Oikos

OIK-04593

Bhaumik, V. and Kunte, K. 2017. Female butterflies modulate investment in reproduction and flight in response to monsoon-driven migrations. – Oikos doi: 10.1111/oik.04593

Appendix 1

Table A1. Species and number of individuals observed in migratory swarms across seasons, years and localities (the Bangalore data are summarized in Fig. 1c). Species represented are: *E. c. core* = *Euploea core core*, *E. s. coreta* = *Euploea sylvester coreta*, *T. l. exoticus* = *Tirumala limniace exoticus*, *T. s. dravidarum* = *Tirumala septentrionis dravidarum*.

Season and location	Species	Total no. of ind.	% species composition	No. of old ind.	% old ind.	No. of males	% male
Return migratory phase: Oct. 2001, Chinnar WLS, Kerala	*E. c. core*	26	10.4	0	0	14	53.8
	E. s. coreta	63	25.2	0	0	37	58.7
	T. l. exoticus	3	1.2	0	0	3	100
	T. s. dravidarum	158	63.2	0	0	78	49.4
Post-migratory swarming phase: Jan. 2012, Kodagu, Karnataka	*E. c. core*	5	5.3	0	0	4	80
	E. s. coreta	63	66.3	0	0	28	44.4
	T. l. exoticus	1	1.1	0	0	0	0
	T. s. dravidarum	26	27.4	0	0	15	57.7
Migratory phase: May–June, 2012, Bengaluru	*E. c. core*	253	31.9	14	5.5	159	62.8
	E. s. coreta	337	42.6	8	2.4	134	39.8
	T. l. exoticus	49	6.2	1	2	26	53.1
	T. s. dravidarum	153	19.3	0	0	75	49
Migratory phase: Aug.–Sept. 2012, Bengaluru	*E. c. core*	10	7.1	1	10	7	70
	E. s. coreta	121	85.8	4	3.3	74	61.2
	T. l. exoticus	9	6.4	0	0	9	100
	T. s. dravidarum	1	0.7	0	0	1	100
Migratory phase: Mar. 2013, Bengaluru	*E. c. core*	0	0	0	0	0	0
	E. s. coreta	260	43.3	0	0	129	49.6
	T. l. exoticus	7	1.2	0	0	7	100
	T. s. dravidarum	334	55.6	0	0	186	55.7
Migratory phase: Apr. 2013, Bengaluru	*E. c. core*	9	6.4	2	22.2	9	100
	E. s. coreta	113	80.1	40	35.4	83	73.5
	T. l. exoticus	0	0	0	0	0	0
	T. s. dravidarum	19	13.5	13	68.4	13	68.4
Migratory phase: Jun. 2014, Bengaluru	*E. c. core*	180	18	9	5.0	137	76.1
	E. s. coreta	112	11.2	3	2.7	79	70.5
	T. l. exoticus	29	2.9	0	0	24	82.8
	T. s. dravidarum	679	67.9	60	8.8	500	73.6
Migratory phase: Apr. 2015, Bengaluru	*E. c. core*	78	12.7	0	0	41	52.6
	E. s. coreta	228	37	0	0	128	56.1
	T. l. exoticus	46	7.5	0	0	33	71.7
	T. s. dravidarum	264	42.9	0	0	151	57.2
Migratory phase: Mar.–Jun. 2016, Bengaluru	*E. c. core*	47	47.5	10	21.3	38	80.9
	E. s. coreta	32	32.3	1	3.1	20	62.5
	T. l. exoticus	12	12.1	0	0	10	83.3
	T. s. dravidarum	8	8.1	2	25	8	100

Table A2. Species, number, and sex of individuals used for morphometric measurements. OV = Ovulating females, RD = females in reproductive diapause. Species represented are: *Euploea core core*, *Euploea sylvester coreta*, *Tirumala limniace exoticus*, and *Tirumala septentrionis dravidarum, Danaus chrysippus, Euploea midamus rogenhoferi, Euploea mulciber mulciber, Tirumala septentrionis septentrionis, Acraea terpsicore, Byasa polyeuctes* and *Delias eucharis* (also see Fig. 2 and 3).

Migratory habit and Species	Sex and phase	n	Thorax mass (range, mg)	Thorax mass (mean±SD, mg)	Thorax mass (median±SE, mg)	Abdomen mass (range, mg)	Abdomen mass (mean±SD, mg)	Abdomen mass (median±SE, mg)	Thorax: abdomen ratio (range)	Thorax: abdomen ratio (mean±SD)	Thorax: abdomen ratio (median±SE)
Migratory danaines											
*E. c. core**	♀ OV	19	34–102	70.8±17.58	77±4.03	48–166	99.02±31	96±7.11	0.51–1.04	0.74±0.15	0.72±0.03
	♀ RD	47	49–103	79.93±12.61	79±1.84	58–193	91.39±30.03	85±4.38	0.46–1.39	0.93±0.21	0.94±0.03
	♂	72	21–139	88.36±19.71	88.2±2.32	29–151	84.93±27.09	80±3.19	0.7–1.49	1.08±0.19	1.11±0.02
E. s. coreta	♀ OV	21	52.5–109	87.8±14.24	89.8±3.11	48–182	111.09±36.81	103±8.03	0.54–1.43	0.85±0.22	0.82±0.05
	♀ RD	108	34–131	82.02±18.64	82.65±1.79	33–180	87.53±32.27	81.15±3.11	0.57–1.62	1±0.22	0.99±0.02
	♂	85	37.9–134	86.27±18.5	87±2.01	36–165	76.3±25.3	72±2.74	0.63–1.73	1.18±0.22	1.21±0.02
T. l. exoticus	♀ OV	9	60–194	145.33±45.22	151±15.07	87–203	172.67±36.62	177±12.21	0.49–1.22	0.84±0.22	0.85±0.07
	♀ RD	31	45.2–177	117.89±28.37	116±5.1	39.9–205.8	107.44±33.37	106±5.99	0.8–1.62	1.14±0.23	1.09±0.04
	♂	42	65.8–193	127.32±29.71	126.5±4.58	44–164.2	96.42±28.47	92.5±4.39	0.88–1.86	1.36±0.21	1.39±0.03
T. s. dravidarum	♀ OV	8	68–122	91.36±21.68	84.5±7.66	73–128	100.63±19.63	98.5±6.94	0.71–1.19	0.92±0.18	0.88±0.06
	♀ RD	120	40–145	87.77±20.01	89±1.83	37–149	86.76±28.34	87±2.59	0.61–1.63	1.07±0.23	1.03±0.02
	♂	66	35–151	94.65±23.04	92.5±2.84	25–154	77.86±26.73	74±3.29	0.77–1.79	1.27±0.23	1.25±0.03
Non-migratory danaines											
D. c. chrysippus	♀	42	28.2–108	64.86±19.34	64.5±2.98	48–138	91.91±22.48	92±3.47	0.41–1.08	0.71±0.15	0.7±0.02
	♂	50	49.6–112	82.99±15.55	86±2.2	26.2–110	67.9±19.84	70±2.81	0.84–2.08	1.28±0.28	1.25±0.04
E. m. rogenhoferi	♀	8	41–154	108.75±43.1	121.5±15.24	49–253	135.13±64.51	135.5±22.81	0.6–1.08	0.85±0.21	0.83±0.07
	♂	13	98–193	147.18±30.34	157±8.42	65–267	140.41±56.74	133±15.74	0.62–1.51	1.12±0.22	1.14±0.06
E. m. mulciber	♀	24	39–135.1	99.9±23.87	103.15±4.87	67–220	144.05±43.62	140.4±8.9	0.57–1.17	0.72±0.15	0.66±0.03
	♂	30	92.2–170	128.01±20.19	126.5±3.69	59–182	112.74±32.92	111.8±6.01	0.78–1.66	1.19±0.24	1.13±0.04
T. s. septentrionis	♀	8	98–162.7	125.79±21.96	129.45±7.76	114–231.2	186.56±45.85	201.1±16.21	0.54–0.86	0.69±0.11	0.69±0.04
	♂	16	90–215	156.21±39.28	162.8±9.82	52.2–231	132.29±52.43	123.5±13.11	0.8–1.94	1.28±0.34	1.19±0.08

<u>Non-danaines</u>											
A. terpsicore	♀	31	14–43	24.83±7.4	23±1.33	18–55	28.85±9.6	27±1.72	0.58–1.37	0.89±0.21	0.82±0.04
	♂	21	13–43.2	25.34±6.54	25±1.43	12–39	24.93±7.15	24±1.56	0.67–1.31	1.04±0.17	1.07±0.04
B. p. polyeuctes	♀	9	100–233	155.48±48.07	158±16.02	96–315	198.74±71.03	213.6±23.68	0.51–1.21	0.83±0.22	0.78±0.07
	♂	17	36.4–230	161.98±45.27	182±10.98	22.1–234	117.36±48.85	112±11.85	0.82–1.92	1.47±0.3	1.53±0.07
D. eucharis	♀	13	45–85.5	67.22±13.29	66.8±3.69	49.6–156	101.88±32.09	105.6±8.9	0.53–1.13	0.7±0.19	0.68±0.05
	♂	24	29.2–98.5	73.02±14.41	77±2.94	17.8–108.3	60.35±18.44	60.1±3.76	0.75–1.9	1.28±0.3	1.23±0.06
<u>Combined data</u>											
Migratory danaines	♀ OV	57	34–194	91.72±33.75	85±4.47	48–203	115.32±41.1	106±5.44	0.49–1.43	0.82±0.2	0.79±0.03
	♀ RD	306	34–177	87.58±22.24	86.5±1.27	33–205.8	89.84±31.01	87.5±1.77	0.46–1.63	1.03±0.23	1.01±0.01
	♂	265	21–193	95.43±26.15	92.6±1.61	25–165	82.22±27.44	76.2±1.69	0.63–1.86	1.2±0.23	1.2±0.01
Non-migratory danaines	♀	82	28.2–162.7	85.34±32.39	81.2±3.58	48–253	120.62±48.76	110.6±5.38	0.41–1.17	0.72±0.16	0.69±0.02
	♂	109	49.6–215	113.78±37.84	104.3±3.62	26.2–267	98.34±45.6	89±4.37	0.62–2.08	1.24±0.27	1.19±0.03
Non-danaine aposematics	♀	53	14–233	57.41±52.43	35±7.2	18–315	75.62±71.88	35±9.87	0.51–1.37	0.83±0.22	0.78±0.03
	♂	62	13–230	81.26±59.57	73.15±7.57	12–234	63.99±45.77	56.4±5.81	0.67–1.92	1.25±0.31	1.19±0.04

Table A3. Test statistics and p-values for the thorax and abdomen masses of the sexes and the species represented in Fig. 2. There are no consistent patterns across the comparison groups. Species and sample sizes are the same as those represented in Table A2.

Groups	Comparison	Test statistic for thorax mass	p-value	Test statistic for abdomen mass	p-value
Euploea c. core	♀ OV – ♀ RD	t = –2.06	**0.0498**	W = 530.5	0.2369
Euploea c. core	♀ OV – ♂	t = –3.77	**0.0007**	t = 1.81	0.0823
Euploea c. core	♀ RD – ♂	t = –2.85	**0.0052**	W = 1873.5	0.3251
Euploea c. core	♀ OV – ♀ RD – ♂	F(2,135) = 8.91	**0.0002**	$\chi^2(2)$ = 3.68	0.1591
Euploea sylvester coreta	♀ OV – ♀ RD	t = 1.61	0.1159	W = 1558	**0.0069**
Euploea sylvester coreta	♀ OV – ♂	t = 0.42	0.6802	W = 1425.5	**0.0000**
Euploea sylvester coreta	♀ RD – ♂	t = –1.58	0.1160	W = 5479.5	**0.0210**
Euploea sylvester coreta	♀ OV – ♀ RD – ♂	F(2,211) = 1.73	0.1793	$\chi^2(2)$ = 18.11	**0.0001**
Tirumala limniace exoticus	♀ OV – ♀ RD	t = 1.72	0.1156	W = 244	**0.0008**
Tirumala limniace exoticus	♀ OV – ♂	t = 1.14	0.2807	W = 348.5	**0.0001**
Tirumala limniace exoticus	♀ RD – ♂	t = –1.38	0.1737	t = 1.48	0.1437
Tirumala limniace exoticus	♀ OV – ♀ RD – ♂	F(2,79) = 2.82	0.0658	$\chi^2(2)$ = 17.53	**0.0002**
Tirumala septentrionis dravidarum	♀ OV – ♀ RD	t = 0.46	0.6604	W = 616.5	0.1806
Tirumala septentrionis dravidarum	♀ OV – ♂	t = –0.4	0.6967	t = 2.96	**0.0136**
Tirumala septentrionis dravidarum	♀ RD – ♂	t = –2.04	**0.0434**	W = 4677	**0.0414**
Tirumala septentrionis dravidarum	♀ OV – ♀ RD – ♂	F(2,191) = 2.27	0.1063	$\chi^2(2)$ = 7.29	**0.0261**
Danaus c. chrysippus	♀ – ♂	t = –4.89	**0.0000**	t = 5.38	**0.0000**
Euploea midamus rogenhoferi	♀ – ♂	t = –2.21	**0.0488**	W = 51.5	1.0000
Euploea m. mulciber	♀ – ♂	t = –4.6	**0.0000**	t = 2.92	**0.0057**
Tirumala. s. septentrionis	♀ – ♂	t = –2.43	**0.0239**	t = 2.6	**0.0192**
Acraea terpsicore	♀ – ♂	W = 278.5	0.3852	W = 390	0.2322
Byasa p. polyeuctes	♀ – ♂	W = 63	0.4910	t = 3.07	**0.0095**
Delias eucharis	♀ – ♂	W = 119	0.2454	t = 4.3	**0.0005**