SOM_1. List of characters used in the phylogenetic analysis. Characters used in previous phylogenetic analyses of Plesiosauria are listed as ‘C’ after the author reference.

1: **Skull length**: ‘short’ (pre-orbital length – tip of the snout to anterior border of orbits–shorter than half of the total length of the skull) =0, ‘elongated’ (pre-orbital length equal to or greater than half of the total length of the skull) =1. 
   Citations: Rieppel (1994, C9); O’Keefe (2001, C6, C8); Kear (2005, C1); Druckenmiller and Russell (2008, C2); Smith and Dyke (2008, C3); Ketchum and Benson (2010, C2).

2: **Dorsal midline ridge of the premaxillae**: absent =0, present =1. 
   Citations: Druckenmiller and Russell (2008, C6); Smith and Dyke (2008, C5); Ketchum and Benson (2010, C11).

3: **Relative size of temporal fenestrae and orbits**: fenestrae equal to or shorter than orbits =0, fenestrae longer than orbits =1. 
   Citations: Bardet et al. (1999, C5); Druckenmiller and Russell (2008, C4); Großmann (2007, C4); Smith (2007, C33); Ketchum and Benson (2010, C1).

4: **Constricted snout at the premaxilla-maxilla suture**: absent =0, present =1. 

5: **Premaxilla-maxilla sutures run parallel anterior to the external nares**: absent =0, present =1. 
   Citation: Smith and Dyke (2008, C9).

6: **Position of the external nares**: in the first half =0, retracted in the posterior half =1 of the preorbital region. 

7: **Dorsomedian foramen between premaxillae**: absent =0, present =1. 
   Citations: O’Keefe (2001, C13); Druckenmiller and Russell (2008, C9); Smith and Dyke (2008, C7); Ketchum and Benson (2010, C9).

8: **Premaxillae-external nares contact**: contacts medial margin =0, diminutive contact on anterior margin =1.
9: Prefrontals-external nares contact: absent = 0, present = 1.
Citations: O’Keefe (2001, C12); Druckenmiller and Russell (2008, C7); Smith and Dyke (2008, C8); Ketchum and Benson (2010, C8).

10: Frontal-external nare contact: absent = 0, present = 1.
Citations: Bardet et al. (1999, C9); O’Keefe (2001, C19); Smith and Dyke (2008, C15); Ketchum and Benson (2010, C18).

11: Posterior extension of the premaxillae: the premaxillae contact the anterior margin of the frontal or nasal = 0, partially split the frontals along the dorsal midline = 1, completely split the frontals and contact the parietal = 2.
Citations: Bardet et al. (1999, C8); Carpenter (1999, C8); O’Keefe (2001, C11); Druckenmiller and Russell (2008, C5); Smith and Dyke (2008, C17); Ketchum and Benson (2010, C10).

12: Maxilla-squamosal contact: absent = 0, present = 1.

13: Maxilla-orbit contact: present = 0, absent = 1.

14: Frontal-orbit margin contact: present = 0, absent = 1.

15: Parietal crest: absent = 0; present = 1.
Citation: Ketchum and Benson (2010, C38).

16: Posterior extension of the parietal: the parietal extends posterior to the temporal fenestra = 0, stop anterior to the posterior margin of the temporal fenestra = 1, stop at the level of the posterior margin of the temporal fenestra = 2.

17: Jugal-squamosal contact: absent = 0, present = 1.

18: Postfrontal shape: triangular = 0, quadrangular = 1.
Citations: Bardet et al. (1999, C7); Großmann (2007, C8); Ketchum & Benson (2010, C23).

19: Postorbital posterior extension: postorbital extends posterior to the jugal = 0, until the jugal posterior margin = 1, stop anterior to the posterior margin of the jugal = 2.

20: Postfrontal-temporal fenestra contact: present = 0, absent = 1.

21: Pineal foramen lies posterior to = 0, anterior to = 1, at the level of = 2 the anterior border of the temporal fenestra.

22: Squamosals united posterior to the parietal: absent = 0, present = 1.

23: Inter-squamosal suture along the dorsal midline: flat = 0, bulbous = 1.

24: Premaxilla-internal naris contact: present = 0, absent = 1.

25: Maxilla-internal naris contact: reduced to the lateral border of the internal nares = 0, extended to the anterior, lateral and posterior borders of the internal nares = 1, absent = 2.
26: **Palatine-internal naris contact**: present =0, absent =1.

27: **Relative positions of internal nares**: overlaps the external nares =0, anterior to external nares =1.
Citations: Druckenmiller and Russell (2008, C46); Ketchum and Benson (2010, C57).

28: **Palatines meet on the midline**: absent =0, present =1.
Citations: O’Keefe (2001, C80); Druckenmiller and Russell (2008, C41); Smith (2007, C38); Ketchum and Benson (2010, C52).

29: **Vomers partially separated by the pterygoids along midline**: absent =0, present =1.
Citation: Ketchum and Benson (2010, C54).

30: **Lateral palatine vacuities**: absent =0, present =1.
Citations: O’Keefe (2001, C78); Druckenmiller and Russell (2008, C45); Smith (2007, C41); Ketchum and Benson (2010, C56).

31: **Anterior interpterygoid vacuity**: absent =0, present =1.

32: **Ectopterygoid boss**: absent =0, present =1.

33: **Contact between the pterygoids posterior to the anterior interpterygoid vacuity**: absent =0, present =1.
Citations: O’Keefe (2001, C63); Ketchum and Benson (2010, C60).

34: **Cultriform process of the parasphenoid**: elongate exposure on palate surface =0, diminutive exposure =1.

35: **Posterior interpterygoid vacuities**: absent =0, present =1.

36: **Sharp keel on the parasphenoid**: present =0, absent =1.

37: **Posterior extension of the parasphenoid**: reached the posterior half of the posterior interpterygoid vacuities =0, extend until the anterior half of the posterior interpterygoid vacuities only =1.

38: **Shape of the posterior interpterygoid vacuities**: round =0, elongate and splint-like =1.
Citation: Smith (2007, C42).

39: **Orientation of posterior interpterygoid vacuities**: long axes sub-parallel =0, long axes convergent =1.

40: **Pterygoids posterior to the posterior interpterygoid vacuities**: do no meet =0, do meet =1.

41: **Ventrally projecting flange on the pterygoid**: absent =0, present =1.
Citations: O’Keefe (2001, C69); Druckenmiller and Russell (2008, C51); Smith (2007, C45); Ketchum and Benson (2010, C64).

42: **Element demarcating the anterior margin of the subtemporal fenestra**: ectopterygoid and pterygoid =0, ectopterygoid only =1.
Citation: Druckenmiller and Russell (2008, C48).

43: Quadratic flange of pterygoid: contacting quadrate only =0; forming contact with both quadrate and squamosal =1.

44: Occipital condyle visible in dorsal view: present =0, absent =1.
Citation: Smith (2007, C50).

45: Occipital condyle constriction: present = 0, absent =1.

46: Bowed mandible (as defined by Druckenmiller and Russell, 2008): absent =0, present =1.
Citations: O’Keefe (2001, C86); Kear, (2005, C24); Druckenmiller and Russell (2008, C75); Smith (2007, C60); Ketchum and Benson (2010, C86).

47: Mandibular symphysis: short (length lower than distance between the tip of the snout to the ventral suture between maxilla and premaxilla) =0, elongated (length sub-equal to the distance between the tip of the snout to the ventral suture between maxilla and premaxilla) =1, very long (length upper than distance between the tip of the snout to the ventral suture between maxilla and premaxilla) =2.

48: Constriction behind mandibular symphysis: absent =0, present =1.

49: Ventral keel on mandibular symphysis: absent =0, present =1.

50: Splenials participation in the mandibular symphysis: do not take part =0, do take part =1.
Citations: Rieppel (1994, C41); O’Keefe (2001, C90); Kear (2005, C28); Druckenmiller and Russell (2008, C76); Smith (2007, C59); Ketchum and Benson (2010, C87).

51: Development of the coronoid eminence: low =0, high =1.
Citation: Druckenmiller and Russell (2008, C85).

52: Contributions to the coronoid eminence laterally: surangular mainly =0, dentary mainly =1.

53: Anterior extension of the angular laterally: at the level of the coronoid eminence =0, anterior to the coronoid eminence =1.

54: Jaw articulation in relation to tooth row: above or colinear with tooth row =0, lower than tooth row =1.
Citations: O’Keefe (2001, C98); Kear (2005, C36); Ketchum and Benson (2010, C94).

55: Number of pairs of premaxillary teeth: five =0, more than five =1.

56: Regularity in size of premaxillary dentition: homodont =0, heterodont =1.
Citations: Brown (1981, C8); Storrs (1991, C39); Rieppel (1994, C44); Carpenter (1999, C10); Bardet et al. (1999, C17); O’Keefe (2001, C100); Druckenmiller and Russell (2008, C89); Ketchum and Benson (2010, C105).

57: Regularity in size of maxillary dentition: homodont =0, heterodont =1.

58: Diastema between premaxilla and maxilla: absent =0, present =1.

59: Tooth ornamentation all around =0, lingually only =1, no ornamentation =2.
60: Proportion of the cervical centra: length > height or length = height =0, length < height =1.

Citations: Brown (1981, C15); Bardet et al. (1999, C20); O’Keefe (2001, C112); Druckenmiller and Russell (2008, C102); Groβmann (2007, C28); Smith (2007, C61); Ketchum and Benson (2010, C120).

61: Articular facets for the cervical centra: amphicoelous =0, gently convex or platicoelous =1.


62: Nutritive foramina in cervical vertebrae: absent =0, present =1.


63: Pair of deep squared depressions on ventral surface of cervical vertebrae enclosing nutritive foramina: absent =0, present =1.

Citations: Smith (2007, C64); Ketchum and Benson (2010, C123).

64: Ventral keel on cervical vertebrae: absent =0, present =1.


65: Rib head of cervical vertebrae: double headed =0, single headed =1.


SOM_2. Character scores included in the phylogenetic analysis. Unknown state of character are given as “?”; Inapplicable characters are coded as “X”.

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| Diderothus grahami | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Hestroiootus gallicus | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Hyophorbeus laevis | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Liberianus varius | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Mittermeier's toxotes | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Plesiobates petersi | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Plesiobates trachynotus | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Niamhmyotus crassipilis | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Sipahorephus nasutus | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Slothioxerus varus | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Sturnius guttata | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Thelesiobates latifrons | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |