Functional anatomy of *Tarbosaurus bataar* from the Nemegt Formation of Mongolia

Tarbosaurus bataar was the largest carnivore living at the area of present day East Asia in the Late Cretaceous (about 70 million years ago). It is commonly assumed that this dinosaur is the most closely related to North American *Tyrannosaurus rex* – one of the largest terrestrial predators of all time. The research on the skulls of these animals showed, however, differences in many respects. It turned out that the biting way of *Tarbosaurus* was similar to the co-occurring, smaller representative of Tyrannosauridae, *Alioramus remotus*. Currently, the results of the phylogenetic analyses do not agree whether *Tarbosaurus* is closer related to *Tyrannosaurus* or *Alioramus*. The similarities between *Tarbosaurus* and *Tyrannosaurus* or other North American representatives of Tyrannosauridae (e.g., *Daspletosaurus*, *Albertosaurus*, or *Gorgosarus*) may result from their parallel evolution connected to achievement of large body sized (over 10 m in length). Although the North American tyrannosaurids comprise a well-understood group of dinosaurs (especially the largest of them: *Tyrannosaurus*), their Asiatic relatives still await study. Among them, *Tarbosaurus* has an exceptionally rich fossil record, because to this moment over 30 almost complete skeletons of that dinosaur were found, allowing detailed understanding and reconstruction of the silhouette of that predator from before 70 million years ago.

The project envisions several goals: (1) reconstruction of *Tarbosaurus*'s skeleton; (2) tracking of the changes connected to the ontogenetic development of that dinosaur; (3) comparison of its skeletal built with the other representatives of Tyrannosauridae as well as determination of their interrelationships; (4) reconstruction of the musculature and movement mechanics of *Tarbosaurus*; and (5) study of the biomechanics and mechanical performance of that dinosaur's skull. Execution of all the project's goals will allow understanding of the changes occurring in the *Tarbosaurus*'s skeleton during ontogeny. To that aim, the fossils of *Tarbosaurus* may provide pivotal data that would allow resolving the problems concerning the other Tyrannosauridae – such as the matter of *Nanotyrannus*, which is considered by the researchers either as a juvenile *Tyrannosaurus*, or as a separate genus. Moreover, thanks to comparisons of *Tarbosaurus* and other large American Tyrannosauridae, it will be possible to identify similarities that appeared independently in relation to the achievement of large body sizes. The planned analyses of the bone shape (including the Principal Component Analysis, Regression Analysis) will enable precise tracking of the ontogenetic changes and determination of the range of intra- and interspecific variability. All of those collected data concerning the ontogenetic, intra-, and interspecific changes will facilitate reconstruction of the interrelationships of Tyrannosauridae. The restoration of the musculature of *Tarbosaurus* will allow simulation of that's predator movement mechanics and its comparison to *Tyrannosaurus*. Finally, employment of the Finite Element Analysis using the CT scans of *Tarbosaurus*'s skull will demonstrate the stress distribution during biting and tearing of its prey. The studies of that kind, which have been already performed on the skull of *Tyrannosaurus*, showed that the stresses accumulated mostly in the nasal bone. This bone is built differently in *Tarbosaurus*, so such an analysis may provide interesting results concerning the way these large (about 12-13 m long) predators catcher their prey. In summary, a comprehensive and multithreaded attempt at reconstruction of the life mode of *Tarbosaurus* will be possible.

In the collection of the Institute of Paleobiology, Polish Academy of Sciences, several dozen skeletons of *Tarbosaurus* are stored, which were discovered during the Polish-Mongolian Paleontological Expeditions to the Gobi Desert and brought to Poland during the 60s and 70s of the 20th century. The postcranial skeletons of *Tarbosaurus* were never described. Despite finding numerous bones of *Tarbosaurus*, which currently are housed in the Russian and Mongolian collections, and – not infrequently – encountered on auctions, numerous research problems related to the anatomy, relationships, and life mode of that dinosaur persist. Numerous skeletons of a single species of a large predator are very rare in the fossil record, therefore the series of skeletons of *Tarbosaurus* stored in Poland, Mongolia, and Russia enables reconstruction of the full picture of the animal living 70 million years ago and having no extant ecological analogues. In turn, description of *Tarbosaurus*'s bones in comparison with other Tyrannosauridae should show the evolutionary paths of one of the largest groups of predatory dinosaurs which ever existed. The papers being an effect of that work will be a basis for lots of other comparative studies of carnivorous dinosaurs and large carnivores in total.