

Body reconstruction and size estimation of plesiosaurs

references for data

Ruihe Jackevan Zhao 

JackevanChaos@outlook.com

This file contains the references of the datasets used in this study.

Neck-SKL regression.xlsx

<i>Libonectes morgani</i>	Welles, 1949 [1]
<i>Meyerasaurus victor</i>	Smith & Vincent, 2010 [2]
<i>Sachicasaurus vitae</i>	Páramo-Fonseca et al, 2018 [3]
<i>Kaiwhekea katiki</i>	Cruickshank & Fordyce, 2002 [4]
<i>Ophthalmothule cryostea</i>	Roberts er al, 2021 [5]
<i>Trinacromerum bentonianum</i>	Thurmond, 1968 [6]
<i>Thililua longicollis</i>	Bardet et al, 2003 [7]
<i>Hauffiosaurus tomistomimus</i>	Benson et al, 2011 [8]
<i>Styxosaurus SDSM 451</i>	Welles & Bump, 1949 [9]
<i>Dolichorhynchops osborni</i>	Carpenter, 1999 [10]; Bonner, 1964 [11]
<i>Hydrotherosaurus alexandrae</i>	Welles, 1943 [12]
<i>Thalassomedon haningtoni</i>	Welles, 1943 [12]
<i>Styxosaurus browni</i>	Welles, 1952 [13]
<i>Edgarosaurus muddi</i>	Drunkenmiller, 2002 [14]
<i>Microcleidus homalospondylus</i>	Benson et al, 2012 [15]
<i>Plesiopterys wildi</i>	O'Keefe, 2004 [16]
<i>Plesiosaurus dolichodeirus</i>	O'Keefe, 2004 [16]
<i>Thalassiodracon hawkinsi</i>	O'Keefe, 2004 [16]
<i>Brancasaurus brancai</i>	Sachs et al, 2016 [17]
<i>Atychodracon megacephalus</i>	Smith, 2015 [18]
<i>Macroplata tenuiceps</i>	Ketchum & Smith, 2010 [19]
<i>Brachauchenius lucasi</i>	McHenry, 2009 [20]
<i>Kronosaurus queenslandicus</i>	McHenry, 2009 [20]
<i>Luskan itilensis</i>	Fischer et al, 2023 [21]
<i>Attenborosaurus conybeari</i>	Benson et al, 2012 [15]
<i>Simolestes vorax</i>	O'Keefe, 2002 [22]
<i>Muraenosaurus leedsii</i>	O'Keefe, 2002 [22]

<i>Cryptoclidus eurymerus</i>	Brown, 1980 [23]
<i>Serpentisuchops pfisterae</i>	Persons et al, 2022 [24]
<i>Callawayasaurus colombiensis</i>	Welles, 1962 [25]
<i>Abyssosaurus nataliae</i>	Berezin, 2011 [26]; Berezin, 2019 [27]
<i>Nakonanectes bradti</i>	Serratos et al, 2017 [28]
<i>Rhomaleosaurus cramptoni</i>	O'Keefe, 2002 [22]
<i>Archaeonectrus rostratus</i>	Benson et al, 2012 [15]
<i>Microcleidus tournemirensis</i>	Bardet et al, 1999 [29]
<i>Thaumatodracon wiedenrothi</i>	Smith & Araújo, 2017 [30]
<i>Liopleurodon ferox</i>	Linder, 1913 [31]
<i>Peloneustes philarchus</i>	Linder, 1913 [31]
" <i>Monquirasaurus</i> " boyacensis	Noè & Gómez-Pérez, 2022 [32]
<i>Nichollssaura borealis</i>	Nagesan, 2017 [33]

Trunk-Rib regression.xlsx

<i>Macroplata tenuiceps</i>	Ketchum & Smith, 2010 [19]
<i>Atychodracon megacephalus</i>	Smith, 2007 [34]
<i>Rhomaleosaurus cramptoni</i>	Smith, 2007 [34]
<i>Archaeonectrus rostratus</i>	Owen, 1865 [35]
<i>Peloneustes philarchus</i>	Linder, 1913 [31]
<i>Sachicasaurus vitae</i>	Páramo-Fonseca et al, 2018 [3]
<i>Stenorhynchosaurus munozi</i>	Páramo-Fonseca et al, 2016 [36]
" <i>Monquirasaurus</i> " boyacensis	Noè & Gómez-Pérez, 2022 [32]
<i>Liopleurodon ferox</i>	Vincent et al, 2024 [37]
<i>Plesiosaurus dolichodeirus</i>	Storrs, 1997 [38]
<i>Seeleyosaurus guilelmiimperatoris</i>	Dames, 1895 [39]
<i>Microcleidus homalospondylus</i>	Owen, 1865 [35]
<i>Cryptoclidus eurymerus</i>	Richards, 2011 [40]
<i>Abyssosaurus nataliae</i>	Berezin, 2019 [27]
<i>Tatenectes laramiensis</i>	O'Keefe et al, 2011 [41]
<i>Nichollssaura borealis</i>	Nagesan, 2017 [33]
<i>Dolichorhynchos osborni</i>	Willison, 1907 [42]
<i>Mauriciosaurus fernandezi</i>	Frey et al, 2017 [43]
<i>Wapuskanectes betsynichollsae</i>	Henderson, 2024 [44]
<i>Kaiwhekea katiki</i>	Cruickshank & Fordyce, 2002 [4]
<i>Albertonectes vanderveldei</i>	Henderson, 2024 [44]
<i>Vegasaurus molyi</i>	O'Gorman et al, 2015 [45]
<i>Hydrotherosaurus alexandrae</i>	Welles, 1943 [12]

Tail regression.xlsx

<i>Albertonectes vanderveldei</i>	Kubo et al, 2012 [46]
<i>Macroplata tenuiceps</i>	Ketchum & Smith, 2010 [19]
<i>Rhomaleosaurus cramptoni</i>	Smith, 2007 [34]
<i>Rhomaleosaurus zetlandicus</i>	Vincent & Smith, 2009 [47]
<i>Archaeonectrus rostratus</i>	Owen, 1865 [35]
<i>Plesiosaurus dolichodeirus</i>	Storrs, 1997 [38]
<i>Seeleyosaurus guilelmiimperatoris</i>	Dames, 1895 [39]
<i>Meyerasaurus victor</i>	Smith & Vincent, 2010 [2]
<i>Hauffiosaurus zanoni</i>	Vincent et al, 2011 [48]
<i>Atychodracon megacephalus</i>	Smith, 2015 [18]
<i>Thalassiodracon hawkinsi</i>	Smith, 2007 [34]
<i>Eoplesiosaurus antiquior</i>	Benson et al, 2012 [15]
<i>Hauffiosaurus tomistomimus</i>	Benson et al, 2011 [8]
<i>Microcleidus brachypterygius</i>	Huene, 1923 [49]
<i>Brancasaurus brancai</i>	Sachs et al, 2016 [17]
<i>Cryptoclidus eurymerus</i>	Andrews, 1910 [50]
<i>Nichollssaura borealis</i>	Nagesan, 2017 [33]
<i>Dolichorhynchops osborni</i>	Willison, 1907 [42]
<i>Wapuskanectes betsynichollsae</i>	Henderson, 2024 [44]
<i>Plesionectes longicollum</i>	Sachs & Madzia, 2025 [51]
<i>Plesiopterys wildi</i>	Marx et al, 2025 [52]

Proxy for Mass.xlsx

<i>Abyssosaurus nataliae</i>	Berezin, 2011 [26]; Berezin, 2019 [27]
<i>Albertonectes vanderveldei</i>	Kubo et al, 2012 [46]
<i>Aristonectes quiriquinensis</i>	Otero et al, 2014 [53]; Otero et al, 2018 [54]
<i>Brancasaurus brancai</i>	Sachs et al, 2016 [17]
<i>Cryptoclidus eurymerus</i>	Andrews, 1910 [50]; Richards, 2011 [40]
<i>Dolichorhynchops osborni</i>	Bonner, 1964 [11]
<i>Hydrotherosaurus alexandrae</i>	Welles, 1943 [12]
<i>Kronosaurus queenslandicus</i>	Romer & Lewis, 1959 [55]; McHenry, 2009 [20]
<i>Liopleurodon ferox</i>	Linder, 1913 [31]
<i>Macroplata tenuiceps</i>	Ketchum & Smith, 2010 [19]
<i>Martinetes bonneri</i>	Adams, 1997 [56]
<i>Mauriciosaurus fernandezi</i>	Frey et al, 2017 [43]
<i>Meyerasaurus victor</i>	Smith & Vincent, 2010 [2]
<i>Microcleidus touruemirensis</i>	Bardet et al, 1999 [29]
“Monquirasaurus” boyacensis	Noè & Gómez-Pérez, 2022 [32]

<i>Nichollssaura borealis</i>	Nagesan, 2017 [33]
<i>Peloneustes philarchus</i>	Linder, 1913 [31]
<i>Plesiopterys wildi</i>	Marx et al, 2025 [52]
<i>Pliosaurus funkei</i>	Knutsen et al, 2012 [57]
<i>Pliosaurus cf. kevani</i>	Tarlo, 1959 [58]
<i>Sachicasaurus vitae</i>	Páramo-Fonseca et al, 2018 [3]
<i>Seeleyosaurus guilelmiimperatoris</i>	Sachs et al, 2025 [59]
<i>Stenorhynchosaurus munozi</i>	Páramo-Fonseca et al, 2016 [36]
<i>Stylosaurus SDSM 451</i>	Welles & Bump, 1949 [9]
<i>Thalassomedon haningtoni</i>	Welles, 1943 [12]
<i>Vegasaurus molyi</i>	O'Gorman et al, 2015 [45]

References

- [1] Samuel Paul Welles. A new elasmosaur from the Eagle Ford Shale of Texas: systematic description. *Fondren Science Series*, 1, 1949.
- [2] Adam S. Smith and Peggy Vincent. A new genus of pliosaur (Reptilia: Sauropterygia) from the Lower Jurassic of Holzmaden, Germany. *Palaeontology*, 53(5):1049–1063, 2010.
- [3] María Eurídice Páramo-Fonseca, Cristian David Benavides-Cabra, and Ingry Esmirna Gutiérrez. A new large pliosaurid from the Barremian (Lower Cretaceous) of Sáchica, Boyacá, Colombia. *Earth Sciences Research Journal*, 22(4):223–238, 2018.
- [4] Arthur R. I. Cruickshank and R. Ewan Fordyce. A new marine reptile (Sauropterygia) from New Zealand: further evidence for a Late Cretaceous austral radiation of cryptoclidid plesiosaurs. *Palaeontology*, 45(3):557–575, 2002.
- [5] Aubrey Jane Roberts, Patrick S. Druckenmiller, Benoit Cordonnier, Lene L. Delsett, and Jørn H. Hurum. A new plesiosaurian from the Jurassic-Cretaceous transitional interval of the Slottsmøya Member (Volgian), with insights into the cranial anatomy of cryptoclidids using computed tomography. *PeerJ*, 8:e8652, March 2020.
- [6] John T. Thurmond. A new polycotylid plesiosaur from the Lake Waco Formation (Cenomanian) of Texas. *Journal of Paleontology*, pages 1289–1296, 1968.
- [7] Nathalie Bardet, Xabier Pereda Suberbiola, and Nour-Eddine Jalil. A new polycotylid plesiosaur from the Late Cretaceous (Turonian) of Morocco. *Comptes Rendus Palevol*, 2(5):307–315, 2003.
- [8] Roger B. J. Benson, Hilary F. Ketchum, Leslie F. Noè, and Marcela Gómez-Pérez. New information on *Hauffiosaurus* (Reptilia, Plesiosauria) based on a new species from the Alum Shale Member (Lower Toarcian: Lower Jurassic) of Yorkshire, UK. *Palaeontology*, 54(3):547–571, may 2011.
- [9] S. P. Welles and James D. Bump. *Alzadasaurus pembertoni*, a new elasmosaur from the Upper Cretaceous of South Dakota. *Journal of Paleontology*, pages 521–535, 1949.

- [10] Kenneth Carpenter. A review of short-necked plesiosaurs from the Cretaceous of the Western Interior, North America. *Neues Jahrbuch für Geologie und Paläontologie-Abhandlungen*, pages 259–287, 1996.
- [11] Orville Bonner. An osteological study of *Nyctosaurus* and *Trinacromerum* with a description of a new species of *Nyctosaurus*. Master's thesis, Fort Hays State University, 1964.
- [12] Samuel Paul Welles. Elasmosaurid plesiosaurs with description of new material from California and Colorado. *University of California Publications in Geological Sciences*, 13:125–254, 1943.
- [13] Samuel Paul Welles. A review of the North American Cretaceous elasmosaurs. *University of California Publications in Geological Sciences*, 29:47–144, 1952.
- [14] Pat. S. Druckenmiller. Osteology of a new plesiosaur from the Lower Cretaceous (Albian) Thermopolis Shale of Montana. *Journal of Vertebrate Paleontology*, 22(1):29–42, 2002.
- [15] Roger B. J. Benson, Mark Evans, and Patrick S. Druckenmiller. High diversity, low disparity and small body size in plesiosaurs (Reptilia, Sauropterygia) from the Triassic-Jurassic boundary. *PLOS ONE*, 7(3):e31838, mar 2012.
- [16] F. Robin O'Keefe. Preliminary description and phylogenetic position of a new plesiosaur (Reptilia: Sauropterygia) from the Toarcian of Holzmaden, Germany. *Journal of Paleontology*, 78(5):973–988, 2004.
- [17] Sven Sachs, Jahn J. Hornung, and Benjamin P. Kear. Reappraisal of Europe's most complete Early Cretaceous plesosaurian: *Brancasaurus brancai* Wegner, 1914 from the "Wealden facies" of Germany. *PeerJ*, 4:e2813, dec 2016.
- [18] Adam S. Smith. Reassessment of '*Plesiosaurus*' *megacephalus* (Sauropterygia: Plesiosauria) from the Triassic-Jurassic boundary, UK. *Palaeontologia Electronica*, 2015.
- [19] Hilary F. Ketchum and Adam S. Smith. The anatomy and taxonomy of *Macroplata tenuiceps* (Sauropterygia, Plesiosauria) from the Hettangian (Lower Jurassic) of Warwickshire, United Kingdom. *Journal of Vertebrate Paleontology*, 30(4):1069–1081, jul 2010.
- [20] Colin Richard McHenry. *Devourer of gods: the palaeoecology of the Cretaceous pliosaur Kronosaurus queenslandicus*. PhD thesis, University of Newcastle, 2009.
- [21] Valentin Fischer, Roger B. J. Benson, Nikolay G. Zverkov, Maxim S. Arkhangelsky, Ilya M. Stenshin, Gleb N. Uspensky, and Natalya E. Prilepskaya. Anatomy and relationships of the bizarre Early Cretaceous pliosaurid *Luskhan itilensis*. *Zoological Journal of the Linnean Society*, 198(1):220–256, 2023.
- [22] F. Robin O'Keefe. The evolution of plesiosaur and pliosaur morphotypes in the Plesiosauria (Reptilia: Sauropterygia). *Paleobiology*, 28(1):101–112, 2002.
- [23] David Seymour Brown. The English Upper Jurassic Plesiosauroidea (Reptilia) and a review of the phylogeny and classification of the Plesiosauria. *Bulletin of the British Museum (Natural History), Geology*, 35(4):253–347, 1981.

- [24] Walter Scott Persons, Hallie P. Street, and Amanda Kelley. A long-snouted and long-necked polycotylid plesiosaur from the Late Cretaceous of North America. *iScience*, 25(10):105033, October 2022.
- [25] Samuel Paul Welles. A new species of elasmosaur from the Aptian of Colombia and a review of the Cretaceous plesiosaurs. *University of California publications in the Geological sciences*, 44:1–96, 1962.
- [26] A. Yu. Berezin. A new plesiosaur of the family Aristonectidae from the Early Cretaceous of the center of the Russian platform. *Paleontological Journal*, 45(6):648–660, November 2011.
- [27] A. Y. Berezin. Morphofunctional features of the plesiosaur *Abyssosaurus nataliae* (Plesiosauridea: Plesiosauria) in connection with adaptation to a deep-sea lifestyle. *Scientific Works of the State Nature Reserve “Prisursky”*, (34):56–70, 2019.
- [28] Danielle J. Serratos, Patrick Druckenmiller, and Roger B. J. Benson. A new elasmosaurid (Sauropterygia, Plesiosauria) from the Bearpaw Shale (Late Cretaceous, Maastrichtian) of Montana demonstrates multiple evolutionary reductions of neck length within Elasmosauridae. *Journal of Vertebrate Paleontology*, 37(2):e1278608, April 2017.
- [29] Nathalie Bardet, Pascal Godefroit, and Jacques Sciau. A new elasmosaurid plesiosaur from the Lower Jurassic of southern France. *Palaeontology*, 42(5):927–952, October 1999.
- [30] Adam S. Smith and Ricardo Araújo. *Thaumatodracon wiedenrothi*, a morphometrically and stratigraphically intermediate new rhomaleosaurid plesiosaurian from the Lower Jurassic (Sinemurian) of Lyme Regis. *Palaeontographica Abteilung A*, 308(4-6):89–125, jul 2017.
- [31] Hermann Linder. Beiträge zur Kenntnis der Plesiosaurier-Gattungen *Peloneustes* und *Pliosaurus*. *Geologische und Palaeontologische Abhandlungen*, 1913.
- [32] Leslie F. Noè and Marcela Gómez-Pérez. Giant pliosaurids (Sauropterygia; Plesiosauria) from the Lower Cretaceous peri-Gondwanan seas of Colombia and Australia. *Cretaceous Research*, 132:105122, apr 2022.
- [33] Ramon Nagesan. Neck mobility of the plesiosaur *Nichollsaura borealis*. Master’s thesis, University of Calgary, 2017.
- [34] Adam Stuart Smith. *Anatomy and systematics of the Rhomaleosauridae (Sauropterygia: Plesiosauria)*. PhD thesis, National University of Ireland, University College Dublin, 2007.
- [35] Richard Owen. Monograph of the fossil reptilia of the Liassic formations. part first. Sauropterygia. *Monographs of the Palaeontographical Society*, 17(75):1–40, 1865.
- [36] María Eurídice Páramo-Fonseca, Marcela Gómez-Pérez, Leslie F. Noè, and Fernando Etayo-Serna. *Stenorhynchosaurus munozi*, gen. et sp. nov. a new pliosaurid from the Upper Barremian (Lower Cretaceous) of Villa de Leiva, Colombia, South America. *Revista de la Academia Colombiana de Ciencias Exactas, Físicas y Naturales*, 40(154):84, March 2016.

- [37] Peggy Vincent, Didier Poncet, Anthony Rard, Jean-Pierre Robin, and Rémi Allemand. New remains of *Liopleurodon* (Reptilia, Plesiosauria) from the Middle Jurassic of western France and paedomorphosis within pliosaurids. *Palaeontologia Electronica*, 2024.
- [38] Glenn W. Storrs. Morphological and taxonomic clarification of the genus *Plesiosaurus*. In *Ancient marine reptiles*, pages 145–190. Elsevier, 1997.
- [39] W. B. Dames. Die plesiosaurier der süddeutschen Liasformation. *Abhandlungen der Königlich Preussischen Akademie der Wissenschaften zu Berlin*, pages 1–81, 1895.
- [40] Courtney D. Richards. Plesiosaur body shape and its impact on hydrodynamic properties, 2011.
- [41] F. Robin O'Keefe, Hallie P. Street, Benjamin C. Wilhelm, Courtney D. Richards, and Helen Zhu. A new skeleton of the cryptoclidid plesiosaur *Tatenectes laramiensis* reveals a novel body shape among plesiosaurs. *Journal of Vertebrate Paleontology*, 31(2):330–339, mar 2011.
- [42] Samuel Wendell Williston. *North American plesiosaurs: Part I*, volume 2. Field Columbian Museum, 1907.
- [43] Eberhard Frey, Eric W. A. Mulder, Wolfgang Stinnesbeck, Héctor E. Rivera-Sylva, José Manuel Padilla-Gutiérrez, and Arturo Homero González-González. A new polycotylid plesiosaur with extensive soft tissue preservation from the early Late Cretaceous of northeast Mexico. *Boletín de la Sociedad Geológica Mexicana*, 69(1):87–134, 2017.
- [44] Donald M. Henderson. Lost, hidden, broken, cut-estimating and interpreting the shapes and masses of damaged assemblages of plesiosaur gastroliths. *PeerJ*, 12:e17925, August 2024.
- [45] José P. O'Gorman, Leonardo Salgado, Eduardo B. Olivero, and Sergio A. Marensi. *Vegasaurus molyi*, gen. et sp. nov. (Plesiosauria, Elasmosauridae), from the Cape Lamb Member (lower maastrichtian) of the Snow Hill Island Formation, Vega Island, Antarctica, and remarks on Wedellian Elasmosauridae. *Journal of Vertebrate Paleontology*, 35(3), May 2015.
- [46] Tai Kubo, Mark T. Mitchell, and Donald M. Henderson. *Albertonectes vanderveldei*, a new elasmosaur (Reptilia, Sauropterygia) from the Upper Cretaceous of Alberta. *Journal of Vertebrate Paleontology*, 32(3):557–572, may 2012.
- [47] P. Vincent and A. S. Smith. A redescription of *Plesiosaurus propinquus* Tate & Blake, 1876 (Reptilia, Plesiosauria), from the Lower Jurassic (Toarcian) of Yorkshire, England. *Proceedings of the Yorkshire Geological Society*, 57(3-4):133–142, nov 2009.
- [48] Peggy Vincent. A re-examination of *Hauffiosaurus zanoni*, a pliosauroid from the Toarcian (Early Jurassic) of Germany. *Journal of Vertebrate Paleontology*, 31(2):340–351, mar 2011.
- [49] F. R. von Huene. Ein neuer Plesiosaurier aus dem oberen Lias Württembergs. *Jahreshefte vaterländ. Naturkunde Württemberg*, 79:1–23, 1923.
- [50] Charles William Andrews. *A descriptive catalogue of the marine reptiles of the Oxford Clay: based on the Leeds Collection in the British Museum (Natural History), London, Part I*. British Museum (Natural History), 1910.

- [51] Sven Sachs and Daniel Madzia. An unusual early-diverging plesiosauroid from the Lower Jurassic Posidonia Shale of Holzmaden, Germany. *PeerJ*, 13:e19665, August 2025.
- [52] Miguel Marx, Sven Sachs, Benjamin P. Kear, Mats E. Eriksson, Klaus Nilkens, and Johan Lindgren. A new specimen of *Plesiopterys wildi* reveals the diversification of cryptoclidian precursors and possible endemism within European Early Jurassic plesiosaur assemblages. *PeerJ*, 13:e18960, March 2025.
- [53] Rodrigo A. Otero, Sergio Soto-Acuña, Frank Robin O'Keefe, José P. O'Gorman, Wolfgang Stinnesbeck, Mario E. Suárez, David Rubilar-Rogers, Christian Salazar, and Luis Arturo Quinzio-Sinn. *Aristonectes quiriquinensis*, sp. nov., a new highly derived elasmosaurid from the upper Maastrichtian of central Chile. *Journal of Vertebrate Paleontology*, 34(1):100–125, jan 2014.
- [54] Rodrigo A. Otero, Sergio Soto-Acuña, and Frank R. O'Keefe. Osteology of *Aristonectes quiriquinensis* (Elasmosauridae, Aristonectinae) from the upper Maastrichtian of central Chile. *Journal of Vertebrate Paleontology*, 38(1):e1408638, jan 2018.
- [55] Alfred Sherwood Romer and Arnold D. Lewis. A mounted skeleton of the giant plesiosaur *Kronosaurus*. *Brevoria Museum of Comparative Zoology*, (112):1–15, 1959.
- [56] Dawn A. Adams. *Trinacromerum bonneri*, new species, last and fastest pliosaur of the Western Interior Seaway. *Texas Journal of Science*, 49(3):179, 1997.
- [57] Espen M. Knutsen, Patric S. Druckenmiller, and Jørn H. Hurum. A new species of *Pliosaurus* (Sauropterygia: Plesiosauria) from the Middle Volgian of central Spitsbergen, Norway. *Norwegian Journal of Geology*, 92:235–258, 2012.
- [58] L. B. Tarlo. *Stretosaurus* gen. nov., a giant pliosaur from the Kimmeridge Clay. *Palaeontology*, 2(1):39–55, 1959.
- [59] Sven Sachs, Daniel Madzia, Miguel Marx, Aubrey J. Roberts, Oliver Hampe, and Benjamin P. Kear. The osteology, taxonomy, and phylogenetic placement of *Seeleyosaurus guilemiimperatoris* (Plesiosauroidea, Microcleididae) from the Lower Jurassic Posidonia Shale of Germany. *The Anatomical Record*, February 2025.