

Preface

Ever since estrogen was synthesized and became available for research in 1936, consistent endeavors have been made to understand the endocrine mechanism of sex differentiation in fishes. Hence, endocrine sex differentiation is the earliest to receive scientific attention among the genetic, endocrine—behavioral and environmental mechanisms of sex differentiation. Not surprisingly, a voluminous body of literature and a large number of books are available. However, even the most recent book on this topic has not covered viviparity, a phenomenon that occurs in 577 (about 20%) fish species and unisexualism. This book represents a comprehensive account covering relevant and related areas of endocrine and behavioral mechanisms of differentiation and transdifferentiation of sex in fish.

Commencing from neuroendocrine regulation, the book explores ovarian and testicular differentiation in gonochores and unisexuals, differentiation of morphotypes and transdifferentiation in sex changers, especially hermaphrodites. The book is perhaps the first to focus on factors that regulate the quantum of yolk accumulation in eggs. Vitellogenesis accumulates widely varying quantum of yolk in the piscine oocyte, whose size ranges from 350 μm (alecithal) to 20 mm (lecithal). Interestingly, for every 0.17 mm increase in egg size, an additional vertebra is formed within North American 71 cyprinid species. The book also brings to focus the obligate need for estradiol, a female hormone in the male to renew Spermatogonial Stem Cells (SSCs). From an analysis of the publications reporting the transplantation of Premordial Germ Cells (PGCs), Oogonial Stem Cells (OSCs) and SSCs, it confirms that differentiation in primary and secondary gonochores means the loss of bisexual potency of germ cells supporting somatic cells (GCSSCs). But the hermaphrodites retain bisexual potency of both PGCs and GCSSCs.

Unisexualism is an enigmatic phenomenon among fishes, although it occurs in less than a dozen species of hybrid origin. To solve the problem of hybrid sterility, the female unisexuals produce unreduced eggs through premeiotic endomitosis. To avoid the onslaught of mutational meltdown,

they have devised the following escape mechanisms: (i) paternal leakage, (ii) paternal genome replacement and/or (iii) paternal genome addition.

The book is perhaps one of the few, that projects the endocrine and behavioral role in sex differentiation among gonochores and transdifferentiation in sex changers. Classifying and describing the Alternate Mating Strategy (AMS) prevalent among fishes, it shows that the subordinates have minimized the disadvantages of their status by adopting AMS that makes the best of a bad situation. It conclusively shows that the changes in morphotypes are intrasexual in gonochores but intersexual in hermaphrodites.

This book recognizes the important role played by behavior in transdifferentiation among hermaphrodites and sex changing gonochores as well as in induction of social status among gonochores that displays AMS. Hitherto, the removal of harem master/mistress is known to induce dramatic sex change among one of the harem members. While collecting the widely scattered information, the book brings to focus that housing in isolation of either one or more individuals of the same sex also induces sex change rather slowly in one of the hermaphrodites. Similar isolation of subordinates or dominants results in ascendance of one of the two subordinates or descendance of one of the dominants in social status of gonochorics that display AMS. Hence social mediation plays a major role in induction of sex change in hermaphrodites and social status in gonochoric morphotypes.

Despite wide diversity in the structure of reproductive organs and system of hermaphrodites, the endocrine-behavior mechanism of sex differentiation remains common and thereby confirms the origin of hermaphrodites from fishes like *Macropodus opercularis* which changes sex more than once in either direction. Sex change and hermaphroditism are unique but an intriguing phenomenon, especially from the point of genetic basis of sex determination. Raveling through the maze of gonochore-hermaphrodite continuum, the book shows for the first time that all hermaphroditic fishes are potential hermaphrodites but functionally gonochores. Consequently, all of them are capable of changing sex once in a single direction or more than once in either direction. Only the frequency is minimal in simultaneous hermaphrodites and maximal in serial hermaphrodites.

To have a better insight into the endocrine mechanism of sex differentiation and to produce monosex progenies, steroids and other chemicals including from herba have been used to induce sex reversal in commercially important fishes. Considering the negative effects of these inducers on survival, growth and especially reproductive performance, the need for the production of YY and WW brooders is shown. But the steroid residuals in marketable fish or in the aquatic systems are too little to harm humans and waters.

The book is a comprehensive synthesis of over 1200 relevant publications collected from a widely scattered 248 journals and other 80 literature sources. Incisive analysis of the cited literature has culminated in proposing many new hypotheses.

September, 2012
Madurai 625014

T.J. Pandian