**Supplemental material 5: character list**

**Abbreviations: SF**, Spaulding & Flynn (2012); **WF**, Wesley-Hunt & Flynn (2005); **ZR**, Zack & Rose (2009)

1. Lacrimal facial process (WF 1)

(0) broad rostral flange

(1) small, present on face

(2) not present on face

(3) orbital flange reduced to area around lacrimal foramen

2. Ventral exposure of premaxilla, posterior extent of premaxilla, lateral to palatal foramen (WF 2)

(0) lateral to canine

(1) anterior to canine

3. Shape of infraorbital foramen (WF 3)

(0) elongate

(1) round

4. Position of infraorbital foramen (WF 4)

(0) positioned above P3

(1) positioned above anterior edge of P4

(2) positioned above mid-posterior portion of P4

5. Length of palate-position of posterior edge of palatine midline relative to tooth row (WF 5)

(0) posterior to upper tooth row

(1) anterior or equal to upper tooth row

6. Palatine canal primary anterior opening (WF 6)

(0) opening through palatine

(1) at maxilla-palatine suture

(2) opening through maxilla

7. Relative length of frontal and parietal at midline (WF 7)

(0) parietal greater than frontal

(1) parietal equal or subequal to frontal

(2) frontal midline much longer than parietal

8. Postorbital process (WF 8)

(0) prominent

(1) small, reduced

9. Paroccipital process size (WF 9)

(0) well-developed

(1) reduced

10. Paroccipital process shape (WF 10)

(0) simple process

(1) laterally flattened, thin, but is distinct process

(2) cupped around bulla, process not distinct

(3) absent

11. Placement of postglenoid foramen (WF 11)

(0) medially placed

(1) more lateral, external, near very edge of skull

12. Postglenoid foramen (WF 12)

(0) present

(1) greatly reduced, or missing

13. Shape of mastoid process (WF 13)

(0) forming a distinct process, expanding out farther than paroccipital process, or subequal

(1) blunt, rounded, does not protrude significantly, more a swelling of the mastoid

(2) thin plate, no distinct process

14. Direction of mastoid process extension (WF 14)

(0) lateral-ventral

(1) ventral

(2) lateral

(3) none, or only swelling

15. Condyloid (hypoglossal) foramen position relative to post lacerate foramen (WF 15)

(0) distant

(1) close (less than the diameter of the hypoglossal foramen away)

(2) conjoined with posterior lacerate foramen

16. Condyloid (hypoglossal) foramen position relative to groove between the occipital condyle and the paroccipital process (WF 16)

(0) inline or within groove

(1) anterior to groove

17. Posterior lacerate foramen (WF 17)

(0) present as a vacuity between the promontorium and the basioccipital

(1) present as an individual foramen

18. Fenestra cochleae (rotunda) position relative to mastoid tubercle (WF 18)

(0) posterior to mastoid tubercle

(1) anterior, subequal to mastoid tubercle

19. Relative distance between the foramen ovale and the alisphenoid canal (WF 19)

(0) separated by at least the diameter of the alisphenoid canal

(1) separated only by a thin wall

(2) no alisphenoid canal present

20. Ossification of tegmen tympani (WF 20)

(0) facial nerve exposed ventrally

(1) facial nerve partially embedded within tegmen tympani and floored in anteromedial segment

(2) facial nerve beneath a bony sheath that defines the fossa for tensor tympani muscle

21. Contact of promontorium and basioccipital (WF 21)

(0) promontorium isolated

(1) promontorium in contact with basioccipital

22. Composition of mastoid tubercle (WF 22)

(0) mastoid tubercle formed by petrosal

(1) mastoid tubercle formed by squamosal

23. Anterior loop of internal carotid artery (WF 23)

(0) lack of an anterior loop of the internal carotid artery

(1) presence of the loop, excavation in basisphenoid

(2) presence of loop, but extrabullar

24. Suprameatal fossa (fossa on squamosal anterior to mastoid) (WF 24)

(0) absent

(1) small

(2) large, well developed

25. Position of internal carotid artery (WF 25)

(0) internal carotid artery laterally positioned, transpromontorial, runs close to margin of fenestra cochlea, presence of a promontory artery, groove for stapedial artery may or may not be present

(1) internal carotid artery transpromontorial but medially positioned, course far from fenestra cochlea

(2) internal carotid artery medial, extrabullar, inside a bony canal formed by the caudal entotympanic.

26. Apron shelf on promontorium posterior to fenestra cochleae for entotympanic attachment (WF 26)

(0) absent

(1) blunt, surface present posterior to fenestra cochleae, but no extensive attachment possible

(2) extended, large area for attachment, may roof posterior bullar chamber

27. Ventral process of promontorium (WF 27)

(0) absent

(1) present, medially positioned on promontorium

(2) present, anteriorly positioned

28. Shape of the promontorium, anterior extension (WF 28)

(0) elongate, apron extension tapers to a point anteriorly, almond like in appearance

(1) elongate, rounded anteriorly

(2) blunt, quickly truncating

(3) elongate, apron is broad, flat extension, not almond-shaped and not blunt

29. Facet on promontorium indicative of ectotympanic contact (WF 29)

(0) absent

(1) present

30. Surface of the anterior-medial promontorium or tympanic wing of basisphenoid (WF 30)

(0) smooth

(1) roughened surface associated with attachment of rostral entotympanic, or rostral entotympanic present

31. Inferior petrosal sinus (WF 31)

(0) inferior petrosal sinus small

(1) inferior petrosal sinus greatly enlarged

(2) excavation into basioccipital extremely deep

32. A deep, well developed fossa or pit on the squamosal/alisphenoid recording the contact with the anterior crus or anterior face of the ectotympanic (WF 32)

(0) absent, may have slight/shallow indentation

(1) present, well developed, or bulla present and fully ossified

33. Shelf between mastoid process and paroccipital process (WF 33)

(0) laterally wide, curved trough with smooth surface

(1) laterally wide, could have flat surface, rugose or bulbous, no smoothed out trough

(2) very thin, outside edge could be raised

(3) no shelf present

34. Extent of flange on basioccipital lateral edge bordering auditory region (WF 34)

(0) absent

(1) small, nascent

(2) well developed when compared to basal miacids

35. Evidence on basisphenoid and basioccipital for marked medial inflation of the entotympanic (WF 35)

(0) absent

(1) present, inflation of entotympanic pushing medially onto and over the basioccipital

36. Evidence of marked posterior inflation of the entotympanic, entotympanic attached during life to paroccipital process or to extensive area posterior to the petrosal (WF 36)

(0) absent

(1) present

37. Fossa for the stapedius muscle (WF 37)

(0) borders tightly defined and anteriorly bound by the mastoid

(1) general area of muscle insertion, open, less defined

38. Epitympanic wing of the petrosal forms ventral floor to the anterior medial corner of the fossa for the tensor tympani muscle (WF 38)

(0) absent

(1) present, but relatively flat and horizontal

(2) ventral floor present, but not horizontal, instead it forms a delicate tube, the bony floor is not an extension of the petrosal

39. Fossa for the tensor tympani muscle, defined and deep, excavating well dorsal of the level of the fenestra vestibule (WF 39)

(0) absent, fossa for the tensor tympani muscle shallow, not strongly defined

(1) present, defined and deep

(2) shallow/absent, tensor tympani inserts on eustachian canal

40. Placement of middle lacerate foramen (WF 40)

(0) foramen a vacuity not defined anteriorly nor posteriorly, positioned directly anterior to petrosal

(1) foramen anteriorly defined, posteriorly bordered by petrosal, positioned equal or posterior to basisphenoid/ basioccipital suture

(2) foramen defined anteriorly, petrosal may be undefined posterior border, foramen positioned in basisphenoid (or edge of alisphenoid) just anterior to basisphenoid/basioccipital suture

(3) foramen defined anteriorly and posteriorly completely bordered by basisphenoid, foramen positioned far anterior to basisphenoid/basioccipital suture

41. Palatine, relative size (WF 60)

(0) midline length of palatine less than midline length of maxilla

(1) midline length greater than midline length of maxilla.

42. Posterior width of palate (versus width between canines) (WF 61)

(0) wider than width at canines

(1) nearly equal (resulting in nearly parallel tooth rows).

43. Turbinal bones (WF 62)

(0) simple development of maxilloturbinals in nasal cavity

(1) maxilloturbinals large and branching, excluding nasoturbinals from narial opening.

44. Posterior projection of nasals (WF 63)

(0) nasals terminate anterior to, or in extreme anterior region of, orbit, projecting at most slightly between frontals

(1) nasals project deeply between frontals, far posterior of anterior orbital rim

(2) nasals with W-shaped termination

(3) nasals with flat termination

45. Jugal (WF 64)

(0) jugal reaches lacrimal, or is separated from it by only thin sliver of maxilla

(1) jugal widely separated from lacrimal, maxilla broadly laps posteriorly over anterior orbital rim.

46. Anterior extent of palatine in orbit (WF 65)

(0) broadly contacts lacrimal

(1) fails to contact lacrimal.

47. Postorbital constriction (WF 66)

(0) just anterior of frontoparietal suture, near posterior margin of frontal

(1) braincase expanded, with frontals making much greater contribution, frontoparietal suture located more anteriorly in frontal.

48. Posterior entrance of carotid artery into auditory capsule (WF 67)

(0) posterior entry, artery not enclosed in osseous tube

(1) posterior entry, artery enclosed in tube

(2) anterior entry, artery enclosed in osseous tube

(3) anterior entry, artery not enclosed in tube

49. Entotympanic (WF 68)

(0) fails to ossify, or is only weakly attached to auditory capsule

(1) ossified at least partially, and firmly fused to the skull.

50. Ectotympanic contributes to external auditory meatal tube (WF 69)

(0) no

(1) yes

51. Ectotympanic septum (WF 70)

(0) absent

(1) present.

52. Entotympanic septum (WF 71)

(0) absent

(1) present.

53. Fenestra cochleae (WF 72)

(0) approximately equal in size to fenestra ovalis, cochlear fossula not developed

(1) at least three times the area of oval window, cochlear fossula well developed

54. Malleus, muscular process (WF 73)

(0) present

(1) absent

55. Malleus, processus gracilis and anterior lamina (WF 74)

(0) well developed

(1) reduced.

56. I3 size

(0) subequal to I1-2 size

(1) enlarged

57. P1 (WF 79)

(0) present

(1) absent.

58. Posterior accessory cusps on P3 (WF 58)

(0) one cusp present

(1) two cusps present

(2) absent

59. P3 lingual cusp (WF 80)

(0) absent

(1) present

60. P4, size of parastyle cusp (WF 55)

(0) absent or very weak

(1) well-developed, defined cusp

61. P4, size of metastylar blade (WF 57)

(0) short

(1) elongate

62. P4 metastylar blade orientation

(0) oblique, sharp inclination between paracone and metastylar portions of postvallum

(1) longitudinal, roughly paralleling paracone portion of postvallum

63. P4 postmetacrista carnassial notch (WF 81)

(0) present, postmetacrista distinctly separated into metacone and metastylar portions

(1) absent, postmetacrista forms a single arcuate crest

64. P4, protocone (WF 56)

(0) large, well-developed

(1) reduced or absent

65. P4 protocone (WF 82)

(0) medial or posterior to paracone

(1) anterior to paracone

66. P4 hypocone (WF 83)

(0) absent

(1) present.

67. M1 size (WF 46)

(0) well-developed

(1) markedly reduced

68. M1 stylocone presence

(0) absent

(1) present

69. M1 stylocone length

(0) long axis shorter than maximum transverse width of paracone

(1) long axis longer than maximum transverse width of paracone

70. M1 stylocone orientation

(0) buccally and slightly mesially

(1) buccally

71. M1 parastyle development

(0) absent

(1) weak

(2) strong

72. M1, width of parastylar shelf (WF 51)

(0) lack of a shelf

(1) broad

(2) narrow, consisting mainly of ridge

73. M1, relative height of paracone and metacone (WF 48)

(0) paracone equal or subequal to metacone

(1) paracone greater than metacone

74. M1 paracone and metacone separation

(0) separate almost to bases

(1) fused to mid-height

(2) completely fused

75. M1 metastylar blade size

(0) prominent, long axis subequal in length to long axis of metacone

(1) small, long axis shorter than long axis of metacone

(2) absent, metacone reaches distal margin of crown

76. M1 metastylar blade orientation

(0) oblique, sharp inclination between metacone and metastylar portions of postmetacrista

(1) longitudinal, roughly paralleling metacone portion of postmetacrista

77. M1 postmetacrista carnassial notch

(0) present, postmetacrista distinctly separated into metacone and metastylar portions

(1) absent, postmetacrista forms a single arcuate crest

78. M1, relative height of paraconule and metaconule (WF 49)

(0) paraconule greater than metaconule

(1) paraconule equal or subequal to metaconule

(2) both absent

(3) metaconule enlarged, greater than paraconule

79. M1, protocone height relative to paracone (WF 42)

(0) protocone lower than paracone

(1) protocone equal or subequal to height of paracone

80. M1 protocone proportions

(0) mesiodistally compressed

(1) broadened

81. M1, a defined cingulum continuous around the lingual face of the protocone (WF 41)

(0) absent, mesial and distal cingula do not connect

(1) complete cingulum present

82. M1 distal cingulum termination

(0) terminates on base of crown, beneath metaconule

(1) interrupts postprotocrista to contact metaconule

(2) joins postmetaconule crista buccal to metaconule

83. Development of M1 distal cingulum and hypocone (WF 50)

(0) cingulum crest like, hypoconal shelf development minimal

(1) cingulum expanded, forming a weak hypocone shelf

(2) cingulum greatly expanded, hypocone shelf strongly developed

84. Presence of M2 (WF 52)

(0) present

(1) residual or reduced, simplified morphology, less than half the size of M1

(2) absent

85. M2 hypocone (WF 87)

(0) absent

(1) present.

86. Presence of M3 (WF 53)

(0) present

(1) absent

87. I1 (WF 78)

(0) present

(1) absent

88. P1 (WF 84)

(0) present

(1) absent

89. P4 protoconid proportions

(0) taller than long

(1) length and height subequal

90. Protostylid on P4

(0) absent

(1) present

91. P4/M1 height

(0) P4 protoconid substantially taller than M1 protoconid

(1) M1 protoconid subequal to P4 protoconid

(2) M1 protoconid substantially taller than P4 protoconid

92. Lower molars (WF 86)

(0) subequal in size

(1) M1 much larger than M2-3 and progressive decrease in size from M1-3

93. Reduction of lower molars (WF 88)

(0) M1-3 present

(1) M1-2 present, M3 absent

(2) M1 present, M2-3 absent

94. M1 mesial cingulid

(0) horizontal, extends to a point at the base of the paraconid

(1) inclined, reaches a point near midpoint of paracristid, relatively high up

95. Lower molar paracristids (WF 54-modified)

(0) absent or non-salient on all lower molars

(1) salient on all lower molars

(2) salient on M1, non-salient or weakly salient on M2-3

96. M1 protoconid and paraconid heights

(0) protoconid much taller than paraconid

(1) protoconid slightly taller than paraconid

(2) protoconid and paraconid heights subequal

97. M1 paraconid shape, lingual view

(0) mesiodistally compressed, finger like

(1) mesiodistally broad, triangular

98. M1 metaconid development

(0) subequal in size to paraconid

(1) reduced, much smaller than other trigonid cusps

(2) absent

99. M1 talonid (WF 85)

(0) present

(1) absent

100. M1 talonid width

(0) narrower than trigonid

(1) subequal to trigonid width

(2) wider than trigonid

101. M1 talonid basin depth

(0) deep

(1) shallow

102. M1 hypoconid size

(0) much larger than other talonid cusps

(1) subequal to other talonid cusps, particularly hypoconulid

103. M1 hypoconid apex position

(0) near distal margin of crown, postcristid very short and indistinct, hypoconid and hypoconulid apices appressed

(1) mesial to distal margin of crown, postcristid distinct, hypoconid and hypoconulid apices well-separated

104. M1 entoconid size

(0) present, height subequal to hypoconid

(1) present, much lower than hypoconid, talonid semitrenchant

(2) absent, talonid trenchant

105. Contour of lingual margin of M1 talonid

(0) changing direction abruptly at the apex of the entoconid

(1) forming a smooth curve at the back of the trigonid

106. M1 entoconid shape

(0) forms a crest that closes the lingual margin of the crown

(1) conical

107. M2 trigonid height

(0) tall

(1) low

108. M2 hypoconulid (WF 59-modified)

(0) relative size equivalent to M1

(1) enlarged relative to m1 hypoconulid

109. (Scapula) glenoid shape (ZRP1-modified)

(0) ovoid, distinctly longer than wide

(1) subcircular, length and width more similar

110. (Scapula) distal deflection of anterior glenoid fossa (ZRP2-modified)

(0) restricted to anterior 1/3 or less

(1) exceeds 1/2 of glenoid anteroposterior length

111. (Scapula) supraglenoid tubercle position (SF 100-modified)

(0) reaches anterior edge of glenoid fossa

(1) remains proximal to anterior edge of glenoid fossa

112. (Scapula) acromion process orientation (SF 101-modified)

(0) deflected anteriorly relative to scapular spine

(1) remains in same plane as the scapular spine

113. (Scapula) acromion process length (SF 102)

(0) process extends past glenoid fossa

(1) process terminates before or at glenoid fossa

114. (Scapula) scapular spine morphology (SF 104-modified)

(0) forms a continuous, linear spine in lateral view

(1) distal half is deflected anteriorly relative to the proximal half

115. (Humerus) orientation and elevation of anteromedial margin of greater tuberosity (SF 112 and 121-combined)

(0) height low, below level of humeral head, and angled medially, remaining close to head

(1) height intermediate, level with humeral head, and angled anteriorly, away from the head

(2) height elevated, above level of humeral head, and angled anteriorly, away from the head

116. (Humerus) lesser tuberosity projection and orientation

(0) limited medial projection away from humeral head, inclined posterodistally in medial view

(1) strong medial projection away from humeral head, inclination is nearly vertical in medial view

117. (Humerus) teres tubercle development (SF 115-modified, ZR P9-modified)

(0) weakly defined, no clear scar for teres major and latissimus dorsi present

(1) well-defined, forming crest or ridge on the medial side of the proximal humeral shaft

118. (Humerus) deltopectoral crest (SF 109-modified)

(0) elevated distally, with a sharp transition into the distal humeral shaft

(1) low distally, blending smoothly into the distal humeral shaft

119. (Humerus) brachial flange (SF 114-modified)

(0) prominent, extending out from the body of the bone as a flat surface

(1) reduced, nothing but a small raised line of bone

120. (Humerus) medial epicondyle development (SF 110-modified)

(0) prominent, projects well medial of remainder of distal humerus, distal margin of endplate faces medially

(1) reduced, does not project well medial of remainder of distal humerus, distal margin faces distomedially

121. (Humerus) shape of endplate of medial epicondyle

(0) subcircular in medial view with proximodistal length only slightly more than anteroposterior depth

(1) proximodistally elongate but anteroposteriorly compressed

122. (Humerus) olecranon fossa depth (SF 107-modified)

(0) shallow

(1) deeper but unperforated

(2) deep and perforated

123. (Humerus) ulnar collateral ligament insertion site size (SF 120)

(0) very large, forming a distinct circular pit

(1) small, forming only a shallow depression

124. (Humerus) radial fossa development (ZR P16-modified)

(0) shallow, margins poorly defined

(1) deep, margins well-defined, particularly lateral margin

125. (Humerus) trochlea projection (SF 116-modified)

(0) extends distally past capitulum when viewed anteriorly, lateral margin of trochlea oriented distolaterally

(1) less projecting, lateral margin of trochlea oriented more distally and less laterally

126. (Humerus) zona conoidea between trochlea and capitulum

(0) absent or indistinct, trochlea grades smoothly into capitulum in distal view

(1) present, a distinct step is present between the trochlea and capitulum in distal view

127. (Humerus) capitular tail (SF 106-modified)

(0) present

(1) absent

128. (Humerus) capitulum shape (SF 123-modified)

(0) relatively flat with a gently convex distal margin

(1) rounded, with a strongly convex distal margin

129. (Humerus) capitulum width (SF 119-modified)

(0) narrow, capitular width approximately 1.5 times proximodistal depth

(1) broad, capitular width approximately double proximodistal depth

130. (Radius) shape of radial head and ulnar facet curvature (SF 139 and 142-combined and modified)

(0) circular, with major and minor axes subequal, ulnar facet strongly curved, capitular eminence weak

(1) circular, with major and minor axes subequal, ulnar facet strongly curved, capitular eminence prominent

(2) oval, major axis greater than minor axis, ulnar facet curved, capitular eminence prominent

(3) oval, major axis greater than minor axis, ulnar facet flattened, capitular eminence prominent

131. (Radius) bicipital tuberosity

(0) well-developed

(1) poorly differentiated from the radial shaft

132. (Radius) distal extensor tubercle

(0) low, does not project strongly from shaft

(1) prominent, projects well away from distal radial shaft

133. (Radius) brachioradialis crest (ZR P23-modified)

(0) prominent, extends well lateral to the scapholunar facet

(1) reduced, does not project beyond the scapholunar facet

134. (Radius) scapholunar facet surface (SF 140-modified)

(0) substantially wider than deep

(1) depth and width subequal or slightly deeper than wide

135. (Radius) projection of styloid process (ZR P25-modified)

(0) weak, does not project substantially distal to remainder of distal radius

(1) projects strongly beyond remainder of distal radius

136. (Radius) large surface for articulation of the scaphoid (SF 141-modified)

(0) present

(1) surface small

137. (Ulna) shape in anterior view (SF 137-modified)

(0) straight

(1) sigmoidal

138. (Ulna) olecranon process length (SF 132-modified)

(0) short, proximodistal length comparable to mediolateral width

(1) elongate, proximodistal length exceeds mediolateral width

139. (Ulna) medial deflection of olecranon process, relative to a line separating the trochlear facet from the radial and posterior humeral facets (ZR P27-modified)

(0) substantial, ~30 degrees

(1) small, ~10 degrees

140. (Ulna) lateral projection of anconeal process (SF 133-modified)

(0) lateral margin forms a shelf projecting at right angle to shaft in anterior view

(1) lateral margin flush with or smoothly continuous with shaft in anterior view

141. (Ulna) curvature of radial notch (SF 129-modified)

(0) absent or weak

(1) strong

142. (Ulna) shape of radial facet (ZR P32-modified)

(0) proximodistally narrow

(1) broad posteriorly but tapers strongly onto coronoid process

(2) broad posteriorly with modest tapering onto coronoid process

143. (Ulna) m. brachialis insertion site position (SF 128-modified)

(0) oriented primarily anteriorly

(1) oriented primarily medially

144. (Ulna) development of distomedial crest for m. pronator quadratus (SF 135)

(0) well developed

(1) small

145. (Ulna) position of m. pronator quadratus crest

(0) at distal end of bone, close to level of distal radial facet

(1) more proximal, ending before reaching distal end of bone

146. (Ulna) orientation of distal radial and triquetrum facets (ZR P35-modified)

(0) anterodistally oriented

(1) primarily distally facing with reduced anterior orientation

147. (Carpus) scaphoid and lunate fusion (WF 92)

(0) unfused

(1) fused

148. (Carpus) position of scaphoid tubercle

(0) ventromedial to radial facet

(1) ventral to radial facet

149. (Carpus) ventral expansion of lateral side of scaphoid radial facet (SF 145-modified)

(0) absent, ventral margin of radial facet is relatively linear, a non-articulating shelf is present ventral to the radial facet

(1) present, the radial facet is more ventrally extensive laterally than medially, the non-articulating area is absent, at least medially

150. (Carpus) orientation of capitate facet of lunate (SF 149-modified)

(0) distal and somewhat medial

(1) primarily medial with little distal component

151. (Carpus) triquetrum shape in proximal view (SF 144)

(0) triangular

(1) rectangular

152. (Pelvis) ventral surface of ilium (SF 206-modified)

(0) broad and flat

(1) narrow

153. (Pelvis) development of iliac neck

(0) short, expansion of iliac blade begins immediately anterior to acetabulum

(1) pronounced, expansion of iliac blade begins well anterior to acetabulum

154. (Pelvis) morphology of anterior inferior iliac spine (rectus tubercle) (ZR P38-modified)

(0) defined, projecting, and rounded

(1) defined, projecting, and ovoid, elongated anteroposteriorly

(2) poorly defined, not projecting

155. (Pelvis) position of ischial spine (SF 202-modified)

(0) located just posterior of the border of the acetabulum

(1) far posterior from acetabulum

156. (Femur) posterolateral extension of femoral head onto neck (ZR P41-modified)

(0) absent, femoral head hemispherical in shape

(1) present, femoral head more spherical

157. (Femur) height of greater trochanter relative to femoral head (SF 161-modified)

(0) greater trochanter is taller than femoral head

(1) greater trochanter is even with femoral head

(2) greater trochanter is lower than head of femur

158. (Femur) orientation of broadest surface of greater trochanter (SF 164-modified)

(0) faces laterally

(1) faces posteriorly

159. (Femur) lesser trochanter morphology (SF 163-modified)

(0) proximodistally short, posterior surface dominated by scar for m. quadratus femoris

(1) more elongate, scar for m. quadratus femoris restricted to distal half of posterior surface

(2) more elongate, scar for m. quadratus femoris restricted to posterodistal margin

(3) very elongate, scar for m. quadratus femoris restricted to distal margin of trochanter, not visible in posterior view

160. (Femur) lesser trochanter orientation (SF 156-modified)

(0) projects posteromedially

(1) projects medially

161. (Femur) position of lesser trochanter relative to the third trochanter (SF 158-modified)

(0) third trochanter is substantially lower

(1) third trochanter is roughly at the same level

162. (Femur) third trochanter (WF 94)

(0) present

(1) absent

163. (Femur) third trochanter development (SF 159)

(0) a prominent feature that juts out from the lateral boundary of the shaft both proximally and distally

(1) a more shelf-like feature that is smoothly connected to the greater trochanter proximally, only jutting out from the boarder of the shaft distally

164. (Femur) medial angulation of proximal femoral shaft

(0) absent, proximal portion of femoral shaft aligned with distal portion

(1) present, proximal femoral shaft deflected medially, beginning at approximately the level of the third trochanter

165. (Femur) supracondylar tuberosities (SF 160)

(0) absent

(1) presence of two or more raised tuberosities just proximal to the condyles of the femur on the posterior shaft

166. (Femur) medial condyle morphology (SF 162)

(0) proximal edge of the articular surface of condyles are flush with the shaft, due to the lack of development of a condylar neck

(1) proximal edge of the articular surface of condyles are not flush with the shaft, due to the development of a condylar neck

167. (Femur) posterior projection of femoral condyles

(0) medial condyle projects further posteriorly than lateral condyle when viewed distally

(1) posterior projection of medial and lateral condyles subequal

168. (Femur) development of patellar groove (SF 166-modified)

(0) wide, shallowly excavated, and short, groove does not continue proximal to epiphysis; not elevated, groove close to level of condyles, distal femur wide relative to depth

(1) wide, deeply excavated, and short, groove does not continue proximal to epiphysis; not elevated, groove close to level of condyles, distal femur wide relative to depth

(2) wide, deeply excavated, and short, groove does not continue proximal to epiphysis; elevated, groove well anterior to level of condyles, distal femur deep

(3) narrow, deeply excavated, and elongate, with a distinct continuation onto distal femoral shaft; elevated, groove well anterior to level of condyles, distal femur deep

169. (Tibia) anterior projection of tibial tuberosity

(0) projects well anterior to tibial condyles

(1) does not project well anterior to tibial condyles

170. (Tibia) transverse position of tibial tuberosity

(0) near medial margin of proximal tibia

(1) centrally positioned

(2) near lateral margin of proximal tibia

171. (Tibia) fossa for origin of m. tibialis anterior lateral to tibial tuberosity

(0) well-defined

(1) poorly defined

172. (Tibia) fossa for origin of mm. flexores digitorum profundi on posterior surface of proximal tibia (SF 169-modified)

(0) well-developed and posterolaterally oriented, demarcated medially by a sharp ridge

(1) poorly defined and posteriorly oriented, no medial ridge

173. (Tibia) angulation of distal tibia relative to tibial shaft (ZR P47)

(0) aligned with shaft, posterior border of distal tibial shaft flat

(1) curved posteriorly relative to shaft, posterior border of distal tibial shaft distinctly concave

174. (Tibia) distal groove for mm. tibialis posterior and flexor digitorum medialis

(0) broad, inclined anterodistally

(1) narrow, vertical

175. (Tibia) posterior projection at distal end of tibia (SF 170-replaced)

(0) small and medially positioned, close to the medial malleolus and supporting a substantial portion of the medial side of the astragalar facet

(1) larger and more lateral, more separated from malleolus and only supporting a small portion of the medial side of the astragalar facet

(2) very prominent and well lateral to the medial malleolus, does not support a portion of the astragalar facet

176. (Tibia) concavity on the distal or distolateral surface of the medial malleolus

(0) present

(1) absent

177. (Tibia) astragalar facet shape (ZR P49-modified)

(0) transversely narrow, anteroposterior depth relatively uniform, deep

(1) transversely narrow, relatively deep medially, tapering substantially laterally

(2) transversely narrow, anteroposterior depth uniformly shallow

(3) transversely broad, anteroposterior depth uniformly shallow

178. (Tibia) mediolateral convexity of the astragalar facet

(0) absent, astragalar facet flat

(1) present, the medial and lateral portions of the lateral astragalar facet have distinctly different orientations

179. (Tibia) check facet at anterior margin of distal tibia facet (ZR P50-modified)

(0) absent or poorly developed

(1) well-developed

180. (Astragalus) proximal extension of medial ridge of lateral tibial facet (ZR P55-modified)

(0) terminates opposite astragalar foramen (if present) well distal to proximal margin of astragalar body

(1) narrow extension well past astragalar foramen (if present) to approach proximal margin of astragalar body

(2) broad extension well past astragalar foramen (if present) to approach proximal margin of astragalar body, greater than half of total facet width

181. (Astragalus) proximal extension of lateral half of lateral tibial facet (SF 185-modified)

(0) restricted, fails to completely cover the proximolateral astragalar body, exposing a portion of the body in dorsal view

(1) more extensive, covers the proximolateral body in dorsal view, obscuring the astragalar foramen (if present)

(2) with a narrow proximal extension of the lateral ridge of the tibial facet, extending proximal to the level of the astragalar foramen (if present)

182. (Astragalus) distal edge of lateral half of lateral tibial facet

(0) relatively dorsal, a large gap is present between the tibial facet and the distolateral corner of the ectal facet

(1) relatively ventral, the lateral side of the lateral tibial facet is less widely separated from the distolateral corner of the ectal facet

183. (Astragalus) excavation of lateral tibial facet (SF 174)

(0) shallow

(1) deeper

184. (Astragalus) orientation of medial tibial facet

(0) dorsomedial, separation from lateral tibial facet relatively subtle

(1) medial, separation from lateral tibial facet abrupt

185. (Astragalus) presence of astragalar foramen (SF 182)

(0) present

(1) absent

186. (Astragalus) orientation of proximomedial plantar tuberosity

(0) medially, forming a medial extension of the astragalar body beyond the tibial facet

(1) proximomedially, astragalar body with limited medial extension beyond the tibial facet

(2) ventrally, astragalar body ends medially at the level of the tibial facet

187. (Astragalus) height of fibular facet (SF 175)

(0) height subequal to length, resulting in a roughly square shaped facet

(1) height much less than length, resulting in a more crescent shaped feature

188. (Astragalus) proportions of ectal facet

(0) broad, long axis not dramatically greater than short axis

(1) narrow, long axis much greater than short axis

189. (Astragalus) orientation of long axis of ectal facet

(0) proximodistally with limited mediolateral tilt

(1) approximately 45 degrees to the long axis of the astragalus, proximodistal and mediolateral orientation similar

190. (Astragalus) cotylar fossa presence and position (SF 187-modified)

(0) present on distomedial astragalar body and dorsal surface of astragalar neck (Didymictis)

(1) present on proximal surface of astragalar neck

(2) absent (Vulpavus)

191. (Astragalus) connection between sustentacular and navicular facets on medial border of astragalar neck (SF 181-modified)

(0) absent, sustentacular facet restricted and isolated medially

(1) present, sustentacular facet extends along medial side of astragalar neck

192. (Astragalus) length of astragalar neck (SF 191-modified)

(0) short, lateral aspect of navicular facet close to distal end of lateral tibial facet

(1) long, lateral aspect of navicular facet well separated from distal end of lateral tibial facet

193. (Astragalus) mediolateral curvature of navicular facet (SF 176-modified)

(0) present, distal margin of astragalar head appears rounded in dorsal view

(1) absent, distal margin of astragalar head appears flat in dorsal view

194. (Astragalus) orientation of long axis of navicular facet (SF 177-modified)

(0) transverse, astragalar head appears dorsoventrally compressed in distal view

(1) oblique, medial side of astragalar head deflected somewhat ventrally in distal view

(2) strongly oblique, medial side of astragalar head strongly deflected ventrally in distal view

195. (Astragalus) proximal extent of navicular facet (SF 180-modified)

(0) proximally extensive, substantial overlap with sustentacular facet

(1) restricted, does not extend far proximally and overlap with sustentacular facet is minimal

196. (Calcaneus) proportions of calcaneal tuber (ZR P65-modified)

(0) short and broad

(1) longer and transversely compressed

197. (Calcaneus) ectal facet curvature (SF 195)

(0) smooth

(1) clearly defined, sharp midpoint bend (rather than a smooth curve)

198. (Calcaneus) ectal facet elongation

(0) short, long axis of facet approximately twice the length of short axis

(1) elongate, long axis substantially longer than short axis due to proximal extension of facet

199. (Calcaneus) ectal facet orientation (ZR P66-modified)

(0) long axis relatively vertical, facet faces directly medially

(1) long axis more inclined, facet faces distomedially

200. (Calcaneus) width of ectal facet (ZR P67)

(0) relatively constant from posterior to anterior, posterior end slightly narrowed

(1) posterior half much narrower than anterior half

201. (Calcaneus) fibular facet (SF 194-modified)

(0) present, wide, extending lateral to distal end of ectal facet

(1) present, wedge-shaped, tapers to nothing adjacent to distal end of ectal facet

(2) absent

202. (Calcaneus) distal elongation (SF 188)

(0) calcaneus distinctly elongate distally, such that the sustentaculum is far from the distal border

(1) calcaneus short distally, sustentaculum is close to distal border

203. (Calcaneus) sustentacular facet size

(0) large

(1) reduced

204. (Calcaneus) peroneal tubercle composition

(0) a single projection

(1) two projections, one anterior and one posterior, separated by a groove

(2) two distinguishable but continuous projections

205. (Calcaneus) position of peroneal tubercle (ZR P70-modified)

(0) close to the distal margin of the calcaneus, just proximal to the cuboid facet

(1) between the cuboid and sustentacular facets

(2) at the level of the sustentacular facet

206. (Calcaneus) projection at dorsal midline of distal calcaneal body (ZR P71)

(0) strong, cuboid facet has a sharp dorsal corner in anterior view

(1) weak, dorsal margin of cuboid facet more gently rounded in distal view

207. (Calcaneus) plantar tubercle position (ZR P72-modified)

(0) at distal margin of calcaneus, flush with cuboid facet

(1) proximal to distal margin, well-separated from cuboid facet

208. (Calcaneus) cuboid facet proportions (SF 192-modified)

(0) cuboid facet substantially deeper than wide in distal view

(1) cuboid facet depth and width subequal

(2) cuboid facet substantially wider than deep in distal view

209. (Calcaneus) dorsal angulation of calcaneal cuboid facet (SF 193-modified)

(0) angled somewhat dorsally

(1) not significantly angled dorsally

210. (Calcaneus) medial orientation of calcaneal cuboid facet

(0) facet faces distally, angulation is 80-90 degrees from long axis in ventral view

(1) facet somewhat angled medially, angulation is 80-70 degrees from long axis in ventral view

(2) facet with substantial medial orientation, angulation is <70 degrees from long axis in ventral view

211. (Cuboid) anterior surface of cuboid (ZR P76-modified)

(0) weakly concave to weakly convex

(1) strongly concave

212. (Cuboid) elongation, dorsal view (SF 197-modified)

(0) short, length and width of body subequal in dorsal view

(1) elongate, body distinctly longer then wide in dorsal view

213. (Cuboid) presence of astragalar facet (SF 199-modified)

(0) present

(1) absent

214. (Cuboid) dorsoventral position of astragalar facet

(0) restricted to ventral half of cuboid, does not approach dorsal margin

(1) centrally positioned, occupies entire depth of cuboid, deepest near middle of bone

(2) restricted to dorsal portion of cuboid, does not reach ventral margin

215. (Cuboid) calcaneal facet orientation

(0) faces proximally, with limited lateral angulation

(1) faces proximodorsally

(2) faces strongly proximolaterally

216. (Cuboid) ventrolateral extension of the calcaneal facet towards the plantar tubercle

(0) absent, calcaneal facet isolated from the plantar tubercle

(1) present, calcaneal facet reaches or approaches plantar tubercle

217. (Cuboid) contact between navicular and ectocuneiform facets

(0) present

(1) absent, facets separated by a non-articulating gap

218. (Cuboid) accessory ectocuneiform facet (ZR P79)

(0) absent

(1) present

219. (Cuboid) plantar tubercle position (SF 198-modified)

(0) distal to the ectocuneiform facet

(1) even with the ectocuneiform facet

220. (Cuboid) proportions of distal metatarsal facet (ZR P80)

(0) depth and width subequal

(1) width substantially greater than depth

221. (Cuboid) size of MT V facet (SF 196)

(0) small, less than 40 percent of total distal articular surface

(1) large, articular surface at least 40% of total distal surface

222. (Navicular) proximodistal extent (SF 200-modified)

(0) shallow, proximodistal extent much less than length or width

(1) intermediate, proximodistal extent somewhat less than length or width

(2) deep, proximodistal extent subequal to length or width

223. (Navicular) transverse width

(0) length substantially greater than width

(1) length and width subequal

(2) width substantially greater than length

224. (Navicular) projection of plantar tubercle

(0) does not project far from body of navicular

(1) projects distally

(2) projects ventrally

225. Unguals (WF 99-modified)

(0) Fissured

(1) Unfissured