**Male reproductive cycle in a population of the endemic butterfly lizard, *Leiolepis ocellata* Peters, 1971 (Squamata: Agamidae) from northern Thailand**

Akkanee Pewhom1,Thidaporn Supapakorn2 andNopparat Srakaew3,\*

1Department of Biology, Faculty of Science, Thaksin University, Phatthalung, 93210, Thailand

2Department of Statistics, Faculty of Science, Kasetsart University, Bangkok, 10900, Thailand

3Department of Zoology, Faculty of Science, Kasetsart University, Bangkok, 10900, Thailand

**\***Correspondence: Nopparat Srakaew (E-mail: fscinrsr@ku.ac.th)

**Additional file 1.** Supplementary tables of correlations between structures of the testes and of the genital ducts of the butterfly lizard *Leiolepis ocellata* and environmental cues in the study area.

**Table S1** Multiple regression showing correlation between the testicular structures of *Leiolepis ocellata* and environmental cues in the study area. *T*-test for the null hypothesis with *β* = 0 and significant results at *α* = 0.05.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Model**  | **Effect**  | **Estimate** | **Standard error** |  ***t*** |  ***P*** |
| GSI | Intercept | 2.6130 | 0.1869 | 13.98 | <0.0001 |
| Rainfall | 0.0011 | 0.0002 | 4.92 | <0.0001 |
| Humidity | -0.0139 | 0.0015 | -9.27 | <0.0001 |
| Temperature | -0.0559 | 0.0038 | -14.61 | <0.0001 |
| Overall model: *F* = 92.98, *r* = 0.8915, *P* < 0.0001 |
| Seminiferous tubule diameter | Intercept | 776.9000 | 83.0600 | 9.35 | <0.0001 |
| Rainfall | 0.0704 | 0.1002 | 0.70 | 0.4830 |
| Humidity | -3.1550 | 0.6526 | -4.84 | <0.0001 |
| Temperature | -12.9400 | 1.7850 | -7.25 | <0.0001 |
| Overall model: *F* = 33.14, *r* = 0.5444, *P* < 0.0001 |
| Seminiferous epithelium height | Intercept | 404.7000 | 30.1700 | 13.41 | <0.0001 |
| Rainfall | 0.0638 | 0.0364 | 1.75 | 0.0812 |
| Humidity | -1.5310 | 0.2371 | -6.46 | <0.0001 |
| Temperature | -8.2000 | 0.6486 | -12.64 | <0.0001 |
| Overall model: *F* = 82.11, *r* = 0.7146, *P* < 0.0001 |

**Table S2** Multiple regression showing correlation between the histomorphological structures of ductuli efferentes of *Leiolepis ocellata* and environmental factors in the study area. *T*-test for the null hypothesis with *β* = 0 and significant results at *α* = 0.05.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Model**  | **Effect**  | **Estimate** | **Standard error** |  ***t*** |  ***P*** |
| Proximal ductuli efferentes width (major axis) | Intercept | 573.0000 | 61.4200 | 9.33 | <0.0001 |
| Rainfall | 0.0605 | 0.0762 | 0.79 | 0.4278 |
| Humidity | -2.6700 | 0.4873 | -5.48 | <0.0001 |
| Temperature | -8.9770 | 1.3300 | -6.75 | <0.0001 |
| Overall model: *F* = 32.60, *r* = 0.5582, *P* < 0.0001 |
| Proximal ductuli efferentes width (minor axis) | Intercept | 288.10 | 18.19 | 15.83 | <0.0001 |
| Rainfall | 0.1461 | 0.0220 | 6.66 | <0.0001 |
| Humidity | -1.4810 | 0.1430 | -10.36 | <0.0001 |
| Temperature | -4.8120 | 0.3911 | -12.30 | <0.0001 |
| Overall model: *F* = 58.29, *r* = 0.6524, *P* < 0.0001 |
| Distal ductuli efferentes width (major axis) | Intercept | 318.2 | 30.67 | 10.38 | <0.0001 |
| Rainfall | 0.1598 | 0.0370 | 4.32 | <0.0001 |
| Humidity | -1.5620 | 0.2410 | -6.48 | <0.0001 |
| Temperature | -5.0700 | 0.6592 | -7.69 | <0.0001 |
| Overall model: *F* = 22.27, *r* = 0.4698, *P* < 0.0001 |
| Distal ductuli efferentes width (minor axis) | Intercept | 138.70 | 8.13 | 17.06 | <0.0001 |
| Rainfall | 0.0484 | 0.0098 | 4.93 | <0.0001 |
| Humidity | -0.6070 | 0.0639 | -9.50 | <0.0001 |
| Temperature | -2.1260 | 0.1747 | -12.16 | <0.0001 |
| Overall model: *F* = 63.34, *r* = 0.6679, *P* < 0.0001 |
| Proximal ductuli efferentes (epithelium height)  | Intercept | 82.7200 | 4.8920 | 16.91 | <0.0001 |
| Rainfall | 0.0280 | 0.0059 | 4.71 | <0.0001 |
| Humidity | -0.4255 | 0.0388 | -10.96 | <0.0001 |
| Temperature | -1.3050 | 0.1059 | -12.32 | <0.0001 |
| Overall model: *F* = 80.47, *r* = 0.7187, *P* < 0.0001 |
| Distal ductuli efferentes (epithelium height)  | Intercept | 36.5700 | 2.6180 | 13.97 | <0.0001 |
| Rainfall | 0.0065 | 0.0032 | 2.07 | 0.0399 |
| Humidity | -0.1440 | 0.0206 | -7.00 | <0.0001 |
| Temperature | -0.5429 | 0.0563 | -9.65 | <0.0001 |
| Overall model: *F* = 51.12, *r* = 0.6276, *P* < 0.0001 |

**Table S3** Multiple regression showing correlation between the histomorphological structures of ductus epididymis of *Leiolepis ocellata* and environmental parameters in the study area. *T*-test for the null hypothesis with *β* = 0 and significant results at *α* = 0.05.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Model**  | **Effect**  | **Estimate** | **Standard error** |  ***t*** |  ***P*** |
| Initial segment (ductal diameter) | Intercept | 850.9000 | 86.8700 | 9.80 | <0.0001 |
| Rainfall | 0.3559 | 0.1061 | 3.35 | 0.0010 |
| Humidity | -3.5470 | 0.6583 | -5.39 | <0.0001 |
| Temperature | -17.0400 | 1.9060 | -8.94 | <0.0001 |
| Overall model: *F* = 29.84, *r* = 0.6038, *P* < 0.0001 |
| Caput (ductal diameter) | Intercept | 848.40 | 95.37 | 8.90 | <0.0001 |
| Rainfall | 0.1841 | 0.1209 | 1.52 | 0.1298 |
| Humidity | -4.4720 | 0.7858 | -5.69 | <0.0001 |
| Temperature | -13.5600 | 1.9900 | -6.81 | <0.0001 |
| Overall model: *F* = 33.59, *r* = 0.6391, *P* < 0.0001 |
| Corpus (ductal diameter) | Intercept | 940.1 | 92.31 | 10.18 | <0.0001 |
| Rainfall | 0.2858 | 0.1114 | 2.57 | 0.0112 |
| Humidity | -5.1130 | 0.7252 | -7.05 | <0.0001 |
| Temperature | -14.8100 | 1.9840 | -7.47 | <0.0001 |
| Overall model: *F* = 34.25, *r* = 0.6302, *P* < 0.0001 |
| Cauda (ductal diameter) | Intercept | 1157.0000 | 113.8000 | 10.17 | <0.0001 |
| Rainfall | 0.4255 | 0.1373 | 3.10 | 0.0023 |
| Humidity | -7.6520 | 0.8942 | 8.56 | <0.0001 |
| Temperature | -15.6900 | 2.4460 | 6.41 | <0.0001 |
| Overall model: *F* = 42.66, *r* = 0.6713, *P* < 0.0001 |
| Initial segment (luminal diameter) | Intercept | 469.8000 | 45.0600 | 10.43 | <0.0001 |
| Rainfall | 0.2045 | 0.0542 | 3.78 | 0.0002 |
| Humidity | -2.1980 | 0.3384 | -6.49 | <0.0001 |
| Temperature | -9.4290 | 0.9682 | -9.74 | <0.0001 |
| Overall model: *F* = 35.88, *r* = 0.6160, *P* < 0.0001 |
| Caput (luminal diameter) | Intercept | 526.8000 | 66.3700 | 7.94 | <0.0001 |
| Rainfall | 0.3261 | 0.0841 | 3.88 | 0.0002 |
| Humidity | -3.9170 | 0.5468 | -7.16 | <0.0001 |
| Temperature | -6.6150 | 1.3850 | -4.78 | <0.0001 |
| Overall model: *F* = 24.65, *r* = 0.5799, *P* < 0.0001 |

**Table S3** Continued.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Model**  | **Effect**  | **Estimate** | **Standard error** |  ***t*** |  ***P*** |
| Corpus (luminal diameter) | Intercept | 570.7000 | 64.3500 | 8.87 | <0.0001 |
| Rainfall | 0.1703 | 0.0830 | 2.05 | 0.0418 |
| Humidity | -3.5150 | 0.5206 | -6.75 | <0.0001 |
| Temperature | -7.2820 | 1.3910 | -5.24 | <0.0001 |
| Overall model: *F* = 27.39, *r* = 0.5642, *P* < 0.0001 |
| Cauda (luminal diameter) | Intercept | 1100.0000 | 104.8000 | 10.50 | <0.0001 |
| Rainfall | 0.5657 | 0.1308 | 4.32 | <0.0001 |
| Humidity | -7.9110 | 0.8384 | -9.44 | <0.0001 |
| Temperature | -14.6900 | 2.2540 | -6.52 | <0.0001 |
| Overall model: *F* = 45.14, *r* = 0.6703, *P* < 0.0001 |
| Initial segment (epithelium height) | Intercept | 262.6000 | 23.5800 | 11.13 | <0.0001 |
| Rainfall | 0.1307 | 0.0292 | 4.47 | <0.0001 |
| Humidity | -1.1990 | 0.1852 | -6.48 | <0.0001 |
| Temperature | -5.2790 | 0.5073 | -10.41 | <0.0001 |
| Overall model: *F* = 39.61, *r* = 0.5870, *P* < 0.0001 |
| Caput (epithelium height) | Intercept | 226.8000 | 15.8600 | 14.30 | <0.0001 |
| Rainfall | 0.1102 | 0.0191 | 5.76 | <0.0001 |
| Humidity | -1.1080 | 0.1246 | -8.89 | <0.0001 |
| Temperature | -4.5410 | 0.3409 | -13.32 | <0.0001 |
| Overall model: *F* = 66.20, *r* = 0.6760, *P* < 0.0001 |
| Corpus (epithelium height) | Intercept | 173.5000 | 11.2400 | 15.43 | <0.0001 |
| Rainfall | 0.0943 | 0.0140 | 6.73 | <0.0001 |
| Humidity | -0.8464 | 0.0883 | -9.59 | <0.0001 |
| Temperature | -3.5480 | 0.2419 | -14.67 | <0.0001 |
| Overall model: *F* = 77.12, *r* = 0.7128, *P* < 0.0001 |
| Cauda (epithelium height) | Intercept | 103.0000 | 5.4830 | 18.78 | <0.0001 |
| Rainfall | 0.0298 | 0.0066 | 4.50 | <0.0001 |
| Humidity | -0.4844 | 0.0431 | -11.24 | <0.0001 |
| Temperature | -2.1360 | 0.1179 | -18.12 | <0.0001 |
| Overall model: *F* = 152.3, *r* = 0.8120, *P* < 0.0001 |

**Table S4** Multiple regression showing correlation between the histomorphological structures of ductus deferens of *Leiolepis ocellata* and environmental factors in the study area. *T*-test for the null hypothesis with *β* = 0 and significant results at *α* = 0.05.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Model**  | **Effect**  | **Estimate** | **Standard error** |  ***t*** |  ***P*** |
| Ductal ductus deferens (ductal diameter) | Intercept | 1921.0000 | 309.6000 | 6.21 | <0.0001 |
| Rainfall | 1.1600 | 0.3735 | 3.11 | 0.0027 |
| Humidity | -13.2900 | 2.4320 | -5.46 | <0.0001 |
| Temperature | -27.6300 | 6.6550 | -4.15 | <0.0001 |
| Overall model: *F* = 12.34, *r* = 0.5723, *P* < 0.0001 |
| Ampulla ductus deferens (ductal diameter) | Intercept | 1765.0000 | 340.1000 | 5.19 | <0.0001 |
| Rainfall | 0.5556 | 0.4102 | 1.35 | 0.1796 |
| Humidity | -9.3930 | 2.6720 | -3.52 | 0.0007 |
| Temperature | -27.2500 | 7.3100 | -3.73 | 0.0004 |
| Overall model: *F* = 8.24, *r* = 0.4954, *P* < 0.0001 |
| Ductal ductus deferens (luminal diameter) | Intercept | 1958.0000 | 307.0000 | 6.38 | <0.0001 |
| Rainfall | 1.2090 | 0.3704 | 3.27 | 0.0016 |
| Humidity | -13.3400 | 2.4120 | -5.53 | <0.0001 |
| Temperature | -29.8400 | 6.5990 | -4.52 | <0.0001 |
| Overall model: *F* = 12.47, *r* = 0.5744, *P* < 0.0001 |
| Ampulla ductus deferens (luminal diameter) | Intercept | 1597.0000 | 362.1000 | 4.4090 | <0.0001 |
| Rainfall | 0.9367 | 0.4368 | 2.1440 | 0.0352 |
| Humidity | -9.7550 | 2.8450 | -3.4290 | 0.0010 |
| Temperature | -23.4300 | 7.7840 | -3.0100 | 0.0035 |
| Overall model: *F* = 4.72, *r* = 0.3964, *P* < 0.01 |
| Ductal ductus deferens (epithelium height) | Intercept | 37.5200 | 4.2890 | 8.75 | <0.0001 |
| Rainfall | 0.0133 | 0.0052 | 2.58 | 0.0109 |
| Humidity | -0.1347 | 0.0337 | -4.00 | <0.0001 |
| Temperature | -0.6882 | 0.0922 | -7.47 | <0.0001 |
| Overall model: *F* = 22.13, *r* = 0.5464, *P* < 0.0001 |
| Ampulla ductus deferens (epithelium height) | Intercept | 137.3000 | 24.3800 | 5.63 | <0.0001 |
| Rainfall | 0.0180 | 0.0294 | 0.61 | 0.5413 |
| Humidity | -0.4337 | 0.1916 | -2.26 | 0.0249 |
| Temperature | -2.2720 | 0.5241 | -4.34 | <0.0001 |
| Overall model: *F* = 9.67, *r* = 0.3960, *P* < 0.0001 |