Abstract

Ray-finned fishes comprise more than half of the vertebrate diversity, and they developed many unique strategies and adaptations to inhabit miscellaneous water environments. This thesis is dedicated to vision, which is an indispensable sense for most fishes. Special focus is laid on photoreceptor morphology and their arrangement in a two-dimensional pattern – cone mosaic. There are three morphological types of photoreceptors commonly found in ray-finned fishes – rods, single cones, and double cones. Triple and quadruple cones that have never been observed in any other vertebrate group sometimes occur too. In this thesis, I discuss the structure and function of individual photoreceptors. While rods are randomly distributed across the retina, cones often form a regular mosaic. Several basic mosaic types can be distinguished according to the position of double cones. Row and square mosaics are the most prevalent. Basic patterns can be further modified in certain fish species. In this thesis, I describe basic patterns, I focus on mosaic development, and I investigate the reasons for regular photoreceptor arrangement. The type of mosaic partly reflects phylogeny, but it is also strongly influenced by the environment and life strategy of the fish. Active fishes inhabiting bright environments are likely to possess the most elaborated mosaic. The mosaic disintegrates with diminishing light or with decreasing demand for visual acuity, and some photoreceptor types disappear from the retina as well. Very structure-specific retinae are found in deep-water fishes that use bioluminescence as the only source of light. In this thesis, I describe the most common photoreceptor arrangements in fishes from various environments and I investigate changes in mosaic structure during development that are related to the change in habitat or life strategy. I also discuss the potential importance of the cone mosaic for polarization vision.