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New, giant horned dinosaur discovered in the ancient swamps of Montana

Lokiceratops rangiformis is among the largest and most ornate horned dinosaur ever found, with two huge blade-like horns on the back of its frill.

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A remarkable, new species of horned, plant-eating dinosaur is being unveiled at the Natural History Museum of Utah. The dinosaur, excavated from the badlands of northern Montana just a few miles from the USA-Canada border, is among the largest and most ornate ever found, with two huge blade-like horns on the back of its frill. The distinctive horn pattern inspired its name, *Lokiceratops rangiformis*, meaning “Loki’s horned face that looks like a caribou.” The new species was announced today in the scientific journal *PeerJ*.

More than 78 million years ago, *Lokiceratops* inhabited the swamps and floodplains along the eastern shore of Laramidia. This island continent represents what is now the western part of North America created when a great seaway divided the continent around 100 million years ago. Mountain building and dramatic changes in climate and sea level have since altered the hothouse world of Laramidia where *Lokiceratops* and other dinosaurs thrived. The behemoth is a member of the horned dinosaurs called ceratopsids, a group that evolved around 92 million years ago during the Late Cretaceous, diversified into a myriad of fantastically ornamented species, and survived until the end of the time of dinosaurs. *Lokiceratops* (*lo-kee-sare-a-tops*) *rangiformis* (*ran-gi-FOHR-meas*) possesses several unique features, among them are the absence of a nose horn, huge, curving blade-like horns on the back of the frill—the largest ever found on a horned dinosaur—and a distinct, asymmetric spike in the middle of the frill.

Lokiceratops rangiformis appeared at least 12 million years earlier than its famous cousin *Triceratops* and was the largest horned dinosaur of its time. The name *Lokiceratops* translates as “Loki’s horned face” honoring the blade-wielding Norse god Loki. The second name, *rangiformis*, refers to the differing horn lengths on each side of the frill, similar to the asymmetric antlers of caribou and reindeer.



IMAGE:

PORTRAIT RECONSTRUCTIONS OF ALL FOUR CENTROSAURINE DINOSAURS THAT LIVED TOGETHER IN THE KENNEDY COULEE ASSEMBLAGE OF NORTHERN MONTANA AND SOUTHERN ALBERTA.

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“This new dinosaur pushes the envelope on bizarre ceratopsian headgear, sporting the largest frill horns ever seen in a ceratopsian,” said Joseph Sertich, a paleontologist with the Smithsonian Tropical Research Institute and Colorado State University, and co-leader of the study. “These skull ornaments are one of the keys to unlocking horned dinosaur diversity and demonstrate that evolutionary selection for showy displays contributed to the dizzying richness of Cretaceous ecosystems.”

Lokiceratops rangiformis is the fourth centrosaurine, and fifth horned dinosaur overall, identified from this single assemblage. While ceratopsian ancestors were widespread across the northern hemisphere throughout the Cretaceous period, their isolation on Laramidia led to the evolution of huge body sizes, and most characteristically, distinctive patterns of horns above their eyes and noses, on their cheeks and along the edges of their elongated head frills. Fossils recovered from this region suggest horned dinosaurs were living and evolving in a small geographic area—a high level of endemism that implies dinosaur diversity is underestimated.

“Previously, paleontologists thought a maximum of two species of horned dinosaurs could coexist at the same place and time. Incredibly, we have identified five living together at the same time,” said co-lead author Mark Loewen, paleontologist at the Natural History Museum of Utah and professor in the Department of Geology & Geophysics at the University of Utah. “The skull of *Lokiceratops rangiformis* is dramatically different from the other four animals it lived alongside.”

Horned dinosaurs were more diverse than previously thought, and some groups had relatively small distributions across the island landmass of Laramidia during the Late Cretaceous

Scientists have argued about the patterns of evolution within the group of horned dinosaurs over the years. “We now recognize over 30 species of centrosaurines within the greater group of horned dinosaurs, with more like *Lokiceratops* being described every year,” said co-author Andrew Farke from the Raymond M. Alf Museum of Paleontology. This study shows that centrosaurine ceratopsid species and clades were confined to small geographic areas. “The endemism present in centrosaurines is greater than in any other group of dinosaurs,” said undergraduate University of Utah student and co-author Savannah Carpenter. “Rapid evolution may have led to the 100- to 200-thousand-year turnover of individual species of these horned dinosaurs,” said Loewen. This rapid evolution is most consistent with sexual selection acting upon these animals. “Sexual selection acting on the genes responsible for the horns of the frill would produce modifications to cis-regulatory elements that would express differences in the size and shape of individual frill horns producing the variations in patterns we see in these animals,” said coauthor Jingmai O’Connor of the Field Museum in Chicago.

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SUBJECT OF RESEARCH

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COI STATEMENT

Andrew A. Farke is an Academic Editor for PeerJ. Brock A. Sisson is owner of Fossilologic LLC, which produces cast replicas of Lokiceratops elements..

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