**Supporting Information**

**Table S1**

(*A*) All morphometrics of measured spermatozoa of *Paramacrobiotus* sp.

|  |  |  |  |
| --- | --- | --- | --- |
| Tail | Mid-piece | Nucleus | Acrosome |
| 17.8 | 3.5 | 18.7 | 39.7 |
| 24.2 | 3.9 | 18.8 | 47.6 |
| 22.5 | 3.5 | 23.2 | 38.9 |
| 19.7 | 3.6 | 22.4 | 42.8 |
| 23.2 | 5.7 | 16.2 | 40.7 |
| 28.3 | 3.7 | 20.8 | 52.6 |
| 18.5 | 2.8 | 22.8 | 42.9 |
| 23.0 | 5.1 | 16.5 | 33.2 |
| 19.5 | 3.9 | 24.9 | 40.7 |
| 20.0 | 1.8 | 15.1 | 46.4 |
| 21.0 | 3.3 | 19.9 | 35.4 |
| 24.8 | 3.9 | 20.9 | 49.1 |
| 22.3 | 4.2 | 23.3 | 36.9 |
| 16.7 | 2.8 | 24.6 | 34.6 |
| 19.8 | 6.6 | 20.9 | 40.3 |
| 19.8 | 5.7 | 22.2 | 37.2 |
| 23.3 | 6.0 | 22.9 | 37.1 |
| 23.6 | 4.2 | 15.8 | 51.2 |
| 22.1 | 3.4 | 22.0 | 32.8 |
| 17.1 | 3.9 | 23.3 | 36.2 |
| 14.6 | 3.5 | 25.7 | 46.6 |
| 21.1 | 3.4 | 24.9 | 51.1 |
| 21.2 | 4.8 | 35.0 | 35.5 |
| 22.0 | 4.0 | 33.9 | 34.9 |
| 22.4 | 3.6 | 23.8 | 42.1 |
| 20.7 | 3.3 | 17.1 | 49.6 |
| 13.9 | 4.3 | 24.2 | 38.1 |
| 13.6 | 3.2 | 20.4 | 39.5 |
| 15.7 | 3.1 | 17.6 | 34.2 |
| 14.4 | 4.8 | 26.9 | 36.8 |
| 15.3 | 2.7 | 19.4 | 33.6 |
| 29.4 | 4.0 | 24.5 | 27.9 |
| 14.1 | 3.1 | 18.2 | 28.9 |
| 15.7 | 3.1 | 18.1 | 35.5 |
| 15.1 | 2.3 | 16.1 | 35.5 |
| 22.5 | 3.6 | 24.6 | 30.3 |
| 18.0 | 2.3 | 13.3 | 28.6 |
| 15.0 | 1.8 | 25.7 | 42.4 |
| 13.5 | 3.3 | 18.8 | 35.0 |
| 21.5 | 3.0 | 23.4 | 32.7 |
| 19.0 | 4.2 | 13.2 | 35.6 |
| 14.6 | 4.2 | 24.6 | 43.8 |
| 13.4 | 2.7 | 20.6 | 43.2 |
| 18.4 | 1.5 | 22.6 | 47.1 |
| 26.3 | 2.6 | 17.6 | 24.5 |
| 15.0 | 6.4 | 19.7 | 41.2 |
| 13.0 | 2.3 | 22.8 | 39.1 |
| 19.8 | 4.5 | 18.6 | 38.2 |

(*B*)All morphometrics of measured spermatozoa of *M. shonaicus*

|  |  |  |  |
| --- | --- | --- | --- |
| Tail | Mid-piece | Nucleus | Acrosome |
| 12.6 | 2.3 | 9.2 | 1.8 |
| 16.2 | 2.2 | 11.4 | 2.1 |
| 15.3 | 1.8 | 9.9 | 1.6 |
| 9.4 | 3.0 | 15.6 | 2.3 |
| 12.3 | 2.3 | 6.4 | 1.8 |
| 10.5 | 2.1 | 9.6 | 1.3 |
| 13.8 | 2.2 | 10.6 | 1.8 |
| 10.9 | 1.7 | 9.0 | 1.2 |
| 15.3 | 3.4 | 10.4 | 1.8 |
| 18.1 | 2.5 | 7.9 | 1.3 |
| 15.4 | 1.8 | 9.1 | 1.8 |
| 16.6 | 2.1 | 8.0 | 1.9 |
| 12.7 | 2.8 | 9.2 | 1.2 |
| 13.3 | 3.3 | 12.9 | 1.2 |
| 11.6 | 2.4 | 7.2 | 1.5 |
| 16.2 | 3.0 | 9.9 | 1.2 |
| 18.7 | 3.6 | 15.2 | 2.9 |
| 14.6 | 1.1 | 13.5 | 1.7 |
| 14.1 | 2.2 | 10.5 | 1.5 |
| 15.6 | 3.1 | 8.9 | 1.8 |
| 18.9 | 3.2 | 12.4 | 1.5 |
| 12.8 | 1.5 | 9.7 | 1.3 |
| 21.7 | 2.4 | 8.5 | 1.9 |
| 16.2 | 2.3 | 12.4 | 0.9 |
| 16.7 | 3.3 | 9.3 | 1.2 |
| 24.2 | 2.7 | 9.3 | 2.7 |
| 20.6 | 2.1 | 11.2 | 1.7 |
| 18.3 | 1.8 | 6.2 | 1.8 |
| 18.2 | 2.4 | 13.4 | 1.1 |
| 19.5 | 3.0 | 8.5 | 1.8 |
| 20.0 | 2.5 | 10.5 | 1.7 |
| 14.3 | 1.8 | 12.8 | 1.5 |
| 14.6 | 1.6 | 12.3 | 1.9 |
| 14.7 | 1.9 | 18.2 | 1.3 |
| 18.9 | 2.2 | 8.0 | 1.8 |
| 13.7 | 3.1 | 10.9 | 1.3 |
| 10.2 | 1.3 | 9.6 | 1.5 |
| 15.8 | 1.8 | 12.7 | 1.2 |
| 17.7 | 1.2 | 10.5 | 1.2 |
| 9.8 | 1.2 | 12.1 | 1.5 |
| 13.3 | 1.8 | 11.2 | 1.5 |
| 17.5 | 1.7 | 14.9 | 1.2 |
| 20.4 | 2.1 | 10.6 | 1.3 |
| 15.5 | 2.5 | 13.0 | 1.9 |
| 16.1 | 1.7 | 8.7 | 0.9 |
| 21.3 | 2.5 | 15.6 | 0.7 |
| 18.1 | 2.6 | 10.6 | 2.1 |
| 17.3 | 2.4 | 8.3 | 2.1 |
| 16.3 | 2.4 | 11.6 | 0.6 |
| 16.1 | 2.8 | 12.2 | 2.3 |

**Table S2**

(*A*) Results of MANOVAs that compare testicular spermatozoa and eggs between *Paramacrobiotus* sp. and *M. shonaicus*

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  |  | Df | Sum Sq | Mean Sq | F value | Pr |
| Spermatozoa | Tail | 1 | 305.48 | 305.478 | 21.836 | 9.47E-06 |
| Mid-piece | 1 | 46.561 | 46.561 | 56.658 | 2.55E-11 |
| Nucleus | 1 | 2803.5 | 2803.5 | 226.98 | <2.2E-16 |
| Acrosome | 1 | 34082 | 34082 | 1515.4 | <2.2E-16 |
| Egg | Egg bare diameter | 1 | 801.37 | 801.37 | 26.76 | 2.71E-06 |
| Egg full diameter | 1 | 6548.4 | 6548.4 | 173.73 | <2.2E-16 |
| Process height | 1 | 582.14 | 582.14 | 538.7 | <2.2E-16 |
| Process base width | 1 | 1578.03 | 1578.03 | 764.08 | <2.2E-16 |
| Process base width ratio | 1 | 27709 | 27709.1 | 80.886 | 8.77E-13 |
| Inter-process distance | 1 | 10.202 | 10.2021 | 33.795 | 2.40E-07 |
| Number of processes on the egg circumference | 1 | 7545.1 | 7545.1 | 1121.2 | <2.2E-16 |

(*B*) Results of MANOVAs between testicular and spermathecal spermatozoa

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  |  | Df | Sum Sq | Mean Sq | F value | Pr |
| *Paramacrobiotus* sp. | Tail | 1 | 1367.76 | 1367.76 | 86.753 | 1.37E-12 |
| Mid-piece | 1 | 0.718 | 0.71822 | 0.5917 | 0.4453 |
| Nucleus | 1 | 56.15 | 56.155 | 2.8552 | 0.09718 |
| Acrosome | 1 | 0.05 | 0.048 | 0.001 | 0.9747 |
| *M. shonaicus* | Tail | 1 | 637.64 | 637.64 | 64.472 | 1.00E-10 |
| Mid-piece | 1 | 0.1383 | 0.13829 | 0.2596 | 0.5513 |
| Nucleus | 1 | 2.134 | 2.1344 | 0.3631 | 0.5493 |
| Acrosome | 1 | 0.0561 | 0.056089 | 0.2325 | 0.6317 |

**Table S3** All morphometrics of measured spermathecal spermatozoa

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Tail | Mid-piece | Nucleus | Acrosome | Species |
| 3.6 | 4.5 | 29.2 | 54.5 | *Paramacrobiotus* sp. |
| 1.3 | 4.3 | 19.4 | 33.5 | *Paramacrobiotus* sp. |
| 1.4 | 4.2 | 23.7 | 28.9 | *Paramacrobiotus* sp. |
| 1.7 | 3.3 | 31.0 | 45.0 | *Paramacrobiotus* sp. |
| 1.6 | 4.2 | 21.2 | 33.1 | *Paramacrobiotus* sp. |
| 4.6 | 2.7 | 10.9 | 0.9 | *M. shonaicus* |
| 3.0 | 1.2 | 13.0 | 0.4 | *M. shonaicus* |
| 4.4 | 2.9 | 9.6 | 2.2 | *M. shonaicus* |
| 3.8 | 1.7 | 12.3 | 2.0 | *M. shonaicus* |
| 4.2 | 2.1 | 11.7 | 1.9 | *M. shonaicus* |

**Table S4** Results of chi-squared tests in the two species

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Species | Oocytes with spermatozoa (number of oocytes with spermatozoa/obseved oocytes) | Eggs with spermatozoa (number of eggs with spermatozoa/obseved eggs) | X-squared | df | *P*-value |
| *Paramacrobiotus* sp. | 0/24 | 8/18 | 8 | 1 | 0.009911 |
| *M. shonaicus* | 0/28 | 6/15 | 6.6512 | 1 | 0.009909 |

**Table S5** All morphometrics of eggs from *Paramacrobiotus* sp.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Egg bare diameter | Egg full diameter | Process height 1 | Process height 2 | Process height 3 | Process base width 1 | Process base width 2 | Process base width 3 | Process base width ratio 1 | Process base width ratio 2 | Process base width ratio 3 | Inter-process distance 1 | Inter-process distance 2 | Inter-process distance 3 | Number of processes on the egg circumference |
| 70.0 | 90.5 | 10.7 | 11.6 | 12.2 | 13.9 | 11.6 | 13.0 | 129.6 | 100.3 | 107.3 | 3.3 | 3.4 | 2.6 | 15 |
| 75.0 | 98.8 | 9.3 | 9.9 | 11.0 | 13.6 | 15.4 | 15.5 | 145.8 | 156.0 | 140.5 | 4.3 | 4.0 | 2.4 | 12 |
| 71.0 | 96.6 | 10.6 | 9.7 | 10.6 | 17.2 | 16.2 | 17.3 | 161.5 | 166.9 | 162.0 | 3.0 | 3.3 | 5.0 | 13 |
| 61.4 | 81.7 | 11.0 | 10.9 | 8.0 | 13.3 | 11.1 | 10.1 | 120.0 | 101.2 | 126.0 | 2.5 | 2.9 | 2.5 | 12 |
| 77.7 | 107.8 | 12.4 | 11.5 | 11.1 | 15.6 | 16.9 | 17.9 | 125.4 | 147.4 | 162.0 | 3.5 | 4.9 | 5.1 | 11 |
| 90.1 | 112.1 | 9.9 | 9.9 | 8.9 | 12.1 | 12.5 | 11.0 | 121.9 | 126.3 | 123.5 | 3.9 | 2.7 | 2.8 | 12 |
| 64.2 | 90.1 | 8.9 | 9.4 | 9.7 | 13.3 | 13.9 | 12.8 | 148.4 | 147.5 | 132.6 | 3.6 | 4.5 | 3.3 | 12 |
| 76.4 | 99.4 | 12.2 | 13.9 | 11.8 | 17.7 | 16.2 | 15.7 | 145.1 | 116.7 | 132.2 | 2.8 | 2.9 | 2.5 | 11 |
| 70.7 | 96.2 | 10.1 | 11.2 | 10.2 | 12.5 | 12.4 | 14.0 | 123.3 | 110.8 | 137.7 | 3.0 | 2.1 | 1.8 | 13 |
| 74.3 | 92.9 | 8.1 | 10.3 | 10.2 | 11.9 | 13.7 | 10.7 | 147.3 | 132.8 | 104.3 | 4.5 | 3.1 | 3.6 | 12 |
| 63.2 | 84.1 | 10.7 | 11.0 | 13.2 | 12.9 | 13.8 | 15.2 | 120.0 | 124.8 | 115.1 | 3.4 | 3.0 | 2.6 | 13 |
| 68.7 | 92.4 | 12.9 | 10.5 | 11.8 | 17.7 | 13.5 | 13.3 | 137.6 | 127.7 | 113.2 | 2.3 | 2.9 | 2.0 | 12 |
| 64.3 | 87.6 | 10.1 | 10.3 | 11.1 | 10.7 | 11.4 | 9.8 | 105.7 | 110.3 | 88.7 | 4.3 | 3.5 | 3.9 | 12 |
| 72.0 | 98.8 | 12.1 | 13.0 | 11.7 | 13.8 | 12.9 | 14.8 | 114.3 | 99.4 | 126.2 | 2.1 | 3.0 | 2.7 | 12 |
| 69.3 | 99.3 | 12.8 | 14.5 | 12.1 | 12.3 | 13.9 | 15.7 | 96.3 | 95.6 | 130.2 | 3.0 | 2.5 | 3.2 | 13 |
| 68.4 | 95.3 | 9.5 | 9.1 | 10.1 | 15.2 | 15.3 | 16.2 | 159.9 | 167.9 | 159.7 | 4.2 | 6.4 | 2.8 | 11 |
| 75.9 | 94.6 | 8.8 | 8.0 | 8.6 | 13.6 | 16.9 | 13.6 | 155.3 | 211.3 | 158.4 | 2.9 | 3.3 | 3.5 | 12 |
| 58.1 | 82.2 | 10.5 | 12.2 | 11.2 | 13.9 | 10.9 | 11.6 | 132.2 | 89.8 | 103.8 | 3.1 | 3.6 | 2.7 | 12 |
| 72.1 | 100.8 | 11.1 | 10.1 | 11.8 | 21.1 | 18.4 | 20.0 | 190.8 | 181.8 | 168.8 | 4.0 | 4.3 | 3.3 | 10 |
| 64.6 | 84.4 | 9.3 | 7.9 | 7.4 | 11.7 | 13.3 | 12.4 | 125.7 | 167.6 | 167.1 | 3.3 | 4.0 | 3.8 | 12 |
| 66.0 | 92.4 | 10.7 | 10.9 | 11.0 | 13.3 | 13.4 | 12.6 | 124.1 | 122.4 | 113.7 | 2.8 | 3.3 | 4.5 | 12 |
| 73.0 | 94.9 | 9.3 | 8.9 | 10.1 | 13.4 | 13.6 | 12.5 | 143.9 | 152.2 | 123.5 | 3.3 | 3.2 | 3.9 | 12 |
| 75.2 | 95.8 | 10.1 | 9.3 | 8.6 | 13.2 | 13.0 | 13.1 | 130.3 | 140.3 | 153.2 | 4.0 | 3.3 | 4.9 | 13 |
| 67.3 | 93.7 | 10.6 | 10.0 | 11.2 | 14.3 | 17.1 | 18.8 | 134.0 | 170.4 | 168.5 | 2.5 | 3.3 | 2.4 | 11 |
| 67.0 | 88.3 | 8.0 | 9.2 | 8.7 | 12.9 | 13.1 | 16.2 | 160.8 | 141.8 | 185.7 | 4.4 | 2.8 | 4.5 | 11 |
| 82.5 | 103.5 | 8.6 | 10.2 | 10.1 | 13.1 | 15.8 | 14.7 | 152.9 | 155.5 | 145.6 | 3.0 | 3.2 | 5.1 | 14 |
| 66.2 | 91.4 | 12.1 | 12.2 | 10.1 | 13.3 | 9.8 | 12.2 | 109.3 | 80.5 | 121.1 | 2.7 | 4.8 | 3.1 | 12 |
| 68.1 | 99.1 | 9.9 | 12.2 | 14.6 | 14.5 | 15.3 | 15.7 | 146.9 | 125.9 | 107.3 | 3.9 | 2.7 | 3.1 | 11 |
| 69.9 | 93.7 | 9.8 | 9.3 | 13.2 | 14.3 | 10.1 | 13.6 | 145.4 | 108.6 | 103.1 | 4.1 | 3.6 | 4.2 | 13 |
| 68.5 | 94.3 | 10.6 | 11.6 | 13.2 | 14.5 | 15.2 | 15.7 | 136.5 | 131.3 | 118.8 | 2.7 | 3.9 | 2.1 | 11 |
| 65.3 | 88.8 | 8.3 | 9.8 | 7.7 | 14.6 | 12.5 | 12.3 | 175.6 | 127.5 | 158.6 | 3.7 | 3.0 | 4.4 | 13 |
| 73.2 | 97.1 | 10.4 | 9.5 | 9.2 | 15.5 | 12.7 | 11.4 | 149.6 | 133.5 | 124.0 | 2.8 | 4.3 | 4.5 | 13 |
| 72.3 | 94.8 | 10.1 | 9.2 | 9.2 | 16.0 | 13.6 | 15.5 | 158.8 | 147.1 | 167.4 | 3.6 | 3.0 | 2.7 | 12 |

**Movie S1** Female laying an egg. Available from https://www.cambridge.org/core/journals/zygote