

Sauropodomorph Lifestyles

Distribution and Preservation

Sauropodomorphs are found from the Late Triassic until the close of the Cretaceous. Most sauropodomorphs are known only from incompletely preserved material. What body parts are missing and why?

The Case for Terrestrial Lifestyle for Sauropods

Sauropods **do not** appear to have lived submerged in deep lakes or rivers to buoy up their huge bulk as previously interpreted. What was this model based on and why doesn't it make sense?

Nostrils on the top of the skull led O. C. Marsh to the conclusion that they used their necks as snorkels. Not all sauropods had high-situated nostrils. What does Bob Bakker think about this situation?

The skeletal structure was light and strong, with numerous air cavities in most bones except the weight bearing ones. Dr. R. T. Bakker pointed out that the pillar-like legs were designed for walking and load bearing, and that sauropod torsos were narrow and slab-sided. This made the sauropods similar to rhinos and elephants. What do sauropod trackways show?

It has been suggested that some sauropod footprints indicate that they were swimming because the prints are

Martin Lockley feels that the trackways interpreted in this way are ambiguous and such tracks may rather indicate conditions of footprint preservation.

A second common argument that had been used to conclude that sauropods were aquatic, or at least lived near ponds and lakes, is the small size of their head and mouth compared with their total body weight. It is clear that they would have had to eat massive amounts of plants in order to nourish their bodies, and the speculation was that supposedly they had to browse nearly all the time, with no time to thoroughly chew. Paleontologists had thought that they had to eat aquatic plants that were easily digested. Why do we now think that they could consume tougher plants?

Sauropodomorphs had weak jaw muscles in small heads and were not great chewers. Their teeth were undifferentiated and had simple crowns that were leaf-shaped (prosauropods and basal sauropods), spatulate (primitively in Sauropoda), or slender and pencil-shaped (Diplodocidae and Titanosauridae). The teeth were at the front of the mouth. They likely nipped or stripped off vegetation and delivered a bolus of foliage to the gullet without much modification in the mouth.

At least some sauropodomorphs had large gizzards filled with stones. How do gastroliths work?

What do they think Sauropodomorph's digestive system was like?

The arguments about whether sauropods could raise their heads high above their bodies on their long necks, or to rear up on their hind legs have been debated for many years. The tripodal stance, using the tail as a third limb, was suggested in the early 1900s and reiterated by Bob Bakker in 1986 for the Diplodocids. How would they hold the chevron bones in the mid-tail region?

In the Diplodocids and Camarasaurids, how are the bodies designed for rearing up?

How is the body design of Brachiosaurids giraffe-like?

The models of rearing and/or high-browsing dinosaurs have been criticized by a number of other scientists, mostly on the basis of the physiological requirements of pumping blood to the brain. Holding the head high above the heart requires high blood pressures. For many sauropods, this distance would have been about 8 metres. Blood pressures must have been on the order of 630 mm of Hg (mercury). Giraffes today have blood pressures reaching 320 mm Hg when they raise their heads to full height to reach foliage. Humans and most other large mammals have blood pressures of about 110 to 150 mm Hg. Scientists estimate that a heart capable of pumping at a systolic pressure of 630 mm Hg would have to be huge, probably weighing 400 kg.

What are some of the theories about sauropods' adaptations to facilitate the pumping of blood to the brains when at full height?

A number of paleontologists have suggested instead that the long necks of sauropods were used more like a vacuum cleaner hose. They were held horizontally or slightly inclined, so that the head was not significantly higher than the heart. They would then have been low browsers and swung their heads from place to place to eat, without having to move their enormous bodies as often.

Michael Parrish and Kent Stevens have reconstructed the vertebrae structures of both the *Apatosaurus* and *Diplodocus* using a sophisticated computer simulation program. What were their conclusions?

Resource Competition

Sauropod communities in the Upper Jurassic of North America included four or five sauropods that co-existed, all feeding on the various plants of the time. The most common of these animals were

Dentition of sauropods include two basic tooth types: a robust, spatulate tooth form, exhibited by *Camarasaurus* and a gracile, peg-like tooth form in *Diplodocus*. Based on these dentitions, it has been inferred that *Diplodocus* used its teeth for nipping or raking the fronds of terrestrial vegetation, while *Camarasaurus* consumed tougher vegetation.

Experimental work by A.R. Fiorillo on the microscopic wear patterns on the teeth of modern mammals provides insight into the possible diets of sauropods. What were the results of his experiments?

Differential browsing height may also be supported by the back of the skulls of *Camarasaurus* and *Diplodocus*. The occipital region is deflected downward at a much greater angle in *Diplodocus* than in *Camarasaurus*, suggesting that the skull of *Diplodocus* was carried at a higher level than that of *Camarasaurus*.

Gigantism

What are the advantages to an herbivore in having large size?

Gigantism itself is a character of the dinosaur group as a whole. If gigantic sauropods did not maintain a high metabolism, but rather relied on inertial homeothermy, then they would not have required the large proportion of food resources that mammals do, and large size would not have precluded large numbers of cohabiting animals. This would allow species to survive various kinds of environmental calamities and not go extinct.

Respiration

Long-necked animals have the problem of a long trachea that has to carry air to and from the lungs. Animals like mammals and reptiles have bi-directional airflow into dead-end lungs, like a bellows, limiting efficiency of oxygen absorption to 20%. A long trachea means that a large volume of air never reaches the lungs, but is simply drawn into the wind-pipe.

What airflow system do birds have?

Sauropods had pneumatic openings in their bones to hold air sacs, believed to have designed for cooling purposes. Sauropodomorphs may also have had unidirectional airflow in their lungs through this series of air sacs, which would have increased the efficiency of oxygen absorption and allowed air cooling as well.

What might be an alternative?

Locomotion and Speed

Most prosauropods were bipedal, although a couple of genera were fully quadrupedal and all sauropods were fully quadrupedal. Sauropoda trackways all show quadrupedal locomotion, but what is missing from the trackways?

Prosauropods were slow and probably achieved speeds no more than 5 km/h (3 mph). Sauropods were quicker with maximum speeds of 20-30 km/h (12.5-19 mph) and walking speeds about 20-40 km/day (12.5-25 miles/day).

Defense

Large size is an effective defense mechanism against predators, and most adult sauropods were probably immune to predation. In what situation may this strategy fail?

The thumb claw was the sauropodomorphs principal means of defense. They are well developed in all groups, and present even in the juvenile forms, indicating that they were not a feature of

Most trackways show that the thumb claw was held above the ground when walking. It has also been speculated that rearing up in a tripodal position would allow employing the claws while still affording stability.

What have some suggested in the case of the Diplodocids?

Although sauropods were huge, so were some theropods. The mass ratio of elephant/lion is $5,000/250 \text{ kg} = 20\text{x}$ compared to *Apatosaurus/Allosaurus* that was $25,000/3,000 \text{ kg} = 8.3\text{x}$.

Many sauropods didn't have whip-like tail endings, but thick tails or even tail-clubs at the end.

Sauropodomorph Reproduction, Growth and Development

How do they think they mated?

A nest of six eggs from the Early Jurassic of South Africa may have been laid by a prosauropod. *Hypselosaurus* is associated with nearly spherical eggs laid in linear pairs and probably covered with mounds of vegetation. The eggs are about the size of an American football. Eggs from Mongolia and India may have been laid by unspecified sauropods. Spherical sauropod eggs of *Titanosaurus* have been found in Patagonia, Argentina.

Sauropodomorphs probably grew slowly and episodically, taking no more than 20 years to reach sexual maturity and may have had life spans of

Sauropodomorphs appear to have lived in a variety of environments such as

