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WHAT IS THE MOST GIANT SAUROPOD FROM ARGENTINA?

Diversity of large titanosaurs from Patagonia

Jorge Orlando Calvo[1]

This work's intent is to establish which was the most giant titanosaurid sauropod from Argentina. The evidence is scarce; however, we have tried to select the largest bones of the nine most giant titanosaurids. *Argentinosaurus* has been proposed as the largest titanosaurid, but recently a new king has been erected: the *Patagotitan*. In this review, we will see that there are some inconsistences and difficulties to define which is the largest. In other words, giant titanosaurids were a group of sauropods with a variable morphology and probably the overall shape was different. Among the largest titanosaurids, we have included *Argyrosaurus superbus*, *Antarctosaurus giganteus*, *Argentinosaurus huinculensis*, *Puertasaurus reuili*, *Futalognkosaurus dukei*, *Traukutitan eocaudata*, *Dreadnoughtus schrani*, *Notocolossus gonzalezparejasi*, and *Patagotitan mayorum*.

Keywords: **sauropods**, **titanosaurids**, **Argentina**, **Cretaceous**, **Patagonia**.

In the last 50 years, giant dinosaurs have been of great interest for both the science community and the media. The reason is clear: humans are fascinated with giant things or animals, which makes dinosaurs very important because they were the largest terrestrial animals that ever lived on Earth. Among them, sauropods were the kings. Giant sauropod fossils are widespread over the world but in the last 20 years, many of the largest ones come from Argentina and all of them belong to the Titanosauria clade. Titanosaurs were a group of derived Titanosauriform sauropodomorphs that lived during the Cretaceous, mainly from Aptian to Maastrichtian times (120 to 66 million years ago). Up to now more than 70 titanosaurian species have been recognized in South America and here we have selected nine of the most gargantuan.

«Humans are fascinated with giant things or animals, which makes dinosaurs very important because they were the largest animals that ever lived on Earth»

Usually, the skeletons of large-bodied animals are (have always been) quite easily destroyed during the process of biostratinomy and diagenesis (exposure and burial). We know that the larger the dinosaur, the less evidence we tend to find, because predators find big dead animals easily and destroy most of the body. Therefore, most of the largest skeletons found are fragmentary; we usually preserve a few bones, and even fewer skull

[1] Córdoba, Argentina (27 April 1961) – Neuquén, Argentina (10 January 2023). The author passed away during the preparation of this article. The last corrections and adaptations of the text were made by the coordinator of the monograph, Dr. Luis Alcalá, and by Metode SSJ's editorial team, following the observations of the anonymous reviewers and respecting the original spirit of the text.

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elements. When we try to estimate the body size for each taxon with certainty, there is not enough evidence; in other words, body size is merely tentative, because most of these taxa are represented only by partial fragmentary remains. Paul (2019) tried to measure the body mass using modeling and evidence from some bones such as dorsal vertebrae, humeri, and femora; in this paper, we use data from these bones to have an idea of body volumes. In this review, to select the biggest titanosaurid, we will choose, if available, those with femora longer than 180 cm.

Nevertheless, well-preserved giant animals are scarce, an exception being the nearly complete single specimen of *Futalognkosaurus*. All of the larger sauropods in South America come from Argentina; they are: (1) *Argyrosaurus superbus*, (2) *Antarctosaurus giganteus*, (3) *Argentinosaurus huinculensis*, (4) *Puertasaurus reuili*, (5) *Futalognkosaurus dukei*, (6) *Traukutitan eocaudata*, (7) *Dreadnoughtus schrani*, (8) *Notocolossus gonzalezparejasi*, and (9) *Patagotitan mayorum*.

WHAT EVIDENCES IS AVAILABLE FROM THE MOST GIANT SAUROPODS IN ARGENTINA?

Incredibly, when we think about giant sauropods, we talk about recent discoveries, mostly due to global media information. However, the oldest record of a giant sauropod in the world is *Argyrosaurus superbus* (Lydekker, 1893). It was discovered by Florentino Ameghino in 1888 and restudied by Mannion and Otero (2012). The holotype was found on the left bank

Courtesy of Lucas Fiorelli

Figure 1. The earliest record of a giant sauropod is *Argyrosaurus superbus*. It was discovered by Florentino Ameghino in 1888. Its femur probably exceeded 180 cm. In the picture, a representation of this species.

«Establishing which is the largest titanosaurid from Argentina is quite difficult because only three taxa have relatively complete skeletons»

ARGYROSAURUS SUPERBUS	
Systematic	Titanosauria
Site and province	Río Chico, Chubut
Formation	Bajo Barreal
Age	Upper Cretaceous
Material	Humerus, ulna, radius, probably two carpals (now lost), and all five metacarpals.
Environment	Fluvial
Authors	Lydekker (1893)
Notes	The name means 'proud silver reptile', from the Greek *argyros* ('silver') and *saurus* ('reptile') and from the Latin *superbus* ('proud').

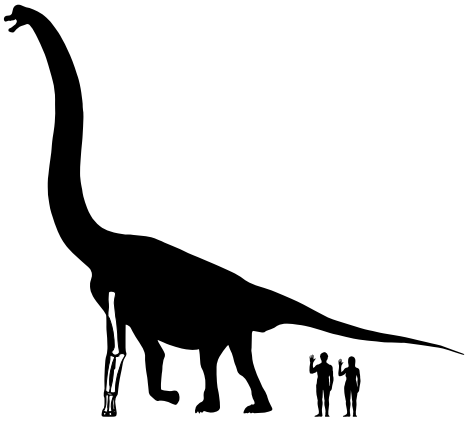

Table 1. *Argyrosaurus superbus*, general information.

of the Chico River, Chubut Province. *Argyrosaurus* is not the largest specimen today (Figure 1, Table 1), but it is big enough to be included in the list of giant titanosaurids, weighing around 25 tons, and having a 137-cm-long humerus and a 96.5-cm-long ulna (Table 10); the latter is larger than that of *Futalognkosaurus dukei*. Therefore, the femur was probably more than 180 cm long.

Beginning in the 20th century, Von Huene (1929) described the giant *Antarctosaurus giganteus* from Aguada del Caño, a municipality located 22 km west of Neuquén capital (Table 2), Neuquén Province. The materials are in poor shape, but the most impressive bones are the two femurs, one of them measuring 231 cm (Figure 2). The preserved pubis, lacking some of the proximal parts, is 145 cm wide (Table 10). With these dimensions, *Antarctosaurus* should be one of the largest sauropods, with a body weight of around 69 tons (Mazzeta et al., 2004).

In 1989 a paleontological team including Dr. Jose Bonaparte and Dr. Jorge Calvo of the National University of Comahue and Dr. Leonardo Salgado from the Cipolletti Museum excavated one of the largest titanosaurid sauropods (Figure 3) from the Huincul formation – probably, the most famous around the world, *Argentinosaurus huinculensis* (Bonaparte & Coria, 1993). It was discovered by a local farmer 5 km east of Plaza Huincul city, Neuquén Province (Table 3). The longest bone is the fibula (155 cm) described originally as a tibia. The widest neural arch on anterior dorsal vertebra is 126 cm wide (Figure 4). At the time the taxon was discovered, it was the largest dinosaur in the world and it was ruled

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Figure 2. Holotype of *Antarctosaurus giganteus* in the La Plata Museum (Argentina). This species would have been one of the largest sauropods, with a body weight of about 69 tons.

«In the last 20 years, many of the largest sauropods come from Argentina and all of them belong to the Titanosauria clade»

ANTARCTOSAURUS GIGANTEUS	
Systematic	Titanosauria
Site and province	Aguada del Caño, Neuquén
Formation	Plottier, Neuquén Group
Age	Upper Cretaceous (Campanian/Maastrichtian)
Material	Two femora, a partial pubis, distal end of tibia and two caudal vertebrae.
Environment	Fluvial
Authors	Von Huene (1929)
Notes	The name means 'giant reptile from the south', referencing its large size.

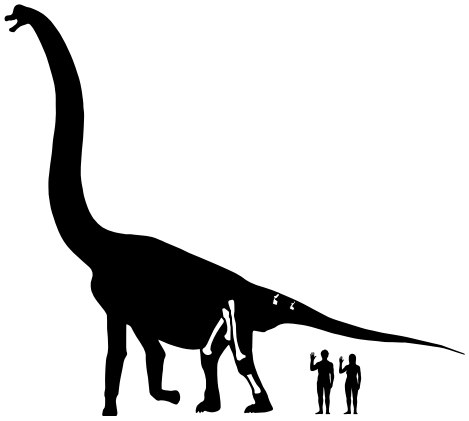


Table 2. *Antarctosaurus giganteus*, general information.

as that for almost 20 years. The supposed weight is around 70 tons (according to Paul, 2019) or 73 tons (Mazzeta et al., 2004).

At the beginning of the 21st century, many other discoveries increased the number of giant titanosaurid sauropods. *Puertasaurus reuili* (Novas et al., 2005) is probably the largest titanosaurid, but the poor material collected impedes a comparison with *Argentinosaurus huinculenis*. The material recorded at Santa Cruz province includes just four vertebrae (Table 4). The anterior dorsal is the widest ever found, with 168 cm at the level of the transverse processes (Figure 5). The morphology is similar to that of *Futalognkosaurus* and *Notocolossus*. According to the big vertebrae size, it could probably reach almost 40 meters in length and 80 tons.

Two years later the finding of *Futalognkosaurus dukei* (Calvo et al., 2007) demonstrated that titanosaurids with large femora were not the longest nor the largest. The holotype was found at the north coast of Barreales lake, Neuquén province (Table 5). This taxon is up to now the most complete single specimen discovered of a giant sauropod (Figure 6). The longest bone is the femur (198 cm), but it also has very high anterior caudals (Table 10). The width of the posterior dorsals is 10% shorter than that of *Argentinosaurus*. The most impressive bone is the sacrum, the largest preserved in the world, 255 cm wide (Figure 7; Table 10). The weight of *Futalognkosaurus* has been estimated in 29 tons (Paul, 2019).

Another fragmentary taxon is *Traukutitan eocaudata* (Juarez Valieri & Calvo, 2011) collected in 1990 by Dr. Calvo at Barreales lake, Neuquén province (Table 6). It was found 1000 meters away from the *Futalognkosaurus* site and on a different formation (Bajo de la Carpa Formation). The history

Courtesy of Lucas Fiorelli

Figure 3. Representation of *Argentinosaurus huinculensis*. When the taxon was discovered in 1989, it was the world's most gigantic dinosaur, and remained so for almost two decades. It was estimated to weigh more than seventy tons.

Jorge Orlando Calvo

Figure 4. Holotype of the anterior dorsal of *Argentinosaurus huinculensis*. Its remains were discovered by a local farmer 5 km east of the town of Plaza Huincul, Neuquén Province, and excavated by Dr. José Bonaparte, Dr. Jorge Calvo, and Dr. Leonardo Salgado.

ARGENTINOSAURUS HUINCULENSIS	
Systematic	Titanosauria
Site and province	Plaza Huincul, Neuquén
Formation	Huincul
Age	Upper Cretaceous (Late Cenomanian)
Material	Fibula, partial sacrum and ilium, seven uncomplete dorsal vertebrae.
Environment	Fluvial
Authors	Bonaparte & Coria (1993)
Notes	The name references Argentina and the site where it was found.

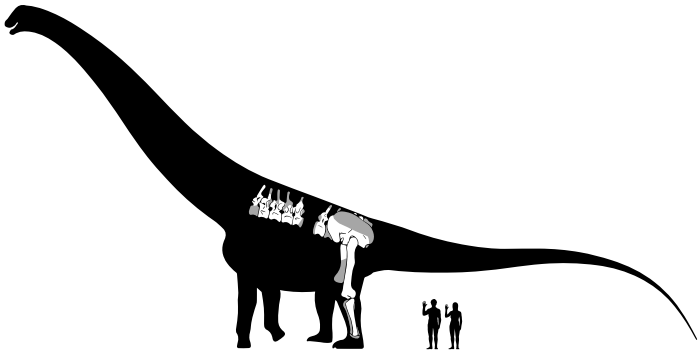


Table 3. *Argentinosaurus huinculensis*, general information.

Courtesy of Dr. Fernando Novas

Figure 5. The anterior dorsal vertebra of *Puertasaurus reuili* (in the image, reconstruction of the holotype) is the largest ever found, at 168 cm wide. It probably belongs to the largest titanosaurid, but the scarce material collected prevents us from comparing it with other species, such as *Argentinosaurus huinculenis*.

«The larger the dinosaur, the less evidence we tend to find, because predators find big dead animals easily and destroy most of the body»

shows how important knowledge of the completeness is when someone describes a fossil. The first description was made by Salgado and Calvo in 1993, but at that time the evidence did not allow experts to specify whether or not the material belonged to a new taxon. Some time later, the material was stored at the collection of the Museum of Geology and Paleontology of the National University of Comahue. Subsequent studies demonstrated that caudal vertebrae have primitive characters from the Titanosaurian group; therefore, a new redescription named it as *Traukutitan eocaudata* (Figure 8). The femur is the longest bone, with 197 cm (Table 10). *Traukutitan* resembles *Futalognkosaurus*, *Mendozasaurus* (González Riga, 2003), and *Puertasaurus* in the morphology of the base of the neural archs and the transverse processes on caudal vertebrae, suggesting that it represents a later Lognkosauria. The size and weight of *Traukutitan* might be around 30 meters and 30 tons, as that of *Futalognkosaurus* and *Dreadnoughtus*.

Dreadnoughtus schrani (Lacovara et al., 2014) is one of the most complete giant titanosaurid skeletons: we have some cranial materials, vertebrae, and many pectoral girdle, forelimb, and hindlimb remains (Table 7). The materials come from Santa Cruz Province, south-western Patagonia, Argentina. At the time that *Dreadnoughtus schrani* was published, it became the most complete giant titanosaur preserved – approximately 45.3 % of the bones expected in a complete titanosaurian skeleton and (depending on how bones are counted) up to 70.4 % of the postcranial elements. However, as we saw before, the most complete specimen of a giant sauropod is

PUERTASAURUS REUILI	
Systematic	Titanosauria
Site and province	Cerro Los Hornos, Santa Cruz
Formation	Cerro Fortaleza
Age	Upper Cretaceous (Campanian/ Maastrichtian)
Material	One cervical, a complete dorsal and two central caudals.
Environment	Fluvial
Authors	Novas et al. (2005)
Notes	The name honors Pablo Puerta and Santiago Reuil, the remarkable fossil-hunters who discovered and prepared the specimen.

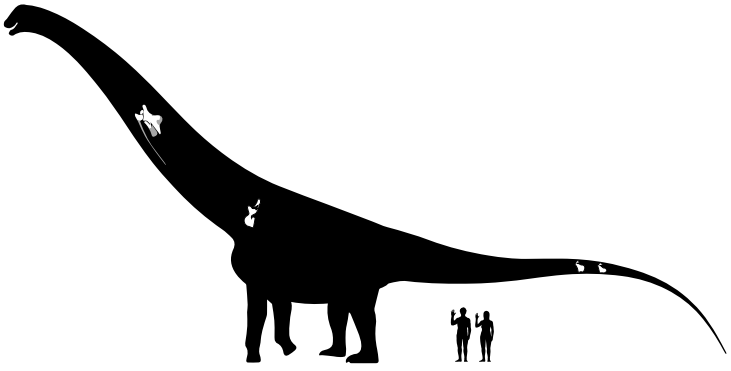


Table 4. *Puertasaurus reuili*, general information.

Futalognkosaurus, with almost all the skeleton. We only lack skull materials, middle and posterior caudals, and some bones of the foot. Anyway, these two taxa are the most complete titanosaurids we can use to compare with other partial giant skeletons. With a 191-cm-long femur, *Dreadnoughtus* would be 26 meters long and weigh 31 tons (Paul, 2019).

Notocolossus gonzalezparejasi (González Riga et al., 2016) is the only record of a giant titanosaurid sauropod outside from Patagonia; it comes from southern Mendoza province. This taxon comes from the same geological Neuquén Group that *Argentinosaurus, Antarctosaurus, Futalognkosaurus*, and *Traukutitan.* The skeleton is based on two specimens whose anterior dorsal vertebrae would measure approximately 150 cm (Table 10) in maximum transverse dimension (i.e., the width across the diapophyses), only 18 cm less than in dorsal vertebra 2 of the gigantic *Puertasaurus,* and substantially greater than that of *Argentinosaurus.* This taxon is the most massive and has the longest titanosaur humerus yet recovered in the world, with 176 cm (Figure 9), 7 cm longer than that of the giant Egyptian titanosaur *Paralititan*. Using the length of the *Notocolossus* humerus, the probable length of the missing femur would be 216.6 cm; therefore, it might have weighed around 70 tons.

Very recently a new giant titanosaurid sauropod was discovered at Chubut province (Figure 10; Table 9), the *Patagotitan mayorum* (Carballido et al., 2017). The taxon is represented by at least six different specimens, but based on the taphonomical, histological, and ecological data available, they were interpreted as belonging to a monospecific sauropod assemblage (Carballido et al., 2017). The longest bone is the femur (238 cm), 7 cm larger than *Antarctosaurus*', which is the main reason this taxon was supported as one of

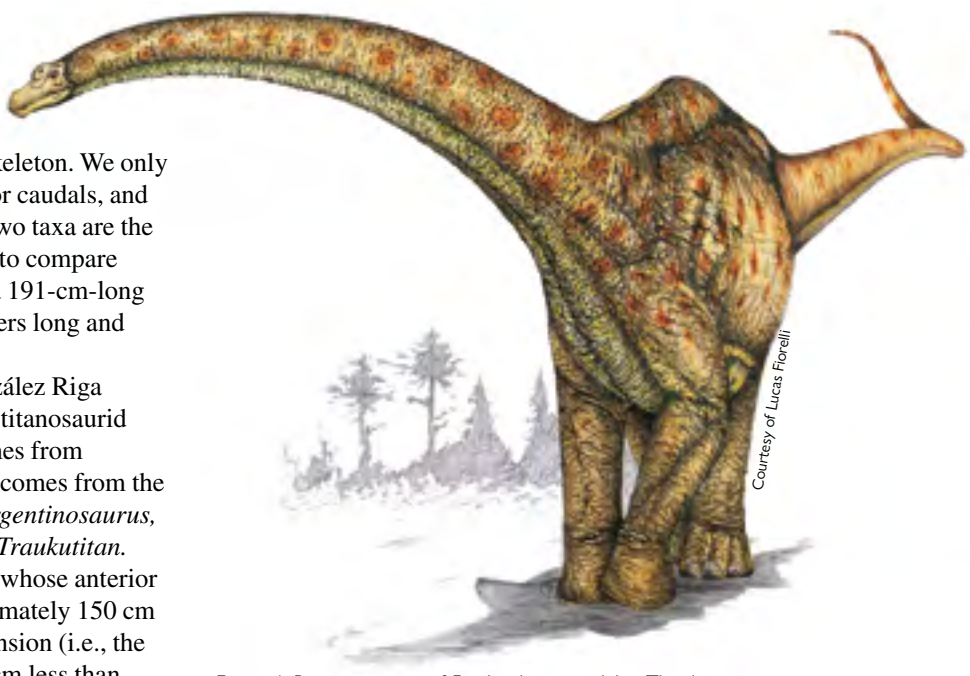


Figure 6. Representation of *Futalognkosaurus dukei.* The discovery of this species showed that titanosaurids with large femurs were neither the longest nor the largest.

Figure 7. The author of the article, Jorge Orlando Calvo, next to the holotype of the sacrum of *Futalognkosaurus dukei.* This is the largest surviving sacrum in the world, 255 cm wide.

FUTALOGNKOSAURUS DUKEI	
Systematic	Titanosauria - Lognkosauria
Site and province	Barreales lake, Neuquén
Formation	Portezuelo
Age	Upper Cretaceous (Turonian)
Material	An almost complete skeleton lacking skull, part of the foot and some caudals.
Environment	Fluvial
Authors	Calvo et al. (2007)
Notes	In Mapuche language, the name means 'giant chief of dinosaurs'.

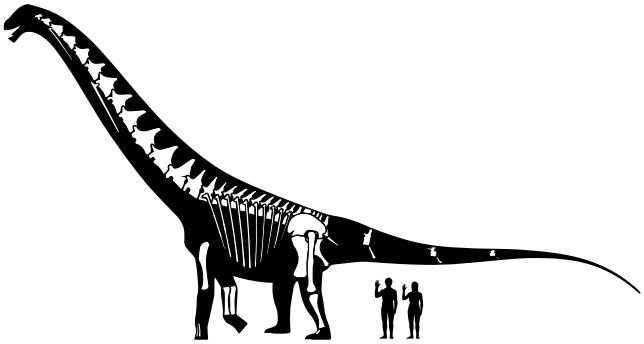


Table 5. *Futalognkosaurus dukei*, general information.

the largest sauropods in the world (Figure 11). Other big bones are the scapula (196.5 cm) and the ulna (105 cm) (Table 10). The rest of the materials are smaller with respect to other sauropods. The 152 cm pubis is the longest one preserved. *Patagotitan* includes many disarticulated bones from different specimens and sizes; therefore, the skeleton of an individual cannot be completed. Carballido et al. (2017) used the most complete giant skeletons – with pieces such as the precaudal of *Futalognkosaurus* and dorsals and caudals of *Dreadnoughtus* – to establish the position of each caudal vertebrae. The weight is around 52 tons (Paul, 2019).

AN OVERVIEW OF GIANT BONES

Some selected bones of giant titanosaurids have been measured to see differences in length or width (Table 10); here we will compare some of them.

Titanosaurid femora are the longest among dinosaurs. Up to now the longest preserved femur belongs to *Patagotitan* (238 cm) followed by *Antarctosaurus* (231 cm) (Table 10). Some pictures show a huge *Argentinosaurus* femur, but it does not come from the original excavation and it lacks both ends, so it is impossible to guess the real size and to which sauropod it belonged.

Titanosaurid humeri are smaller than femora; the longest humerus belonged to *Notocolossus* (176 cm), followed by *Patagotitan* (167.5 cm). Another giant titanosaurus from Africa was *Paralititan* (169 cm), but the largest is still that of *Notocolossus*.

Titanosauria caudal vertebrae are the most common bones, preserved in many species; however, most of them are small; in the last 20 years, bigger caudals were found associated to articulated skeletons. Among the biggest caudals, we often use the most anterior ones because they are more accurate. The highest record is that of *Futalognkosaurus* (90 cm high) followed by *Patagotitan* (86.9 cm high).

Dorsal vertebrae vary in size and morphology along the vertebral column, so the height or width depend of the position of each specific one. For many taxa, we do not have a complete sequence and therefore is complicated to compare with other species. Anyway, we usually try to differentiate anterior, middle, and posterior ones when comparing vertebrae. *Argentinosaurus* has an almost complete middle dorsal (the 4th?) whose neural arch is 126 cm wide at the

Courtesy of Lucas Fiorelli

Figure 8. Representation of *Traukutitan eocaudata*. The size and weight of this dinosaur could be close to 30 metres and 30 tons, similar to *Futalognkosaurus* and *Dreadnoughtus*.

TRAUKUTITAN EOCAUDATA	
Systematic	Titanosauria
Site and province	Barreales lake, Neuquén
Formation	Bajo de la Carpa, Neuquén Group
Age	Upper Cretaceous
Material	Two femurs and several anterior caudal vertebrae.
Environment	Fluvial
Authors	Juarez Valieri & Calvo (2011)
Notes	From *Trauku*, the Araucanian mountain spirit, usually represented as a giant; and titan, the name of the mythical Greek giants. *Eocaudata* references the basal morphology of their middle caudal vertebrae.

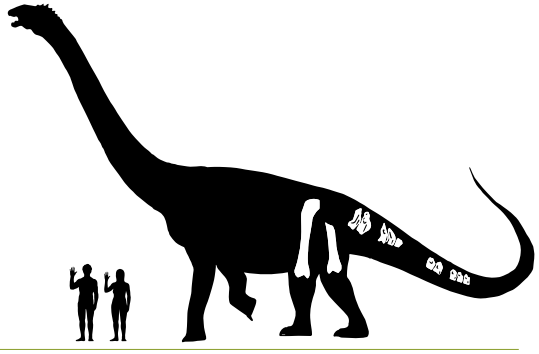


Table 6. *Traukutitan eocaudata*, general information.

level of the transverse process. In other taxa, the 2nd dorsal of *Puertasaurus* (168 cm) is wider than that of *Argentinosaurus* and followed by *Notocolossus* (150 cm). The rest of the taxa have shorter anterior dorsals (Table 10).

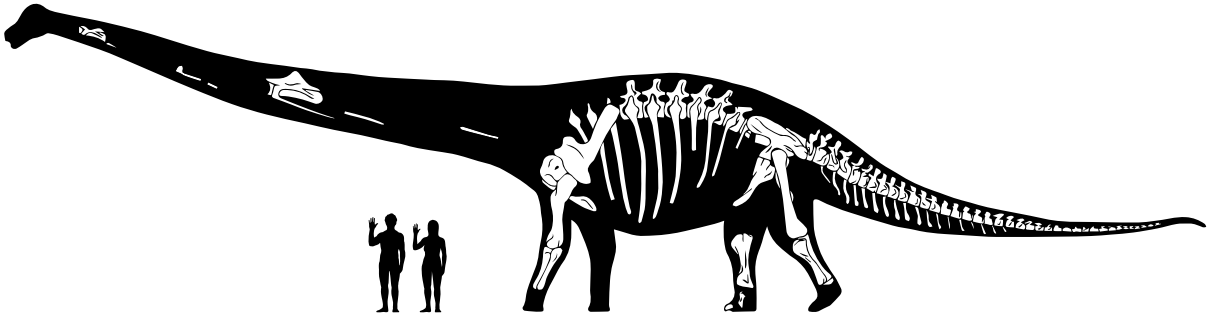
Giant pelvises are uncommon and the only one preserved is that of *Futalognkosaurus* (reaching 255 cm wide). This huge pelvis has the highest 1st caudal, 90 cm wide. It has been published that *Patagotitan* was one of the largest sauropods with 52 tons; however, if we establish the relationship based on pelvis evidence, that size seems to be quite far from reality. The *Patagotitan* caudal is a few cms smaller than that of *Futalognkosaurus*, even though the pubis of *Patagotitan* is 7 cm longer. It is possible that the sacra of both taxa would be similar. When we look at body weight relationships, it is difficult to accept that *Patagotitan* weighed 52 tons and *Futalognkosaurus* weighed 29 tons, as Paul (2019) indicated.

Dinosaur scapulae are very commonly found; however, few have been discovered from giant sauropods. The longest scapula is that of *Patagotitan* (196.5 cm) followed by *Dreadnoughtus* (174 cm) and *Futalognkosaurus* (170 cm). The scapula articulates with the humerus, and when establishing a humerus/scapula relationship, the result is 91 % for *Futalognkosaurus* and *Dreadnoughtus*, but only 85 % for *Patagotitan*. Probably, the *Patagotitan* scapula is not associated to the humerus, or the scapular blade is smaller in this taxon.

WHAT IS THE LARGEST TITANOSAURID SAUROPOD?

When we talk about the largest sauropods, we can be confused about whether we are talking about total length, height, or even body mass. Generally, paleontologists use body mass because it is related to most biological processes; again, there is no complete skeleton record of all the specimens, so many of the interpolated data could be wrong. Therefore, if we try to infer body size, we usually use appendicular

DREADNOUGHTUS SCHRANI



Systematic	Titanosauria
Site and province	Cerro Fortaleza, east bank of the La Leona River, Santa Cruz
Formation	Cerro Fortaleza
Age	Upper Cretaceous (Campanian/Maastrichtian)
Material	Skull bones, a posterior cervical vertebra, eight partial to nearly complete vertebrae, sacrum, 32 caudal vertebrae, pectoral girdle and forelimb, pelvic elements, and hind limb; lacking manus and part of the pes. A second smaller specimen with a partially articulated postcranial skeleton, with a partial anterior cervical vertebra, multiple dorsal vertebrae and ribs, sacrum, seven caudal vertebrae, pelvis and a femur.
Environment	Fluvial
Authors	Lacovara et al. (2014)
Notes	*Dreadnought* is Old English for 'fearing nothing'. The species name honors the American entrepreneur Adam Schran for his support of this research.

Table 7. *Dreadnoughtus schrani*, general information.

bones because they appear to be intimately related to these animals' acquisition of a large body size. Some characters of limb bones appear to be directly related to their massive weight increase; these include columnar graviportal limb posture, increased femoral midshaft eccentricity, increased limb bone robusticity, and shortened distal limb segments. However, other bones such as pelvises or caudal and dorsal vertebrae have been used to compare sauropod sizes. Most of the body size estimations obtained for sauropods use femora and humeri (Carrano, 2006).

Establishing which is the largest titanosaurid from Argentina is quite difficult because only three taxa have relatively complete skeletons, and the rest are represented by isolated bones. The best-preserved skeletons we have belong to *Patagotitan, Dreadnoughtus*, and *Futalognkosaurus.* Many attempts have been made to establish which is the largest titanosaurid, but there are still some doubts regarding the results. For instance, both *Dreadnoughtus* and *Futalognkosaurus* have similar size, 26 meters long, and a weight of approximately 30 tons, but *Patagotitan* weighed 52 tons (Paul, 2019). That means that *Patagotitan* would be 80 % heavier than the other two; however, when we review the size of different bones, we do not see such difference. The largest bone differences of *Futalognkosaurus* and *Dreadnoughtus* with respect to *Patagotitan* are: humerus, 7 cm (5 %); femur, 40 cm (21 %); pubis, 15 cm (11 %); anterior dorsal vertebra, 26 cm (23 %);

Courtesy of Bernardo González Riga

Figure 9. Holotype of the humerus of *Notocolossus gonzalezparejasi*. This is the longest titanosaur humerus in the world to date, at 176 cm.

«There is no complete skeleton record of all the specimens, so many of the interpolated data could be wrong»

NOTOCOLOSSUS GONZALEZPAREJASI	
Systematic	Titanosauria-Lithostrotia
Site and province	Cerro Guillermo, Mendoza
Formation	Plottier
Age	Upper Cretaceous (Coniacian/Lower Santonian)
Material	The holotype includes an anterior dorsal vertebra, an anterior caudal vertebra, a humerus, and the proximal end of a pubis. A second specimen includes seven articulated anterior caudal series and the complete and articulated right astragalus and pes.
Environment	Fluvial
Authors	González Riga et al. (2016)
Notes	The name includes the Greek *notos* ('southern') and the Latin *colossus*, referencing its gigantic size; and the species is dedicated to Dr. Jorge González Parejas, who collaborated and provided legal guidance.

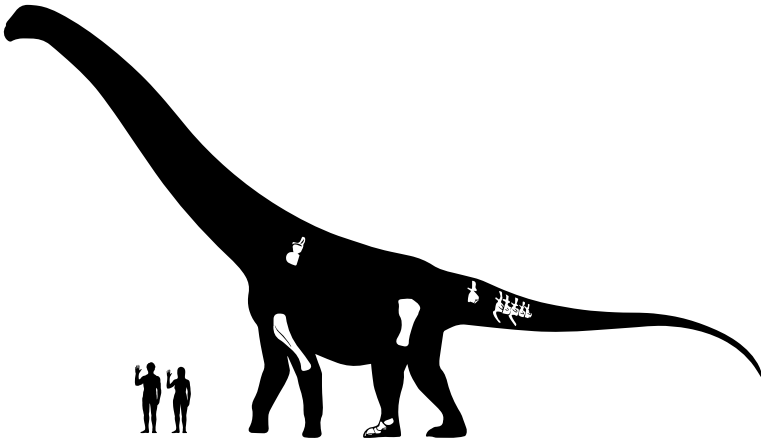


Table 8. *Notocolossus gonzalezparejasi*, general information.

first caudal, -3 cm; ulna, 4 cm (4 %); scapula, 22 cm (13 %). Therefore, the estimated weight of *Patagotitan* seems too heavy if we compare the bones, so it probably should be smaller in size or weight; probably, it may be 25 % larger and weigh around 40 tons.

Now, if we consider the rest of the largest incomplete titanosaurs, such as *Argentinosaurus*, *Notocolossus, Puertasaurus, Traukutitan,* and *Antarctosaurus,* few bones are comparable among them. As we see in Table 10, the longest femur belonged to *Patagotitan*, followed closely by *Antarctosaurus*. The largest humerus belonged to *Notocolossus*, followed by *Patagotitan* and, closely, by *Dreadnoughtus* and *Futalognkosaurus*. The question is why *Argentinosaurus* is placed as the largest titanosaurid, with 70 tons. We only have a few bones, with no humerus nor femur. When we study anterior dorsals in the different taxa of giant Titanosauria, we can see that there are two morphologies. Some have higher and wider distal neural spines, like *Argentinosaurus* and *Patagotitan*, while others have short and triangular neural spines, like *Puertasaurus*, *Dreadnoughtus*, *Futalognkosaurus*, and *Notocolossus*. This means that there are different body morphologies among titanosaurid sauropods, which could be associated to the disparity of bone dimensions.

According to the femur or humerus length alone, we could make a mistake by saying that the longer the humerus or the longer the femur, the largest the sauropod would be. For instance, the *Notocolossus*

Courtesy of Pablo Puerta

Figure 10. Excavation of *Patagotitan mayorum* showing the large bones found.

Courtesy of J. Farfaglia

Figure 11. Femur from the holotype of *Patagotitan mayorum*. This bone is 238 cm long, the longest femur preserved to date.

PATAGOTITAN MAYORUM	
Systematic	Titanosauria-Lognkosauria
Site and province	La Flecha Ranch, Chubut
Formation	Cerro Barcino
Age	Lower Cretaceous (Albian)
Material	An anterior, two middle cervical vertebrae, seven dorsal vertebrae, six anterior caudal vertebrae, sternal plates, scapulocoracoid, pubes, and femora.
Environment	Fluvial floodplain
Authors	Carballido et al. (2017)
Notes	The name includes *Patago-* from Patagonia (southern South America) and *-titan* (Greek divinity, a symbol of strength and large size). The species name honors the Mayo family for their hospitality during fieldwork at the La Flecha Ranch. The taxon is represented by at least six individuals found in the same quarry, distributed in three distinct but close horizons corresponding to three different burial events.

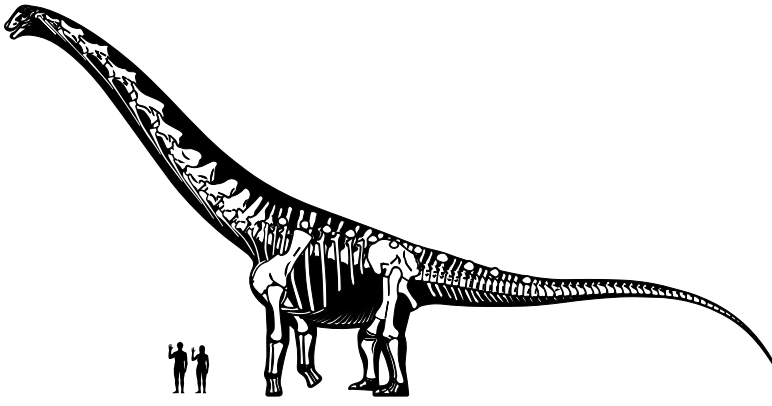


Table 9. *Patagotitan mayorum,* general information.

Taxon	humerus	femur	dorsal	caudal	scapula	pubis	fibula	ulna	body mass
Patagotitan	167.5	238.0	138.0	86.9	196.5	152.0	———	105.0	52.0
Dreadnoughtus	160.0	191.0	110.0	80.0	174.0	126.0	103.0	101.0	31.0
Futalognkosaurus	156.0	198.0	112.0	90.0	170.0	137.0	114.0	94.0	29.0
Notocolossus	176.0	———	150.0	———	———	———	———	———	70.0
Antarctosaurus	———	231.0	———	———	———	145.0	———	———	69.0
Argentinosaurus	———	———	126.00	———	———	———	155.0	———	70.0
Puertasaurus	———	———	168.00	———	———	———	———	———	80.0
Traukutitan	———	197.0	———	———	———	———	———	———	30.0
Argyrosaurus	137.0	———	———	———	———	———	———	96.5	25.0

Table 10. Measures in centimeters of the largest bones of the largest titanosaurid taxa. Highlighted are the largest titanosaurid bones.

humerus (176 cm), together with the stylopodial proportions of more completely preserved titanosaurs, indicates the length of the missing femur at 216.6 cm (González Riga et al., 2016); but if we look at the robustness of *Patagotitan*, it is similar to *Notocolossus* (sensu Carballido et al., 2017) with a humerus/femur ratio of 0.7. *Notocolossus* might have had a 251-cm-long femur, which would represent the longest femur and, probably, the largest sauropod.

As we stated before, humerus and/or femur length might indicate a wrong size and weight estimate for a sauropod. On the other hand, vertebrae, scapulae, and pelvic bones are comparable in some titanosaurid candidates to the greatest titanosaurid sauropod. In sum, according to the size of the available bones and interpolating data with those of the most complete skeletons, the largest known Titanosauria should be *Notocolossus* or *Puertasaurus*, although further work – including the discovery of new fossils and a definitive method of size estimation – will be necessary to reach a consensus in the scientific community.

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