

## A NEW SPECIES OF *SAURICHTHYS* (ACTINOPTERYGII: SAURICHTYDAE) FROM THE MIDDLE TRIASSIC OF MONTE SAN GIORGIO

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### SUPPLEMENTARY MATERIAL

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#### *Appendix 1.*

#### **Characters used in phylogenetic analysis**

1. Skull fineness (ordered): ratio of the length of the antorbital segment to the height of the maxilla + preoperculum in lateral view 0-0-1; 1- 2-9; 2- greater than 10.
2. Parasphenoid: 0- Foramen for orbital artery absent; 1- Foramen for orbital artery posterior to ascending process; 2- foramen at the base of the ascending process (modified from Wu et al. 2013).
3. Nasal and antorbitals bones: 0- both present; 1- only a single element present (modified from Wu et al. 2013).
4. Orbits: 0-opening dorsally, such that the interorbital distance is approximately half as wide as the width of the skull roof immediately posterior to the orbits; 1-interorbital constriction of frontals minimal
5. Sclerotic ring: 0- well ossified and robust; 1- thin and poorly ossified or absent.
6. Infraorbitals: 0- robust elements present ventral to dermosphenotic along the posterior orbital margin; 1- infraorbitals reduced or absent along the posterior orbital margin, leaving the posterior orbital rim open.
7. Parietals: 0-paired; 1-fused (modified from Rieppel 1992).
8. Posterior margin of dermopterotics: 0- U-shaped; 1- V-shaped.
9. Posterior margin of dermopterotics: 0- distance between posterior projections greater than anterior-posterior length along midline; 1- distance between posterior projections less than anterior-posterior length along midline.
10. Post-temporal bone: 0-discrete; 1-fused to supracleithrum or absent (modified from Wu et al. 2013).
11. Ratio of the length of the postorbital segment to maximum height of postorbital segment, measured between the dorsal margin of the preoperculum and the ventral margin of maxilla (ordered): 0-  $\leq 1.2$ ; 1- 1.2-2; 2-  $\geq 2$ .
12. Robust marginal dentition: 0- subnarial; 1- beginning anterior to external nares.
13. Maxilla: 0- bearing robust marginal dentition; 1- maxilla edentulous or only bearing denticles.
14. Preopercle: 0- with anterolateral exposure greater than 1/3 height of maxilla; 1- reduced.
15. Opercle: 0-higher than long; 1-longer than high.
16. Opercle: 0-straight anterior margin; 1-anterior edge angular, forming a triangle with the apex as the point of articulation with the skull.
17. Operculum: 0-posterior margin angular, giving the element a triangular outline; 1-posterior margin

rounded, giving the element a D-shaped outline.

18. Angular: 0- excluded from lateral view posterior to the orbital margin; 1- visible in lateral view ventral to the orbit.

19. Posterolateral angular: 0- ornamented with ganoine tubercles; 1- ridge-and-groove ornamentation along posterolateral angular.

20. Mandibular rami: lateral shelf reducing space between rami 0- present; 1- absent.

21. Length of mandibular symphysis as a proportion of total mandibular length (ordered): 0-  $\leq 0.2$ ; 1-  $\geq 0.4$ .

22. Jaws: with crypts for opposing tooth 0- deep, creating distortion in the orientation of bone fibers; 1- jaw margins straight or only slight resorption around tooth crypts.

23. Number of vertebrae anterior to the caudal fin (ordered): 0- 40-50; 1- 51-60; 2- 61-70; 3- 71-80; 4- 81-90; 5-  $\geq 91$ .

24. Neural spines: 0- rectangular and flattened in cross-section; 1- thin and rounded in cross-section.

25. Prezygapophyses anterior to the median fins: 0- absent, 1- present and elongate (modified from Rieppel 1992). Note that we do not distinguish between extremely elongate prezygapophyses of *S. grignae* and the more typical prezygapophyses of, e.g., *S. curionii*.

26. Neural arches + spines immediately posterior to the skull: 0- approximately half the height of neural arches and spines between the pelvic and anal fins; 1- little change in the height of neural spines along the length of the column.

27. Anterior abdominal neural arches: 0- neural spine present; 1- box-like.

28. Neural spines in region of the abdominal-caudal transition: 0- approximately twice the height of the neural arches; 1- much shorter.

29. Interdorsals: 0- resembling true neural arches; 1- small, poorly ossified or unossified.

30. Interventrals: 0- resembling true haemal arches; 1- significantly smaller than haemal arches or unossified.

31. True haemal arches anterior to anal fin: 0- box-like; 1- bearing elongate haemal spines; 2- unossified.

32. True haemal arches posterior to anal fin but anterior to caudal fin: 0- box-like; 1- bearing short haemal spines; 2- unossified.

33. Haemal arch and interventral: 0 – fused; 1 – discrete ossifications. Cases where the interventral is unossified are coded as ?.

34. Abdominal-caudal osteological transition: 0- corresponding to location of pelvic fins, 1- anterior to pelvic fins.

#### *Dorsal and anal fins*

35. Anterior edge of dorsal fin: 0- inserting in the anterior 79% of the body; 1- anterior insertion is in the posterior 20% or less of fork length.

36. Length of the dorsal fin: 0- base of the dorsal fin equal or greater in length to the length of the caudal peduncle; 1- caudal peduncle longer than dorsal fin base.

37. Fringing fulcra: 0- absent; 1- present (from Rieppel 1992). Fringing fulcra are present dorsal to the vertebral column in the caudal fin of *Birgeria*, however as fringing fulcra are not associated with the lepidotrichia in this genus, the character is coded as absent.

38. Segmentation of the lepidotrichia in the dorsal and anal fins (ordered): 0- 6-10 segments; 1- 2-5 segments; 2- unsegmented.

39. Number of ossified dorsal axonosts (ordered): 0-  $\geq 15$ ; 1- 10-13; 2-  $\leq 9$ .

40. Dorsal fin axonosts: 0- located mostly anterior to fin position; 1- ventral to fin position.

41. First dorsal axonost: 0- flattened and anteroposteriorly expanded relative to succeeding axonosts; 1- not differentiated from succeeding axonosts.

42. Anal fin, anterior axonosts: 0- almost half the length of the fin; 1- short relative to the fin.

43. Baseosts of the median fins (middle radials of Hilton et al. 2011): 0- posterior elements small and rounded or unossified; 1- hourglass shaped.

*Caudal Fin*

44. Segmentation of the lepidotrichia in the caudal fin (ordered): 0-  $\geq 10$ ; 1- 2-6; 2- unsegmented.
45. Lepidotrichial segments from the longest rays: 0- Proximal segment shorter than the total length of the next two distal segments; 1- Proximal segment longer than the total of the next two distal segments.
46. Caudal fin: 0- width of the epaxial or hypaxial lobe approximately constant along the proximodistal axis (caudal fin v-shaped); 1-lobe becoming wider proximally (caudal fin essentially triangular).
47. Caudal fin: 0- body axis extending into dorsal lobe of fin; 1- body axis straight.
48. Cleithrum: 0- with posterior process straight; 1- with posterior process descending; 2- with flat posterior margin.
49. Cleithrum: 0- with dorsal process curving anteriorly; 1- with dorsal process straight or posteriorly inclined.
50. Cleithrum: 0 – with anterior process entire; 1- with bifurcated anterior process.
51. Pelvic bone: 0- subrectangular, posterior edges close to midline; 1- hatchet-shaped, divergence posterior to anterior symphyseal region.
52. Pelvic fins: 0- located closer to the anal fin than half the length of the tail stock, 1- located further anteriorly than half length of tailstock.
53. Pelvic fin: 0- well-ossified radials present; 1- absent.
54. Segmentation of the lepidotrichia in the pelvic fin: 0- present; 1- absent.
55. Scale rows at the level of the abdominal- caudal transition (ordered): 0- complete, 1- six rows; 2- four rows; 3- two rows; 4- 0 rows. (modified from Rieppel, 1992).
56. Squamation: 0- restricted to well-organized rows; 1- patches of small scales present in the abdominal region.
57. Mid-dorsal and mid-ventral scales, abdominal region: 0- laterally broad; 1- elongate, but still relatively wide; 2- needle-like
58. Mid-dorsal scales anterior to median fins: 0- tubercular ornamentation on mid dorsal scales present; 1- absent.
59. Approximate relationship between the abdominal midlateral and mid-dorsal scales: 0- 1:1 1- 1:2 or more.
60. Mid-lateral scales anterior to median fins: 0- tubercular ornamentation present; 1- absent.
61. Mid-lateral scales, abdominal region: 0- deep and rectangular; 1- deep and tapering; 2- rib-like; 3- deeper than long, but much shallower than body depth; 4- small and rounded.
62. Ventrolateral scales: 0- dorsoventrally higher than mid-lateral scales; 1-reduced. If both lateral scale rows are absent anterior to the median fins, this character is coded as unknown.
63. Anal loop scales: 0- not significantly differentiated from the ventral scale row; 1- at least one highly modified scale present.
64. Anus: 0- immediately posterior to pelvic fins; 1- posterior to pelvic fins, anal loop extending to a point immediately anterior to the anal fin.
65. Tail stock: 0- reinforced by highly modified scutes; 1- no sudden divergence from the caudal squamation immediately posterior to the dorsal fin.
66. Haemal arches ossified anterior to pelvic fins absent 0, present 1.

Appendix 2.  
Matrix – TNT format.

```
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begin data;
dimensions ntax=24 nchar=65;
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Australosomus      0001000??0000010?1?10?0101001011000010011000100000010000010100??1
Birgeria          0001010000000000?001014101001111?0001011101010021011004??????????
S. paucitrichus  1?1????1?101110011??0?01?01001?101?11???1?1011???1??102???2110?
S. costasquamosus 1?1011?101111100110??1401?000011101111?11111001111?11010101021100
S. deperditus     1???1?????111000111??0401000??22??0111200101?1101??1112021?141100
S. striolatus    2?110?????1?1?10111?1?4?0?11??22??1112?????2?11????1112021?141100
S. dawaziensis   1?1?11???1111100110??0301?0000021001001?0??000101011?020201041000
S. curionii      1210111011101101110011 {34}010000011101111110101001111011110211141101
S. macrocephalus 1?11111001101100110010 {34}01000001110111111?111001101?11010211131101
Si. longipectoralis ?2100100010?1101110?11501?00011010?101011101?01201001111001031101
Si. longimedialis 1210010001001101110??1 {34}01??00110100101011101?01211?0?111001031101
Si. minuta       1210010001001101110??13????00?101?0101111101?01211?0?111001031101
Saurorhynchus    121110101?1111011110104110000011111112211?02?01010?0113021?????10
S. madagascariensis 11110001001011000100?1 {45}01100000?000110 {01}?11101?1011?10021000011000
S. ornatus       ?111110110201000010???01??0000?0???1?????????0?01?002120104100?
S. orientalis    ??1?????????11?0100?????01?????????????1?????????0?????1100001100?
S. toxolepis     1?1111000?2?110000????2?????????????0??221???2?010?0?1?11110??11??0
S. calcaratus    ??1?100??11?11101?????????????00?0112?00102??1010?1?12011?141?00
S. grignae       ??????????????????????301?000011100001?1??01001???1103020?????01
S. rieppeli      ??????????????????0??110?3011000002000100111011111????1?03020????010
S. breviabdominalis 1?1111111011100110111 {12}01?00001010011111010111111011010100021100
S. wimani        1?11??11102??0?0011??1?01100000000?1112?11101?1??01?02100001?0?0
S. spinosa       1?10111??100?100110??11?0?1?00??1?010221???2?1111?1111020?130101
S. sceltrichensis 1?10111111101101110010 {34}010000010101021001?2?01111?111102000?1100
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