

# New record of snakes from the Cretaceous of Patagonia (Argentina)

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Albino A. M. 2000. — New record of snakes from the Cretaceous of Patagonia (Argentina).  
*Geodiversitas* 22 (2) : 247-253.

## KEY WORDS

Cretaceous,  
Serpentes,  
Madtsoiidae,  
?Boidae,  
*incertae sedis*,  
Patagonia,  
paleobiogeography.

## ABSTRACT

New remains of snakes from the Late Cretaceous (La Colonia Formation; Campanian-Maastrichtian) of Argentina increase the record of the earliest Patagonian snakes. They include the southernmost record of the madtsoiid snake *Alamitophis*, another probable madtsoiid, perhaps a boid, and a snake *incertae sedis*.

## MOTS CLÉS

Crétacé,  
serpents,  
Madtsoiidae,  
?Boidae,  
*incertae sedis*,  
Patagonie,  
paléobiogéographie.

## RÉSUMÉ

*De nouveaux restes de serpents du Crétacé supérieur de Patagonie (Argentine).*  
De nouveaux restes de serpents du Crétacé supérieur (Formation La Colonia ; Campanien-Maastrichtien) d'Argentine sont décrits. Ils comprennent le représentant le plus austral du madtsoïidé *Alamitophis*, un autre probable madtsoïidé, peut-être un Boidae et un serpent *incertae sedis*.

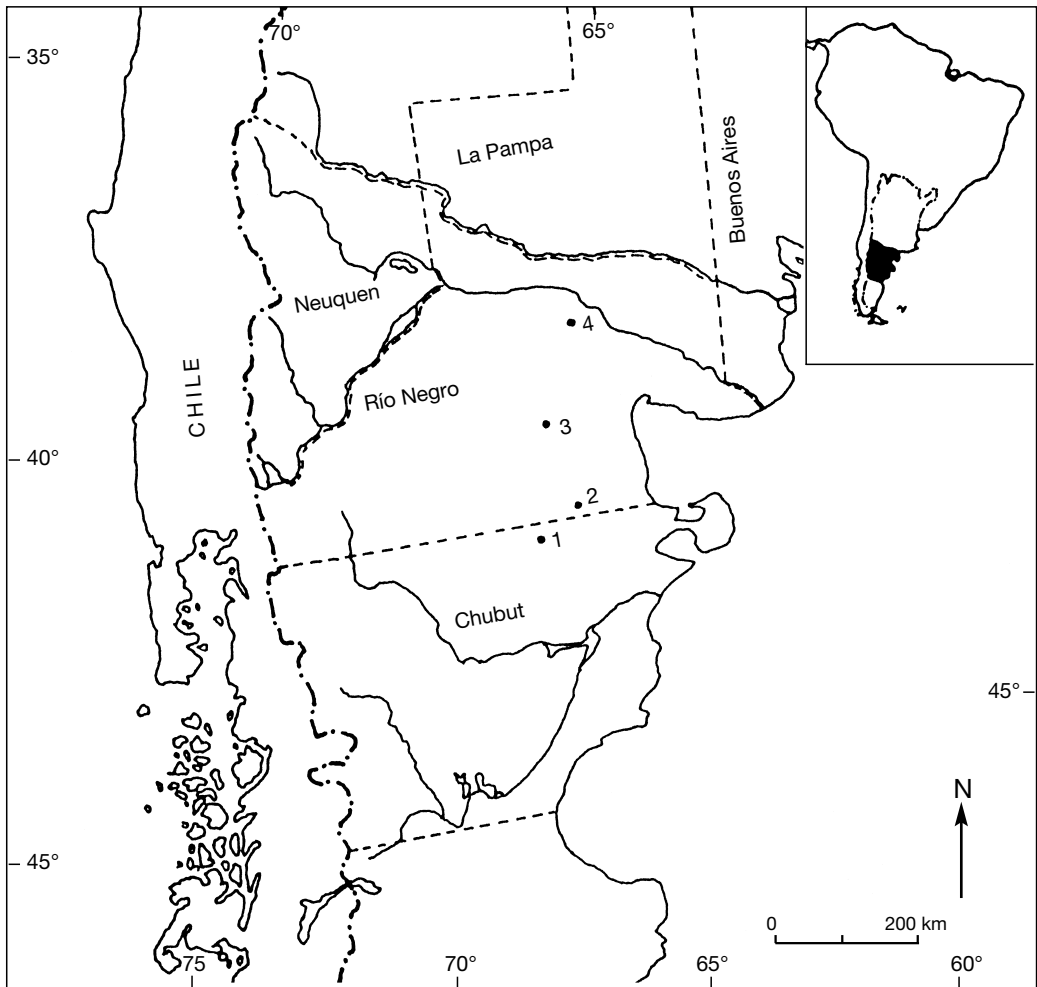


FIG. 1. — Localities. 1, eastern slopes between El Buitre Chico and El Buitre hills, La Colonia area, “Comarca Norpatagónica”. Second facies association of the La Colonia Formation (Campanian-Maastrichtian age); 2, Cerro Cuadrado, Arroyo Verde, middle section of the Los Alamos Formation (Campanian age, Bonaparte 1996); 3-4, other Late Cretaceous Patagonian localities bearing remains of *Alamitophis argentinus*; 3, El Palomar; 4, Bajo Trapalcó.

INTRODUCTION

According to previous records, Cretaceous Patagonian snakes include Dinilysiidae, Madtsoiidae and Boidae (Albino 1996). During the last years, expeditions from both the Museo de La Plata (MLP) and the Museo Paleontológico “Egidio Feruglio” in Trelew (MPEF) to the southern slopes of the North Patagonian massif (“Comarca Norpatagónica”) in North-central Chubut prov-

ince have permitted to recover vertebrate remains from the middle portion of the second facies association of the La Colonia Formation (Pesce 1979), Campanian-Maastrichtian age (Pascual *et al.* in prep.). The vertebrates come from the eastern slopes of the La Colonia area, between El Buitre Chico and El Buitre hills (approximately between 42°55’S, 43°02’S and 67°28’W, 67°41’W) (Fig. 1). The second facies association of the La Colonia Formation is interpreted as

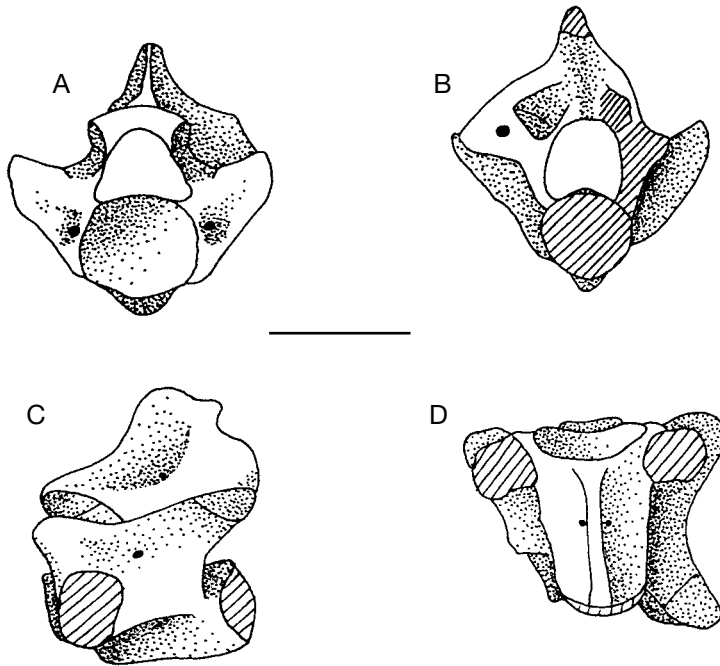


FIG. 2. — MPEF-PV 643, *Alamitophis argentinus*, trunk vertebra. **A**, anterior view; **B**, posterior view; **C**, lateral view; **D**, ventral view. Scale bar: 5 mm.

having been deposited in an estuary, tidal flat or coastal plain environment, influenced both by occasional high fresh water streamflow from the continent and tidal currents from the sea (Pascual *et al.* in prep.). Most of the collected vertebrates (fishes, turtles, crocodiles, plesiosaurs, dinosaurs, snakes and mammals) come from this second facies association (Pascual *et al.* in prep.). The aim of this paper is to describe the first snake remains proceeding from that locality.

## SYSTEMATICS

Order SERPENTES Linnaeus, 1758

Suborder ALETHINOPHIDIA Nopcsa, 1923

Family MADTSOIIDAE Hoffstetter, 1961

The monophyletic madtsoiid snakes are recorded from the Cretaceous to the Pleistocene, but in South America they have only been recorded up

to the Eocene (Albino 1996). Their mid-trunk vertebrae have a unique true derived feature: presence of parazygantral foramina. They are also characterized by the presence of paracotylar foramina, the synapophyses located low from the centrum and the absence of prezygapophysial processes (Albino 1996).

Genus *Alamitophis* Albino, 1986

*Alamitophis argentinus* Albino, 1986

(Fig. 2)

MATERIAL EXAMINED. — MPEF-PV 643, trunk vertebra.

## REMARKS

The specimen is characterized by its small size, high and wide neural arch, high and thick neural spine, thin zygosphenes without a median lobe, parazygantral and paracotylar foramina present, high neural canal, zygapophyses located at a high level and inclined above horizontal, prezyga-

pophysial process absent, moderately elongate and anteriorly not widened vertebral centrum, distinctive haemal keel and large and wide cotyle.

Family ?MADTSOIIDAE

MATERIAL EXAMINED. — MPEF-PV 641, MPEF-PV 644 and MPEF-PV 645, incomplete vertebrae.

REMARKS

The parazygantral foramina are not visible in these specimens because the postzygapophyses are broken, therefore the remains are tentatively referred to madtsoiids due to the general constitution and the absence of prezygapophysial processes. MPEF-PV 641 is an incomplete vertebra characterized by its large size, wide neural arch, short and anteriorly widened vertebral centrum, small neural canal, thick zygosphene, prezygapophyses inclined above horizontal, prezygapophysial processes absent, large and rounded cotyle, lateral, subcentral and paracotylar foramina present, synapophyses located low from the centrum, and haemal keel developed. MPEF-PV 645 is a large fragment with the right prezygapophysis and part of the right postzygapophysis. It is attributed to the same taxon as MPEF-PV 641 specimen. Its centrum is wide, short and anteriorly widened, with developed haemal keel, prezygapophysial process absent and a very small paracotylar foramen on the right side of the large cotyle. Both MPEF-PV 641 and MPEF-PV 645 vertebrae are very different to those of other cretaceous madtsoiids of Patagonia. MPEF-PV 644 is a left prezygapophysis characterized by the absence of prezygapophysial process and the presence of paracotylar foramen.

Family ?BOIDAE or MADTSOIIDAE

MATERIAL EXAMINED. — MPEF-PV 646, MPEF-PV 647, MPEF-PV 648 and MPEF-PV 649, incomplete vertebrae.

REMARKS

These specimens cannot be accurately determined due to their fragmentary preservation. Zygapophyses, synapophyses and posterior part

of the neural arch are not completely preserved in the most complete specimen (MPEF-PV 646). It is a medium-sized vertebra and it has an elongate and narrow vertebral centrum, wide neural arch, large cotyle, thick and narrow zygosphene, left prezygapophysis located at a high level and inclined above the horizontal, and paracotylar foramina present. It is not possible to see whether there is a prezygapophysial process; however, the vertebra is rather distinct from all other vertebrae described in this paper. MPEF-PV 647 is a thick and large zygosphene reminiscent to that of large boids or madtsoiids. Other remains (MPEF-PV 648 and 649) are extremely fragmentary and tentatively assigned to boid or madtsoiid.

Order SERPENTES *incertae sedis*  
(Fig. 3)

MATERIAL EXAMINED. — MPEF-PV 642, trunk vertebra.

REMARKS

It is a small, narrow, rather depressed and elongated vertebra. It has no marked median notch in the posterior border of the neural arch. This is a plesiomorphic state in snakes. The roof of the neural arch is depressed in posterior view. The neural spine is long, inclined and posteriorly thick. The zygapophysial plane is located at a high level and the prezygapophysial facets are clearly slanting like in primitive snakes. There is not a true prezygapophysial process (plesiomorphic state), although there is an expansion under the prezygapophysial articular facets and the vertebra is wider at that level. The postzygapophyses are at a higher level than the prezygapophyses. The thin zygosphene is narrower than the cotyle, it is elevated at a medium level and its roof is not notched. The neural canal is large. The subcentral ridges of the vertebral centrum are not well defined and anteriorly the centrum is not significantly widened. There is not a marked haemal keel. The cotyle is large, wider than high and there are no paracotylar foramina. The subcentral and lateral foramina are present. The combination of characters in the fossil has not been found in any known snake, however, it is not conven-

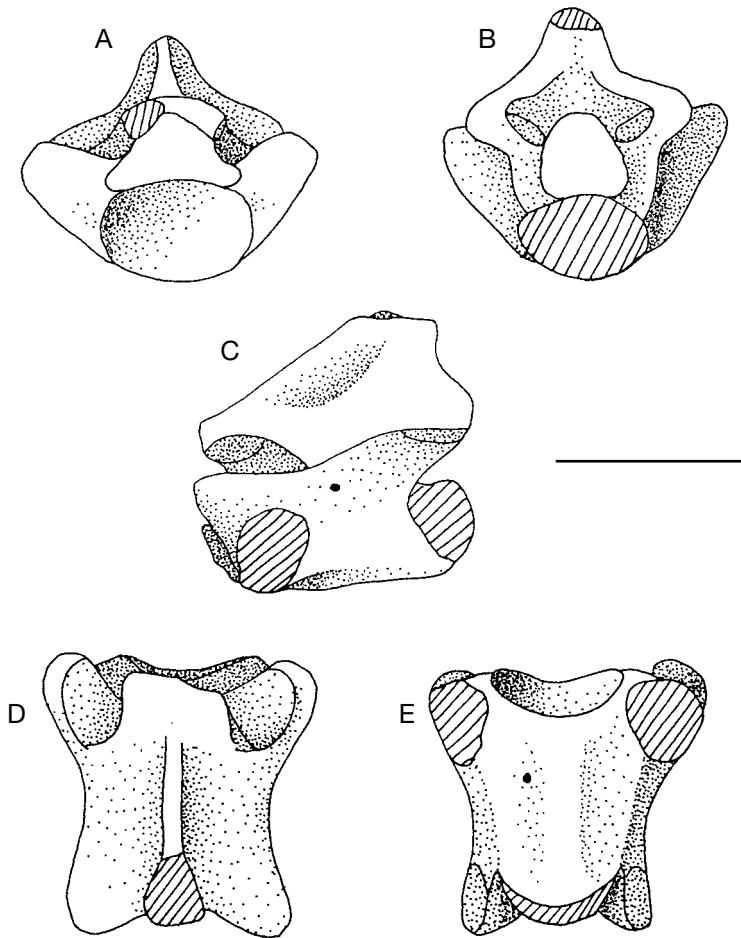


FIG. 3. — MPEF-PV 642, Serpentes *incertae sedis*, trunk vertebra. **A**, anterior view; **B**, posterior view; **C**, lateral view; **D**, dorsal view; **E**, ventral view. Scale bar: 3 mm.

ient to designate a new taxon because at the moment there is a unique preserved vertebra.

## DISCUSSION

The primitive fossil snake *Dinilyisia patagonica* Woodward, 1901 from the Late Cretaceous of Patagonia and the distribution of extant primitive alethinophidians in Gondwanan areas suggest that a great diversity of primitive snakes lived in Gondwana (Underwood & Stimson 1990). Earliest distribution of madtsoiids and boids and their Cretaceous-Paleogene South American

record (Albino 1996) support this opinion. The *incertae sedis* snake vertebra discovered at the La Colonia Formation (see this paper) corroborates that idea because it has common features with the most primitive snakes. That indicates that South America played an important role in the early radiation of snakes.

According to the record, madtsoiids and boids were common in the Patagonian Cretaceous-Paleogene land communities (Albino 1996). The oldest boids in South America come from the middle section of the Los Alamos Formation (Campanian, Bonaparte 1996) in the locality of Cerro Cuadrado, Río Negro province, Argentina

(Fig. 1) (Albino 1996). High and wide neural arches without parazygantral foramina and depressed neural arches with thin zygosphenes have been observed (Albino 1990). These remains are very poorly preserved therefore they have not been described. The probable Boidae of the La Colonia Formation, North-central Chubut province (Fig. 1) (see this paper) also suggests that the oldest South American boids come from the Campanian-Maastrichtian age of Patagonia.

On the other hand, the most diverse and abundant fauna of madtsoiids from the Cretaceous to the Eocene comes from Patagonia (Albino 1986, 1993, 1994, 1996). Three well-diagnostics Cretaceous madtsoiids come from the middle section of the Los Alamitos Formation, in Cerro Cuadrado, Río Negro province (Fig. 1): *Alamitophis argentinus* Albino, 1986, *Alamitophis elongatus* Albino, 1994 and *Patagoniophis parvus* Albino, 1994. The first species is also recognized in the Late Cretaceous localities of Bajo Trapalcó and El Palomar (Fig. 1). *A. argentinus* is at the moment the unique species common to La Colonia and Los Alamitos Formations herpetofaunas. This record confirms the presence of that species during the Campanian-Maastrichtian age of Patagonia and it is the southernmost record of the genus.

Other probable madtsoiid remains from the La Colonia Formation (see this paper) are greater than those of the small *Alamitophis* Albino, 1986 and *Patagoniophis* Albino, 1986. They represent a probable third madtsoiid genus from the Late Cretaceous of South America. Therefore, the snakes from the La Colonia Formation include at least four taxa: the small madtsoiid *Alamitophis argentinus*, a large-sized probable madtsoiid, a probable boid and a snake *incertae sedis*.

*Alamitophis* and *Patagoniophis* are also recorded from the early Eocene of Australia (Scanlon 1993) supporting the Gondwanan origin of the madtsoiid family (Albino 1986, 1994). *Alamitophis* and *Patagoniophis* distribution evidences a faunal continuity between the Australian continent and southern South America (Scanlon 1993). The proximity between Antarctica, Australia and Patagonia during the Cretaceous-

Tertiary transition resulted in a broad area where land vertebrates were distributed, including snakes. This presumption is also supported by the discovery of monotremes of late early Palaeocene age in Patagonia (Pascual *et al.* 1992), and the hypothesis (based on a cladistic analysis of 17 taxon cladograms) that the biotas of southern South America, Australia, Tasmania, New Guinea, New Caledonia and New Zealand constitute a monophyletic group (Crisci *et al.* 1991).

### Acknowledgements

The author is grateful to Rosendo Pascual (MLP) and Ruben Cúneo (MPEF) for the loan of the specimens, and to both reviewers, Jean-Claude Rage and Zbigniew Szyndlar, for their helpful comments. The field work was supported by a grant to R. Pascual from the CONICET (PMP-PICT 0227). Carmen Milloc (UNMDP) drew Figure 1.

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*Submitted for publication on 25 March 1999;  
accepted on 9 July 1999.*