Allosaurus anax: The Unsung King of the North American Jurassic.

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Allosaurus has long been regarded as one of the most emblematic large theropod dinosaurs of the Late Jurassic. First named in 1877, its remains have been recovered across a wide swath of western North America (the Morrison Formation) and even in parts of Europe, attesting to its success and broad ecological spread.

Among its various species, *Allosaurus fragilis* is particularly notable as its fossils indicate it was the predominant large carnivore in the Morrison Formation. Many partial to complete skeletons are known from localities in Utah, Colorado, Wyoming and beyond. Estimates for typical *A. fragilis* individuals place them at roughly 8–9 m in length (with some up to 10 m) with a lean, gracile build compared to later or larger allosaurids.

Morphologically, Allosaurus had a relatively broad skull with characteristic short, crest-like horns above its eyes. Its forelimbs were comparatively small with large claws. They were, however, larger in relation to body size when compared to those of later theropods such as the Tyrannosaurs (i.e., *T. rex*) and the Abelisaurids. Its body was balanced by powerful hindlimbs and a long muscular tail. Such traits made for an efficient layout for a large bipedal predator.

Due to its abundance, and the number of fairly complete fossils discovered, Allosaurus (especially *A. fragilis)* has become the *"face"* of the Jurassic large theropods. Often being viewed as the archetypal apex predator in many popular reconstructions, museum exhibits, and media portrayals. Apart from some of the megatheropods from the Cretaceous period, Allosaurus may be regarded as the most emblematic of the large predatory dinosaurs.

In 2024, a landmark study by Danison, Wedel, Barta, Woodward, Flora, Lee & Snively re-evaluated the fossil material historically attributed to *Saurophaganax maximus*. Their findings challenge long-standing assumptions and restructure the taxonomy of what had been thought to be an enormous allosaurid.

The authors state that much of the material collected from the Kenton 1 Quarry (in Oklahoma, Morrison Formation) and attributed to Saurophaganax was chimeric. This means it combined bones from more than one species. Some of these bones turned out to belong to sauropods (long-necked herbivores), not theropods. The original holotype (a partial neural arch) is thus "undetermined saurischian," and offers no reliable diagnostic traits to support a distinct genus.

Among the *Saurophaganax* assemblage, within the material are certain theropod bones, including a postorbital (OMNH 1771), some dorsal vertebrae, and hindlimb elements.

All of which are convincingly referred to as an allosaurid, and show affinities with the genus Allosaurus. However, these elements also exhibit subtle but consistent differences from currently recognized species. Compared with *Allosaurus fragilis,* the material is distinct in several subtle but consistent features. Its postorbital bone lacks the rough cranial ornamentation (postorbital boss and prominent ridge) typically seen in *A. fragilis*, its dorsal vertebrae are more elongate and hourglass-shaped with pneumatic (air-filled) centra, some cervical vertebrae show nearly vertical postzygapophyses, and the proximal fibula bears three shallow medial fossae not known in *A. fragilis* (Danison et al., 2024).

Due to this, the authors formally named the new species *Allosaurus anax* (*"anax"* being Greek for *"king"* or *"lord,"* nodding to the former giant status of Saurophaganax). Therefore, the theropod material once lumped under *Saurophaganax maximus* is now referred to as *Allosaurus anax*. Meanwhile, Saurophaganax is regarded as dubious (nomen dubium), since its holotype cannot be confidently assigned to a unique theropod.

In addition to the anatomical differences, *A. anax* appears to have reached a significantly larger body size. The available theropod material suggests individuals up to around five tons, making *A. anax* arguably the largest species of Allosaurus identified so far (Danison et al., 2024; related reporting).

The fragmentary nature of *A. anax* remains a significant limitation. Without more complete, associated skeletons, many conclusions will remain tentative. We cannot yet know for certain how big the largest individuals truly were, what their exact body proportions looked like, or how they may have differed ecologically from *A. fragilis* or other contemporaneous theropods.

Although the exact size and length are not known with true certainty, some fairly good estimates do exist. Estimated mass of *A. anax* (4,634 kg, 3,871 kg, and 3,776 kg) are based on circumferences of the three femora that likely belong to the species (OMNH 1371, OMNH 1708, and OMNH 2114 respectively) exceeds the maximum asymptotic body size that Prondvai (2017) estimated for *A. fragilis* by more than 1,500 kg (Andy D. Danison, Mathew J. Wedel, Daniel E. Barta, Holly N. Woodward, Holley M. Flora, Andrew H. Lee, and Eric Snively, 2024).

Vividen: Paleontology, 2025, estimates *A. anax* at around 12.8 meters maximum length and 6.5 tonnes. If such estimates are true, *A. anax* would have been the largest predatory dinosaur of the Jurassic period. If we adopt a more conservative approach and approximate the length of *A. anax* to be around 11 meters, it would still classify as the largest predator of the Jurassic period, alongside *Torvosaurus tanneri*.

Because *A. anax* is known only from fragmentary remains much about its biology and behavior remains speculative. That said, given its close relationship to other forms within the Allosaurus genus, and more broadly its shared anatomy, it was certainly a large, bipedal, carnivorous theropod.

Where *A. anax* may have diverged is in its size and robustness. The authors of the 2024 revision suggest that the known material comes from especially large individuals, possibly among the largest allosaurids of the Morrison ecosystem. Their larger size would have allowed *A. anax* to tackle bigger prey, perhaps including subadult or slightly larger sauropods. Though evidence remains absent, so such inferences must remain cautious given the fragmentary record.

Because of the poor preservation and limited overlapping material, it remains unknown whether the referred bones belonged to a single individual or to multiple. That means we do not yet have a full skeleton, skull morphology, or other data that would allow confident reconstructions of its hunting style, growth trajectory, or ecology beyond a general theropod model.

The recognition of *A. anax* does however add a significant new dimension to our understanding of large predators in the Late Jurassic Morrison ecosystem. With this reclassification, we now have evidence that Morrison allosaurids were more diverse in size and ecological roles than previously thought. This is especially true with all three species (*Allosaurus fragilis, Allosaurus jimmadesi,* and *Allosaurus anax*) sharing some temporal overlap in the Late Jurassic Period of North America.

Furthermore, Allosaurus was known to coexist with other predators as well. Allosaurus, Ceratosaurus and Torvosaurus are well-documented sympatric forms in parts of the Late Jurassic Morrison Formation. Multiple lines of evidence indicate they avoided wholesale competitive exclusion by partitioning resources and behaviour. Morphology and tooth/skull differences (e.g., Ceratosaurus' relatively gracile, often more recurved teeth and shorter skull versus the deeper, more robust jaws of Torvosaurus and the varying snout shapes seen in Allosaurus) imply different prey-capture strategies and prey preferences (Henderson, 1998; Britt, 1991).

Independent data such as tooth and bite-mark surveys and isotopic work show theropod feeding was a mix of active predation and extensive scavenging. Allosaurus was the most common trace-maker on Morrison bones but other taxa (including Ceratosaurus and Torvosaurus) were present in the record. This is consistent with overlapping but not identical diets and with temporal/spatial resource partitioning reducing direct competition (Drumheller et al., 2020; Lei et al., 2023; Breeden et al., 2011).

The recent redescription recognizing *Allosaurus anax* indicates that an unusually large allosaur species existed alongside the more common *A. fragilis,* adding an upper tier to the Morrison theropod guild. If *A. anax* was both larger and less abundant than *A. fragilis*, it may have overlapped more directly with Torvosaurus in the *"largest-predator"* niche, even as Allosaurus as a whole remained the numerically dominant carnivore (Danison et al., 2024). Rather than replacing other large theropods, the presence of *A. anax* appears to have expanded the ecological spectrum filled by allosaurids, enhancing but not disrupting the well-documented multi-taxon predator community of the Morrison Formation (Drumheller et al., 2020; Danison et al., 2024).

This expanded diversity also supports the idea of niche partitioning among Morrison's apex predators. Typical medium-bodied *A. fragilis* individuals may have targeted smaller or more agile prey, while the more robust *A. anax* could have specialized on larger and more challenging prey items. The sheer volume of *A. fragilis* material suggests it was by far the most prevalent form, whereas *A. jimmadseni* and especially *A. anax* appear to have been considerably rarer. This is likely a reflection of both fossil biases and ecological realities. As larger species generally occur at lower population densities due to higher resource demands.

A comparable pattern is seen in *Torvosaurus tanneri*, which is known from relatively few and geographically restricted sites (notably Dry Mesa), making it far rarer in the fossil record than *A. fragilis* (Galton & Jensen, 1979; Foster & Chure, 1998; Black, 2013). As a substantially larger predator, *T. tanneri* would have required greater energetic intake, naturally limiting its population density to avoid exceeding the carrying capacity of Morrison environments (Foster, 2007). By contrast, the slightly smaller and more versatile *A. fragilis* could sustain higher densities and exploit a wider array of prey, helping explain its overwhelming abundance in the fossil record (Foster, 2007; Chure & Loewen, 2020).

The reclassification of Saurophaganax-material into *Allosaurus anax* is more than just a name change. It reflects how paleontology is continually refined. Sometimes specimens collected decades ago, perhaps described under less rigorous standards, turn out to be composite. The 2024 study demonstrates the importance of revisiting old material with updated comparative frameworks, careful anatomical assessment, and phylogenetic principles.

Allosaurus anax stands as a fascinating addition to the pantheon of North American Jurassic predators. Born out of a careful reanalysis of century-old fossil material, it demonstrates how scientific knowledge evolves and how sometimes our most iconic dinosaurs become more complex than we thought.

While the fragmentary nature of *A. anax* means much remains unknown, its recognition helps refine our picture of predator diversity, body-size variation, and ecological structure in Late Jurassic ecosystems. And while *A. fragilis* remains the best-known and most abundant Allosaurus species, *A. anax* offers a glimpse of an even larger and more formidable form within this already iconic genus.

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