A sea turtle skull from the Cretaceous of Chile with comments on the taxonomy and biogeography of *Euclastes* (formerly *Osteopygis*)

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**Abstract**

The taxonomic status of turtle specimens from the Upper Cretaceous (upper Maastrichtian) Quiriquina Formation of Chile is unresolved. The previously described specimens were considered either stem-chelonionid sea turtles or baenids (a freshwater clade otherwise restricted to North America). A third specimen, a skull described here, supports previous reports that stem-chelonionid sea turtles are present in the Quiriquina Formation. The new skull is referred to the stem-chelonionid genus *Euclastes* (formerly *Osteopygis*), but not assigned to a species because the alpha taxonomy is complicated by lingering confusion about the taxonomic status of a previously described skull from the Quiriquina Formation (the holotype of *Australobaena chilensis*). Revisions to the higher-level taxonomy of durophagous stem-chelonionids, combined with the specimen described here, and other new material from Gondwana, reveal an emerging pattern of *Euclastes* biogeography and stratigraphic distribution. According to current data, *Euclastes* is one of the first stem chelonii found outside the Western Interior Seaway, dominates Maastrichtian stem-chelonionid localities, crosses the K/Pg boundary, and eventually goes extinct at the end of the Paleocene as the stem-chelonoid radiation accelerates in the Paleogene.

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1. Introduction

Fossil discoveries from Chile are providing new insights about the biogeography of Late Cretaceous marine reptiles (Otero et al., 2009, 2010, 2012a,b; Rubilar-Rogers et al., 2012). The description and analysis of these fossils allow for new comparisons to other fossil localities in the Southern Hemisphere, Pacific Basin, and beyond. For example, Otero et al. (2012a) describe elasmosaurid pleiosaur and dermochelyid sea turtles that demonstrate taxonomic similarities between marine reptiles of the North Pacific and the high latitude Weddellian Biogeographic Province of the Southern Hemisphere (following Zinsmeister [1979] the Weddellian Biogeographic Province includes New Zealand, Antarctica, and parts of South America from the Late Cretaceous to the Eocene). The referral of some Chilean elasmosaurid material to *Aristonectes* also indicates a similarity to Weddellian sites (e.g., Antarctica; Otero et al., 2012b; Otero and O’Gorman, 2013), further demonstrating regional endemicity. The discovery and description of new material from Chile is key to developing these emerging patterns, because Chile’s long coast dominates the southeastern Pacific. Thus, Chile provides key data for global comparisons, as well as a large latitudinal sampling of marine reptiles from units of similar age (Campanian–Maastrichtian).

Here we describe the skull of a durophagous (feeding on hard-shelled prey) chelonionid sea turtle from the Upper Cretaceous (Maastrichtian) Quiriquina Formation of central Chile (SGO.PV.6504: Figs. 1–4). Previous reports of turtles from the Quiriquina Formation include just two other specimens: 1) a lower jaw of a durophagous chelonionid (Q/377; Gasparini and Biró-Bagóczky, 1986); 2) a durophagous turtle cranium (Karl et al., 1998) that was initially considered a chelonionid, then later referred to an extinct, otherwise entirely North American, freshwater clade (Karl and Tichy, 2002). The new specimen from the Quiriquina Formation described here gives us an opportunity to discuss some of the taxonomic issues surrounding durophagous chelonionid sea turtles in general and the turtles from the Quiriquina Formation in particular. The description of this skull also highlights emerging patterns of diversity and biogeography of the stem-chelonoid radiation across the K/P boundary.

*Institutional Abbreviations.* IGPS, Institut für Geologie und Paläontologie der Universität Salzburg, Austria; Q, Museo Paleontológico Lajos Biró, Departamento de Geociencias, Universidad de Concepción, Chile; SGO, Museo Nacional de Historia Natural, Chile.
Santiago, Chile; SFMF, Sammlungen des Forschungs instituts und Museums Senckenberg, Frankfurt, Germany.

2. Locality and geologic setting

SGO.PV.6504 was recovered near the village of Cocholgüe (−36.59444, −72.97778), a coastal hamlet located in the Biobío Region, 25 km N of Concepción, approximately 400 km South of Santiago, in central Chile (Fig. 1). The sedimentary rocks exposed along the coast north and south of Cocholgüe are Maastrichtian to Paleogene in age and include complete and well-exposed sections of the Quiriquina Formation (Biró-Bagóczky, 1982; Stinnesbeck, 1986). Cocholgüe was considered as the paratype locality of the Quiriquina Formation by Biró-Bagóczky (1982). The unit is comprised by a basal fossiliferous microconglomerate and cross-bedded yellow sandstone, directly overlying a paleo-cliff of Paleozoic slates. The basal transgressive sand and conglomerate horizon is between 1.5 and 2 m thick and contains marine invertebrates. The upper levels comprise bioturbated glauconitic sandstone and siltstone with sandy calcareous concretions that reach a thickness of 45 m (Fig. 2). The fossil-bearing level is placed in the upper portion of the unit, about 5 m below the erosive contact with the Curanilahue Formation of Eocene age. These are exposed during low tides, which causes rapid erosion of bones that are exposed on the surface. Vertebrates are common in the middle levels of the Quiriquina Formation, and are frequently associated with small banks of Cardium (Bucar- dium) acuticostatum d’Orbigny, 1842. The studied material was found 1 m away from the skeleton of Aristonectes quiriquinensis Otero, Soto-Acuña, O’Keefe, O’Gorman, Stinnesbeck, Suárez, Rubilar-Rogers, Salazar, and Quinzio-Sinn, 2014 recovered between 2001 and 2009. The removal of large boulders by the tsunami that affected central Chile on February 27, 2010 (Fritz et al., 2011) probably exposed SGO.PV.6504.

The Quiriquina Formation was initially considered to be Cam- panian–Maastrichtian in age based on abundant and diverse ammonoids and bivalves (e.g., Biró-Bagóczky, 1982), but subsequent revisions of the ammonoid assemblage refined the age to the Maastrichtian (Stinnesbeck, 1996) and then to the upper Maastrichtian (Salazar et al., 2010; Stinnesbeck et al., 2012).

3. Systematic paleontology

Testudines Batsch, 1788
Cryptodira Cope, 1868
Chelonioidea Baur, 1893
Pancheloniiidae Joyce, Parham, and Gauthier, 2004
Euclastes Cope, 1867
Euclastes sp.

Material. SGO.PV.6504 (Figs. 3 and 4), a nearly complete skull that was found ventral surface up. The ventral portion of the skull posterior to the triturating surface is highly eroded so the contacts and shapes of most of the basicranium are obscured. The skull roof is largely complete, but crushed.

Diagnosis. SGO.PV.6504 is a turtle skull that is readily identified as a durophagous pancheloniid based on its secondary palate that includes a vomer, maxillae, and premaxillae. SGO.PV.6504 can be diagnosed from Mexichelys coahuilaensis (Brinkman, Aquillen-

We follow Parham and Pyenson (2010) in recognizing just three valid species within the genus Euclastes: Euclastes platyops Cope, 1867, Euclastes acutirostris Jalil et al., 2009, and Euclastes wielandi (Hay, 1908). SGO.PV.6504 can be distinguished from Eu. platyops by its more blunt snout, relatively larger premaxillae (as seen in ventral view), and a transverse suture between the anteriormost portion of the palatines and maxillae in ventral view. SGO.PV.6504 can be distinguished from the recently described Eu. acutirostris by its more rounded snout and obvious depressions in the palate that would occlude with a horny rhamphotheca. It matches specimens of Eu. wielandi in the shape anterior skull and secondary palate, as well as the presence of a low tomial ridge and medial and labial grooves (Figs. 3 and 4) that correspond to the reception of a horny rhamphotheca as seen in IGPS Nr. 590/1 (Karl et al., 1998). The height of the tomial ridge and the shape of palatal bones vary among specimens of Eu. wielandi from the same horizon (see Taxonomy). The medial and labial grooves of SGO.PV.6504 are slightly more distinct than those seen on known specimens referred to Euclastes wielandi from either USA or Morocco (Hay, 1908; Zangerl, 1953; Karl et al., 1998; Hirayama and Tong, 2003) and so SGO.PV.6504 might be considered a new species. However, given our understanding of individual and ontogenetic variation in palatal characters (Parham and Pyenson, 2010), the limited specimens available for comparison, and the possibility that there may be an available name for Quiriquina durophagous stem chelonoids (see Taxonomy), we conservatively refer SGO.PV.6504 to “Euclastes sp.” pending further study.

Description. SGO.PV.6504 (Figs. 3 and 4) is an articulated cranium that includes a well-preserved palate, a mostly complete, but crushed, skull roof, and a damaged basicranium that is highly eroded. The total preserved length of SGO.PV.6504, including the damaged posterior extent of the supraoccipital, is 148 mm. The maximum width of the skull, measured at the level of the post-orbitals, is 125 mm. The preservation of the specimen is such that most of the sutures are difficult to ascertain; the anterior palate is an exception.

The triturating surface of the palate is mostly complete with some of the sutures visible. Like other durophagous stem cheloniids, SGO.PV.6504 has a broad upper triturating surface made up of the premaxillae, maxillae, vomer, and palatines. Where the bones are present, the sutures between them are discernible except for the contact between the right palatine and maxilla. Plates of

Fig. 2. Stratigraphic column for the Quiriquina Formation at Cocholgüe, Biobío Region, Chile showing the position of SGO.PV.6504.
Similarly, the lower beak would have included a medial ridge as evinced by a medial depression in the palate that extends from the premaxillae and along the length of the vomer. The jaw from the Quiriquina (Q/377; Fig. 5) shows a medial convexity that occluded with a medial ridge, which would have been emphasized in the feeding apparatus by the rhamphotheca. A medial ridge is seen in the dentaries of other durophagous stem cheloniids (Hay, 1908; de la Fuente et al., 2009; Parham and Pyenson, 2010), though none of those species show palatal depressions that are as distinct as in SGO.PV.6504. The result of these depressions on the triturating surface is the development of ventral convexities on the anteriomedial portions of the maxillae.

The premaxillae are not fused ventrally, and are narrow posteriorly where they form a broad contact with the anterior part of the vomer that is perpendicular to the midline. The vomer widens posteriorly until it contacts the medial suture of the palatines. Posterior to this contact it narrows to a point, a feature not seen in specimens referred to Eu. wielandi. The palatines form the lateral wall of the internal narial opening, and contact the maxillae laterally. There is a suture showing the contact between the right

Fig. 3. Photographs of SGO.PV.6504 in dorsal (A), ventral (B), lateral (C), anterior (D), and posterior (E) views. Scale bar = 50 mm. Abbreviations: frontal (fr), jugal (j), maxillae (mx), palatines (pal), parietal (pa), postorbital (po), prefrontal (prf), premaxillae (pmx), pterygoid (pt), supraoccipital (so), and vomer (v). Scale bar = 50 mm.
maxilla and right jugal ventrally, indicating that the jugal contributed to palate posterolaterally. It is not possible to determine whether the pterygoid also contributed to the triturating surface (as in Eu. acutirostris and some specimens of Eu. wielandi [Hirayama and Tong, 2003]). The floor of the orbit is preserved and on the right side, and a suture showing the contact of the prefrontal with the palatine is visible. Along the lower, lateral edge of the orbit, a contact between the maxilla and the jugal coincides with a crack. The contact between the jugal and the palatine is not visible.

Posterior to the triturating surface, the bones on the ventral portion of the skull surface are highly eroded. The outline of the basicranium is visible, although the pterygoids are largely missing. Instead, the majority of the outline is determinable through the exposed interior of the basisphenoid and the quadrates. At the posterior end of the ventral surface of the skull, fragmentary basioccipitals and exoccipitals are visible, as is the natural ventral surface of the supraoccipital that forms the dorsal rim of the foramen magnum.

The skull roof is largely complete, though crushed. Despite this crushing, the narrowness of the skull roof between the orbits indicates that the direction of the orbits included a dorsal component. The sutures in the anterior part of the skull roof are completely obscured. Between the orbits, the contact between the prefrontals and frontals is visible. The sutures are obscured along the dorsal rim of the orbit and so it is not possible to determine if the frontal reached the orbit, or if there is a contact between the prefrontal and the postorbital. Posterior to this, the contact of the left parietal with the left postorbital is preserved along a crack in the skull.

The posterior end of the skull roof is incomplete, but enough remains to show that temporal emargination was limited. The damaged posterior projection of the supraoccipital is preserved, but the posterior extent of the parietals is not visible. Although the sutures are largely obscured, scale sulci are visible. On the right side, the quadratojugal is identifiable by the curved natural surface of the roof of the cavum tympani (Figs. 3 and 4), which is facing laterally because of crushing.

4. Discussion

4.1. Taxonomy

Durophagous stem-cheloniiid sea turtles have a tortured taxonomic history because for decades many species were referred to the genus Osteopygis Cope, 1869 or incorrectly placed in the clade Osteopyginae Zangerl, 1953. Parham (2005) showed that Osteopygis was a chimera, and that the type specimen of Osteopygis (a partial shell) belongs to a freshwater turtle (a "macrobaenid"-grade basal cryptodire). The durophagous sea turtle skulls were mistakenly referred to Osteopygis because of combination of factors including: 1) the taphonomy of the type region (the Hornerstown Formation of New Jersey) results in mixed specimens; 2) mistakes made during the initial collection and curation of material (see Hay, 1908); 3) prior ignorance about "macrobaenids" (Parham, 2005). The situation was further obscured when Zangerl (1953) erected the Osteopyginae to include a chimeric Osteopygis and durophagous sea turtles from the Cenozoic of Europe with typically chelonioid postcrania. Since then, the association of durophagous sea turtles with Osteopygis or Osteopyginae became fully entrenched in the literature (e.g., Foster, 1980; Fastovsky, 1985; Weems, 1988; Hirayama, 1994; Parham and Fastovsky, 1997; Hirayama and Tong, 2003), including some recent papers that were published after Parham (2005; e.g., Bardet, 2012; Sato et al., 2012). With the exception of one study that provided no counter-argumentation or evidence (Tong et al., 2012), every study that cites Parham (2005) accepts the distinction between the chelonioid skulls and "macrobaenid" postcrania (e.g., Kear and Lee, 2006; Brinkman et al., 2009; Jalil et al., 2009; Brinkman, 2013). This distinction is confirmed by the discovery of former "osteopygines," i.e., durophagous stem cheloniiids, that have typical stem-cheloniiid postcrania (Zangerl, 1971; de la Fuente et al., 2009). Meanwhile, studies on non-marine turtles confirm that Osteopygis is one of a growing number of North American "macrobaenids" (Parham and Hutchison, 2003; Vandermark et al., 2009; Brinkman et al., 2010; Brinkman, 2013).
The recognition that Osteopygis is not a chelonioid necessitated nomenclatural changes for broad-skulled durophagous sea turtles. Parham (2005) recommended that all cranium-based species of former Osteopyginae be referred to the oldest available genus name, Euclastes. Later, Jalil et al. (2009) and Parham and Pyenson (2010) independently revisited this taxonomic act and suggested that multiple genera could be recognized because the former “Osteopyginae” incorporated distinct morphotypes. Any taxonomy is complicated by the fact that most specimens are too incompletely known to include in phylogenetic analyses and the potential for homoplasy is very high (Jalil et al., 2009). Parham and Pyenson (2010) provided a provisional character-based diagnosis of four genera: Euclastes, Glossochelys, Erquelinnesia, and Pacifichelys. We adopt that provisional scheme here and so refer SGO.PV.6504 to the genus Euclastes (see Diagnosis).

SGO.PV.6504 most closely matches Euclastes wielandi based on the overall shape of the skull, direction of orbits, and the arrangement and shape of the palatal bones (see Diagnosis). The comparison of specimens from a single horizon demonstrates that character associated with the feeding apparatus (palate and jaws) is susceptible to ontogenetic variation and individual differences. Zangerl (1953) first noted this variation among specimens of Eu. wielandi (then called Osteopygis) from the type region and synonymized some taxa that were based on cranial material. Hirayama and Tong (2003) noted the variation among specimens of Eu. wielandi from Africa. Other authors have noted variation among series of another durophagous stem chelonid (Pacifichelys, formerly Euclastes) from both North and South America (Lynch and Parham, 2003; Parham and Pyenson, 2010). The variation within a species of durophagous stem chelonid includes the shape of the vomer, the length of the triturating surfaces, the flatness of the jaw and palate, and the height of the tomial ridge. The variation in these latter two characters can emphasize an increased capacity for durophagy in larger, and presumably older, specimens (Parham and Pyenson, 2010). SGO.PV.6504 falls within the range of other specimens referred to Euclastes in the height of the tomial ridge (Zangerl, 1953; Karl et al., 1998; Hirayama and Tong, 2003). However, the convexity of the palate caused by the occlusal grooves is more pronounced than in other specimens referred to Euclastes. The vomer of SGO.PV.6504 is unique in that it appears to taper to an acute angle posteriorly, although breakage may be a factor. Given the variability in the shape of the vomer overall, it is debatable whether this character is sufficient to diagnose a new species. Additional skull material from the Quiriquina Formation may show that the posteriorly tapering ventral exposure of the vomer and the pronounced occlusal grooves are consistent among individuals, thereby justifying the recognition of a taxon distinct from Eu. wielandi. On the other hand, additional specimens could show that SGO.PV.6504 lies on one end of a continuum of morphologies that overlaps with known species and so should not be considered a distinct taxon. We want to avoid exacerbating the tortured taxonomic history of durophagous stem chelonids by participating in “taxonomic inflation” (Parham et al., 2006), and so refer SGO.PV.6504 to Euclastes sp. pending further study.

In addition to the uncertainty described above, another reason for taxonomic conservatism here is the possibility that even if the Quiriquina Euclastes is a distinct taxon from other Euclastes, it may have an available name. Australobaena chilensis Karl and Tichy, 2002 is based on a skull from the Quiriquina Formation (SMFM R 4151) that was originally identified as Osteopygis (i.e., Euclastes) by Karl et al. (1998). The original, identification is logical given the prior report of Osteopygis (i.e., Euclastes) from the Quiriquina Formation (Gasparini and Biró-Bágozky, 1986) as well as the described morphology of SMFM R 4151. Like other specimens referred to Euclastes, SMFM R 4151 has a broad upper triturating surface made up of the premaxillae, maxillae, vomer, and palatines. Moreover, the shape and relative proportions of the bones are typical of Euclastes. However, Karl and Tichy (2002) amended the identification of SMFM R 4151 and the jaw from the Quiriquina described by Gasparini and Biró-Bágozky (1986) to a new genus and species, Australobaena chilensis. They surprisingly assigned A. chilensis to an otherwise entirely North American clade of freshwater turtles (Baenidae Cope, 1882). They justified this decision with new data on the morphology of SMFM R 4151 presented in drawings. Because of taxonomic priority, the status of Australobaena chilensis is important for understanding the Quiriquina turtle specimens. But at the present time, it is difficult to determine the validity of Australobaena chilensis without additional data on SMFM R 4151. At the very least, the discovery of SGO.PV.6504 casts doubt in the referral of the jaw (Q/377) to the Baenidae, while reaffirming the original identification by Gasparini and Biró-Bágozky (1986) of this element as Euclastes (formerly “Osteopygis”).

Fig. 5. Dorsal and ventral views of a lower jaw (Q/377) from the Quiriquina Formation described by Gasparini and Biró-Bágozky (1986). Scale bar = 50 mm.
4.2. Biogeography

Extant cheloniid sea turtles (the crown) share a common ancestor in the Cenozoic (Parham and Pyenson, 2010). The stem of Cheloniidae extends into the Cretaceous Western Interior Seaway (WIS) of North America when and where they diverged from the lineage leading to leatherback (*Dermochelys coriacea* [de Blainville, 1816]) (Joyce, 2007; Joyce et al., 2013). This scenario is based on the exclusion of the Protostegidae Cope, 1872 from Chelonioidea following Joyce (2007) and Joyce et al. (2013). Protostegids are an early, diverse, and widespread clade of sea turtles that is traditionally placed on the stem of *D. coriacea*. Studies that place protostegids within the crown are based on phylogenetic matrices that are dominated by marine-adapted taxa thereby forcing sea turtle monophyly and/or maintain significant conflicts with well-established molecular results on other parts of the tree (e.g., Hirayama, 1998; Kear and Lee, 2006; Bardet et al., 2013; Tong and Meylan, 2013). Whereas the results of those studies require complex biogeographic and stratigraphic explanations, the American origin of chelonioids presented above is biogeographically and stratigraphically consistent with the origin of their closest relatives, chelydrids and kinosternoids (Joyce et al., 2013). This latter, more consistent, pattern is why Joyce et al. (2013) coined the name ‘Americhelydia’ for the clade that includes chelonioids, chelydrids, and kinosternoids. Non-marine americhelydians are restricted to North America until the Cenozoic (Danilov, 2005; Cadena et al., 2012), but by the end of the Cretaceous, chelonioids, including stem cheloniids, had dispersed out of the WIS to the coasts of other continents.

The most obvious pattern associated with the dispersal of stem-cheloniids out the WIS is the widespread appearance of *Euclastes* in the Maastrichtian. In addition to the Chilian records, *Euclastes* is known from both coasts of North America and two sites in Africa (Fig. 6; Foster, 1980; Fastovsky, 1985; Gmira, 1995; *Maastrichtian fide Jalil et al., 2009*; Hirayama and Tong, 2003; Jalil et al., 2009). Scale bar = 3000 km. (Maps licensing information: http://www.mapresources.com/license).

![Fig. 6. Maps showing the general localities of *Euclastes* (sensu stricto) during the Maastrichtian (left) and Paleocene (right). 1) Eastern USA (Aquia, Hornerstown, and Vincentown Formations; Cope, 1867; Hay, 1908; Zangerl, 1953; Weems, 1888); 2) California, USA (Moreno Formation; Foster, 1980); 3) Chile (Quiriquina Formation; Gasparini and Biró-Bagóczky, 1986; This study); 4) Angola (Mucuio Formation; Mateus et al., 2012); 5) North Africa (Phosphates; Gmira, 1995; *Maastrichtian fide Jalil et al., 2009*; Hirayama and Tong, 2003; Jalil et al., 2009). Scale bar = 3000 km. (Maps licensing information: http://www.mapresources.com/license).](image-url)

Continents. The discovery and description of additional turtle material from Maastrichtian sites will undoubtedly refine or alter that pattern and the biogeographic pattern presented here, potentially expanding our knowledge about the distribution of other taxa. In addition to the sites listed above, fragmentary cf. stem-cheloniid fossils are known from Maastrichtian sites in Egypt (de Lapparent de Broin and Werner, 1998), Syria (Bardet et al., 2000), and Jordan (Bardet and Pereda-Suberbiola, 2002). The reports of these specimens demonstrate the high potential for future finds that could contribute new data to Maastrichtian stem-cheloniid biogeography.

*Euclastes* is widespread compared to its WIS predecessors, with one species, *Eu. wielandi*, known from North America and Africa (Parham, 2005). Even so, *Euclastes* lacks the cosmopolitan distribution of most extant sea turtles. Jalil et al. (2009) explained this by referring to the locomotory apparatus of *Euclastes*, but that discussion is complicated by reference to postcranial material that is either inadequately described or referable to other durophagous stem chelonoids (Hay, 1908; Zangerl, 1953, 1971). In fact, the limb material of *Euclastes* is not known. An isolated humerus from the Maastrichtian of Egypt (de Lapparent de Broin and Werner, 1998) shows that panchelonids with derived locomotory capabilities existed at that time.

*Euclastes* crosses the K/Pg boundary, appearing in the Paleocene of North America, Africa, and Europe. One species, *Eu. wielandi*, is known from both Cretaceous and Paleocene sites (Parham, 2005). In contrast to the Maastrichtian, in the Paleocene, non-*Euclastes* stem-chelonids are known from multiple species and continents (Tasbacka Nessov, 1986; Tong and Hirayama, 2002) and *Eryquelnesia* (Zangerl, 1971; de la Fuente and Casadío, 2000; see Parham and Pyenson, 2010). And in contrast to its apparent ubiquity in the Maastrichtian, the Paleocene has stem-chelonoid bearing sites that do not include *Euclastes* (Zangerl, 1971; de la Fuente and Casadío, 2000; Tong and Hirayama, 2002). By the Eocene, the stem-chelonoid radiation is in full flower and several genera are known from sites around the world (de Lapparent de Broin, 2000; Danilov, 2005; Parham and Pyenson, 2010). Lynch and Parham (2003) report ‘Euclastes’ from two Eocene sites; one of these records has been assigned to the genus *Glossochelys* by Parham and Pyenson (2010) and the other is based on unpublished material of uncertain age (de Lapparent de Broin, 2000); it may have later appeared as *Eu. acutirostris* from the Paleocene [Jalil et al., 2009]). Given the current data, we consider the stratigraphic range of *Euclastes* to be from the latest Cretaceous to the Paleocene (Maastrichtian to Thanetian) and restricted to the Americas and Africa.
5. Conclusions

A new skull of *Euclastes* (SGO.PV.6504) from the Upper Cretaceous of Chile confirms the previous report of stem-chelonian sea turtles from the Quiriquina Formation. Although SGO.PV.6504 lies outside the range of variation of other known specimens, we refrain from describing a new species pending additional data, especially from the other known turtle skull from the Quiriquina formation ([*Australoabana chilensis*]. Revisions to the taxonomy of durophagous stem cheloniids ([Lynch and Parham, 2003; Parham and Pyenson, 2010] combined with the reporting of new material (e.g., [Mateus et al., 2012]) reveal an emerging pattern of *Euclastes* biogeography. *Euclastes* dominates Maastrichtian stem-chelonid localities, crosses the K/Pg boundary, and eventually goes extinct at the end of the Paleocene as the stem-chelonid radiation accelerates.

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References


