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Anatomy of the Tree Pangolin (*Manis tricuspis*) Brain



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Abstract

Pangolins are the most highly trafficked mammals globally, and as such are under great threat of extinction. Unfortunately, our knowledge of their biology, and thus our ability to counter such threats through targeted breeding and re-introduction program is restricted. Historically, only a handful of scientific papers have examined aspects of the anatomy of the central nervous system, with the current thesis addressing this gap in our knowledge by providing comprehensive architectural and chemical neuroanatomical analyses of portions of the central nervous system of the tree pangolin (*Manis tricuspis*) including qualitative and quantitative analyses of: the olfactory system; the unusual locus coeruleus complex; the hippocampal formation; the diencephalon; and the brainstem and cerebellum. The observations made in the current series of studies highlights that the majority of the anatomy and neurochemistry of the tree pangolin central nervous system is what could be considered typical for a generalized mammal. Despite this, many observations of either specializations or reductions of specific parts of the nervous system were observed. Features that are of specific interest in terms of understanding pangolin behaviour include a very short spinal cord, enhanced olfactory and auditory systems, unusual aspects related to both the cholinergic and noradrenergic systems, and a rostral decussation of the pyramidal tract connecting with an enlarged hypoglossal nucleus, which is associated with a specialized serotonergic innervation (raphe obscurus nucleus) and an unusual architecture of the salivatory nuclei of the medulla oblongata. In summary, the observations made appear to relate to neural control of behaviours associated with predator avoidance (spinal cord, olfactory and auditory systems), the location of food (olfactory and auditory systems), sleep (cholinergic and noradrenergic systems), and the ingestion of food (pyramidal tract, hypoglossal nucleus, raphe obscurus, salivatory nuclei). These observations indicate that interesting avenues for developing a

greater understanding of pangolin behaviour should focus in these areas as indicated by the current neuroanatomical analysis. While additional anatomical studies need to be undertaken, for example on the amygdaloid complex and cerebral cortex, the current series of studies has identified several important aspects of pangolin biology that should help guide future research into these most unusual mammals.