

## THE AQUATIC SLOTH *THALASSOCNUS* (MAMMALIA, XENARTHRA) FROM THE LATE MIOCENE OF NORTH-CENTRAL CHILE: BIOGEOGRAPHIC AND ECOLOGICAL IMPLICATIONS

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Sloths are one of the most conspicuous groups of the mammalian fauna of South America. They were widely distributed and extremely diversified in terrestrial environments from the Oligocene to the Pleistocene (Hoffstetter, 1982). Modern sloths are restricted to an arboreal life style in neotropical forest (Mendel, 1981), but many different habits have been inferred for fossil ground sloths. These include arboreality (Pujos et al., 2007), fossoriality (Bargo et al., 2000), and scavenging (Fariña and Blanco, 1996). In addition to these terrestrial habits, an aquatic ecology has been suggested for the nothrotheriid *Thalassocnus* of the late Miocene-Pliocene Pisco Formation in the Sacaco area, Peru (Muizon and McDonald, 1995). *Thalassocnus* remains are found associated with whales, dolphins, seabirds, crocodiles, bony fishes, sharks and rays in sediments corresponding to a nearshore marine environment. (Muizon and DeVries, 1985). Five species of *Thalassocnus* are currently recognized (McDonald and Muizon, 2002; Muizon et al., 2003, 2004a). These include *T. antiquus* (late Miocene), *T. natans* (latest Miocene), *T. littoralis* (early Pliocene), *T. carolomartini* (early late Pliocene), and *T. yaucensis* (late Pliocene). Morphological analysis provides evidence of feeding and locomotor adaptations of the *Thalassocnus* 'lineage' to an aquatic environment (e.g., Muizon et al., 2003, 2004b).

In north-central Chile, the late Miocene marine deposits of the Bahía Inglesa Formation resemble the vertebrate faunal composition, to Pisco Formation (Walsh and Naish, 2002). In 2002, a partial mandible of *Thalassocnus* (SGO.PV 1093) was found in the Bahía Inglesa Formation from the Caldera area (Canto, Yáñez, and Cozzuol, 2002). This record is more than 1600 km south of Sacaco area. It represents the first non-Pisco Formation remains of *Thalassocnus* and provides evidence of a wider and more complex offsetting for the evolution of the genus. Biogeographical and ecological interpretations based on the new data are discussed below, and the discovery of *Thalassocnus* and associated fauna allow us to provide new supporting data for the late Miocene age of the Bahía Inglesa Formation.

The Chilean specimen of *Thalassocnus* sp. (SGO.PV 1093) is housed in the Museo Nacional de Historia Natural, Santiago, Chile. This specimen was compared with *Thalassocnus antiquus* (MUSM 228, holotype), *T. natans* (MNHN SAS 734, holotype; MUSM 433), *T. littoralis* (MUSM 1033; MUSM 223, formerly referred to *T. natans* in Salas et al., 2005), *T. carolomartini* (MNHN SAO 203), and *T. yaucensis* (MUSM 37, holotype;

MUSM 1034). Measurements of SGO-PV 1093 were made to a tenth of millimeter using analog calipers.

**Institutional Abbreviations**—**MNHN SAO**, Sacaco collection of the Muséum national d'Histoire naturelle, Paris, France; **MNHN SAS**, Sacaco Sur collection of the Muséum national d'Histoire naturelle, Paris, France; **MUSM**, Departamento de Paleontología de Vertebrados, Museo de Historia Natural de la Universidad Nacional Mayor de San Marcos, Lima, Perú; **SGO.PV**, Colección de Paleontología de Vertebrados del Museo Nacional de Historia Natural, Santiago, Chile.

### GEOGRAPHIC SETTING, GEOLOGY, AND AGE

The Bahía Inglesa Formation, in the arid Caldera region, was described by Rojo (1985) and corresponds to a marine transgression on the northern-central coast of Chile (Fig. 1A) during the middle Miocene-early Pliocene (Marquardt et al., 2000). The type section is exposed in the inland of the Bahía Inglesa area and several outcrops dot the surrounding ravines that reach the sea (Fig. 1B). These fossiliferous deposits consist of 42 m of siltstones, fine sands, shelly coquinas, pebble beds, and a phosphatite (Walsh and Hume, 2001). Three stratigraphic sequences can be recognized of which the second is the well-known phosphatite bonebed (Unit 2, of Walsh and Hume, 2001) that bears a broad variety of marine fossil vertebrates (Walsh, 2002). The uppermost sequence is the sand and siltstone Lechero Member (Unit 3 of Walsh and Hume, 2001). SGO.PV 1093 was found in a small section of the Lechero Member located on private property 6 km northeast of the city of Caldera (Fig. 1B). The locality, known as 'Estanques de Copec' (EDC), includes at least one hectare of well exposed outcrops of this member with beds containing shark teeth and cetacean remains.

Different lines of evidence imply either an early Pliocene or late Miocene age for the Lechero Member. Planktonic foraminifera found in this sequence indicate an age of 4.5–2.6 Ma and 4.8 Ma (Ibaraki, 1995; Marchant et al., 2000) whereas the malacofauna generally suggests a late Miocene age (Guzman et al., 2000; DeVries, pers. comm., 2007). Based on the presence of the shark *Carcharodon carcharias*, but never *Cosmopolitodus* (= *Isurus*) *hastalis*, the Lechero Member had been constrained to the Pliocene (Long, 1993; Walsh and Hume, 2001; Walsh and Naish, 2002). However, during field work in EDC, one of us (JC) collected some shark teeth belonging to *C. (=I.) hastalis*, which had been shown to be an indication of Miocene horizons in the Pisco Formation (Muizon and DeVries, 1985). Additionally, anatomical characters of the *Thalassocnus* species from Chile

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