## Supplementary Materials S1: Material and Methods

# A molecular phylogeny of *Stylodipus* (Dipodidae, Mammalia): a small genus with a complex history

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**Supplementary Table S1-A.** Geographic and genotype information of specimens comprising main data set used in study.

| loc. No in Fig. 1 | locality | specimen code | voucher if available | *cytb* | *IRBP* | *DMPI* | *CHY* | *THY* |
|---|---|---|---|---|---|---|---|---|
| | | | *S. telum* | | | | | |
| 1a | Ukraine, Kherson: Solyonoozernyy, N46.4533 E32.0234 | X2 | S198866 | H24 | xxxxxx | D1/D1 | C9/C9 | T1/T1 |
| | N46.4526 E32.0210 | X3 | S198867 | H21 | Ir8/Ir8 | D3/D3 | C9/C9 | xxxxxx |
| | N46.4576 E31.9948 | RX2 | Soloz32 p.coll. M.Rusin | H23 | no | D1/D3 | C9/C11 | T1/T1 |
| | N46.4550 E32.0118 | RX4 | Soloz59 p.coll. M.Rusin | H26 | Ir8/Ir10 | D1/D3 | C9/C9 | T1/T1 |
| 1b | Ukraine, Kherson: Sagi, N46.6078 E32.84181 | RX1 | Sagi2 p.coll. M.Rusin | H22 | no | D1/D3 | C9/C9 | T1/T1 |
| | N46.6079 E32.84181 | RX3 | Sagi1 p.coll. M.Rusin | H25 | Ir9/Ir9 | D1/D22 | C9/C11 | T1/T4 |
| 2 | Russia, Volgograd: Tsimlya Sands, Nizhnegnutov, N48.020806 E42.412092 | X1 | S198979 | H19 | Ir7/Ir8 | D2/D2 | C9/C9 | T1/T9 |
| | Tsimlya Sands, N48.0205 E42.4246 | S202221 | S202221 | H19 | no | no | no | no |
| 3 | Russia, Kalmykiya: Achinery, N45.388472 E45.368203 | Kalm/2003 | | H20 | Ir8/Ir8 | D23/D24 | C9/C11 | T9/T13 |
| 4 | Kazakhstan, W Kazakhstan: Karabau, | S156391 | S156391 | H10 | no | no | no | no |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | N48.469295 E52.978063 | | | | | | | |
| 5 | Kazakhstan, Mangistau: Kulkara, Ustyurt, N44.239193 E53.859366 | S69276 | S69276 | H6 | no | no | no | no |
| 6 | Kazakhstan, Qaraghandy: Barbol S, N47.371193 E63.254952 | K19-29 | S 202732 | H9 | xxxxxx | no | no | no |
| 7 | Kazakhstan Qostanay: Nayrzum N51.511674 E64.511433 | S84566 | S84566 | H1 | no | no | no | no |
| | | S84572 | S84572 | H2 | no | no | no | no |
| | | K22-26 | | H1 | xxxxxx | D6/D6 | xxxxxx | T1/T1 |
| | | K22-27 | | H1 | Ir5/Ir16 | D6/D6 | xxxxxx | T1/T11 |
| | | K22-28 | | H2 | xxxxxx | D6/D6 | xxxxxx | T1/T1 |
| | | K22-29 | | H2 | xxxxxx | D6/D6 | xxxxxx | T1/T11 |
| 8 | Kazakhstan, Qyzylorda: Irisbay, 8 km W ("Zhanadarya River valley"), N44.012633 E63.308226 | S143352 | S143352 | H5 | no | no | no | no |
| | | S143353 | S143353 | H3 | no | no | no | no |
| 9 | Kazakhstan Qostanay: Turgay, Urpek – Karasu, N50.130125 E65.285503 | K12-238 | | H5 | xxxxxx | D7/D7 | C9/C9 | T1/T9 |
| | | K12-260 | | H8 | Ir11/Ir11 | D20/D21 | C9/C9 | xxxxxx |
| | | K12-270 | | H4 | xxxxxx | D6/D19 | C8/C9 | T1/T1 |
| 10 | Kazakhstan Qaraghandy: Dzhezkazgan – Dzhezdy, N47.941345 E67.416535 | K19-08 | S202714 | H12 | Ir8/Ir10 | D6/D16 | C8/C9 | T1/T9 |
| | | K19-09 | S202715 | H11 | xxxxxx | D8/D8 | C8/C9 | xxxxxx |
| | | K19-10 | S202716 | H13 | xxxxxx | xxxxxx | C8/C9 | T1/T9 |
| | | K19-11 | S202717 | H16 | xxxxxx | no | no | T9/T9 |
| | | K19-12 | S202718 | H7 | Ir11/Ir11 | D6/D6 | C8/C9 | T9/T11 |
| 11 | Kazakhstan Qaraghandy: Balkhash Lake NW shore, Gul'shad 30 km SW, N46.383251 E74.01962 | K16-22 | S197362 | H18 | Ir6/Ir7 | D4/D4 | C9/C10 | T9/T9 |
| 12 | Kazakhstan Qaraghandy: Bektauata Mt NW | K16-04 | S197359 | H15 | xxxxxx | xxxxxx | C9/C9 | T9/T10 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | slope,<br>N47.481304 74.694713 | K16-05 | S197360 | H14 | Ir14/Ir17 | xxxxxx | C9/C9 | T1/T1 |
| | | K16-16 | S197361 | H17 | xxxxxx | D17/D18 | C9/C9 | T9/T9 |
| 13 | Kazakhstan East Kazakhstan Chingiztau, Zhangizsu,<br>5 km W, 32 km SE Zhurekadyr,<br>N48.31837 E79.919794 | S148037 | S148037 | H27 | xxxxxx | xxxxxx | C4/C5 | xxxxxx |
| | | S148039 | S148039 | H27 | Ir18/Ir18 | D5/D26 | C4/C4 | T12/T12 |
| | | S148041 | S148041 | H27 | xxxxxx | xxxxxx | C3/C5 | T10/T12 |
| 14 | Kazakhstan East Kazakhstan, Zaisan Lake N shore, Shakelmes,<br>N 48.068611 E84.138333 | K12-64 | S190956 | H32 | Ir12/Ir12 | D25/D11 | C1/C2 | T2/T2 |
| | | K12-65 | S190957 | H34 | Ir12/Ir12 | xxxxxx | C1/C2 | T2/T2 |
| | | K13-85 | S192680 | H35 | Ir12/Ir12 | D11/D11 | xxxxxx | T2/T2 |
| | | K13-86 | S192681 | H33 | Ir12/Ir12 | D11/D11 | C2/C2 | T2/T2 |
| | | *S. sungorus* | | | | | | |
| | China, unknown locality | KR054627 | | H28 | no | no | no | no |
| 15 | China, Xinjiang: Fuhai Co. N46.46435 E87.51709 | XJ18156 | | H31 | no | no | no | no |
| 16 | Mongolia, Hovd, Bulgan, 40 km WSW, Gurvan-Khukhed-Uul,<br>N46.006111 E91,060278 | M15-108 | S196484 | H29 | Ir15/Ir17 | D5/D9 | C4/C4 | T3/T3 |
| 17 | Mongolia, Hovd: Baytag-Bogdo-Nuru N foothills,<br>N45.304273 E91.001775 | M15-82 | S196478 | H29 | no | no | no | T3/T3 |
| | | M15-83 | | H29 | no | no | no | no |
| | | M15-84 | | H29 | xxxxxx | D9/D10 | C4/C4 | T3/T3 |
| | | M15-85 | | H30 | no | no | no | T3/T3 |
| | | M15-91 | S196479 | H29 | no | D5/D5 | C4/C4 | T3/T3 |
| | | M15-92 | S196480 | H29 | no | D9/D9 | C4/C4 | T3/T3 |
| | | M15-94 | S196481 | H29 | xxxxxx | D10/D9 | C4/C4 | T3/T3 |
| | | M15-101 | S196482 | no | no | D5/D10 | C2/C4 | T3/T3 |
| | | M15-102 | S196483 | H29 | Ir13/Ir15 | D9/D9 | C4/C4 | T3/T3 |
| 18 | Mongolia, Govi-Altay: Bij-Gol, | M15-29 | | H29 | Ir13/Ir15 | no | no | no |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | N45.581389 E93.840279 | M15-30 | S 196476 | no | no | no | no | T3/T3 |
| | | M15-31 | | H29 | no | D9/D9 | C2/C4 | T3/T3 |
| | | M15-32 | | H29 | Ir13/Ir17 | D5/D5 | C2/C4 | T3/T3 |
| | | M15-53 | S196477 | H29 | Ir15/Ir15 | D5/D9 | C4/C4 | T3/T3 |
| | | M15-54 | | H29 | Ir13/Ir15 | D5/D9 | C4/C4 | T3/T3 |
| 19 | Mongolia, Govi-Altay: Gun-Tamga-Bulak, N45.254675 E93.657213 | M11-94 | S189200 | H29 | Ir13/Ir13 | D5/D9 | xxxxxx | T3/T3 |
| | | M11-95 | S189201 | H29 | Ir13/Ir17 | xxxxxx | C4/C4 | T3/T3 |
| | | M11-96 | S189202 | H29 | Ir13/iR15 | D10/D9 | C4/C4 | T3/T3 |
| | | M11-141 | S189203 | H29 | xxxxxx | D10/D9 | C4/C4 | T3/T3 |
| 20 | Mongolia, Govi-Altay: Ubur-Darvagtain-hutag, N45.169722 E93.854443 | M21-136 | | H29 | xxxxxx | xxxxxx | no | no |
| | | M21-149 | | H29 | xxxxxx | xxxxxx | no | no |
| | *S. andrewsi* | | | | | | | |
| 21 | Mongolia, Hovd: Bridge on Zavhan-Gol 10 km W, N48.304722 N93.378889 | M11-51 | S189197 | H44 | xxxxxx | D15/D13 | xxxxxx | T7/T8 |
| | | M11-52 | S189198 | H59 | no | D13/D13 | C6/C6 | T5/T7 |
| | | M11-53 | S189199 | H59 | xxxxxx | D15/D13 | C6/C6 | T7/T7 |
| 22 | Mongolia, Dzavhan: Dzavhan-Gol L bank, N46.844111 E96.359833 | M17-141 | | H49 | Ir1/Ir3 | no | no | no |
| | | M17-142 | S198778 | H54 | no | no | no | no |
| 23a | Mongolia, Govi-Altay: Altay-Hot 20 km W, N46.349167 E96.009444 | M15-165 | S196471 | H51 | no | D12/D12 | C6/C7 | T5/T7 |
| | | M15-166 | S196472 | H52 | no | D13/D13 | no | T5/T6 |
| 23b | Mongolia, Govi-Altay: Altay-Hot 22 km W, N46.328056 E95.969167 | M15-175 | | H57 | no | D12/D13 | C6/C6 | T7/T8 |
| | | M15-176 | S196473 | H52 | Ir3/Ir3 | D12/D13 | C6/C6 | T5/T7 |
| | | M15-177 | S196474 | H52 | no | no | no | T7/T7 |
| | | M15-178 | | no | no | D14/D13 | xxxxxx | T5/T7 |
| | | M15-179 | | H57 | no | D13/D13 | C6/C6 | T5/T7 |
| | | M15-180 | S196475 | H51 | no | no | no | xxxxxx |
| 24 | Mongolia, Govi-Altay: Namalzah-gol, | M21-26 | | H50 | xxxxxx | xxxxxx | no | no |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | N45.864122 E96.654676 | | | | | | | |
| 25 | Mongolia, Bayanhongor: Bon Tsagan nur, NW [25 km], N45.768306 E98.750167 | M17-163 | S198782 | H53 | Ir1/Ir3 | D15/D13 | C6/C6 | xxxxxx |
| | | M17-164 | S198783 | H52 | xxxxxx | D12/D13 | C6/C6 | xxxxxx |
| 26 | Mongolia, Bayanhongor: Bayan-Under NE of, N44.871667 E98.959167 | M13-2 | S192433 | H52 | Ir1/Ir4 | D15/D13 | C6/C6 | xxxxxx |
| | | M13-3 | S192434 | H45 | Ir1/Ir1 | D12/D13 | C6/C6 | T7/T7 |
| | | M13-4 | S192435 | H55 | xxxxxx | D12/D13 | C6/C6 | T5/T7 |
| | | M13-5 | S192436 | H45 | Ir1/Ir1 | D12/D13 | C6/C6 | T6/T7 |
| 27 | Mongolia, Bayanhongor: Orog Nuur E shore, N45.019778 E100.904444 | M17-172 | | H48 | no | D12/D12 | no | xxxxxx |
| | | M17-173 | S198779 | H46 | no | D12/D15 | xxxxxx | xxxxxx |
| 28 | Mongolia, Ömnögovi: Moltsog-els, N44.207222 E104.041389 | M22-129 | | H47 | xxxxxx | xxxxxx | no | no |
| 29 | Mongolia, Ömnögovi: Tsogt-Ovoo S of, N44.2195 E105.065444 | M17-230 | | H56 | xxxxxx | xxxxxx | C6/C6 | T5/T6 |
| | | M17-231 | S198780 | H41 | Ir1/Ir1 | no | no | T6/T7 |
| | | M17-234 | | H43 | xxxxxx | D13/D13 | xxxxxx | T6/T7 |
| | | M17-235 | S198781 | H52 | xxxxxx | D13/D13 | C6/C6 | T7/T7 |
| 30 | Mongolia, Ömnögovi: Hurmen NE of , N43.367222 E104.300833 | M13-183 | S192437 | H58 | Ir1/Ir1 | D13/D13 | C6/C6 | T7/T7 |
| | | M13-184 | S192438 | no | no | D12/D13 | C6/C7 | T6/T7 |
| 31 | Mongolia, Ömnögovi: Dersen-us, N42.328889 E104.959444 | M22-88 | | H36 | no | xxxxxx | no | no |
| 32 | Mongolia, Ömnögovi: Aguy-Ula, N42.5875 E107.8275 | M14-187 | S194134 | H42 | Ir1/Ir1 | D15/D13 | C6/C6 | T7/T7 |
| | | M14-188 | S194135 | H38 | Ir1/Ir2 | D12/D12 | C6/C6 | T7/T7 |
| | | M14-190 | S194136 | H40 | Ir1/Ir1 | D12/D15 | C6/C6 | T6/T7 |
| | | M14-191 | S194137 | H39 | Ir1/Ir2 | D12/D15 | C6/C6 | T7/T7 |
| 33 | China, Nei Mongol: Darhan Muminggan United Banner, Mandulazhen, N42.5503 E110.0964 | NM10012 | | H37 | xxxxxx | no | no | no |
| | | NM-1 | | | xxxxxx | | | |
| | | NM-2 | | | xxxxxx | | | |

| | | | |
|---|---|---|---|
| 34 | China, Nei Mongol: Darhan Muminggan United Banner, Mandulazhen, N42.5306 E110.1539 | NM-3 | xxxxxx |
| 35 | China, Nei Mongol: Urad Rear Banner, N41.5542 E106.9628 | NM-4 | xxxxxx |

Notes: No. 15 and 33-35: coordinates were provided by Prof. Qisen Yang and Dr. Jilong Cheng, Key Laboratory of Zoological Systematics and Evolution, Institute of Zoology, Chinese Academy of Sciences.

For sequences designated with 'xxxxxx' allelic phases were not determined.

**Supplementary Table S1-B.** List of sequences used in molecular dating and species tree reconstruction.

See Supplementary Table S1-B in xls format.

**Supplementary Table S2.** GenBank Accession Numbers for the sequences used in the study.

See Supplementary Table S2 in xls format.

**List of bibliographic sources of sequences retrieved from GenBank:**


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**Supplementary Table S3.** Original primers designed for amplification and sequencing of short fragments of *cytb* and nuclear genes of *Stylodipus* spp.

| primer | sequence (5'-3') |
|---|---|
| | ***cytb*** |
| L247a* | CGCCAATGGRGCYTCCATATTCTTTA |
| H305e* | TGAATGTGTAGGARCCRTAGTAGAG |
| H810a* | GGCGTAGGCAAATAGGAAATATCATTCG |
| L755b* | GAYCCAGACAATTACAYACCAGCAAAC |
| L476_Stel | CCACCCTYGTTGAGTGAATCTGA |
| H602_Stel | GGAGTTTAGTCCGATTGGGTTGTTAGAG |
| L400_Sand | CCCTGAGGCCAAATATCCTTCTGAG |
| H602_Sand | GGAGTTCAATCCGATTGGGTTGTTAGAG |
| | ***CHY*** |
| F3_jac | CACMCTGCAGGAGGTGAAGATGAG |
| R320a | CCCAGCCACTCCCACCTTATTA |
| F283a | CACCCATCCTAGTCTGCTACACA |
| R1a_jac | GGGAGATTCTGGTGAARACAGCA |
| | ***DMPI*** |
| F262A | CAGGGACCTGGACAGTGGAGATGAG |
| R357A | CGTGGCTGCTGTCTCCCTCACT |
| F145d | CTGAGTGACAGCAGTGACACKGAAGAG |
| R710d | CCYGGRTTCTGCACGGATTGG |
| | ***THY*** |
| R353b* | CCCAGTTTACTTCTATTCTTTTGTCACAG |
| F270a* | GGTGCCACTTTTGTCTCTGGAGGACT |
| | ***IRBP*** |
| R340a* | CCGGGATGCAGATARGAGATGACATAG |
| F802b* | CCCAGCTGAGCAAGCTCTGGAGAAAG |
| F320a* | CGTGTGGAGGAAGCTCATGGGCACT |

| | |
|---|---|
| R892a* | GCACACGGTCCACCAGCGTATAATAATC |
| F597dip* | GGACATCGCCTACATCCTCAAGCAG |
| | ***DMP1*** |
| F145d_jac | CTGAGTGACAGCAGTGACACKGAAGAG |
| R710d_jac | CCYGGRTTCTGCACGGATTGG |
| F262a* | CAGGGACCTGGACAGTGGAGATGAG |
| R357a* | CGTGGCTGCTGTCTCCCTCACT |
| | ***OSTA*** |
| F1d_jac_osta | CCTCTCATGCTCACRAGGTAAAG |
| R3d_jac_osta | GGAAAGGRCCCAAYATCAGGAG |
| | *R**OGDI*** |
| F1b_ rogdi | GCTSATGGAYGCYGTGATGCTG |
| R_rogdi | CACGGTGAGGCASAGCTTGTTGA |
| | ***ABDH1I*** |
| F1b_jac_abdh | ACAGCTCAGCTCTGTTATCCAGGTGAT |
| R1a_jac_abdh | GCCKCTTAATCTCAGRGTRGTGACTG |
| | ***AAT*** |
| F1a_jac_aat | GAGGCCTGGCMGCCTGYTTCATC |
| R1a_jac_aat | GGACAGAAAYAAACTGGGTRCAGGTASAACTC A |

Notes: Tann = 59°C for primers designed for *OSTA*, *ROGDI*, *ABHD11*, and *AAT* markers.

Tann for other primers see in the previous publications [10, 11, 12, 52] and below in the Table S4.

**Supplementary Table S4.** Combination of primers and PCR conditions for amplification of short DNA fragments from historical specimens.

| locus | Combination of primers | T, C° |
|---|---|---|
| *cytb* | L7 / H305e | 51.9 |
| | L247a / H602_Stel | 60.5 |
| | L476_Stel / H810a | 55.9 |
| | L755b / H6 | 51.9 |
| *CHY* | F3 / R320a | 56 |
| | F283a / R1a | |
| *DMP1* | F145d / R357a | 60 |
| | F262A / R710d | |
| *THY* | F_sb47a / R353b | 57 |
| | F270a / R_590Sb1 | |
| *IRBP* | F25 / R340a | 62 |
| | F802b / R1175 | |
| | F320a / R701 | |
| | F597 / R892a | |

**Supplementary Table S5.** Models for the *cytb* data and nuclear gene concatenate employed in the maximum likelihood analysis.

| locus | codon positions | | |
|---|---|---|---|
| | 1st | 2nd | 3rd |
| *cytb* | K2P+I | HKY+F+I | TN+F |
| | 1st + 2nd | | 3rd |
| *IRBP* | K2P | | TPM2+F+G4 |
| *DMPI* | F81+F+I | | TPM2F+G4 |
| | 1st +2nd+3rd codon positions | | |
| *CHY* | K2P+I | | |
| *THY* | K2P+I | | |

**Supplementary Table S6.** Means and standard deviations of lognormal distributions used as prior calibration densities in species tree reconstruction.

| Node | Mean | Standard deviation |
|---|---|---|
| *Dipus* /other Dipodinae | 8.54 | 0.21 |
| *Jaculus* / *Stylodipud* | 6.82 | 0.66 |
| *Chimaerodipus* / *Stylodipus* | 4.79 | 0.11 |
| *S. andrewsi* / *S.telum* complex | 2.1 | 0.21 |