

Appendix 1. Phylogenetic definitions used in this study

Clade name	Internal specifier(s)	External specifier(s)	Type of definition	Authorship	Comments
Ankylopollexia	<i>Camptosaurus dispar</i> (Marsh, 1879), <i>Parasaurolophus walkeri</i> Parks, 1922	none	node-based	Sereno (1998)	We follow the original definition proposed for the name.
Cerapoda	<i>Parasaurolophus walkeri</i> Parks, 1922, <i>Triceratops horridus</i> Marsh, 1889	none	node-based	Butler <i>et al.</i> (2008)	The original definition by Weishampel (2004) covers the same part of the ornithischian tree as Neornithischia, making it its synonym. We follow the definition of Butler <i>et al.</i> (2008) that reflects its traditional use as a node-based name uniting marginocephalians and ornithopods.
Clypeodonta	<i>Hypsilophodon foxii</i> Huxley, 1869, <i>Edmontosaurus regalis</i> Lambe, 1917	none	node-based	Norman (2015)	The name Clypeodonta was first used for a clade of ornithopods composed of the subclades Hypsilophodontia and Iguanodontia. The topology from this analysis differs markedly from that of Norman (2015), giving the clade a broader set of taxonomic contents than originally intended. As it is a relatively new name with no ‘traditional’ meaning, we see no reason for its redefinition. However, given the unstable position of <i>H. foxii</i> among neornithischians, the name might have only limited utility. Clypeodonta was defined one page prior to

					Hypsilophodontia, giving the former nomenclatural priority.
Dryomorpha	<i>Dryosaurus altus</i> (Marsh, 1878), <i>Parasaurolophus walkeri</i> Parks, 1922	none	node-based	Sereno (2005)	We follow the original definition proposed for the name. Even though Sereno (2005) formulated the definition as ‘The most [sic] inclusive clade containing <i>Dryosaurus altus</i> (Marsh 1878) and <i>Parasaurolophus walkeri</i> Parks 1922,’ it seems clear that he intended to use Dryomorpha for a node-based name anchored on <i>D. altus</i> and <i>P. walkeri</i> .
Dryosauridae	<i>Dryosaurus altus</i> (Marsh, 1878)	<i>Parasaurolophus walkeri</i> Parks, 1922	branch-based	Sereno (1998)	We follow the original definition proposed for the name.
Elasmaria	<i>Talenkauen santacrucensis</i> Novas <i>et al.</i> , 2004, <i>Macrogyphosaurus gondwanicus</i> Calvo <i>et al.</i> , 2007	none	node-based	Calvo <i>et al.</i> (2007)	We follow the original definition proposed for the name.
Euiguanodontia	<i>Gasparinisaura cincosaltensis</i> Coria & Salgado, 1996, <i>Dryosaurus altus</i> (Marsh, 1878), <i>Camptosaurus dispar</i> (Marsh, 1879)	<i>Tenontosaurus tilletti</i> Ostrom, 1970	node-based	new	The first definition proposed for Euiguanodontia was published by Coria & Salgado (1996) who used the name for a subset of Iguanodontia and defined it using <i>Gasparinisaura</i> , Dryosauridae, and Ankylopollexia. In order to maintain the original intent of Coria & Salgado (1996), and bring the definition into accordance with the <i>ICPN</i> , the name should be used only if the delimiting taxa are inferred within the contents of Iguanodontia, and the

					<p>phylogenetic definition should include species or specimens as the specifiers. Therefore, we use <i>Dryosaurus altus</i> and <i>Camptosaurus dispar</i> as the internal specifiers, instead of Dryosauridae and Ankylopollexia, respectively; and add <i>Tenontosaurus tilletti</i> as an external specifier. <i>T. tilletti</i> was originally kept outside Euiguanodontia (Coria & Salgado 1996: Fig. 13). At the same time, it is an internal specifier in the redefined Iguanodontia. Thus, such phylogenetic definition keeps the name Euiguanodontia in use only when it applies for a subset of Iguanodontia.</p>
Hypsilophodontia	<p><i>Hypsilophodon foxii</i> Huxley, 1869, <i>Tenontosaurus tilletti</i> Ostrom, 1970</p>	none	node-based	Norman (2015)	<p>The first definition proposed for this name does not reflect the differing positions of <i>H. foxii</i> on the neornithischian phylogenetic tree obtained by various authors. When applied to the topology presented in this study, this name covers the same part of the neornithischian tree as Clypeodonta, but the latter name has priority.</p>
Iguanodontia	<p><i>Iguanodon bernissartensis</i> Boulenger, 1881, <i>Dryosaurus altus</i> (Marsh, 1878), <i>Rhabdodon priscus</i> Matheron, 1869, <i>Tenontosaurus tilletti</i> Ostrom, 1970</p>	none	node-based	new	<p>The first definition proposed for Iguanodontia applied the name to the most inclusive clade containing <i>Parasaurolophus walkeri</i> but not <i>Hypsilophodon foxii</i> (Seren, 1998). In that study, Iguanodontia, Hypsilophodontidae, and Heterodontosauridae were the three subclades that formed Ornithopoda. Sereno (2005) added <i>Thescelosaurus neglectus</i> as an external specifier to account for the discovery that ‘hypsilophodontids’ are a paraphyletic set of taxa in an attempt to retain the concept</p>

					<p>of Iguanodontia as a more restricted subclade within Ornithopoda. However, these definitions do not adhere to Art. 11 of the <i>ICPN</i> as they do not include the name-bearing taxon, <i>Iguanodon bernissartensis</i>, to be an internal specifier. Additionally, given the fluctuating positions of former ‘hypsilophodontids’ (and the rootward movement of heterodontosaurids within Ornithischia) in recent phylogenetic analyses, the use of these two external specifiers does not always guarantee that Iguanodontia retains its traditional concept as a restricted subclade within Ornithopoda (especially in the topologies presented in this study where Iguanodontia <i>sensu</i> Sereno [2005] would cover a large branch of the neornithischian tree, including even marginocephalians). We propose to redefine the name and apply Iguanodontia to a well-supported clade containing <i>Rhabdodon</i>-like taxa (<i>Rhabdodontomorpha sensu</i> this study), <i>Tenontosaurus</i>, dryosaurids, and ankylopollexians. This clade is stable in most recent studies (e.g. Butler <i>et al.</i> 2008; Brown <i>et al.</i> 2013; Boyd 2015; this study) and includes the same set of taxa as in Sereno (1998: Fig. 5B) and Sereno (1999: Fig. 2), restoring the traditional concept of this clade.</p>
Jeholosauridae	<i>Jeholosaurus shangyuanensis</i> Xu <i>et al.</i> , 2000	<i>Hypsilophodon foxii</i> Huxley, 1869, <i>Iguanodon bernissartensis</i> Boulenger,	branch-based	Han <i>et al.</i> (2012)	We follow the original definition proposed for the name.

		1881, <i>Protoceratops andrewsi</i> Granger & Gregory, 1923, <i>Pachycephalosaurus wyomingensis</i> (Gilmore, 1931), <i>Thescelosaurus neglectus</i> Gilmore, 1913			
Marginocephalia	<i>Ceratops montanus</i> Marsh, 1888, <i>Triceratops horridus</i> Marsh, 1889, <i>Pachycephalosaurus wyomingensis</i> (Gilmore, 1931)	none	node-based	new	The first definition of Marginocephalia was node-based and used ‘Ceratopsia’ and ‘Pachycephalosauria’ as the internal specifiers (Currie & Padian 1997). Such delimitation of Marginocephalia is still in use. To follow the definition, and adhere to the <i>ICPN</i> (Art. 11), we have to use name-bearing species or their type specimens as specifiers which makes the name to be anchored on the types of <i>Ceratops montanus</i> and <i>Pachycephalosaurus wyomingensis</i> . Even if <i>C. montanus</i> may be a <i>nomen dubium</i> , its type specimen is unequivocally nested deeply within Ceratopsia and thus its use does not change the extent of the name. However, we keep <i>T. horridus</i> as a third internal specifier following its status as a well-known ceratopsian and a traditional internal specifier of Marginocephalia (e.g. Sereno 1998; Sereno 2005; Butler <i>et al.</i> 2008; Boyd 2015)

Neornithischia	<i>Triceratops horridus</i> Marsh, 1889, <i>Parasaurolophus walkeri</i> Parks, 1922	<i>Ankylosaurus magniventris</i> Brown, 1908	branch-based	Sereno (1998)	The preferred definition is the original definition. It sufficiently reflects the sister-taxon relationships between neornithischians and thyreophorans, and the well-supported hypothesis that marginocephalians are more closely related to ornithopods than either are to thyreophorans.
Ornithopoda	<i>Parasaurolophus walkeri</i> Parks, 1922	<i>Triceratops horridus</i> Marsh, 1889	branch-based	Butler <i>et al.</i> (2008)	The first definition proposed for the name Ornithopoda was node-based (Sereno 1998) and used <i>Heterodontosaurus tucki</i> and <i>Parasaurolophus walkeri</i> as the internal specifiers. Given the inference of the Heterodontosauridae in a basal position on the ornithischian tree in most recent analyses (including ours; see Fig. 4), the original definition does not reflect the traditional use of the name. Norman <i>et al.</i> (2004) were the first to propose a branch-based definition for Ornithopoda but preferred <i>Edmontosaurus regalis</i> as the internal specifier over <i>P. walkeri</i> . Here, we follow the definition published by Butler <i>et al.</i> (2008). It covers the same branch as Ornithopoda <i>sensu</i> Norman <i>et al.</i> (2004) but differs in that it includes <i>P. walkeri</i> as the internal specifier. Considering that this taxon was originally proposed by Sereno (1998) to specify the extent of the name, this definition seems to be a more appropriate choice.
Orodrominae	<i>Orodromeus makelai</i> Horner & Weishampel, 1988	<i>Thescelosaurus neglectus</i> Gilmore, 1913	branch-based	Brown <i>et al.</i> (2013)	We follow the original definition proposed for the name as alternative topologies do not lead to an unintended use of Orodrominae.

Rhabdodontidae	<i>Rhabdodon priscus</i> Matheron, 1869, <i>Zalmoxes robustus</i> (Nopcsa, 1900)	none	node-based	Weishampel <i>et al.</i> (2003)	We follow the original definition proposed for the name, rather than the branch-based revision proposed by Sereno (2005) to avoid potential synonymy with Rhabdodontomorpha.
Rhabdodontomorpha	<i>Rhabdodon priscus</i> Matheron, 1869, <i>Muttaborrasaurus langdoni</i> Bartholomai & Molnar, 1981	<i>Iguanodon bernissartensis</i> Boulenger, 1881	branch-based	new	The original definition of Rhabdodontomorpha (Dieudonné <i>et al.</i> 2016) was incorrectly formulated by containing ‘the most inclusive clade’ instead of ‘the least inclusive clade.’ We think that the name may have some utility in the future but prefer a new, branch-based definition. This new definition refers to the same known contents as intended by the original authors, but by using a branch-based instead of node-based definition it is applicable for the whole branch of <i>Rhabdodon</i> -like ornithopods.
Thescelosauridae	<i>Thescelosaurus neglectus</i> Gilmore, 1913, <i>Orodromeus makelai</i> Horner & Weishampel, 1988	<i>Iguanodon bernissartensis</i> Boulenger, 1881	node-based	new	Thescelosauridae was originally defined by Brown <i>et al.</i> (2013) as the least inclusive clade containing <i>Thescelosaurus neglectus</i> and <i>Orodromeus makelai</i> . Even though our analysis inferred a clade containing the two taxa and their relatives, separated from other neornithischians, the initial definition is incompatible with results of some older analyses, such as that of Butler <i>et al.</i> (2008). The addition of an external specifier prevents the use of the name for an unintended clade.

Thescelosaurinae	<i>Thescelosaurus neglectus</i> Gilmore, 1913	<i>Orodromeus makelai</i> Horner & Weishampel, 1988, <i>Parasaurolophus</i> <i>walkeri</i> Parks, 1922	branch-based	Boyd (2015)	Brown & Druckenmiller (2011) used <i>Hypsilophodon foxii</i> as the second external specifier for this clade name. However, most versions of the Butler <i>et al.</i> (2008) dataset infer <i>Thescelosaurus neglectus</i> to be more deeply nested within the ornithopod tree than <i>H. foxii</i> , resulting in this clade containing a much more inclusive set of taxa than originally intended. Boyd (2015) replaced <i>H. foxii</i> with <i>Parasaurolophus walkeri</i> to correct this problem.
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References

- Boulenger, G. A.** 1881. Sur l'arc pelvien chez les dinosauriens de Bernissart. *Bulletins de L'Académie Royale de Belgique, 3eme Série*, **1**, 600–608.
- Brown, B.** 1908. The Ankylosauridae, a new family of armored dinosaurs from the Upper Cretaceous. *Bulletin of the American Museum of Natural History*, **24**, 187–201.
- Brown, C. M. & Druckenmiller, P.** 2011. Basal ornithopod (Dinosauria: Ornithischia) teeth from the Prince Creek Formation (early Maastrichtian) of Alaska. *Canadian Journal of Earth Sciences*, **48**, 1342–1354.
- Currie, P. J. & Padian, K.** 1997. Cerapoda. P. 105 in P. J. Currie & K. Padian (eds) *Encyclopedia of dinosaurs*. Academic Press, San Diego.
- Gilmore, C. W.** 1913. A new dinosaur from the Lance Formation of Wyoming. *Smithsonian Miscellaneous Collections*, **61**, 1–5.
- Gilmore, C. W.** 1931. A new species of troodont dinosaur from the Lance Formation of Wyoming. *Proceedings of the United States National Museum*, **79**, 1–6.
- Granger, W. & Gregory, W. K.** 1923. *Protoceratops andrewsi*, a pre-ceratopsian dinosaur from Mongolia, with an appendix on the structural relationships of the *Protoceratops* beds. *American Museum Novitates*, **72**, 1–9.
- Han, F.-L., Barrett, P. M., Butler, R. J. & Xing, X.** 2012. Postcranial anatomy of *Jeholosaurus shangyuanensis* (Dinosauria, Ornithischia) from the Lower Cretaceous Yixian Formation of China. *Journal of Vertebrate Paleontology*, **32**, 1370–1395.
- Horner, J. & Weishampel, D. B.** 1988. A comparative embryological study of two ornithischian dinosaurs. *Nature*, **332**, 256–257.
- Huxley, T. J.** 1869. On *Hypsilophodon*, a new genus of Dinosauria. *Abstracts of the Proceedings of the Geological Society of London*, **204**, 3–4.
- Lambe, L. M.** 1917. A new genus and species of crestless hadrosaur from the Edmonton Formation of Alberta. *The Ottawa Naturalist*, **31**, 65–73.
- Marsh, O. C.** 1878. Principal characters of American Jurassic dinosaurs. *American Journal of Science*, **3**, 411–416.
- Marsh, O. C.** 1879. Notice of new Jurassic reptiles. *American Journal of Science*, **3**, 501–505.
- Marsh, O. C.** 1888. A new family of horned Dinosauria, from the Cretaceous. *The American Journal of Science*, **36**, 477–478.
- Marsh, O. C.** 1889. Notice of gigantic horned Dinosauria from the Cretaceous. *American Journal of Science*, **38**, 173–175.
- Matheron, P.** 1869. Notes sur les reptiles fossiles des dépôts fluvio-lucustres crétacés du bassin à lignite de Fuveau. *Bulletin de la Société Géologique de France*, **2**, 781–795.
- Nopcsa, F.** 1900. Dinosaurierreste aus Siebenbürgen (Schädel von *Limnosaurus transsylvanicus* nov. gen. et spec.). *Denkschriften der Kaiserlichen Akademie der Wissenschaften. Mathematisch-Naturwissenschaftliche Classe*, **68**, 555–591.

- Norman, D. B., Sues, H.-D., Witmer, L. M. & Coria, R. A.** 2004. Basal Ornithopoda. Pp. 393–412 in D. B. Weishampel, P. Dodson & H. Osmólska (eds) *The Dinosauria*. 2nd edition. University of California Press, Berkeley.
- Ostrom, J. H.** 1970. Stratigraphy and paleontology of the Cloverly Formation (Lower Cretaceous) of the Bighorn Basin area, Wyoming and Montana. *Bulletin of the Yale Peabody Museum of Natural History*, **35**, 1–234.
- Parks, W. A.** 1922. *Parasaurolophus walkeri*, a new genus and species of crested trachodont dinosaur. *University of Toronto Studies, Geological Series*, **13**, 1–32.
- Sereno, P. C.** 2005. The logical basis of phylogenetic taxonomy. *Systematic Biology*, **54**, 595–619.
- Weishampel, D. B.** 2004. Ornithischia. Pp. 323–324 in D. B. Weishampel, P. Dodson & H. Osmólska (eds) *The Dinosauria*. 2nd edition. University of California Press, Berkeley.
- Xu, X., Wang, X. L. & You, H. L.** 2000. A primitive ornithopod from the Early Cretaceous Yixian Formation of Liaoning. *Vertebrata Palasiatica*, **38**, 318–325.