

PNAS

www.pnas.org

Supplementary Information for

Diurnal biting of malaria mosquitoes in the Central African Republic indicates residual transmission may be 'out of control'

Claire Sangbakembi-Ngounou, Carlo Costantini, Neil Michel Longo-Pendy, Carine Ngoagouni, Ousman Akone-Ella, Nil Rahola, Sylvie Cornelie, Pierre Kengne, Emmanuel Rivalyn Nakouné, Narcisse Patrice Komas, and Diego Ayala

Corresponding author

Email: diego.ayala@ird.fr carlo.costantini@ird.fr

This PDF file includes:

Figures S1 to S6
Tables S1 to S12

Legends for Datasets S1
SI References

Other supplementary materials for this manuscript include the following:

Datasets S1

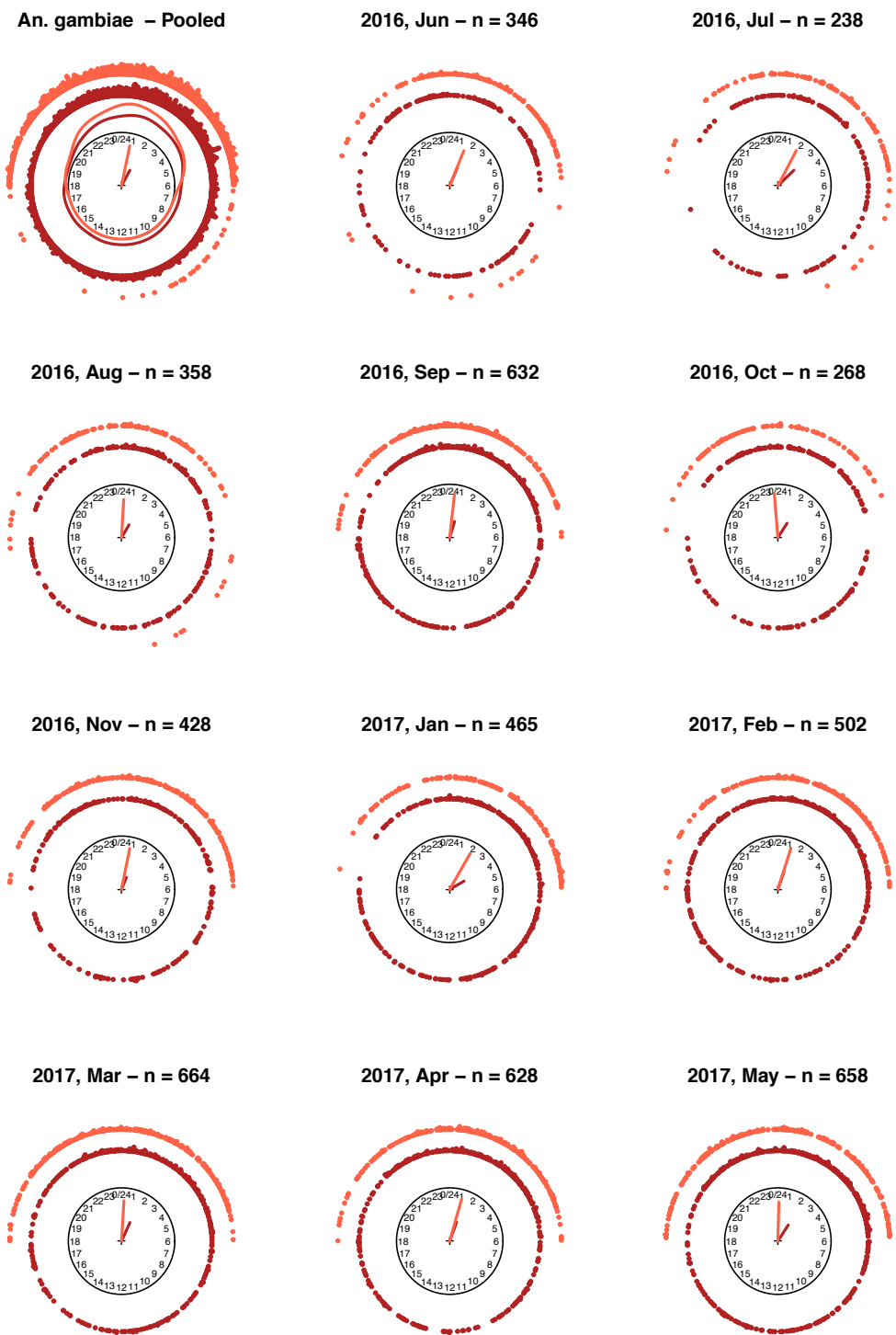


Fig. S1. Circular representation of monthly biting events of *Anopheles gambiae* across the collection period. Darker colors represent indoor collections, and lighter colors outdoor collections. “n” indicates the number of biting events across the four sites in Bangui.

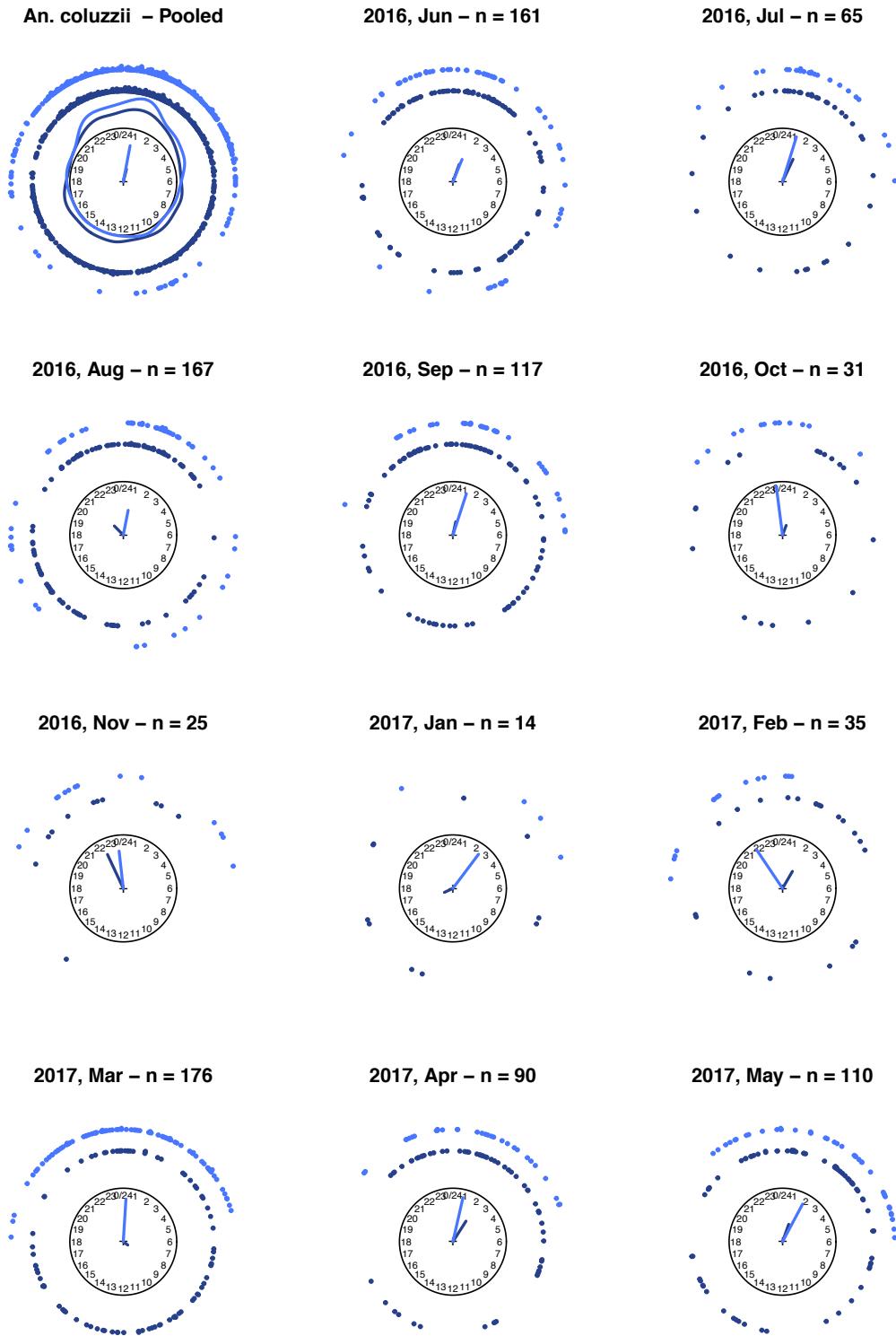
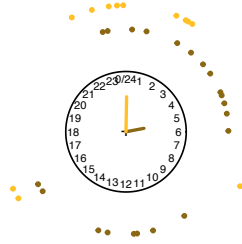


Fig. S2. Circular representation of monthly biting events of *Anopheles coluzzii* across the collection period. Darker colors represent indoor collections, and lighter colors outdoor collections. “n” indicates the number of biting events across the four sites in Bangui.

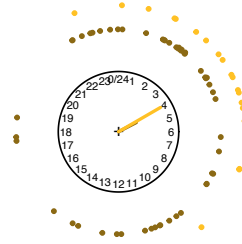
An. funestus – Pooled



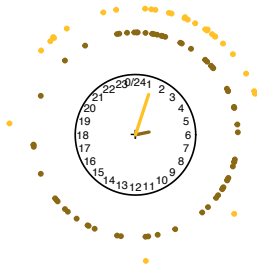
2016, Jun – n = 33



2016, Jul – n = 72



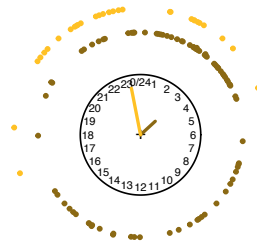
2016, Aug – n = 95



2016, Sep – n = 224



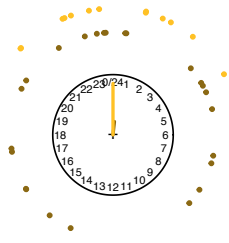
2016, Oct – n = 118



2016, Nov – n = 147



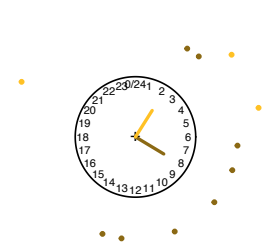
2017, Jan – n = 37



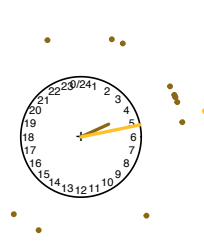
2017, Feb – n = 4



2017, Mar – n = 11



2017, Apr – n = 13



2017, May – n = 20

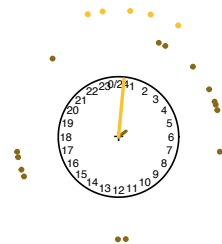


Fig. S3. Circular representation of monthly biting events of *Anopheles funestus* across the collection period. Darker colors represent indoor collections, and lighter colors outdoor collections. “n” indicates the number of biting events across the four sites in Bangui.



Fig. S4. Circular representation of monthly biting events of *Anopheles pharoensis* across the collection period. Darker colors represent indoor collections, and lighter colors outdoor collections. “n” indicates the number of biting events across the four sites in Bangui.



Fig. S5. Circular representation of biting events of *Anopheles pharoensis* across the collection sites in Bangui. Darker colors represent indoor collections, and lighter colors outdoor collections. “Each dot is a biting event.”

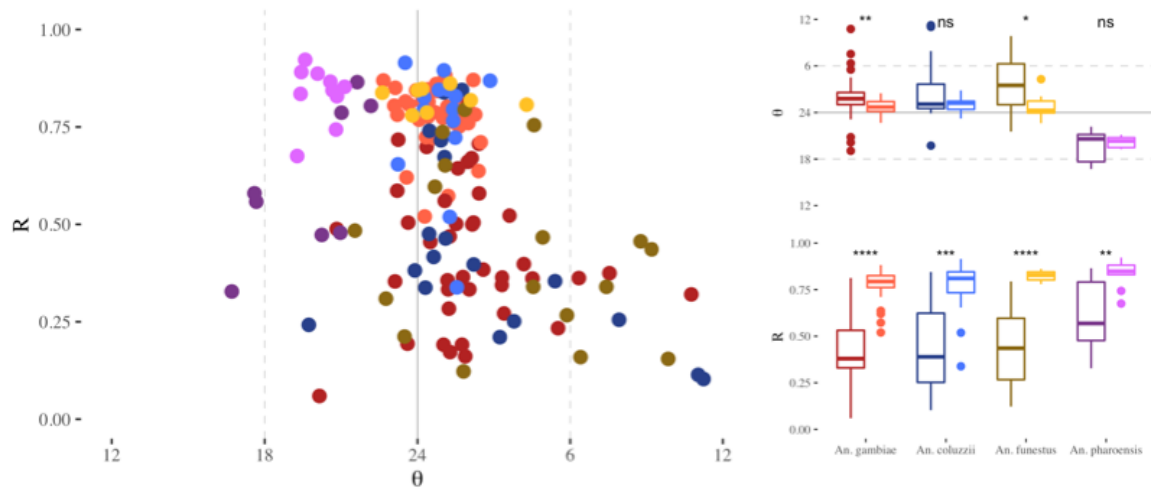


Fig. S6. Bivariate distribution of monthly estimates of sample mean (θ) and resultant lengths (R) of biting events. Each symbol represents a sample from one month and one site for each species and location (indoors darker colors, outdoors lighter colors). *Anopheles gambiae* (red), *A. coluzzii* (blue), *A. funestus* (yellow), *A. pharoensis* (violet). Mean directions are expressed in hours, with 0/24 indicating midnight; dashed lines at 6/18 delimit nighttime, from sunset (18h) to sunrise (6h). Boxplots represent the median, interquartile interval and range for each species and location. Significance was calculated using the Wilcoxon test for multiple mean comparisons θ (top-right) and R (bottom-right). Significant values are indicated by asterisks (ns: not significant, *** < 0.001, ** < 0.01, * < 0.05, after Bonferroni correction).

Table S1. Summary of circular statistics for each species, location and month.

Species	Location	YearMonth	n	θ	θ_{low}	θ_{upp}	R	R.low	R.upp	b2	b2.lo w	b2.up p	a2	a2.low	a2.upp
An. coluzzii	Indoors	2016-06	101	1.33	0.98	1.68	0.34	0.20	0.48	0.15	-0.05	0.34	0.25	0.06	0.44
An. coluzzii	Indoors	2016-07	40	1.68	1.32	2.04	0.46	0.24	0.68	0.15	-0.19	0.48	0.45	0.19	0.71
An. coluzzii	Indoors	2016-08	108	-2.98	-3.59	-2.37	0.23	0.12	0.34	-0.61	-0.92	-0.30	-0.24	-0.61	0.13
An. coluzzii	Indoors	2016-09	83	0.83	0.29	1.36	0.25	0.09	0.40	0.03	-0.20	0.25	0.22	-0.07	0.51
An. coluzzii	Indoors	2016-10	18	1.36	-0.12	2.83	0.14	-0.21	0.49	0.50	-0.21	1.21	0.47	0.07	0.88
An. coluzzii	Indoors	2016-11	11	-1.68	-2.18	-1.18	0.68	0.44	0.91	-0.12	-0.43	0.20	0.26	-0.10	0.63
An. coluzzii	Indoors	2017-01	10	-7.84	-10.05	-5.62	0.06	-0.40	0.53	3.69	2.71	4.67	0.68	0.20	1.17
An. coluzzii	Indoors	2017-02	21	2.03	1.35	2.71	0.35	0.04	0.66	-0.02	-0.50	0.46	0.39	0.06	0.72
An. coluzzii	Indoors	2017-03	78	11.30	10.44	12.15	0.15	-0.02	0.32	0.11	-0.18	0.39	0.23	0.07	0.39
An. coluzzii	Indoors	2017-04	70	2.22	1.94	2.50	0.51	0.37	0.65	0.12	0.00	0.24	0.22	0.04	0.40
An. coluzzii	Indoors	2017-05	69	1.30	0.88	1.73	0.34	0.17	0.50	-0.05	-0.26	0.16	0.24	0.07	0.40
An. coluzzii	Outdoors	2016-06	60	1.50	1.15	1.85	0.45	0.29	0.61	0.32	0.15	0.49	0.22	-0.09	0.53
An. coluzzii	Outdoors	2016-07	25	1.15	0.95	1.34	0.87	0.80	0.95	0.03	-0.05	0.12	0.61	0.39	0.83
An. coluzzii	Outdoors	2016-08	59	0.74	0.43	1.05	0.47	0.30	0.64	-0.05	-0.30	0.20	0.36	0.18	0.55
An. coluzzii	Outdoors	2016-09	34	1.20	0.99	1.42	0.81	0.73	0.89	0.03	-0.06	0.13	0.43	0.22	0.64
An. coluzzii	Outdoors	2016-10	13	-0.49	-0.71	-0.27	0.91	0.85	0.98	0.01	-0.05	0.06	0.70	0.50	0.91
An. coluzzii	Outdoors	2016-11	14	-0.41	-0.90	0.08	0.68	0.53	0.83	0.28	0.06	0.50	0.09	-0.42	0.60
An. coluzzii	Outdoors	2017-01	4	2.42	1.74	3.11	0.75	0.53	0.97	-0.33	-0.47	-0.19	0.27	-0.56	1.09
An. coluzzii	Outdoors	2017-02	14	-2.26	-2.55	-1.97	0.86	0.80	0.92	-0.05	-0.14	0.04	0.50	0.29	0.71
An. coluzzii	Outdoors	2017-03	70	-0.29	-0.45	-0.12	0.80	0.75	0.85	0.05	-0.02	0.12	0.37	0.22	0.51
An. coluzzii	Outdoors	2017-04	48	1.34	1.19	1.49	0.86	0.82	0.91	-0.02	-0.07	0.03	0.56	0.41	0.70
An. coluzzii	Outdoors	2017-05	41	1.87	1.65	2.09	0.79	0.74	0.85	-0.03	-0.13	0.07	0.32	0.16	0.48
An. funestus	Indoors	2016-06	21	5.38	4.36	6.40	0.26	0.00	0.53	0.80	0.55	1.05	-0.05	-0.90	0.81
An. funestus	Indoors	2016-07	52	4.20	3.62	4.78	0.32	0.15	0.49	0.32	0.14	0.50	-0.03	-0.41	0.35

Species	Location	YearMonth	n	θ	θ_{low}	θ_{upp}	R	R.low	R.upp	b2	b2.lo w	b2.up p	a2	a2.low	a2.upp
An. funestus	Indoors	2016-08	65	5.25	4.51	5.99	0.21	0.05	0.38	0.17	0.00	0.34	-0.01	-0.26	0.23
An. funestus	Indoors	2016-09	156	1.82	1.54	2.09	0.35	0.24	0.46	-0.06	-0.20	0.07	0.25	0.14	0.36
An. funestus	Indoors	2016-10	88	3.17	2.79	3.56	0.33	0.18	0.48	0.15	-0.05	0.34	0.28	0.03	0.52
An. funestus	Indoors	2016-11	108	2.07	1.70	2.43	0.35	0.23	0.47	0.17	0.06	0.29	0.08	-0.11	0.27
An. funestus	Indoors	2017-01	24	0.38	-0.92	1.69	0.17	-0.09	0.43	-0.32	-0.64	0.01	-0.11	-0.45	0.23
An. funestus	Indoors	2017-02	2	-5.23	-19.15	8.70	-2.40	NA	NA	0.00	-27.58	27.58	-101.95	-101.95	-101.95
An. funestus	Indoors	2017-03	8	8.04	7.11	8.98	0.49	0.22	0.75	-0.22	-0.75	0.31	-0.27	-0.90	0.35
An. funestus	Indoors	2017-04	12	4.39	3.77	5.00	0.48	0.10	0.86	0.05	-0.43	0.52	0.46	0.02	0.90
An. funestus	Indoors	2017-05	15	3.29	1.59	4.98	0.10	-0.32	0.52	13.88	12.33	15.44	1.18	0.59	1.77
An. funestus	Outdoors	2016-06	12	0.04	-0.48	0.56	0.56	0.21	0.91	-0.13	-0.72	0.46	0.49	0.08	0.90
An. funestus	Outdoors	2016-07	20	3.99	3.70	4.29	0.80	0.69	0.90	-0.03	-0.17	0.11	0.40	0.13	0.67
An. funestus	Outdoors	2016-08	30	1.20	0.92	1.48	0.70	0.54	0.86	-0.03	-0.21	0.15	0.39	0.16	0.62
An. funestus	Outdoors	2016-09	68	0.31	0.15	0.47	0.81	0.75	0.86	-0.04	-0.11	0.03	0.41	0.27	0.55
An. funestus	Outdoors	2016-10	30	-0.74	-0.99	-0.49	0.78	0.69	0.88	-0.02	-0.15	0.12	0.36	0.16	0.57
An. funestus	Outdoors	2016-11	39	0.64	0.40	0.88	0.77	0.69	0.84	0.03	-0.08	0.15	0.30	0.10	0.49
An. funestus	Outdoors	2017-01	13	0.00	-0.31	0.32	0.84	0.76	0.93	0.03	-0.08	0.14	0.47	0.22	0.72
An. funestus	Outdoors	2017-02	2	-0.94	-1.14	-0.74	0.98	0.98	0.98	0.00	-0.01	0.01	0.94	NA	NA
An. funestus	Outdoors	2017-03	3	1.78	0.21	3.36	0.35	-0.16	0.87	-2.08	-2.57	-1.60	0.06	-2.50	2.63
An. funestus	Outdoors	2017-04	1	5.23	5.23	5.23	1.00	1.00	1.00	0.00	0.00	0.00	1.00	1.00	1.00
An. funestus	Outdoors	2017-05	5	0.36	0.13	0.59	0.96	0.93	0.98	0.01	-0.02	0.03	0.84	0.74	0.94
An. gambiae	Indoors	2016-06	189	1.53	1.29	1.78	0.37	0.28	0.47	0.14	0.03	0.25	0.17	0.06	0.28
An. gambiae	Indoors	2016-07	123	3.06	2.79	3.34	0.42	0.30	0.53	0.24	0.13	0.35	0.15	-0.04	0.33
An. gambiae	Indoors	2016-08	234	2.04	1.75	2.32	0.28	0.18	0.37	0.11	-0.04	0.26	0.25	0.12	0.39
An. gambiae	Indoors	2016-09	408	1.12	0.93	1.30	0.31	0.24	0.39	-0.04	-0.15	0.07	0.28	0.22	0.35
An. gambiae	Indoors	2016-10	185	2.19	1.91	2.47	0.32	0.21	0.42	0.21	0.07	0.35	0.23	0.04	0.42

Species	Location	YearMonth	n	θ	θ_{low}	θ_{upp}	R	R.low	R.upp	b2	b2.lo w	b2.up p	a2	a2.low	a2.upp
An. gambiae	Indoors	2016-11	222	1.49	1.12	1.85	0.24	0.15	0.33	0.15	0.06	0.25	0.10	-0.06	0.26
An. gambiae	Indoors	2017-01	313	4.01	3.77	4.25	0.31	0.24	0.38	0.19	0.12	0.26	0.08	-0.04	0.21
An. gambiae	Indoors	2017-02	318	1.28	1.07	1.48	0.34	0.27	0.42	-0.09	-0.18	0.00	0.16	0.08	0.24
An. gambiae	Indoors	2017-03	350	1.35	1.15	1.56	0.32	0.25	0.40	0.07	-0.02	0.17	0.19	0.12	0.27
An. gambiae	Indoors	2017-04	407	1.56	1.43	1.70	0.43	0.36	0.49	-0.02	-0.10	0.06	0.27	0.20	0.33
An. gambiae	Indoors	2017-05	418	2.18	2.01	2.35	0.36	0.29	0.42	0.05	-0.02	0.12	0.18	0.11	0.25
An. gambiae	Outdoors	2016-06	157	1.47	1.34	1.59	0.71	0.64	0.78	0.05	-0.03	0.13	0.37	0.29	0.46
An. gambiae	Outdoors	2016-07	115	1.84	1.70	1.98	0.75	0.68	0.81	0.03	-0.06	0.12	0.35	0.24	0.46
An. gambiae	Outdoors	2016-08	124	0.22	0.08	0.35	0.72	0.64	0.79	0.07	-0.02	0.16	0.41	0.30	0.51
An. gambiae	Outdoors	2016-09	224	0.42	0.34	0.50	0.83	0.80	0.86	-0.01	-0.05	0.03	0.49	0.42	0.57
An. gambiae	Outdoors	2016-10	83	-0.31	-0.44	-0.18	0.83	0.80	0.87	0.03	-0.02	0.08	0.46	0.35	0.58
An. gambiae	Outdoors	2016-11	206	0.75	0.65	0.85	0.78	0.75	0.81	-0.01	-0.06	0.04	0.33	0.25	0.41
An. gambiae	Outdoors	2017-01	152	1.98	1.86	2.10	0.78	0.74	0.81	-0.08	-0.14	-0.03	0.32	0.22	0.42
An. gambiae	Outdoors	2017-02	184	1.17	1.08	1.27	0.81	0.77	0.85	-0.07	-0.11	-0.02	0.44	0.35	0.52
An. gambiae	Outdoors	2017-03	225	-0.12	-0.23	-0.01	0.73	0.70	0.77	0.04	-0.02	0.10	0.21	0.12	0.29
An. gambiae	Outdoors	2017-04	310	1.13	1.06	1.19	0.84	0.81	0.86	-0.06	-0.09	-0.02	0.50	0.44	0.57
An. gambiae	Outdoors	2017-05	240	0.09	-0.01	0.20	0.73	0.70	0.77	0.04	-0.01	0.09	0.24	0.15	0.32
An. pharoensis	Indoors	2016-06	40	-2.77	-2.95	-2.59	0.84	0.78	0.91	0.11	0.01	0.20	0.51	0.34	0.67
An. pharoensis	Indoors	2016-07	27	-2.54	-2.86	-2.22	0.67	0.49	0.84	0.09	-0.09	0.27	0.32	0.11	0.54
An. pharoensis	Indoors	2016-08	27	-3.05	-3.27	-2.82	0.74	0.54	0.93	0.11	0.02	0.20	0.61	0.42	0.81
An. pharoensis	Indoors	2016-09	53	-6.44	-6.79	-6.10	0.47	0.29	0.64	-0.23	-0.39	-0.06	0.29	0.00	0.58
An. pharoensis	Indoors	2016-10	54	-6.15	-6.49	-5.81	0.49	0.33	0.65	0.06	-0.08	0.20	0.18	-0.01	0.36
An. pharoensis	Indoors	2016-11	17	-1.44	-2.35	-0.53	0.35	0.10	0.60	-0.14	-0.62	0.35	-0.26	-0.61	0.09
An. pharoensis	Indoors	2017-01	38	-3.45	-3.79	-3.11	0.51	0.31	0.72	0.34	0.13	0.56	0.41	0.01	0.80
An. pharoensis	Indoors	2017-02	11	-3.85	-4.60	-3.10	0.45	0.09	0.82	0.26	-0.03	0.55	0.25	-0.48	0.97

Species	Location	YearMonth	n	θ	θ_{low}	θ_{upp}	R	R.low	R.upp	b2	b2.lo w	b2.up p	a2	a2.low	a2.upp
An. pharoensis	Indoors	2017-03	8	-5.50	-6.30	-4.69	0.27	-0.34	0.89	3.79	2.44	5.15	1.11	0.50	1.71
An. pharoensis	Indoors	2017-04	11	-5.45	-6.22	-4.68	0.47	0.16	0.79	-0.07	-0.48	0.33	0.06	-0.34	0.45
An. pharoensis	Indoors	2017-05	59	-6.99	-7.57	-6.42	0.26	0.07	0.45	0.04	-0.30	0.38	0.29	-0.01	0.60
An. pharoensis	Outdoors	2016-06	82	-2.96	-3.09	-2.82	0.81	0.76	0.87	0.09	0.01	0.17	0.45	0.35	0.56
An. pharoensis	Outdoors	2016-07	69	-3.68	-3.79	-3.56	0.88	0.83	0.93	0.11	0.05	0.18	0.63	0.50	0.76
An. pharoensis	Outdoors	2016-08	49	-3.07	-3.26	-2.89	0.81	0.74	0.88	0.14	0.05	0.24	0.43	0.26	0.60
An. pharoensis	Outdoors	2016-09	74	-4.36	-4.46	-4.26	0.84	0.75	0.93	0.18	0.07	0.30	0.72	0.59	0.84
An. pharoensis	Outdoors	2016-10	50	-4.05	-4.36	-3.75	0.58	0.44	0.71	0.15	-0.02	0.32	0.17	-0.07	0.40
An. pharoensis	Outdoors	2016-11	47	-2.96	-3.14	-2.78	0.80	0.70	0.89	0.15	0.03	0.26	0.49	0.32	0.66
An. pharoensis	Outdoors	2017-01	45	-4.78	-4.89	-4.66	0.91	0.85	0.97	0.13	0.03	0.23	0.76	0.59	0.92
An. pharoensis	Outdoors	2017-02	6	-3.67	-4.15	-3.19	0.81	0.61	1.01	0.28	0.08	0.48	0.47	-0.18	1.13
An. pharoensis	Outdoors	2017-03	6	-5.40	-5.47	-5.32	0.99	0.99	1.00	0.00	0.00	0.00	0.98	0.97	0.99
An. pharoensis	Outdoors	2017-04	10	-1.36	-1.96	-0.76	0.64	0.42	0.86	0.23	-0.03	0.49	0.11	-0.45	0.66
An. pharoensis	Outdoors	2017-05	29	-3.79	-3.99	-3.59	0.83	0.72	0.94	0.15	0.00	0.30	0.57	0.38	0.76

YearMonth Year and Month of collection

n Number of specimens analyzed

θ the sample median direction in radians measured clockwise

θ_{low} theta low confidence interval 95 %

θ_{upp} theta high confidence interval 95%

R concentration, the sample mean resultant length, $R \in [0,1]$, when data spread evenly around the circle $R=0$, and when all data points are clustered at the same point $R=1$

R low R low confidence interval 95 %

R upp R high confidence interval 95%

b2 Second sine moment

b2 low b2 low confidence interval 95 %

b2 upp b2 high confidence interval 95%

a2 Second cosine moment

a2 low a2 low confidence interval 95 %

a2 upp a2 high confidence interval 95%

Table S2. Summary of circular statistics for each species, location and site.

Species	Site	Location	n	θ	θ_{low}	θ_{upp}	R	R.low	R.upp	b2	b2.low	b2.upp	a2	a2.low	a2.upp
An. gambiae	Gbanikola	Indoors	618	0.82	0.71	0.94	0.40	0.35	0.46	0.08	0.00	0.15	0.28	0.22	0.33
An. gambiae	Gbanikola	Outdoors	428	0.17	0.10	0.24	0.74	0.71	0.78	0.07	0.03	0.11	0.37	0.31	0.43
An. gambiae	Ile_des_Singes	Indoors	447	1.98	1.89	2.08	0.60	0.55	0.64	-0.01	-0.06	0.05	0.23	0.17	0.29
An. gambiae	Ile_des_Singes	Outdoors	253	0.54	0.45	0.63	0.78	0.75	0.82	0.01	-0.04	0.05	0.39	0.31	0.46
An. gambiae	Ouango	Indoors	1394	1.60	1.46	1.74	0.24	0.20	0.28	0.04	-0.02	0.10	0.19	0.16	0.23
An. gambiae	Ouango	Outdoors	968	0.88	0.84	0.93	0.79	0.77	0.80	-0.05	-0.07	-0.03	0.37	0.33	0.40
An. gambiae	PK10	Indoors	708	3.33	3.19	3.48	0.33	0.28	0.38	0.20	0.14	0.25	0.16	0.08	0.24
An. gambiae	PK10	Outdoors	371	1.33	1.25	1.41	0.75	0.72	0.78	-0.05	-0.09	0.00	0.31	0.25	0.38
An. coluzzii	Gbanikola	Indoors	347	-0.32	-0.60	-0.04	0.23	0.15	0.31	-0.06	-0.22	0.11	0.28	0.18	0.38
An. coluzzii	Gbanikola	Outdoors	228	0.79	0.68	0.90	0.66	0.59	0.72	0.12	0.05	0.19	0.38	0.29	0.46
An. coluzzii	Ile_des_Singes	Indoors	122	1.16	0.98	1.33	0.59	0.49	0.69	0.00	-0.11	0.11	0.31	0.20	0.42
An. coluzzii	Ile_des_Singes	Outdoors	83	-0.13	-0.31	0.05	0.70	0.62	0.79	-0.07	-0.17	0.02	0.29	0.15	0.43
An. coluzzii	Ouango	Indoors	124	6.27	5.47	7.06	0.15	0.04	0.26	0.00	-0.23	0.23	-0.15	-0.27	-0.03
An. coluzzii	Ouango	Outdoors	66	1.45	1.28	1.62	0.78	0.72	0.85	-0.04	-0.12	0.05	0.37	0.23	0.52
An. coluzzii	PK10	Indoors	16	8.56	5.00	12.12	-0.07	-0.38	0.24	-22.46	-23.78	-21.13	-1.33	-2.37	-0.29
An. coluzzii	PK10	Outdoors	5	0.68	0.01	1.34	0.75	0.66	0.84	0.01	-0.40	0.42	0.07	-0.25	0.39
An. funestus	Gbanikola	Indoors	114	0.55	0.37	0.72	0.58	0.47	0.69	-0.03	-0.16	0.09	0.40	0.29	0.52
An. funestus	Gbanikola	Outdoors	79	0.19	0.04	0.34	0.78	0.70	0.85	0.01	-0.07	0.09	0.44	0.32	0.56
An. funestus	Ile_des_Singes	Indoors	102	0.89	0.70	1.09	0.62	0.53	0.71	-0.05	-0.15	0.04	0.21	0.08	0.34
An. funestus	Ile_des_Singes	Outdoors	37	-1.10	-1.33	-0.87	0.79	0.72	0.86	0.02	-0.09	0.12	0.34	0.16	0.52
An. funestus	Ouango	Indoors	145	7.23	6.37	8.09	0.13	0.03	0.23	-0.27	-0.55	0.01	-0.21	-0.35	-0.07
An. funestus	Ouango	Outdoors	67	1.32	1.15	1.49	0.78	0.72	0.85	-0.02	-0.11	0.08	0.38	0.25	0.51
An. funestus	PK10	Indoors	190	5.99	5.73	6.25	0.37	0.28	0.46	0.30	0.22	0.39	0.08	-0.11	0.27

An. funestus	PK10	Outdoors	40	2.18	1.91	2.44	0.68	0.55	0.81	-0.01	-0.14	0.11	0.30	0.11	0.49
An. pharoensis	Gbanikola	Indoors	212	-4.27	-4.41	-4.12	0.54	0.45	0.62	0.06	-0.05	0.16	0.36	0.26	0.46
An. pharoensis	Gbanikola	Outdoors	315	-3.82	-3.89	-3.75	0.81	0.78	0.85	0.13	0.08	0.17	0.52	0.45	0.58
An. pharoensis	Ile_des_Singes	Indoors	13	-4.86	-5.52	-4.20	0.52	0.25	0.79	0.18	-0.14	0.50	0.09	-0.39	0.56
An. pharoensis	Ile_des_Singes	Outdoors	13	-2.24	-2.79	-1.69	0.58	0.29	0.86	0.43	0.12	0.74	0.31	-0.40	1.01
An. pharoensis	Ouango	Indoors	103	-4.91	-5.26	-4.56	0.33	0.19	0.47	0.00	-0.18	0.19	0.26	0.12	0.40
An. pharoensis	Ouango	Outdoors	114	-3.36	-3.49	-3.24	0.79	0.73	0.84	0.18	0.11	0.25	0.42	0.30	0.54
An. pharoensis	PK10	Indoors	17	-1.79	-2.55	-1.03	0.38	0.07	0.68	0.12	-0.21	0.46	0.14	-0.26	0.55
An. pharoensis	PK10	Outdoors	25	-3.66	-3.89	-3.43	0.79	0.63	0.94	0.24	0.01	0.46	0.58	0.30	0.85

Site Site of collection across Bangui
n Number of specimens analyzed
 θ the sample median direction in radians measured clockwise
 θ low theta low confidence interval 95 %
 θ upp theta high confidence interval 95%
R concentration, the sample mean resultant length, $R \in [0,1]$, when data spread evenly around the circle $R=0$, and when all data points are clustered at the same point $R=1$
R low R low confidence interval 95 %
R upp R high confidence interval 95%
b2 Second sine moment
b2 low b2 low confidence interval 95 %
b2 upp b2 high confidence interval 95%
a2 Second cosine moment
a2 low a2 low confidence interval 95 %
a2 upp a2 high confidence interval 95%

Table S3. Summary of circular statistic parameters for each species by location.

Species	Location	n	θ	θ_{low}	θ_{upp}	R	R.low	R.upp	b2	b2.low	b2.upp	a2	a2.low	a2.upp
An. coluzzii	Indoors	609	0.94	0.74	1.14	0.24	0.19	0.30	0.03	-0.07	0.14	0.25	0.19	0.31
An. coluzzii	Outdoors	382	0.71	0.63	0.80	0.69	0.64	0.73	0.05	0.00	0.10	0.35	0.29	0.42
An. funestus	Indoors	551	2.90	2.72	3.08	0.30	0.24	0.36	0.11	0.04	0.18	0.18	0.11	0.26
An. funestus	Outdoors	223	0.64	0.53	0.74	0.74	0.69	0.78	0.00	-0.06	0.06	0.33	0.25	0.41
An. gambiae	Indoors	3167	1.89	1.82	1.95	0.33	0.31	0.36	0.08	0.05	0.11	0.21	0.18	0.23
An. gambiae	Outdoors	2020	0.77	0.74	0.81	0.77	0.75	0.78	-0.01	-0.03	0.00	0.34	0.32	0.37
An. pharoensis	Indoors	345	-4.33	-4.47	-4.20	0.47	0.40	0.53	0.05	-0.04	0.13	0.30	0.22	0.38
An. pharoensis	Outdoors	467	-3.67	-3.73	-3.61	0.80	0.77	0.83	0.16	0.12	0.20	0.49	0.43	0.55

n Number of specimens analyzed

θ the sample median direction in radians measured clockwise

θ_{low} theta low confidence interval 95 %

θ_{upp} theta high confidence interval 95%

R concentration, the sample mean resultant length, $R \in [0,1]$, when data spread evenly around the circle $R = 0$, and when all data points are clustered at the same point $R=1$

R low R low confidence interval 95 %

R upp R high confidence interval 95%

b2 Second sine moment

b2 low b2 low confidence interval 95 %

b2 upp b2 high confidence interval 95%

a2 Second cosine moment

a2 low a2 low confidence interval 95 %

a2 upp a2 high confidence interval 95%

Table S4. Uniformity tests for each species and location.

Species	Location	n	Rayleigh	Kuiper	Watson	Rao
An. coluzzii	Indoors	609	0.00	0.00	0.00	0.00
An. coluzzii	Outdoors	382	0.00	0.00	0.00	0.00
An. funestus	Indoors	551	0.00	0.00	0.00	0.00
An. funestus	Outdoors	223	0.00	0.00	0.00	0.00
An. gambiae	Indoors	3167	0.00	0.00	0.00	0.00
An. gambiae	Outdoors	2020	0.00	0.00	0.00	0.00
An. pharoensis	Indoors	345	0.00	0.00	0.00	0.00
An. pharoensis	Outdoors	467	0.00	0.00	0.00	0.00

n Number of mosquitoes collected
Rayleigh p value for the uniformity Rayleigh test
Kuiper p value for the uniformity Kuiper test
Watson p value for the uniformity Watson test
Rao p value for the uniformity Rao test

Table S5. Reflective Symmetry Test by species and location

Species	Location	n	z	P
An. coluzzii	Indoors	609	0.74	0.46
An. coluzzii	Outdoors	382	1.78	0.07
An. funestus	Indoors	551	3.12	0.00
An. funestus	Outdoors	223	0.02	0.98
An. gambiae	Indoors	3167	4.95	0.00
An. gambiae	Outdoors	2020	1.47	0.14
An. pharoensis	Indoors	345	1.15	0.25
An. pharoensis	Outdoors	467	7.12	0.00

n number of mosquitoes

z unknown central direction based on the studentized statistic

P p value of Reflective Symmetry Test

Table S6. Fisher's non-parametric test for a common median direction

Species	Location	Nocturnal species		A. gambiae	A. coluzzii	A. funestus	A. pharoensis	
		Outdoor	Indoor	Indoor	Indoor	Indoor	Outdoor	Indoor
Nocturnal species	Outdoor		0	0.893	0.0001	0	0	
A. gambiae	Indoor	55.7987		0.003	0.0144	0	0	
A. coluzzii	Indoor	0.018	8.7885		0	0	0	
A. funestus	Indoor	15.8649	5.985	174.263		0	0	
A. pharoensis	Outdoor	362.3028	371.8034	129.4856	196.7383		0.228	
	Indoor	107.4398	107.6439	87.7287	129.4856	1.457		

Below the main diagonal Pg statistic
 Above the main diagonal P value

Table S7. Wallraff's non-parametric test for a common concentration parameters

		Nocturnal species	A. gambiae	A. coluzzii	A. funestus	A. pharoensis	
	Location	Outdoor	Indoor	Indoor	Indoor	Outdoor	Indoor
Nocturnal species	Outdoor		0	0	0	0	0.002
A. gambiae	Indoor	454.224		0.159	0.192	0	0
A. coluzzii	Indoor	169.907	1.986		0.894	0	0
A. funestus	Indoor	181.247	1.705	0.018		0	0
A. pharoensis	Outdoor	141.864	378.46	249.634	250.067		0.001
	Indoor	9.61	93.089	77.398	71.531	11.468	

Below the main diagonal Chi-squared statistic
 Above the main diagonal P value

Table S8. Summary of statistics for fitting von Misses Distribution by species and location

Species	Location	n	Kuiper	Rayleigh	Rao	Watson
An. coluzzii	Indoors	599	0.00	0.00	0.00	0.00
An. coluzzii	Outdoors	378	0.01	0.04	0.06	0.02
An. funestus	Indoors	541	0.00	0.00	0.16	0.00
An. funestus	Outdoors	212	0.27	0.66	0.28	0.46
An. gambiae	Indoors	3167	0.00	0.00	0.01	0.00
An. gambiae	Outdoors	2020	0.00	0.00	0.01	0.00
An. pharoensis	Indoors	337	0.00	0.00	0.00	0.00
An. pharoensis	Outdoors	445	0.00	0.00	0.00	0.00

n Number of specimens tested (limited to n>10)
Kuiper estimated p-value for the Kuiper test
Rayleigh estimated p-value for the Rayleigh test
Rao estimated p-value for the Rao spacing test
Watson estimated p-value for the Watson U2 test

Table S9. Summary of statistics for fitting Jones-Pesey Distribution by species and location

Species	Location	n	maxLogLik	mu	kappa	psi	Kuiper	Rayleigh	Rao	Watson
An. coluzzii	Indoors	599	-1036.68	0.22	0.73	- 3.25	0.10	0.70	0.10	0.10
An. coluzzii	Outdoors	378	-483.26	0.17	1.75	- 0.29	0.20	0.40	0.20	0.10
An. funestus	Indoors	541	-933.90	0.63	0.68	- 1.83	0.10	0.30	0.40	0.10
An. funestus	Outdoors	212	-250.74	0.16	2.40	0.07	0.50	0.70	0.40	0.50
An. gambiae	Indoors	3167	-5397.45	0.40	0.75	- 1.81	0.10	0.20	0.30	0.10
An. gambiae	Outdoors	2020	-2234.20	0.20	3.24	0.17	0.20	0.40	0.10	0.10
An. pharoensis	Indoors	337	-511.60	5.05	1.20	- 2.01	0.10	0.10	0.30	0.10
An. pharoensis	Outdoors	445	-446.58	5.22	2.25	- 0.37	0.10	0.10	0.10	0.10

n Number of specimens tested (limited to $n > 10$)

maxLogLik maximum value of the the log-likelihood function

mu maximum likelihood estimates of μ

kappa maximum likelihood estimates of K

psi maximum likelihood estimates of ψ

Kuiper estimated p-value for the Kuiper test

Rayleigh estimated p-value for the Rayleigh test

Rao estimated p-value for the Rao spacing test

Watson estimated p-value for the Watson U2 test

Table S10. Summary of statistics for fitting Inverse Batschelet Distribution by species and location

Species	Location	n	maxLogLik	AIC	BIC	xi	kappa	nu	lambda	Kuiper	Rayleigh	Rao	Watson
An. coluzzii	Indoors	599	-1036.11	2080.22	2097.80	1.39	0.82	0.63	1.00	0.00	0.14	0.00	0.00
An. coluzzii	Outdoors	378	-482.21	972.42	988.16	0.48	1.83	0.20	0.20	0.00	0.98	0.00	0.00
An. funestus	Indoors	541	-929.08	1866.16	1883.33	1.68	0.73	0.69	0.35	0.00	0.95	0.00	0.00
An. funestus	Outdoors	212	-250.55	509.11	522.53	0.15	2.41	-0.01	-0.10	0.00	0.95	0.00	0.00
An. gambiae	Indoors	3167	-5377.30	10762.61	10786.85	1.45	0.80	0.64	0.49	0.00	0.44	0.00	0.00
An. gambiae	Outdoors	2020	-2229.42	4466.85	4489.29	0.09	3.08	-0.08	-0.24	0.00	0.88	0.00	0.00
An. pharoensis	Indoors	337	-514.65	1037.29	1052.57	0.24	1.35	0.79	1.00	0.00	0.61	0.00	0.00
An. pharoensis	Outdoors	445	-380.64	769.28	785.68	0.70	2.58	1.00	0.50	0.00	0.02	0.00	0.00

n Number of specimens tested (limited to n>10)
maxLogLik maximum value of the the log-likelihood function
AIC Akaike information criterion
BIC Bayesian information criterion
xi maximum likelihood estimates of ξ
kappa maximum likelihood estimates of K
nu maximum likelihood estimates of ν
lambda maximum likelihood estimates of λ
Kuiper estimated p-value for the Kuiper test
Rayleigh estimated p-value for the Rayleigh test
Rao estimated p-value for the Rao spacing test
Watson estimated p-value for the Watson U2 test

Table S11. Best number of clusters per species, month and location

Species	Month	Clusters Indoor	Clusters Outdoor
An. coluzzii	2016-06	3	5
An. coluzzii	2016-07	2	Na
An. coluzzii	2016-08	3	4
An. coluzzii	2016-09	3	Na
An. coluzzii	2016-05	6	4
An. coluzzii	2016-10	Na	Na
An. coluzzii	2016-11	Na	Na
An. coluzzii	2017-01	Na	Na
An. coluzzii	2017-02	Na	Na
An. coluzzii	2017-03	2	2
An. coluzzii	2017-04	5	5
An. funestus	2016-06	Na	Na
An. funestus	2016-07	3	Na
An. funestus	2016-08	1	Na
An. funestus	2016-09	3	4
An. funestus	2016-05	Na	Na
An. funestus	2016-10	3	Na
An. funestus	2016-11	3	Na
An. funestus	2017-01	Na	Na
An. funestus	2017-02	Na	Na
An. funestus	2017-03	Na	Na
An. funestus	2017-04	Na	Na
An. gambiae	2016-06	6	5
An. gambiae	2016-07	3	4
An. gambiae	2016-08	4	5
An. gambiae	2016-09	4	5
An. gambiae	2016-05	4	5
An. gambiae	2016-10	3	2
An. gambiae	2016-11	4	3
An. gambiae	2017-01	4	3
An. gambiae	2017-02	4	4
An. gambiae	2017-03	4	4
An. gambiae	2017-04	5	4
An. pharoensis	2016-06	6	3
An. pharoensis	2016-07	Na	3
An. pharoensis	2016-08	Na	3

Species	Month	Clusters Indoor	Clusters Outdoor
An. pharoensis	2016-09	3	4
An. pharoensis	2016-05	4	Na
An. pharoensis	2016-10	5	4
An. pharoensis	2016-11	Na	5
An. pharoensis	2017-01	Na	3
An. pharoensis	2017-02	Na	Na
An. pharoensis	2017-03	Na	Na
An. pharoensis	2017-04	Na	Na

Na: When number of mosquitoes <40
Best fitting number of clusters for Indoor and Outdoor collections

Table S12. Insecticide resistance status in Anopheles mosquitoes collected in Bangui

Species	Total	KDR-west			KDR-east		
		RR	RS	SS	RR	RS	SS
<i>An. gambiae</i>	247	237	5	1	4	0	0
<i>An. coluzzii</i>	114	68	38	7	0	0	1

Abbreviations: RR homozygous resistant alleles; RS heterozygous resistant and susceptible alleles; SS homozygous susceptible alleles

The presence of the target-site L1014F (kdr-w) and L1014S (kdr-e) mutations was determined using the TaqMan assay, as described in Bass et al.¹ only in randomly selected *An. gambiae* and *An. coluzzii* specimens.

Dataset S1 (separate file). The mosquito biting events in Bangui Central African Republic.

- ID Identification for each mosquito
- Date Date of collection
- Sites Sites of collection in Bangui
- Species Taxonomic and molecular identification of Anopheles collected in Bangui
- Location Indoor or Outdoor
- Hour_collection Hour of collection
- Feeding_status Unfed or blood-fed
- P. falciparum Infection with P. falciparum
- kdr_w Presence of the allele KDR, mutation West
- kdr_e Presence of the allele KDR, mutation East
- Lat Latitude
- Long Longitude

SI References

Sample References:

1. C. Bass et al., Detection of knockdown resistance (kdr) mutations in *Anopheles gambiae*: a comparison of two new high-throughput assays with existing methods. *Malaria journal* 6, 1-14 (2007).