The work presented here centers around the toxic action of three pesticides, comprising organochlorine, organophosphate and bypyridilium compounds, on the euryhaline fish *Etroplus maculatus* (Bloch) (family: cichlidae). Aspects like individual toxicity, modulations in the activities of some selected enzymes, consequent to exposure to sublethal levels of pesticides, sublethal effects on peripheral haematology and alterations caused on the tissue architecture of brain, gills and liver, have been documented.

The chapter on Introduction presents material and notes on various aspects of the toxicants and the relevance of the study.

In general, information on the toxic effects of pesticides on fishes are detailed out in the Review of Literature. In this chapter, available papers on lethal and sublethal toxicity of pesticides are critically reviewed.

The chapter on Material and Methods details out, the animal used for the present day, methods of collection, instrumentation employed, chemical methods followed and the experimental designs to evaluate lethal toxicity and sublethal toxicity on enzyme activity, peripheral haematology and histopathology. The enzymes selected for
the study are Alkaline phosphatase (ALP E.C. 3.1.3.1), Acid phosphatase (ACP E.C. 3.1.3.2), Glutamate oxaloacetate transaminase (GOT E.C. 2.6.1.1) and Glutamate pyruvate transaminase (GPT E.C. 2.6.1.2) from the tissues like brain, gill and liver. The haematological parameters under study are Total erythrocyte counts (TEC), Haemoglobin content (Hb), Haematocrit (Ht), Erythrocyte constants like Mean corpuscular volume (MCV), Mean corpuscular haemoglobin (MCH) and Mean corpuscular haemoglobin concentration (MCHC) and Erythrocyte indices like Colour index (CI), Volume index (VI) and Saturation index (SI). Histopathological studies are restricted to the brain, gill and liver tissues. The statistical techniques used for analysis and computation of data are also outlined in this chapter.

The Experimental Results are presented under different sub heads. Two sets of concentrations, based on corresponding 96 h LC 50, are selected to evaluate the sublethal effects of individual pesticides, viz. DDT, Dimecron and Gramoxone. In short term exposure comparatively higher concentrations are used to delineate the effects caused due to high concentration over a short term period while long term experiments are designed to get an insight into the effects of low concentrations of pesticides over a long period of exposure.
Among the pesticides used DDT, an organochlorine was the most toxic for *Etroplus maculatus* giving 96 h LC 50 value of 0.005 ppm. The organophosphate, Dimecron, was found least toxic (96 h LC 50 0.17 ppm) and the Gramoxone, bipyridilium compound (Paraquat Dichloride) recorded an intermediate 96 h LC 50 value of 0.05 ppm. It was noticed that lethal concentrations of pesticides reduced as a function of time.

In general, during short term exposure studies the activity of two phosphomonoesterases, viz. alkaline and acid phosphatases, were found elevated following pesticide exposure in brain, gills and liver of *E. maculatus*. However, the alkaline phosphatase activity in gill showed a more or less "no response" in many cases. But in case of transaminases, viz. Glutamate oxaloacetate transaminase (GOT) and Glutamate pyruvate transaminase (GPT) activity elevated was recorded following short term exposure to pesticides.

In most cases, during long term exposure, pesticides caused more or less dose dependent modulation in enzymatic activity. Both phosphatases, ALP and ACP, showed inhibition while transaminases, GOT and GPT were found stimulated. However, non-linear pattern of enzymatic activity were also recorded, especially in gill. Of the three tissues, liver enzymes showed maximum activity response towards
pesticide insult. Generally no chemical-specific changes in activity could be observed.

Since lysosomes, cell membranes and endoplasmic reticulum are the major sub cellular units to encounter xenobiotics, a variation in the activity of both phosphatases bound to these cellular components is inevitable, while the animal is under stress. In animals, the two transaminases, GOT and GPT, are two important enzymes that catalyse the process of biological transamination. The variation in their activity can be considered as an indicator of pathological influence of pesticides.

During short term exposure to three pesticides, compensatory responses were noted in haematological parameters which in many cases were found non-linear. These compensatory haematological adjustments exhibited by *E. maculatus* were indicative of the immediate response to the respiratory stress following pesticide exposure. However, in long term exposure, pesticide caused negative effects on haematological parameters like reduction in TEC, Hb, Ht and corresponding reduction in erythrocyte constants and indices indicating development of a definite anaemic condition induced by pesticide. Further, the alterations in the haematological make up of *E. maculatus* are indicative of, apart from respiratory stress and consequent changes in metabolism,
physiological impairment such as reduced erythropoiesis, haemoglobin synthesis and its incorporation in red cells.

The histopathological examination of tissues like brain, gills and liver revealed pertinent changes in their tissue architecture, however, these changes were of non-specific nature. Nuclear pyknosis, vascular congestion and hyperaemia were the changes noted in brain following pesticide exposure. Gill lesions included oedema and hyperplasia of secondary filaments, hypertrophy and necrosis of inter-lamellar region, branchial congestion and swelling and elongation of filaments. Pesticide exposed liver of *E. maculatus* showed cytoplasmic vacuolization, periportal atrophy, radial disorientation, granulocytic infiltration, hypertrophy and nuclear pyknosis.

The chapter on Discussion enlightens the result obtained in the light of the available literature. It becomes clear that more investigations are warranted on the sublethal exposure of fishes to low levels of pesticides. List of scientific papers consulted with for the enrichment of the present work are provided under References.