[Pigment Cells and Novel Aspects of Researches in Animal Colors]

Organized by Noriko Oshima
Department of Biomolecular Science, Faculty of Science, Toho University

Significance of Body Color and Its Changes and Complex Regulation of Chromatophore Motility in Teleost Fish

Noriko Oshima
Department of Biomolecular Science, Faculty of Science, Toho University

Animals utilize conspicuous colors and patterns as “aposematic” coloration. Inconspicuous them are conversely exploited as “cryptic” coloration. For fishes lacking the ability of vocal communication, such colors, patterns and their changes represent strategies of the utmost importance for the survival of individuals or of species. For example, “protective” color, which constitutes part of the cryptic coloration, is useful for avoiding attacks by predators, while conspicuous displays function to frighten predators. On many occasions, delicate changes in hues and patterns are used for communication with conspecifics. Further, in colorful places such as coral reefs, the yellows and blues that adorn many fishes blend well with that average reef background, providing camouflage from predators. Therefore, we must understand how marine creatures' eyes perceive the light and see each other—far differently than humans see them. Colors of fishes are due to the presence of pigment cells (chromatophores) in the dermis of skin tissue, where many varieties of chromatophores are located. Rapid changes of hues and color patterns are caused by the motility of chromatophores, and aggregation of pigment granules in the perikaryon and dispersion throughout the cytoplasm are the characteristic of the cellular motility of an ordinary dendritic chromatophores. Generally, in addition to several hormones such as MSH, MCH and melatonin, a neurotransmitter, norepinephrine controls the motile activities. However, there are exceptional cases, in which acetylcholine (ACh) is liberated from sympathetic nerve fibers: Melanophores of catfishes belonging to the family Siluridae possess cholinoceptors of the muscarinic type and are responsive to ACh, leading to pigment aggregation. Recently, prolactin has been found to cause pigment dispersion only in erythrophores and xanthophores, suggesting the possible involvement of the peptide in nuptial coloration. Endothelins (ET-1, -2 and –3) also induce pigment aggregation (in melanophores, xanthophores and erythrophores) or dispersion (in leucophores). ETs might play a role in the delicate and exquisite control of hues and patterns. In addition to biogenic chemical substances, light is an important factor affecting the chromatic state of the skin. Light-sensitive chromatophores that respond directly to light have been found in some adult fishes, indicating the possible existence of visual pigment in the cells. We lately found that Nile tilapia erythrophores recognize differences in the peak wavelength of incident light, and suggested the presence of multiple cone-type visual pigments in the cells. These chromatophores may be responsible for generation of peculiar color that may ethologically signify much. Thus, the chromatic systems of fish among members of the class Osteichthyes have developed extraordinarily sophisticated properties during the evolution of this class of vertebrates over the course of more than 400 million years.

Thermoreceptive and Photoreceptive Pigment Cells as Sensors of Changing Environmental Conditions

Yoko Miyashita and Tsuneo Moriya
Division of Biology, School of Medicine, Sapporo Medical University

In addition to being constantly involved in the front line of a defense system against varied environmental stresses, animal body skin functions as a sensor of changing environmental factors. Pigment cells which are involved in body coloration are localized in the skin tissue. We are interested in understanding the possible function(s) of pigment cells as sensors of environmental factors. Many poikilothermic vertebrates are able to change body color to adapt to their ambient coloration. These changes depend upon the activities of chromatophores, which are the pigment cells in the body skin of poikilothermic animals. Generally, the motility of chro-