

A NEW GINGLYMODI (ACTINOPTERYGII, HOLOSTEI) FROM THE
LATE JURASSIC – EARLY CRETACEOUS OF THAILAND, WITH
COMMENTS ON THE EARLY DIVERSIFICATION OF
LEPISOSTEIFORMES IN SOUTHEAST ASIA

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Characters used in the phylogenetic analysis

1. Premaxilla immovably attached to the braincase by means of a long nasal process tightly sutured to the frontals:

- 0. No
- 1. Yes

Character defined by Grande (2010: 6) and used in a slightly different way by López-Arbarelo (2012: 47). Char. 13 in Cavin et al. (2013) and Deesri et al. (2014).

2. Ascending process of the premaxilla:

- 0. Not participating in the dermal skull roof cover
- 1. Participating in the dermal skull roof cover

Character defined by Wenz (1999) and used by Cavin (2010: 9) and López-Arbarelo (2012: 48). Grande (2010: 7) proposed the following definition ‘nasal process of premaxilla forms much of the ornamented dermal roof in the snout region’, but this definition is too restrictive for our set of taxa. Char. 15 in Cavin et al. (2013) and Deesri et al. (2014).

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3. **Anterior portion of premaxilla lining the nasal pit and pierced by a large foramen for the olfactory nerve:**
 0. No
 1. Yes

Character defined by Grande (2010: 8). Char. 14 in Cavin et al. (2013) and Deesri et al. (2014).
4. **Premaxilla width to length ratio based on the dorsally exposed region:**
 0. 2-0.28
 1. 0.18-0.02

Character defined by Grande (2010: 9). We altered the maximal value of state 0 in order to accommodate species with a very short premaxilla. Char. 16 in Cavin et al. (2013) and Deesri et al. (2014).
5. **Premaxillary tooth row curves anteriorly at symphysis and laterally onto projecting horns as it nears frontal:**
 0. No
 1. Yes

Character defined by Grande (2010: 101). Char. 17 in Cavin et al. (2013) and Deesri et al. (2014).
6. **Supraorbital canal on premaxillary process:**
 0. Absent
 1. Present

Character defined by Wiley (1976) and used by Cavin (2010: 10), Grande (2010: 24) and López-Arbarello (2012: 49). Char. 18 in Cavin et al. (2013) and Deesri et al. (2014).
7. **Posterior extent of median rostral bone:**
 0. With lamellar bone component separating the nasals, at least anteriorly
 1. A simple tube at the anterior end of snout with no internasal lamella
 2. No autogenous median rostral

Character defined by Grande (2010: 5). Char. 12 in Cavin et al. (2013) and Deesri et al. (2014)
8. **Ethmoid region:**
 0. 'Normal'
 1. Shortened (orbit in the anterior third of the head length)
 2. Lengthened (orbit in the posterior half of the head length)

This character was discussed in Cavin (2010: 37). It corresponds in part to Grande (2010)'s character 1, but the limits between character states are altered because the set of compared species are different. Char. 8 in Cavin et al. (2013) and Deesri et al. (2014).

9. Ethmoidal region:

- 0. Ossified
- 1. Reduced

Character defined by Olsen and McCune (1991) and used by Cavin (2010: 8) and Grande (2010: 35). Char. 9 in Cavin et al. (2013) and Deesri et al. (2014).

10. Nasals long and narrow:

- 0. Absent
- 1. Present

Character defined by López-Arbarello's (2012: 28).

11. Ornamentation of the dermal bones of the skull:

- 0. Ornamented with tubercles or ridges
- 1. Smooth or very slightly ornamented
- 2. Ornamented with firmly anchored large, pointed conical teeth

Character defined by Grande (2010: 2). Char. 89 in Cavin et al. (2013) and Deesri et al. (2014), with a new state defined by López-Arbarello (2012: 19).

12. Frontal:

- 0. Narrower anteriorly than posteriorly
- 1. As broad, or almost as broad anteriorly than posteriorly

This character was discussed by Jain (1983) and used by Cavin (2010: 11). It correspond in a slightly different way to López-Arbarello's (2012) characters 24 and 25. Character state 2 defined by López-Arbarello's (2012: 27). Char. 19 in Cavin et al. (2013) and Deesri et al. (2014)

13. Length of frontal:

- 0. Frontals less than 3 times longer than their maximum width
- 1. Frontals 3 times or more longer than their maximum width

Character defined by López-Arbarello (2012: 23).

14. Frontal ethmoidal sagittal lamina:

- 0. Absent
- 1. Present

Character defined by López-Arbarello's (2012: 26)

15. Parietals:

- 0. Symmetrical
- 1. Asymmetrical

Character defined by Jain (1983) and used by Cavin (2010: 13). Char. 21 in Cavin et al. (2013) and Deesri et al. (2014)

16. Parietal portion of the supraorbital sensory canal:

- 0. Present

1. Absent

Character defined by Wiley (1976) and used by Cavin (2010: 14) and in a different way by López-Arbarelo (2012: 88). Char. 22 in Cavin et al. (2013) and Deesri et al. (2014)

17. Deep groove housing the middle pit line in dermopterotic and parietal:

0. Absent
1. Present

Character defined by López-Arbarelo (2012: 90)

18. Junction of supraorbital canal with infraorbital canal:

0. Exclusively within frontal bone
1. Includes both frontal and dermopterotic bones
2. Exclusively within dermopterotic bone

This character was defined by Wiley and used by Cavin and Suteethorn (2006: 20) and Grande (2010: 25). We added here the state [1] corresponding to the situation observed in most 'semionotids' and macrosemiids as pointed out by Grande (2010). Char. 24 in Cavin et al. (2013) and Deesri et al. (2014)

19. Commissure between right and left supraorbital canal within frontal:

0. Absent
1. Present

Character defined by Grande (2010: 26). Char. 25 in Cavin et al. (2013) and Deesri et al. (2014)

20. Frontal / parietal length ratio:

0. $\geq 2,5$
1. $< 2,5$

This character was discussed by Jain (1983) and used by Cavin (2010: 12) and in a slightly different way by López-Arbarelo (2012: 22). Char. 20 in Cavin et al. (2013) and Deesri et al. (2014)

21. Shape and number of extrascapulars:

0. Two Exsc, medially narrow
1. More than 2, subrectangular
2. Some extrascapulars fused with parietals

This character was defined by Wiley and used by Cavin (2010: 15) and Grande (2010: 13) and correspond to a mix of López-Arbarelo (2012)'s characters 20 and 21. Char. 23 in Cavin et al. (2013) and Deesri et al. (2014)

22. Elongation of rostral region anterior to lower jaw symphysis:

0. Extends anterior to dentary symphysis by less than 20% of mandibular length
1. Extends well anterior to dentary symphysis by more than 50% of mandibular length

Character defined by Grande (2010: 4). Char. 9 in López-Arbarello (2012). Char. 10 in Cavin et al. (2013) and Deesri et al. (2014)

23. Large posteriorly directed process on the epiotic:

- 0. Absent
- 1. Present

Character defined by Olsen and McCune (1991) and redefined by Cavin (2010:1). Char. 1 in Cavin et al. (2013) and Deesri et al. (2014)

24. Posttemporal fossa:

- 0. Present
- 1. Absent

Character defined by Gardiner et al. (1996), altered by Cavin and Suteethorn (2006) and used by Cavin (2010: 3) and López-Arbarello (2012: 2), both with a reversed polarity, and Grande (2010: 32). Char. 2 in Cavin et al. (2013) and Deesri et al. (2014)

25. Supraoccipital bone:

- 0. Absent
- 1. Present

Character defined by Grande (2010: 28). Char. 3 in Cavin et al. (2013) and Deesri et al. (2014)

26. Lateral process of basioccipital:

- 0. Absent
- 1. Present

Character defined by Grande (2010: 105). Char. 4 in Cavin et al. (2013) and Deesri et al. (2014)

27. Opisthotic:

- 0. Present
- 1. Absent

Character defined by Olsen and McCune (1991) and used by Cavin (2010: 4), Grande (2010: 33), and López-Arbarello (2012: 4). Char. 5 in Cavin et al. (2013) and Deesri et al. (2014)

28. Intercalars:

- 0. Present, no contact with the prootic
- 1. Present, contact with the prootic
- 2. Absent

Character defined by Olsen and McCune (1991), and used by Cavin (2010: 5), Grande (2010: 30) and López-Arbarello (2012: 5). We distinguish here a new state, i.e. a distinction between states 0 and 1. Char. 6 in Cavin et al. (2013) and Deesri et al. (2014)

29. Basisphenoid:

- 0. Present
- 1. Absent

Character defined by Wiley (1976) and used by Cavin (2010: 6) and López-Arbarello (2012: 6). Char. 7 in Cavin et al. (2013) and Deesri et al. (2014)

30. Sphenotic with a small dermal component:

- 0. No
- 1. Yes

Character defined by Grande (2010: 23). Char. 7 in López-Arbarello (2012), Char. 34 in Cavin et al. (2013) and Deesri et al. (2014)

31. Vomer differentiated and molded to underside of ethmoid region:

- 0. No
- 1. Yes

Character defined by Grande (2010: 36). Char. 11 in Cavin et al. (2013) and Deesri et al. (2014)

32. One or more infraorbitals anterior to the circumorbital ring (not including the antorbital):

- 0. Absent
- 1. Present, squarish or longer than deep
- 2. Present, deeper than long

Character defined by Olsen and McCune (1991) and used by Cavin (2010: 16) and López-Arbarello (2012: 34). It corresponds to Grande's (2010) characters 20 and 21. Char. 27 in Cavin et al. (2013) and Deesri et al. (2014). Distinction between states 1 and 2 is new.

33. Infraorbitals:

- 0. Edentulous
- 1. Toothed infraorbitals

Character defined by Wiley (1976) and used by Cavin (2010: 17), Grande (2010: 42) and López-Arbarello (2012: 33). Char. 28 in Cavin et al. (2013) and Deesri et al. (2014)

34. Shape of infraorbital bones at the posterior border of the orbit:

- 0. Deeper than long, sometimes almost tubular
- 1. Approximately quadrangular, or longer than deep, expanded posteriorly

Character defined by López-Arbarello (2012: 37), but with two derived states. However, we consider that the distinction between her states 1 and 2 is unclear for some taxa (Pliodetes, Araripelepidotes, Dentilepisosteus, etc.), and here we merge character states 1 and 2.

35. Posteroventral infraorbital:

- 0. Comparable in size to other infraorbitals, not reaching the preopercle
- 1. Comparable in size to other infraorbitals, reaching or almost reaching the preopercle
- 2. Larger than other infraorbitals, reaching or almost reaching the preopercle

Character defined by López-Arbarello (2012: 36)

36. Tube-like canal bearing anterior arm on antorbital:

- 0. Absent
- 1. Present

Character defined by Grande (2010: 12). Char. 26 in Cavin et al. (2013) and Deesri et al. (2014)

37. Orbital ring:

- 0. Open
- 1. Closed, contact of anterior suborbital with a single infraorbital
- 2. Closed, contact of anterior suborbital with more than one infraorbitals

Character defined by Cavin (2010: 20). It correspond in part to Grande's (2010) character 15. Char. 29 in López-Arbarello (2012), 35 in Cavin et al. (2013) and Deesri et al. (2014)

38. Ventral border of infraorbital series flexes abruptly dorsally at the anterior margin of the orbit:

- 0. Absent
- 1. Present

*Character defined by López-Arbarello's (2012: 30). (Character difficult to assess in some terminal taxa, i.e. compare *Lepidotes gigas* and *Scheenstia zappi* in López-Arbarello 2012)*

39. Skull length/orbit diameter:

- 0. <6
- 1. >6

This character was discussed by Jain (1983) and used by Cavin (2010: 38). Char. 36 in Cavin et al. (2013) and Deesri et al. (2014)

40. Supraorbital bone/bones:

- 0. Absent
- 1. 1
- 2. 2
- 3. More than 2

Character defined by Grande (2010: 14). Char. 31 in Cavin et al. (2013) and Deesri et al. (2014). Char. 31 in López-Arbarello (2012) correspond in part to this character, but is more difficult to assess.

41. Orbital canal:

- 0. Absent
- 1. Present

Character defined by López-Arbarello (2012: 89)

42. Pattern and disposition of suborbitals:

- 0. A few suborbitals (2-8) arranged in a single row
- 1. A single suborbital
- 2. A mosaic of suborbitals
- 3. No suborbital
- 4. Two suborbitals, the ventral one much larger than the dorsal one

This character was discussed by Jain (1983), and defined by Cavin (2010: 18). It corresponds in a slightly modified way to Grande's (2010) character 18 and to López-Arbarello's (2012) characters 41 to 44. Char. 29 in Cavin et al. (2013) and Deesri et al. (2014)

43. Cheek:

- 0. Not complete (quadrate visible)
- 1. Quadrate covers by infraorbital(s)
- 2. Quadrate covers laterally by suborbital(s)

Character defined in a different way by Cavin (2010: 19) and corresponding in part to López-Arbarello's (2012) characters 40 and 46. Char. 30 in Cavin et al. (2013) and Deesri et al. (2014)

44. Dermosphenotic:

- 0. Loosely attached to the skull roof, reaches the orbital margin
- 1. Tightly sutured into the skull roof, reaches the orbital margin
- 2. Does not reach the orbital margin

Character corresponding to two characters defined by Grande (2010: 16 and 102) and, in part, to López-Arbarello's (2012) character 38. Char. 32 in Cavin et al. (2013) and Deesri et al. (2014)

45. Dermosphenotic/sphenotic association:

- 0. Closely associated with each other (i.e. contacting or fused to each other)
- 1. Not in contact with each other

Character defined by Grande (2010: 22). Char. 39 in López-Arbarello (2012), and 33 in Cavin et al. (2013) and Deesri et al. (2014)

46. Quadrate position:

- 0. Below or behind the orbit
- 1. In front of the orbit

Character defined by Wiley (1976) and used by Cavin (2010: 23), Grande (2010: 48) and López-Arbarello (2012: 16). Grande's (2010) character 17 – 'anterior extent of the preopercle' - is regarded as similar because the anterior extremity of the

horizontal arm of the preopercle reaches the posterior limit of the lower jaw, as does the quadrate. Char. 37 in Cavin et al. (2013) and Deesri et al. (2014)

47. Quadrate/metapterygoid contact or close association:

- 0. Present
- 1. Absent

Character defined by Grande (2010: 60). Char. 39 in Cavin et al. (2013) and Deesri et al. (2014)

48. Dermopalatine teeth:

- 0. Adults with large fangs or large crushing teeth on dermopalatine (i.e. teeth as large as any in the premaxilla and dentary)
- 1. Adults with only very small teeth on dermopalatine (i.e. smaller than the large of the premaxilla and dentary)
- 2. Dermopalatine without teeth
- 3. Both jaw teeth and dermopalatine teeth are very tiny

Character defined by Grande (2010: 66). Char. 42 in Cavin et al. (2013) and Deesri et al. (2014)

49. Part of the dorsal surface of the ectopterygoid ornamented and forming part of the skull roof:

- 0. No
- 1. Yes

Character defined by Grande (2010: 61). Char. 14 López-Arbarelo (2012). Char. 40 in Cavin et al. (2013) and Deesri et al. (2014)

50. Length of ectopterygoid relative to endopterygoid:

- 0. Less than twice the length of the endopterygoid
- 1. More than twice the length of the endopterygoid

Character defined by Grande (2010: 62). It corresponds to Char. 12 and 13 in López-Arbarelo (2012). Char. 41 in Cavin et al. (2013) and Deesri et al. (2014)

51. Entopterygoid dentition:

- 0. Present
- 1. Absent

Character defined by López-Arbarelo (2012: 15).

52. Quadratojugal:

- 0. Absent
- 1. Present and independant
- 2. Present and partially fused to the quadrate
- 3. Completely fused to the quadrate

Character defined by Arratia (2001) and used by Cavin (2010: 24). This character was redefined by López-Arbarelo (2012: 17) and corresponds to a mix of Char. 43

and 44 in Cavin et al. (2013) and Deesri et al. (2014).

53. Symplectic bone shape:

- 0. Slightly curved tube or splint
- 1. Hatchet shaped
- 2. L-shaped
- 3. Irregularly shaped subrectangular bone with two ventrally pointed arms

Character defined by Grande (2010: 68). It corresponds in part to Cavin's (2010) character 26. Char. 45 in Cavin et al. (2013) and Deesri et al. (2014)

54. Symplectic/quadrato articulation:

- 0. Present
- 1. Symplectic separated from quadrato by a quadratojugal

Character defined by Grande (2010: 69). It corresponds in part to Cavin's (2010) character 26. Char. 46 in Cavin et al. (2013) and Deesri et al. (2014)

55. Laterally sliding articulation between metapterygoid and the basipterygoid process (= parasphenoid-prootic process) in adults:

- 0. Absent
- 1. Present

Character defined by Grande (2010: 59). Char. 38 in Cavin et al. (2013) and Deesri et al. (2014)

56. Tritorial dentition between palate and coronoids:

- 0. Absent
- 1. Moderate
- 2. Strong

Character defined by Cavin (2010: 27) and López-Arbarello (2012: 55). Grande's (2010) character 57 - coronoid tooth morphology - is included in this character. Char. 47 in Cavin et al. (2013) and Deesri et al. (2014)

57. Teeth with plicidentine:

- 0. Absent
- 1. Present

Character defined by Wiley (1976) and used in Cavin (2010: 28), Grande (2010: 41) and López-Arbarello (2012: 54). Char. 48 in Cavin et al. (2013) and Deesri et al. (2014)

58. Maxilla:

- 0. Free, with a posterior plate
- 1. Free, short, with a constant depth
- 2. Atrophied maxilla fused with the infraorbitals

Character state 2 was defined by Wiley (1976) and corresponds, with other words, to Grande's (2010) character 44 and to López-Arbarello's (2012) characters 50 and 51.

This character with the three states was used by Cavin (2010: 29). Char. 49 in Cavin et al. (2013) and Deesri et al. (2014)

59. Maxilla with well-developed anterior articular process:

- 0. Yes
- 1. No

Character defined by Grande (2010: 45). Char. 50 in Cavin et al. (2013) and Deesri et al. (2014)

60. Mobility of maxilla:

- 0. Present
- 1. Absent

Character defined by Grande (2010: 46). Char. 51 in Cavin et al. (2013) and Deesri et al. (2014)

61. Marginal teeth of upper jaw:

- 0. Conical teeth of moderate to large size
- 1. Microteeth
- 2. No teeth on margin of upper jaw

Character defined by Grande (2010: 43). Character state 2 corresponds to Cavin's (2001) character 30 and López-Arbarelo's (2012) character 53. Char. 52 in Cavin et al. (2013) and Deesri et al. (2014)

62. Supramaxillary elements:

- 0. Absent
- 1. Present

Character defined by Grande and Bemis (1998) and used by Cavin (2010: 31), Grande (2010: 47) and López-Arbarelo (2012: 52). Char. 53 in Cavin et al. (2013) and Deesri et al. (2014)

63. Lower jaw articulation:

- 0. Single
- 1. Double

Character of halecomorphs discussed by Grande and Bemis (1998) and used by Grande (2010: 49) (the character was uninformative in Cavin's [2010] analysis). Char. 54 in Cavin et al. (2013) and Deesri et al. (2014)

64. Mandibular length as a percentage of head length:

- 0. Less than 44%
- 1. More than 44%

Character defined by Grande (2010: 50). Char. 55 in Cavin et al. (2013) and Deesri et al. (2014)

65. Long posterior process on the dentary in lateral view:

- 0. Absent
- 1. Present, ventral to the angular
- 2. Present, dorsal to the angular

Character defined by Thies (1989) and used by Cavin (2010: 33) and in a slightly different way by López-Arbarello (2012: 56). Char. 56 in Cavin et al. (2013) and Deesri et al. (2014)

66. Tooth organization of dentary:

- 0. Dentary teeth in a single row and all of similar size, arranged along the anterior third of the mandible at least
- 1. In addition to a lateral single row of similar sized teeth, there is a medial row of much larger fangs
- 2. A pavement of small similar sized teeth not in rows
- 3. No teeth on dentary
- 4. Dentary teeth in a single row and all of similar size, concentrated at the anterior extremity of the mandible

Character defined by Grande (2010: 39) and used in a slightly different way by López-Arbarello (2012: 57). State 4 correspond to Grande's (2010) character 56 and to López-Arbarello's (2012) character 59. Char. 57 in Cavin et al. (2013) and Deesri et al. (2014)

67. Supernumerary sensory canal or canalicles in the anterior part of the lower jaw:

- 0. Absent
- 1. Present

Character defined by Cavin and Suteethorn (2006) and used in Cavin (2010: 34). Char. 58 in Cavin et al. (2013) and Deesri et al. (2014)

68. Type of mandibular coronoid process:

- 0. A single bone
- 1. A compound structure involving more than one bone
- 2. Absent

This character is a reorganization of Grande's (2010) character 51 and Cavin's (2010) character 35. Char. 59 in Cavin et al. (2013) and Deesri et al. (2014)

69. Prearticular:

- 0. Present
- 1. Absent

Character defined by Grande (2010: 52). Char. 60 in Cavin et al. (2013) and Deesri et al. (2014)

70. Supraangular:

- 0. Absent
- 1. Present

Character defined by Grande (2010: 53). Char. 61 in Cavin et al. (2013) and Deesri et

al. (2014)

71. Coronoid bone:

- 0. Present as separate ossifications
- 1. Absent

Character defined by Grande (2010: 55). Char. 62 in Cavin et al. (2013) and Deesri et al. (2014)

72. Mentomeckelian bone:

- 0. Present
- 1. Absent

Character defined by Grande (2010: 58). Char. 63 in Cavin et al. (2013) and Deesri et al. (2014)

73. A series of paired primary basihyal toothplates supported by a spatulated tongue:

- 0. Absent
- 1. Present

Character defined by Wiley (1976), used by Cavin (2010: 32) and Grande (2010: 77). Char. 64 in Cavin et al. (2013) and Deesri et al. (2014)

74. Number of branchiostegal rays:

- 0. More than 4
- 1. Usually 4
- 2. Usually 3
- 3. Usually 1
- 4. None

Character defined by Grande (2010: 74). Char. 65 in Cavin et al. (2013) and Deesri et al. (2014)

75. Gulars:

- 0. Present
- 1. Absent

Character defined by Olsen and McCune (1991), used by Cavin (2010: 36), Grande (2010:75) and López-Arbarello (2012: 70, with one more state). Char. 66 in Cavin et al. (2013) and Deesri et al. (2014)

76. Dorsal limb of preopercle:

- 0. Mostly exposed forming a significant part of the ornamented lateral surface of the skull anterior to the opercle and reaches dorsally the dermopterotic
- 1. Separated from the dermopterotic by the suborbital series
- 2. Partly covered by a large suborbital
- 3. Entirely covered or nearly covered by suborbital bones in adults

Character defined by Grande (2010: 73) and used by López-Arbarello (2012: 61),

Cavin et al. (2013: 68) and Deesri et al. (2013: 68) in a different way (without characters states 1 and 2, and without specification of the suborbital). Character state 2 corresponds to López-Arbarello's (2012) char. 45 and character state 1 is new here.

77. Preopercle:

- 0. Crescent-shaped ($>110^\circ$)
- 1. L-shaped ($\leq 110^\circ$)

Character defined by Cavin (2010: 21) and used by López-Arbarello (2012: 60). Char. 69 in Cavin et al. (2013) and Deesri et al. (2014).

78. Shape of the opercle:

- 0. Subrectangular, deeper than long
- 1. Rounded to quadrate, approximately as deep as long
- 2. Tapering anteroventrally

Character defined by López-Arbarello (2012: 63)

79. Exposed, anterodorsal projection of subopercle:

- 0. Little or narrow projection extending dorsally
- 1. Forming an elongated process extending one third or two thirds the way up along the anterior edge of the opercle

Character defined by Grande (2010: 71) and used in a slightly different way by López-Arbarello (2012: 64 and 66). Char. 67 in Cavin et al. (2013) and Deesri et al. (2014)

80. Interopercle:

- 0. Absent
- 1. Present, large, approximately as long as the ventral arm of the preopercle
- 2. Present, small, remote from mandible

Character absence/presence defined by Olsen and McCune (1991) and used by Cavin (2010: 22, reversed) and Grande (2010: 19, reversed). Grande provided new data about the distribution of this character among gars. Char. 68 in López-Arbarello (2012), and Char. 70 in Cavin et al. (2013) and Deesri et al. (2014). States 1 and 2 are defined by López-Arbarello (2012: 69).

81. Ventral process of posttemporal bone:

- 0. Absent
- 1. Weakly developed
- 2. Well-developed as a ventral rod-like process suturing to intercalary process
- 3. Developed as a flat-flange

Character defined by Grande (2010: 92). Char. 71 in Cavin et al. (2013) and Deesri et al. (2014)

82. Knob-like anteroventral process of posttemporal:

- 0. Absent
- 1. Present

Character defined by López-Arbarello (2012: 72)

83. Posttemporal penetration by lateral line canal:

- 0. Present
- 1. Absent

Character defined by Grande (2010: 91). Char. 87 in López-Arbarello (2012), 72 in Cavin et al. (2013) and Deesri et al. (2014)

84. Supracleithrum with a concave articular facet for articulation with the posttemporal:

- 0. No
- 1. Yes

Character defined by Grande (2010: 93). Char. 73 in López-Arbarello (2012), Cavin et al. (2013) and Deesri et al. (2014)

85. Medial processes of supracleithrum:

- 0. Absent
- 1. Present

Character defined by Wiley (1976) and used by Grande (2010: 97). Char. 74 in Cavin et al. (2013) and Deesri et al. (2014)

86. Medial wing on cleithrum:

- 0. Absent
- 1. Present

Character defined by Wiley (1976) and used by Grande (2010: 94). Char. 75 in Cavin et al. (2013) and Deesri et al. (2014)

87. Series of denticles along the ridge between the branchial and lateral surfaces of the cleithrum:

- 0. Absent
- 1. One or two rows
- 2. Several rows

Character defined by López-Arbarello (2012: 74)

88. Clavicle or 'clavicle elements':

- 0. Present
- 1. Absent

Character defined by Grande (2010). The character corresponds to both his characters 95 and 96 according to the discussion of this author. Char. 76 in Cavin et al. (2013) and Deesri et al. (2014)

89. Ratio body length / body depth:

- 0. > 3,5, dorsal fin in the middle of the back
- 1. > 3,5, dorsal fin posterior

2. = < 3,5, dorsal fin posterior

Character defined by Cavin (2010: 40) and in a different way by Grande (2010: 34) and by López-Arbarello (2012: 1). Char. 80 in Cavin et al. (2013) and Deesri et al. (2014)

90. Vertebral centra:

0. Not ossified
1. Some centra only partly or fully ossified
2. All centra ossified, annular or amphicoelous
3. All centra strongly ossified, opisthocoelous

The opisthocoelous condition is a typical gar character used by Cavin (2010: 39), Grande (2010: 82) and López-Arbarello (2012: 71). We add here two new states to integrate other conditions observed in the set of compared taxa. Char. 77 in Cavin et al. (2013) and Deesri et al. (2014)

91. A series of diplospondylous spool-shaped vertebrae in preural region:

0. Absent
1. Present

This typical character of amiids was used by Grande (2010: 98). Char. 78 in Cavin et al. (2013) and Deesri et al. (2014)

92. Long epineural intermuscular bones:

0. Absent
1. Present

This typical character of teleosts was used by Grande (2010: 100). Char. 79 in Cavin et al. (2013) and Deesri et al. (2014)

93. Fin ray to pterygiophore ratios of dorsal and anal fins:

0. 2:1 or greater
1. About 1:1

Character defined by Grande (2010: 89). Char. 83 in Cavin et al. (2013) and Deesri et al. (2014)

94. Basal and fringing fulcra of the fins:

0. Present, small (< 1/3 ray length)
1. Present, enlarged (> 1/3 ray length)
2. Absent

Character used by Cavin (2010: 43). It includes Grande's (2010) character 90 and correspond in part to López-Arbarello's (2012) characters 75, 76 and 78). Char. 88 in Cavin et al. (2013) and Deesri et al. (2014)

95. Large dorsal fin, with more than 20 rays:

0. Absent
1. Present

Character defined by López-Arbarello (2012: 77)

96. Caudal fin:

- 0. Two lobes
- 1. One rounded lobe

Character defined by Cavin (2010: 41). Char. 84 in Cavin et al. (2013) and Deesri et al. (2014)

97. Caudal fin ray branching:

- 0. Two or more unbranched principal rays
- 1. Normally all principal rays are branched

Character defined by Grande (2010: 87). Char. 81 in Cavin et al. (2013) and Deesri et al. (2014)

98. Number of principal caudal fin rays in adults:

- 0. 11-13 (but usually 12)
- 1. Usually more than 12
- 2. Usually less than 12

Character defined by Grande (2010: 88). Char. 82 in Cavin et al. (2013) and Deesri et al. (2014)

99. Number of lepidotrichia in the lower, non-axial lobe of the tail:

- 0. Not equal to 6 or 8
- 1. 6
- 2. 8

Character defined by López-Arbarello (2012: 80 and 81)

100. Dorsal ridge scales:

- 0. Inconspicuous
- 1. Conspicuous, with a low spine
- 2. Conspicuous, with a high spine

Character discussed by several authors and defined by Cavin (2010: 42) with addition of char. state 2 from López-Arbarello (2012: 83). Char. 85 in Cavin et al. (2013) and Deesri et al. (2014)

101. Flank scale with large prominent posteriorly pointing spines:

- 0. No
- 1. Yes

Character defined by Grande (2010: 38) and used by López-Arbarello (2012: 84). Char. 87 in Cavin et al. (2013) and Deesri et al. (2014)

102. Vertical peg-and-socket articulation:

- 0. Present
- 1. Absent

Character defined by López-Arbarello (2012: 85)

103. Longitudinal articulation of the scales of the body:

- 0. Absent
- 1. Single
- 2. Double

Character defined by López-Arbarello (2012: 86)

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