**Appendix 1: Morphological character list**

A total of 154 characters were derived from Migotto (2013, unpublished thesis), two from Elzanowski and Stidham (2010), two from Elzanowski and Zelenkov (2015), six from Gaff and Boles (2010), one from Worthy et al. (2016), three from Mayr (2014) and three from Mayr (2018). The remaining characters were novel traits derived from observations and comparisons between the extant and fossil specimens.

Ordered characters shown by \* at end of character states.

**Skull**

1. Transverse ridge on frontal behind hinge (Migotto 2013, char. 1): 0 = absent; 1 = present.
2. Depression in the os frontale (Migotto 2013, char. 2): 0 = absent; 1 = present.
3. Width of depression in the frontal (Migotto 2013, 3): 0 = narrow; 1 = broad.
4. Type of articulation of the lacrimal and frontal (Migotto 2013, 4; modified from Migotto 2008, 01): 0 = sutured; 1 = fused.
5. Processus supraorbitale lacrimale (Migotto 2013, 5; modified from Brito 2008, 05): 0 = undifferentiated from frontal; 1 = differentiated from frontal.
6. Medial face of processus supraorbitale lacrimale (Migotto 2013, 6; modified from Brito 2008, 09): 0 = connected to frontal; 1 = free from frontal.
7. Size of processus supraorbitale lacrimale (Migotto 2013, 7; modified from Brito 2008, 07): 0 = reduced; 1 = short; 2 = long. \*
8. Ossa supraorbitalia (Migotto 2013, 8; modified from Jollie 1977): 0 = absent; 1 = reduced; 2 = present. \*
9. Shape of processus orbitalis lacrimale (Migotto 2013, 9; modified from Holdaway 1994, 11): 0 = thin; 1 = inflated.
10. Lateral projection of processus orbitalis lacrimale (Migotto 2013, 10; Brito 2008, 13): 0 = absent; 1 = present.
11. Lateral concavity of processus orbitalis lacrimale (Migotto 2013, 11; Brito 2008, 09): 0 = absent; 1 = slightly accentuated; 2 = accentuated. \*
12. Rostromedial fenestra in processus supraorbitalis lacrimale (Migotto 2013, 12; modified from Migotto 2008, 12): 0 = absent; 1 = present (foramen); 2 = present (notch/fenestra).
13. Contact between processus orbitalis lacrimale and os ectethmoidale (Migotto 2013, 13; modified from Migotto 2008, 10): 0 = present (articulated); 1 = present (fused).
14. Size of lateral portion of ectethmoidale (Migotto 2013, 14): 0 = long; 1 = average; 2 = short. \*
15. Foramen orbitonasalis medialis (Migotto 2013, 15; Migotto 2008, 13): 0 = confluent with sulcus n. olfactorii; 1 = not confluent.
16. Fonticuli interorbitales (Migotto 2013, 16; modified from Jollie 1977b): 0 = absent; 1 = present.
17. Shape of processus postorbitalis (Migotto 2013, 17; modified from Holdaway 1994, 25): 0 = gracile; 1 = thickened; 2 = robust. \*
18. Length of processus postorbitalis relative to zygomatic process (Migotto 2013, 18; modified from Migotto 2008, 19): 0 = short (dorsal to); 1 = long (ventral to).
19. Lamina parasphenoidalis processus medialis (Migotto 2013, 19; Brito 2008, 29): 0 = barely evident; 1 = short; 2 = long. \*
20. Lateral fusion of lamina parasphenoidalis to base of rostrum parasphenoidale (Migotto 2013, 20; modified from Migotto 2008, 22): 0 = present; 1 = absent; 2 = incomplete. \*
21. Tuberculum basilaris (Migotto 2013, 21; modified from Migotto 2008, 24): 0 = absent; 1 = present.
22. Medial process of crista parabasalis dorsally bounding tympanic fossa (Migotto 2013, 22): 0 = reduced; 1 = long.
23. Processus basipterygoideus (Migotto 2013, 23; Jollie 1977b): 0 = present (functional); 1 = present (vestigial); 2 = absent. \*
24. Processus zygomaticus (Migotto 2013, 24; modified from Migotto 2008, 26): 0 = vestigial; 1 = developed; 2 = highly developed (*Ciconia*). \*
25. Crista otica dorsalis (Migotto 2013, 25; modified from Migotto 2008, 28): 0 = vestigial; 1 = short; 2 = laterally expanded. \*
26. Position of crista otica dorsalis in relation to jugal bar (Migotto 2013, 26; modified from Migotto 2008, 29): 0 = oblique; 1 = perpendicular.
27. Squamosal overlapping quadrate-squamosal joint (Migotto 2013, 27): 0 = hidden; 1 = exposed.
28. Conformation of pterygoid-palatine joint (Migotto 2013, 28; Migotto 2008, 33): 0 = pterygoid articulates/abuts to parasphenoidal and palatine; 1 = pterygoid articulates/abuts only to palatine.
29. Alignment of lateral edges of processus paroccipitalis in caudal view (Migotto 2013, 29): 0 = parallel or near parallel; 1 = convergent ventrally.
30. Direction of plane of foramen magnum (Migotto 2013, 30; modified from Migotto 2008, 36): 0 = caudal; 1 = caudoventral; 2 = ventral. \*
31. Prominentia cerebellaris (modified from Migotto 2013, 31; modified from Migotto 2008, 37): 0 = little or no inflation; 1 = inflated.
32. Shape of crista nuchalis transversa in caudal aspect (Migotto 2013, 32; Brito 2008, 53): 0 = inverted ‘u’-shape; 1 = ‘m’-shape.
33. Angle between processus maxillaris nasale and jugal bar (Migotto 2013, 33; modified from Migotto 2008, 40): 0 = acute (around 30°); 1 = around 50°; 2 = broad (around 80°). \*
34. Crista tomialis (Migotto 2013, 34): 0 = absent; 1 = present.
35. Shape of angulus tomialis maxillaris (Migotto 2013, 35; modified from Migotto 2008, 41): 0 = continuous with jugal bar; 1 = discrete projection ventral to jugal.
36. Position of angulus tomialis maxillaris relative to the maxillary bar/process of nasal (Migotto 2013, 36): 0 = rostral portion of maxilla; 1 = equal to maxillary bar; 2 = extends past maxillary bar. \*
37. Openness of nares (Migotto 2013, 37; modified from Migotto 2008, 43): 0 = completely open; 1 = partially covered by nasal bone (caudal part covered); 2 = partially covered by nasal bone (dorsal part covered).
38. Palatines ventrally concave when paired in caudoventral view (Migotto 2013, 38; modified from Migotto 2008, 45): 0 = absent; 1 = present.
39. Medial angle of palatine (Migotto 2013, 39; Brito 2008, 69): 0 = present; 1 = absent.
40. Dorsoventral height of rostrum relative to tomial margin (Migotto 2013, 40; modified from Brito 2008, 78): 0 = long; 1 = short.
41. Contact between medial borders of caudal palatines (Migotto 2013, 41): 0 = partial, separated by parasphenoid caudally; 1 = complete.
42. Processus maxillopalatinus (Migotto 2013, 42): 0 = reduced; 1 = developed.
43. Contact between processus maxillopalatinus (Migotto 2013, 43; modified from Migotto 2008, 47): 0 = fused; 1 = adjacent to each other; 2 = widely separated. \*
44. Fenestra ventromedialis (Migotto 2013, 44; modified from Holdaway 1994, 06; also refer to Livezey and Zusi 2007, 0289): 0 = absent; 1 = present (narrow); 2 = present (wide). \*
45. Fenestra ventrolateralis (Migotto 2013, 45; Migotto 2008, 49; Livezey and Zusi 2007, 0290): 0 = absent or small; 1 = present.
46. Vomer (Migotto 2013, 46; modified from Jollie 1977b): 0 = absent; 1 = present.
47. Shape of rostral extremity of vomer (Migotto 2013, 47): 0 = pointed; 1 = inflated.
48. Foramen in palatine lamina dorsale (Migotto 2013, 48): 0 = absent; 1 = present.
49. Pterygoid foramina (Migotto 2013, 49; Brito 2008, 76): 0 = absent; 1 = present.
50. Position of quadrato-quadratojugal joint relative to processus postorbitalis on dorsoventral axis (Migotto 2013, 50; modified from Migotto 2008, 53): 0 = rostral or close to it; 1 = caudal.
51. Quadrate, condylus mandibularis caudalis differentiation from condylus lateralis and condylus medialis (Elzanowski and Zelenkov 2015; Migotto 2013, 51; modified from Migotto 2008, 54): 0 = well differentiated; 1 = slightly differentiated; 2 = absent. \*
52. Processus retroarticularis (Migotto 2013, 52; Holdaway 1994, 34): 0 = absent; 1 = present (vestigial); 2 = present (developed). \*
53. Position of mandibular symphysis relative to rostrocaudal axis of mandible (Migotto 2013, 53; modified from Holdaway 1994, 27): 0 = coincides with axis; 1 = does not coincide, noticeably depressed below axis.
54. Processus lateralis of mandible (Migotto 2013, 54; modified from Migotto 2008, 59): 0 = slightly differentiated from mandible; 1 = short; 2 = long. \*
55. Processus coronoideus (Migotto 2013, 55): 0 = absent; 1 = present
56. Mandible, caudal margin of fossa aditus canalis neurovascularis (Migotto 2013, 56): 0 = forms a crest; 1 = forms a distinct tuberculum pseudotemporale; 2 = flat.
57. Position of processus coronoideus relative to external muscle adductor of mandible (Migotto 2013, 57): 0 =close; 1 = separate.
58. Cranium, cranial base, number of foramina nervi hypoglossi (Mayr, 2018): 0 = 4 or more; 1 = 3; 2 = 2. \*
59. Cranium, cranial base, configuration of foramina nervi hypoglossi (Mayr, 2018): 0 = clustered into tight group; 1 = one or more foramina separated clearly from rest of group; 2 = foramina arranged into vertical line.
60. Cranium, cranial base, position of foramen nervi glossopharyngealis relative to ostium canalis opthalmicus externus and ostium canalis carotici (Mayr, 2018): 0 = forms relatively straight line falling between ostium canalis opthalmicus externus and ostium canalis carotici; 1 = forms peak of ‘triangle’ or angle outwards between the two ostia; 2 = set well outside the two ostia. \*
61. Quadrate, proximal end, processus oticus, size of capitulum oticum relative to capitulum squamosum: 0 = equal size; 1 = unequal size (capit. otic. larger).
62. Quadrate, proximal end, processus oticus, caudal foramen under capitulum: 0 = present; 1 = absent.
63. Quadrate, proximal end, foramen pneumaticum caudomediale (Elzanowski and Zelenkov 2015): 0 = present; 1 = absent.
64. Quadrate, distal end, foramen pneumaticum basiorbitale (Elzanowski and Stidham 2010): 0 = present; 1 = absent.
65. Quadrate, distal end, foramen pneumaticum rostromediale (Elzanowski and Stidham 2010): 0 = present; 1 = absent.
66. Quadrate, size of condylus lateralis relative to condylus medialis: 0 = greatly enlarged, more than twice the size of condylus medialis; 1 = twice to 1.5 times the size; 2 = roughly equal. \*
67. Quadrate, processus orbitalis orientation relative to corpus of processus oticus: 0 = medial orientation (continuing out in straight line); 1 = medioventral; 2 = mediodorsal.
68. Quadrate, condylus lateralis, size of arcus jugal facet: 0 = moderate, roughly half of lateral facies; 1 = large, over two thirds of lateral facies.

**Sternum**

1. Number and position of incisura/fenestra sterni (Migotto 2013, 58): 0 = none; 1 = shallow incisura medialis; 2 = outer incisura/fenestra (fenestra lateralis extends close to trabecula lateralis) present; 3 = both fenestra/incisura medialis and lateralis present.
2. Conformation of fenestra/incisura lateralis (Migotto 2013, 59): 0 = open; 1 = enclosed.
3. Abutment of crista medialis carinae to spina externa (modified from Migotto 2013, 60): 0 = absent; 1 = present; 2 = separated by deep fossa (*Ciconia*).
4. Contiguity of caudal end of carina to caudal margin of sternum (Migotto 2013, 61): 0 = absent, carina terminates before caudal margin; 1 = present, carina terminates at caudal margin.
5. Size of region between caudal end of carina and caudal margin of sternum (Migotto 2013, 62): 0 = absent or small; 1 = large.
6. Projection of spina externa in rostrum sterni (Migotto 2013, 63; Holdaway 1994, 55): 0 = short; 1 = long (compressed in *Ciconia*, *Sagittarius*).
7. Position of apex of carina relative to the sulcus sellaris medialis on a dorsoventral axis (Migotto 2013, 64): 0 = separated caudally; 1 = adjacent; 2 = overlapping cranially. \*
8. Position of sulci articularis coracoidei (Migotto 2013, 65; modified from Jollie 1977b): 0 = separate; 1 = overlapping.
9. Processus of labrum internum sternae (Migotto 2013, 66): 0 = absent or vestigial; 1 = small; 2 = robust. \*
10. Caudolateral extremity of fossa sternocoracoidei (Migotto 2013, 67): 0 = distinct with thick border; 1 = little differentiation, forms line.
11. Number of processus costales: 0 = 4; 1 = 5; 2 = 6; 3 = 7; 4 = 8.
12. Caudolateral extension of fossa sternocoracoidei (modified from Migotto 2013, 68; modified from Holdaway 1994, 51): 0 = reaches 2nd processus costalis; 1 = reaches 3rd processus costalis; 2 = reaches 4th processus costalis; 3 = reaches 5th or 6th processus costalis; 4 = reaches past 6th processus costalis or not visible (*Ciconia*).
13. Foramen in fossa sternocoracoidei (Migotto 2013, 69; Holdaway 1994, 48): 0 = absent; 1 = present.
14. Anteromedial projection on processus craniolateralis (Migotto 2013, 70): 0 = absent; 1 = present (short); 2 = present (developed). \*
15. Pneumatic foramen on dorsal face of processus craniolateralis (Migotto 2013, 71): 0 = absent; 1 = present.
16. Thickened carina apex relative to spina externa of rostrum sterni (Migotto 2013, 72): 0 = proportionate; 1 = spina externa thicker than carina apex; 2 = carina apex thicker than spina externa. \*
17. Carinae apex thickness (Migotto 2013, 73): 0 = absent, apex carinae tapers from pila carinae; 1 = present, apex thick as or thicker than pila.
18. Type of origin point for lig. sternocoracoideum laterale (Migotto 2013, 74): 0 = crest; 1 = tuberculum.
19. Sternum, ventral surface, position of dorsolateral intermuscular line relative to point of origin for lig. sternocoracoideum laterale (Migotto 2013, 75): 0 = adjacent; 1 = separated medially.
20. Caudal extension of dorsolateral intermuscular line down body of sternum (Migotto 2013, 76): 0 = extends to cranial third of body; 1 = extends to middle third of body; 2 = extends to caudal third of body. \*
21. Depth of carina: 0 = greater than depth of sternum; 1 = roughly equal to depth of sternum; 2 = less than depth of sternum. \*
22. Extension of spina interna: 0 = present; 1 = absent.
23. Distinct foramen pneumaticum in dorsal face of sternum depth: 0 = absent; 1 = present.

**Scapula**

1. Pneumatic foramen in cranial region of acromion (Migotto 2013, 82): 0 = absent; 1 = present.
2. Cranial projection of acromion in ventral or medial view: 0 = low projection; 1 = distinct projection.
3. Presence of a foramen on medial facies (derived from Migotto 2013, 83): 0 = absent; 1 = present on medial facies.
4. Presence of a foramen on ventral facies caudal to humeral facet (derived from Migotto 2013, 83): 0 = absent; 1 = present.

**Coracoid**

1. Incisura/foramen nervi supracoracoidei (Migotto 2013, 84; modified from Olson 1987): 0 = absent; 1 = present.
2. Position of incisura/foramen nervi supracoracoidei (modified from Migotto 2013, 85): 0 = directly adjacent to medial margin of shaft; 1 = set adjacent to medial margin of cotyla scapularis; 2 = set almost central between the medial and lateral margins of shaft.
3. Coracoid, shaft, medial edge, incisura n. supracoracoidei enclosed by bridge of bone: 0 = open; 1 = enclosed.
4. Coracoid, shaft, medial edge, incisura n. supracoracoidei size: 0 = large, takes up at least half of shaft length omal to impressio m. sternocoracoidei (see *Falco berigora*); 1 = small, takes up ¼ or less of shaft length.
5. Foramen opening into corpus from foramina nervi supracoracoidei (Migotto 2013, 86): 0 = absent; 1 = present.
6. Coracoid, omal end, orientation of omal margin of processus procoracoideus relative to sternal margin: 0 = parallel; 1 = orientated in a distal slope.
7. Coracoid, omal end, size of cotyla scapularis relative to the shaft width: 0 = small, less than ¼ width; 1 = large, 1/4 or more width.
8. Sternal margin of facies articularis clavicularis forms crest overhanging sulcus supracoracoideus (Migotto 2013, 87; modified from Holdaway 1994, 59): 0 = present; 1 = absent.
9. Coracoid, omal end, position of pneumatic foramina relative to sides of sulcus supracoracoideus (Migotto 2013, 88): 0 = ventral; 1 = dorsal.
10. Coracoid, omal end, presence of pneumatic foramina in sulcus supracoracoideus: 0 = present; 1 = absent.
11. Coracoid, omal end, depth of pneumatic foramina in sulcus supracoracoideus: 0 = deep, pneumatic holes extend well into shaft; 1 = shallow, mildly pneumatised, barely goes past facies of sulcus.
12. Shape of coracobrachial ligament attachment (Migotto 2013, 89): 0 = triangular; 1 = rectangular, 2 = absent (*Falco*).
13. Coracoid, omal end, position of tuberculum for insertion of coracobrachial ligament on dorsal facies of coracoid body (Migotto 2013, 90; modified from Holdaway 1994, 68): 0 = medial; 1 = central; 2 = lateral. \*
14. Contiguity of coracobrachial ligament attachment to the cranial border of sulcus m. sternocoracoidei (Migotto 2013, 91): 0 = absent; 1 = present.
15. Depth of impression m. sternocoracoidei (Migotto 2013, 92): 0 = shallow; 1 = deep.
16. Coracoid, omal end, dorsal view, facies articularis humeralis, lateral projection: 0 = long and little projection; 1 = short and projecting (see *Accipiter* *fasciatus*); 2 = long and projecting.
17. Coracoid, length vs sternal articular width: 0 = short, robust; 1 =moderate; 2 = elongate, narrow. \*
18. Coracoid, sternal end, lateral edge, processus lateralis projection: 0 = non-projecting, barely extends past lateral-most point of facies articularis sternalis; 1 = well projecting, extends distinctly lateral of facies articularis sternalis.
19. Coracoid, distal end, lateral edge, processus lateralis robustness: 0 = the process is broad, with the distal edge approximately the same height as the proximal-most end; 1 = the process is tapered and narrow, distal edge narrower in height than proximal-most end, sternal edge quite compressed in relation to coracoid sternal end.
20. Coracoid, distal end, omal-sternal width of the facet on the facies articularis sternalis: 0 = narrow, consistent along facies; 1 = widened into a flange at angulus medialis end.
21. Coracoid, distal end, projection of dorsal flange relative to distal margin of facies articularis: 0 = set well proximal of margin; 1 = set near adjacent to margin.

**Humerus**

1. Humerus, proximal end, cranial surface, pneumatic fossa set in base of caput humeri: 0 = absent; 1 = present (see *Coragyps atratus* B36873).
2. Humerus, proximal end, dorsal side, tuberculum dorsale presence (modified from Migotto 2013, char. 93): 0 = projecting caudally; 1 = projecting dorsoproximally.
3. Humerus, proximal end, dorsal side, level of tuberculum dorsale relative to sulcus lig. transversus (Migotto 2013, char, 94): 0 = distal to; 1 = aligned with.
4. Humerus, proximal end, cranial surface, depth of sulcus lig. transversus: 0 = shallow; 1 = deep, makes very distinct impression into bone.
5. Humerus, proximal end, cranial surface, inflation of the intumescentia humeri: 0 = surface inflated in rounded mound; 1 = surface flattened or slightly concave.
6. Humerus, proximal end, caudal surface, shape of fossa pneumotricipitalis ventralis: 0 = narrowed, half-oval; 1 = broadened, semicircular.
7. Humerus, proximal end, caudal surface, depth of fossa pneumotricipitalis dorsalis (Migotto 2013, char. 96): 0 = absent or barely differentiated; 1 = distinct/deep.
8. Humerus, proximal end, caudal surface, crus ventrale fossa, scar for attachment for M. scapulohumeralis caudalis/ dorsalis scapulae (see Matsuoka and Hasegawa 2007): 0 = elevated on crus ventrale fossa; 1 = not prominent on surface.
9. Humerus, proximal end, caudal surface, towards ventral side, depth of incisura capitis: 0 = shallow, no excavation present; 1 = secondarily deepened.
10. Humerus, proximal end, located ventral of incisura capitis, capital ridge on shaft (Migotto 2013, char. 95): 0 = absent; 1 = present.
11. Humerus, proximal end, caudal surface, distal of incisura capitis, adjacent to crus dorsale fossa, size of insertion at dorsal side of incisura capitis (see Matsuoka and Hasegawa 2007): 0 = quite large and round; 1 = oval shaped and narrow (see *Circus assimilis*).
12. Humerus, proximal end, caudal surface, distal of incisura capitis, visibility of insertion at dorsal side of incisura capitis: 0 = well defined, distinct shape; 1 = faint, poorly defined.
13. Humerus, proximal end, dorsal side, position of angulus deltopectoralis relative to distal end of crista bicipitalis (analogous to Migotto 2013 char. 99 and Holdaway 1994 char. 98): 0 = level or positioned just distal of crista bicipitalis; 1 = positioned well distal of crista bicipitalis.
14. Humerus, proximal end, proximal end, profile of proximal part of crista (Migotto 2013 char. 100, Holdaway 1994 char. 71): 0 = concave; 1 = flat
15. Humerus, proximal end, dorsal side, angulus deltopectoralis (Migotto 2013, char. 98): 0 = rounded; 1 = angled.
16. Humerus, proximal end, alignment of distal end of crista deltopectoralis relative to shaft (Migotto 2013, char. 97): 0 = perpendicular; 1 = parallel (Perpendicular is taken to mean deltoid crest directed cranially e.g. *Lophoictinia*, parallel directed dorsally e.g. *Aegypius*).
17. Humerus, proximal end, ventral view, angle between distal crista deltopectoralis and shaft (Migotto 2013 char.101, Holdaway 1994 char. 72): 0 = shallow; 1 = markedly angled.
18. Humerus, proximal end, caudal aspect, presence of sulcus on caudal surface of crista deltopectoralis: 0 = in proximal half of crista, quite deep; 1 = in proximal half of crista, shallow; 2 = no sulcus. \*
19. Humerus, proximal end, ventrally on the crista deltopectoralis, breadth of insertion scar of m. pectoralis: 0 = narrow; 1 = robust.
20. Humerus, proximal end, crista deltopectoralis, in cranial view, length and distal end of scar for m. pectoralis (analogous to Migotto 2013 char. 104): 0 = long, extends level with base of crista bicipitalis; 1 = short, ends well before base of crista bicipitalis.
21. Humerus, proximal end, ventral side, distal margin of crista bicipitalis in caudal view (analogous to Migotto 2013 char. 102, Holdaway 1994 char. 84): 0 = little flaring, terminates close to shaft; 1 = forms distoventrally convex flange.
22. Humerus, proximal end, cranial facies, distal of crista bicipitalis, sulcus nervus coracobrachialis (modified from Migotto 2013, char. 103): 0 = absent; 1 = present (faint); 2 = present (distinct). \*
23. Humerus, shaft, curvature: 0 = straight, little or none; 1 = slightly sigmoid; 2 = markedly sigmoid (see *Accipiter fasciatus*). \*
24. Humerus, shaft, scar for m. latissimus dorsi on caudal facies: 0 = faint, poorly defined line down shaft; 1 = distinct line down shaft.
25. Humerus, shaft width, measured just proximal to epicondylus dorsalis, as a proportion of distal width from condylus ventralis to condylus dorsalis (Gaff and Boles 2010, character 7): 0 = less than 25%; 1 = more than 25% (broad).
26. Humerus, distal end, ventral side, projection of processus flexorius in medial view (Gaff and Boles 2010, character 5): 0 = protrudes caudally out from shaft (*Aquila*); 1 = caudal protrusion reduced/flattened (*Haliaeetus*).
27. Humerus, distal end, ventral side, projection of processus flexorius in cranial view (Migotto 2013, character 106; Gaff and Boles 2010, character 5): 0 = small, does not project past condylus ventralis; 1 = medium, equal with condylus ventralis; 2 = large, projects past condylus ventralis. \*
28. Humerus, distal end, ventral side, shape of processus flexorius in medial view (Gaff and Boles 2010, character 5): 0 = base well rounded (*Aquila*); 1 = base less round/flattened (*Haliaeetus*).
29. Humerus, distal end, ventral side, width of fossa on tuberculum supracondylare ventrale relative to gap between condyles: 0 = large (equal to or greater than size of gap); 1 = small (less than size of gap).
30. Humerus, distal end, ventral side, depth of fossa for pronator superficialis on tuberculum supracondylare ventrale: 0 = deep; 1 = shallow.
31. Humerus, distal end, projection of tuberculum supracondylare dorsale in cranial view (modified from Migotto 2013 char. 105): 0 = barely projecting dorsad of condyle; 1 = projecting noticeably dorsal from condyle; 2 = projecting strongly from condyle. \*
32. Humerus, distal end, caudal view, depth fossa olecrani (Gaff and Boles 2010, char. 2): 0 = shallow (see *Aquila*); 1 = deep and defined (see *Haliaeetus*); 2 = secondary deepening within fossa (see *Falco berigora*). \*
33. Humerus, distal end, cranial view, ventral side, shape of scar for m. pronator superficialis (Gaff and Boles 2010, char. 3): 0 = quite circular (see *Aquila*); 1 = ovoid, not as well defined (see *Haliaeetus*).
34. Humerus, distal end, cranial face, fossa m. brachialis depth: 0 = shallow; 1 = deep.
35. Humerus, distal end, cranial face, proximity of fossa m. brachialis to dorsal facies of shaft: 0 = distant, intervening shaft very broad (1/2 width of fossa (see *Falco berigora*); 1 = moderate separation, intervening area 1/4 width of fossa; 2 = narrow separation <1/4 width of fossa (see *Aegypius monachus*). \*
36. Humerus, distal end, cranial face, orientation of dorsal margin of fossa brachialis proximally: 0 = curving dorsally towards shaft edge; 1 = curving ventrally.
37. Humerus, distal end, cranial face, extent of pneumatisation in fossa brachialis: 0 = little or none; 1 = highly pneumatic, fossae large.
38. Humerus, distal end, cranial face, orientation of interior margin of tuberculum supracondylare ventrale relative to the shaft axis: 0 = parallel to shaft; 1 = angled across shaft.
39. Humerus, distal end, cranial face, distance between interior margin of tuberculum supracondylare ventrale and tip of condylus dorsalis relative to distance between condylus dorsalis and dorsal margin: 0 = wider; 1 = equal.

**Ulna**

1. Ulna, proximal end, delimitation dorsally and ventrally of incisura radialis (Migotto 2013, 107): 0 = crests; 1 = tuberosities or single tubercule.
2. Ulna, proximal end, pneumatic foramina in incisura radialis (Migotto 2013, 108): 0 = absent or small; 1 = present (conspicuous).
3. Ulna, proximal end, pneumatic foramen in impressio m. brachialis (Migotto 2013, 109): 0 = absent; 1 = present.
4. Ulna, proximal end, ventral side, impressio m. brachialis depth: 0 = shallow, little deepening in towards proximal end; 1 = well deepened.
5. Ulna, proximal end, size of projection of olecranon above cotyla (Migotto 2013, 110): 0 = small; 1 = large.
6. Ulna, proximal end, pneumatic foramen located between olecranon and cotyla dorsalis in cranial view (Migotto 2013, 111): 0 = absent; 1 = present.
7. Ulna, proximal end, shape of distal and lateral margins of processus cotylaris dorsalis (Migotto 2013, 112): 0 = rounded; 1 = pointed.
8. Ulna, proximal end, dorsal aspect, projection of shaft past cotyla ventralis: 0 = flattened to weak projection, does not project past cotyla; 1 = moderate projection, projects equal to or slightly past edge of cotyla ventralis; 2 = strongly projecting, projects well past edge of cotyla ventralis. \*
9. Ulna, proximal end, depth of impressio m. scapulotricipitalis: 0 = small; 1 = large
10. Ulna, distal end, shape of dorsal side of tuberculum carpale (Migotto 2013, 113): 0 = undifferentiated from rest of tuberculum; 1 = differentiated (flat facies); 2 = differentiated (shallow fossa). \*
11. Ulna, distal end, tuberculum carpale, presence of foramen on ventral side (Migotto 2013, 114): 0 = absent; 1 = present.
12. Ulna, distal end, sulcus intercondylaris (Migotto 2013, 115): 0 = shallow; 1 = deep.
13. Ulna, distal end, tuberculum carpale status: 0 = flattened, weakly to moderately protruding; 1 = pointed, well protruding.
14. Curvature of shaft in ventral or dorsal aspect: 0 = straight, little or none; 1 = distinct, especially proximally (see *Accipiter fasciatus*).

**Radius**

1. Radius, proximal end, presence of pneumatic foramen associated with the tuberculum bicipitalis radialis (Migotto 2013, 116): 0 = absent; 1 = present.
2. Radius, distal end, presence of a pneumatic foramen in the depressio ligamenti (modified from Migotto 2013, 117): 0 = absent; 1 = present.
3. Radius, distal end, position of pneumatic foramen in the depressio ligamenti (modified from Migotto 2013, 117): 0 = medial side; 1 = lateral side.

**Carpometacarpus**

1. Carpometacarpus, proximal end, pneumatic foramina in fovea carpalis cranialis (Migotto 2013, 119): 0 = absent; 1 = present.
2. Carpometacarpus, proximal end, angle formed between processus extensorius and external rim of trochlea carpalis (Migotto 2013, 120): 0 = obtuse (greater than 100°); 1 = right angle (roughly 90°).
3. Carpometacarpus, proximal end, contiguity between facies articularis digiti alulae and proximal region of os metacarpale majus (Migotto 2013, 121; Holdaway 1994, 141): 0 = present, connected to os metacarpale majus; 1 = absent, not connected.
4. Carpometacarpus, proximal end, pneumatic surface on proximal region of os metacarpale minus (derived from Migotto 2013, 122; Holdaway 1994, 132): 0 = present; 1 = absent.
5. Carpometacarpus, proximal end, shape of surface of proximal region of os metacarpale minus (derived from Migotto 2013, 122; Holdaway 1994, 132): 0 = concave; 1 = flat.
6. Carpometacarpus, proximal end, position of distal end of ventral rim of trochlea carpalis relative to processus alularis: 0 = located well proximal to; 1 = equivalent to or slightly proximal of.
7. Carpometacarpus, proximal end, pneumatisation of fossa infratrochlearis: 0 = present; 1 = absent.
8. Carpometacarpus, proximal end, ventral facies, deep sulcus separating the processus pisiformis and the processus extensorius: 0 = absent; 1 = present
9. Carpometacarpus, proximal end, dorsally, pneumatisation of fossa supratrochlearis: 0 = present; 1 = absent.
10. Carpometacarpus, proximal end, distance between processus pisiformis and proximal-most point of spatium intermetacarpale: 0 = long, greater than proximal width of carpometacarpus; 1 = short, equal or less than proximal width.
11. Carpometacarpus, curvature of os metacarpale minus: 0 = flattened; 1 = arched caudally.
12. Carpometacarpus, distal end, projection of facies articularis digitalis minor past facies articularis digitalis major: 0 = greatly projecting; 1 = slightly projecting; 2 = roughly level. \*
13. Carpometacarpus, distal end, projection of ridge bordering sulcus tendineus distally in dorsal view: 0 = low; 1 = distinct thickening on either side of groove.
14. Carpometacarpus, distal end of os metacarpale majus, ventral projection: 0 = projects weakly cranially in low angle; 1= protrudes out strongly cranially in steep angle.
15. Carpometacarpus, distal end, length of distal synostosis to facet for digit 2 relative to spatium intermetacarpale (modified from Worthy et al 2016): 0 = short, less than width of spatium intermetacarpale; 1 = moderate, equal width of spatium intermetacarpale; 2 = elongate, up to twice as long. \*

**Ossa Carpi**

1. Os carpi radiale, projection of facies articularis metacarpalis (see Mayr 2014): 0 = not projecting in cranial view; 1 = partially projecting in cranial view (rounded or low prominence); 2 = strongly projecting in cranial view (both ends visible, pointed edges). \*
2. Os carpi radiale, notch for m. ulnometacarpalis ventralis (see Mayr 2014): 0 = low profile of inner edge; 1 = distinct inner edge projecting ventrally.
3. Os carpi radiale, facies articularis ulnaris, indentation depth (see Mayr 2014): 0 = shallow or slight; 1 = deep, distinct.

**Pelvis**

1. Pelvis, dorsal view, shape of pelvis: 0 = short and broad; 1 = elongate.
2. Pelvis, dorsal view, ala preacetabularis ilii, canalis iliosynsacri: 0 = absent; 1 = present.
3. Pelvis, dorsal view, proximity of dorsal iliac crests in preacetabular zone (Migotto 2013, 124): 0 = close set or touching; 1 = separated.
4. Pelvis, dorsal view, foramina intertransversaria (Migotto 2013, 125): 0 = open; 1 = partially or completely closed.
5. Pelvis, crista iliosynsacralis in interacetabular region (Migotto 2013, 126): 0 = flat or slightly grooved; 1 = inflated.
6. Pelvis, Lateral extremity of crista dorsolateralis ilii (Migotto 2013, 127): 0 = laterally expanded; 1 = retracted/withdrawn.
7. Pelvis, fossa iliocaudalis depth: 0 = shallow or absent; 1 = deep.
8. Pelvis, processus ventralis on extremitas cranialis synsacra: 0 = absent; 1 = present.
9. Pelvis, anterior fossa renalis: 0 = shallow; 1 = deep.
10. Pelvis, caudal fossa renalis (Migotto 2013, 128): 0 = shallow; 1 = deep.
11. Pelvis, caudal margin of foramen obturatum (Migotto 2013, 129): 0 = open, confluent to ischiopubica fenestra; 1 = closed.
12. Pelvis, incisura of terminal region of ischium (Migotto 2013, 130): 0 = absent; 1 = present (slight, see *Pandion haliaetus*); 2 = present (pronounced, see *Coragyps atratus*). \*
13. Pelvis, sutura iliosynsacralis conformation of postacetabular zone in dorsal aspect from caudal margin up: 0 = abruptly strikes out in 45° angle line before turning inwards (forms a right angle ‘L’ shape, *Falco berigora*); 1 = forms a gradually angled line that follows outward towards edges of ala postacetabularis (*Pandion haliaetus*); 2 = roughly forms a straight line following proximally up pelvis (*Aquila audax*).
14. Pelvis, ventral view, caudal of foramen acetabuli, conformation of widest distal processus costales of vertebrae acetabulum: 0 = thin struts limited to synsacrum; 1 = thin struts, forms a thin bridge attaching directly to ventral side of antitrochanter; 2 = thick struts, forms robust bridge attaching directly to ventral side of antitrochanter. \*

**Femur**

1. Femur, proximal end, proximal projection of crista trochanteris from facies articularis antitrochanterica (Migotto 2013, 131): 0 = high; 1 = low.
2. Femur, proximal end, fossa trochanteris (Migotto 2013, 132): 0 = distinct depression; 1 = shallow or absent.
3. Femur, proximal end, cranial aspect, number of pneumatic foramina on crista trochanteris (Migotto 2013, 133): 0 = none; 1 = one; 2 = two. \*
4. Femur, proximal end, caudal surface, depth of depression immediately distad of facies articularis antitrochanterica: 0 = shallow or no depression; 1 = deep, distinct impression.
5. Femur, proximal end, cranial aspect, position of linea intermuscularis cranialis on the upper corpus femoris (Migotto 2013, 134): 0 = lateral connects to end of crista trochanterica; 1 = medial, passing to medial side of pneumatic zone.
6. Femur, proximal end, projection of facies articularis antitrochanterica over cranial facies: 0 = overhanging; 1 = not overhanging.
7. Femur, proximal end, position of fovea lig. capitis: 0 = set high in caput femoris, small and circular (see *Falco berigora*); 1 = set high in caput femoris, large and circular; 2 = set low in caput femoris, large and ovular.
8. Femur, distal end, shape of proximal part of condylus fibularis in caudal aspect (Migotto 2013, 135): 0 = short; 1 = extended out to the side.
9. Femur, distal end, crista supracondylaris medialis (Migotto 2013, 136): 0 = absent or minute; 1 = present.
10. Femur, distal end, depth of fovea tendineus m. tibialis cranialis: 0 = deep and distinct; 1 = shallow.
11. Femur, distal end, depth of impressio m. gastrocnemialis lateralis: 0 = deep; 1 = shallow.
12. Femur, distal end, size of impressio m. gastrocnemialis lateralis: 0 = large; 1 = small.
13. Femur, distal end, caudal view, connectivity of lateral and medial condyles: 0 = connected by proximodistally compressed ridge; 1 = no connection, separated by distinct sulcus.
14. Femur, distal end, shape of ligament attachment point proximal to fossa poplitea: 0 = line/ridge; 1 = circular; 2 = oval; 3 = absent.
15. Femur, distal end, depth of fossa poplitea: 0 = shallow; 1 = moderately deep; 2 = very deep, (see *Pandion*). \*

**Tibiotarsus**

1. Tibiotarsus, proximal end, linearity of proximal profile of crista patellaris assessed in cranial aspect (Migotto 2013, 137): 0 = straight; 1 = convex proximally.
2. Tibiotarsus, proximal end, level of distal extremity of crista cnemialis cranialis in relation to proximal end of crista fibularis (Migotto 2013, 138): 0 = proximal; 1 = coinciding; 2 = caudal. \*
3. Tibiotarsus, proximal end, crista cnemialis cranialis length distally on shaft and cranial projection: 0 = markedly projects from shaft; 1 = does not project.
4. Proximal end, caudal facies, depth of fossa flexoria: 0 = shallow; 1 = deep, distinct fossa in shaft adjacent to facies articularis.
5. Tibiotarsus, proximal end, depression in the facies gastrocnemialis lateral of crista cnemialis cranialis (Migotto 2013, 139): 0 = deep; 1 = shallow or none.
6. Tibiotarsus, proximal end, depth of fossa retropatellaris: 0 = shallow, faint impression into proximal articular surface; 1 = deep, distinct impression.
7. Tibiotarsus, distal end, alignment of pons supratendineus in relation to long axis of shaft (Migotto 2013, 140; Holdaway 1994, 215): 0 = perpendicular (e.g. *Polyboroides*); 1 = oblique; 2 = nearly parallel (e.g. *Accipiter*). Note the canalis extensorius runs at right angle to the alignment of the pons. \*
8. Tibiotarsus, distal end, depth of sulcus extensorius under bridge of pons (Migotto 2013, 141): 0 = shallow; 1 = deep; 2 = very deep. \*
9. Tibiotarsus, distal end, condylus lateralis, sulcus m. fibularis (peronei) depth (Migotto 2013, 142): 0 = shallow; 1 = deep.
10. Tibiotarsus, distal end, expansion of condyles beyond shaft margins (anterior view): 0 = condyles expanded; 1 = condyles not expanded.
11. Tibiotarsus, distal end, condylus medialis, epicondylus medialis (Migotto 2013, 143): 0 = weakly present; 1 = developed, prominent of condyles; 2 = developed, occluded by condyles.
12. Tibiotarsus, distal end, cranial view, distal notch of incisura intercondylaris (modified from Migotto 2013, 144; modified from Holdaway 1994, char. 244): 0 = shallow; 1 = deep (u-shape); 2 = deep (v-shape).
13. Tibiotarsus, distal end, caudal surface of trochlea cartilaginis tibialis (modified Migotto 2013, 145): 0 = flat or bound by low caudal projections of condyli; 1 = deep groove bound by high caudal projections of condyli.
14. Tibiotarsus, distal end, number of openings to canalis extensorius: 0 = 2; 1 = 3 (as per falconids eg *Falco berigora*).
15. Tibiotarsus, distal end, distal view, level of cranial margin of condyles: 0 = equal; 1 = lateral condyle more cranial; 2 = medial condyle more cranial.
16. Tibiotarsus, distal end, distal view, medial condyle depth relative to width: 0 = deeper than wide; 1 = depth equals width; 2 = depth less than width (>0.5 mm). \*
17. Tibiotarsus, distal end, cranial view, ratio of height to width of medial condyle: 0 = roughly equal ratio (<15% difference); 1 = wider than high; 2 = higher than wide.
18. Tibiotarsus, distal end, cranial view, ratio of height to width of lateral condyle: 0 = roughly equal ratio (<15% difference); 1 = wider than high; 2 = higher than wide.
19. Tibiotarsus, distal end, projection of epicondylus lateralis from condylus lateralis: 0 = projects markedly from condyle (*Falco berigora*); 1 = no projection.
20. Tibiotarsus, distal end, position of proximal/medial attachment for tuberositas retinaculum extensoriis medialis (ligamentum transversum): 0 = set close to proximal side of pons supratendineus; 1 = set well proximal to pons supratendineus.
21. Tibiotarsus, distal end, position of distal/lateral attachment for ligamentum transversum: 0 = at end of distal side of pons supratendineus bridge, well offset from margin (*Elanus*); 1 = level with distal pons supratendineus; but extending to lateral margin.
22. Tibiotarsus, distal end, projection of crista on medial margin of trochlea cartilaginis tibialis: 0 = strongly projecting, forms rough 90° angle between main shaft and condyle; 1 = strongly projecting, flat line; 2 = weakly projecting.

**Tarsometatarsus**

1. Tarsometatarsus, proximal end, hypotarsus structure (terminology after Mayr 2016) plantar connection of crista lateralis flexoris hallucis longus and crista medialis flexoris digitorum longus to enclose a canal (based on Migotto 2013 char. 147): 0 = fully overlapping, monosulcate; 1 = partial overlap, cristae approach one another plantarly and join at some points but do not form a complete bridge over the length of the cristae (see *Aviceda subcristata* and *Pernis apivorus*); 2 = no overlap, sulcus hypotarsi completely open. \*
2. Tarsometatarsus, proximal end, dorsoplantar depth of cristae relative to each other (analogous to Migotto 2013 char. 148): 0 = crista medialis flexor digitorum longus and crista lateralis flexor hallucis longus of roughly equal depth; 1 = crista medialis flexor digitorum longus distinctly deeper than crista lateralis flexor hallucis longus.
3. Tarsometatarsus, proximal end, proximodistal length of crista medialis hypotarsi relative to crista lateralis hypotarsi: 0 = crista medialis hypotarsi much longer than crista lateralis hypotarsi; 1 = crista medialis and lateralis hypotarsi of roughly equal length.
4. Tarsometatarsus, proximal end, length of crista medialis lateralis relative to width: 0 = wider than long (1.5- 2x); 1 = roughly equal; 2 = longer than wide (1.5-2x). \*
5. Tarsometatarsus, proximal end, proximal aspect, cristae hypotarsi, depth of sulcus hypotarsi relative to the cotylae: 0 = sulcus hypotarsi set well plantar of cotylae (see *Coragyps atratus*); 1 = sulcus hypotarsi in line or close to cotylae.
6. Tarsometatarsus, proximal end, proximal aspect, sulcus hypotarsi, position of sulcus hypotarsi relative to sulcus flexorius: 0 = roughly equal; 1 = sulcus hypotarsi set plantar to sulcus flexorius.
7. Tarsometatarsus, proximal end, proximal view, incisura at base of crista lateralis flexoris hallucis longus hypotarsi, canal for m. fibularis longus (Migotto 2013, 149; modified from Jollie 1977b): 0 = absent; 1 = present (shallow); 2 = present (deep). \*
8. Tarsometatarsus, proximal end, lateral side, plantar aspect, length of sulcus for musculus fibularis longus on shaft (see Mayr 2016): 0 = absent or reduced; 1 = medium length, forms short, shallow sulcus (that extends to proximal third of length; 2 = very long sulcus, extends to at least halfway down shaft (*Pandion haliaetus*). \*
9. Tarsometatarsus, proximal end, depth of fossa infracotylaris dorsalis (Migotto 2013, 155): 0 = shallow; 1 = deep.
10. Tarsometatarsus, proximal end, lateral side, distinctness of impressio ligamentum collateralis lateralis: 0 = prominent tuberosity; 1 = indistinct scar, no prominence.
11. Tarsometatarsus, proximal end, length of crista medialis hypotarsi relative to depth: 0 = depth greater than length; 1 = depth equal to length; 2 = depth lesser than length. \*
12. Tarsometatarsus, proximal end, distal projection/hook on plantar end of crista medialis hypotarsi (modified from Migotto 2013, 151): 0 = none present; 1 = short, barely projects from crista; 2 = long, projects distinctly from crista. \*
13. Tarsometatarsus, proximal end, position of crista medialis hypotarsi: 0 = in line with outer edge of cotyla medialis; 1 = in line with centre of cotyla medialis; 2 = centred proximally between cotylae (see *Falco berigora*). \*
14. Tarsometatarsus, proximal end, proximal prominence of eminentia intercotylaris in dorsal view: 0 = little to moderate proximal projection; 1 = hyperprotruding, extends well proximal to cotyla (see *Coragyps atratus*).
15. Position of distal end of crista medianoplantaris relative to foramina vascularia proximalia medialis (Migotto 2013, 152): 0 = proximal; 1 = coinciding; 2 = distal. \*
16. Tarsometatarsus, proximal end, plantar aspect, position of foramen vasculare proximale medialis in lateromedial axis (Migotto 2013, 153): 0 = medial to crista medianoplantaris; 1 = lateral to crista medianoplantaris.
17. Tarsometatarsus, proximal end, plantar aspect, size of foramina vascularia proximalia: 0 = small, pinhole like; 1 = large, distinct holes.
18. Tarsometatarsus, proximal end, plantar and dorsal aspect, foramina vascularia proximalia, openness: 0 = both foramina open plantarly; 1 = foramina lateralis closed plantarly; 2 = foramina medialis closed plantarly.
19. Tarsometatarsus, proximal end, medial side, plantar aspect, width of proximal end of fossa parahypotarsalis medialis: 0 = very narrow; 1 = broad and poorly defined; 2 = broad and distinct.
20. Attachment ridges for impressiones retinaculi extensorii (Migotto 2013, 154 [modified]): 0 = absent; 1 = present (open, forms attachment for bridge); 2 = present (enclosed). \*
21. Tarsometatarsus, proximal end, prominence of tuberositas m. tibialis cranialis in lateral view: 0 = barely visible or none; 1 = very distinct protuberance from shaft.
22. Tarsometatarsus, proximal end, dorso-plantar depth of medial shaft adjacent to midlength fossa parahypotarsalis medialis: 0 = very thick; 1 = dorso-plantarly compressed but slightly thickened; 2 = highly dorso-plantarly compressed, thin. \*
23. Tarsometatarsus, proximal end, shape of tuberositas m. tibialis cranialis: 0 = elongate ridge; 1 = roughly circular or semi-ovular.
24. Tarsometatarsus, proximal end, proximity of tuberositas m. tibialis cranialis to foramina vascularia proximalia (analogous to Migotto 2013, 156, but slightly different states): 0 = abutting or just distal to foramina; 1 = set well distal from foramina.
25. Tarsometatarsus, proximal end, mediolateral position of tuberositas m. tibialis cranialis relative to foramina vascularia proximalia: 0 = offset medially, located distal to medial foramen (see *Falco berigora*); 1 = set roughly central between foramina (but see *Elanus scriptus* for unusual foramina positions); 2 = offset laterally, located distal to lateral foramen. \*
26. Tarsometatarsus, proximal end, central shaft, number of scars for tuberosities m. tibialis cranialis: 0 = 1; 1 = 2.
27. Tarsometatarsus, proximal end, shaft on medial side of tuberositas m. tib. cranialis, depth of sulcus extensorius (analogous to Migotto 2013, 157): 0 = distinct, noticeable groove between outer shaft edge and tuberositas; 1 = indistinct, flattened.
28. Tarsometatarsus, shaft, dorsal facies subcutanea lateralis at midlength of shaft: 0 = flat, ends level; 1 = strongly concave.
29. Tarsometatarsus, shaft, dorsal facies, position and depth of sulcus extensorius: 0 = deep, positioned strictly on dorsal facies; 1 = deep, pressing medially towards distal end; 2 = shallow, pressing medially towards distal end.
30. Tarsometatarsus, proximal end + shaft, plantar aspect, merging of fossa parahypotarsalis medialis and sulcus flexorius: 0 = not merged (see *Pandion* *haliaetus*); 1 = merge close to proximal end; 2 = merge roughly halfway along the shaft or more distal; 3 = non-conventional sulcus flexorius, not applicable (*Falco*).
31. Tarsometatarsus, shaft, development of lateral crista on plantar surface of shaft (modified from Migotto 2013, 158): 0 = lateral crista absent to weakly developed; 1 = lateral crista well developed.
32. Tarsometatarsus, distal end, extension of incisura for m. flexor hallucis brevis relative to fossa metatarsi I: 0 = ends more proximally; 1 = ends equidistant with; 2 = ends distally to; 3 = absent or positioned differently. \*
33. Tarsometatarsus, distal end, plantar facies, width of sulcus for abductor muscle IV: 0 = narrow; 1 = broad; 2 = indistinct.
34. Tarsometatarsus, distal end, position of fossa metatarsi I: 0 = located on the medial facies of the shaft; 1 = offset medially on plantar facies; 2 = on plantar facies well-separated from medial edge. \*
35. Tarsometatarsus, distal end, relative distal extent of trochleae, in dorsal aspect: 0 = all roughly equal; 1 = trochlea metatarsi IV ends proximal to trochleae metatarsorum III and II which have equal distal extent; 2 = trochlea metatarsi IV has least distal extent and trochlea metatarsi III the most distal extent; 3 = trochlea metatarsi IV has least distal extent and trochlea metatarsi II the most distal extent.
36. Tarsometatarsus, distal end, plantar development of external rim of trochlea metatarsi II: 0 = projecting plantarly; 1 = projecting medio-plantarly; 2 = no projection.
37. Tarsometatarsus, distal end, plantar development of external rim of trochlea metatarsi IV: 0 = short to moderately projecting; 1 = very long, flange strongly projecting out from trochlea plantarly (see *Pandion*).
38. Tarsometatarsus, Angle of distal face of trochlea metatarsi IV relative to lateromedial axis (modified from Migotto 2013, 160): 0 = absent, distal facies parallel; 1 = present, distal facies oblique on medial facing edge; 2 = present, distal facies oblique on lateral facing edge.
39. Tarsometatarsus, distal end, plantar aspect, diameter of foramen vasculare distale compared to width of incisura intertrochlearis lateralis: 0 = ½ width or less (see *Falco berigora*); 1 = between ½ to equal width; 2 = greater width (see *Aviceda subcristata*).

**Digits**

**Pedal digit I, phalanx 1**

1. Os metatarsale I, presence of projecting ridge on lateral section of sulcus on anterior facies (that facing plantar facies of tarsometatarsus) of trochlea metatarsi I: 0 = absent; 1 = present, slightly protruding; 2 = present, highly protruding (see *Haliaeetus*, *Haliastur*, *Milvus*). \*
2. Os metatarsale I, tuberculum located at mid-length on medial edge of metatarsal; 0 = absent; 1 = present, slight projection; 2 = present, large projection. \*
3. Os metatarsale I, shape of lateral edge of shaft leading distally to lateral side trochlea metatarsi I: 0 = straight (see *Pernis*, *Aviceda*); 1 = concave.
4. Os metatarsale I, sulcus distomedial to articular facet: 0 = small, 1 = large.
5. Robustness of digit 1 phalanx 1 compared to phalanges on all other digits: 0 = least robust (*Coragyps atratus*); 1 = equal or slightly more robust than most phalanges on other digits (*Falco berigora*); 2 = significantly more robust than any other phalanx (*Aquila audax*). \*
6. Digit 1, ungual phalanx, length of facies articularis relative to length of tuberculum flexorius: 0 = roughly equal; 1 = tuberculum longer; 2 = facies articularis longer.

**Pedal digit II**

1. Fusion between 1st and 2nd phalanges of digit II (Migotto 2008, ch. 161): 0 = absent; 1 = present.
2. Size difference between phalanges one and two (if unfused): 0 = one as long as, or slightly longer than, two (*Coragyps atratus*); 1 = one shortened, roughly half the length of two (*Falco berigora*); 2 = one greatly shortened, compressed cube less than half the length of two (*Aquila audax*). \*
3. Digit 2, ungual phalanx, length of facies articularis relative to length of tuberculum flexorius: 0 = roughly equal; 1 = tuberculum longer; 2 = facies articularis longer.

**Pedal digit III**

1. Size difference between phalanges two and three: 0 = equal in size (*Coragyps atratus*); 1 = 3 larger than 2; 2 = 2 larger than 3.
2. Phalanx 4, prominent ridge on medial side of corpus phalangis (from juncture cotyla articularis): 0 = absent; 1 = present.
3. Phalanx 4, ridge at juncture of lateral and plantar sides of corpus phalangis: 0 = rounded; 1 = sharp/pointed.
4. Phalanx 4, height to width ratio of cotyla articularis: 0 = higher than wide; 1 = equal height to width; 2 = wider than high.
5. Phalanx 4, symmetry of tuberculum flexorium in plantar aspect: 0 = medial side larger than lateral; 1 = complete or almost complete symmetry; 2 = lateral side larger than medial. \*
6. Phalanx 4, width to length ratio of tuberculum flexorium in plantar aspect: 0 = wider than long; 1 = longer than wide; 2 = equal width and length.
7. Phalanx 4, ridge on midline of tuberculum flexorium: 0 = absent, 1 = present.
8. Digit 3, ungual phalanx, length of facies articularis relative to length of tuberculum flexorius: 0 = roughly equal; 1 = tuberculum longer; 2 = facies articularis longer.

**Pedal digit IV**

1. Length of phalanx 1 relative to phalanx 4: 0 = as long as, or longer than, 4 (*Coragyps atratus*); 1 = slightly shorter than 4 (2/3 to ½ length, see *Aquila audax*); 2 = considerably shorter than 4 (1/3 or less, see *Falco berigora*). \*
2. Shortening of phalanges 2 and 3 relative to 4: 0 = slightly shorter than 4 (*Coragyps atratus*); 1 = greatly shorter than 4, almost cube-shaped (Accipitridae, Falconidae).
3. Digit 4, ungual phalanx, length of facies articularis relative to length of tuberculum flexorius: 0 = roughly equal; 1 = tuberculum longer; 2 = facies articularis longer.

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