**Supplemental material 6: character/taxon matrix**

**Key**—**A** = 0&1; **B** = 1&2; **C** =0&2.

*Protungulatum donnae* ?????????? ?????????? ????000?00 ??????0??? ?????????? ??0??????1 0??0000100 10002??111 001010?000 0000010001 00100000?? ?????????0 ?00110000? ?????????? ?????????? ?????????? ?????????? ?????????2 0000000012 0001000010 1100110211 ?????????? ?????

*Mithrandir gillianus* ???0?????? ?????????? ?????????? ?????????? ?????????? ???????210 0??00?00?? 10002??111 0C2010?000 1000010001 0110001001 0????0?110 1100000002 1????????? ?????????? ?000?00010 0000000302 0000000001 0000000012 0001000010 1100000211 0001000010 0110?

*Altacreodus magnus* ?????????? ?????????? ?????????? ?????????? ?????????? ?????????1 0100000101 1111100?10 0??000?000 1001100001 00001000?? ?????????? ?????????? ?????????? ?????????? ?????????? ?????????? ?????????? ?????????? ?????????? ?????????? ?????????? ?????

*Arfia* spp. ???1???1?? ?????????? ?????????? ?????????? ?????????? ?????0020A 01000000?? 1001011111 0000000000 0001110001 00100000?? ????200111 1201000002 ?010100100 011??????? ?0011000?? 000000?301 0011001111 2000000110 0101000011 1100100111 ?????????? ?????

*Prolimnocyon* spp. ???01??0?0 0000???00? ?0??000100 ??0???0??? ?0???????? ??????001A 0100A000?? 2001000000 000000?000 1001111000 1000100001 0???001100 0010100012 00?001?100 010000???? ?000111000 000?001201 ?110000001 0000000011 ?100000010 1100210111 0001000?00 0????

*Thinocyon* spp. 0?001?0000 0000010001 1000000100 0000000000 0000000000 00000?0001 01000000?? 2001000000 0000010000 1011111000 1000100010 0???001100 011010?002 000?0?0100 ?1101000?? ????111000 0000001211 101?0010?1 0000000001 1100000010 1100210111 00??0????? ?1??0

*Limnocyon* spp. 0100000000 0000010001 10?00001?? 0?0000???0 00?00?0?0? ??0??0000A 01000000?? 2001000000 0000011000 ?01111110A 1000100010 0???100100 0010000002 0111110100 ?11000000? ?000111021 0000001211 ?10???0001 0000000101 1100000010 1100201011 100?000?0? ?1100

*Galecyon* spp. ???0?????? ?????????? ????000100 ?????????? ?????????? ???????001 01001000?? 2011010000 00000??000 2001111000 1000000010 0???100111 011100000? ??????0100 0111010?00 ?000100000 0001????01 0000000112 0000000010 1101000010 1100110111 0001001111 0????

*Prototomus martis* ?????????? ?????????? ?????????? ?????????? ?????????? ?????????0 01010000?? 1001000000 000000?000 0001111000 00000000?? ?????????? ?????????? ?????????? ?????????? ?????100?0 000000?2?? ??10000011 0000000010 1100000010 1100100111 0001001100 01?0?

*Pyrocyon strenuus* ???01??1?? 00???????? ?????????? ?????????? ?0???????? ??????0??1 01000000?? 1001000000 000000?000 0001111000 1000000000 0???100110 ?11000?012 0010?1?100 010100???? ???111??00 0011001201 0000000111 1000000110 1100000010 100?100111 1001101000 01020

*Prototomus phobos* 0??0????00 ?01??????? ?????????? ?????????? ????0????? ??????0001 0101000??? ?001000000 100000?000 000111?000 10001000?? ????0001?? ?????????? ?100?????? ?????????? ??????1000 0001000201 000?0?0??1 0000000010 ?100000010 1100110111 0001001?00 0?1?0

*Tritemnodon agilis* 01001?0100 001000000? 10?00?0100 ?000000?00 ?0?00?0?0? ??0??00001 01010000?? B011000000 0000000001 0001111A00 10011000?? ?001100111 0111000002 000010?1?0 0110000000 0000111000 0011000201 0000000112 1000000110 1101000010 1100110111 0000000100 01120

*Sinopa* spp. 0??01?0100 001001000? 10?000010? ??0000000? 00?00?000? ?????00011 01000000?? 1001000101 A0000000AA 0001111001 00101000?? ????100111 0111000002 10101?0100 ?1????0?0? 0?01011000 0011001301 000?000111 1100000110 1101010010 1100100111 ?101001?0? ?11?A

*Tytthaena parrisi* ?????????? ?????????? ?????????? ?????????? ?????????? ?????????1 0100100101 1001000000 10000????? ???111?000 10000000?? ?????????? ?????????? ?????????? ?????????? ?????????? ?????????? ?????????? ?????????? ?????????? ?????????? ?????????? ?????

*Palaeonictis occidentalis* ???00??1?? ?????????? ?????????? ?????????? ?????????? ?????10011 01001000?? A001110100 1001010000 111A110000 0110010010 ????A0?0?0 110?00?002 0000100100 ??1???01?? ?002???0?? ????000011 ?00??????0 2000010002 000000?010 2101100101 1002210?00 0???0

*Dipsalidictis krausei* 0100100100 000001111? 0001010101 000000000? 00?00?0?00 ?????10001 0?00000101 1001000000 100001?000 1011111000 10000001?? ?????????? ?????????? ?????????? ?????????? ?????11?01 001000?10? ?0??2??0?0 0000010012 0000100000 210?110?11 0002210?10 001?0

*Oxyaena* spp. ???01??1?? ?????????? ?????????? ?????????? ?????????? ?????10011 1100A000?? 2001010000 A000010000 1011101000 1100000010 1???101000 1100000002 0000100100 011000001? 0002112031 0010000101 1000213000 0000010012 1000100000 2101110211 0002210110 00200

*Machaeroides* spp. 010001?110 0001111110 1?00?10100 000000?00? 00?00?0?00 ?????100A1 A1010000?? 1002010200 0?01011000 1011101100 1002??00?? ????211000 1111000002 00001?0000 ?11000101? ?002012?01 10000??1?? ?????????? ?????????? ?????????? ?????????? ?????????? ?????

CM 2386 ?????????? ?????????? ?????????? ?????????? ?????????? ?????????? ?????????? ?????????? ?????????? ?????????? ????????01 1???21???0 111?000002 0??????0?? 00???????? ?002011021 ?0?0000111 1100213000 2000010012 ?????00001 2102100011 0001210110 0???0

*Ictidopappus mustelinus* ?????????? ?????????? ?????????? ?????????? ?????????? ??????0001 11?00001?1 ?1??00??00 00000???00 21?0?01000 101100?1?? ?????????? ?????????? ?????????? ?????????? ?????????? ?????????? ?????????? ?????????? ?????????? ?????????? ?????????? ?????

*Protictis haydenianus* ???0???0?? ?????????? ?????????? ?????????? ?????????? ?????000A1 1000100101 21102???11 0000010011 2110200000 00100001?? ?????????? ?????????? ?????????? ?????????? ?????????? ?????????? ?????????? ?????????? ?????????? ?????????? ?????????? ?????

*Bryanictis microlestes* ???0?????? ?????????? ?????????? ?????????? ?????????? ???????0A1 1000100100 21102??111 A01001?011 2110200001 00A00001?? ?????????? ?????????? ?????????? ?????????? ?????????? ?????????? ?????????? ?????????? ?????????? ?????????? ?????????? ?????

*Simpsonictis* spp. ?????????? ?????????? ?????????? ?????????? ?????????? ?????????1 A000100100 2011B00010 00A0???0AA 211A10000A 001A0001?? ?????????? ?????????? ?????????? ?????????? ?????????? ?????????? ?????????? ?????????? ?????????? ?????????? ?????????? ?????

*Viverravus schaffi* ?10101?110 100000?002 1000000000 0001000001 0??000?000 ??0??00001 1000100101 21102??011 0000010011 2111200001 00000001?? ?????????? ?????????? ?????????? ?????????? ?????????? ?????????? ?????????? ?????????? ?????????? ?????????? ?????????? ?????

*Viverravus minutus* ??0101?1?? 10?0000002 1000000000 0021001001 ?0??000000 ??0?????0? 1000100??? ??00???21? 0?00010011 2110200000 10010001?? ?????????? ?????????? ?????????? ?????????? ?????????? ?????????? ?????????? ?????????? ?????????? ?????????? ?????????? ?????

*Viverravus gracilis* ????0??100 10000100?? 1?00000000 0001001001 ?0??000000 ??0?????01 1000100??? ?20????21? 0?00010011 21102?0?00 10010001?? ????00???0 1000000002 ?11001???? ?????????? ?012011000 1000001300 01010?0101 2?0102?000 01010????? ?????????? ?????????? ?????

*Viverravus acutus* ??0001?110 10000000?2 1010000000 00?1001001 00100?0000 000???0101 1000100100 21102??010 0000010011 2110201000 0001000101 0???00?100 ?00?000002 0?????0000 ?2?01????? ??1?0?1?00 1000????10 0101001101 1001120000 01010?0010 010?0?0?11 ?????????? ?????

*Didymictis* spp. 0??00??110 0002000?0? 1000000?00 1001101000 ????000000 ??0??00001 1000100101 21102??A11 0200010011 2110200000 0010000110 0???200111 1201000003 1111100100 0210110101 ?010000010 1000001302 0001001111 1101000100 0102010010 0010001211 0000100110 02011

*Uintacyon gingerichi* ?????????? ?????????? ?????????? ?????????? ?????????? ??????0000 1000100110 111110?000 10000????? ?1?1200000 10011000?? ?????????? ?????????? ?????????? ?????????? ?????????? ?????????? ?????????? ?????????? ?????????? ?????????? ?????????? ?????

*Uintacyon massetericus* ???1???1?? 0010?1?1?? 1000010101 0??0000??? ?????????? ?????????0 100110010A 111110?000 0B000??000 2100200000 1002??1000 1???0110?0 0010110000 0????????? ?????????? ??0011?021 0010?????? ??00112000 0000020002 0100100100 2100210100 ?????????? ?????

*Vassacyon promicrodon* ???1?????? ?????????? ?????????? ?????????? ?????????? ??????0200 1000100100 111A100A01 A0B010?000 2101200000 100A101000 1???0010?0 ?010001000 0100??0001 ?1?0001?10 ?????12021 ????001011 ?0??110??? 0?000????2 ?00??0010? ?10?????0? 1002010110 0???1

*Gracilocyon* spp. ?????????? ?????????? ?????????? ?????????? ?????????? ?????????? ??????0101 11111000?0 00000??000 2101100000 10011000?? ?????????? ?????????? ?????????? ?????????? ?????????? ?????????? ?????????? ?????????? ?????????? ?????????? ?????????? ?????

*Dormaalocyon latouri* ?????????? ?????????? ?????????? ?????????? ?????????? ???????000 1000100101 1111B00011 001000?000 2101100000 10011010?? ?????????? ?????????? ?????????? ?????????? ?????????? ?????????? ?????????1 0000020002 0100100100 210?210111 ?????????? ?????

*Vulpavus australis* ???1?????? ?????????? ?????????? ?????????? ?????????? ??????000A 100A100100 B1002??111 A010A0?000 1100210001 0010101000 1???0110?0 ?0?0110000 000011?001 000???001? ?001112021 0010001011 1000112000 00000200A2 0100100100 2100210100 1102010110 0010?

*Vulpavus ovatus* 1111110000 0010001101 1001010101 00?0000011 0??0000000 ??0??01201 0000100100 1100100111 1010000100 110?2?0000 ???????0?? ?????????? ?????????? ?????????? ?????????? ?????????? ?????????? ?????????? ?????????? ?????????? ?????????? ?????????? ????1

*Vulpavus profectus* 11101??100 0010010110 0100000101 0000001010 0??0000000 ??0??10201 0000100100 11102??101 AC20100001 1100211001 0000001000 1???01?0?0 0010011000 0000111000 ??000010?? ?????????? ????00?011 1000110001 0000020002 0100100?0? 21002?0100 ?1020????? ?0??1

*Vulpavus palustris* ?1111????? ?????????? ?????????? ?????????? ?????????? ??????0??1 0?001000?? 11102??101 A220100??0 ?1?????001 ?01?00???? ?????????? ?????????? ?????????? ?????????? ?????????? ?????????? ?????????? ?????????? ?????????? ?????????? ?????????? ?????

*Oodectes jepseni* ?????????? ?????????? ?????????? ?????????? ?????????? ???????200 1001100100 11111010?0 000000?000 2100210000 10011010?? ?????????? ?????????? ?????????? ?????????? ?????????? ?????????? ?????????? ?????????? ?????????? ?????????? ?????????? ?????

*Oodectes herpestoides* 1011100000 0010001102 1001000101 0000000010 00?0000000 ??0??00200 0000100100 111010?000 1100000000 1101110000 10011000?? ???00?10?0 ?000111100 00001??000 ?1100????? ?????11021 ???0001011 1?0?1??0?? ?????????? ??????0??? 210?2?0??0 ?????????? ????1

*Miacis exiguus* ?????????? ?????????? ?????????? ?????????? ?0???????? ??????0000 10011001A0 B110100001 A00000?000 2101210000 00001010?? ?????????? ?????????? ?????????? ?????????? ?????????? ?????????? ?????????? ?????????? ?????????? ?????????? ?????????? ?????

*Miacis petilus* ?????????? ?????????? ?????????? ?????????? ?????????? ???????000 1001100100 11102??001 0000???000 210A200000 10001010?? ????01?000 001010100? ???????000 0?1000???? ??00?11021 0010001001 10001120A0 0000020002 0100?????? ?????????? ?????????? ?????

*Miacis parvivorus* ?011?????? 0013??0101 1000000101 00000?0010 ????00?000 ??0??00C00 1001100100 111A2??001 A010A0000A 2101200000 10001010?? ?????????? ?????????? ?????????? ?????????? ?????????? ?????????? ?????????? ?????????? ?????????? ?????????? ?????????? ????1