CHAPTER ... I

INTRODUCTION
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(1) GENERAL

The Valley of Kashmir situated in the Western Himalayas, between the latitudes of 32°.17' and 36°.58' North and longitudes of 73°.26' and 86°.50' East, is 131 km in length and 40 km in width with an average elevation of 1600 meters above sea level. The Valley is surrounded on all sides by high mountains, and the valley on this account is zoo-geographically cut off from Jammu on the South and Ladakh on the North, the other two provinces of the State of Jammu & Kashmir.

Fishes are of great economic importance in Kashmir Valley, being one of the most important protein constituents of diet. In fact 60-65% people of the valley obtain their protein from this source. The fish fauna of Kashmir has received considerable attention from both zoo-geographical and biological stand points. Besides Heckel (1838-1844) and Hora (1934-1944), extensive work has been done by Das et al. (1963-1971) in a series of papers dealing with their origin, evolution, ecology, distribution and reproductive behaviour.

As a consequence of food importance of fishes, fishing in Kashmir has assumed a major professional dimension which unfortunately lacks an adequate scientific management. It thus becomes important to manage the propagation of the old species and introduce successfully new species without changing or disturbing the natural biological balance of the different species in the specific environmental media. This aspect of
fishery science has not received much attention hitherto with the result that endemic Kashmir fishes are on the decline and the coarse Carp (Cyprinus-carpio) now forms 75% of the fish population in the lakes.

In Kashmir, the fresh water bodies, whether lotic or lentic provide a great diversity in their physical, chemical and biological conditions from season to season, the chief biotic potential of these environs being plankton. The fishes develop a complex inter-relationship with the plankton to form a nutritional chain in the medium. The fish food chain is thus subject to seasonal variations, and exerts direct influence on the biology of fishes. One of the seasonal variations effected, is the seasonal gonadial changes in the fishes inhabiting the loto-lentic Dal lake of Kashmir, including the fecundity of the fishes. This was thus selected as the topic of the present investigations in a discrete water body such as Dal lake, which is an eutrophic lake situate between 34°08' - 34°30' latitude north and 74°48' - 74°53' longitude east, with a water spread of about 25 km². The water of the lake is greenish, being shallow in most of its parts. It has a high production of standing crop of both the producers (plankton and macrophytes) and the consumers (fishes, zooplankton and pedon).

(2) FECUNDITY

Studies on fish fecundity (egg production) form an important aspect of fishery science, particularly in the management of heavily-fished commercial species. In order to ensure the rational exploitation of the fish stocks, the
productivity of a particular species should be known. The work done on the subject is meagre in India. The main purpose of the present study is to investigate fish productivity and population balance of endemic and exotic fish species in Kashmir Valley.

The introduction of the Carp (Cyprinus carpio) into the waters of the Kashmir, which is a prolific breeder with very high egg production as compared to the endemic fishes of the valley, has brought about as crisis in the fisheries of the valley. This exotic fish has now invaded the whole flat land water bodies of the valley, and disturbed the natural biological balance of the endemic fishes of Kashmir. It has now been observed during the present investigations that only 20-30% indigenous fishes appear in a catch, while the rest 70-80% fishes consists normally of the Carp.

(3) GONADIAL CYCLES

Reproduction is one of the most important consideration in understanding the ecology of animals. The survival of any species in a seasonally changing environment depends on the development of mechanisms that permit it to adjust physiological functions to changes in that environment. Reproduction would, therefore, be expected to occur during the season that assures maximum survival of young. Information on reproductive cycling (e.g., the schedule and duration of the breeding season) and the relation of this cycling to the environment is essential for understanding the biology of a species and hence for scientific management of a fishery.
Reproductive activities in most animals undergo cyclical changes. The patterns of these changes in the gonads are characteristic for each species. Important recent studies abroad available on the cyclical changes of teleosts, are those of Henderson (1962); Barr (1963); Mizuc (1964); Colgrove (1966); Breeder (1966); Simpson and Wardle (1967); Moser (1967); Stephon Dadzic (1969); Hayder (1970); Peter (1971) and Barlow & Victor (1972).

Only a few workers Gokhale (1952); Ghosh and Kar (1957); Chopra (1958); Nair (1958, 59); Dharmamba (1959); Das (1964); Das and Malhotra (1965); Ahsan (1966); Malhotra (1968); and Das et al. (1969) studied the gonadial activities of fresh water fishes in India. But only preliminary work has been attempted on Kashmir fishes so far, the only attempt in this field being that of Das and Malhotra (1964), a study based on two female fishes alone. Studies on the testicular changes in Kashmir teleosts is being attempted for the first time.

**OOGENESIS**:

The Ovary of fishes normally consists of ovarian follicles developing from or in association with the germinal epithelium which covers the surface of the ovary as an extension of the peritoneum. The ovarian follicles of the fish ovary are supported by a highly vascular connective tissue, the **stroma**, which is also rich in elastic tissue and smooth muscles, extending into a somewhat denser connective tissue layer the **tunica albuginea** lying just under the germinal epithelium.
From the mature ovarian follicles the eggs may be discharged into the cavity of the ovary or directly into the peritoneum. As the follicles differentiate and the contained ovum mature, the epithelial cells increase in size and number to form a glandular granulosa layer. Soon theca becomes more distinct and differentiated into theca interna and theca externa. A non-cellular layer zona pellucida, separates the ovum from granulosa.

CORPUS LUTEUM:

A Corpus luteum regularly appears both in pre and post-ovulatory condition. In pre-ovulatory condition corpus luteum develops from atretic follicles (pre-ovulatory corpora lutea); while in post-ovulatory condition it develops from discharged follicles (post-ovulatory or corpora lutea). The present work also embodies studies on the remarkable problem of the development of corpus luteum and the extent and importance of atretic follicles.

SPERMATOCYUGESIS:

The spermatogenesis, like oogenesis occurs within the testicular units which are very much like the seminiferous tubules of mamalian testes. These units may be separated by a delicate connective tissue - the basement membrane - to form lobules. The basement membrane normally contains two types of cells, the gonocytes giving rise to the several generations of spermatogenic cells and the Sertoli cells. Just prior to spawning, the tubules filled with the mature sperms rupture and release their contents into the cavity of the testis.
In addition testes show \textit{intersitial cells} (Leydig cells) identifiable as the tubular intersitial cells of the many different fishes (Marshall 1960; Hoar 1965; Chan and phillips 1967; Moser 1967).

(4) **SPAWNING SEASON OF KASHMIR FISHES**:

The spawning season of Kashmir fishes in general, is different from that of the fresh water fishes of India. They usually breed during the spring rains from 1st week of April to the last week of July, these three months of Kashmir rainy season being the climax of the spawning period; while most of the fishes in India breed from July to September. Thus Kashmir fishes have a definite breeding season, which may alter from short periods to a few months, depending upon environmental factors and internal capacities. Due to these habits some fishes spawn in spring (\textit{Schizothorax esocinus}, \textit{Nemachilus kashmirensis}), some in summer and late summer (\textit{Carps}, \textit{Puntius} and \textit{Crossocheilus}) and still others in the fall/winter season (\textit{Trouts}).

In the Dal lake, some fishes such as \textit{Schizothorax} and \textit{Labeo}, exhibit migration only in the breeding season, moving to nearby hill streams and feeding canals to spawn in the colder waters. This peculiarity of Kashmir fishes makes this study all the more important and necessary from the management point of view.

(5) **REPRODUCTIVE ECOLOGY**

Reproductive cycle in fishes is almost a cyclical phenomenon. An annual cycle of the environmental (chemical and physical) factors like temperature, photoperiod, pH,
oxygen, carbondioxide, silicates, phosphates, markedly alter the fresh water habitates. In these seasonally unstable environments, reproduction is geared to take advantage of seasons, which offers the great opportunities for the development of the various activities of the body and for survival of the new generation.

These cycles of gonadial development frequently alter many aspects of metabolism as well as reproductive behaviour and reproductive physiology. Moreover the endocrine system forms a major link between the environmental conditions and the structure and function of the reproductive organs.

Physical stimuli serve as proximate factors which are conveyed through the brain-pituitary-gonad axis to ensure that the fishes are ready to carry out the reproductive processes at a time and place most favourable to the production of the gametes in gonads. A fine adjustment is provided by the fishes in their responses to the physical environmental and by their behavioural interaction with conspecifics. These environmental factors and indeed the Neurohypophysial hormones appear to play a role in the control of spawning and other reproductive activities of the fishes.

In view of all these interesting features peculiar to fishes, it was felt very necessary to undertake the present studies on the cyclic changes in the gonads of Kashmir fishes, (both exotic and endemic) and trace any observable differences and their significance.