

SUPPLEMENTARY MATERIAL

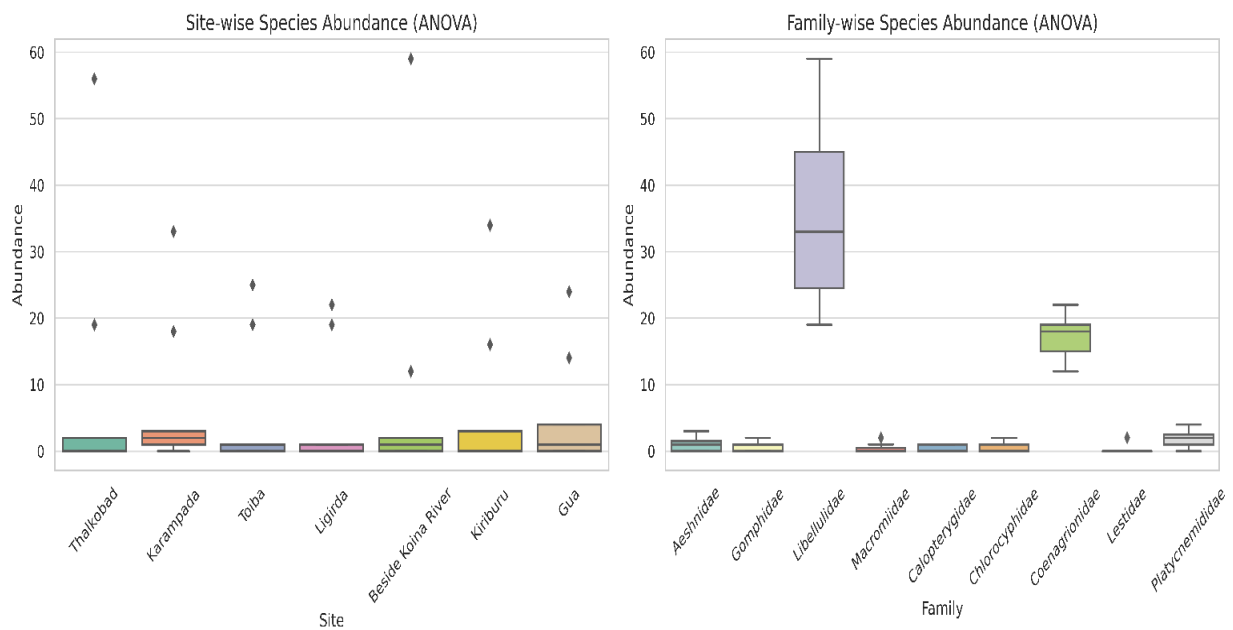
Assessing the diversity and abundance of dragonflies and damselflies in selected sites of Saranda Forest, Jharkhand, eastern India

Md Abu Imran Mallick,¹ Sima Paik²

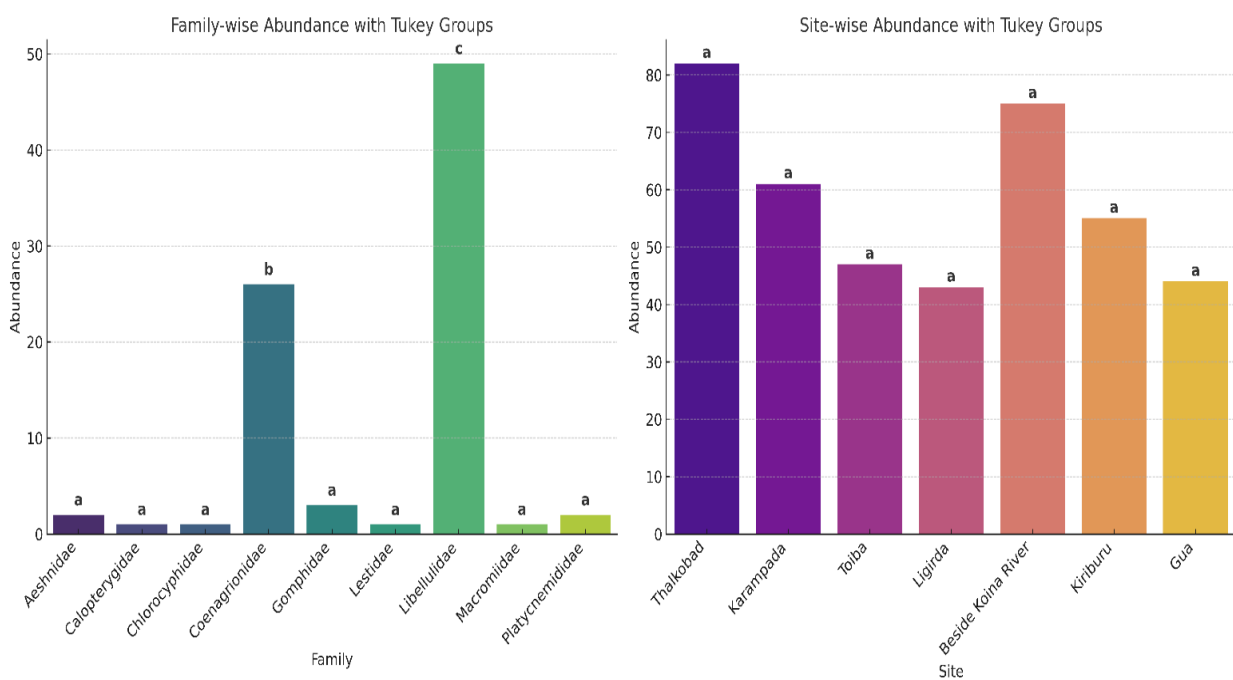
¹Jamshedpur Forest Division, Jamshedpur, Jharkhand; ²Department of Zoology, University of Calcutta, Kolkata, West Bengal, India

Correspondence: Md Abu Imran Mallick, Jamshedpur Forest Division, Jamshedpur – 831001, Jharkhand, India. E-mail: imranmallick708@gmail.com

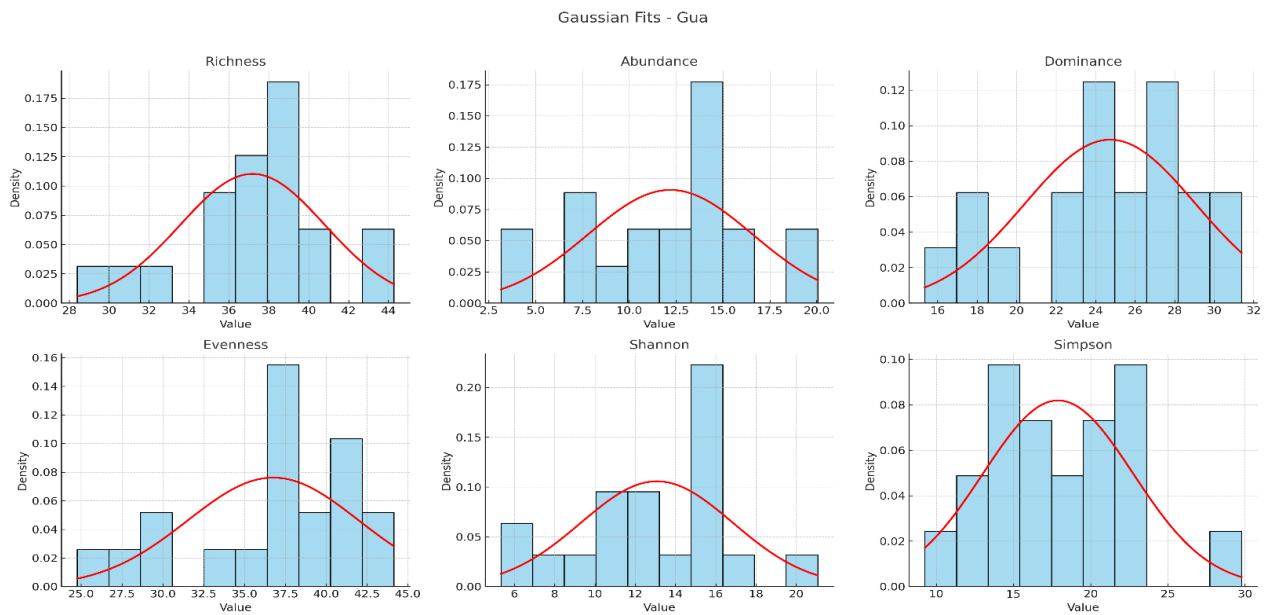
Key words: abundance, conservation, diversity indices, ecological indicator, habitat heterogeneity, Odonata, Saranda Forest.



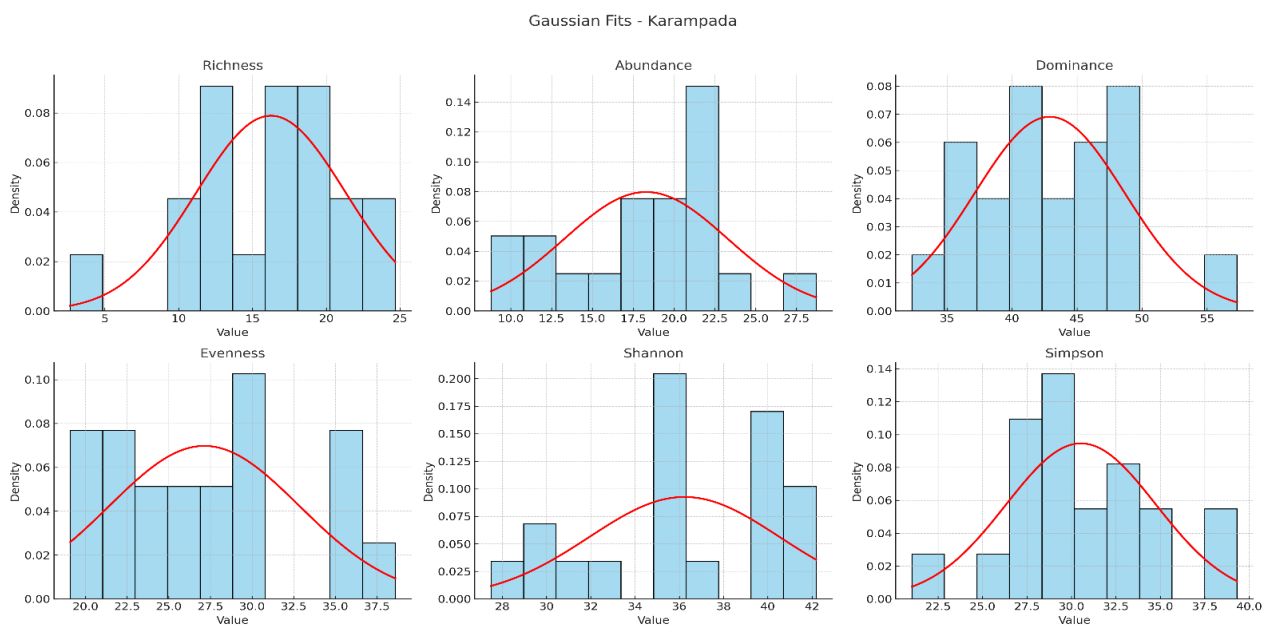
Supplementary Figure 1. One-way analysis of variance (ANOVA) boxplots showing site-wise variation in odonate species abundance (left) and family-wise variation in abundance (right).



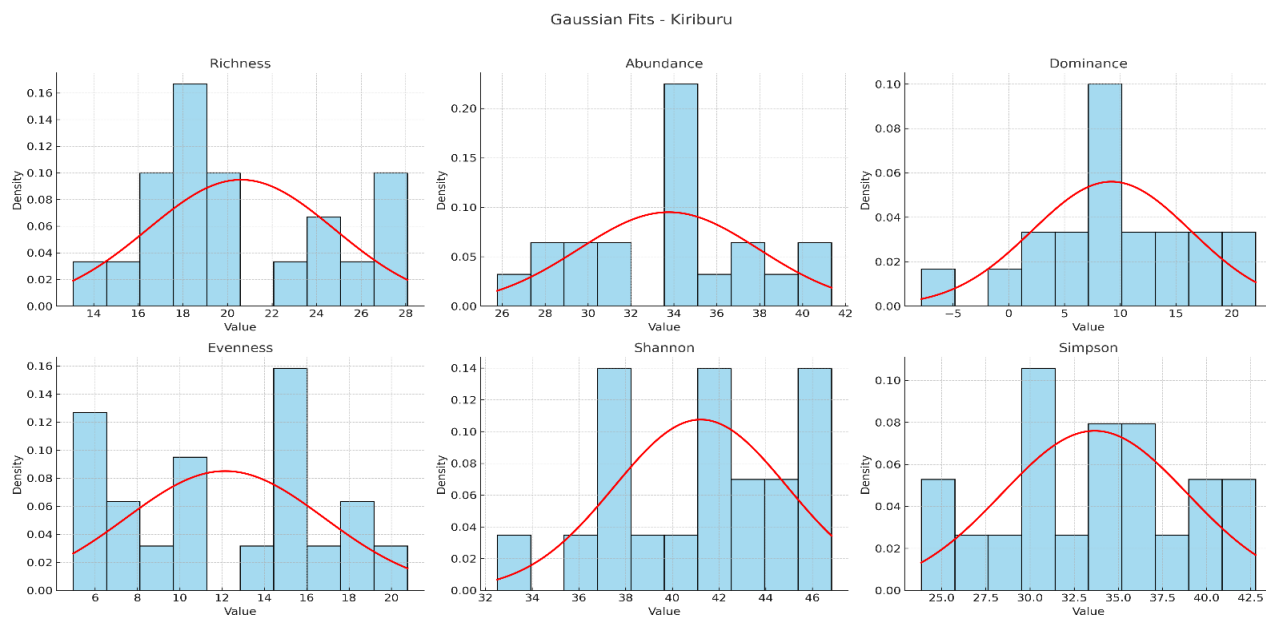
Supplementary Figure 2. Tukey's Honestly Significant Difference test showing multiple comparisons of odonate abundance among families and across study sites. Different letters indicate significant differences at $p < 0.05$.



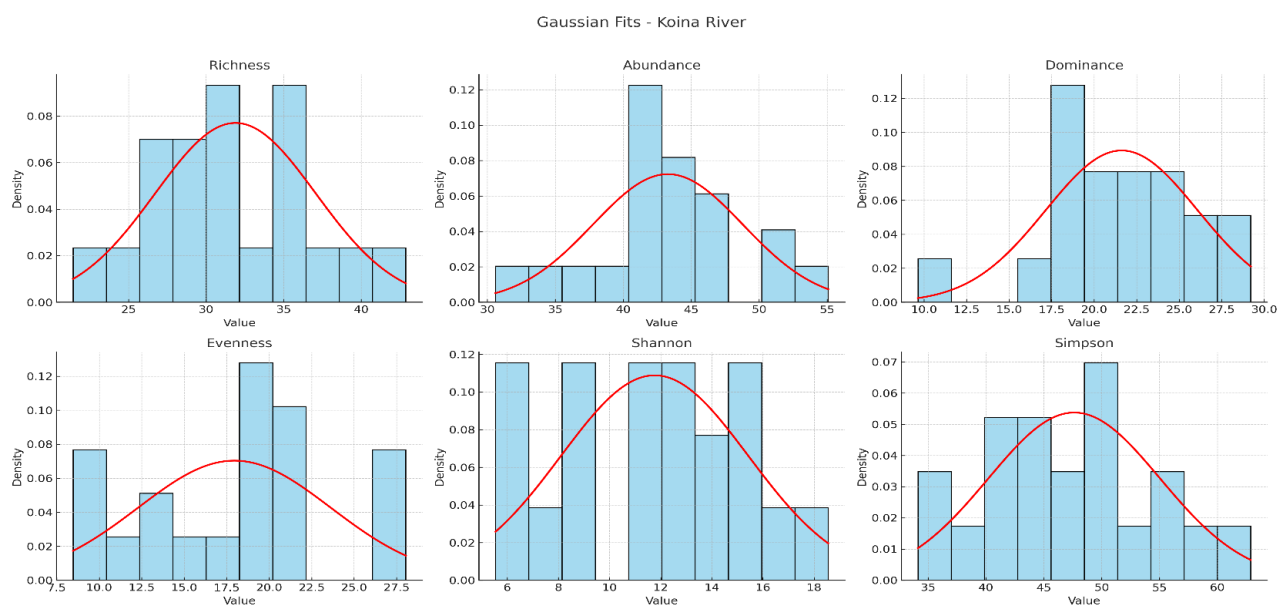
Supplementary Figure 3. Gaussian fit distributions of biodiversity indices at the Gua site, including richness, abundance, dominance, evenness, Shannon, and Simpson indices.



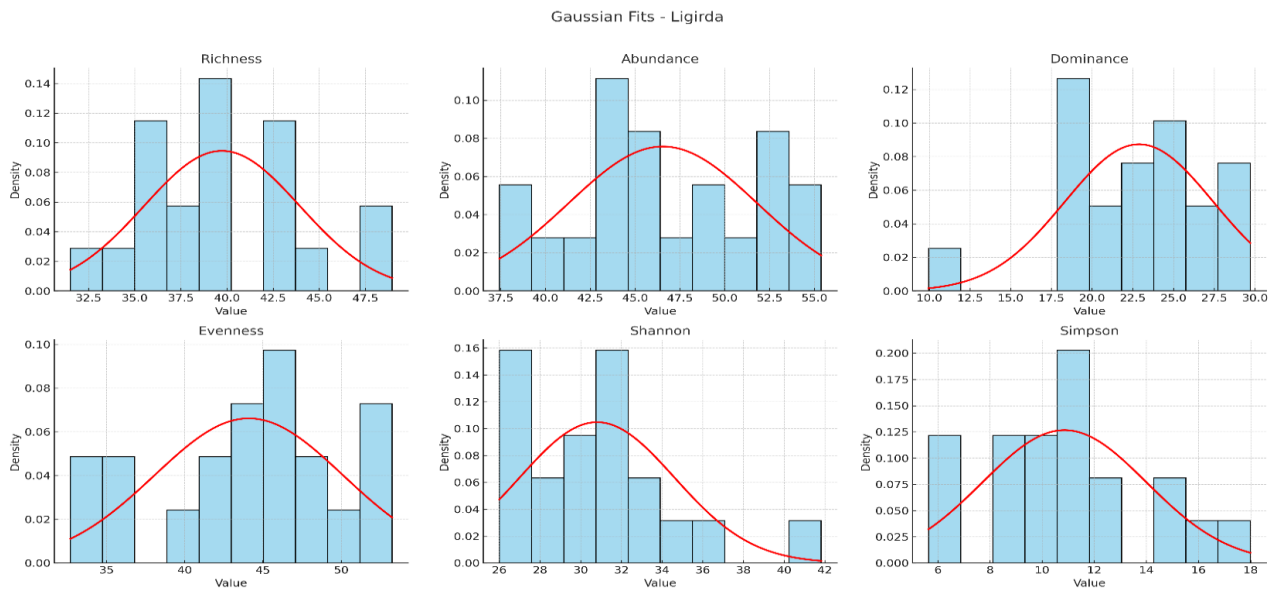
Supplementary Figure 4. Gaussian fit distributions of biodiversity indices at the Karampada site, including richness, abundance, dominance, evenness, Shannon, and Simpson indices.



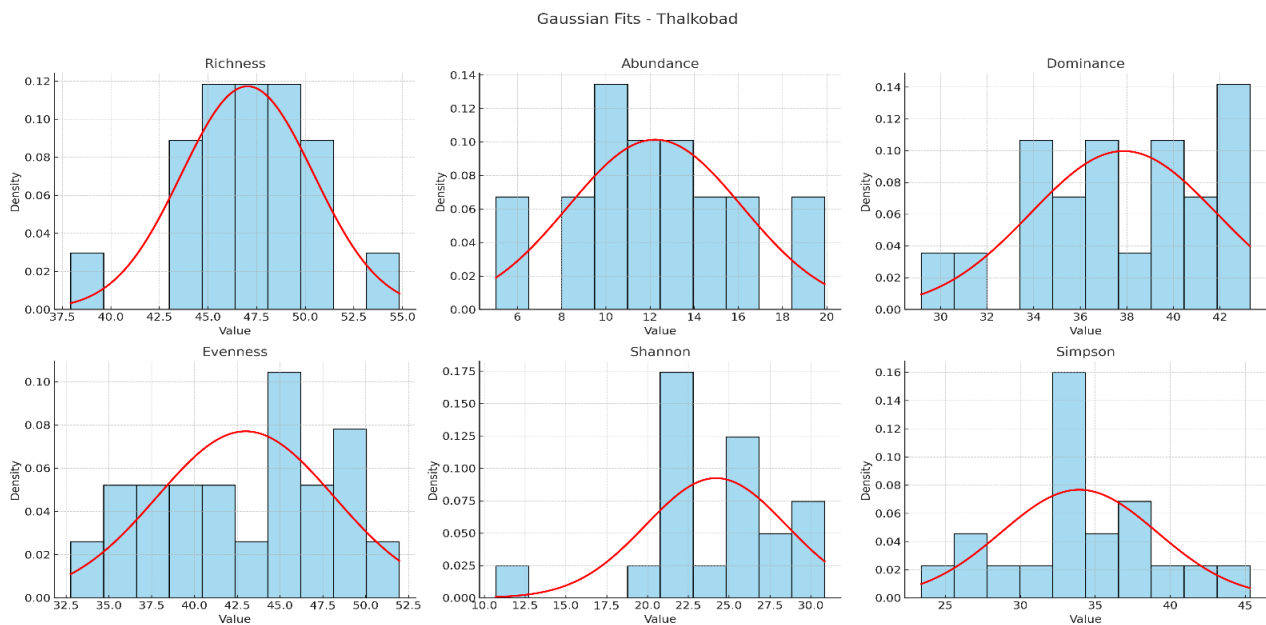
Supplementary Figure 5. Gaussian fit distributions of biodiversity indices at the Kiriburu site, including richness, abundance, dominance, evenness, Shannon, and Simpson indices.



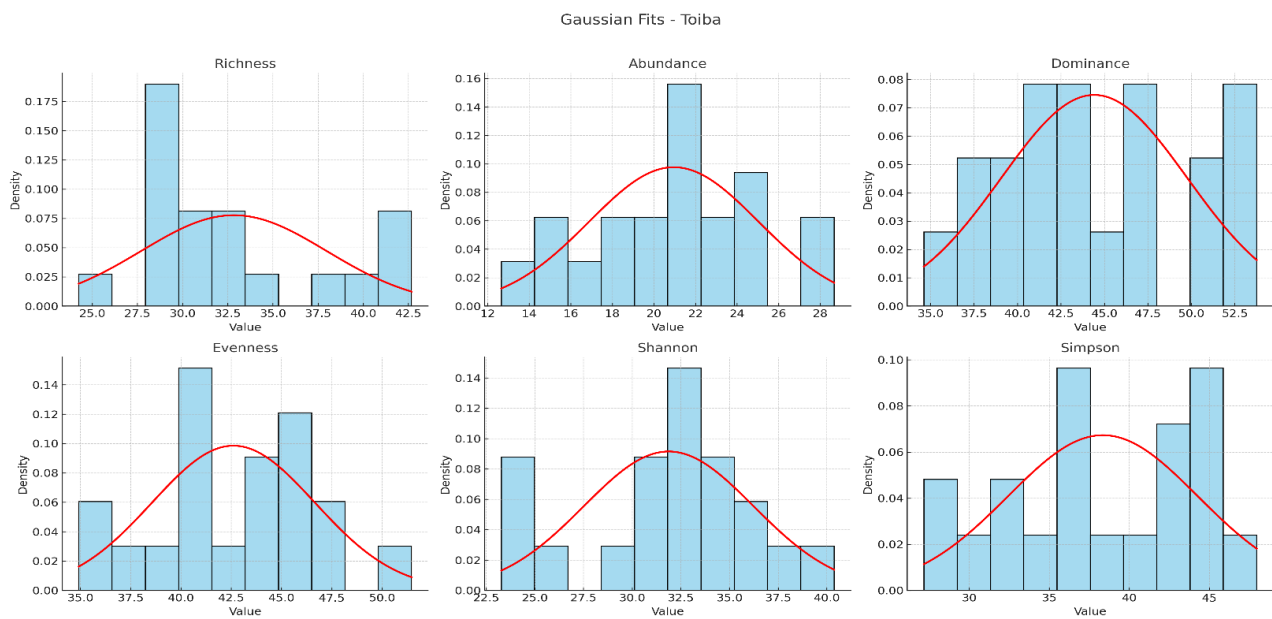
Supplementary Figure 6. Gaussian fit distributions of biodiversity indices at the Koina River site, including richness, abundance, dominance, evenness, Shannon, and Simpson indices.



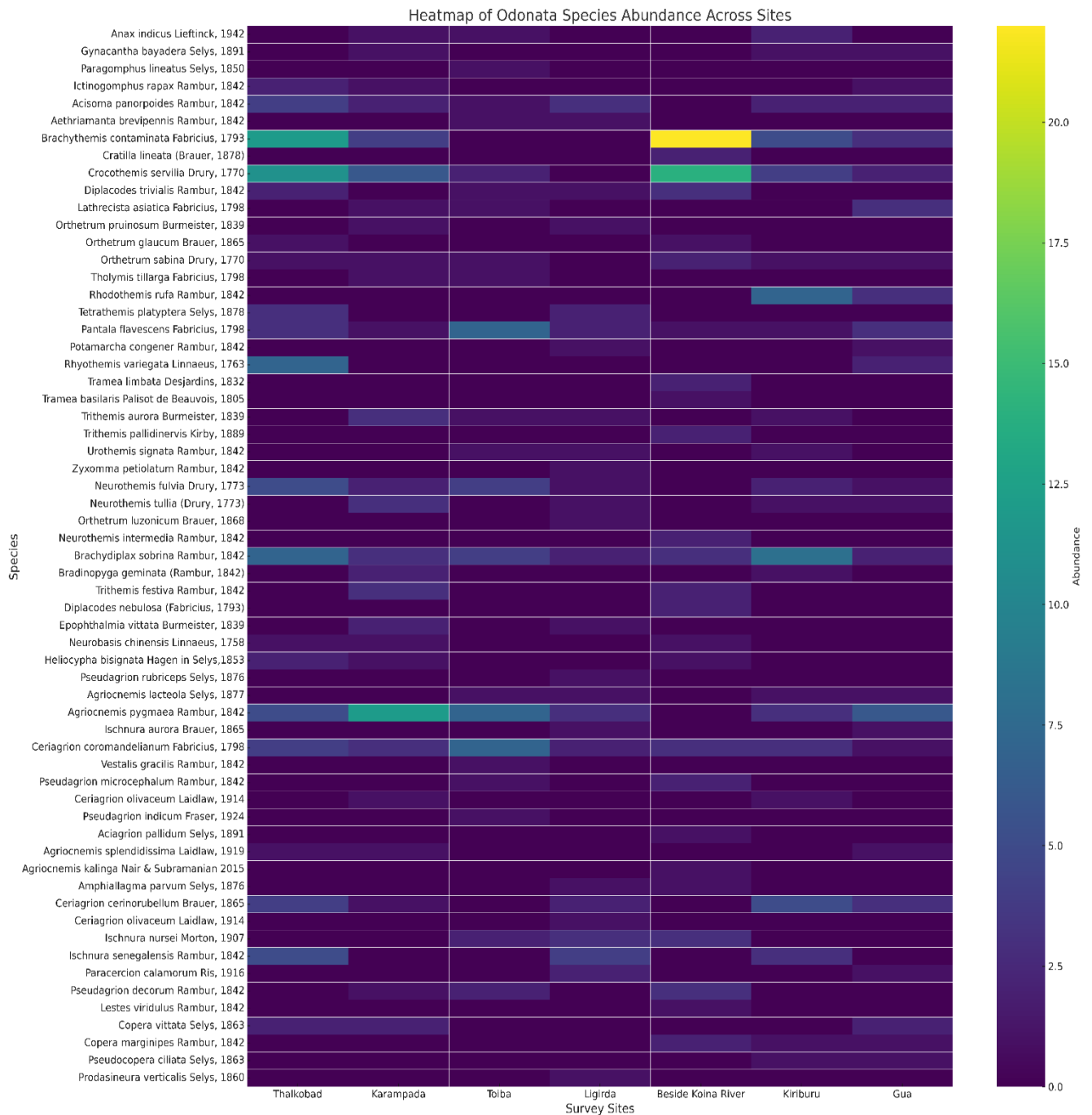
Supplementary Figure 7. Gaussian fit distributions of biodiversity indices at the Ligirda site, including richness, abundance, dominance, evenness, Shannon, and Simpson indices.



Supplementary Figure 8. Gaussian fit distributions of biodiversity indices at the Thalkobad site, including richness, abundance, dominance, evenness, Shannon, and Simpson indices.

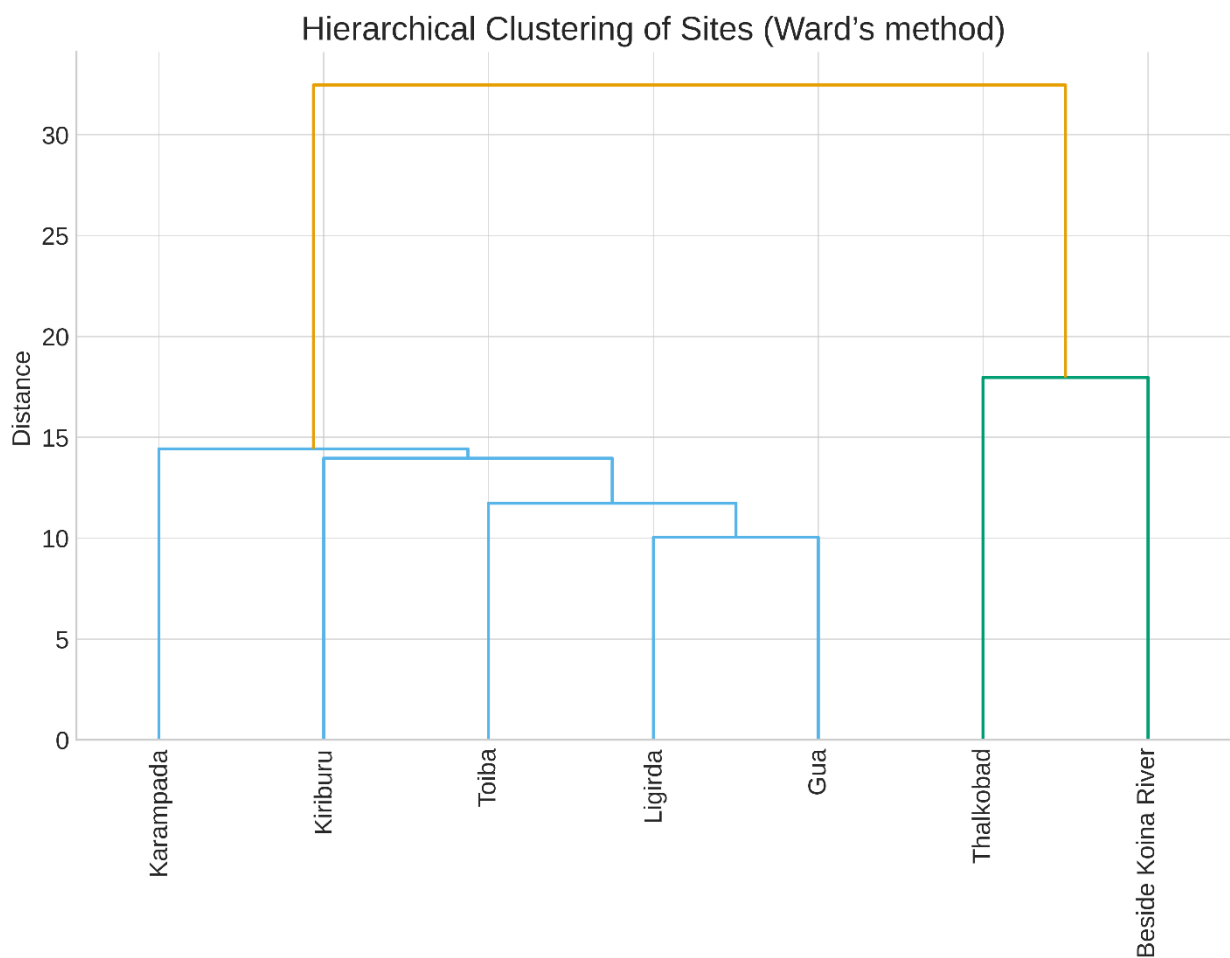


Supplementary Figure 9. Gaussian fit distributions of biodiversity indices at the Toiba site, including richness, abundance, dominance, evenness, Shannon, and Simpson indices.



Supplementary Figure 10. Heatmap of odonate species abundance across study sites (Thalkobad, Karampada, Toiba, Ligirda, Beside Koina River, Kiriburu, and Gua) showing heterogeneous species distribution patterns.





Supplementary Figure 12. Hierarchical clustering of sites based on odonate species abundance using Ward's method.

Supplementary Table 1. List of odonate species recorded from the Saranda Forest, Jharkhand, showing their family affiliation, common name, scientific name, International Union for Conservation of Nature conservation status, abundance, and relative abundance.

Sl. No.	Family	Common Name	Scientific Name	IUCN Status	Abundance	Relative abundance
1	Aeshnidae	Elephant Emperor	<i>Anax indicus</i> Lieftinck, 1942	LC	4	0.982
2	Aeshnidae	Parakeet Darner	<i>Gynacantha bayadera</i> Selys, 1891	LC	3	0.737
3	Gomphidae	Lined Hooktail	<i>Paragomphus lineatus</i> Selys, 1850	LC	1	0.245
4	Gomphidae	Indian Common Clubtail	<i>Ictinogomphus rapax</i> Rambur, 1842	LC	4	0.982
5	Libellulidae	Trumpet tail	<i>Acisoma panorpoides</i> Rambur, 1842	LC	14	3.439
6	Libellulidae	Scarlet Marsh Hawk	<i>Aethriamanta brevipennis</i> Rambur, 1842	LC	2	0.491
7	Libellulidae	Ditch Jewel	<i>Brachythemis contaminata</i> Fabricius, 1793	LC	46	11.302
8	Libellulidae	Emerald-Banded Skimmer	<i>Cratilla lineata</i> (Brauer, 1878)	LC	2	0.491
9	Libellulidae	Ruddy marsh skimmer	<i>Crocothemis servilia</i> Drury, 1770	LC	39	9.582
10	Libellulidae	Blue Ground Skimmer	<i>Diplacodes trivialis</i> Rambur, 1842	LC	7	1.719
11	Libellulidae	Asiatic Blood-Tail	<i>Lathrecista asiatica</i> Fabricius, 1798	LC	5	1.228
12	Libellulidae	Crimson-tailed Marsh Hawk	<i>Orthetrum pruinosum</i> Burmeister, 1839	LC	2	0.491
13	Libellulidae	Blue Marsh Hawk	<i>Orthetrum glaucum</i> Brauer, 1865	LC	2	0.491
14	Libellulidae	Green Marsh Hawk	<i>Orthetrum sabina</i> Drury, 1770	LC	7	1.719
15	Libellulidae	Coral-Tailed Cloudwing	<i>Tholymis tillarga</i> Fabricius, 1798	LC	2	0.491
16	Libellulidae	Rufous Marsh Glider	<i>Rhodothemis rufa</i> Rambur, 1842	LC	10	2.457
17	Libellulidae	Pigmy Skimmer	<i>Tetrathemis platyptera</i> Selys, 1878	LC	5	1.228
18	Libellulidae	Wandering Glider	<i>Pantala flavescens</i> Fabricius, 1798	LC	18	4.422
19	Libellulidae	Yellow-tailed Ashy Skimmer	<i>Potamarcha congener</i> Rambur, 1842	LC	2	0.491
20	Libellulidae	Common Picturewing	<i>Rhyothemis variegata</i> Linnaeus, 1763	LC	9	2.211
21	Libellulidae	Black Marsh Trotter	<i>Tamea limbata</i> Desjardins, 1832	LC	2	0.491
22	Libellulidae	Red Marsh Trotter	<i>Tamea basilaris</i> Palisot de Beauvois, 1805	LC	1	0.245
23	Libellulidae	Crimson Marsh Glider	<i>Trithemis aurora</i> Burmeister, 1839	LC	6	1.474
24	Libellulidae	Long-Legged Marsh Glider	<i>Trithemis pallidinervis</i> Kirby, 1889	LC	2	0.491
25	Libellulidae	Greater Crimson Glider	<i>Urothemis signata</i> Rambur, 1842	LC	3	0.737
26	Libellulidae	Brown Dusk Hawk	<i>Zyxomma petiolatum</i> Rambur, 1842	LC	1	0.245
27	Libellulidae	Fulvous Forest Skimmer	<i>Neurothemis fulvia</i> Drury, 1773	LC	15	3.685
28	Libellulidae	Pied Paddy Skimmer	<i>Neurothemis tullia</i> (Drury, 1773)	LC	6	1.474
29	Libellulidae	Tri-coloured Marsh Hawk	<i>Orthetrum luzonicum</i> Brauer, 1868	LC	1	0.245
30	Libellulidae	Paddyfield Parasol	<i>Neurothemis intermedia</i> Rambur, 1842	LC	2	0.491
31	Libellulidae	Little Blue Marsh Hawk	<i>Brachydiplax sobrina</i> Rambur, 1842	LC	29	7.125
32	Libellulidae	Granite Ghost	<i>Bradinopyga geminata</i> (Rambur, 1842)	LC	3	0.737
33	Libellulidae	Black Stream Glider	<i>Trithemis festiva</i> Rambur, 1842	LC	5	1.228
34	Libellulidae	Black-Tipped Percher	<i>Diplacodes nebulosa</i> (Fabricius, 1793)	LC	2	0.491

35	Macromiidae	Common Torrent Hawk	<i>Epophthalmia vittata</i> Burmeister, 1839	LC	3	0.737
36	Calopterygidae	Stream Glory	<i>Neurobasis chinensis</i> Linnaeus, 1758	LC	3	0.737
37	Chlorocyphidae	Stream Ruby	<i>Heliocypha bisignata</i> Hagen in Selys, 1853	LC	4	0.982
38	Coenagrionidae	Saffron-faced Blue Sprite	<i>Pseudagrion rubriceps</i> Selys, 1876	LC	1	0.245
39	Coenagrionidae	Milky Dartlet	<i>Agriocnemis lacteola</i> Selys, 1877	LC	4	0.982
40	Coenagrionidae	Pygmy Dartlet	<i>Agriocnemis pygmaea</i> Rambur, 1842	LC	36	8.845
41	Coenagrionidae	Golden Dartlet	<i>Ischnura aurora</i> Brauer, 1865	LC	2	0.491
42	Coenagrionidae	Coromandel Marsh Dart	<i>Ceriagrion coromandelianum</i> Fabricius, 1798	LC	23	5.651
43	Calopterygidae	Clear-winged Forest Glory	<i>Vestalis gracilis</i> Rambur, 1842	LC	1	0.245
44	Coenagrionidae	Blue Grass Dart	<i>Pseudagrion microcephalum</i> Rambur, 1842	LC	2	0.491
45	Coenagrionidae	Rusty Marsh Dart	<i>Ceriagrion olivaceum</i> Laidlaw, 1914	LC	2	0.491
46	Coenagrionidae	Yellow-striped Sprite	<i>Pseudagrion indicum</i> Fraser, 1924	LC	1	0.245
47	Coenagrionidae	Pale Slender Dartlet	<i>Aciagrion pallidum</i> Selys, 1891	LC	1	0.245
48	Coenagrionidae	Splendid Dartlet	<i>Agriocnemis splendidissima</i> Laidlaw, 1919	LC	2	0.491
49	Coenagrionidae	Indian Hooded Dartlet	<i>Agriocnemis kalinga</i> Nair & Subramanian 2015	LC	3	0.737
50	Coenagrionidae	Azure Dartlet	<i>Amphiallagma parvum</i> Selys, 1876	LC	1	0.245
51	Coenagrionidae	Orange-tailed Marsh Dart	<i>Ceriagrion cerinorubellum</i> Brauer, 1865	LC	15	3.685
52	Coenagrionidae	Rusty Marsh Dart	<i>Ceriagrion olivaceum</i> Laidlaw, 1914	LC	1	0.245
53	Coenagrionidae	Pixie Dartlet	<i>Ischnura nursei</i> Morton, 1907	LC	3	0.737
54	Coenagrionidae	Senegal Golden Dartlet	<i>Ischnura senegalensis</i> Rambur, 1842	LC	17	4.176
55	Coenagrionidae	Dusky Lilly-squatter	<i>Paracercion calamorum</i> Ris, 1916	LC	4	0.982
56	Coenagrionidae	Three-lined Sprite	<i>Pseudagrion decorum</i> Rambur, 1842	LC	1	0.245
57	Lestidae	Emerald-striped Spreadwing	<i>Lestes viridulus</i> Rambur, 1842	LC	2	0.491
58	Platycnemididae	Blue Bush Dart	<i>Copera vittata</i> Selys, 1863	LC	6	1.474
59	Platycnemididae	Yellow Bush Dart	<i>Copera marginipes</i> Rambur, 1842	LC	2	0.491
60	Platycnemididae	Pied Bush Dart	<i>Pseudocopera ciliata</i> Selys, 1863	LC	4	0.982
61	Platycnemididae	Red-striped Black Threadtail	<i>Prodasineura verticalis</i> Selys, 1860	LC	1	0.245

Supplementary Table 2. Site-wise biodiversity indices of odonate species across seven study sites in Saranda Forest.

	Thalkobad	Karampada	Toiba	Ligirda	Beside Koina River	Kiriburu	Gua
Taxa S	20	27	21	28	24	22	24
Individuals	82	61	47	43	75	55	44
Dominance D	0.077	0.073	0.09	0.045	0.135	0.075	0.058
Simpson 1-D	0.922	0.926	0.909	0.954	0.864	0.924	0.941
Shannon H	2.744	2.971	2.686	3.209	2.576	2.808	3.008
Evenness $e^{H/S}$	0.777	0.722	0.698	0.884	0.547	0.753	0.843
Brillouin	2.411	2.468	2.202	2.531	2.198	2.345	2.416
Menhinick	2.209	3.457	3.063	4.27	2.771	2.966	3.618
Margalef	4.312	6.325	5.195	7.179	5.327	5.24	6.078
Equitability J	0.915	0.901	0.882	0.963	0.81	0.908	0.946
Fisher α	8.428	18.54	14.57	34.81	12.2	13.59	21.61
Berger-Parker	0.146	0.196	0.148	0.093	0.293	0.145	0.136
Chao-1	21.2	42.17	51.33	49.86	27.6	35.75	37

Supplementary Table 3. One-way analysis of variance results showing variation in odonate species across study sites and families. Species abundance did not differ significantly among sites ($p>0.05$), whereas significant differences were observed among families ($p<0.001$), indicating family-level variation contributes more strongly to community diversity patterns.

1	Odonate species among different study sites	Source of variation	df	Sum Sq	Mean Sq	F	P-Value
		Between Sites	6	158.32	26.39	0.1502	0.9883
		Within (Residual)	56	9837.33	175.67		
		Total	62	9995.65	202.06		
2	Odonate species inn different families	Source of variation	df	Sum Sq	Mean Sq	F	P-Value
		Between Families	8	8396.51	1049.56	35.44	7.95×10^{-19}
		Within (Residual)	54	1599.14	29.61		
		Total	62	9995.65	1079.17		

Supplementary Table 4. Tukey's Honestly Significant Difference results showing site-wise and family-wise odonate abundance. Site-wise comparisons revealed no significant differences across sites ($p>0.05$), while family-wise analysis showed strong variation, with Libellulidae significantly more abundant than all other families.

1	Site-wise Tukey			
Site	Mean abundance	Group	Analysis of variance F-value	Analysis of variance p-value
Beside Koina River	8.34	a	0.16	0.98
Gua	4.89	a	0.16	0.98
Karampada	6.78	a	0.16	0.98
Kiriburu	6.12	a	0.16	0.98
Ligirda	4.78	a	0.16	0.98
Thalkobad	9.12	a	0.16	0.98
Toiba	5.23	a	0.16	0.98
2	Familly-wise Tukey			
Family	Mean abundance	Group	Analysis of variance F-value	Analysis of variance p-value
Aeshnidae	1	a	35.45	7.94939E-19
Calopterygidae	0.43	a	35.45	7.94939E-19
Chlorocyphidae	0.58	a	35.45	7.94939E-19
Coenagrionidae	17.15	b	35.45	7.94939E-19
Gomphidae	0.72	a	35.45	7.94939E-19
Lestidae	0.28	a	35.45	7.94939E-19
Libellulidae	35.72	c	35.45	7.94939E-19
Macromiidae	0.43	a	35.45	7.94939E-19
Platycnemididae	1.86	a	35.45	7.94939E-19