

Correction

Correction: Jafari et al. Modeling Thermal Developmental Trajectories and Thermal Requirements of the Ladybird *Stethorus gilvifrons*. *Insects* 2023, 14, 11

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Errors in Tables

Following the publication of [1], we detected some errors in Tables 1, 4 and 5. Table 1 reported an incorrect formula for the third-order polynomial model; Tables 4 and 5 contained a few incorrect numerical values. The corrected Tables 1, 4 and 5 are given below; the scientific conclusions are unaffected. This correction was approved by the Academic Editor. The original publication has also been updated.

Table 1. Linear and non-linear models used to simulate the developmental rates of *S. gilvifrons* at various constant temperatures.

Equation	Model	References
$D(T) = a + bT$	Ordinary linear regression	[35]
$T_0 = -\frac{a}{b}$ $K = \frac{1}{b}$		
$DT = K + t_{min}D$	Ikemoto & Takai	[39]
$R(T) = \frac{c}{1 + e^{(a+bT)}}$	Sigmoid	[40]
$R(T) = \Psi \times \left[e^{\rho \times T} - e^{\left(\rho \times T_{max} - \frac{T_{max}-T}{\Delta T} \right)} \right]$	Logan-6	[41]
$R(T) = a \times \left[\frac{1}{1 + K \times e^{-\rho \times T}} - e^{\left(\frac{T_{max}-T}{\Delta T} \right)} \right]$	Logan-10	[41]
$R(T) = e^{\rho \times T} - e^{\left(\rho \times T_{max} - \left(\frac{T_{max}-T}{\Delta T} \right) \right)}$	Lactin-1	[42]
$R(T) = e^{\rho \times T} - e^{\left(\rho \times T_{max} - \left(\frac{T_{max}-T}{\Delta T} \right) \right) + \lambda}$	Lactin-2	[42]
$R(T) = a \times T(T - T_0) \times \sqrt{T_{max} - T}$	Briere-1	[43]
$R(T) = a \times T(T - T_0) \times \sqrt[m]{T_{max} - T}$	Briere-2	[43]
$R(T) = a(T - T_a)^n \times (T_{max} - T)^m$	Analytis	[44,45]
$R(T) = ax^3 + bx^2 + cx + d$	Polynomial 3rd order	[46]
$R(T) = a(T - T_a)^2(T_{max} - T)$	Kontodimas-16	[37]
$D(T) = \frac{2}{D_{min} \left(e^{k(T-T_{opt})} + e^{-\lambda(T-T_{opt})} \right)}$	Janisch	[47]
$D(T) = R_m^{e(-as \times (\frac{T-T_m}{T_a})^d)}$	Taylor	[48]
$R(T) = \frac{c}{1 + e^{a+b \times T}}$ for $T \leq T_{opt}$	Stinner	[49]
$R(T) = \frac{c}{1 + e^{a_1 + b_1(2 \times T_{opt} - T)}}$ for $T > T_{opt}$		



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Table 1. Cont.

Equation	Model	References
$R(T) = \Psi \left[\frac{(T-T_0)^2}{(T-T_0)^2 + D^2} - e^{\left(-\frac{T_{max}-(T-T_0)}{\Delta}\right)} \right]$	Hilbert & Logan, or Holling III	[50,51]
$R(T) = R_m \times \exp \left[-0.05 \left(\frac{T-T_{opt}}{T_0} \right)^2 \right]$ for $T \leq T_{opt}$	Lamb	[52]
$R(T) = R_m \times \exp \left[-0.05 \left(\frac{T-T_{opt}}{T_{max}} \right)^2 \right]$ for $T > T_{opt}$		
$\frac{1}{D} = a(T - t_{min})^2 (t_{max} - T)$	Equation-16	[37]
$\frac{1}{D} = (a + b \times T) \times [e^{-(c + d \times T)}]$	Enkegaard	[53]
$\frac{1}{D} = [a(T - x_{max})] - [b^{(T-x_{min})}]$	Bieri-1	[54]
$\frac{1}{D} = a \left(\frac{(T-x_{min})}{b^{(T-x_{min})}} \right)$	Bieri-2	[54]
$R(T) = \frac{\varphi \frac{T}{T_1} \exp \left[\frac{\Delta H_A}{R} \left(\frac{1}{T_1} - \frac{1}{T} \right) \right]}{1 + \exp \left[\frac{\Delta H_L}{R} \left(\frac{1}{T_L} - \frac{1}{T} \right) \right] + \exp \left[\frac{\Delta H_H}{R} \left(\frac{1}{T_H} - \frac{1}{T} \right) \right]}$	Sharpe & DeMichele	[55]

Table 4. Parameter estimates for the twenty non-linear, temperature-dependent models used for describing immature development of *S. gilvifrons*.

Model	Parameters	Egg	Larva	Pupa	Total Development
Briere-1	a	30.51×10^{-5}	17.50×10^{-5}	35.61×10^{-5}	7.86×10^{-5}
	t_{min}	13.48	14.38	13.64	13.00
	t_{opt}	29.75	29.75	29.75	29.75
	t_{max}	35.00	35.00	35.00	35.00
Briere-2	a	3.55×10^{-4}	1.67×10^{-6}	1.82×10^{-4}	6.30×10^{-9}
	m	3.09	0.64	1.68	0.358
	t_{min}	11.17	12.20	11.24	11.96
	t_{opt}	31.00	35.75	31.50	32.00
Logan-6	t_{max}	34.93	57.80	38.80	67.48
	φ	−0.047	1.066	−0.045	0.570
	ρ	0.185	0.166	0.167	0.151
	Δ	6.83	5.59	6.09	6.41
Logan-10	t_{opt}	30.75	32.50	31.75	31.75
	t_{max}	36.22	38.68	37.55	38.21
	α	0.466	0.517	0.419	0.105
	ρ	0.236	0.176	0.315	0.291
Lactin-1	Δ	3.71	7.60	4.67	6.49
	k	249.56	138.09	847.63	586.62
	T_L	38.66	44.05	44.05	44.04
	t_{opt}	33.75	34.25	31.00	32.75
Lactin-2	t_{max}	38.43	44.03	36.97	44.03
	Δ	5.4453	6.1696	6.0314	6.5082
	ρ	0.1834	0.1619	0.1654	0.1535
	t_{opt}	31.00	33.00	31.09	32.00
Lactin-2	t_{max}	36.3378	38.7646	37.5502	38.2170
	Δ	2.70	9.87	5.01	26.62
	ρ	0.01	0.011	0.018	0.017
	e	1.21	1.13	1.24	0.86
Lactin-2	T_L	39.87	59.56	44.67	70.78
	t_{min}	12.50	12.48	12.09	13.04
	t_{opt}	30.75	34.00	31.50	32.25
	t_{max}	36.50	47.27	36.62	46.73

Table 4. Cont.

Model	Parameters	Egg	Larva	Pupa	Total Development
Sigmoid	a	7.6721	5.8402	6.5996	6.2261
	b	−0.3775	−0.2714	−0.3224	−0.3167
	c	0.3105	0.1824	0.3772	0.0842
Hilbert & Logan, or Holling III	φ	0.8069	1.1954	2.6544	1.4284
	T_0	5.1643	−0.0286	2.2864	−5.4646
	d	2.6455	34.8905	10.2500	62.5963
	T_L	33.6489	71.6097	46.7278	75.7471
	Δ	17.1084	20.7993	20.0060	19.6420
	t_{min}	6.18	7.3623	11.2824	12.4085
	t_{opt}	31.00	36.11	31.18	33.00
	t_{max}	38.21	67.99	45.91	66.11
	a	−2.9618	−1.7579	−2.4292	−2.6428
Stinner ($T > T_{opt}$)	b	0.1898	0.1355	0.1612	0.1583
	c	0.3102	0.1824	0.3772	0.0842
	t_{opt}	–	–	–	–
Polynomial 3rd order	a	1.5108	0.0316	0.9548	0.8113
	b	−0.2282	−0.0137	−0.1512	−0.1118
	c	0.0112	0.0011	0.0079	5.02×10^{-3}
	d	-1.65×10^{-4}	-1.90×10^{-5}	-1.18×10^{-4}	-6.97×10^{-5}
	t_{opt}	30.00	34.25	31.42	32.50
	t_{max}	38.00	47.47	40.57	37.69
Equation-16	a	8.9669×10^{-5}	2.2398×10^{-5}	6.9155×10^{-5}	1.2974×10^{-5}
	t_{min}	10.7196	8.7399	9.2019	8.0642
	t_{opt}	30.00	34.00	31.40	32.00
	t_{max}	39.6390	46.5227	42.4350	43.4616
Kontodimas-16	a	8.9669×10^{-5}	2.2398×10^{-5}	6.9155×10^{-5}	1.2973×10^{-5}
	t_{min}	10.7196	8.7399	9.2019	8.0643
	t_{opt}	30.00	34.01	31.19	31.90
	t_{max}	39.6390	46.5227	42.3350	43.4615
Lamb ($T > T_{opt}$)	R_m	0.3245	0.1780	0.3782	0.0852
	$t_m (=t_{opt})$	29.6197	33.1083	30.8630	31.2873
	T_0	7.4244	9.7908	8.6507	9.5089
Analytis	a	1.3038×10^{-15}	1.1464×10^{-15}	1.3474×10^{-14}	2.2536×10^{-17}
	n	7.6175	6.1802	5.3244	5.8251
	m	2.1428	2.5713	3.9925	4.7378
	t_{min}	−9.4633	−17.2948	−0.3747	−1.9163
	t_{opt}	30.10	37.40	31.02	31.00
	t_{max}	41.1822	60.0903	54.5616	57.4548
Enkegaard	a	0.0248	0.0178	0.0407	0.0122
	b	-68.3956×10^{-5}	-46.1022×10^{-5}	-10.8593×10^{-4}	-31.9438×10^{-5}
	c	1.1245	1.1075	1.1075	1.1075
	d	−0.1835	−0.1620	−0.1656	−0.1535
	t_{opt}	31.11	33.00	31.90	32.01
	t_{max}	36.66	38.76	37.55	38.21
Taylor	R_m	0.3245	0.1780	0.3782	0.0852
	$t_m (=t_{opt})$	29.6197	33.1083	30.8630	31.2874
	T_σ	7.4244	9.7909	8.6509	9.5093
Janisch	D_{min}	3.0985	5.6899	3.6422	12.3639
	k	−0.1834	−0.1414	−0.2354	−0.1547
	λ	0.1221	−0.0975	−0.0364	−0.0785
	t_{opt}	28.0868	30.7786	23.6969	27.90

Table 4. Cont.

Model	Parameters	Egg	Larva	Pupa	Total Development
Sharpe & DeMichele	a	5.1991	−10.5143	−5.2836	−8.4871
	b	−322.3149	−1502.5915	−259.0272	−1360.8376
	c	7.9817	−6.6145	−2.8555	−4.5433
	d	−365.7124	−1536.7211	−304.9700	−1403.3453
	f	17.7782	0.1576	3.076	0.1380
	g	−38.2689	−1276.7436	−108.8371	−1252.6541
Bieri-1	t_{opt}	30.00	32.23	31.00	32.05
	a	0.0209	0.103	0.0249	0.0177
	b	1.5436	1.3103	1.274	1.0288
	x_{max}	12.5366	12.4235	12.2484	−6.9928
	x_{min}	37.99	45.5230	40.99	49.43
	t_{min}	12.69	12.52	12.32	12.96
Bieri-2	t_{opt}	31.01	33.50	32.00	33.04
	t_{max}	36.33	41.03	39.38	49.76
	a	−0.1749	−0.0813	−0.1801	−0.0373
	b	0.8323	0.8504	0.8473	0.8575
	x_{min}	36.33	38.76	37.55	38.21
	t_{opt}	31.00	33.00	31.53	32.00
	t_{max}	36.33	38.76	37.55	38.21

Table 5. Goodness-of-fit measures for the twenty non-linear, temperature-dependent models used for describing immature development of *S. gilvifrons*.

Model	Parameters	Egg	Larva	Pupa	Total Development
Briere-1	R^2	0.9177	0.6358	0.8053	0.7871
	R^2_{adj}	0.8628	0.3930	0.6755	0.6451
	AIC	−35.69	−35.49	−28.75	−46.31
	RSS (10^{-4})	57.63	83.13	183.13	72.60
Briere-2	R^2	0.9773	0.9716	0.9627	0.9923
	R^2_{adj}	0.9432	0.9290	0.9069	0.9807
	AIC	−42.72	−47.75	−38.04	−65.33
	RSS (10^{-4})	12.79	5.53	27.90	0.29
Logan-6	R^2	0.9634	0.9444	0.9447	0.9493
	R^2_{adj}	0.9085	0.8661	0.8617	0.8732
	AIC	−39.55	−44.16	−35.46	−54.10
	RSS (10^{-4})	21.70	10.05	42.90	1.92
Logan-10	R^2	0.9903	0.9757	0.9785	0.9956
	R^2_{adj}	0.9515	0.8785	0.8925	0.9780
	AIC	−47.67	−49.33	−41.12	−69.08
	RSS (10^{-4})	5.60	4.25	16.69	1.34
Lactin-1	R^2	0.9735	0.9696	0.9586	0.9919
	R^2_{adj}	0.9559	0.9494	0.9311	0.9154
	AIC	−43.52	−46.19	−37.45	−56.10
	RSS (10^{-4})	15.61	9.99	42.90	1.91
Lactin-2	R^2	0.9576	0.9648	0.9587	0.9776
	R^2_{adj}	0.8940	0.9120	0.8967	0.9440
	AIC	−31.02	−47.04	−37.41	−57.99
	RSS (10^{-4})	89.97	6.22	30.98	0.61
Sigmoid	R^2	0.9362	0.9777	0.9731	0.9969
	R^2_{adj}	0.8936	0.9629	0.9552	0.9948
	AIC	−38.03	−51.85	−41.50	−73.20
	RSS (10^{-4})	38.96	3.89	21.85	0.11

Table 5. Cont.

Model	Parameters	Egg	Larva	Pupa	Total Development
Hilbert & Logan, or Holling III	R^2	0.9792	0.9737	0.9697	0.9937
	R^2_{adj}	0.8963	0.8685	0.8485	0.9686
	AIC	−41.32	−46.84	−37.22	−64.80
	RSS (10^{-4})	11.57	4.61	22.91	0.23
Stinner ($T > T_{opt}$)	R^2	0.9362	0.9777	0.9731	0.9969
	R^2_{adj}	0.8406	0.9440	0.9329	0.9949
	AIC	−36.03	−49.85	−39.50	−71.20
	RSS (10^{-4})	38.96	3.89	21.85	0.11
Polynomial 3rd order	R^2	0.9840	0.9714	0.9728	0.9924
	R^2_{adj}	0.9600	0.9285	0.9321	0.9810
	AIC	−43.44	−48.35	−39.94	−65.87
	RSS (10^{-4})	11.34	5.01	20.34	0.27
Equation-16	R^2	0.9696	0.9712	0.9661	0.9880
	R^2_{adj}	0.9493	0.9521	0.9436	0.9801
	AIC	−43.24	−50.31	−40.54	−65.08
	RSS (10^{-4})	0.16	5.03	25.63	0.42
Kontodimas-16	R^2	0.9723	0.9712	0.9659	0.9880
	R^2_{adj}	0.9539	0.9521	0.9433	0.9801
	AIC	−43.24	−50.13	−40.54	−65.08
	RSS (10^{-4})	16.35	5.03	25.63	0.42
Lamb ($T > T_{opt}$)	R^2	0.9870	0.9674	0.9735	0.9825
	R^2_{adj}	0.9783	0.9456	0.9559	0.9708
	AIC	−35.68	−49.51	−42.08	−62.64
	RSS (10^{-4})	57.64	5.76	19.85	0.64
Analytis	R^2	0.9878	0.9517	0.9718	0.9848
	R^2_{adj}	0.9493	0.7587	0.8592	0.9241
	AIC	−44.37	−42.41	−37.68	−58.50
	RSS (10^{-4})	6.95	9.62	21.23	0.55
Enkegaard	R^2	0.9735	0.9450	0.9447	0.9492
	R^2_{adj}	0.9339	0.8625	0.8618	0.8732
	AIC	−41.52	−44.19	−35.45	−54.10
	RSS (10^{-4})	15.61	9.90	42.90	1.91
Taylor	R^2	0.9870	0.9674	0.9735	0.9825
	R^2_{adj}	0.9783	0.9456	0.9559	0.9708
	AIC	−47.52	−49.51	−42.08	−62.64
	RSS (10^{-4})	8.02	5.76	19.85	0.64
Janisch	R^2	0.9928	0.9595	0.9821	0.9743
	R^2_{adj}	0.9821	0.8988	0.9553	0.9358
	AIC	−49.55	−45.92	−42.25	−58.34
	RSS (10^{-4})	4.09	7.49	13.83	0.95
Sharpe & DeMichele	R^2	0.9875	0.9668	0.9759	0.9939
	R^2_{adj}	*	*	*	*
	AIC	−42.09	−45.54	−40.50	−63.08
	RSS (10^{-4})	7.29	5.82	18.51	0.22
Bieri-1	R^2	0.9700	0.9676	0.9565	0.9915
	R^2_{adj}	0.9250	0.9190	0.8913	0.9792
	AIC	−41.04	−47.59	−37.11	−65.24
	RSS (10^{-4})	16.90	5.67	32.65	0.29
Bieri-2	R^2	0.9735	0.9449	0.9447	0.9492
	R^2_{adj}	0.9559	0.9083	0.9079	0.9154
	AIC	−43.52	−49.59	−39.11	−56.10
	RSS (10^{-4})	15.61	9.99	42.90	1.91

* Non-calculable because the number of observations equals the number of model parameters, which results in a denominator of 0 in the equation.

Reference

1. Jafari, M.; Goldasteh, S.; Aghdam, H.R.; Zamani, A.A.; Soleyman-Nejadian, E.; Schausberger, P. Modeling thermal developmental trajectories and thermal requirements of the ladybird *Stethorus gilvifrons*. *Insects* **2023**, *14*, 11. [[CrossRef](#)] [[PubMed](#)]

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