Table S1. Moulting configurations in *Arthricocephalites xinzhaiheensis*. Prefix: JLS= Lazizhai Section, Jianhe Country, Guizhou province, South China; JB=Jiaobang Village, Jianhe County, Gui zhou province, South China; ST=Songtao Country, Gui zhou province, South China; M1-7= Meraspid degree 1-7; H= holaspid stage; / = no data (the trunk is broken); 1= Yes; 0= No; ★= data sources come from *Wang et al. (2020)*; ★★= data sources come from *Wang et a*l. *2020* and the number of thoracic segment is revised; JLS170-16-1 and JLS160-19-163 appearing *Wang* *et al*. *(2020)* are excluded here.

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| **Moulting configurations in *Arthricocephalites xinzhaiheensis*** |
| Serial number | **Somersault configuration in *Arthricocephalites xinzhaiheensis*** |
| Number | Number of thoracic segment | Stage | Length of trunk (mm) | Width of trunk (mm) | Inversion of LCU | Data sources |
| 1 | JLS170-19-281 | 1 | M1 | 0.52  | 0.94  | 1 | This study |
| 2 | JLS170-19-1941 | 2 | M2 | 0.84  | 1.16  | 1 | This study |
| 3 | JLS170-19-352 | 2 | M2 | 0.85  | 1.21  | 1 | This study |
| 4 | JLS170-19-286 | 3 | M3 | 0.87  | 1.16  | 1 | This study |
| 5 | JLS170-19-720 | 3 | M3 | 0.92  | 1.15  | 1 | This study |
| 6 | JLS170-19-2952 | 3 | M3 | 1.03  | 1.49  | 1 | This study |
| 7 | JLS170-19-291 | 3 | M3 | 1.13  | 1.49  | 1 | This study |
| 8 | JLS170-19-1914 | 4 | M4 | 1.02  | 1.42  | 1 | This study |
| 9 | JLS170-19-2099 | 4 | M4 | 1.15  | 1.53  | 1 | This study |
| 10 | JLS84-19-120 | 4 | M4 | 1.18  | 1.33  | 1 | This study |
| 11 | JLS170-19-1151 | 4 | M4 | 1.27  | 1.53  | 1 | This study |
| 12 | JLS170-19-2879 | 4 | M4 | 1.34  | 1.77  | 1 | This study |
| 13 | JLS170-19-296 | 4 | M4 | 1.56  | 1.73  | 1 | This study |
| 14 | JLS170-19-295 | 4 | M4 | 1.77  | 1.90  | 1 | This study |
| 15 | JLS170-19-1902 | 5 | M5 | 1.48  | 1.62  | 1 | This study |
| 16 | JLS170-19-2945 | 5 | M5 | 1.48  | 1.66  | 1 | This study |
| 17 | JLS160-19-1360 | 5 | M5 | 1.71  | 2.21  | 1 | This study |
| 18 | JLS160-19-591 | 5 | M5 | 1.69  | 1.97  | 1 | This study |
| 19 | JLS170-19-1375 | 5 | M5 | 1.76  | 2.04  | 1 | This study |
| 20 | JLS170-19-827 | 5 | M5 | 1.77  | 2.13  | 1 | This study |
| 21 | JLS170-19-1559 | 5 | M5 | 1.84  | 2.18  | 1 | This study |
| 22 | JB137-64 | 5 | M5 | 1.87  | 1.85  | 1 | This study |
| 23 | JLS160-19-611 | 5 | M5 | 1.88  | 2.30  | 1 | This study |
| 24 | LLS90-19-2 | 5 | M5 | 1.98  | 2.30  | 1 | This study |
| 25 | JLS82-19-399 | 5 | M5 | 2.14  | 2.03  | 1 | This study |
| 26 | JLS86-19-53 | 5 | M5 | 2.35  | 2.51  | 1 | This study |
| 27 | JLS160-19-612 | 6 | M6 | 1.75  | 2.06  | 1 | This study |
| 28 | JLS170-19-1484 | 6 | M6 | 2.28  | 2.22  | 1 | This study |
| 29 | JLS170-19-459 | 6 | M6 | 2.45  | 2.60  | 1 | This study |
| 30 | JLS170-19-779 | 6 | M6 | 2.44  | 2.32  | 1 | This study |
| 31 | JLS85-19-401 | 6 | M6 | 3.27  | 3.50  | 1 | This study |
| 32 | JLS170-19-78 | 6 | M6 | 3.38  | 3.51  | 1 | This study |
| 33 | JLS170-19-1482 | 6 | M6 | 3.37  | 3.52  | 1 | This study |
| 34 | JLS170-19-2819 | 6 | M6 | 3.49  | 3.38  | 1 | This study |
| 35 | JLS170-19-18533 | 6 | M6 | 3.46  | 3.32  | 1 | This study |
| 36 | JLS170-19-2978 | 7 | M7 | 2.42  | 2.15  | 1 | This study |
| 37 | JLS170-19-5901 | 7 | M7 | 3.13  | 3.52  | 1 | This study |
| 38 | JLS84.5-19-121 | 7 | M7 | 3.24  | 3.97  | 1 | This study |
| 39 | JLS84.5-19-473 | 7 | M7 | 3.53  | 2.73  | 1 | This study |
| 40 | JLS170-19-380 | 7 | M7 | 3.60  | 3.65  | 1 | This study |
| 41 | JLS170-19-650 | 7 | M7 | 3.62  | 3.91  | 1 | This study |
| 42 | JLS84-19-120 | 7 | M7 | 3.69  | 3.08  | 1 | This study |
| 43 | JLS170-18-463 | 8 | H | 4.26  | 4.30  | 1 | ★ |
| 44 | JLS160-19-1455 | 8 | H | 4.49  | 3.88  | 1 | This study |
| 45 | JLS162-19-142 | 8 | H | 4.50  | 4.29  | 1 | This study |
| 46 | JLS160-19-272 | 8 | H | 4.99  | 4.75  | 1 | This study |
| 47 | ST3 | 8 | H | 5.10  | 4.19  | 1 | This study |
| 48 | JLS160-19-403 | 8 | H | 511  | 4.52  | 1 | This study |
| 49 | JLS170-19-1446 | 8 | H | 6.09  | 5.11  | 1 | This study |
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| Serial number | **Henningsmoen's configuration in *Arthricocephalites xinzhaiheensis*** |
| Number | Number of thoracic segment | Stage | Length of trunk (μm) | Width of trunk (μm) | Inversion of cranidium | Data sources |
| 50 | JLS170-17-11 | 6 | M6 | 1.92  | 2.24  | no cranidium | ★★ |
| 51 | JLS85-16-712 | 6 | M6 | 2.55  | 2.35  | 0 | ★★ |
| 52 | JLS170-19-1377 | 6 | M6 | 3.33  | 3.53  | 1 | This study |
| 53 | JLS170-19-1768 | 7 | M7 | 2.79  | 2.87  | 0 | This study |
| 54 | JLS170-19-136 | 7 | M7 | 2.90  | 2.87  | no cranidium | This study |
| 55 | JB134-17-2 | 7 | M7 | 3.00  | 2.95  | no cranidium | ★★ |
| 56 | JLS85-17-4 | 7 | M7 | 3.36  | 2.43  | no cranidium | ★ |
| 57 | JLS170-19-1764 | 7 | M7 | 3.48  | 3.63  | no cranidium | This study |
| 58 | JLS170-19-944 | 7 | M7 | 3.38  | 3.05  | no cranidium | This study |
| 59 | JLS170-19-719 | 7 | M7 | 3.45  | 3.00  | no cranidium | This study |
| 60 | JLS170-19-1378 | 7 | M7 | 3.50  | 3.61  | no cranidium | This study |
| 61 | JLS170-17-9 | 7 | M7 | 3.50  | 2.95  | no cranidium | ★★ |
| 62 | JLS85-17-3 | 7 | M7 | 3.58  | 3.75  | 0 | ★★ |
| 63 | JLS170-19-14812 | 7 | M7 | 3.69  | 3.20  | no cranidium | This study |
| 64 | JLS170-18-3 | 7 | M7 | 3.65  | 3.08  | no cranidium | ★★ |
| 65 | JLS85-16-1 | 7 | M7 | 3.69  | 3.08  | 0 | ★★ |
| 66 | JLS170-19-1767 | 7 | M7 | 3.73  | 3.68  | no cranidium | This study |
| 67 | JLS85-17-1 | 7 | M7 | 3.70  | 3.01  | 0 | ★★ |
| 68 | JLS170-17-12 | 7 | M7 | 3.73  | 3.08  | no cranidium | ★★ |
| 69 | ST228-17-2 | 7 | M7 | 3.96  | 3.15  | no cranidium | ★★ |
| 70 | JLS85-17-2 | 7 | M7 | 4.31  | 3.13  | 0 | ★★ |
| 71 | JLS170-18-8 | 7 | M7 | 4.32  | 4.10  | no cranidium | ★★ |
| 72 | JLS170-19-3 | 7 | M7 | 4.46  | 4.88  | no cranidium | ★ |
| 73 | JLS170-18-9 | 7 | M7 | 4.79  | 4.58  | no cranidium | ★★ |
| 74 | JLS121-16-1 | 7 | M7 | 4.89  | 4.55  | no cranidium | ★★ |
| 75 | JLS170-19-737 | 7 | M7 | / | / | no cranidium | ★ |
| 76 | JLS170-19-1732 | 8 | H | 4.02  | 4.14  | no cranidium | This study |
| 77 | JLS84.5-19-692 | 8 | H | 4.44  | 3.21  | no cranidium | This study |
| 78 | JLS170-17-8 | 8 | H | 4.07  | 3.42  | no cranidium | ★ |
| 79 | JLS125-16-1 | 8 | H | 4.09  | 3.65  | no cranidium | ★ |
| 80 | JLS85-19-691 | 8 | H | 4.18  | 3.60  | no cranidium | This study |
| 81 | JLS170-19-220 | 8 | H | 4.23  | 3.64  | 1 | ★ |
| 82 | JLS160-19-996 | 8 | H | 4.36  | 4.11  | 1 | ★ |
| 83 | JLS170-18-11 | 8 | H | 4.27  | 3.48  | no cranidium | ★ |
| 84 | JLS170-19-14810 | 8 | H | 4.38  | 3.34  | no cranidium | This study |
| 85 | JLS170-17-7 | 8 | H | 4.38  | 3.18  | no cranidium | ★ |
| 86 | JLS170-19-128 | 8 | H | 4.32  | 4.27  | no cranidium | ★ |
| 87 | JLS170-16-61 | 8 | H | 4.38  | 4.01  | no cranidium | ★ |
| 88 | JLS170-19-943 | 8 | H | 4.61  | 4.07  | no cranidium | This study |
| 89 | JLS170-17-10 | 8 | H | 4.52  | 4.08  | no cranidium | ★ |
| 90 | JLS170-19-41 | 8 | H | 4.51  | 3.82  | 0 | ★ |
| 91 | JLS170-17-2 | 8 | H | 4.53  | 4.05  | 1 | ★ |
| 92 | JLS85-16-699 | 8 | H | 4.64  | 4.03  | no cranidium | ★ |
| 93 | JLS164-16-2 | 8 | H | 5.31  | 5.37  | no cranidium | ★ |
| 94 | JLS85-19-187 | 8 | H | 4.72  | 4.59  | no cranidium | This study |
| 95 | JLS170-17-1 | 8 | H | 4.80  | 4.04  | 1 | ★ |
| 96 | JLS170-18-4 | 8 | H | 4.83  | 3.83  | no cranidium | ★ |
| 97 | JLS84.5-19-186 | 8 | H | 5.00  | 4.06  | no cranidium | This study |
| 98 | JLS170-18-1 | 8 | H | 5.16  | 3.86  | no cranidium | ★ |
| 99 | JLS160-17-3 | 8 | H | 5.29  | 4.60  | no cranidium | ★ |
| 100 | JLS170-17-6 | 8 | H | 5.37  | 5.15  | no cranidium | ★ |
| 101 | JLS170-18-2 | 8 | H | 5.37  | 4.66  | no cranidium | ★ |
| 102 | JLS170-19-1540 | 8 | H | 5.45  | 3.90  | no cranidium | This study |
| 103 | JLS170-19-833 | 8 | H | 5.47  | 5.20  | no cranidium | This study |
| 104 | JLS85-17-6 | 8 | H | 5.41  | 4.01  | no cranidium | ★ |
| 105 | JLS170-19-98 | 8 | H | 5.23  | 4.49  | no cranidium | ★ |
| 106 | JLS85-17-7 | 8 | H | 5.51  | 3.81  | no cranidium | ★ |
| 107 | JLS170-18-5 | 8 | H | 5.53  | 4.49  | no cranidium | ★ |
| 108 | JLS85-17-8 | 8 | H | 5.60  | 4.14  | no cranidium | ★ |
| 109 | JLS160-17-4 | 8 | H | 5.57  | 5.15  | no cranidium | ★ |
| 110 | JLS87-16-1 | 8 | H | 5.65  | 5.60  | no cranidium | ★ |
| 111 | JLS160-17-1 | 8 | H | 5.74  | 4.47  | no cranidium | ★ |
| 112 | JLS85-16-314 | 8 | H | 5.84  | 5.89  | no cranidium | ★ |
| 113 | JLS85-19-188 | 8 | H | 6.02  | 3.99  | 0 | This study |
| 114 | JLS170-16-63 | 8 | H | 5.99  | 5.05  | no cranidium | ★ |
| 115 | JLS160-16-211 | 8 | H | 6.00  | 5.32  | no cranidium | ★ |
| 116 | JLS160-17-2 | 8 | H | 6.20  | 5.30  | no cranidium | ★ |
| 117 | ST317.4-19-1 | 8 | H | 6.12  | 5.44  | no cranidium | This study |
| 118 | JLS164-16-1 | 8 | H | 6.14  | 5.60  | no cranidium | ★ |
| 119 | JLS85-16-62 | 8 | H | 6.40  | 6.54  | no cranidium | ★ |
| 120 | JLS170-16-3 | 8 | H | 6.33  | 5.21  | no cranidium | ★ |
| 121 | JLS85-17-5 | 8 | H | 6.30  | 4.48  | no cranidium | ★ |
| 122 | JLS85-19-185 | 8 | H | 6.38  | 4.71  | no cranidium | This study |
| 123 | JLS160-19-1300 | 8 | H | 6.49  | 5.64  | no cranidium | ★ |
| 124 | JLS170-17-5 | 8 | H | 6.59  | 5.08  | no cranidium | ★ |
| 125 | JLS85-16-91 | 8 | H | 7.05  | 5.83  | no cranidium | ★ |
| 126 | JLS160-19-1006 | 8 | H | 7.34  | 6.24  | no cranidium | ★ |
| 127 | ST295-17-1 | 8 | H | 9.34  | 7.87  | no cranidium | ★ |
| 128 | JLS84.5-19-189 | 8 | H | / | / | no cranidium | This study |
| 129 | JLS85-16-63 | 8 | H | / | / | no cranidium | ★ |
| 130 | JLS170-16-1 | 8 | H | / | / | 1 | ★ |
| 131 | JLS160-19-1272 | 8 | H | / | / | no cranidium | ★ |

References

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