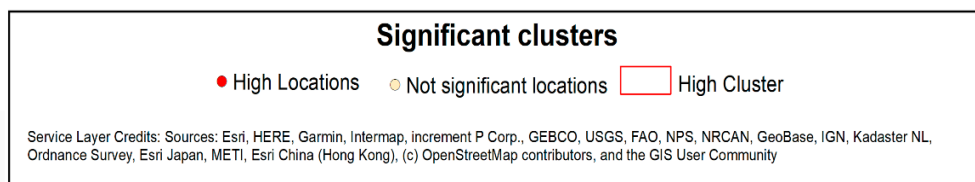
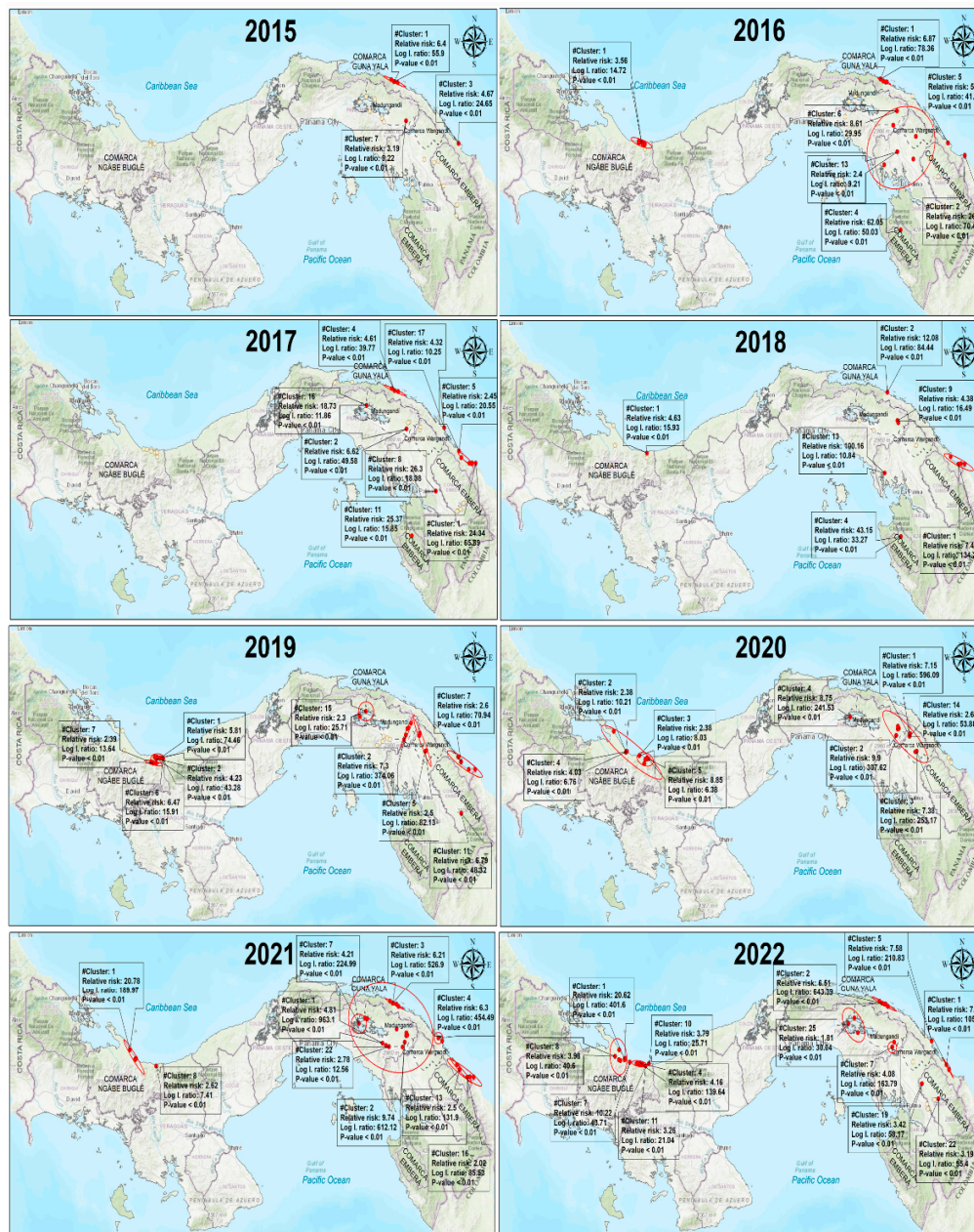


Figure S3. Cluster of malaria cases detected using the purely temporal clustering from 2015 to 2022 in Panama.

Table S1: Spatial scan statistics of significant clusters of malaria cases at the Indigenous Comarcas in the western region of Panama, January 2015 to December 2022

Year	Cluster	Locality (High clusters)	Population	Malaria cases	Malaria cases (expected)	RR	LRR	p
2016	1	Segunda Corriente	893	53	29.46	3.56	14.72	< 0.01
		Quebrada Peña,						
		Loma Chucara						
		Limoncito						
		Segunda Corriente						
		Santa Catalina Arriba						
2018	1	Santa Catalina o Calovébora	768	166	77.88	5.81	74.46	< 0.01
		Aguacate Arriba						
		Boca de Aguacate						
		Aguacate Arriba						
		San Soledad						
		Llano Piña						
		Caño Escondido (Santa Catlina)						
		Boca de Tontri o Toncri						
		Cahuita Arriba						
		Los Primitivos						
		Boca de Aguacate						
		Aguacate Arriba						
		Llano Piña						
		Caño Escondido (Santa Catalina)						
		Los Primitivos						
		Loma Pava						
		Alto Piña						
		San Soledad						
2020	3	Caracol No. 1	334	35	17.83	2.38	8.03	< 0.01
		Alto Piña						
		Santa Catalina Arriba or Quebrada Catalina						
		Boca de Aguacate						
		Aguacate Arriba						
		Caño Escondido						
	5	Caño Lagarto	55	11	2.94	4.03	6.76	< 0.01
2021	1	Tiger Head or Playa Tigre	151	115	12.3	20.78	189.97	< 0.01
		Librate						
		Begabudi						
		Caño Lagarto						
	7	Aguacate Arriba	116	23	9.45	2.62	7.4	< 0.01
2022	1	Librate	100	203	11.98	20.62	401.6	< 0.01
		Begabudi						
		Caño Lagarto						
	4	Chelele	561	234	67.2	4.16	139.63	< 0.01
		Caracol No. 1						
		Segunda Corriente						
		Quebrada Peña						
		Loma Chucara						
	7	Limoncito	26	31	3.11	10.22	43.71	< 0.01
		Palo Blanco						
		Odobari						
	8	Dorori or Brodori Medio	145	66	17.37	3.98	40.6	< 0.01
		Tiger Head or Playa Tigre						
		Muay Abajo						
	10	Zaragoza	100	44	11.98	3.79	25.71	< 0.01
	11	Aguacate Arriba	116	44	13.89	3.26	21.04	< 0.01

Table S2: Spatial scan statistics of significant clusters of malaria cases at the Indigenous Comarcas in the eastern region of Panama, January 2015 to December 2022.

Time	Cluster	Locality (high clusters)	Population	Malaria cases	Malaria cases (expected)	RR	LLR	p
2015	1	Achiote or Achiotal or Maguebgandi	944	78	13.26	6.87	78.36	< 0.01
		Río Diablo or Aidirgandi						
		Wichub Mullu						
		Playón Grande or Ukupa						
	3	La Mel	90	31	1.26	26.21	70.42	< 0.01
2016	7	Puerto Limón or Narasgandi	573	20	6.51	3.19	9.22	< 0.01
	1	Achiote or Achiotal or Maguebgandi	944	78	13.26	6.87	78.36	< 0.01
		Río Diablo or Aidirgandi						
		Wichub Mullu						
		Playón Grande or Ukupa						
	2	La Miel	90	31	1.26	26.21	70.42	< 0.01
	4	Boca De Tigre	19	16	0.27	62.05	50.03	< 0.01
	5	Carreto or Yansibdiwar	692	49	9.72	5.52	41.73	< 0.01
	6	Cañazas o Narganí	208	24	2.92	8.61	29.95	< 0.01
	13	La Peñita	1022	33	14.36	2.4	9.21	< 0.01
		Río Cañazas or Akanwila						
		Quebrada Muerto						
		Villa Nueva						
2017	1	La Miel	90	30	1.33	24.34	65.89	< 0.01
		Puerto Limón or Narasgandí	573	50	8.47	6.62	49.58	< 0.01
	4	Achiote or Achiotal or Maguebgandí	943	57	13.93	4.61	39.77	< 0.01
		Río Diablo or Aidirgandí						
		Playón Grande or Ukupa						
	5	Carreto or Yansibdiwar	2406	77	35.55	2.45	20.55	< 0.01
		Anachucuna or Aswemullu						
		Armila						
		Puerto obaldía						
	8	Quebrada Grande	21	8	0.31	26.3	18.38	< 0.00
	11	Boca De Tigre	19	7	0.28	25.37	15.85	< 0.01
	16	Espavé (P)	22	6	0.33	18.73	11.86	< 0.01
	17	Isla Pino or Dubbag	242	15	3.58	4.32	10.25	< 0.01
2018	1	Anachucuna or Aswemullu	1804	139	27.22	7.4	134.29	< 0.01
		Armila						
		Puerto obaldía						
		La Miel						
	2	Playón Grande or Ukupa	354	56	5.34	12.08	84.44	< 0.01
	4	Boca de Tigre	19	12	0.29	43.15	33.27	< 0.01
	9	Cañazas or Nargandí	381	24	5.75	4.38	16.49	< 0.01
		Río Sábalo						
	13	La Peñita	3	2	0.03	100.16	10.84	< 0.01

2019	1	Río Cañazas or Akanwila	1379	371	65.84	5.64	374.06	< 0.01
		Puerto Limón or Narasgandi						
		Naca U ogobnawila						
		Rio Sabalo						
		Cañazas or Nargandi						
	5	Walá	2885	300	137.74	2.5	85.12	< 0.01
		Nurra						
		Wagandí						
		Morti						
	2	Río Cañazas or Akanwila	1379	371	65.84	7.3	374.06	< 0.01
		Puerto Limón or Narasgandi						
		Naca U ogobnawila						
		Rio Sabalo						
	5	Cañazas or Nargandi	2885	300	137.74	2.5	82.13	< 0.01
		Walá						
		Nurra						
		Wagandí						
	7	Morti	2083	232	99.45	2.6	70.94	< 0.01
		Carreto or Yansibdiwar						
		Anachucuna						
		Pueblo Nuevo-Ng						
	11	Armila	146	46	6.97	6.79	48.32	< 0.01
		La Miel						
		El Tigre						
		Puente Bayano or Akua Yala						
	15	Pintupu or Iguayala	947	100	45.21	2.3	25.71	< 0.01
2020	1	Puerto Limón or Narasgandi	4249	759	207.99	7.15	596.09	< 0.01
		Naca U ogobnawila						
		Cañazas or Nargandi						
		Río Sábalo or Kuinubdi						
		Wala						
		Nurra						
		Wagandí						
	2	Mortí	573	234	28.05	9.9	307.62	< 0.01
		Puerto Limón or Narasgandi						
		Akuayala or Puente Bayano						
	14	Wala	1444	170	70.68	2.61	53.88	< 0.01

2021	1	Akuayala or Puente Bayano	7397	1863	706.41	4.81	963.10	< 0.01
		Pintupu or Iguayalla						
		Aguas Claras or Icantí						
		Ipetí Kuna						
		Wacuco or Dianwardumadí (P)						
		Río Rubén or Quidmorgandí (P)						
		Maguebgandi or Achiote						
		Aidirgandi or Piedra De Amolar						
		Playon Grande or Ukupa						
		Piria						
		Irgandi						
		Río Cañazas or Akanwila						
		Puerto Limón 0 Narasgandí						
		Naca						
	Cañazas or Nargandí							
	Río Sábalo or Kuinubdi							
	2	Puerto Limón 0 Narasgandí	573	465	54.72	9.74	612.12	< 0.01
	3	Maguebgandi or Achiote	1136	574	108.49	6.21	526.90	< 0.01
		Aidirgandi or Piedra De Amolar						
	4	Playon Grande or Ukupa	914	482	87.29	6.3	454.49	< 0.01
		Irgandí						
	7	Mansucun or Mamsuggun	947	350	90.44	4.21	224.99	< 0.01
		Isla Pino						
	13	Akuayala or Puente Bayano	2086	456	199.21	2.5	131.90	< 0.01
		Pintupu or Iguayalla						
		Yancibdiwar or Carreto						
Anachucuna								
16	Pueblo Nuevo	2689	480	256.8	2.02	85.53	< 0.01	
	Armila							
	Pueblo Nuevo							
	Puerto obaldía							
	La Miel							
22	Río Rubén or Quidmorgandí (P)	125	33	11.94	2.78	12.56	< 0.01	
2022	1	Carreto or Yansibdiwar	1441	958	151.34	7.97	1050.59	< 0.01
		Anachucuna or Aswemullu						
		Pueblo Nuevo						
	2	Maguebgandi or Achiote or Achiotal	1137	669	119.41	6.51	643.39	< 0.01
		Aidirgandí or Piedra De Amolar						
		Wichub Mullu						
		Playon Grande or Ukupa						
	5	Irgandi	242	185	25.42	7.58	210.83	< 0.01
		Isla Pino						
	7	Río Cañazas or Akanwila	635	259	66.69	4.08	163.79	< 0.01
		Puerto Limon or Narasgandi						
	19	Canaán Membrillo	321	113	33.71	3.42	58.17	< 0.01
		Río Membrillo						
	22	Bajo Chiquito	363	119	38.12	3.19	5.40	< 0.01
25	Akuayala or Puente Bayano	1146	213	120.36	1.81	30.04	< 0.01	
	Pintupu or Iguayala							
	Wagandi or Wuagandi							