

# An integrative analysis uncovers a new, pseudo-cryptic species of Amazonian marmoset (Primates: Callitrichidae: *Mico*) from the arc of deforestation

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Supplementary Table S1. Primate species currently known to occur in southern Amazonia, the arc of deforestation, and their conservation status according to IUCN<sup>10</sup>.

| Species                     | Conservation Status          |
|-----------------------------|------------------------------|
| <i>Alouatta ululata</i>     | <b>Endangered</b>            |
| <i>Alouatta belzebul</i>    | <b>Vulnerable</b>            |
| <i>Alouatta discolor</i>    | <b>Vulnerable</b>            |
| <i>Alouatta caraya</i>      | Near Threatened              |
| <i>Alouatta nigerrima</i>   | Least Concern                |
| <i>Alouatta sara</i>        | Least Concern                |
| <i>Alouatta seniculus</i>   | Least Concern                |
| <i>Aotus infulatus</i>      | Least Concern                |
| <i>Aotus nigriceps</i>      | Least Concern                |
| <i>Ateles chamek</i>        | <b>Endangered</b>            |
| <i>Ateles marginatus</i>    | <b>Endangered</b>            |
| <i>Callibella humilis</i>   | Least Concern                |
| <i>Cebus kaapori</i>        | <b>Critically Endangered</b> |
| <i>Cebus unicolor</i>       | <b>Vulnerable</b>            |
| <i>Chiropotes satanas</i>   | <b>Endangered</b>            |
| <i>Chiropotes albinasus</i> | <b>Vulnerable</b>            |
| <i>Chiropotes utahickae</i> | <b>Vulnerable</b>            |
| <i>Lagothrix cana</i>       | <b>Endangered</b>            |
| <i>Leontocebus weddelli</i> | Least Concern                |
| <i>Mico leucippe</i>        | <b>Vulnerable</b>            |
| <i>Mico marcai</i>          | <b>Vulnerable</b>            |
| <i>Mico munduruku</i>       | <b>Vulnerable</b>            |
| <i>Mico rondoni</i>         | <b>Vulnerable</b>            |
| <i>Mico humeralifer</i>     | Near Threatened              |
| <i>Mico melanurus</i>       | Near Threatened              |
| <i>Mico nigriceps</i>       | Near Threatened              |
| <i>Mico acariensis</i>      | Least Concern                |
| <i>Mico argentatus</i>      | Least Concern                |
| <i>Mico chrysoleucos</i>    | Least Concern                |
| <i>Mico emiliae</i>         | Least Concern                |

| Species                           | Conservation Status          |
|-----------------------------------|------------------------------|
| <i>Mico intermedius</i>           | Least Concern                |
| <i>Mico mauesi</i>                | Least Concern                |
| <i>Mico saterei</i>               | Least Concern                |
| <i>Pithecia mittermeieri</i>      | <b>Vulnerable</b>            |
| <i>Pithecia rylandsyi</i>         | <b>Vulnerable</b>            |
| <i>Plecturocebus grovesi</i>      | <b>Critically Endangered</b> |
| <i>Plecturocebus vieirai</i>      | <b>Critically Endangered</b> |
| <i>Plecturocebus brunneus</i>     | <b>Vulnerable</b>            |
| <i>Plecturocebus parecis</i>      | Near Threatened              |
| <i>Plecturocebus baptista</i>     | Least Concern                |
| <i>Plecturocebus bernhardi</i>    | Least Concern                |
| <i>Plecturocebus cinerascens</i>  | Least Concern                |
| <i>Plecturocebus donacophilus</i> | Least Concern                |
| <i>Plecturocebus hoffmannsi</i>   | Least Concern                |
| <i>Plecturocebus moloch</i>       | Least Concern                |
| <i>Saguinus ursulus</i>           | <b>Vulnerable</b>            |
| <i>Saguinus niger</i>             | <b>Vulnerable</b>            |
| <i>Saimiri ustus</i>              | Near Threatened              |
| <i>Saimiri boliviensis</i>        | Least Concern                |
| <i>Saimiri collinsi</i>           | Least Concern                |
| <i>Sapajus apella</i>             | Least Concern                |
| <i>Sapajus cay</i>                | Least Concern                |

Supplementary Table S2. Geographical coordinates (*datum* WGS 84) here attributed for the localities of *Mico emiliae* specimens and for specimens historically identified as *M. emiliae* but belonging to distinct taxa (see Figure 1).

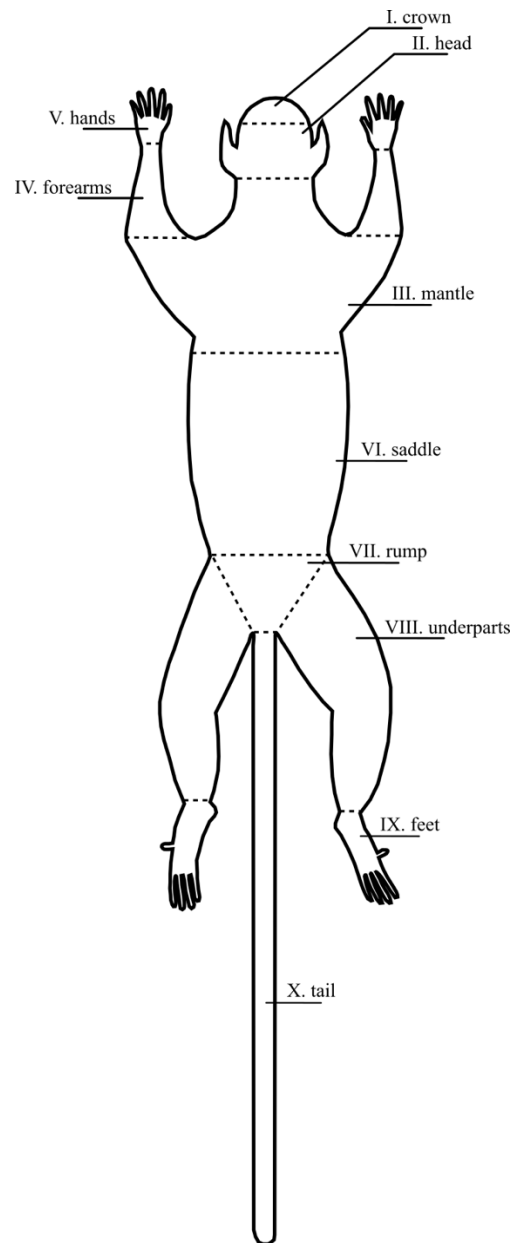
| Localities                              | Coordinates            | Taxa                              |
|-----------------------------------------|------------------------|-----------------------------------|
| Maloca, upper Curuá River <sup>12</sup> | 07°36'59"S, 54°52'00"W | <i>Mico emiliae</i>               |
| Peixoto de Azevedo River <sup>17</sup>  | 10°13'02"S, 55°21'41"W |                                   |
| Serra do Cachimbo <sup>48</sup>         | 09°22'00"S, 55°00'00"W |                                   |
| Roosevelt River <sup>19,20</sup>        | 07°33'50"S, 60°41'12"W | <i>Mico marcai</i>                |
| Nova Brasília <sup>19 †</sup>           | 10°53'15"S, 61°54'35"W | <i>Mico</i> aff. <i>marcai</i>    |
| Urupá River <sup>19 †</sup>             | 10°53'10"S, 61°57'15"W | <i>Mico</i> aff. <i>melanurus</i> |
| Samuel dam <sup>20,21</sup>             | 08°45'00"S, 63°28'00"W | <i>Mico rondoni</i>               |
| Santa Bárbara <sup>20,21</sup>          | 08°46'35"S, 63°53'44"W |                                   |
| Alta Floresta <sup>21 †</sup>           | 09°51'50"S, 56°04'20"W | <i>Mico schneideri</i> sp. n.     |
| Ouroândia <sup>21 †</sup>               | 10°23'26"S, 56°24'28"W |                                   |

† Taxa identification revised from the original source.

Supplementary Table S3. Framework adopted in this study for taxonomic assessment and decision-making<sup>28</sup> and following the monophyly and diagnosability conceptualization of the phylogenetic species concept<sup>30</sup>.

| Sources of information                        | Criteria               | Single source | Integrated sources |
|-----------------------------------------------|------------------------|---------------|--------------------|
| Morphology data<br>Pelage pigmentation        | Diagnosability         | H0 / H1       |                    |
| Molecular data<br>Nuclear genome              | Monophyly              | H0 / H1       | H0 / H1            |
| Distribution data<br>Localities of occurrence | Allopatry<br>Parapatry | H0 / H1       |                    |

Supplementary Figure S4. Schematic representation of the chromogenetic fields<sup>32</sup> here examined as morphological characters<sup>3</sup>. Illustration: R. Costa-Araújo.



Supplementary Table S5. Prepared skins and specimens in fluid examined in the mammal collections of the Field Museum of Natural History (FMNH), Instituto Nacional de Pesquisas da Amazônia (INPA), Museu Paraense Emílio Goeldi (MPEG), Museu Nacional. Universidade Federal do Rio de Janeiro (MN), Museu de Zoologia da Universidade de São Paulo (MZUSP), Natural History Museum London (NHM), Naturhistorisches Museum Wien (NMW), Universidade Federal de Rondônia (UNIR), and Universidade Federal do Mato Grosso (UFMT) for collection of morphological data. The type specimens are indicated with bold letters and the specimens obtained for this study are indicated with asterisk.

| Taxon                           | Specimens                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|---------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <i>Mico acariensis</i> (n=6)    | INPA: <b>3931</b> ; MPEG: 45578*, 45579*, 45580*, 45581*, 45582*.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| <i>Mico argentatus</i> (n=171)  | FMNH: 19499, 19533, 50839, 50840, 50841, 92177, 92178, 92179, 92180; INPA: 2473; MPEG: 29, 38, 151, 154, 156, 157, 162, 163, 164, 165, 165, 166, 269, 328, 336, 6878, 8951, 8952, 8982, 8983, 8984, 8985, 8986, 8987, 9200, 9201, 9202, 9203, 9204, 9205, 9206, 9207, 9208, 9212, 10021, 10022, 10023, 10024, 10025, 10026, 21373, 21374, 21375, 21376, 21377, 21378, 21379, 21380, 21381, 21382, 21383, 21384, 21385, 21386, 21387, 21388, 21389, 21390, 21391, 21392, 21393, 21394, 21414, 21630, 21631, 21632, 21633, 21634, 21635, 21636, 21637, 22922, 22923, 22924, 22925, 22926, 22927, 22928, 22929, 23156, 23157, 23158, 45605*, 45606*, 45607*, 45608*, 45609*; MN: 2412, 2834, 2845, 2846, 2847, 2878, 4508, 5116, 5718, 5946, 5953, 5954, 11571, 11572, 11573, 11574, 11575, 11576, 11577, 11915, 23826; MZUSP: 3588, 3589, 3591, 3593, 3594, 3595, 3596, 4313, 4829, 4833, 4840, 4865, 4899, 4900, 4901, 4902, 4903, 4904, 4905, 4906, 4907, 4908, 4909, 4910, 4911, 4913, 4914, 4915, 4916, 4918, 4940, 4959, 4964, 4965, 4966, 4967, 4968, 4969, 4970, 4971, 4972, 4973, 4974, 4975, 5007, 5026, 6633, 11272, 11307, 11308, 11367, 11407, 11307, 11308. |
| <i>Mico chrysoleucos</i> (n=74) | FMNH: 50821, 50822, 50823, 50825, 50826, 50827, 50828, 50829, 50830, 50831, 50832, 50833, 50834; INPA: 4110, 4038, 4039, 7388*, 7389*, 7390*; MPEG: 237, 544, 23064, 45576*, 45577*, 45587*, 45590*, 45591*, 45610*; MN 2835, 2836, 2837, 5947, 5948, 5949, 5950, 5951, 5952, 6054, 6055, 6061, 6062, 6095; MZUSP: 4210, 4211, 4884, 4885, 4886, 4887, 4888, 4890, 4892, 4893, 4894, 4976, 5006, 5008, 5009, 5018, 5019, 5020, 5022, 5028, 5029, 5030, 11246, 11409, 11410, 11411, 13466, 13467; NMW: <b>ST 970, B 3455, B 3456, B 3457.</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| <i>Mico emiliae</i> (n=11)      | INPA: 7287*, 7288*, 7289*, 7290*; MPEG: <b>170</b> , 37807, 37808, 37809, 45566*; MZUSP: 35106; NHM: <b>20.7.14.12.</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| <i>Mico humeralifer</i> (n=122) | FMNH: 19508, 92165, 92166, 92167, 92168, 92169, 92170, 92171, 92172, 92173; INPA: 4111, 4083, 7385*, 7386*, 7282*; MPEG: 30, 172, 173, 174, 175, 178, 265, 266, 267, 268, 337, 1384, 9213, 21397, 21398, 21399, 21400, 21401, 21402, 21403, 21404, 21405, 21406, 21407, 21408, 21409, 21410, 21411, 21412, 38387, 38504, 38505, 39474, 39475, 40984, 44282, 44283, 5904*, 5905*; MN 2838, 2839, 2840, 11000, 23818; MZUSP: 3577, 3578, 3579, 3580, 3582, 3584, 3585,                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |

| Taxon                                | Specimens                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|--------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                      | 3586, 4927, 10095, 10096, 10097, 10098, 10099, 11249, 11250, 11251, 11252, 11253, 11254, 11255, 11256, 11257, 11258, 11259, 11260, 11261, 11262, 11263, 11264, 11265, 11266, 11268, 11269, 11270, 11271, 11294, 11297, 11298, 11299, 11300, 11301, 11302, 11303, 11304, 11306, 11309, 11310, 11312, 11332, 11333, 11347, 11348, 11349, 11350, 11351, 11356, 11357, 11358, 11360, 11393, 11396, 11397, 11398, 11399, 11400, 11401, 11412, 11413, 18866. |
| <i>Mico intermedius</i> (n=10)       | MPEG: <b>8156, 12599</b> , 23065, 45585*, 45592*, 45594*, 45595*, 45598*, 45600*; MN 2850.                                                                                                                                                                                                                                                                                                                                                             |
| <i>Mico leucippe</i> (n=30)          | FMNH: 92174, 92175, 92176; MPEG: 43661, 45563*, 45564*, 45565*, 45567*, 45568*, 45569*; MN 4798; MZUSP: 3598, 9964, 9965, 10093, 10094, 11248, 11279, 11280, 11281, 11291, 11295, 11296, 11305, 11311, 11361, 11394, 11402, 11403; NHM <b>9.3.9.2</b> .                                                                                                                                                                                                |
| <i>Mico manicorensis</i> (n=1)       | INPA: <b>2511</b> .                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| <i>Mico marcai</i> (n=9)             | MPEG: 45638, 45640, 42807, 42808, 43008, 45641; MN 2851, 2856, 2857.                                                                                                                                                                                                                                                                                                                                                                                   |
| <i>Mico mauesi</i> (n=11)            | INPA: 4105, 4106, 4107, 4108, 4109, 4082; MPEG: <b>22177</b> , 23962, 23963, 23964; MZUSP: 29027.                                                                                                                                                                                                                                                                                                                                                      |
| <i>Mico melanurus</i> (n=54)         | FMNH: 26730, 44859, 51888; INPA: 7296*, 7283*, 7383*; MPEG: 15266, 15267, 21395, 21396, 45571*; MN 2848, 2849, 2852, 2853, 2854, 2855, 2858, 2859, 5829, 5843, 5845, 5847, 5849, 23827, 24778, 24912, 24913, 25008; MZUSP: 3367, 3368, 3369, 3370, 3376, 4263, 4264, 4265, 4266, 6327, 6328, 6329, 6330, 6332, 6333, 24734; NMW: ST 1578, B 3447, B 3448, B 3449, B 3451, B 3758; UNIR: 192, 346, 356.                                                 |
| <i>Mico nigriceps</i> (n=17)         | MPEG: <b>21996, 21997, 21998, 21999</b> , 22955, 22956, 22957, 22958, 22959, 22960, 22961, 22962, 45614*, 45615*, 45616*, 45617*, 45618*.                                                                                                                                                                                                                                                                                                              |
| <i>Mico rondoni</i> (n=46)           | MPEG: 21365, <b>21366, 21367, 21646, 21647</b> , 21648, 21649, 21650, 21651, 21652, 21653, 21654, 21655, 21656, 21657, 21658, <b>21659, 21660</b> , 21885, <b>21886</b> , 21887, 21888, 21889, 21891, 21892, <b>21893, 21894</b> , 21895, <b>21896, 21897</b> , 21898, 28691, 45620*; MN 28486; MZUSP: 20142; UNIR: 15, 26, 48, 78, 159, 162, 165, 396, 556, 639, 158.                                                                                 |
| <i>Mico saterei</i> (n=14)           | INPA: 4040, 4101, 4102, 4103, 4104, 4082, 5672; MPEG: <b>23955, 23956, 23957, 23958, 23959, 23960, 23961</b> .                                                                                                                                                                                                                                                                                                                                         |
| <i>Mico schneideri</i> sp. n. (n=14) | INPA: <b>7293*, 7294*, 7295*</b> ; MPEG: <b>24595, 24596, 24606, 24608, 24609, 24610, 24611</b> ; UFMT: <b>3851, 3852, 4833, 4834</b> .                                                                                                                                                                                                                                                                                                                |

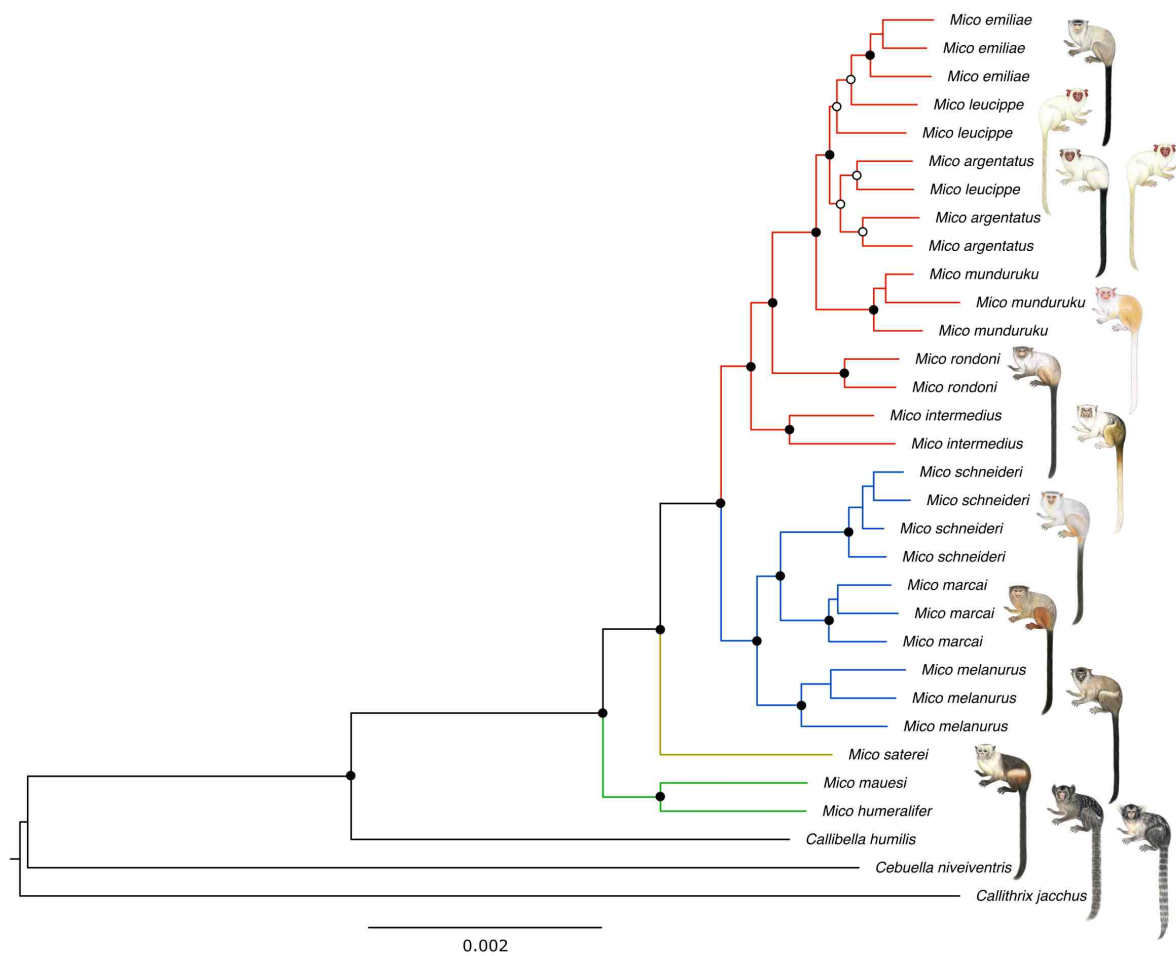
Supplementary Table S6. Specimens stored in the collections of the Coleção de Tecidos de Genética Animal (CTGA) of the Universidade Federal do Amazonas, Instituto Nacional de Pesquisas da Amazônia (INPA), Instituto de Desenvolvimento Sustentável Mamirauá (IDSM), Museu Paraense Emílio Goeldi (MPEG), Universidade Federal do Mato Grosso (UFMT), and Universidade Federal de Rondônia (UNIR) sampled to generate genomic DNA sequences (ddRAD) for phylogenetic analysis.

| Taxon                         | Specimens                                  |
|-------------------------------|--------------------------------------------|
| <i>Callibella humilis</i>     | INPA 4090                                  |
| <i>Callithrix jacchus</i>     | CTGA 7017*                                 |
| <i>Cebuella niveiventris</i>  | CTGA 170                                   |
| <i>Mico argentatus</i>        | CTGA 434, 6015, 6016; MPEG 45605*†         |
| <i>Mico emiliae</i>           | INPA 7287*, 7289*, 7290*†; MPEG 45566*     |
| <i>Mico humeralifer</i>       | INPA 7282*                                 |
| <i>Mico intermedius</i>       | UFMT 4705; IDSM 792                        |
| <i>Mico leucippe</i>          | CTGA 5912*; MPEG 45564*, 45575*†, 45568*   |
| <i>Mico marcai</i>            | MPEG 43008, 45638, 45645                   |
| <i>Mico mauesi</i>            | CTGA 5881*                                 |
| <i>Mico melanurus</i>         | INPA 7283*, 7383*; UNIR 346                |
| <i>Mico munduruku</i>         | INPA 7284*, 7382*; MPEG 45559*, 45622†     |
| <i>Mico rondoni</i>           | MPEG 45620*; UNIR 556                      |
| <i>Mico saterei</i>           | INPA 4101                                  |
| <i>Mico schneideri</i> sp. n. | INPA 7293*, 7294*; MPEG 45573*; UFMT 4834. |

\*Specimens obtained for this research.

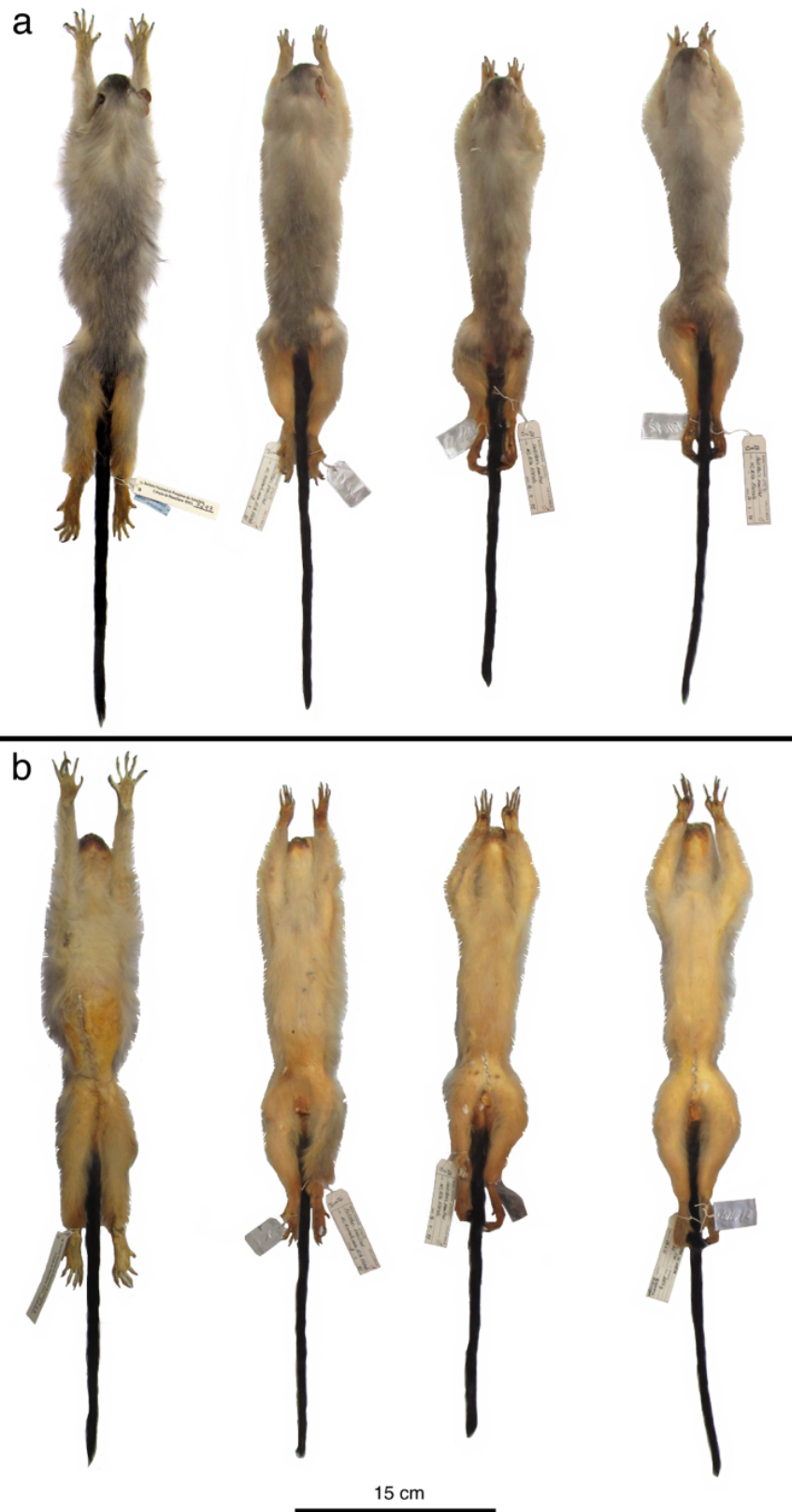
†Specimens included in path sampling analysis.

Supplementary Figure S7. Maximum Likelihood phylogeny of the genus *Mico* inferred with ddRAD data, indicating the four main lineages of this genus in distinct colours (black lines are outgroups). Clades supported are indicated by black circles, unresolved branches (<70% bootstrap proportion) are in white circles. Illustrations: Stephen Nash.



Supplementary Table S8. Geographical coordinates (*datum* WGS 84) here attributed to localities used to delimit species geographical distributions (see Figure 6). Bold=type specimens; asterisks=specimens examined for morphology data; crosses=specimens sampled for genomic data.

| Localities                                    | Coordinates            | Types of record     | References     | Specimen codes                                                                |
|-----------------------------------------------|------------------------|---------------------|----------------|-------------------------------------------------------------------------------|
| <i>Mico emiliae</i>                           |                        |                     |                |                                                                               |
| 1 Maloca, upper Curuá River—type locality     | 07°36'59"S, 54°52'00"W | preserved specimens | 12, this paper | <b>MPEG 170*</b> ;<br><b>NHM 20.7.14.12*</b>                                  |
| 2 Upper Curuá River, right margin             | 08°07'32"S, 54°59'46"W | preserved specimens | this paper     | MPEG 45566*†                                                                  |
| 3 Thaimaçu, left margin of São Benedito River | 09°03'06"S, 56°35'12"W | preserved specimens | 58, this paper | INPA 7288*, 7289*†, 7290†*                                                    |
| 4 Cachimbo highlands                          | 09°22'00"S, 55°00'00"W | preserved specimens | 48             | MPEG 37807*, 37808*,<br>37809*                                                |
| 5 Peixoto de Azevedo River                    | 10°13'02"S, 55°21'41"W | survey              | 17             | -                                                                             |
| 6 Sinop, right margin of Teles Pires River    | 11°50'10"S, 55°29'59"W | preserved specimen  | this paper     | INPA 7287*†                                                                   |
| 7 von der Steinen River                       | 13°15'41"S, 54°52'02"W | survey              | this paper     | -                                                                             |
| 8 Ronuro River                                | 13°18'19"S, 54°33'42"W | survey              | this paper     | -                                                                             |
| 9 Serra do Pardo National Park                | 05°48'03"S, 52°37'58"W | survey              | 59             | -                                                                             |
| <i>Mico schneideri</i> sp. n.                 |                        |                     |                |                                                                               |
| 10 Paranaíta city—type locality               | 09°41'21"S, 56°29'10"W | preserved specimen  | this paper     | <b>INPA 7293*†, 7294*†, 7295*</b>                                             |
| 11 Juruena                                    | 09°47'41"S, 58°11'43"W | survey              | this paper     | -                                                                             |
| 12 Alta Floresta                              | 09°58'57"S, 56°04'21"W | preserved specimen  | this paper     | <b>MPEG 24595*, 24596*,<br/>45573*†; UFMT 3851*, 3852*,<br/>4833*, 4834*†</b> |
| 13 Ouro-lândia                                | 10°23'26"S, 56°24'28"W | preserved specimen  | this paper     | <b>MPEG 24606*, 24608*,<br/>24609*, 24610*, 24611*</b>                        |
| 14 Sinop, left margin of Teles Pires River    | 11°27'48"S, 55°33'48"W | survey              | this paper     | -                                                                             |
| 15 Left margin of Verde River                 | 11°53'14"S, 55°52'18"W | survey              | this paper     | -                                                                             |
| <i>Mico melanurus</i>                         |                        |                     |                |                                                                               |
| 16 Tangará da Serra                           | 14°18'00"S, 57°44'00"W | survey              | 60             | -                                                                             |



Supplementary Figure S9. Intraspecific variation in pelage colour of *Mico schneideri* sp. n.: a. dorsal view; b. ventral view. Left to right: holotype (INPA 7293) and paratypes MPEG 24608, 24595, 24596.