Preface

Molecular biology is having a major impact in all areas of biological research. However, rather than being regarded as a separate discipline it should be seen as an extension to our existing repertoire of techniques, enabling us to study biological mechanisms at the whole organism, tissue, cellular and now at the molecular level. This volume presents some of the recent advances which have been made in understanding fundamental biological mechanisms in aquatic organisms by the application of molecular biology techniques.

In spite of homeostatic mechanisms, cellular environmental changes tend to be more extreme in aquatic animals as they cannot avoid external environmental changes such as temperature or salinity by simple behavioural means. The first four and the final chapter of this volume describe some of the recent advances made in understanding how adaptation to the environment is achieved at the level of gene expression. The first chapter (Cheng) describes how Antarctic notothenioid species of fish have adapted to their extremely cold environment by the production of antifreeze glycopeptides and provides new insights at the genomic level as to how heterogeneity of the antifreeze glycopeptides has arisen. In addition to long-term adaptation, some species of fish need to adapt to more acute seasonal changes in temperature. The chapter by Tiku *et al.* describes how the lipid composition of the cell membrane in carp is controlled by desaturases in response to cold temperature exposure, demonstrating a fascinating situation where transcription of a gene is increased by a decrease in the environmental temperature. The function of skeletal muscle is also acutely affected by changes in environmental temperature, and the chapter by Goldspink describes how changes in the expression of different isoforms of the myosin heavy chain genes in Carp are involved in maintaining locomotor function over a wide temperature range. As well having to overcome changes in environmental temperature, some species of fish have to contend with considerable changes in salinity, and the chapter by Cutler *et al.* describes how ion transporting proteins are involved

in this adaptation. Prolactin has also been shown to be important in osmoregulation, and the chapter by Prunet *et al.* describes the molecular characterization of the receptor for this polypeptide hormone.

The next four chapters of the volume cover aspects of gene expression in the growth and development of aquatic organisms. El Haj describes some of the genes which are involved in the growth of crustaceans which represent an interesting group of animals in that they grow intermittently. The chapter by Xu *et al.* describes why the zebrafish has emerged as a key model for developmental biologists, showing that as well as being interesting subjects of study in their own right, aquatic organisms can provide useful experimental models for the study of vertebrate development as a whole. Most of the body mass of fish is composed of skeletal muscle and the major contractile protein in this tissue is the myosin heavy chain. The chapters by Ennion and Gauvry *et al.* describe the advances made in understanding the genes which code for the different isoforms of this protein and their differential expression in growth and development in carp and trout, respectively.

The transfer of engineered or foreign genes to produce transgenic animals offers, in many ways, a better system of studying gene expression than transfecting cells in culture, as the latter tend to behave as embryonic cells and frequently give erroneous results. Using transgenic animals, it should be possible to define the regulatory elements that are involved in tissue-specific, developmental stage-specific expression as well as the response elements for gene switching induced by the hormonal and physical signals associated with altered environmental conditions. In many respects the production of transgenic fish has been less successful than mammalian transgenics and this has mainly been due to the comparative lack of fish-derived gene regulatory sequences. A lot of the early work in transgeneic fish was performed with mammalian-derived gene regulatory sequences and, perhaps not surprisingly, the efficiency of these sequences in fish species was relatively poor. Recently there has been a rapid increase in the amount of data available for fish gene regulatory sequences and the chapters by Maclean and Müller deal with the techniques for assessing the efficiency of gene regulatory sequences in transgenic fish.

These are exciting times and, by using the available and emerging molecular biology methods, we can understand the basic mechanisms of growth, developmental and adaptation at a fundamental level.

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