

SUPPLEMENTARY ONLINE MATERIAL FOR

**The glyptodont *Eleutherocercus solidus* from the Late Neogene  
of north-western Argentina: Morphology, chronology, and phylogeny**

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**Supplementary Online Material**

**SOM 1.** Character list.

**SOM 2.** Character-taxon matrix used in the cladistics analysis.

## SOM 1

### Character list

- (0) Angle between the major axis of the descending process of the zygomatic arch and the plane at the level of the dental series  $<80^\circ$  (in frontal view) (Cuadrelli et al., 2020): (0) absent; (1) present.
- (1) Morphology of the infraorbital foramina (Zurita et al., 2013): (0) circular or oval; (1) oval with a lower channel.
- (2) Pneumatization of the rostral area of the skull (Zurita et al., 2013): (0) absent; (1) present.
- (3) Ossified nasal cartilages (Zurita et al., 2013): (0) absent; (1) present.
- (4) Dorsal profile of the skull in lateral view (modified from Cuadrelli et al., 2020): (0) nasal parallel to frontal; (1) nasal tangent to the fronto-parietal profile.
- (5) Angle between naso-frontal region and parietal region, located at orbital notch level (in lateral view): (0) absent; (1) present.
- (6) Morphology of the orbital notch in lateral view (Zurita et al. 2013): (0) dorsoventrally elongated; (1) circular.
- (7) Angle between posterior margin of the orbital notch and the palate plane near to  $90^\circ$ : (0) absent; (1) present.
- (8) Anterolateral border of the nasal openings with a sigmoid contour (modified from Zurita et al. 2013): (0) absent; (1) present.
- (9) Morphology of the dorsal area located ahead the orbitals (Zurita et al. 2013): (0) non-quadrangular; (1) quadrangular.
- (10) Cranium plus the zygomatic arches approximates a circular shape, in dorsal view: (0) absent; (1) present.
- (11) Morphology of the palate (Zurita et al., 2014): (0) with a transverse expansion absent or limited to one margin; (1) with a transverse expansion in its distal and proximal margins.
- (12) Transverse diameter of the palate at the level of Mf1 (Zurita et al., 2014): (0) equal to the antero-posterior diameter occupied by the Mf1-Mf3; (1) equal to the antero-posterior diameter occupied by the Mf1-Mf4.
- (13) Flat occlusal surface on all Mf (Fericola 2008): (0) absent; (1) present.
- (14) Evident labiolingual trilobation begins (modified from Zurita *et al.* 2013, 2017; Zamorano & Brandoni 2013): (0) Mf1; (1) Mf2; (2) Mf3; (3) Mf 4.
- (15) Labio-lingual axis of the Mf1 greater than or equal to 75% of the anteroposterior axis (modified from Fericola 2008; Zamorano & Brandoni 2013): (0) absent; (1) present.
- (16) Antero-posterior diameter of Mf1: (0)  $>50\%$  of the antero-posterior diameter of Mf2; (1)  $<50\%$  of the antero-posterior diameter of Mf2.
- (17) Morphology of the Mf2/mf2 (Quiñones *et al.*, 2020): (0) sub-elliptic with its anterior and posterior borders rounded; (1) sub-elliptic with its anterior and posterior borders pointed; (2) scarcely lobulated, particularly of the lingual margin; (3) scarcely lobulated in both margins.
- (18) Relationship between the anterior toothless portion of the mandible with respect to its total length (Fericola 2008): (0)  $>10\%$ ; (1)  $<10\%$ .
- (19) Angle between the major axis of the horizontal ramus of the mandible and the major axis of the ascending ramus of the same (Fericola 2008): (0)  $<90^\circ$ ; (1) greater than or equal to  $90^\circ$ .
- (20) Cephalic shield constituted only by small osteoderms (Zurita *et al.* 2013): (0) absent; (1) present.

- (21) Cephalic shield with peripheral figures (modified from Cuadrelli et al., 2020): (0) absent; (1) present.
- (22) Entepicondilar foramen (Cuadrelli *et al.*, 2020): (0) absent; (1) present.
- (23) Scaphoid articulates with metacarpal of digit V (Cuadrelli *et al.*, 2020): (0) absent; (1) present.
- (24) Third trochanter extending over more than one-third of the diaphysis length (Cuadrelli *et al.*, 2020): (0) absent; (1) present.
- (25) Cephalic notch with tubercular osteoderms (Zurita *et al.* 2013): (0) absent; (1) present.
- (26) Maximum number of peripheral figures (modified from Zurita *et al.* 2013): (0) without figures; (1) up to 12; (2) up to 20; (3) 21 or more.
- (27) Number of series of peripheral and accessory figures (modified from Zurita *et al.* 2013): (0) one series, with accessory peripheral figures in <10% of osteoderms; (1) one series with accessory peripheral figures in >10% of osteoderms; (2) non-ornamented osteoderms.
- (28) Morphology of the osteoderms constituting the margin of the dorsal carapace (Zurita *et al.* 2013): (0) tubercular osteoderms absent or limited to the caudal notch; (1) tubercular osteoderms present throughout the margin of the dorsal carapace.
- (29) Number of series of peripheral figures (modified from Zurita *et al.* 2013): (0) one series; (1) two or more series; (2) without figures and uniformly perforated.
- (30) Osteoderms of the lateroventral region of dorsal carapace (Zurita *et al.* 2013): (0) with circular central figure; (1) with angular central figure; (2) not ornamented.
- (31) Osteoderms of the lateroventral region of the dorsal carapace (Zurita *et al.* 2013): (0) in central position or displaced towards posterior, with more than six peripheral figures; (1) displaced towards the posterior margin, with five or less peripheral figures.
- (32) Development of the central sulci of the osteoderms of the dorsal area of the carapace (Zurita et al., 2013): (0) width < 4mm; (1) between 4-6mm.
- (33) Dorsal area of the dorsal carapace with reticular ornamentation pattern (Cuadrelli et al. 2020): (0) absent; (1) present.
- (34) Small foramina with nearly homogenous distribution along the exposed surface of the osteoderms (only applicable to osteoderms without ornamentation pattern): (0) absent; (1) present.
- (35) Exposed surface of the osteoderms of the posterior region of the dorsal carapace (Zurita *et al.* 2013): (0) flat or concave with central cavity; (1) flat or convex; (2) blistered; (3) not ornamented.
- (36) Dorsal carapace divided into preiliac and postiliac regions, both occupied 50% of the curvature (Cuadrelli 2020, Tesis): (0) absent; (1) present.
- (37) Carapace convexity, in lateral view (Cuadrelli et al., 2020): (0) absent; (1) present.
- (38) Posterior region of the dorsal carapace with a hypertrophied dome-shaped glandular structure: (0) absent; (1) present.
- (39) Expression area of the convexity of the dorsal carapace, in lateral view (Cuadrelli et al., 2020): (0) convex at anterior level; (1) convex at medium level; (2) convex at posterior level; (3) convexity do not expressed.
- (40) Periphery figures of the osteoderms that constituted the caudal notch of the dorsal carapace (modified from Cuadrelli et al., 2020): (0) osteoderms with lateral and proximal figures; (1) osteoderms only with proximal figures.
- (41) Ornamentation of marginal osteoderms of the caudal notch (modified from Cuadrelli *et al.* 2020): (0) osteoderms with one series of proximal peripheral figures; (1) osteoderms with two or more series of peripheral figures.
- (42) Percentage that the central figure occupies over the total surface of the osteoderms next to the caudal notch (Cuadrelli et al., 2020): (0) <50%; (1) >50% but <80%; (2) >80%; (3) not ornamented.
- (43) Central figure of the osteoderms of the caudal notch (Zurita *et al.* 2013): (0) without central trapezoidal figure; (1) with central trapezoidal figure.
- (44) Dorsal contour of caudal notch, in lateral view (Zurita *et al.* 2013): (0) ventrally inclined; (1) dorsally inclined.
- (45) Ornamentation of the dorsal carapace vs ornamentation of the caudal armour (Zamorano & Brandoni 2013; Zurita 2017): (0) different; (1) similar.

- (46) Morphology of the exposed surface of the osteoderms of the caudal rings (Zurita *et al.* 2013): (0) flat and without ornamentation; (1) flat with peripheral figures; (2) distal series of osteoderms with tubercular surface.
- (47) Periferic figures in the exposed surface of the distal series of the osteoderms of the caudal rings (Cuadrelli., 2020, tesis): (0) absent; (1) present.
- (48) Morphology of the caudal armor (Zurita *et al.* 2013): (0) rings representing more than 90% of the total length; (1) rings plus caudal tube (the latter representing more than 20% of the length of the caudal armor); (2) rings plus caudal tube (the latter representing more than 40% of the length of the caudal armor).
- (49) Transversal contour of the distal third of the caudal tube: (0) Nearly circular; (1) dorso-ventrally flated.
- (50) Morphology of the terminal part of the caudal armour (Cuadrelli et al., 2020): (0) caudal tube not developed; (1) caudal tube not expanded transversely in its terminal portion; (2) caudal tube expanded transversely in its terminal portion.
- (51) Ornamentation pattern of the dorsal osteoderms of the caudal tube: (0) smooth surface; (1) rosette pattern; (2) reticular pattern; (3) smooth surface with numerous foraminas.
- (52) Osteoderms of the lateral area of the caudal tube (modified from Zurita *et al.* 2013): (0) without peripheral figures; (1) with peripheral figures.
- (53) Presence of depressions with convex central area in the lateral and/or terminal area of the caudal tube (modified from Porpino *et al.* 2010): (0) absent; (1) present.
- (54) Presence of concave depressions for the insertion of spines in the terminal area of the caudal armour (Cuadrelli et al. 2020): (0) absent; (1) present.
- (55) Terminal tubercle of the caudal armor: (0) formed by two fussed rings; (1) formed by three fussed rings.
- (56) Morphology of the terminal part of the caudal armor (Modified from Cuadrelli 2020): (0) not transversally expanded; (1) slightly transversally expanded; (2) very transversally expanded.

**SOM 2. Character-taxon matrix used in the cladistics analysis. Note: ?, missing data.**

**(Part 1)**

	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
<i>Euphractus sexcintus</i>	-	0	0	0	1	-	0	0	0	0	0	0	0	0	-	1	0	0	1
<i>Pampatherium humdboltii</i>	-	0	0	0	1	-	0	0	?	0	0	0	0	0	-	1	1	0	1
<i>Propalaeohoplophorus australis</i>	0	0	0	0	1	-	0	0	0	0	0	0	0	1	3	1	0	0	1
<i>Eucinepeltus petestatus</i>	0	0	0	0	1	-	0	0	0	0	0	0	0	1	3	1	0	0	?
<i>Cochlops muricatus</i>	0	0	0	0	1	-	0	0	0	0	0	0	0	1	2	1	0	0	?
<i>Doedicurus clavicaudatus</i>	0	0	0	0	1	-	0	1	0	0	0	1	1	1	2	1	1	2	0
<i>Neosclerocalyptus paskoensis</i>	0	0	1	1	-	-	0	0	0	?	0	0	0	1	1	1	0	2	0
<i>Panochthus tuberculatus</i>	0	0	1	0	0	1	0	0	1	0	0	1	0	1	1	0	0	3	0
<i>Hoplophorus euphractus</i>	?	0	1	0	?	?	0	?	1	0	0	?	?	1	?	?	?	?	?
<i>Pseudoplophorus absolutus</i>	0	0	0	0	1	-	0	0	0	0	0	0	0	1	?	1	0	0	0
<i>Glyptotherium texanum</i>	1	0	0	0	1	-	1	0	0	1	0	0	0	1	1	0	0	3	0
<i>Glyptotherium cylindricum</i>	?	?	?	0	1	?	?	?	0	1	0	?	?	1	1	0	?	3	0
<i>Boreostemma acostae</i>	0	0	0	0	1	-	0	0	0	0	0	0	0	1	1	0	0	3	0
<i>Boreostemma venezolensis</i>	?	?	?	0	?	?	?	?	0	0	?	?	?	?	1	?	?	?	?
<i>Glyptodon munizi</i>	1	1	0	0	1	-	1	0	0	1	1	0	0	1	0	0	0	3	0
<i>Glyptodon reticulatus</i>	1	1	0	0	1	-	1	0	0	1	1	0	0	1	0	0	0	3	0
<i>Plophorus figuratus</i>	0	0	0	0	1	-	0	0	0	0	0	0	0	1	2	1	0	0	?
<i>Glyptodon jatunkhirkhi</i>	1	1	0	0	1	?	1	0	0	1	1	0	?	1	0	0	0	3	?
<i>Eleutherocercus antiquus</i>	0	0	0	0	0	0	0	1	0	0	0	1	1	1	2	1	1	2	?
<i>Panochthus intermedius</i>	0	0	1	0	0	1	0	0	1	0	0	?	0	1	?	0	?	3	?
<i>Neosclerocalyptus ornatus</i>	0	0	1	1	-	-	0	0	0	0	0	0	0	1	1	1	0	2	?
<i>Eleutherocercus solidus</i>	0	0	0	0	0	0	0	1	0	0	0	1	1	1	2	1	1	2	0
<i>Porpanochthus bullifer</i>	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?

**(Part 2)**

	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37
<i>Euphractus sexcintus</i>	1	1	0	1	1	0	0	-	-	0	-	1	-	0	0	-	?	-	-
<i>Pampatherium humdboltii</i>	1	1	1	?	1	0	0	-	-	?	-	0	-	?	0	-	?	-	-
<i>Propalaeohoplophorus australis</i>	0	0	1	1	?	0	0	2	0	0	0	0	1	0	0	-	2	?	1
<i>Eucinepeltus petestatus</i>	0	0	0	?	?	?	0	2	1	0	0	0	0	0	0	-	0	0	?
<i>Cochlops muricatus</i>	?	0	1	?	?	?	0	2	1	0	0	0	0	0	0	-	0	0	?
<i>Doedicurus clavicaudatus</i>	0	0	0	1	1	1	?	0	2	0	-	2	-	-	0	0	3	0	1
<i>Neosclerocalyptus paskoensis</i>	0	0	1	1	1	1	0	2	1	0	0	0	0	0	0	-	0	0	0
<i>Panochthus tuberculatus</i>	0	0	1	1	1	1	0	3	1	0	1	?	0	0	1	-	0	0	1
<i>Hoplophorus euphractus</i>	?	?	?	?	?	?	0	2	1	0	0	0	0	0	?	-	0	0	1
<i>Pseudoplophorus absolutus</i>	0	0	0	1	1	1	0	2	1	0	1	0	0	0	0	-	0	?	?
<i>Glyptotherium texanum</i>	0	?	?	0	0	1	0	1	0	1	0	1	0	0	0	-	1	1	1
<i>Glyptotherium cylindricum</i>	0	?	?	0	0	1	0	1	0	1	0	1	0	0	0	-	1	1	1
<i>Boreostemma acostae</i>	0	1	0	0	1	0	0	1	0	0	0	1	1	0	0	-	0	0	1
<i>Boreostemma venezolensis</i>	0	?	?	?	?	?	0	1	0	0	0	1	1	0	0	-	0	0	1
<i>Glyptodon munizi</i>	0	1	0	0	0	1	1	1	0	1	0	1	0	1	0	-	0	0	1
<i>Glyptodon reticulatus</i>	0	1	0	0	0	1	1	1	0	1	0	1	0	1	0	-	0	0	1
<i>Plophorus figuratus</i>	0	?	?	?	?	1	?	2	1	0	1	0	0	0	0	-	0	0	1
<i>Glyptodon jatunkhirkhi</i>	?	?	?	0	0	1	?	1	0	1	0	1	0	1	0	-	0	0	1
<i>Eleutherocercus antiquus</i>	?	?	?	?	?	1	?	0	2	?	-	2	-	-	0	1	3	?	1
<i>Panochthus intermedius</i>	0	0	1	1	1	1	0	3	1	0	1	0	0	0	1	-	0	0	1
<i>Neosclerocalyptus ornatus</i>	?	?	?	1	?	1	0	2	1	0	0	0	0	0	0	-	0	0	0
<i>Eleutherocercus solidus</i>	0	?	?	?	?	1	?	0	2	?	-	2	-	-	0	1	3	?	?
<i>Porpanochthus bullifer</i>	?	?	?	?	?	?	?	3	1	0	1	?	?	0	1	-	2	?	1

**(Part 3)**

	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56
<i>Euphractus sexcintus</i>	0	-	?	?	0	0	0	0	0	0	0	-	0	-	-	-	0	-	-
<i>Pampatherium humdboltii</i>	0	-	?	?	0	0	-	0	0	0	0	-	0	-	-	-	0	-	-
<i>Propalaeohoplophorus australis</i>	0	1	0	0	1	1	0	0	0	0	1	-	1	-	0	0	0	-	-
<i>Eucinepeltus petestatus</i>	0	?	0	0	1	0	0	?	0	1	1	-	?	?	?	?	?	?	?
<i>Cochlops muricatus</i>	0	?	0	0	1	0	0	?	0	1	1	0	1	0	0	0	0	-	0
<i>Doedicurus clavicaudatus</i>	0	0	-	?	3	0	0	1	0	-	2	1	2	3	0	0	1	-	2
<i>Neosclerocalyptus paskoensis</i>	0	3	0	0	0	0	0	1	0	1	2	0	1	1	1	0	0	-	0
<i>Panochthus tuberculatus</i>	0	0	0	1	0	0	0	1	0	1	2	1	1	2	1	1	0	-	0
<i>Hoplophorus euphractus</i>	0	1	0	1	0	0	0	1	?	?	2	1	1	1	1	1	0	-	0
<i>Pseudoplophorus absolutus</i>	0	?	0	0	?	0	0	1	?	?	2	0	1	1	1	0	0	-	0
<i>Glyptotherium texanum</i>	0	1	1	0	2	0	1	0	1	0	0	-	0	-	0	0	0	1	-
<i>Glyptotherium cylindricum</i>	0	1	1	0	2	0	1	0	1	0	0	-	0	-	?	?	0	1	-
<i>Boreostemma acostae</i>	0	1	1	0	1	1	0	0	0	0	0	-	0	-	0	0	0	-	-
<i>Boreostemma venezolensis</i>	0	1	1	0	?	1	0	?	0	0	?	?	?	?	?	?	?	?	?
<i>Glyptodon munizi</i>	0	2	1	0	2	0	0	0	2	0	0	-	0	-	0	0	0	0	-
<i>Glyptodon reticulatus</i>	0	2	1	0	2	0	0	0	2	0	0	-	0	-	0	0	0	0	-
<i>Plophorus figuratus</i>	0	1	?	?	0	0	0	1	?	?	2	0	1	1	1	0	0	-	0
<i>Glyptodon jatunkhirkhi</i>	0	1	1	0	2	0	1	0	1	0	0	-	0	-	0	0	0	0	?
<i>Eleutherocercus antiquus</i>	1	?	-	?	3	0	?	0	?	?	2	1	2	1	1	0	1	-	1
<i>Panochthus intermedius</i>	0	0	0	1	0	0	0	1	0	1	2	1	1	2	1	1	0	-	0
<i>Neosclerocalyptus ornatus</i>	0	3	?	?	0	0	0	1	0	1	2	0	1	1	1	0	0	-	0
<i>Eleutherocercus solidus</i>	1	?	?	?	?	0	?	0	?	?	2	1	2	1	1	0	1	-	1
<i>Porpanochthus bullifer</i>	?	1	0	1	0	0	?	1	?	?	2	1	1	2	1	1	0	-	0