SOM S2

Characters and character states used in the phylogenetic analysis.

Characters followed by an asterisk are "ordered." Ordered characters are scaled by the number of character states, such that the sum of the steps in the morphocline equals 100. This weight is indicated as “weight = number”. To maintain consistency for more broadly-based phylogenetic analyses, I include many characters that may be invariable in platyrrhines but are informative within Anthropoidea or Primates as a whole. Likewise the weighting scheme is based upon the broader context of living and fossil primate taxa.

Except as noted, characters of the cranium and permanent teeth are those used in Kay et al. (2008a). New or emended characters of the cranium or permanent teeth are commented upon. Marivaux et al. (2016). Some dental characters used previously by Kay were replaced by Marivaux et al. (2016). We follow these recommendations here; the struck characters are crossed through in this character list and Marivaux’s new characters (numbers 400-424) are appended at the end of the file.

Cranial characters adopted from Horovitz (1999) and Kay et al. (2004b) are so designated. Many cranial and dental characters not specifically referenced are drawn from the following sources: (Forsyth-Major, 1901; Pocock, 1925; Hill, 1957; Clark, 1959; Du Brul, 1965; Hershkovitz, 1974; Hershkovitz, 1977; Cartmill, 1978; Rosenberger, 1979; Conroy, 1981; MacPhee and Cartmill, 1986; Ross, 1993; Kay, 1994; Ross, 1994; MacPhee et al., 1995; Horovitz, 1997; Kay et al., 1997; Ross et al., 1998; Horovitz, 1999; Horovitz and MacPhee, 1999; Kay and Kirk, 2000; Lieberman et al., 2000; Kay et al., 2006; Rossie, 2006)

Characters and character states of the deciduous teeth are based on Kay and Meldrum (1997).

Postcranial character and character states are drawn from sources indicated in the comments. The most abundant sources for postcranial characters are the comparative studies of Dagosto, Fleagle, Ford, Gebo, Horovitz, and Seiffert especially (Fleagle and Simons, 1978, 1979; Ford, 1980b; Ford, 1986; Fleagle and Kay, 1987; Fleagle and Meldrum, 1988; Dagosto, 1990; Dagosto and Gebo, 1994; Ford, 1994; Dagosto and Schmid, 1996; Horovitz, 1999; Simons and Seiffert, 1999; Gebo et al., 2000; Seiffert and Simons, 2001). These characters are commented upon at greater length because many are either new or highly modified from other workers.

Cranial characters

Paranasal Sinuses

1. (Weight= 100). Ethmofrontal sinus (Type II (Rossie, 2006)): 0= present; 1= absent

2. (Weight= 100). Sphenofrontal sinus (Type I (Rossie, 2006)): 0= present; 1= absent

3. (Weight= 100). Maxillary sinus: 0= present; 1= absent

4. (Weight= 100). Anterior ethmoidal sinus: 0= present; 1= absent

5. (Weight= 100). Sphenoidal sinus: 0= present; 1= absent

Zygomatic region

6.* (Weight= 50). Zygomaticofacial foramen (character 27 in Horovitz, 1999): 0= small relative to M^1 breadth; 1= large relative to M^1 breadth; 2= very large relative to M^1 breadth.

7. (Weight= 100). Zygomatic arch position (character 23 in Horovitz, 1999): 0= above the alveolar border of the maxilla; 1= below the alveolar border.

8. (Weight= 100). Extent of inferior orbital fissure (character 84 in Horovitz, 1999): 0= ventrolateral limit of the inferior orbital fissure does not reach the zygomatic arch; 1= the ventrolateral limit of the inferior orbital fissure reaches the zygomatic arch.

9. (Unordered; weight= 100). Zygomatico-parietal contact at pterion (cranial character 46 in Kay et al., 2004b): 0= no postorbital closure; 1= zygomatico-parietal contact; 2= alisphenoid-frontal contact.

Lacrimal Region

10. (Weight= 100). Position of lacrimal foramen (cranial character 30 in Kay et al., 2004b): 0= outside orbital margin; 1= within the orbit or on the rim.

11.* (Weight= 50). Extra-orbital exposure of the lacrimal: 0= lacrimal fossa is completed anteriorly by maxillary; 1= lacrimal has some facial exposure; 2= lacrimal contacts nasal (excludes maxillary-frontal contact).

12. (Weight= 100). Zygomatic-lacrimal contact (cranial character 26 in Kay et al., 2004b): 0= present on ventral orbital rim; 1= absent on ventral orbital rim.

13. (Unordered; weight= 100). Contact between lacrimal and palatine bones (cranial character 28 in Kay et al., 2004b): 0= contact present; 1= lacrimal and palatine separated; contact between frontal and maxilla (or in some taxa, by a small *os planum* of the ethmoid); 2= separated by a large *os planum*.

Facial region

14.* (Weight= 50). Position of the infraorbital foramen relative to the Frankfurt horizontal plane (character 26 in Horovitz, 1999): 0= posterior to P^4; 1P= positioned above P^4 through P^3; 2= positioned above P^2.

15.* (Weight= 50). Angle of cranial kyphosis (Lieberman et al., 2000): 0= <= 140 degrees; 1= >140 degrees; <155 degrees; 2=>=155 degrees.

16. (Weight= 100). Nasal fossa width (character 25 in Horovitz, 1999): 0= narrower than the palate width; 1= broader than the palate width.

17. (Weight= 100). Nasal capsule (Maier, 1980): 0= Processus alaris superior present; 1= Processus alaris superior absent.

18. (Weight= 100). Snout length (cranial character 37 in Kay et al., 2004b): 0= long snout; 1= short snout.

19. (Weight= 100). Maxilla depth (cranial character 38 in Kay et al., 2004b): 0= deep; 1= shallow.

20. (Weight= 100). Inter-incisor diastema width (cranial character 42 in Kay et al., 2004b): 0= broad and wider than that of extant haplorhines; 1= narrow, haplorhine-like.

21: (Weight= 100). Ascending wing of premaxilla (cranial character 49 in Kay et al., 2004b): 0= narrow; 1= broad.

Temporomandibular region

22.* (Weight= 50). Postglenoid foramen (character 12 in Horovitz, 1999): 0= absent; 1= small; 2= large.

23. (Weight= 100). Temporomandibular joint morphology (cranial character 40 in Kay et al., 2004b): 0= biconcave and transversely wide; 1= antero-posteriorly oriented trough.

24.* (Weight= 50). Postglenoid process size (100 times postglenoid process length divided by prosthion-inion length) (cranial character 41 in Kay et al., 2004b): 0= weak or absent (<0.39); 1= strong (=>0.39, <0.69); 2= very strong (=>0.69).

Pterygoid and palatal region

25.* (Weight= 50). Palate shape: 0= v-shaped (the distance between lingual surfaces of the upper canines divided by the between the lingual surfaces of the upper second molars is <0.39); 1= intermediate (ratio values of => 0.39; =< 0.64; 2= approaches parallel (ratio values > 0.64).

26. (Weight= 100). Interpterygoid fossa (Du Brul, 1965): 0= deep;1= shallow.

27.* (Weight= 50). Length of medial pterygoid plate cranial character 36 (in Kay et al., 2004b): 0= long medial pterygoid plate extending one-third to one half of the distance to the anterior surface of the bulla enclosing a large fossa between medial and lateral pterygoids; 1= short but distinct from lateral pterygoid plate for its entire dorsoventral extent. Ventrally there is a hamular process; more dorsally the plate merges with the lateral plate or if distinct, the fossa is slit-like; 2= medial pterygoid plate entirely absent, or reduced to a low rugosity. Only the hamulus is present.

28. (Unordered; weight= 100). Encroachment of the auditory bulla on the pterygoid fossa (cranial character 17 in Kay et al., 2004b): 0= no encroachment; 1= encroachment by the anterior accessory cavity; 2= present and formed by the tympanic cavity.

29. (Unordered; weight= 100). Nature of contact between the lateral pterygoid plate and the bulla wall (cranial character 18 in Kay et al., 2004b) : 0= absent; 1= laminar; 2= abutting.

30. (Weight= 100). Extent of contact between the lateral pterygoid plate and the bulla wall (cranial character 19 in Kay et al., 2004b): 0= slight; 1= or very extensive.

31. (Weight= 100). Pyramidal process of palate and post-alveolar notch: 0= no post-alveolar notch between the pyramidal process and the maxillary tuberosity; 1= offset from maxillary tuberosity by a distinct post-alveolar notch.

32.* (Weight= 50). Mediolateral position of pyramidal processes (100 times the ratio of inter-pyramidal breadth to outer M1 palate breadth) (cranial character 35 in Kay et al., 2004b): 0= medially placed (=<43); 1= intermediate (>43; =<64) 2= laterally placed (>64).

33. (Weight= 100). Posterior palatine torus (cranial character 34 in Kay et al., 2004b): 0= present; 1= absent.

34.* (Weight= 50). Posterior nasal spine (cranial character 33 in Kay et al., 2004b): 0= reduced or absent; 1= small but distinct; 2= robust and long.

35. (Weight= 100). Posterior extent of the turbinals: 0= extend posterior to the palatine; 1= completely anterior to the palatine.

36. (Weight= 100). Angle of the incisive canal in palate: 0= obliquely oriented with respect to the plane of the palate; 1= more closely resembles a right angle with the palate.

Temporal fossa

37. (Weight= 100). Temporal emissary foramen (character 20 in Horovitz, 1999): 0= Present and large; 1= Small or absent.

Nuchal region

38.* (Weight= 50). Paroccipital processes: 0= forms a distinct shelf or process; 1= forms a raised ridge; 2= weak or absent.

39. (Weight= 100). Pneumatization of mastoid (cranial character 3 in Kay et al., 2004b): 0= absent; 1= present.

Orbital region

40.* (Weight= 50). Lateral cranial profile at glabella: 0= depressed; 1= flat; 2= convex.

41. (Weight= 100). Interorbital fenestra: 0= absent;1= present.

42.* (Weight= 50). Size of orbits (cranial character 23 in Kay et al., 2004b): 0= small; 1= large; 2= extremely large.

43. (Weight= 50). Orbital convergence (Ross, 1996): 0= less than 55 degrees; 1= 55 to 65 degrees, 2= greater than 65 degrees.

44.* (Weight= 50). Interorbital breadth: 0= narrow;1= broad; 2= extremely broad.

45.* (Weight= 100). Exposure of vomer in orbit: 0= unexposed; 1= exposed.

46. (Weight= 100). Postorbital closure (cranial character 24 in Kay et al., 2004b): 0= none; 1= postorbital bar present; 2= postorbital septum present.

47. (Weight= 100). Composition of the postorbital septum (cranial character 25 in Kay et al., 2004b): 0= zygomatic forms most of the septum; 1= frontal forms most of the septum.

48. (Weight= 100). Position of interorbital constriction relative to olfactory tract. Cranial character 27 in Kay et al. (2004b): 0= absent; 1= present below olfactory tract.

49. (Weight= 100). Foramen rotundum (Kay et al. (2004c) cranial character 29): 0= superior orbital fissure transmits maxillary nerve; 1= separate foramen (f. rotundum) for maxillary nerve.

50. (Weight= 100). Metopic suture in adults (cranial character 31 in Kay et al., 2004b): 0= unfused; 1= fused.

Ear region

51. (Weight= 100). Cochlear housing as exposed in middle ear (character 15 in Horovitz, 1999): 0= singular; 1= dual.

52. (Weight= 100). Trans-bullar septa (character 14 in Horovitz, 1999): 0= ventrolateral region of middle ear without septa; 1= anteroventral region with septa.

53. (Unordered; weight= 100). Transverse septum arising from the cochlear housing (cranial character 1 in Kay et al., 2004b): 0= Absent; 1= present and forming the lateral wall of an anterior accessory cavity pneumatized from the tympanic cavity; 2= present and forming the lateral wall of an anterior accessory cavity pneumatized from the epitympanic recess.

54. (Weight= 100). Extent of pneumatization of anterior accessory cavity (cranial character 2 in Kay et al., 2004b): 0= Anterior accessory cavity lies anterior to the tympanic cavity and is not trabeculated; 1= anterior accessory cavity extends medial to the tympanic cavity, and is trabeculated.

55. (Weight= 100). Presence or absence of perbullar pathway for the internal carotid artery cranial character 4 in Kay et al. (2004b): 0= absent; 1= present and formed exclusively by the petrosal bone.

56. (Weight= 100). Anteroposterior location of posterior carotid foramen in bulla(cranial character 5 in Kay et al., 2004b): 0= Posterior to line joining midpoints of tympanic bones; 1= anterior to this line.

57.* (Weight= 50). Mediolateral position of posterior carotid foramen in bulla (cranial character 6 in Kay et al., 2004b): 0= medial; 1= midline of the bulla; 2= lateral.

58. (Weight= 100). Ventro-dorsal position of the carotid foramen in the bulla (cranial character 7 in Kay et al., 2004b): 0= dorsal, adjacent to basioccipital or mastoid bone; 1= ventral.

59. (Weight= 100). Position of posterior carotid foramen relative to fenestra cochleae (cranial character 8 in Kay et al., 2004b): 0= posterior; 1= ventral; 2= anterior.

60. (Weight= 100). Position of the internal carotid canal relative to the fenestra cochleae (cranial character 9 in Kay et al., 2004b): 0= runs across ventral lip of the fenestra cochleae, shielding it from ventral view when a canal is present; 1= internal carotid canal does not shield the fenestra cochleae from ventral view.

61. (Weight= 100). Position of the portion of the internal carotid /promontory artery (or its accompanying nerves) lying on the promontorium anterior to the fenestra cochleae (cranial character 10 in Kay et al., 2004b): 0= on ventrolateral surface of promontorium; 1= contacting only the cupula of the cochlea.

62. (Unordered; weight= 100). Size of stapedial and promontory canals (cranial character 11 in Kay et al., 2004b): 0= both stapedial and promontory canals are large; 1= stapedial slightly smaller than promontory; 2= stapedial highly reduced or absent altogether; 3= stapedial larger than promontory; 4= both promontory and stapedial canals absent.

63. (Weight= 100). Morphology of promontory canal, when present (cranial character 12 in Kay et al., 2004b): 0= open trough; 1= complete canal.

64. (Weight= 100). Canal for internal carotid artery or nerves (cranial character 13 in Kay et al., 2004b): 0= absent; 1= present.

65. (Weight= 100). Position of ventral edge of the tympanic bone (cranial character 14 in Kay et al., 2004b): 0= intrabullar, or aphaneric; 1= extrabullar or phaneric.

66. (Weight= 100). The shape of the tympanic bone (cranial character 15 in Kay et al., 2004b): 0= ribbon-like or only slightly expanded; 1= laterally expanded into a collar or tube.

67. (Unordered; weight= 100). Morphology of annular bridge (cranial character 16 in Kay et al., 2004b): 0= Linea semicircularis or partial annular bridge formed on the entotympanic bulla; 1= Linea semicircularis formed on the petrosal bulla; 2= a complete annular bridge present.

68. (Weight= 100). Flange of basioccipital overlapping medial bulla wall (cranial character 20 in Kay et al., 2004b): 0= absent or minimal; 1= extensive.

69. (Weight= 100). Basioccipital stem (character of Beard and MacPhee, 1994): 0= narrow; 1= broad.

70. (Weight= 100). Suprameatal foramen (cranial character 21 in Kay et al., 2004b): 0= absent; 1= present, small and in the posterior root of the zygomatic arch; 2= present, large, and above the external auditory meatus.

71. (Weight= 100). Patent parotic fissure (cranial character 22 in Kay et al., 2004b): 0= present; 1= absent.

72. (Weight= 100). Enclosure of intratympanic portion of facial nerve in a bony canal (cranial character 47 in Kay et al., 2004b): 0= no canal, facial runs in a sulcus; 1=bony canal present.

73. (Weight= 100). Epitympanic crest (cranial character 48 in Kay et al., 2004b): 0= absent; 1= present.

Brain and internal cranial characters

74. (Weight= 100). Tentorium cerebelli ossification (character 13 in Horovitz, 1999): 0= absent; 1= present.

75. (Weight= 100). Vascular canal connecting sigmoid sinus with subarcuate fossa (Cartmill's canal of Kay et al., 2008b) (character 17 in Horovitz, 1999): 0= absent; 1= present.

76.* (Weight= 50). Size of olfactory bulbs (data in Kay et al., 2004a): 0= large olfactory lobe; 1= moderate olfactory lobe; 2= small olfactory lobe.

77.* (Weight= 50). Relative brain size: 0= small; 1= large; 2= very large.

Mandible

78. (Weight= 100). Symphyseal orientation: 0= more horizontal orientation of *planum alveolare*; 1= more vertically oriented relative to *planum alveolare*.

79.* (Weight= 50). Lateral profile of mandible (ratio of mandible depth (measured buccally) at P_2 and M_2): 0= superior and inferior border of the mandibular corpus are essentially parallel from the premolar to the mandibular angle (=< 1.26); 1= inferior border deepens posteriorly (>1.26; =< 1.72); 2= 'hyper-deep' (>1.72).

80. (Weight= 100). Mandibular corpus depth (cranial character 45 in Kay et al., 2004b): 0= shallow; 1= deep.

81. (Weight= 100). Symphyseal fusion in young adult (cranial character 39 in Kay et al., 2004b): 0= absent; 1= present.

82.* (Weight= 50). Coronoid height relative to condyle: 0= very far above condyle; 1= above the level of condyle; 2= slightly above or equal to coronoid.

83.* (Weight= 50). Condyle height relative to tooth row (cranial character 44 in Kay et al., 2004b): 0= at level of tooth row; 1= slightly above; 2= well above tooth row.

84.* (Weight= 50). Angle of the mandible: 0= hook-shaped angle; 1= moderately expanded angle; 2= extremely expanded angle.

85. (Weight= 100). Depth of the coronoid-condylar notch: 0= deep; 1= shallow.

Permanent dentition

Lower incisors

86. i1.* (Weight= 33). Lower incisor number: 0= three; 1= two; 2= one: I_1 present, I_2 absent; 3= lower incisors absent.

87. i2. (Weight= 100). Lower incisor occlusal arrangement: 0= edges wear flat producing an arcuate battery from lateral perspective; 1= cusp tips staggered.

88. i3. (Weight= 100). Lower incisor crown spacing: 0= no spaces; 1= spaces present between crowns.

89. i4. (Weight= 100). I_2-C_1 diastema: 0= present; 1= absent. Comments: The presence of a diastema is variable in platyrrhines and never exceeds in breadth the mesiodistal dimension of the I_2.

90. i5.* (Weight= 50). I_{1-2} size (ratio of I_{1-2} area to M_2 area): 0= very small (=<0.69); 1= moderate sized (=>0.70, =<1.07); 2= large (>1.07).

91. i6.* (Weight= 33). I_1: I_2 proportions (ratio of I_1 area to I_2 area): 0= I_1 much smaller than I_2 (<0.71); 1= I_1 smaller than I_2 (=>0.71, <0.78); 2= I_1 almost as large as I_2 (=>0.78, <1.00); 3= I_1> I_2 (=>1.01).

92. i7.* (Weight= 50). I_1 crown width (spatulate incisors only): 0= considerably wider (m-d) than root (spatulate): 1= narrow at apex, but still wider than root; 2= "styliform" (crown apex approximately the same width as the cervical margin).

93. i8. (Weight= 100). I_2 crown cross-sectional shape (ratio of m-d length to b-l breadth): 0= rounded oval (=>0.64); 1= mesiodistally compressed (<0.64).

94. i9.* (Weight= 50). Lower incisor crown height (crown heights judged from cemento-enamel junction to crown tip on the buccal surface): 0= low crowned; 1= moderately high crowned; 2= high crowned.

95. i10. (Weight= 100). I_{1-2} crown buccal outline: 0= gently curved in lateral perspective; 1= acutely curved.

96. i11.* (Weight= 50). Lower incisor roots: 0= erect or vertical; 1= slightly procumbent; 2= very procumbent.

97. i12.* (Weight= 50). Lower incisor crowns: 0= erect or vertical; 1= procumbent; 2= very procumbent.

98. i13.* (Weight= 50). Tooth comb: 0= absent; 1= with three teeth; 2= with two teeth.

99. i14. (Weight= 100). I_1 crown shape: 0= spatulate; 1= lanceolate, pointed.

100. i15. (Weight= 100). I_2 heel development (a lingual swelling at the base of crown): 0= heel absent; 1= heel present.

101. i16. (Weight= 100). Incisor lingual enamel: 0= well developed; 1= poorly developed or absent.

102. i17.* (Weight= 50). Lower incisor lingual cingulum: 0= absent to weak; 1= strong but incomplete; 2= strong and complete.

103. i19.* (Weight= 50). I_1 area to M_1 area: 0= I_1 very small (ratio =< 0.32); 1= moderately enlarged (>0.32, <=0.40); 2= very enlarged (> 0.40).

Lower canines

104. c1.* (Weight= 33). Female C_1 size (area relative to molars): 0= very small (C_1/ M_1 <0.40); 1= moderate (=>0.4, <0.80); 2= large (=>0.80, <=1.20); 3= very large (=>1.20)

105. c2.* (Weight= 50). C_1 dimorphism (square root male C_1 area divided by square root of female C_1 area): 0= low (<1.07); 1= moderate (>=1.07, <1.17); 2= high (>=1.17).

106. c3. (Weight= 100). C_1 cross-sectional shape: 0= rounded oval mesiodistal length/buccolingual breadth>1.00, < 1.90; 1= mesiodistally compressed (ratio => 1.90.

107. c4. (Weight= 100). C_1 lingual crest development: 0= rounded; 1= sharp.

108. c5. (not ordered; Weight= 100). Canine paracristid (not scored if species has canine incorporated into a tooth comb): 0= oblique to occlusal plane; 1= nearly horizontal to occlusal plane; 2= forms part of cropping mechanism with i1-2.

109. c6.* (Weight= 50). Canine height (females): 0= low, squat; 1= narrow, short; 2= tall, at or above tooth row.

Lower premolars

110. p1. (Weight= 100). $P^1/_1$: 0= present; 1= absent

111. p2. (Weight= 100). P_2: 0= present; 1= absent.

112. p3. (Weight= 100). P_2 roots: 0= single; 1= double.

113. p4.* (Weight= 50). $P_{3\text{-}4}$ roots: 0= P_3 single, P_4 single; 1= P_3 single, P_4 double; 2= P_3 double, P_4 double.

114. p5.* (Weight= 50). Premolar crowding (overlapping of crowns): 0= no crowding; 1= slightly crowded; 2= very crowded.

115. p6.* (Weight= 50). P_3 paraconid: 0= large; 1= small; 2= absent or extremely small.

116. p7.* (Weight= 50). P_4 paraconid: 0= large; 1= small; 2= absent or extremely small.

117. p9.* (Weight= 33). P_4 paraconid position: 0= mesial to protoconid; 1= mesiolingual, between protoconid and metaconid; 2= mesial to metaconid; widely spaced from metaconid; 3= twinned with metaconid.

118. p11.* (Weight= 50). P_{3-4} cristid obliqua: 0= absent; 1= weak; 2= strong.

119. p13. (not ordered; Weight= 100). P_2 protoconid height and shape: 0= slender, projects above protoconids of P_{3-4}; 1= massive, projects above protoconids of P_{3-4}; 2= not projecting, in line with P_3; 3= extremely short, shorter than P_3.

120. p14. (Weight= 100). P_4 metaconid position: 0= close to protoconid; 1= widely spaced from protoconid.

121. p15.* (Weight= 50). P_2 metaconid size: 0= absent or trace; 1= small; 2= large.

122. p16.* (Weight= 50). P_3 metaconid size: 0= absent or trace; 1= small; 2= large.

123. p17.* (Weight= 50). P_4 metaconid size: 0= absent or trace; 1= small; 2= large, almost as tall as protoconid.

124. p18. (Weight= 100). P_4 trigonid-- lingual wall: 0= basin closed by a premetacristid; 1= open with premetacristid absent or short.

125. p19.* (Weight= 50). P_3 entoconid and lingual talonid crest: 0= absent; 1= lingual talonid crest present but an entoconid does not stand out above it; 2= entoconid is a small discrete cusp.

126. p20.* (Weight= 50). P_4 entoconid and lingual talonid crest: 0= absent; 1= lingual talonid crest present but an entoconid does not stand out above it; 2= entoconid is a small discrete cusp.

127. p21. (Weight= 100). P_4 lateral and medial protocristid: 0= continuous between metaconid and protoconid; 1= discontinuous between metaconid and protoconid.

128. p22. (Weight= 100). P_3 lateral protocristid orientation: 0= transversely oriented; 1= distolingually oriented.

129. p23a. (Weight= 100). P_4 lateral protocristid: 0= present; 1= absent.

130. p23. (Weight= 100). P_4 lateral protocristid orientation: 0= transversely oriented; 1= distolingually oriented.

131. p24. (Weight= 100). P_{3-4} posterior trigonid wall: 0= complete [taxa without metaconids are assigned this character state]; 1= deeply notched

132. p25. (Weight= 100). P_{3-4} hypoconid size: 0= large; 1= cristiform, small, or absent.

133. p26. (Weight= 100). P_{3-4} hypoconid (or distal terminus of oblique cristid) position: 0= distal to protoconid; 1= distal to metaconid, or between protoconid and metaconid.

134. p26a. (Weight= 100). P_4 talonid breadth: 0=narrow; 1=broad.

135. p27. (Weight= 100). P_4 hypocristid shearing development: 0= weak or absent; 1= strong.

136. p28.* (Weight= 50). P_2 buccal cingulum development: 0= absent; 1= incomplete, broken at protoconid and hypoconid; 2= complete.

137. p29. (Weight= 100). Lower premolar inflation: 0= cusps marginal, not basally inflated; 1= crown surfaces constricted, cusp margins sloping.

138. p30.* (Weight= 50). P_4 exodaenodonty: 0= not exodaenodont; 1= slightly exodaenodont; 2= very exodaenodont.

139. p31.* (Weight= 33). P_4 talonid length (ratio of midline m-d length of trigonid to m-d length of talonid): 0= extremely short or non-existent (trigonid length/ talonid length) => 1.61); 1= short (much shorter than trigonid) (tri:tal => 1.27; < 1.61); 2= equal or slightly shorter in length to trigonid (tri:tal => 0.92; < 1.27); 3= talonid longer than trigonid (tri:tal < 0.91).

140. p34. (Weight= 100). P_4 anterobuccal cingulum development: 0= absent or trace; 1= strong.

141. p36.* (Weight= 50). P_4 postprotoconid ridge: 0= weak or absent; 1= present; 2= very strong.

142. p37.* (Weight= 50). P_4 postmetaconid ridge: 0= weak or absent; 1= moderate; 2= very strong.

143. p40.* (Weight= 50). P_4 paraconid height: 0= low; 1= moderate; 2= high (nearly as high as protoconid).

144. p41.* (Weight= 50). $P_{3\text{-}4}$ protoconid height: 0= P_3 much lower than P_4; 1= P_3 equal or slightly lower than P_4; 2= P_3 higher than P_4.

145. p42.* (Weight= 25). Ratio of P_3 to P_4 area: 0= 0.45-0.59; 1= 0.60-0.69; 2= 0.70-0.79; 3= >0.80, <1.10; 4, => 1.10.

146. p43.* (Weight= 20). P_4 m-d L/ b-l W: 0= (<0.95); 1= (=>0.96, <1.14); 2= (=>1.15, <1.20); 3= (=> 1.21, <1.35; 4= (=> 1.36, <1.46); 5= (>1.47).

147. p44.* (Weight= 20). P_4 to M_1 area: 0= (<0.62); 1= (=>0.63, <0.72); 2= (=>0.73, <0.82); 3= (=>0.83, <0.92); 4= (=>0.93, <1.02); 5= (>1.03).

148. p45. (Unordered; weight= 100). P_{3-4} root orientation: 0= P_{3-4} roots roots aligned mesiodistally; 1= P_3 root shifted laterally, P_4 mesial root aligned mesiodistally; 2= P_3 roots aligned mesiodistally, P_4 mesial root shifted laterally. [Score as missing if roots are singular].

Lower Molars

149. m1. (Weight= 100). $M^3/_3$: 0= present; 1= absent.

150. m2. (Weight= 100). M_1 root number: 0= one; 1= two.

151. m3. (Weight= 100). M_2 root number: 0= one; 1= two.

152. m4. (Weight= 100). M_3 root number: 0= one; 1= two.

153. m6.* (Weight= 50). M_2 trigonid width (ratio of buccolingual breadths of trigonid and talonid): 0= much wider than talonid (=> 1.11); 1= widths similar (<1.11, >0.90); 2= much narrower than talonid (=<0.90).

154. m6a. (Weight= 100). M_1 trigonid length: 0= M_1 trigonid short on the lingual side; 1= M_1 with elongate lingual face.

155. m7.* (Weight= 50). M_3 trigonid width (based on relative buccolingual breadths): 0= much wider than talonid (=> 1.20); 1= trigonid and talonid widths similar (=<1.20-1.05); 2= trigonid narrower than talonid (<1.05).

156. m8.* (Weight= 33). M_1 paraconid position: 0= mesial to protoconid; 1= mesiolingual, between protoconid and metaconid; 2= mesial to metaconid but widely spaced from it; 3= twinned with metaconid.

157. m9.* (Weight= 33). M_2 paraconid position: 0= mesial to protoconid; 1= mesiolingual, between protoconid and metaconid; 2= mesial to metaconid but widely spaced from it; 3= twinned with metaconid.

158. m10.* (Weight= 33). M_3 paraconid position: 0= mesial to protoconid; 1= mesiolingual, between protoconid and metaconid; 2= mesial to metaconid but widely spaced from it; 3= twinned with metaconid.

159. m11. (Weight= 100). M_1 parastylid: 0= absent; 1= present.

160. m12.* (Weight= 50). Molar metastylids: 0= absent; 1= small; 2= large.

161. m13. (Weight= 100). M_3 hypoconulid: 0= single; 1= double.

162. m14.* (Weight= 50). M_3 heel: 0= absent; 1= narrower than talonid; 2= approximately equal in width to talonid.

163. m15.* (Weight= 50). Molar occlusal enamel surface: 0= smooth; 1= slightly crenulated; 2= highly crenulate.

164. m16.* (Weight= 50). M_1 trigonid height (ratio of trigonid height to talonid height): 0= higher than talonid (=> 1.20); 1= slightly higher than talonid (=> 1.10, <1.20); 2= trigonid and talonid of similar height(< 1.10).

165. m17.* (Weight= 50). M_{1-2} cusp relief (ratio of hypoflexid height to hypoconid height, measured buccally): 0= low (<1.20); 1= moderate (=>1.20, < 1.35); 2= high (> 1.35).

166. m18. (Weight= 100). M_1 trigonid lingual configuration: 0= open; 1= closed.

167. m19. (Weight= 100). M_1 metaconid position: 0= lingual to protoconid; 1= slightly distolingual to protoconid.

168. m20.* (Weight= 50). M_{1-2} paraconid development: 0= absent; 1= small; 2= large.

169. m21. (Weight= 100). M_{1-2} lateral protocristid orientation: 0= runs toward metaconid; 1= runs toward hypoflexid.

170. m22. (unordered; weight= 100). M_1 distal trigonid wall: 0= complete; 1= deeply notched by protoconid/metaconid sulcus; 2= medial and lateral protocristid do not meet but no sulcus is discerned.

171. m23. (Unordered; weight= 100). M_2 distal trigonid wall: 0= complete; 1= deeply notched by a sulcus between protoconid and metaconid; 2= medial and lateral protocristid do not meet but no sulcus is present.

172. m24a. (Weight= 100). M_1 wear facet X: 0= present; 1= absent.

173. m24. (Weight= 100). M_2 wear facet X: 0= present; 1= absent.

174. m25.* (Weight= 50). M_{1-2} entoconid: 0= absent or very low, 1= lower than metaconid; 2= large.

175. m26.* (Weight= 50). M_{1-2} postentoconid sulcus: 0= prominent; 1= shallow sulcus ; 2= absent.

176. m27.* (Weight= 33). M_1 hypoconulid size: 0= large; 1= moderate; 2= small; 3= absent.

177. m28* (Weight= 33). M_2 hypoconulid size: 0= large; 1= moderate; 2= small; 3= absent.

178. m29.* (Weight= 33). M_3 hypoconulid size: 0= large; 1= moderate; 2= small; 3= absent.

179. m30.* (Weight= 50). M_{1-2} hypoconulid position: 0= twinned to entoconid; 1= near midline; 2= slightly buccal to midline.

180. m31.* (Weight= 50). M_{1-2} cristid obliqua development: 0= weak (rounded); 1= strong (trenchant); 2= very strong (trenchant).

181. m32.* (Weight= 50). M_1 cristid obliqua orientation: 0= reaches trigonid wall at a point distal to protoconid; 1= reaches trigonid wall at a point distolingual to protoconid; 2= reaches trigonid wall at a point distal to metaconid.

182. m33.* (Weight= 50). M_2 cristid obliqua orientation: 0= reaches trigonid wall at a point distal to protoconid; 1= reaches trigonid wall at a point distolingual to protoconid; 2= reaches trigonid wall at a point distal to metaconid.

183. m34. (Unordered; weight= 100). M_1 cristid obliqua terminus: 0= runs to base of trigonid; 1= runs part way up the distal trigonid wall; 2= connects with protoconid tip or protocristid; 3= connects with metaconid.

184. m35. (Unordered; weight= 100). M_2 cristid obliqua terminus: 0= runs to base of trigonid; 1= runs part way up the distal trigonid wall; 2= connects with protoconid tip or protocristid; 3= connects with metaconid.

185. m36. (unordered; weight= 100). M_3 cristid obliqua terminus: 0= runs to base of trigonid; 1= runs part way up the distal trigonid wall; 2= connects with protoconid tip or protocristid; 3= connects with metaconid.

186. m37. (Weight= 100). M_{1-2} centroconid development: 0= present; 1= absent.

187. m38.* (Weight= 50). M_{1-2} hypocristid development: 0= absent or seen only as a trace; 1= weak; 2= strong.

188. m39.* (Weight= 50). M_3 hypocristid development: 0= absent or seen only as a trace; 1= weak; 2= strong.

189. m40.* (Weight= 50). M_{1-2} talonid-- lingual configuration: 0= open; 1= closed, notched lingually; 2= closed, no notch.

190. m41. (Weight= 100). M_{1-2} distal fovea: 0= absent; 1= present.

191. m44. (Weight= 100). Molar cusp inflation: 0= cusps not inflated, marginally positioned; 1= very inflated.

192. m45.* (Weight= 50). $M_{1\text{-}2}$ buccal cingulum development: 0= absent to trace; 1= partial, broken at protoconid and hypoconid; 2= complete.

193. m46.* (Weight= 50). M_1 hypoflexid depth: 0= very shallow; 1= moderate; 2= deep.

194. m47.* (Weight= 50). M_2 hypoflexid depth: 0= very shallow; 1= moderate; 2= deep.

195. m53.* (Weight= 25). Ration of M_2 length to M_3 length: 0= M_3 much longer than M_2 (0.71-0.80); 1= M_3 longer than M_2 (0.81-0.90); 2= M_3 equal than M_2 (0.91-1.00); 3= M_3 smaller than M_2 (1.01-1.12); 4= M_3 much smaller than M_2 (=>1.13). Score as ‘5’ if M_3 absent.

196. m54.* (Weight= 33). M_1 length: 0= <2.5 mm; 1= >= 2.5, <3.8 mm; 2= >=3.8, =< 6.0 mm; 3= >= 6.0.

197. m55.* (Weight= 33). M_1 L/W: 0= 1.0-1.15; 1= 1.16-1.22; 2= 1.23-1.32; 3= >1.33.

198. m57. (Weight= 100). $M_{1\text{-}2}$ entoconid position relative to hypoconid: 0=transverse to hypoconid; 1= distal to hypoconid.

Upper Incisors

199. I1.* (Weight= 50). I^1-I^2 interstitial contact: 0= absent; teeth widely spaced; 1= present as narrow contact; 2= I^2 tightly packed against I^1, with I^1 preparacrista abbreviated.

200. I2. (Weight= 100). I^1-I^1 interstitial contact: 0= present; 1= absent: a wide space occurs in the midline between these teeth.

201. I3. (Weight= 100). I^2 –C^1 diastema: 0= present; 1= absent.

202. I4.* (Weight= 50). Ratio of I^1 area to I^2 area: 0= areas approximately equal (=<1.00); 1= I^1 slightly larger than I^2 (>1.00, <1.40); 2= I^1 much larger than I^2 (>1.40).

203. I5.* (Weight= 50). I^1 size (I^1 area: M^1 area): 0= small (=<0.50); 1= moderate (>0.50, <0.56); 2= large (=>0.56).

204. I6.* (Weight= 50). I^1 occlusal shape (mesiodistal length/ buccolingual breadth): 0= rounded oval (<1.05); 1= buccolingually compressed (>1.05, <1.30); 2= extremely compressed (>1.30).

205. I7.* (Weight= 50). I^2 occlusal shape (mesiodistal length /buccolingual breadth): 0= rounded oval (=<1.05); 1= slightly compressed (>1.05, <1.30); 2= extremely compressed =>1.30).

206. I8.* (Weight= 50). I^1 crown shape: 0= spatulate; no apparent occlusal cusp, mesial and distal edges continuous and rounded; 1= semi-spatulate, central cusp present but blunt with discernable mesial and distal occlusal crests; 2= central occlusal cusp pointed, occlusal edges steep.

207. I9. (Weight= 100). I^1 lingual fovea: 0= simple; 1= dual with mid-crown pillar.

208. I10. (Weight= 100). I^1 occlusal edge orientation (spatulate incisors only): 0= occlusal edge orthogonal to long axis of root; 1= occlusal edge wears at a steep angle to long axis of root; 2= crown with pronounced mesial asymmetry (=mesial process) in unworn state.

209. I11.* (Weight= 50). I^{1-2} lingual cingulum: 0= weak, discontinuous; 1= narrow, continuous; 2= strong.

210. I12. (Weight= 100). I^1 basal lingual cusp: 0= absent; 1= present.

211. I13. (Weight= 100). $I^1$and I^2 buccal cingulum: 0= absent; 1= present.

Upper canines

212. C1. (Weight= 100). C^1 cross-sectional shape (ratio of maximum length in the occlusal plane to maximum breadth in the occlusal plane at right angles to maximum length): 0= oval (>= 1.16); 1= rounded (<1.16).

213. C2. (Unordered, weight= 100). Upper canine occlusion: 0= C^1 wears against P^{1-2}; 1= C^1 wears against P^2; 2= C^1 wears against P^{2-3}; 3= C^1 wears against P^3.

214. C3. (Weight= 100). C^1 mesial groove (females): 0= shallow or absent; 1= deep.

215. C4.* (Weight= 50). C^1 lingual cingulum: 0= weak or absent; 1= strong; 2= very strong.

Upper premolars

216. P1.* (Weight= 50). P^2 root number: 0= one; 1= two; 2= three. If tooth is absent, character scored as "9".

217. P2.* (Weight= 50). P^3 root number: 0= one; 1= two; 2= three.

218. P3.* (Weight= 50). P^4 root number: 0= one; 1= two; 2= three.

219. P4.* (Weight= 50). Ratio of P^2 area to P^3 area: 0= P^2 very small (<=0.85); 1= P^2 small (>0.85, <0.95); 2= P^2 equal (=>0.95). If tooth is absent, character scored "9".

220. P5.* (Weight= 33). Ratio of P^4 area to M^1 area: 0= P^4<< M^1 (<= 0.66); 1= P^4< M^1 (> 0.66, <=0.76); 2= P^4= M^1 (0.77-1.05); 3= P^4> M^1 (>1.06).

221. P6.* (Weight= 50). P^2 occlusal shape (mesiodistal length/buccolingual breadth): 0= buccolingually broad (< 0.80); 1= round (md length/b-l breadth > 0.80, <1.05); 2= mesiodistally elongate (> 1.05).

222. P8. (Weight= 100). P^{3-4} trigone/talon proportions: 0= trigone and talon proportions similar; 1= trigone much shorter than talon with the protocone situated on the mesial aspect of the crown.

Comments: Character modified from that of Kay et al, (2004c). In some species, P^4 protocone in a mesial position, with either a long postprotocrista or a short postprotocrista and separate hypocone. An example of this would be *Brachyteles*. Others, e. g., *Callithrix*, have the protocone more centrally placed. Concommitantly, this means that the talon is either large, as in *Brachyteles*, or much smaller, as in *Callithrix*.

223. P9. (Weight= 100). P^3 protocone: 0= present; 1= absent.

224. P10. (Weight= 100). P^4 metacone: 0= absent; 1= present.

225. P11. (Weight= 100). P P^4 protocone: 0= low relative to paracone; 1= high relative to paracone.

226. P12. (Weight= 100). P^2 protocone: 0= present as discrete cusp; 1= absent or indistinguishable from lingual cingular ridge.

227. P13.* (Weight= 33). Premolar hypocones: 0= absent; 1= present on P^4 only; 2= present on P^{3-4}; 3= present on P^{2-4}.

228. P13a.* (Weight= 50). P^4 hypocone: 0= absent or trace; 1=bump on postprotocone crista or postcingulum; 2= distinct cusp on distal margin.

229. P14.* (Weight= 50). P^4 paraconule: 0= large; 1= small; 2= absent.

230. P15. (Weight= 100). P^{3-4} parastyles: 0= present; 1= weak or absent.

231. P16. (Weight= 100). P^{3-4} metastyles: 0= weak or absent; 1= present.

232. P17. (Weight= 100). P^{3-4} postprotocrista: 0=strong, reaches the distal margin and joins the postcingulum; 1= weak, short.

233. P18. (Weight= 100). P^{2-3} profile of distal crown margin: 0= convex, smoothly rounded; 1= concave, "waisted" between buccal and lingual cusps.

234. P19. (Weight= 100). P^{3-4} lingual cingulum: 0= absent or weak; 1= strong.

236. P21. (Weight= 100). P^{3-4} buccal cingulum: 0= absent or weak; 1= strong.

Upper molars

237. M1.* (Weight= 50). M^{1-2} root count: 0= three, three; 1= three, two; 2= two, two.

238. M2.* (Weight= 50). M^3 root count: 0= three; 1= two; 2= one.

239. M3.* (Weight= 50). M^3 shape (ratio of buccolingual breadth/ mesiodistal length) : 0= very transverse (>1.65); 1= transverse (<1.65, >1.30); 2= squared (=<1.30).

240. M4.* (Weight= 50). Ratio of M^1 area to M^2 area : 0= M^1>> M^2 (=>1.40); 1= M^1 > M^2 (<1.40, >1.0); 2= $M^{1=}$< M^2 (=<1.0).

241. M5.* (Weight= 50). M^{1-2} <u>*Nannopithex*</u>-fold: 0= absent; 1= weak; 2= strong.

242. M6.* (Weight= 50). M^{1-2} pseudohypocone: 0= absent; 1= small; 2= large.

243. M7. (Weight= 100). M^{1-2} metaconule: 0= single (or absent); 1= double.

244. M8.* (Weight= 50). M^{1-2} paraconule: 0= absent; 1= small; 2= large.

245. M9.* (Weight= 50). M^{1-2} preprotoconule crista: 0= absent; 1= weak; 2= strong.

246. M10.* (Weight= 50). M^{1} hypocone size: 0= large; 1= small; 2= absent, cristiform, or very small.

247. M11.* (Weight= 50). M^{2} hypocone size: 0= large; 1= small; 2= absent, cristiform, or very small.

~~248. M12. (Weight= 100). M^{1-2} hypocone position: 0= distal, slightly lingual to protocone; 1= distal, far lingual to protocone.~~

249. M13.* (Weight= 50). M^{1-2} prehypocrista: 0= absent; 1= weak; 2= strong, reaches to the postprotocrista, encloses the talon lingually.

250. M13a. (Weight= 100). M^{1-2} prehypocrista orientation: 0= buccolingually towards postprotocrista; 1= buccally towards metaconule.

Comments: This character is an autapomorphy of *Cebus* among extant platyrrhines but seen also in *Acrecebus* (Kay and Cozzuol, 2006).

251. M14.* (Weight= 50). M^3 prehypocrista development: 0= absent; 1= weak; 2= strong, reaches to postprotocrista to enclose the talon lingually.

252. M15. (Weight= 100). M^1 or M^2 paraconule position: 0= attached to preprotocrista; 1= not attached to preprotocrista.

253. M16.* (Weight= 50). M^{1-2} metaconule size: 0= absent; 1= small to moderate; 2= large.

~~M17. (Unordered; weight= 100). M^{1-2} mesostyle size: 0= absent; 1= present, attached to ectocrista; 2= present on buccal cingulum.~~ CHARACTER DELETED SEE MARIVAUX CHARACTER #

~~M18. (Unordered; weight= 100). M^{1-2} postprotocrista: 0= strong, runs to base of metaconule or metacone; 1= strong but short; does not reach base of metacone; 2= absent.~~ CHARACTER DELETED SEE MARIVAUX CHARACTER #

~~M18A. (Weight=100). M^{1-2} postprotocrista spur: 0= postprotocrista splits with a spur running distally towards the hypocone (if present); 1: spur absent.~~

~~Comments: This is a new character not found in Kay~~ et al. ~~2004.~~ CHARACTER DELETED SEE MARIVAUX CHARACTER #

~~M19. (Weight= 100). M^{1-2} lateral posterior transverse crista: 0= sharp; 1= indistinct.~~ CHARACTER DELETED SEE MARIVAUX CHARACTER #

254. M20.* (Weight= 50). P^4-M^{1-2} pericone: 0= absent; 1= small; 2= large.

~~M22.* (Weight= 50). M^{1-3} lingual cingulum development: 0= absent; 1= weak, broken; 2= strong, complete.~~ CHARACTER DELETED SEE MARIVAUX CHARACTER #

255. M24.* (Weight= 50). M^{1-2} buccal cingulum development: 0= absent; 1= weak; 2= strong.

256. M27. (Weight= 100). M^{1-2} premetaconule cristae: 0= absent or weak; 1= strong

257. M28. (Weight= 100). M^{1-2} postmetaconule cristae: 0= absent or weak; 1= strong

258. M30.* (Weight= 50). M^3 paraconule: 0= absent; 1= small-moderate; 2= large

259. M31.* (Weight= 50). Molar protocone lingual inflation: 0= not inflated; 1= slightly inflated; 2= very inflated.

260. M33.* (Weight= 100). M^2 buccal expansion of paracone: 0= no expansion; 1= expanded.

261. M34.* (Weight= 50). M^3 metacone: 0= absent or very small; 1= moderate (but smaller than paracone); 2= large (equal to paracone).

262. M36.* (Weight= 50). M^3 hypocone: 0= absent or very small; 1= small; 2= large.

~~M44.* (Weight= 50). M^{1-3} anterior cingulum: 0= strong, complete, long; 1= strong, short; 2= weak or absent~~ CHARACTER DELETED SEE MARIVAUX CHARACTER #

263. M46.* (Weight= 50). M^1 size relative to M^3 (based on the ratio of areas of each tooth): 0= M^1 >= 2.5 times the size of M^3 (scored as ‘0’ when M^3 is absent); 1= M^1 <2.5, >= 1.5 times M^3; 2= M^1 <1.5 times M^3.

Humeral characters

264. H1of (Ross et al., 1998)*. (Weight= 50). Shape of humeral trochlea: 0=cylindrical, distal edge perpendicular to humeral shaft; 1=slightly conical, distal edge slightly angled to shaft; 2=conical, distal edge steeply angled to humeral shaft.

Comments: Character from Fleagle and Kay (1987); see also Dagosto and Gebo (1994).This character refers to the angle of the trochlear profile, viewed from the dorsoventral perspective relative to the long axis of the humerus. For an illustration, see (Fig. 1. Pg. 575 in Dagosto and Gebo, 1994).

265. H2 of (Ross et al., 1998). (Weight= 100). Relative heights of medial and lateral edges of humeral trochlea: 0=subequal—spool-shaped; see below; 1= medial flared relative to lateral.

Comments: This character refers to the medial and lateral margins, or lips, of the dorsal surface of the trochlea. Ford (1980b) states that the primate humeral trochlea, viewed from a dorsal aspect, ranges from spool-shaped to cylindrical. In the spool-shaped condition the lateral and medial edges of the distal part of the trochlea are raised above the middle part of the trochlea. In other words, in a x-sectional profile of the distal trochlea, the spool shape would be raised at the medial and lateral edges and the midpoint depressed whereas a cylindrical dorsal profile the edges are less raised and the center less depressed (shallower). The character of Ross et al. (1998) is somewhat different in that it calls attention to a pronounced *asymmetry* between the lateral and medial margins in some taxa compared with others.

266. H3 of (Ross et al., 1998)*. (Weight= 33). Trochleocapitular ridge: 0= absent; 1=slightly distinct; 2=moderately distinct; 3=very distinct.

Comments: Originally defined by Ford (pages 271-272 1980b) as having 7 states from 'none' (0) to 'sharply edged' (6); she later reduced this to 5 states (0-4) (page 663 in Ford, 1994). Kay et al. (1997) and Ross et al. (1998) reduced this still further to 4 states. The distinctions are qualitative.

267. H4 of (Ross et al., 1998). (Weight= 100). Waisting of the trochlea: Minimum trochlear diameter (MinTD)/maximum trochlear diameter (MaxTD), expressed as a percentage (Ford, 1994): 0= greater than 70 (unwaisted); 1= equal to or less than 70 (waisted).

Comments: The measurements are made in the dorsoventral plane, perpendicular to the long axis of the trochlea; see Ford (page 266a-267 Figure 10d in 1980b).

268. H5 of (Ross et al., 1998)*. (Weight= 33). Width of capitulum relative to trochlea: Ventral capitulum width/ventral trochlear width expressed as a percentage (Ford 1994): 0=<100; 1=between 100 and 140; 2=140–200; 3=above 200.

Comments: Ventral width of the capitulum is the 'maximum width of the capitulum on the ventral surface as visible from the distal view (page 267 in Ford, 1980b)'. The trochleocapitular ridge is the demarcating feature as illustrated in Figure 10c, page 266a (Ford, 1980b), equivalent to Figure 2, p. 166 in Ford (1988).This appears to be the same measurement described by Szalay & Dagosto, (1980) as the capitular width (CW). The ventral trochlear width is not defined by Ford (1980b). However, Ford (1988, p. 169) states:

“[The relative size of the capitulum] is measured as the ratio of ventral capitular width to dorsal trochlear width (VCW/DTW x 100). Others have used a similar index but substituted ventral trochlear width for dorsal trochlear width. Here, ventral trochlear width did not yield results that fell into discrete groups, but results using DTW are consistent with those of others.” Ford (1994) defines the ratio as VCW/VTW x 100, and seems to have arrived at her scores for this trait by taking the inverse of the ratio given by Szalay & Dagosto, (1980): (TW x 100)/CW where TW is the trochlear width measured from a ventral perspective and CW is the capitulum width.

269. H6 of (Ross et al., 1998)*. (Weight= 50). Entepicondylar foramen (Ford, 1986): 0= present; 1=variable; 2=absent.

270. H7 of (Ross et al., 1998). (Unordered, Weight= 100). Entepicondylar foramen position (Ford, 1986): 0= over medial epicondyle; 1= above ventral trochlea; 2=above dorsal trochlea; 3=absent.
<u>Comments</u>: For foramen position, see character PC-105 of Ford (1986). From the ventral perspective, at one extreme (state 0) the entepicondylar foramen is located wholly over the medial epicondyle. At the opposite extreme (state 2), the entepicondylar foramen is located more laterally over the trochlea and partially overlaps the distal trochlear surface. In an intermediate condition, the foramen is positioned over the trochlea ventrally but does not overlap the dorsal trochlear surface. Ford (page 270 1980b) also discusses this mentions that state 0 is found in the zlambdalestid *Barunlestes*.

271. H8 of (Ross et al., 1998). (Weight= 100). Medial epicondyle size (Fleagle and Kay, 1987): 0=small; 1= prominent.

Comments: Fleagle and Kay (Table 2, p. 316 1987), following Napier and Davis (1959) note that the medial epicondyle of cercopithecoids is reduced by comparison with other primates. We note also that the medial epicondyle of *Loris* is greatly abbreviated, unlike the case in *Perodicticus* or *Varecia*. Index originally developed by Napier and Davis (1959). Conroy (1976) provides data for *Apidium* and Szalay and Dagosto (1980) for a variety of other taxa.

272. H9 of (Ross et al., 1998)*. (Weight= 50). Dorsal position of medial epicondyle (Ford 1994): 0= parallel; 1=slight dorsal angle; 2=large dorsal angle.

Comments: The dorsal displacement of medial epicondyle is mentioned by several authors going back to Napier and Davis (1959), at least. Ford (page 274-275 1980b) uses 5 states to describe this from no displacement, i. e., medial epicondyle parallel to transverse axis of the trochlea (state 0) to a large degree of dorsal displacement. Ross et al. (1998) use 3 states: 0= parallel, i. e., no displacement to 2—large dorsal angle, as in OW monkeys.

273. H10 of (Ross et al., 1998) (Unordered, Weight= 100). Shape of dorsal trochlea (Fleagle and Simons, 1995): 0=no pronounced lips on dorsal trochlear edges; 1=both medial and lateral edges pronounced; 2=very pronounced lateral lip.

Comments: Fleagle and Simons (p. 244-5 1995) state that the posterior surface of the trochlea exhibits several contrasting states. In omomyids and small platyrrhines (*Saimiri*) the trochlear surface is gently concave with pronounced edges laterally and medially. In strepsirrhines (they illustrate *Otolemur*) the posterior surface of the trochlea generally lacks pronounced lips. In cercopithecoids there is a very deep posterior (dorsal) trochlear surface with a very pronounced lateral lip. State 2 is reserved for this extreme state of development in cercopithecoids (Fleagle and Simons, 1995):.

274. H11 of (Ross et al., 1998)*. (Weight= 50). Dorsoepitrochlear fossa (Fleagle and Simons, 1995):0= present, strong; 1=small, shallow; 2=absent.

Comments: The dorsoepitrochlear fossa is a pit on the dorsal face of the medial epicondyle that marks the origin of the ulnar collateral ligament (Conroy, 1976). Kay et al. (1997) scored the degree of development of the pit in three states from present and strong (state 0) to absent (2). This follows the discussion of Ford (pp. 279-281 1980b) except that Kay et al. scored the trait with one fewer character states and in the reverse of Ford's scoring—Kay et al.'s scoring of a strong pit is state 0 whereas Ford's is state 3.

275. H12 of Ross et al. (1998)*. (Weight= 50). Olecranon fossa shape (Fleagle and Simons, 1995):0=shallow; 1= moderate; 2=deep.

Comments: Olecranon fossa depth was described in an index by Fleagle and Simons, (page 181 1982) as (olecranon depth/ anterior humeral articular surface width) x 100. Data is provided for a few taxa in Fleagle and Simons (1982) Table 2 but the measurements are not defined. Likewise Fleagle and Simons (1995) provide data on the olecranon fossa width, height and depth, as well as anterior humeral articular surface width in *Apidium* but provide no comparative data and do not define these measurements. Fleagle (pers. comm.) takes olecranon fossa depth as a projection from the posterior surface of the humerus to the center of the fossa.

276. H13 of (Ross et al., 1998). (Weight= 100). Supinator crest (Fleagle and Kay, 1987):0= prominent [extends far proximally]; 1=low [terminates close to the distal end of the bone].
Comments: Ford (pp. 275-278 1980b) defines the "supinator crest" as the crest that "runs along the lateral edge of the distal epiphysis and is the area of origin for the *m. brachioradialis* and *m. extensor carpi radialis* and *brevis*. She states it to be the equivalent of the lateral supracondylar ridge of human anatomy. She notes that in the literature of primate anatomy, the crest is not always clearly discriminated from the brachialis flange from which a part of *m. brachialis* arises. Following Fleagle and Kay (1987), Kay et al. (1997) distinguish between the proximal extent of the supinator crest in character H13, and the breadth of the flange (H14)—broad, moderate or narrow. Fleagle and Kay (p. 489 1987) note that in *Apidium*, the supinator crest extends 'well up the posterior part of the humeral shaft' indicating a far proximal origin for carrying the origin for *m. brachialis* and proximally'. In their Table 2, the supinator crest is indicated to be either 'high' or 'low' which refers to the extent of it's more proximal (or more distal) origin.

277. H14 of Ross et al. (1998)*. (Weight= 50). Brachialis flange: 0=broad; 1= moderate; 2=narrow.
Comments: See above for H13. *Pondaungia* has a moderate brachialis flange (state 1), comparable to that of *Propliopithecus* (state 1). Seiffert et al. state that the brachialis flange of *Catopithecus* is not as well developed as in propliopithecines and more closely resembles

that of parapithecids and *Proteopithecus* (Seiffert et al., 2000). However, Ross et al. (1998)scored the development of the brachialis flange as moderate in both propliopithecids and parapithecids, reserving the 'broad' category for Eocene taxa like *Adapis*, where it is extreme in its development, and narrow for taxa in which it is little more than a raised edge. I score all Fayum taxa as 'moderate' (state 1).

278. H15 of Ross et al. (1998). (Weight= 100). Bicipital groove (Fleagle and Kay, 1987): 0=shallow; 1= deep.

Comments: Following Fleagle and coauthors (Fleagle and Simons, 1982; Fleagle and Kay, 1987), the bicipital groove (= intertubercular sulcus of human anatomy) is deep in hylobatids, great apes, and *Ateles* (state 1), and shallow in most other primates. There is substantially more variation here that should be described and metrically documented. Ciochon (1993) defines measurements for bicipital groove width and depth in cercopithecoids but provides no comparative data.

279. H16 of Ross et al. (1998) [not ordered]. (Weight= 100). Deltopectoral crest; (Ford, 1980b; Fleagle and Kay, 1987):0= prominent; 1=low [rounded and indistinct edge, especially proximally]; 2=flattened superiorly.

Comments: The deltopectoral crest borders the lateral side of the bicipital groove and provides origin for m. pectoralis (more proximally) and m. deltoideus (more distally and laterally). The crest often blends laterally into a well-delineated deltoid plane.

280. H17 of Ross et al. (1998). (Weight= 100). Deltotriceps crest (Fleagle and Kay, 1987):0=low; 1= prominent.

Comments: The lateral edge of the deltoid plane often forms a sharply raised crest, marking the intermuscular septum between deltoideus (laterally) and triceps (ventromedially) (fig. 3G, trait 'b' Fleagle and Kay, 1987). No such crest is seen in *Ateles* or Hominoidea.

281. Medial torsion of humeral head (Weight= 100) (Evans and Krahl, 1945; Napier and Davis, 1959; Harrison, 1987): (Weight= 100). Rotation: 0= Not medially rotated; 1= Medially rotated.

Wrist characters

282. W1 of (Ross et al., 1998). (Weight= 100). Size of os centrale, orientation of centrale–trapezoid facet, and articulation with hamate (Napier and Davis, 1959; Schön and Ziemer, 1973; Beard et al., 1988; Ross et al., 1998): 0=small centrale, facet faces distally, no articulation with hamate; 1=large centrale, facet faces distoradially, articulation with hamate.

283. W2 of Ross et al. (1998). (Weight= 100). Ulnar-pisiform articulation (Lewis, 1971; Beard et al., 1988; Ross et al., 1998): 0=facet on pisiform for ulnar styloid process is roughly equal in size to that for triquetrum; 1=facet on pisiform for ulnar styloid process is much enlarged and deeply excavated.

Femoral characters

284. F1 of Ross et al. (1998)*. (Weight=50). Length of femoral neck. : Neck length measurement number 2/BSTD expressed as a percentage (Dagosto et al., 1995; Dagosto and Schmid, 1996): 0= <75 (short); 1=75–120; 2= >120 (long).

Comments: Defined by Dagosto and Schmid (Fig. 1 Dagosto and Schmid, 1996) as N2 (the distance between the low point on the intertrochanteric fossa and the medial-most extent of the femoral head) divided by the femoral shaft breadth. (or N1: a point on the line representing the long axis of the proximal end of the femur to the 'midpoint' of the femoral head). Comparative data in Dagosto and Schmid (Table 1 Dagosto and Schmid, 1996).

285. F2 of Ross et al. (1998)*. (Weight= 50). Angle of femoral neck (Dagosto et al., 1995): 0=<60; 1=60–70; 2=>70.

Comments: Defined as angle (NA) in Dagosto and Schmid (1996), Fig 1, the angle formed by the intersection of the line representing the long axis of the proximal end of the of the femur and a line from the midpoint of the femoral head. The greater the angle, the more the head is angled relative to the shaft of the femur. This is illustrated by Dagosto and Gebo (Fig. 1A, p. 573 1994). adapines, platyrrhines, and *Apidium* have heads at < 60 degrees or less to the femoral shaft whereas in *Tarsius* and *Hemiacodon* the neck is more angled. *Cantius* and lemuriforms are intermediate.

286. F3 of Ross et al. (1998). (Weight= 100). Angle of lesser trochanter LTA of (Dagosto and Gebo, 1994; Dagosto and Schmid, 1996): 0=medial (0–30); 1= posterior (>30).

Comments: This is LTA of Dagosto and Schmid (Fig. 1 and Table 1 1996), the angle of intersection between the line bisecting the femoral head and greater trochanter and the line representing the plane of projection of the lesser trochanter. The lesser trochanter projects ventrally to varying degrees. The 'posterior' (ventral) position is illustrated in *Saimiri*, *Apidium* and *Necrolemur* (Figure 1b in Dagosto and Gebo, 1994), whereas the lesser trochanter is more medially directed in *Cantius*, *Tarsius*, and lemuriforms.

287. F4 of Ross et al. (1998)*. (Weight= 50). Size of third trochanter (Dagosto and Gebo, 1994): 0= large-- third trochanter projection index >25; 1= moderate-- third trochanter projection index > 10, ≤25; 2= crestiform or absent.

Comments: I have modified this slightly so as to use an index provided by Dagosto and Schmid (1996), supplemented by that of Dagosto et al. (1999). If the trochanter is said to be 'small' or 'none', I scored it as state 2; if the index was greater than 10, it is scored as 'moderate'. Dagosto and Gebo (1994) illustrate this in Fig. 1, p. 573 (compare *Hemiacodon* and *Saimiri*). No taxon is scored as 'small' in their data set. Adapins, lemuriforms, *Tarsius*, and omomyids are scored as large; the third trochanter is crestiform or absent in platyrrhines and *Apidium* (state 2). *Catopithecus* (DPC 8256 and DPC 7529) has a prominent third trochanter (score as 0). Comparative data in Dagosto and Schmid (1996, Table 1) for third trochanter projection: 100 x third trochanter breadth/ BSTD (see above). Gebo et al. (1994) note that one Quarry I femur attributable to *Aegyptopithecus* (DPC 8709) has a small third trochanter, whereas in other propliopithecids (I and V femora) it is more prominent (scored as 1/2). *Proteopithecus sylviae* has a very strong third trochanter (score = 0) (fig. 1 Simons and Seiffert, 1999).

288. F5 of (Ross et al., 1998)*. (Weight= 33). Knee shape. Antero-posterior diameter of distal femur/ mediolateral diameter of distal femur expressed as a percentage (Dagosto and Gebo, 1994): 0= greater than 107; 1= 107 to 99; 2= less than 99 and greater than 71; 3= less than 71. Comments: This is character 35 of Ford (1994).

289. F6 of (Ross et al., 1998)*. (Weight= 50). Femoral head shape (Dagosto and Gebo, 1994): 0= spherical; 1= semicyclindrical; 2=cylindrical.

Comments: As scored by Dagosto and Gebo, '94, only *Tarsius* has a cylindrical femoral head—the posterior, dorsal, and medial surfaces of the head are flattened (Dagosto and Schmid, '96). *Hemiacodon* is scored as 'semicylindrical'—the joint surface of the head is extended onto the posterodorsal aspect of the femoral neck and the posterior surface is relatively flat but the dorsal surface is not flat and the medial surface is not as flattened as in galagos or *Tarsius*. This is illustrated in Dagosto and Gebo ('94,Fig. 5B).

290. F7 of (Ross et al., 1998). (Weight= 100). Anterior extension of greater trochanter (Dagosto and Gebo, 1994): 0= no extension; 1= extension.

291. F8 of Ross et al. (1998)*. Bowing of femur. (Weight= 50). Anterior bowing of proximal femur (Ford, 1986; Dagosto and Gebo, 1994): 0= straight; 1= slightly bowed; 2= pronounced bowing.

Comments: Dagosto and Gebo (1994) refer to this as bending, not bowing, and say it is characteristic of *Tarsius*, *Hemiacodon*, and *Microchoerus*. This is character 26 of Ford (1994).

292. F9 of Ross et al. (1998)*. (Weight= 50). Relative length of trochanteric fossa. Intertrochanteric fossa length/BSDLT) expressed as a percent (Dagosto and Schmid, 1996): 0= long (>125); 1= moderate (110–125); 2= very short (<110).

Comments: BSDLT is the breadth of the femoral shaft taken just distal to the trochanters (comparative data in Dagosto and Schmid, 1996).

293. F10 of Ross et al. (1998)*. (Weight= 100). Intertrochanteric crest (Dagosto and Gebo, 1994): 0= crest absent; 1=crest present.

Comments: Illustration in Figures 6, 7 of Gebo et al. (1994).

294. F11 of Ross et al. (1998)*. (Weight= 50). Size of lesser trochanter (Dagosto, 1990): 0=large; 1=intermediate; 2=small.

295. F12 of Ross et al. (1998). (Weight= 100). Lateral border of distal femur (i.e., the lateral rim of the patellar groove) (Dagosto, 1990): 0=low; 1=high.

Comments: Dagosto (1990) further describes this character as: "lateral border of the distal femur higher than medial [border], sharp, not rounded."

296. Crista paratrochanterica *, (Weight= 50). Crista paratrochanterica on posterior femoral neck (Hershkovitz, 1988): 0= flat; 1= low ridge or cusp; 2= high ridge.

Comments: This is character 22 of Ford (1994).

297. Femoral head projection*. (Weight= 50). Projection of the femoral head relative to the greater trochanter: 0= greater trochanter projects well above the femoral head; 1= Greater trochanter is at the same level as the femoral head; 2: greater trochanter well below (distal to) the femoral head.

Comments: The greater trochanter projects well above the femoral head in many mammals (cf. many rodents). Greater trochanter at the same level as femoral head in most extant platyrrhines but well below (distal to) the femoral head in atelids *Ateles* and *Brachyteles*.

Comments: This is character 36 of Ford (1994).

Limb indices

298. Intermembral Index*. (Weight= 50). Sum of lengths of humerus and radius divided by summed lengths of femur plus tibia expressed as a percentage: 0= long hindlimb ≤72; 1= moderate hindlimb, 73 to ≤85; 2= short hindlimb, ≥86.

Comments: Platyrrhine data in Fleagle and Meldrum (Fleagle and Meldrum, 1988), Rose (1996) and Llorens et al. (2001).

299. Humero-femoral index. (Weight= 50). Ratio of humerus length to femur length expressed as a percentage: 0= ≤65; 1= ≥66, ≤82; 2= ≥83.

Comments: Platyrrhine data in Fleagle and Meldrum (Fleagle and Meldrum, 1988) and Llorens et al. (2001).

Tibial characters

300. T1 of Ross et al. (1998). (Weight= 33). Contact between distal tibia and fibula (page 570 Dagosto and Gebo, 1994): 0= absent, small facet; 1= small facet; 2= extensive facet; 3= proximal fusion (synostosis).

301. T3 of Ross et al. (1998). (Weight= 100). Distal tibia articulation Shape: 0= square; 1= triangular.

Comments: All anthropoids have the 'square' condition; see Dagosto, (1985); (Figure 5A Dagosto and Gebo, 1994).

302. T3a. (Weight= 33). Shape of distal tibial articular for talus, if 'square': 0= narrow articular surface (width to breadth ratio <100); 1= wider articular surface width to breadth =>100; <130; 2= wide articular surface (>130).

Comments: See Ford (1980, Fig. 6) for measurements.

303. T4 of Ross et al. (1998). (Weight= 33). Medial malleolus rotation: 0= none; 1= slight; 2= strong.

Comments: In strepsirrhines, the medial malleolus of the distal tibia is strongly medially rotated; in anthropoids and *Tarsius* the rotation is slight (page 581 Dagosto and Gebo, 1994). As scored by them, no primate has state '0'.

304. T5 of Ross et al. (1998). (Weight= 33). Medial malleolar articulation: 0= flat; 1= anteriorly convex; 2= all convex .

Comments: This expresses the comment by Dagosto and Gebo (1994)that strepsirrhines have an all-convex condition whereas anthropoids have an anteriorly convex malleolar facet. In fact, no primate has a flat facet. All platyrrhines have state 1.

305. T6 of Ross et al. (1998). (Weight= 50). Shape distal tibia shaft: 0= no compression; 1= antero-posteriorly compressed.

Comments: The distal tibial shaft of *Tarsius* and *Microchoerus* is actually a fused tibia and fibula. Thus the apparent anterior-posterior compression is arguably a mediolateral widening on account of fusion of the bones. In any event the character is found only in *Tarsius* in this dataset. All platyrrhines are state '0'.

306. T7 of Ross et al. (1998).   (Weight= 100). Tibialis posterior groove: 0= variably distinct, on the lateral side of the medial malleolus; 1= medial to a raised crest on the posterior side of malleolus.

Comments: This is supposedly a *Tarsier*-anthropoid trait (Dagosto and Gebo, 1994), but I find no groove in *Tarsius*.

307. Tala trochlea. (Weight= 50). Posterior border of the trochlear facet for talus: 0= flat; 1= rounded; 2= sharp.

Comments: This is character 15 of Ford (1994).

308. Tibial malleolar height. (Weight= 50). Medial malleolar height of the tibia relative to the antero-posterior diameter of distal tibial shaft, expressed as a percentage: 0= less than or equal to 68; 1= greater than 68 and less than or equal to 101; 2= greater than 101.

Comments: This is character 20 of Ford (1994).

Astragulus (talus) characters

309. A1 of Ross et al. (1998). (Weight= 100). Position of the groove for the tendon of *m. flexor fibularis longus*: 0= lateral to the posterior part of the tibiotalar joint; 1= groove is plantar and central to the facet.

Comments: Beard et al. (1988) identify synapomorphies defining Strepsirrhini include lateral the position of groove for *m. flexor hallucis longus* (=*m. flexor fibularis* of other authors).

310. A2 of Ross et al. (1998). (Weight= 50). Shape of talofibular facet: 0= steep-sided; 1= steep-sided with a plantar lip; 2= sloped obliquely.

Comments: Beard et al. (1988) identify as a synapomorphy defining Strepsirrhini a "laterally sloped talofibular facet". Seiffert & Simons (2001) describe the fibular facet as 'laterally projecting' (Fig. 2 Seiffert and Simons, 2001).

311. A3 of Ross et al. (1998). (Weight= 100). Length of the talo-tibial articulation: 0= dorsoventrally deep, extends to plantar aspect of talus; 1= dorsoventrally restricted,

confined to dorsal part of talus.

Comments: See Fig. 2 in Gebo (1986).

312. A4* of Ross et al. (1998). (Weight= 100). Size of the posterior trochlear shelf of talus: 0= none or weakly developed; 1= well developed (prominent).

Comments: See Fig. 5A, Dagosto and Gebo (1994).

313. A5'. (Weight= 50). Talar neck length (neck length/talus length) expressed as a percentage: 0= short (less than or equal to 44); 1= moderate, between 45 and 56 inclusive; 2= long, greater than 56.

Comments: Data in Marivaux et al. (2003) ranges from 33 to 66. I code it as 33-44, 45-56, 56-67. See also Fig. 2 (Marivaux et al., 2003).

314. A7 of Ross et al. (1998). (Weight= 100). Symmetry of the lateral versus medial talar trochlea: 0= trochlea symmetric; 1= lateral trochlear rim is raised relative to medial trochlear rim.

Comments: This is character number 71 in Seiffert et al. (2004); see also Marivaux et al. (2006).

315. A8 of Ross et al. (1998). (Weight= 100). Talar cotylar fossa: 0= shallow; 1= deep, medially projecting.

Comments: This is character number73 in Seiffert et al. (2004); see also Seiffert and Simons (2001).

316. A9'*. (Weight= 50). Width of talar head (Head Width/Head Height expressed as a percentage): 0= <115; 1= 115 to 127; 2= >127.

<u>Comments</u>: Character modified from Marivaux et al. (2006). Talar head width ranges from 104 to 142 in anthropoid taxa from Marivaux et al.'s data. I make three categories, not two, because I do not see any obvious distributional discontinuities.

317. A10* of Ross et al. (1998). (Weight= 50). Talar neck angle: 0= < 20°; 1= 20-30°; 2= > 30°.

<u>Comments</u>: Measurement definitions and data from Marivaux et al. (2006).

318. A11* of Ross et al. (1998). (Weight= 50). Talar body height. (HT/MTRW) expressed as a percentage: 0= < 100; 1= 100-120; 2= >120.

<u>Comments</u>: Measurement definitions and data are from Marivaux et al. (2006).

319. A12* of Ross et al. (1998). (Weight= 100). Talar shape (TW/TL) expressed as a percentage: 0= < 60; 1= >60.

<u>Comments</u>: Measurement definitions and data from Marivaux et al. (2006).

Calcaneal characters

320. C1 of Ross et al. (1998). (Weight= 50). Anterior calcaneal elongation. Length of calcaneus distal to talo–calcaneal facet/total calcaneal length expressed as a percentage: 0= not elongate (<40); 1= moderately elongate (40–45); 2=long (>45).

Comments. Index from Dagosto (1990).

321. C3 of Ross et al. (1998). (Weight= 100). Posterior calcaneal bowing: 0= absent; 1= present.

Comments: Index from Dagosto and Gebo (1994). This is a characteristic of Omomyidae.

322. Calcaneal peroneal tubercle. (Weight= 20). Presence and location of peroneal tubercle: 0= absent; 1= located the far anterior end of bone; 2= in the anterior half; 3= centered; 4= in the posterior half.

Comments= The 'peroneal tubercle' is the peroneal trochlea of human anatomy "the lateral surface of the calcaneus is nearly flat but has a tubercle on its lower part half way along its length. This is the peroneal trochlea which intervenes between the two peroneal tendons (brevis and longus and provides attachment for the inferior peroneal retinaculum which holds them in place (page 196 Romanes, 1972)". This is Character 2 in Ford (1994) and more or less equivalent to C2 of Dagosto and Gebo (1994): position of the peroneal tubercle relative to posterior talo-calcaneal joint, see also Gebo (1986) and Dagosto (1988.) But Ford (1994) judges the position of the tubercle relative to the whole bone, not relative to the posterior facet.

323. Calcaneal sustentacular facet. (Weight= 50). Presence of a connection between anterior and medial sustentacular facets of the calcaneus: 0= facets separate; 1= sharply angled to one another or do not connect everywhere; 2= facets broadly confluent.

Comments: In many primates (including most platyrrhines and hominoids) the sustentacular facet and the anterior calcaneal facet are continuous, superiorly facing, and often supported by a continuous bony shelf extending anteriorly from the sustentaculum. (Fleagle and Simons, 1995).

324. Angle of posterior talar facet (of calcaneus). (Weight= 33). 0= less than 3 degrees; 1= from 3 to 8 degrees; 2= from 8 to 24 degrees; 3= greater than 24 degrees.

Comments: This is the angle (on the calcaneus) of the posterior talar articular facet (=ectal facet) relative to the long axis of the calcaneus (Ford, 1994). Ford (1980b)defines the ratio: "Angle of Posterior Articular Facet (PAS) - the angle formed between the long axis of the posterior articular surface for the astragalus and the long axis of the calcaneus." Ford's (Ford, 1980b), Appendix B, page 365 gives the platyrrhine values.

325. Length of posterior articular facet (of calcaneus). (Weight= 50). Ratio of posterior articular facet length to maximum length of cuboid articular surface (PASL/L) (Ford, 1980a): 0= less than 90; 1= 90 to less than 110; 2= 110 degrees to less than 128; 3= 128 or more.

Comments: See Character 9, table of measurements in Ford (1980a).

326. Breadth of posterior articular facet (of calcaneus). (Weight= 100). Ratio of posterior articular facet width (PASW) to maximum length of the cuboid articular surface, expressed as a percentage: 0= less than 70; 1= greater than 70.

Comments: Character 10 in Ford (1994) is edited to a two-state character, as there are no taxa with a ratio of less than 48.

327. Anterior calcaneal length. (Weight= 20). The ratio of the length of anterior calcaneus to the maximum calcaneal length: 0= less than or equal to 28 percent; 1= greater than 28 percent and less than 33 percent; 2= greater than 33 percent and less than 48 percent; 3= greater than 48 percent and less than 60 percent; 4= greater than 60 percent.

Comments: Character 51 from Ford (1994).

328. Ford 53 Calcaneus. Shape of posterior articular facet (on calcaneus). (Weight= 50). Ratio of the width to length of the posterior articular facet for talus expressed as percentage: 0= less than 42 percent; 1= 42 percent to 76 percent; 2= greater than 76 percent.

Comments: Character 53 from Ford (1994).

329. Posterior calcaneus length. (Weight= 50). Length of posterior calcaneus relative to maximum length of cuboid articular surface expressed as a percentage: 0= less than or equal to 61; 1= between 61 and 107; 2= greater than or equal to 107.

Comments: Character 54 from Ford (1994).

Navicular characters[1]

330. N1* of Ross et al. (1998). (Weight= 50). Navicular shape. Length relative to width of the navicular, expressed as a percentage: 0= short (< 90); 1= moderate (100-150); 2= long (> 150).

Comments: Data from Kay et al. (2004b).

331. N3 of Ross et al. (1998). (Weight= 100). Naviculocuboid articulation. The naviculocuboid articulation: 0= cuboid facet on navicular contacts only the ectocuneiform; 1= cuboid facet contacts the ectocuneiform and mesocuneiform facet.

Comments: Data from Kay et al. (2004b).

Entocuneiform characters

332. E1* of Ross et al. (1998). (Weight= 100). Shape of entocuneiform/first metatarsal articulation:0= dorsally reduced; 1= dorsal moiety of joint enlarged relative to ventral moiety; 2= dorsal moiety greatly enlarged.

Comments: Data from Kay et al. (2004b).

[1] For the most part the data for the navicular, entocuneiform, and entocuneiform are restricted to *Aotus*, *Callicebus* and *Saimiri*, based on Kay *et al.* (2004).
Other taxa not examined.

333. E2 of Ross et al. (1998). (Weight= 100). Lateral process of the entocuneiform:0= small; 1= hypertrophied.

Comments: Data from Kay et al. (2004b).

General foot characters

334. O1 of Ross et al. (1998). (Weight= 50). Foot axis: 0= mesaxonic; 1= paraxonic; 2= ectaxonic.

Comments: Data from Kay et al. (2004b).

335. O2 of Ross et al. (1998). (Weight= 100). Toilet claw (first phalanx, hind foot):0= absent; 1= present.

Comments: Data from Kay et al. (2004b).

336. External thumb: (Weight= 100). 0= present; 1= reduced or absent.

Comments: Data in Hill (1957; 1960; 1962)

337. O3 of Ross et al. (1998). (Weight= 100). Prehallux:0= present; 1= absent.

Comments: Data from Kay et al. (2004b).

338. O4. Metatarsus length. (Weight= 100.: 0= short; 1= long.

Comments: Data from Kay et al. (2004b).

Metatarsal characters

339. MT1* of Ross et al. (1998). (Weight= 50). Peroneal tubercle of the first metatarsal:0= very large; 1= large; 2= small.

Comments: See Dagosto (1990).

340. MT2 of Ross et al. (1998). (Weight= 100). Hallux length:0= short; 1= long.

Comments: See Dagosto (1990).

Other postcranial and miscellaneous characters

341. Claws (hand). (Weight= 100): 0= absent; 1= present.

Comments: See Hershkovitz (1977)

342. Lumbar vertebrae count. (Weight= 100). Number of lumbar vertebrae: 0= greater than 5; 1= ≤5.

Comments: Following Horovitz (1999) character number 2.

343. Tail length. (Weight= 50). Ratio of tail length to head and body length expressed as a percentage: 0=short (TL:HB<73); 1= moderate (=>73,<116); 2= long (>116) .

Comments: See data in Rosenberger (1983).

344. Glabrous skin on tail. (Weight= 100). Friction pads on the tail: 0= absent; 1= present.

Comments: See Hershkovitz (1977).

345. Baculum: (Weight= 100). 0= absent: 1= present.

Comments: Data in Hershkovitz (1977); Dixson (1987).

346. Scent glands on genitilia (Weight= 100): 0= present; 1= absent.

Comments: Data in Epple and Lorenz (1967); Hershkovitz (1977).

Lower deciduous tooth characters

All character numbers from Kay and Meldrum (1997). For terminology consult Kay (1978, 1980)

347. dp1. (Weight= 100): dP^{2-3} root numbers: 0= single; 1= double.

348. dp2a. (Weight= 50). dP^2 trigonid to talonid proportions: 0= dP^2 trigonid >> talonid; 1= dP^2 trigonid slightly longer than talonid; 2= dP^2 trigonid and talonid of similar length.

349. dp3b. (Weight= 50). dP^3 trigonid to talonid proportions: 0= dP^3 trigonid >> talonid; 1= dP^3 trigonid slightly longer than talonid; 2= dP^3 trigonid and talonid of similar length.

350. dp4. (Weight= 50). Protoconid projection: 0= dP^2 protoconid slender, projecting; 1= dP^2 robust, projecting; 2= dP^2 protoconid does not project above dp3-4.

351. dp5a. (Weight= 100). dp2 metaconid: 0=metaconid close to protoconid; 1= metaconid widely spaced from protoconid.

352. dp5b. (Weight= 100). dP^3 metaconid: 0=metaconid close to protoconid; 1= metaconid widely spaced from protoconid.

353. dp6a. (Weight= 50). dP^2 metaconid: 0= absent; 1=trace or small; 2= large.

354. dp6b. (Weight= 50). dP^3 metaconid: 0= absent; 1=trace or small; 2= large.

355. dp8a. (Weight= 100). dP^2 trigonid: 0=closed lingually; 1= 0pen lingually.

356. dp8b. (Weight= 100). dP^3 trigonid: 0=closed lingually; 1= 0pen lingually.

357. dp11a. (Weight= 50). dP^2 entoconid: 0= absent; 1= present but cristiform; 2= present as discrete cusp.

358. dp11b. (Weight= 50). dP^3 entoconid: 0= absent; 1= present but cristiform; 2= present as discrete cusp.

359. dp14a. (Weight= 100). dP^2 lateral and medial protocristids: 0=confluent; 1=separate.

360. dp14b. (Weight= 100). dP^3 lateral and medial protocristids: 0=confluent; 1=separate.

361. dp15a. (Weight= 100). dP^2 metaconid position: 0=lingual or slightly distal to protoconid; 1=far distal to protoconid.

362. dp15b. (Weight= 100). dP^3 metaconid position (or orientation of postmetacristid): 0=lingual or slightly distal to protoconid; 1=far distal to protoconid.

363. dp18a. (Weight= 50). dP^2 hypoconid size: 0=large; 1=small; 2= absent.

364. dp18b. (Weight= 50). dP^3 hypoconid size: 0=large; 1=small; 2= absent.

365. dp19. (Weight= 50). dP^3 hypoconid position: 0=distal to protoconid; 1=intermediate; 2= distal to metaconid.

366. dp21. (Weight= 50). dP^3 hypocristid: 0= absent; 1=weak; 2= small.

367. dp22. (Weight= 50). $dP^{2\text{-}3}$ buccal cingulum: 0= absent; 1=incomplete; 2= complete.

368. dp23. (Weight= 50). dP^2 shape: 0=buccolingually compressed; 1=rounded oval; 2= buccolingually broad.

369. dp24. (Weight= 100). dP^4 roots: 0=one root; 1=two roots.

370. dp25. (Weight= 100). dP^4 cusp relief: 0= moderate to high relief; 1=low relief.

371. dp26. (Weight= 50). dP^4 trigonid to talonid width: 0= wide (trigonid mesiodistal equal or greater than 1.1 times talonid mesiodistal length); 1= widths similar (less than 1.1 and greater than 0.95); 2= narrow (equal to or less than 0.95).

372. dp27. (Weight= 100). dP^4 trigonid: 0=open lingually; 1=closed lingually.

373. dp28. (Weight= 100). dP^4 metaconid position: 0=lingual or slightly distal to protoconid; 1=far distal to protoconid.

374. dp29. (Weight= 50). dP^4 paraconid: 0= absent or cristiform; 1=small discrete cusp; 2= large cusp.

375. dp30. (Weight= 50). dP^4 lateral protocristid: 0=runs towards metaconid; 1=runs toward hypoflexid; 2= absent.

376. dp31. (Weight= 100). dP^4 posterior trigonid wall: 0=complete; 1=sulcus between lateral and medial protocristids.

377. dp32. (Weight= 100). dP^4 facet X: 0= present; 1= absent.

378. dp33. (Weight= 33). dP^4 entoconid: 0= absent; 1=cristiform; 2= small discrete cusp; 3= large.

379. dp34. (Weight= 100). dP^4 postentoconid sulcus: 0= present; 1= absent.

380. dp35. (Weight= 50). dP^4 hypoconulid: 0=large; 1= moderate; 2= trace or absent.

381. dp36. (Weight= 50). dP^4 hypoconulid: 0=twinned to entoconid; 1=slightly lingual to midline; 2= in midline.

382. dp37. (Weight= 50). dP^4 oblique cristid: 0= absent; 1=rounded; 2= trenchant.

383. dp38. (Weight= 50). dP^4 cristid obliqua orientation: 0=towards protoconid; 1=between protoconid and metaconid; 2= towards metaconid.

384. dp39. (Weight= 50). dP^4 cristid obliqua terminus: 0=to base of trigonid; 1= partway up trigonid; 2= to protoconid or protocristid.

385. dp40. (Weight= 50). dP^4 centroconid: 0= present; 1= absent.

386. dp41. (Weight= 50). dP^4 hypocristid: 0= absent; 1=weak; 2= strong.

387. dp42. (Weight= 50). dP^4 buccal cingulum: 0= absent; 1= partial, broken; 2= complete.

388. dp43. (Weight= 100). dP^4 talonid: 0=open lingually; 1=closed lingually.

389. dp44. (Weight= 50). dP^4 hypoflexid: 0=very shallow; 1=shallow; 2= deep.

390. dp45. (Weight= 100). dP^4 distal fovea: 0= absent; 1= present.

391. dp46. (Weight= 100). dP^4 hypocristid accessory cusp: 0= absent; 1= present.

392. dp47. (Weight= 100). dP^4 cristid obliqua: 0=straight; 1=notched.

393. dp48. (Weight= 100). dP^4 trigonid mesiodistal proportions: 0=elongate relative to talonid; 1=short relative to talonid.

Re-interpreted and added upper molar characters from Marivaux et al., (2016).

394. ML-175. M12’*. (Weight= 33). M1-2 hypocone position: 0= distal, far lingual to protocone; 1= distal, slightly lingual to protocone; 2= same level (mesiodistally opposed); 3= distal, slightly buccal to protocone.

ERROR: MISSING IN C-T MATRIX. ML-179. M16*. (Weight= 33). M1-2 metaconule: 0= absent to indistinct; 1= small; 2= moderate; 3= large.

395. ML-181. M17’*. (Weight= 50). M1-2 mesostyle size: 0= absent to indistinct; 1= moderate; 2= strong.

396. ML-182. M17”. (Weight= 100). M1-2 mesostyle position: 0= attached to ectocrista; 1= present on buccal cingulum.

397. ML-207. ML156. (Weight= 100). M1-2 postprotocrista development: 0= strong; 1= tiny.

399. ML-208. ML157*. (Weight= 50). M1 postprotocrista length: 0= indistinct to absent; 1= short; 2= long.

400. ML-209. ML158*. (Weight= 50). M2 postprotocrista length: 0= indistinct to absent; 1= short; 2= long.

401. ML-210. ML159. (Weight= 100). M1 postprotocrista direction: 0= transverse, buccally directed; 1= lateral, directed toward the lingual posterior cingulum (postprotocone fold-like).

402. ML-211. ML160. (Weight= 100). M2 postprotocrista direction: 0= transverse, buccally directed; 1= lateral, directed toward lingual posterior cingulum (postprotocone fold-like).

403. ML-212. ML161. (Weight= 100). M1 postprotocrista terminus: 0= runs to base of metacone (with hypometacrista); 1= runs to metaconule (at the level of the small or virtual metaconule); 2= runs to posterior cingulum; 3= limited at a point distal to protocone.

NO NUMBER DELETED? ML-213. ML162. (Weight= 100). M2 postprotocrista terminus: 0= runs to base of metacone (with hypometacrista = posterolateral transverse crista of Kay (1977); 1= runs to metaconule (at the level of the small or virtual metaconule); 2= runs to posterior cingulum; 3= limited at a point distal to protocone.

404. ML-218. ML168*. (Weight= 50). M1-2 hypometacrista: 0= absent; 1= weakly developed (low and short); 2= well-developed (high).

405. ML-219. ML169*. (Weight= 50). M1-2 hypoparacrista = anterolateral transverse crista of Kay (1977): 0= absent; 1= weakly developed (short); 2= well-developed (high).

406. ML-220. MLN*. (Weight= 50). Hypometaconule crista (= metacrista or crista obliqua): 0= indistinct to absent; 1= moderate (not connected to protocone); 2= well-developed (connected to protocone or postprotocrista).

407. ML-184. M22*. (Weight= 33). M1-2 lingual cingulum development: 0= absent; 1= faintly visible; 2= well-defined; 3= strong.

408. ML-185. M22'. (Weight= 100). M1-2 lingual cingulum structure: 0= mesiodistally complete; 1= broken lingually (interrupted).

409. ML-197. ML147*. (Weight= 50). M1-2 metastyle: 0= indistinct to absent; 1= moderate; 2= strong.

410. ML-198. ML148*. (Weight= 50). M1-2 parastyle: 0= indistinct to absent; 1= moderate; 2= strong.

411. ML-201. ML151*. (Weight= 50). M1-3 posterior cingulum: 0= weakly developed; 1= moderate, does not reach the metastyle; 2= connected to metastyle.

412. ML-202. ML151'*. (Weight= 50). M1-2 posterior cingulum lobe (distomedial) inflation: 0= no inflation; 1= slightly inflated; 2= strongly inflated.

413. ML-203. ML152*. (Weight= 50). M1-3 posterior margin (waisting between buccal and lingual cusps): 0= indistinct to absent; 1= present but shallow; 2= present, deep.

414. ML-204. ML153*. (Weight= 33). M1-2 postparacrista: 0= indistinct to absent; 1= weakly developed; 2= well-developed (but well-marked notch between postparacrista and premetacrista); 3= strongly elevated (weak notch between postparacrista and premetacrista).

415. ML-205. ML154*. (Weight= 33). M1-2 premetacrista: 0= indistinct to absent; 1= weakly developed; 2= well-developed (but well-marked notch between premetacrista and postparacrista); 3= strongly elevated (weak notch between premetacrista and postparacrista).

416. 268'(from Marivaux modifies Kay M44) (Weight= 50). M44 prime.* M1-3 anterior cingulum: 0= strong; 1= weak; 2= absent.

417. 268''(from Marivaux modifies Kay M44) (Weight= 33). M44 double prime.* M1-3 anterior cingulum: 0= complete (very long), reaches the parastyle; 1= long, stop at the level of the paraconule (or where a paraconule should occur); 2= short, does not reach the paraconule (or where a paraconule should occur); 3= very short, mesiolingually limited (not extended).

418 'ML-179. M16*. M1-2 metaconule / 0= absent to indistinct; 1= small; 2=moderate; 3=Large.

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