Introduction

Ferrets enjoy a long history of interaction with humans. Initially domesticated to hunt rabbits, they now largely serve as pets. In science, they have come to represent an important model for a large variety of investigations. The ferret has found its way into the lab due to its moderate size and the relative ease with which it can be bred, raised, and kept under laboratory conditions.

It first garnered interest due to its highly evolved gyrencephalic cortex. The ferret brain is immature and lissencephalic at birth, but reaches its adult level of cortical folding and white matter maturation within a month. This makes the ferret an ideal animal model for studies of brain development and gyrification.

The structure and function of the nervous system of the ferret are in the focus of a range of disciplines, such as developmental studies, investigation in sensory to cognitive systems, theoretical neuroscience, social cognitive interaction, and others. Investigations of sensory systems of all qualities are performed at all levels of the nervous system in the ferret and serve to elucidate the foundations of normal sensory processing in realistic environmental context as well as pathological alterations.

A strong argument for the use of ferrets as an animal model to explore processing aspects in the nearly intact nervous system is the ability to get these animals to perform complicated behavioral tasks under experimental conditions like neurophysiological recordings, electrical or magnetic stimulation, or two-photon or optogenetically based procedures. Such experimental approaches rely on minimally invasive access to the brain structure under investigation and need to be controlled with high precision in target determination.

With the improvement of magnetic resonance imaging (MRI) techniques, MRI has become increasingly popular also for carnivore studies (for ferrets, see Hutchinson et al. (2017) and Zhou et al. (2016a)). To interpret and make full use of MRI results in translational research, images need to be linked to histologically delineated brain structures and electrophysiological findings, gene expression data, and more. For the rat and mouse, the most popular mammalian animal models in neuroscience, conventional brain atlases are available (for the rat, Paxinos and Watson (2013) and Paxinos et al. (2009); for the mouse, Franklin and Paxinos (2012) and Watson and Paxinos (2010)). For these animals, much progress has been made in building new-generation atlases. These atlases combine the advantages of imaging techniques with the knowledge about the anatomical structures and stereotaxic landmarks based on histological material from the classic atlases (for the rat, see Paxinos et al. (2015) and the Waxholm Space Atlas (Papp et al. 2014); for the mouse, see the Allen Brain Atlas (Allen Institute for Brain Science, 2017)). Such combined studies are still rare for mammals other than the rat and mouse, however. Saleem and Logothetis (2012) published an innovative stereotaxic atlas for the rhesus monkey, combining high-resolution MR images with detailed neuroanatomical delineations in histological material. A brain atlas for the rodent *Octodon degus,* bringing together histological and MR images, was presented by Kumazawa-Manita et al. (2013). A brain model for the marmoset monkey was reconstructed from histological sections with volume-rendering technology by Hashikawa et al. (2015). An atlas covering the cerebral cortex was published lately for the cat (Stolzberg et al. 2017). We recently presented a brain atlas of a popular rodent animal model, the Mongolian gerbil (*Meriones unguiculatus*), in CT/MRI-aided stereotaxic coordinates (Radtke-Schuller et al. 2016) which served as a template for the ferret atlas presented here. To date, no other published ferret brain atlas exists that has labeling and delineation of structures on a cyto-, myelo-, or chemoarchitectonic basis, and the availability of such information for carnivores is generally sparse. A ferret brain atlas with labels and delineations of structures on a microscopic level based on high-resolution magnetic resonance scans is lacking as well. The present atlas is intended to contribute to the filling of these gaps.

S. Radtke-Schuller, *Cyto- and Myeloarchitectural Brain Atlas of the Ferret (Mustela putorius) in MRI Aided Stereotaxic Coordinates*, https://doi.org/10.1007/978-3-319-76626-3_1

The atlas of the ferret brain provides high-quality histological material to identify brain structures in reliable stereotaxic coordinates by matching the series of histological sections to magnetic resonance images of the *in vivo* brain in the same ferret. The relationship between coordinates of brain structures and skull landmarks is essential for any stereotaxic procedure, in order to reliably target brain structures for recording, imaging, tracer injections, virus applications, or more. The *in vivo* position of the brain within the ferret skull was therefore verified by superposition of the magnetic resonance brain images with computerized tomography (CT) images of the skull. The atlas provides a common reference base to collect and compare data from any kind of research in the ferret brain.

In the light of ever-growing data on neuroanatomical details and advancing knowledge on connectivity in the ferret brain, the present atlas should be looked at as a current snapshot that invites ongoing knowledgeable implementation and perfection.