Did a Large Theropod Cause Europasaurus To Go Extinct?

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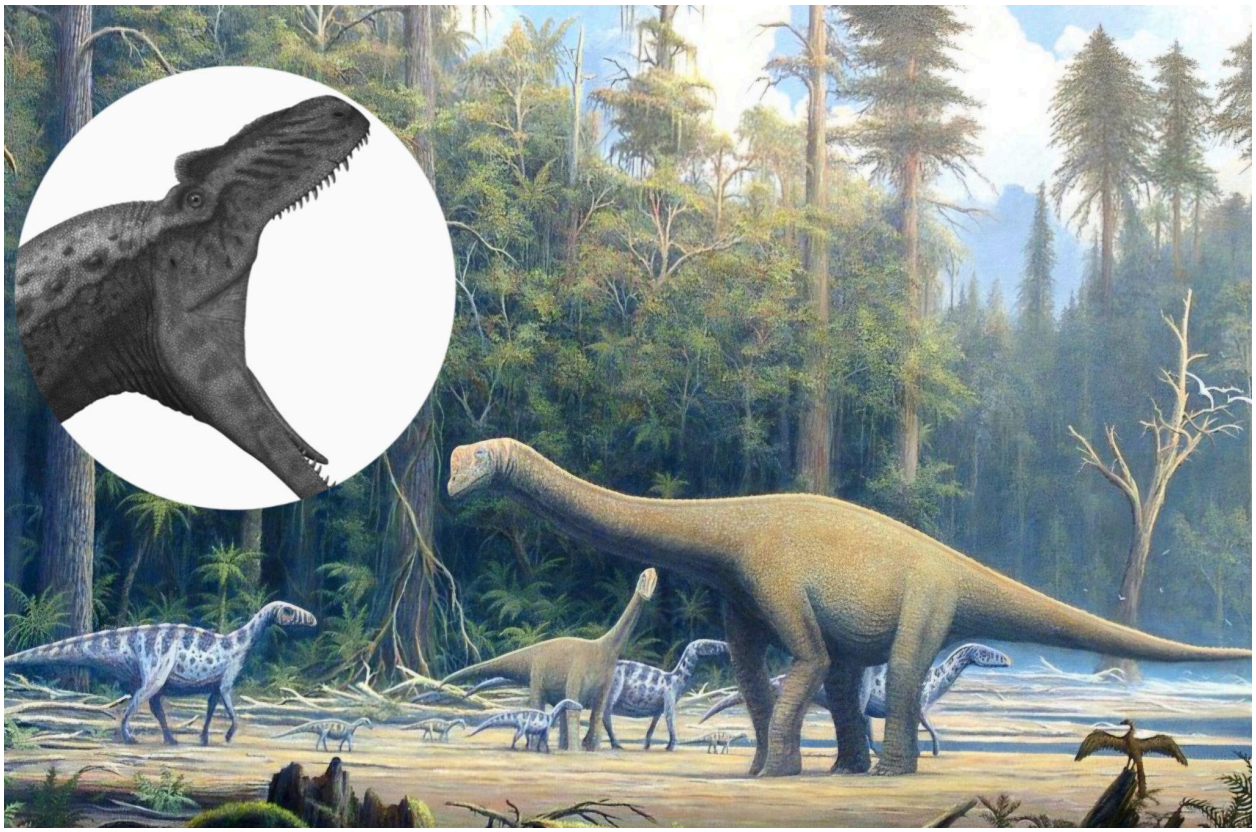


Life reconstruction of Europasaurus with a looming Theropod. Photo credit: Gerhard Boeggemann & Steveoc86.

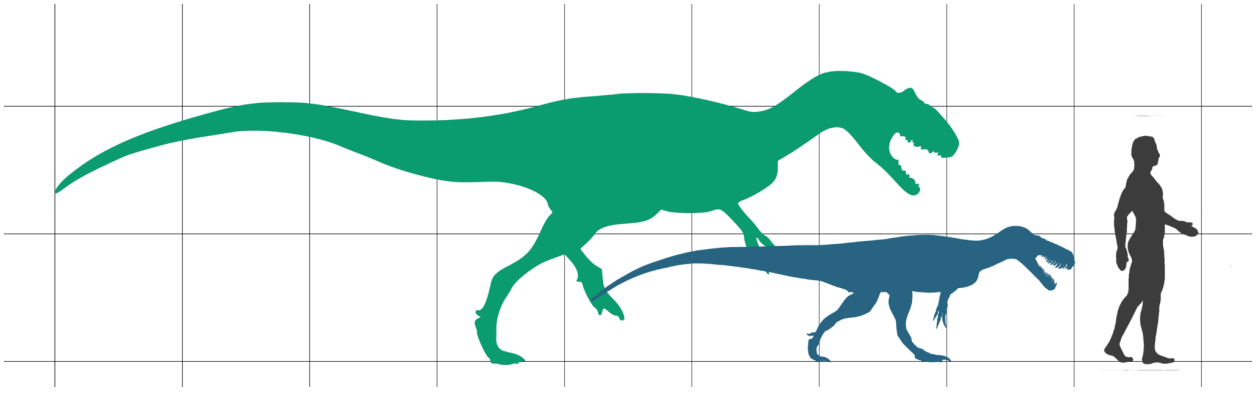
Europasaurus was a basal form of macronarian sauropod that lived during the Late Jurassic period (middle Kimmeridgian). It occured in northern Germany and has been recognized as a case of insular dwarfism, which arose due to the seclusion of a sauropod population on an island located within the Lower Saxony basin. As such, *Europasaurus* was a very small sauropod, growing to only about 19–20 feet long and weighing around 1,650–4,630 lb as an adult. This is quite petite compared to some of the other massive sauropod forms that lived during the Jurassic Period.

It has been suggested that an ancestor of Europasaurus would have quickly decreased in body size after emigrating to an island that existed at the time, as the largest of the islands in the region around northern Germany was smaller than 200,000 km (120,000 mi) squared. This relatively small area may not have been able to support a community of large sauropods. Alternatively, a macronarian may have shrunken concurrently with a larger landmass, until

achieving the size of Europasaurus (Sander, P.M.; Mateus, O.V.; Laven, T.; Knötschke, N. ,2006, "Bone histology indicates insular dwarfism in a new Late Jurassic sauropod dinosaur". Nature. 441 (7094): 739–741).

The dwarfism in *Europasaurus* represents the only significant rapid body mass change in derived Sauropodomorpha, with the general trend of taxa being a growth in overall size in other groups (Benson, R.B.J.; Campione, N.E.; Carrano, M.T.; Mannion, P.D.; Sullivan, C.; Upchurch, P.; Evans, D.C. (2014). "Rates of Dinosaur Body Mass Evolution Indicate 170 Million Years of Sustained Ecological Innovation on the Avian Stem Lineage". PLOS Biology. 12 (5) e1001853). The theropods residing on the island, which coexisted with *Europasaurus*, would have measured approximately 4 m (13 ft). However, dinosaur footprints found at the Langenberg Quarry may provide insight into the extinction of *Europasaurus* (as well as other insular dwarf species that inhabited the islands in the area). These footprints are situated 5 m (16 ft) above the layer containing *Europasaurus* remains, indicating that a significant drop in sea level occurred at least 35,000 years after the deposition of these individuals, leading to a faunal turnover. The decline in sea level facilitated the creation of a land bridge, which was subsequently used by larger theropods to reach the region. Footprints measuring up to 54 cm (21 in), suggested a body size of approximately 7 to 8 m (23 to 26 ft), which suggested a possible allosaurian. The researchers who described these tracks, including Jens Lallensack and his team, proposed that these theropod species likely contributed to the extinction of the specialized dwarf fauna.

If this theory holds, it underscores the significant influence that the introduction of new, larger predators can have on the existing ecological community within a region. This is not dissimilar to the decline and degradation in biodiversity that may result from the introduction of invasive species in extant communities.



Size comparison of the native torvosaur (blue) and arriving theropod (green). Photo credit: Scott Hartman

Because *Europasaurus* evolved in isolation, its reduced size suggests it was adapted to a low-predation environment (or at least one lacking large predators). Once large theropods immigrated, they would have introduced new predation pressures that the dwarf sauropods might not have been well-adapted to evade or defend against. Also, there may have been competition for resources or ecological disruption upon arrival of mainland faunas.

Therefore, the arrival of large theropods via a land-bridge during a sea-level fall is hypothesized to have eliminated the resident dwarf island fauna.

Based on Diedrich (2011) and more recent works, the theropods that might have caused or contributed to the extinction pressure on *Europasaurus* are uncertain, but *Allosaurus* (or at least an Allosaurus-like large allosauroid) and *Megalosaurus* are two of the leading candidates. Diedrich (2011b) suggests that some large theropod tracks in northern Germany (specifically from sites such as Nettelstedt and Bergkirchen in the Wiehen Mountains) may have been made by *Allosaurus sp*. or *Megalosaurus sp*., based on isolated teeth associated with those tracks.

Later analyses of isolated theropod teeth from the same general region (northern Germany) confirm the presence of a diversity of “avetheropodan” theropod lineages, including Allosauroidea, Megalosauroidea, and other basal tetanurans. Thus, the fauna included theropods capable of producing the large footprints found a few meters above the *Europasaurus* bone bed in the Langenberg Quarry. As mentioned before, an *Allosaurus*-type predator is plausible, though no skeletal remains definitively assignable to *Allosaurus* (or a named species thereof) have been discovered exactly in those beds at Langenberg that coincide with the footprints.

In addition, large megalosaurid theropods such as *Torvosaurus* are known from Late Jurassic Europe (e.g. Portugal) and could potentially be analogs for the kind of apex predator pressure involved.

Putting together the evidence and counterpoints, the scenario is plausible, but not definitively proven. The Langenberg tracks provide a rare and valuable data point for how faunal change may have occurred in this island ecosystem. The geological and stratigraphic record aligns well with the idea of a land bridge forming due to sea level fall, allowing new large predators to invade. If these predators arrived, they could indeed have put *Europasaurus* under novel predation pressure it was not adapted for.

However, proving that this was the cause of its extinction would require more evidence, more precise dating, more continuous fossil record above the *Europasaurus* layers, identification of theropod remains close in time and place, and perhaps evidence of interaction (bite marks, etc.).

While not indisputable, this hypothesis is still well-supported by the stratigraphic, paleogeographic, and footprint evidence. It adds a dramatic dimension to understanding how insular dwarf species, not just *Europasaurus*, but others might go extinct when conditions allow invasive or non-resident species to arrive.

References

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Stratigraphic and geological context: Fischer, 1991; Thies et al., 2007; Schweigert, 1999. (As used in Lallensack et al.)