Late Ku. Durga K. Banmeru Science College,
(B.Sc.,B.B.A.,B.C.A.,M.Sc.(Comp. Science))
Loni Road, Lonar Dist. Buldhana - 443302
Ph./Fax No. : 07260 - 221315
(Affiliated to Sant Gadgebaba Amravati University, Amravati
& UGC 2 (f) & 12 (B) approved)
कै.कु. दुर्गा क. बनमेरू विज्ञान महाविद्यालय,
(बी.एस्सी.,बी.बी.ए.,बी.सी.ए.,एम.एस्सी. (कॉम्प्यु.सायन्स))
लोणी रोड, लोणार जि. बुलढाणा - ४४३३०२
दूरध्वनी / फॅक्स क्र. : ०७२६० - २२१३१५
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युजीसी २ (एफ) व १२(बी) मान्यता प्राप्त)
अमृतं तु विद्या । विज्ञानं यज्ञ तनुते ।।
www.lkdkbanmerucollege.ac.in E-mail : pkbanmeru@yahoo.co.in; lkdkbscl@rediffmail.com
Dr. Prakash K. Banmeru
Principal
Dr. Santosh K. Banmeru
Secretary
डॉ.प्रकाश क. बनमेरू
प्राचार्य
डॉ.संतोष क. बनमेरू
सचिव

Internal Quality Assurance Cell (IQAC)

Criterion 3: Research Innovations & Extensions

Key Indicator: 3.4 Extension Activities

3.4.3.1: Number of extension and outreach Programs conducted in collaboration with industry, community, and Non- Government Organizations through NSS/ NCC/ Red Cross/ YRC etc., year wise during the last five years

Sr. No.	Title	Link
1.	NSS extension and outreach Programs conducted AY 2017-18	View Documents
2	NSS extension and outreach Programs conducted AY 2018-19	View Documents
3	NSS extension and outreach Programs conducted AY 2019-20	View Documents
4	NSS extension and outreach Programs conducted AY 2020-21	View Documents
5	NSS extension and outreach Programs conducted AY 2021-22	View Documents

Principal
प्राचार्य
Late. Ku. Durga K. Banmeru Science College
LONAR, Dist.Buldhana

स्थापना : जून २००० (शासन क्र. एनजीसी २०००/न.म.वि.(१/२०००)म.शि.-३/वि. २८ जून २०००)
College Code No. : 337
महाविद्यालय कोड क्र. ३३७

Amrut Sevabhavi Sanstha Parbhani's
Late Ku. Durga K. Banmeru Science College,
(B.Sc.,B.B.A.,B.C.A.,M.Sc.(Comp. Science))
Loni Road, Lonar Dist. Buldhana - 443302
Ph./Fax No. : 07260 - 221315
(Affiliated to Sant Gadgebaba Amravati University, Amravati
& UGC 2 (f) & 12 (B) approved)

अमृत सेवाभावी संस्था, परभणी द्वारा संचलित
कै.कु. दुर्गा क. बनमेरू विज्ञान महाविद्यालय,
(बी.एस्सी.,बी.बी.ए.,बी.सी.ए.,एम.एस्सी. (कॉम्प्यु.सायन्स))
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www.lkdkbanmerucollege.ac.in
E-mail : pkbanmeru@yahoo.co.in; lkdkbscl@rediffmail.com

Dr. Prakash K. Banmeru
Principal

Dr. Santosh K. Banmeru
Secretary

डॉ.प्रकाश क. बनमेरू
[redacted] प्राचार्य

डॉ.संतोष क. बनमेरू
सचिव

Internal Quality Assurance Cell (IQAC)

Criterion 3: Research Innovations & Extensions

Key Indicator: 3.3: Research Publications and Awards

3.3.1: Number of research papers published per teacher in the Journals notified on UGC CARE/ Approved list during the last five years

Sr. No.	Subject	Name of the Teacher	Research Papers in UGC CARE list/ Approved
1	Chemistry	Dr. S. B. Borul	View Document
		Mr. K. K. Wavhal	
2	Physics	Mr. Sharique Shaikh	
3	Botany	Dr. M. R. Bhise	
4	Zoology	Dr. M. V. Gaikwad	

Principal
प्राचार्य
Late. Ku. Durga K. Banmeru Science College
LONAR, Dist.Buldhana

Black Mildew's are the very specific group of ascomycetous fungi having interesting miro-morphological characters. Tiny colonies on living leaves show microscopic ornamental structures. Though, Western Ghats of India are not much explored, appears to be hub for these types of fungi, especially Mahabaleshwar, which is known for tourist place and its huge biodiversity. Present work is the systematic documentation of black mildew's representing to contemporary research in mycology highlighting issues of untapped diversity and ecology of Black mildews fungi. Each taxon is well described with appropriate line drawings, photo-micrographs, identification key, and specific ecological note. The mounting technique of the black mildews is interesting and speciality of this work. As such, this work provides a baseline data to ease their identification in the field, as well as in the laboratory. This work will become asset for the researchers, teachers, students and foresters.

Dr. Mahendra Bhise is presently as Assistant Professor at L. K. D. K. Banmeru Science College, Lonar, Dist. Buldana (M.S.). Studied in Botany (Mycology & Plant Pathology) at the Pune University, Pune & successfully completed his Ph.D. in Fungal Taxonomy from Shivaji University, Kolhapur. He is interested in Taxonomy of Black Mildews.

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BLACK MILDEW FUNGI FROM MAHABALESHWAR

Bhise, Patil, Salunkhe

Mahendra Bhise
Chandrahas Patil
Chandrakant Salunkhe

Foliicolous Black Mildew Fungi From Mahabaleshwar (Western Ghats)

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Biochemical Studies Of Supporting Cells In Fishes

First Edition

Dr. Milind Vitthal Gaikwad.

InSc

BIOCHEMICAL STUDIES OF SUPPORTING CELLS IN FISHES

First Edition

Dr. Milind Vitthal Gaikwad
Assistant .Prof
Head,Dept.of Zoology,
Late Ku.Durga K.Banmeru Science College
Lonar,Dist.Buldhana
Maharashtra

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RESPECFULLY
DEDICATED

To

MY PARENTS

Late Shri. Vitthalrao Gangaram Gaikwad

And

Sou. Parwatibai Vitthal Gaikwad

Preface

The present work deals with the biological study of fresh water fishes from Marathwada region. The biological and speciation of fishes like, *Channa gachua* is done in the present work with special references to meristic and metric studies. Reproduction in any animal is one of the basic functions to propagate the respective population in cyclic manner. Fishes has got a complicated reproductive behavior and very typical embryonic development. Morphologically, testis consists of different organelles, with cells like Sertoli and Ledig's cells or interstitial cell which are really supportive and functional unit of the gonads. The somatic (Sertoli) cell in fishes plays an essential role in embryonic determination of sex and spermatogenesis during adult life. Individual Sertoli cell aries as a clone of developing germ cells with nutrient and growth factors and it is also well established that the number of Sertoli cells are closely related to both testicular size and sperm output. Sertoli cell continue to proliferate and differentiate until the beginning of the puberty, when they seize dividing and start nursing the germ cells. At this point and in time, the future capacity of the test is to sperm production has thus been determined prior to puberty. Sertoli cells are immature and differ considerably with respect to morphology and biochemical activity from their mature cell. Several investigation have been focused on hormonal and paracrine regulations of the mature cells, but mechanical underlying the maturation and general maintenance of well functioning Sertoli cells remain obscure. Disturbance to Sertoli cell differentiation is thought to be involved in the pathogenesis of both poor sperm count and testicular cancer. It is speculated that, environmental agents that disrupts the estrogenic as well as androgenic balance in the testis play role in this connection.

The development of germ cells is critically dependent on the presence of somatic cells of the testis. In this regards Sertoli cell in fishes and probably in all vertebrates, play a pivotal role in the differentiation and development of a functional testis. In all mammalian species investigated up-till to now, no Sertoli cell proliferation has been observed after puberty and postnatal Sertoli cell mitotic activity ceases during the first wave of spermatogenesis when primary spermatocytes are actively proliferating. These events coincide with the formation of Sertoli cell barrier, tubular lumen, and an elaborated cytoskeleton, which is morphological and functional marker of Sertoli cell differentiation.

Histomorphometric investigation is an adequate approach to better understanding the spermatogenic process and testis function. Such an evaluation allows estimating the spermatogenic efficiency in each species, for example, the determination of the number of spermatogonial generations, the magnitude of the germ cell loss during spermatogenesis, and Sertoli cell efficiency. Very little information is available on Sertoli cell proliferation in teleost, the most numerous group of vertebrates.

Fish spermatogenesis takes place in cyst within the seminiferous tubule. The germ cells derived from single primary spermatogonia then divide synchronously to constitute an isogonics germ cell cloned that is bordered by Cytoplasmic extension of a single layer of Sertoli cells. Hence, in cystic spermatogenesis, a Sertoli is usually in contact with only one germ cell accompanied through the different stages of spermatogenesis and associated group of Sertoli cells. Spermiation, the release of mature germ cells by Sertoli cells, is achieved by opening the cyst. In some fish species, spermiation is associated with the degeneration of at least some of the Sertoli cells, so that Sertoli cells might have to be replaced in part to maintain the capacity for supporting subsequent waves of spermatogenesis. Moreover, in many species, developmental cycles with more than 50-fold changes in testis weight occur during successive annual reproductive seasons. This might be associated with yearly recurrent waves of Sertoli cells proliferation.

Finally, many fish species grow throughout life, which might require Sertoli cell proliferation in adults as a basis for allometric testis growth. The main objective of the present work was to perform a comprehensive morphometric study of different types of spermatogenic cysts and to investigate whether Sertoli cells and other cells of the testis are mitotically active. An alarming decline in reproductive behavior is recorded in vertebrate during recent decade considering environmental stressors.

In the evolutionary study, any aspect of fishes occupies a peculiar position in animal kingdom due to several reasons. To sustain population of age old animals in the recent years, it has become difficult to the scientists. Fishes being most delicate and susceptible animal, with complicated reproduction for study, requires a special attention for stock assessment and development. In prehistoric period, human being had very hard life even to obtain food for his survival. To overcome this problem, we started thinking to exploit the natural resources including hunting of the animals. Hence, through his power of thinking and interpretation concentrated attention to intense the aquatic resources for various purposes including the aquaculture.

Natural resources have been explored for the welfare of mankind and made progress in every field including the aquaculture. Due to ever increasing population growth, availability of land resource to overcome the increasing demand of nutrition food, have diverted their mind to exploit exploration of aquatic resources is the only way out to meet out the demand of food. Amongst the aquaculture, fish culture has become a prime object in this venture due to its multiple advantages and multipurpose uses,

In India 30% population is suffering severely for malnutrition, fish culture may be useful tool to provide healthy and easily digestible food. Taking these facts into consideration, scientists have been conducting many experiments in order to increase the fish population.

The relative change in gonadosomatic index (G.S.I), Lukine (1987) reported during pre-vitellogenesis and early vitellogenesis and features of follicle cells are indicative of high synthesis and secretary activities. Thus, the phenomenon of oogenesis in teleost fish is similar to amphibians. However, with little differing to dogfish, *Squalus acanthus* and ray, Lwamatsu, *et.a.,l* (1988) studied the developmental stages of oocytes during oogenesis in *Oryzias latipes* and grossly classified into perevitellogenic, phases and postvitellogenic phase. Joshi and Joshi (1989) recorded the seasonal changes in testicular activity in association with interstitial cells in *Puntius dukai*. He further reported that, the interstitial cells showed changes with advancement of spermatogenesis. The cell number during spawning markedly increases as spermatogenesis advances. Sadhu *et.al* (1990) studied the cell lodgments and chemical nature of ovarian and interstitial cells in teleost, *Punctius stigma* and *Mystus bleekeri* and reported that, in *Puntius stigma* it arises from the remainders of post ovulatory follicles and from stromal tissue in *Mystus bleeker*. Billard, (1992), reported that the spermatogenic activity in teleosts commences at frequent intervals of the year. Nair (1966) classified the gonads on maturity into six stages in female and 4 stages in the male catfish, *Arius subrostratus*. They have also studied the pattern of distribution of ova in different regions of the ovary and reported that, the ripe ova found in the anterior portion of the ovary, where as maturing in the oviducal region.

In view of the above reports, the present work is devoted to study the secretary cells and their developmental stages of gonads in non-cyprinid fish *Channa gachua* to conclude as to whether the growth line in gonad of the groups is similar or not.

These fishes are frequently found adjacent to muddy bottoms, including reefs. *Channna* is conspicuously coloured with brown and is nutritious food fish. The largest species, the *Channa murelius* grows in to 45 centimetres in length; other species are less than half of this size with elongate body deep, it is comparably long than *Channa gachua* with forked tail fins and widely separated dorsal fins present. Perhaps the *Channa* species unpopular among fish keepers attributed to its feeding habits.

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I wish to express immense gratitude and indebtedness to Professor, **Y.K.Khillare**, research guide, Department of Zoology, Dr. Babasaheb Ambedkar Marathwada University, Aurangabad for providing opportunity to carry out research work under his guidence. I am very grateful to him for his valuable guidance, help and constant encouragement throughout the course of work.

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I am very much thankful to my colleagues Mr. Shingare S.M., Dr. Thete P.B. Dr. Pathan T.S., Mr. Gaikwad S.L., Mrs. Kawade S.J., Mrs Mandakini Maske.,I am so thankful to my Principal, Late Ku. Durga K. Banmeru Science College Lonar.

I would like to express my special gratitude to my parents who thaught me the value of life and sisters for their constant encouragement and support to stand in life.

DR. M.V.GAIKWAD

Content

Chapter 1

Introduction

The study of fishes particularly in evolutionary history is always a fascinating. The first vertebrate animal known through the fossil record is an agnathan (lawless fish) found in the Cambrian period. Once upon a time, ostracoderms had abundant occupancy throughout the world but, later on due to some reasons, became extinct and only cyclostomes survived as relics of agnatha vertebrates. The jawed vertebrate (Gnathostoma) including acanthodes and placoderms also became extinct. Finally, sharks and bony fishes took a lead over all above groups of vertebrates i.e. ostracodenns, acanthodians and placoderms. Today, the evolutionary history of the fishes has reached to its climax where the actinopterygian stalk gave rise to the teleosteans fishes, having skull usually hyostylic and araphistylic. Gill clefts are covered by operculurn having single exterior opening, and air bladder, as highly organized apparatus. In earlier days, human being had very hard life and resides near the aquatic resources and obtaining his food by hunting fishes and since then fish has become an integral component of human diet. In this venture, fish has become a primary object due to its multiple advantages to the human beings. The developing country like India, made wonderful progress in aquaculture to meet out the demand of nutritional food in the present reference of population crises, because merely improvement in agriculture products and sufficient availability to meet the need of the people cannot solve the problem of malnutrition. Along with the industrialization, increased pollution has severely affected the water resources as quality and fertility of soil. The diet of all average Indians is less nutritious and contains very low calories which are inversely proportional to the energy demand; hence the diet is called as nutrition deficient diet. Therefore, the main requirement is the nutritious diet that can be supplicated through additional diet as the animal proteins. Fish flesh is highly protein contain and can be easily made available from any aquatic sources. Fish proteins are supposed to be the cheaper and of superior quality and contains components essential for body building than any plant Proteins. Due to it enormous utility value, piscine culture caught attention of the century all over the world. Taking into account of the need, suitable indigenous species are now available for culture. The fish species undertaken for present day aquaculture program are belonging to the, carp group. Besides this, few new species of perches and quick growing saltwater fishes are also under taken for culture. To cope up with the technique of aquaculture, knowledge of relative growth, maturity of fishes is therefore necessary.

The biosphere provides shelters to all kinds of the animals including oceanic, land dwelling and terrestrial in prevailing atmosphere. Their fossil records coordinate their existence in their successive period of the geological era, ranging from most primitive to a highly organized mammal.

Availability of natural food has great effect on the distribution, abundance and growth of fish species, knowledge of the food of fish and it's feeding behavior helps in understanding ecological relationship and there fore, useful in the fish management. Food of an animal may different at different stages of life and also differ from place to place and from season to season. It also differs according to abundance and availability of the food organisms. Therefore, it became necessary to study the food of fishes of different fish species at different localities, seasons and stages of life history to get complete picture of feeding habitat in respective species .Studies on the growth performance in fishes in relation to feeding period information for successful application in the management and exploitation of the resources. Growth rate is different in animal to animal pretending to sexual maturity. Fish makes a vital contribution to the survival and health of a significant portion of the world's population satisfying their diet also. It is especially important in the developing world. In some of Asia's poorest countries (Bangladesh, Cambodia) people derive as much as 75% of their daily protein from fish. In West Africa fish accounts for 30% of animal protein intake, and this number would be larger if the poor could not afford to buy more. Fish is a nutrition rich food for poor people, fish provides essential nourishment, especially quality proteins and fats (macronutrients), vitamins and minerals (micronutrients). Fish is a source of income, which can be used to purchase other additional food items.

Fish body weight and weight of gonad gives the gonado-somatic Index (G.S.I.). Fish growth and the G.S.I. is high mean while the development and growth of gonad simultaneously take place in the fish. The term "fecundity" can be expressed as the number of eggs laid in a single in one season by the species. In order to assess the population stock of any species the accurate estimation of the fecundity is essential. With the help of this information make to understand, that whether fish has attain the maturity and able to produce number of eggs in the spawning period. Present study insured that the growth of fish body weight and gonadal development along with egg laying capacity (fecundity) and when the fish attains its first maturity. Information on the reproductive biology of *C. gachua* is an essential component of the biological research.

The fresh water fish *Channa gachua* is a bottom dweller. Regression coefficients obtained from length-weight relationships (L-W) is indicative of isometric growth and differs not only between species but sometimes stocks of same species. The length-weight relationships are to sex, maturity, season is environmental conditions dependent (e.g. pollution). Seasonal changes in the structure of gonads are simultaneously studied. Gonads i.e. ovary and testis, on their stages of maturity are divided into five phases;

- Virgin or immature
- Maturing
- Mature or Ripe
- Spent and reproductive behavior as
    - Preparatory phase
    - Pre-spawning
    - Spawning phase
    - Post Spawning phase.

In the present investigation, an attempt has been made to correlate the developmental changes in supporting cells of gonads with the maturity. Changes concomitant with the gonad maturity and correspond to different maturity stages as:

- Pre-spawning phase
- Spawning phase
- Post-spawning phase and
- Preparatory phase.

In histological study of Sertoli cell and Leydig's or interstitial cells, spermatogenesis appears to be a fairly conserved process throughout the vertebrate series. Thus, spermatogonia develop into spermatocytes undergo meiosis to produce spermatids which enter spermiogenesis where they undergo a morphological transformation into spermatozoa. There is, however, variation amongst the vertebrates in how germ cell development and maturation is accomplished. This difference can broadly be divided into two distinct patterns, one in anamniotes (fish, amphibia) and the other in amniotes (reptiles, birds, mammals). For anamniotes, spermatogenesis occurs in spermatocysts (cysts) which for most species. This seeming independence of Sertoli cell regulation that allows germ cells through several developmental stages. Thus, due to either, to the anatomical organization of the testis, or structural simplicity of the germinal units, nonmammalian vertebrates can provide excellent experimental models for investigating many basic problems of male reproduction.

Although the testis in teleosts has been investigated for many years, little attention has been paid to the structure of the outer layers that enclose the testis and to its possible contributions to its organization. The present study, in a freshwater fish *Channa gachua* describes the arrangement and cytology of these tissues for convenience, referred to collectively as the outer wall, (OW) that includes the outer peritoneal layer and adjacent collagen fibers, myoid cells and diverse other cells e.g., fibrocytes, presumptive mesenchyme, macrophages, granulocytes, nerves, and blood vessels. Beneath the OW, there are two compartments; one is the gamete-laden spermatocysts, the other the interstitium, which is composed of cells and tissues that lie between the spermatocysts.

The two main organs in fish that are involved in the reproductive process are testes and ovaries. There are three types of fish ovaries; Gymnovian ovaries involve the release of oocytes into the coelomic cavity, which travel through the ostium and then enter the oviduct. In secondary gymnovian ovaries; ova are shed into the coelom, which then results in them going direcly into the oviduct. In cystovarian fish ovaries, the oocytes are directly deposited into the exterior by traveling through the oviduct. Depending on the species, they may have one of these three types of ovaries. Within the lobules, primary spermatogonia undergo numerous mitotic divisions to produce groups or cysts containing differentiating spermatogonial cells, all of them are in the same stage of development in a given cyst, Billard *et al*., (1982); Pudney, 1995). The terminology for these cells has long been confused. The term "lobule boundary cells" was first introduced by Marshall & Lofts (1956), followed by O'Halloran *et al*.(1970), who considered these cells homologous with the mammalian Leydig cells. The function of Sertoli cells in fish is not well established, but the ultrastructural morphology demonstrates the presence of spherical mitochondria with parallel crystae and lipid deposits in the cytoplasm Billard *et al.*, (1972); Cruz *et al.*, (1984); Grier, (1975); Mattei *et al.*, (1982), which are characteristics of steroid-producing cells, suggesting a possible role in steroid synthesis, or at least locations where these hormones are stocked Grier *et al*, (1977); Cruz *et al*, (1984); Mattei *et al.*, (1982). Cruz-Höfling and Cruz-Landim, (1984); However, knowledge about endocrine control of spermatogenesis in teleost fish has mostly been drawn from measurements of hormone levels in the peripheral blood, injection of pituitary extracts, gonadotropins, and steroids into either intact or hypophysectomized specimens Billard *et al.*, (1972). A layer of epithelial cells and basal lamina separates the cysts from each other. Therefore, the lobules of teleost testis contain two cell types: somatic epithelial cells lining the periphery of the lobules and cysts of germ cells within them. All the cysts are enveloped by differentiated cells, known as "cystic cells", "lobule boundary cells", or "Sertoli cells" Romagosa *et al.*, (2000).Fostier *et al.*, (2001); Weltzien *et al.*, (2002). Regulation of vertebrate spermatogenesis and testis development by hormones and growth factors, as well as the strategies applied by animals in the functional organization and regulation of the system of storage, mobilization and transport of energy substrates, particularly lipids, under specific conditions ranging from elevated metabolic rates during exercise to metabolic disorders.

The present work also deals with the biology of fresh water fishes from Marathwada region. The biological and speciation of fish like *Channa gachua* was done with special references to meristic and metric study.

The systematic possession of the fish in the animal kingdom is as follows.
Channa gachua (Ham.1822)

Phyllum	Chordata
Subphyllum	Vertebrata
Class	Pisces
Subclass	Teleost
Order	Physostomi
Family	Channaidae
Genus	*Channa*
Species	*gachua*

Study on the biology of reproductive in fishes is very critical. Study on the biology of reproductive in fishes is still more complicated but useful to understand the reproductive potential and annual regeneration capacity of the fish stocks. Earlier researcher has put forth description of reproductive strategies and the assessment of fecundity is fundamental topics in the biology of reproduction in fishes and population dynamics of fish species Hunter *et. al*, (1992).Studies on reproduction and gonadal changes, including the assessment of ova size at maturity, fecundity, duration of reproductive seasons, daily spawning behavior and spawning fraction, permits quantification of the reproductive capacity of individual fish in the particular spawning season.

This information in combination with estimation of egg production at river shows estimation of spawning stock biomass Lasker (1985) Saville (1964) and Parker (1980).

Sex ratio of a fish to their population during different seasons is useful in estimating relative abundance of the sexes in spawning stocks and growth rate of both the sexes Qasim (1966). In order to assess the reproductive activity, fishes of various size groups were frequently sampled and categorized. The age and size of sexually matured is essential to establish the optimum marketable size of a fish. Normally, all fishes do not attain maturity length at once and same age of the sexes. Considerable differences do exist among individuals. Qasim (1973) ascertained that, maturity is closely related to the growth rate of fishes and hence two phases of maturity (pre and post) should be closely distinguished. Maturation refers to the cyclic morphological changes taking place in the male and female gonads as they grow up fully to fully ripe ready to and release gametes. Significant changes in colour, visibility, shape and size of gonads reflect various maturity stages in many fishes. Determination of maturity stages of fish gonads and fishes provides information of maturity of a fish. Such knowledge reveals the age and size at first maturity of the fish species, spawning season, native place of breeding and period.

Fecundity is defined as the number of ova in the gonad of a female fish prior to spawning. Fecundity is also termed as the number of ova laid during the average life of a fish. This is estimated by different means and expressed in many ways. Remarkable differences in fecundity among species often reflect different reproductive strategies of the fishes (Pitcher and Hart (1982); Wootan (1984); Heltman *et at*, (1997). Female in better condition exhibit higher fecundit,y Kjesbu et al., (1991).

Fish size and condition are thus exhibits key parameters to properly assess fecundity at the population level in female. Padmaja *et. a.,l* (1997) studied oocyte development in larvivorous fish, *Aplocheilus panchax.* The developmental stages of ovarian maturity are judged by visual observations as histological survey. Staging of ovary is generally done on the basic of its appearance, color, size, weight and intensity of blood vascularization,

Stage I- Immature or virgin
Stage II- Maturing
Stage III- Mature or ripe
Stage IV - Spent

Condition value indices vary among individuals, and may vary annually within individuals to individuals. Changes in environmental factors and environmental stressor, such as temperature, may affect condition by influencing fish behavior and metabolism so also the food availability including pollutant action. Even within stock, fecundity is known to undergo annually long term changes, Norwood *et al*, (1986); Kjesbu *et al*, (1998) and have shown to be proportional to fish size and condition, health of the fish.

Bigger and healthy fish produce more eggs, both in absolute and in relative terms to body mass. Decrease in fecundity is due to condition that reflected in lower number of oocytes that developed through atresia. Fecundity and atresia can also be affected by environmental pollution Johnsons *et a*l, (1998). In the light of these issues, regular estimation of fecundity in conjunction with environmental and other biological data, would not only help to understand the underlying mechanism regulating fecundity, but could help to explain variability in recruitment.

Spawning is the process of emission of gametes (eggs and milt) from the body of fishes to exterior where the process of fertilization takes place. Determination of spawning potential in the lifespan, spawning season in the year and frequency of in the season of a fish is essential to assess the reproductive ability of population of the fishes. Spawning is confined to short spells of time (late summer) in most of the fishes inhabiting temperate waters with accurate level of temperature. Where as in tropical and sub-tropical waters with relatively minor temperature fluctuations, the spawning period is usually prolonged, extending almost throughout the year, but of course with one or two peaks of profuse spawning. Physical and chemical parameters, quality of water, external environment and internal biological conditions, such as feeding and growth in addition to migration, influences spawning in fishes. Breeding biology of a number of fresh water fishes, estuarine and marine have been reported through literature. Moreover, establishment of extensive databases on reproductive parameters with corresponding on abiotic factors enables the study of causal relationships between reproductive potential and environmental variables. This leads to better understanding reproductive output and enhances ability to estimate ovarian recruitment Kraus *et al,* (2002).There is essential role of gonadal cells to nourish and develop the gonads of the fish.

The study of fishes in evolutionary history is a fascinating story. The first vertebrate animal known through the fossil record is an agnathan (lawless fish) found in the Cambrian period. Once upon a time, ostracodenns had abundant occupancy throughout the world but, later on due to some reasons, became extinct and only cyclostomes survived as relics of agnathan vertebrates. The jawed vertebrate (Gnathostomatta) including acanthodes and placoderms also became extinct. Finally, sharks and bony fishes took a lead over all above groups of vertebrates i.e. ostracodenns, acanthodians and placoderms.

Today, the evolutionary history of the fishes has reached to its climax where the actinopterygian stalk gave rise to the teleosteans fishes, having skull usually hyostylic and araphistylic. Gill clefts are covered by operculurn having single exterior opening, and air bladder, as highly organized apparatus. In earlier days, human being had very hard life and resides near the aquatic resources and obtaining his food by hunting fishes and since then fish has become an integral component of human diet. In this venture, fish has become a primary object due to its multiple advantages to the human beings. The developing country like India, made wonderful progress in agriculture to meet out the demand of food in the present reference of population crises. Merely improvement in agriculture products and sufficient availability to meet the need of the people cannot solve the problem of malnutrition. Along with the industrialization, increased pollution has severely affected the water resources as quality and fertility of soil. The diet of all average Indians bellow powdery line is less nutritious and contains very low calories which are inversely proportional to the energy demand, hence, the diet is called as nutrition deficient diet. Therefore, the main requirement is the nutritious diet that can be supplicated through additional diet as the animal proteins. Fish flesh is highly nutritious and can be easily made available from any aquatic sources. Fish proteins are supposed to be the cheaper and of superior quality and contains components essential for body building than any plant Proteins. Due to it enormous utility value, piscine culture caught attention of the century all over the world. Taking into account of the need, suitable indigenous species are now available for culture. The fish species undertaken for present day aquaculture program are belonging to the, carp group. To cope up with the technique of aquaculture, knowledge of relative growth, maturity of fishes is therefore necessary.

Availability of natural food has great effect on the distribution, abundance and growth of fish species, knowledge of the fish food and it's feeding behavior will help in understanding ecological relationship and therefore useful in the fish management. Food of an animal may different at different stages of life and also differ from place to place and from season to season. It also differs according to abundance and availability of the food organisms. Therefore it became necessary to study the food of fishes of different fish species at different localities, seasons and stages of life history to get complete picture of feeding habitat in respective species .Studies on the growth performance in fishes in related to feeding period could be the information for successful application in the management and exploitation of the resources. Growth rate is different in animal to animal pretending to sexual maturity .The algal feeding and it's digestion by the herbivorous fish was studied by Moriarty (1973).

Fish makes a vital contribution to the survival and health of a portion of the population satisfying their diet. In some of Asian countries (Bangladesh, Cambodia) people derive as much as 75% of their daily protein from fish. In West Africa, fish accounts for 30% of animal protein intake.

Fish body weight and gonad gives the gonado-somatic Index (G.S.I.), with the Fish growth, G.S.I. is high. The term "fecundity" can be expressed as the number of eggs laid in a single season by the species. In order to assess the population stock of any species, accurate estimation of the fecundity is essential. Present study insure that the growth of fish and gonadal development along with egg laying capacity (fecundity) when the fish attains its first maturity. Information on the reproductive biology of *C. gachua* is an essential component of the biological research. Through the examination and classification of gonads into developmental stages such as reproductive period, spawning frequency, size at sexual Author Wootton (1984) and Bruton (1989), have reported that, numerous fishes inhabits variable ecosystems are able to adjust a with parameters responsible for environmental changes. Many workers have shown how the environmental fluctuations greatly influenced the processes of growth and reproduction in fish species exhibit seasonal growth and reproductive pattern Kelso (1973); Foltz *et al* (1977), Medford *et al* (1978); Bulow *et al*.(1978); Adams *et al*. (1982); Dabrowski (1985); Flath *et al* (1985), Dygert (1990). The importance of seasonal changes in the body composition and physiological status of fish in growth and reproduction as well as the relation length and weight have been accepted Love (1957), MacKinnon (1972); Craig (1977); Marais *et al* (1977); Dawson *et al* (1980); Pierce *et al*. (1980) and Costopoulus *et al* (1989). Usually, studies on the variations of factor related indices with body energy content have been used as indicators of seasonal physiological status and body composition changes. Also, the gonad somatic index and gonad energy content have been used as indicators of gonad composition and stage and development Herrera *et al.* (1988); Cone (1989); Fernandez (1989); Marais (1990), Springer *et al* (1990), Marais *et al* (1991); Rajasilta (1992). Measurements of total energy usually been used to quantify and transfer of energy seasonal allocation of energy for growth and reproduction Healey (1972), Solomon *et al* (1972); Hoss (1974); Elliott (1976); Diana *et al* (1979); Pierce *et al* (1981) and Paul *et al.*,(1993). The seasonal values of somatic and gonad somatic indices were estimated and were correlated to find the relationship between gonad development and length-weight of the fish. Maturity and sex ratios can also be determined. The most accurate and detailed means of staging gonads on microscopic examination and histological preparation and each specimen.

Consequently gonads are routinely staged this way during reproductive studies, is limited detail and often unreliable West (1990); McPherson (1992); Garcia *et al.* (1997).Documentations of the procedures and adoptation of some of these techniques in such assessment which is essential components of the research. Recent research by the Department of Fisheries in Western Australia, on reproductive biology of narrow-barred Spanish mackerel done by Michael Mackie and Paul Lewis (2001) .Snake headed fish, bottom dweller and inhibits in shallow and pelagic areas, where as adult are found in submerged and bottom level of freshwater medium. Length-weight relationship and fecundity in *Channa punctatus* was studied by Sarkar (1997). Length-weight relationship is also studied by Acharya (1990) in fish Otolithoriches biaurithes of Bombay (Mumbai). The weight is always the cube of its length. Regression coefficients obtained from length-weight relationships (L-W) is indicative of isometric growths and differ not only between species but, sometimes also between stocks of same species. The development of fish involves several stages, each of which has its own length-weight relationships. There may also be difference in the relationship due to sex, maturity, season and environmental conditions (e.g. pollution. Seasonal changes in the structure of gonads are simultaneously studied on maturity stages are divided into five phases; 1 Virgin or immature 2) Maturing 3) Mature or Ripe 4) Spent Quyyam and Quasim, (1964).

Stage I- Immature or virgin
Stage II- Maturing
Stage III- Mature or ripe
Stage IV - Spent

1.1 Gonado-Somatic Index (G.S.I)

A proper knowledge of gonad development in relation with the body weight is necessary to consider the stages of maturity and spawning phase. This is reported in terms of Gonad somatic index (G.S.I.) which expresses the relative change in gonad weight to the body weight. It is reported that the G.S.I. value increases with the maturity of fish. In the present investigation, the Gono-somatic index has been studied in both fish, *Channa gachua*. Fish body weight and weight of gonad gives the gonado-somatic Index (G.S.I.). The G.S.I. remains high while the development and growth of gonad. The term "fecundity" can be expressed as the number of eggs laid in a single season by the species. In order to assess the population stock of any species, accurate estimation of the fecundity is essential. With the help of this, it helps to understand whether fish has attain the maturity and able to produce eggs. Many workers had reported the relation between ova size and possible production of offspring. Fowler (1972) reported influence of ova size on the survival and growth of salmon *Salmo salar et al.,* (1971) reported The intra and inter specific variations in egg size are also dependent an individual fish generally produces eggs of uniform size Bagenal (1969); Zonova (1973); Larsson *et. al.,* (1978) have reported the differences in ova diameter and size of the female brooder and mainly determined by the genotype of parental fish Springate *et al.,* (1985). According to Springate and Bromage (1985) the availability of food also affects egg size.

Chapter 2

Material and Method

2.1 Collection of samples

Fresh water fish, Channa *gachua*, were collected from river Godavari in Maharashtra (India) for the present study from January 2008 to December 2011. Fingerlings *C. gachua* and 7 cm length and 4.5g in weight in the vicinity of river Godavari, under Fishes were fed with planktons as a natural food. The fishes were fed twice a day, at the rate of 4% to the body weight of fish. Twenty percent of fish were sampled monthly for their growth check-up.

Estimation of fecundity: For Fecundity, ovaries were taken from anterior, middle and posterior regions of both lobes and were counted. Prior to estimate fecundity, ovaries were removed from the fixative (formalin) and both ovarian lobes were slit to allow excess liquid to drain. The outer membrane dried using paper towel before the ovary was weighed to 0.1 mg. Tissue samples were taken from the middle region and one-fifth of the distance from each end of one lobe. These samples were cut in to 3 x 3 mm square of outer membrane in the whole gonad weight), and weighed.

During the study period, sampling for *Channa gachua* began in January, 2008 and extended until December 2010, the two fishing methods employed were gillnetting and cast netting. In the laboratory, each specimen was measured, weighed and split open. The sex and the stages of development of the gonad were determined by visual inspection and graded according to Nikolsky's (1963) scale. The gonads were removed and weighed. The gonad weight expressed as a percentage of the fish somatic weight Sturm (1978) was used as the gonado-somatic index (GSI).

The surrounding ovarian tissues were removed and the numbers of eggs in each pair of ovaries were determined by direct enumeration. The egg diameters were measured using ocular micrometre in a binocular microscope. Fecundity, only the largest eggs were used in estimating the fecundity of the species. The total lengths of the specimen examined ranged from 12.5 cm to 18 cm, the standard lengths while the weights ranged from 34g to 78g. The total fecundity in the ovary ranged from 1090 eggs in a fish of total length 15.6cm, The highest fecundity was observed in the biggest specimen while lowest fecundity of 604 eggs was not observed in the smallest specimen. The smallest specimen had a fecundity of 611 eggs. The mean relative fecundity was 15.11 eggs per gram body weight and this ranged from 2.88 eggs to 19.97 eggs per gram body weight.The equation describing the relationship between fecundity and standard length is given as:

$F = aL^b$ Bagenal, (1967)

Where F = Fecundity

L = Standard length in cm

b = Slope of the regression line (regression constant).

a = Intercept of the regression with the y - axis (regression

coefficient).

Fecundity can express as:

$$\text{1) Fecundity (F)} = \frac{\text{Total wt. of ovary}}{\text{Wt. of sub-sample}} \times \text{No. of mature eggs in sub-sample}$$

2) Gonado-Somatic Index (GSI) is measured by using following formula:

$$\text{GSI (\%)} = \frac{\text{Weight of gonad}}{\text{Weight of fish}} \times 100$$

Growth Measurement: Measurement of the length and weight of the fish were undertaken immediately after the specimens were procured from Godavari river. The fish was first wiped with blotting paper to remove excess mucus. Then lengths of the fishes were taken on a measuring board with 0.1 cm graduation and weighed individually on a weighing scale of 0.5 grams sensitivity. Monthly length and weight data was organized into various groups with 1.0cm class intervals. Length- weight data of 100 specimens out of which 50 females measuring 10. cm to 22 cm in length, and 50 males measuring 10 cm to 22 cm in length was recorded in the present study. Data on each sex was also noted and analyzed separately, following Petersons's frequency method.

During the present investigation, length-weight relationship of the fish, *C.gachua* was calculated separately using the formula proposed by Tesch (1971) as follows

W=a Lb
Where
W- Weight of the fish
L -length of the fish
a- constant and
b or n-exponent

Expression were later on transformed to logarithmic forms using expression

Log W= log a + log L b

Where, a-intercept of the line on Y-axis and b- Slope of the regression line.

Subsequently, the regression between the male and female was found out from the student's-t test. Coefficient of correlation (r) between the measurements of length and weight was also determined. The regression coefficient of each group was tested for significance of difference from 'Cube' relation Le Cren, (1951); Beverton and Holt (1957) employing student's test.

t = $\underline{\text{B-b}}$

Standard error of 'b'

Where, B-cube value (3) and b- regression coefficient

The following equation was adapted to calculate the Relative Condition Factor (Kn).

K = W / a Ln
Where

W — weight of the fish
L - Length of the fish
a -- constant and
n --exponent

The computer software SPSS version 11.0 and Minitab 15 version were used for all statistical analyses and graph plotting.

Histology technique: Histology technique is an area of research in life sciences that gives total architecture and also functional ability of the tissue. Histology of male, female gonads and with supporting cells has been carried out.

2.2 Fixitive

Bouin's fixative

Sutured aqueous picric acid ……………………………………………..75ml
40% formaldehyde……………………………………..........................25 ml
Acetic acid glacial ……..……………………………………………...05 ml
Tissues fixed for 18 hours to 24 hours and then studied.

Stains preparation

Haematoxylin ……………………………………………………...1 gms
Absolute alcohol …………………………….........................200 ml
Ammonium or potassium Alum ……………………………………20 gms
Distilled water………………………………. ………………..200 ml.
Mercuric oxide ………………………………………………….0.5 gms
Glacial acetic acid ……………………………………………………..8 ml

Dissolved the haematoxylin in absolute alcohol and add alum solution previously dissolved in hot distilled water. Heated the mixture up to boiling point and add mercuric oxide. Cool rapidly and used after filtered.

Eosin

1% stock alcoholic solution

1. Eosin ……………………………………………………………1gm
2. Distilled water …………………………………………….......20 ml
3. Dissolved and added alcohol 95% ………………………………80 ml

Working solution: (1:3) one part of eosin stock solution and 3 parts of 80% alcohol and to this added 0.5 ml glacial acetic acid to each 100 ml of stain and stirred just before use.

Biochemical analysis; Sex hormones: (Male and Female)

2.3 Sonicator

Instrument: Placed the tube on ice and immerse probe in the sample. (Probe should be immersed completely, without touching the tube at all!! bottom or sides!)

Press the Start key and pulse 3 times 30 seconds for each sample, until sample gets clear. Place the probe inside the ice for 20 seconds between samples. (For prevention of sonicator over-heating) While sonicating, make sure sample is not getting hot as the sonication proceeds.Make sure the sample doesn’t move during the sonication (check that the tip is always immersed. To check the efficiency of the Sonicator At the end of the procedure check the total energy in Joules shown on the screen. Write the numbers! Check differences between various tubes and tubes at the beginning of the procedure (first tube) and at the end of the procedure (last tube).

If the sample is heated during the 3 x 30’’: wait longer period of time between 30’’ pulses. If your sample is in volume larger then 10ml you should replace the sonicator tip to the one suitable for larger volumes. Using the small tip, designed for smaller volumes will damage the tip and reduce the sonication efficency.

Working: Press Timer: press 30 seconds then press Enter to confirm Press Pulser: Cycle ON 5 seconds, cycle OFF 5 seconds then: Enter to confirm. Go to the amplitude knob (bottom right) set to 37% (Do not exceed 40%)

Protein profile and characterization is done by gel-electrophoresis with the help of native electrophoresis protein was present ranging from 96 to 55 kd and by SDS-PAGE characterization of protein were carried out. Quantitative estimation of protein done by Lowry’s method (1951).Quantitative estimation of lipid done by Blackstock and Barnes

(1973) and quantitative estimation of glycogen done by Dezwann and Zandae z(1972). Chemilumnicence technology was used (CLIA-USA) for detection of sex steroids.

2.4 Chemoluminescence Technology

Chemoluminescence is the generation of electromagnetic radiation as light by the release of energy from a chemical reaction. Serum was further used for photo-detector in Chemoluminicence. Different tracers and signaling reagents were used to carry out luminescence reactions for hormones.Standardization of chemilumnisence apparatus for detection and quantification of freshwater fish sex hormone from serum. Standardization was done each time for total hormones using standard markers from USA.

Immunoassay: Testosterone (17â-hydroxyandrost-4-ene-3-one) is a C19 steroid with an unsaturated bond between C-4 and C-5, a ketone group in C-3 and a hydroxyl group in the position at C-17. This steroid hormone has a molecular weight of 288.4. Testosterone is the most important androgen secreted into the blood. In males, testosterone is secreted primarily by the Leydig cells of the testes; in female's ca. 50% of circulating testosterone is derived from peripheral conversion of androstenedione, ca. 25% from the ovary and ca. 25% from the adrenal glands. Testosterone is responsible for the development of secondary male sex characteristics and its measurements are helpful in evaluating the hypogonadal states.

In higher vertebrate female, high levels of testosterone are generally found in hirsutism and virilization, polycystic ovaries, ovarian tumors, adrenal tumors and adrenal hyperplasia. In men, high levels of testosterone are associated to the hypothalamic pituitary unit diseases, testicular tumors, congenital adrenal hyperplasia and prostate cancer.

Principle of the test used: Chemoluminescence Immunoassay is based on the principle of competitive binding between Testosterone in the test specimen and Testosterone-HRP conjugate for a constant amount of rabbit anti- Testosterone. In the incubation, goat anti rabbit IgG-coated wells are incubated with 10 µl of Testosterone standards, controls, patient samples, 100 µl Testosterone-HRP conjugate reagent and 50 µl rabbit anti-Testosterone reagent at 37°C for 90 minutes. During the incubation, a fixed amount of HRP-labeled Testosterone competes with the endogenous Testosterone in the standard, sample, or quality control serum for a fixed number of binding sites of the specific Testosterone antibody. Thus, the amount of Testosterone peroxidase conjugate immunologically bound to the well progressively decreases as the concentration of Testosterone in the specimen increases.

Unbound Testosterone peroxidase conjugate is then removed and the wells washed. Next, a solution of chemiluminescent substrate is then added and read relative light units (RLU) with a Luminometer. The intensity of the emitting light is proportional to the amount of enzyme present and is inversely related to the amount of unlabeled TESTOSTERONE in the sample. By reference to a series of T Testosterone standards assayed in the same way, the concentration of testosterone in the unknown sample is quantified.

Materials provided with test kit: Goat Anti-Rabbit IgG-coated microtiter wells, 96 wells. Testosterone Reference Standards: 0, 0.1, 0.5, 2.0, 6.0 and 18.0 ng/ml. Liquids, 0.50 ml each, ready to use. Rabbit Anti-Testosterone Reagent (pink color), 7.0 ml Testosterone-HRP Conjugate Reagent (blue color),12 ml 20x Wash Buffer, 30 ml Chemoluminescence Reagent A, 6.0 ml. Chemiluminescence Reagent B, 6.0 ml. Distilled water. Precision pipettes: 0.01ml, 0.05ml, 0.10ml.Disposable pipette tips.Glass tube or flasks to mix Reagent A and B., Microtiter well luminometer, Vortex mixer or equivalent, Absorbent paper and Graph paper.

Reagent Preparation: To prepare substrate solution, make an 1:1 mixing of Reagent A with Reagent B right before use. Mix gently to ensure complete mixing. Discard excess after use. Prepare the washing solution by diluting 1 part of the 20X PBS concentrate to 19 parts of distilled water.

Assay Procedure: Secure the desired number of coated wells in the holder. Dispense 10 µl of standards, specimens and controls into appropriate wells. Dispense 100 µl of Testosterone-HRP Conjugate Reagent into each well. Testosterone standards assayed in the same way, the concentration of testosterone in the unknown sample is quantified. Similar test was carried for DHEAS, Testosterone, estradiol, progesterone, cortisol, luteinizing hormone and follicular stimulating hormone.

The estimation of hormones can be done with an ultraviolet spectrophotometric method presented for the quantitative estimation of steroids which are in concentrations of more than 1.25 μ/ml. Estradiol-17β, progesterone, and testosterone were used in these studies. Based on uv light absorption at 230 nm for estradiol and progesterone, and at 240 nm for testosterone, the relative concentration of each steroid could be estimated. This method is very simple and rapid. It is economical, requires no sophisticated instruments, and is very practical for estimating steroids in pharmaceutical preparations, chemicals, or biological specimens Khayam H**.** (2004).

TEST FISH

Channa gachua Male.

Channa gachua female.

PLATE -I

Photo 1 Ovary position in Female Channa gachua (Ham-1822)

Photo 2.Mature ovary in Female Channa gachua (Ham-1822)

PLATE -II

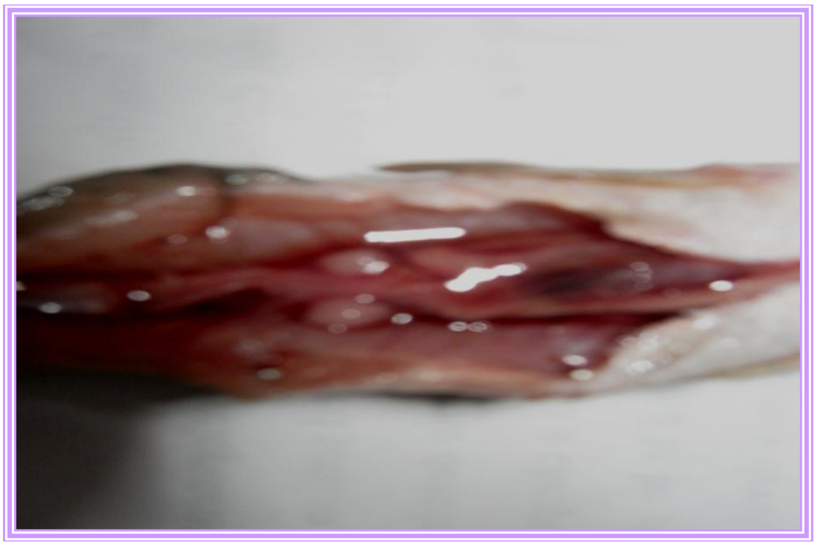


Photo 3. Testis in growing phase of Channa gachua

Photo 4. Testis in growing phase of Channa gachua

PLATE -III

Photo 7 - Matured testis phase position in *Channa gachua.* (Ham-1822)

Photo 8 - Matured Testis

Chapter 3

Metric and Meristic Study

The metric and meristic studies can be represented by a mathematical expression called a power or scaling equation West *et al.* (1997); Harte *et al.* 1999). The scaling laws has also been used further to body temperature, biological clocks, ontogenetic growth, home ranges of animals and species diversity patterns West *et al.* (2001); Haskell *et al.* (2002) and Enquist *et al.* (2002). Both single cause and multiple cause explanations of positive correlation have been debated at length (Darveau *et al.* 2002; Banavar *et al.* 2003; West *et al*(. 2003; Brown *et al.* 2005) and these debates are far from being settled. In this paper, efforts have been made to establish scallometric relationships in a freshwater Scaling equation simply describe how a system's feature changes in proportion to the scale of the system. In biology, scaling equations describe a variety of allometric relationships. The general equation of positive correlation is given by, $Y = {}_{a}X^{b}$ (1) Where, 'Y' is a dependent variable, 'a' is normalization constant, 'X' is the independent variable, and 'b' is the scaling exponent. Taking the logarithms of both sides of this equation gives the expression for a straight line: X log b a log Y log + = (2) Thus, the statistics of linear regression can be used to fit scaling functions to maintained data. The exponent b is of particular interest as it can depict two important outcomes. Firstly, whether X and Y are related as expected by Euclidian geometry, i.e. are they must be isometric, for instance whether mass scales as cube of length, area as square of length, etc. Secondly, while comparing two variables belonging to same scalar quantity, for example, length of head and length of body, mass of brain and mass body etc. Variables grows more rapidly than the other ($b > 1$), less rapidly than the other ($b < 1$) or grows in proportion ($b = 1$). Studies in positive correlation have attracted both ecologist and evolutionary biologists for a variety of reasons. Ecologists have used allometric relationships to characterize growth patterns in organisms. For instance, especially in fish, the allometric relationship between length and weight is used for determining the conditioning factor, a measure of well being of the live stock in the given environment (Peck *et al.* 2005). Evolutionary significance of positive correlation has focused on identifying universal scaling laws, which can explain fundamental structural, metabolic and physiological rules that span over 21 orders of magnitude in size of biological diversity (West and Brown, 2005). Current research on positive correlation laws is influenced by three schools of thoughts that have emerged from observations on scaling between basic metabolic rate (BMR) and mass (M) of an organism (West and Brown, 2005). Both these schools rely on single cause explanations of scaling exponent. The third school of thought suggests that there are multiple causes for the scaling exponent and that the exponent is not a fixed value but rather a follows a distribution selected evolutionarily based on the metabolic activities of the organism (Kozlowski and Konarzewski, 2005). Interestingly, all three claims are supported experimentally under different sets of conditions. Present study addresses two major concepts, first, how do various tissues change with increase in conjunction and growth of the fish. Second, how do tissues associate with reproductive organs and shows seasonal growth as per the reproductive cycle, scale with the body parameters. In the present study, it shows that the scaling exponents of characters directly related to the reproductive success shows non-isometric relationships, probably due to their selection for maximum reproductive output.

While scaling exponents of characters that are not directly related to reproductive success with scale, isometrically. There may be any probable reasons that lead to the selection of non-isometric relations in the allometric scaling. If a system is self-similar, there exists some feature constant on all scales (Kharat *et al.* 2008).

3.1 Results and Discussions

For a constant density, the mass and weight of fish is expected to scale as cube of length as per the Euclidian geometry. Thus, the exponent b in a length-weight relationship should be close to value of it's cube 3. However, the length-weight relationship in *Channa gachua*, for the pooled data of three year showed a best fit curve defined by the equation, W = $_{0.2823}$ $L^{2.8567}$re 1., r = 0.8296, p < 0.001). This exponent 2.8567 (SE 0.2541) is far lesser than the expected cubic value.

Monthly growth in term of length-weight relationship during circannual cycle (2007-08) is average length=12.0 and average weight= 29.4 and regression equation W=2.00L3.00, t-test=0.05 * (table no.1), Average length= 13.8, average weight= 20.6 and regression equation is W=2.00L3.93, t-test=0.05 * (table no. 2), Average length= 16.7 average weight=51.3 and regression equation W=2.00L2.40 with t-test=0.01* * (table no3). Average length= 14.2 average weight= 45 and regression equation =12.00L2.39 with t-test = 0.05* (table no 4) .Average length= 16.1, average weight= 60 and regression equation W= 51.9 L 2. 43 with t-test = 0.05* (table no.5).Average length= 17.2 average weight=65 and regression equation is W= 57.3 L 2.41, with t-test=0.05 *(table no.6). Average length=13.0 average weight=25.0 regression equation W=67.9 L 2.49, with t-test=0.05 * (table no.7).Average length=20.0 average weight=80.0 regression equation W=67.9 L 2.049 with t-test=0.05 * (table no.8).

Average length=13.2, average weight=19.4 regression equation W = 543.L 2.48 with t-test=0.05 * (table no.9).Average length=7.1average weight=8.2, regression equation W = 56.8 L 2.128 with t-test=0.05 * (table no. 10).Average length=8.0, average weight=5.0, regression equation W = 32.7L 2.47 with t-test=0.05 *. (Table no.11)Average length=8.2, average weight= 10.0, regression equation W = 56.8 L 2.172 with t-test=0.05 * (table no.12).

Length-weight relationship during circannual cycle (2008-2009) is average length=13.1 and average weight= 19.5 and regression equation W=3.00L3.41, t-test=0.05 * (table no.13), Average length= 12.1, average weight= 18.8 and regression equation is W=2.00L3.93, t-test=0.05 * (table no. 12), Average length= 15.8 average weight=39.1 and regression equation W=2.96L2.40with t-test=0.05* * (table no13). Average length= 14.8 average weight= 45.7 and regression equation W=2.96L2.139 with t-test = 0.05* (table no 14).

Average length= 15.8, average weight= 39.1 and regression equation W=2.96L2.40with t-test = 0.05* (table no.15). Average length= 14.8 average weight=45.7 and regression equation is W=2.96L2.139 with t-test=0.05 *(table no.16).Average length=15.5 average weight=35.0 regression equation W=2.96L2.41 with t-test=0.01 * (table no.17). Average length=12.2 average weight=23.0 regression equation W=2.96L2.141 with t-test=0.05 * (table no.18). Average length=13.5, average weight=35.2 regression equation W=0.1L2.51 with t-test=0.01 * (table no.19). Average length=14.4 average weight=35.0, regression equation W=25.1L2.41with t-test=0.01 * (table no. 20).Average length=15.2, average weight=48.1, regression equation W=23.9L283 with t-test=0.01 *. (Table no. 21).

Average length=15.4, average weight= 45.0, regression equation W=35.2L 2.41 with t-test=0.05 * (table no.22).Average length= 10.2, average weight= 13.5 regression equation W=24.6L 2.49 with t-test=0.05* *(table no.23). Average length= 17.8, average weight= 54.0 regression equation W= 43.2 L 2.43 with t-test=0.05* *(table no.24)

Length-weight relationship during circannual cycle (2009-2010) is average length=8.5 and average weight= 9.4 and regression equation W=24.4 L 2.49, t-test=0.05 * (table no.25), Average length= 13.9 , average weight= 38.1 and regression equation is W= W= 34.9L 2.42, t-test=0.05 * (table no. 26), Average length= 18.5 average weight=50.0 and regression equation W=36.1 L 2.41 with t-test=0.05* * (table no.27).Average length= 14.5 average weight= 33.1 and regression equation W=54.2 L 2.41with t-test = 0.01* (table no 28). Average length= 18.2, average weight= 74.1and regression equation W= 23.1 L 2.41 with t-test = 0.05* (table no.29). Average length= 15.1 average weight=35.1and regression equation is W= 32.1 L 2.74 with t-test=0.01 *(table no.31).Average length=14.3 average weight=35.0 regression equation W= 36.2 L 2.50 with t-test=0.01 * (table no.32). Average length=11.5 average weight=23.1 regression equation W= 21.1 L 2.43 with t-test=0.01 * (table no.33).

Average length=12.9, average weight=28.8regression equation W= 54.2 L 2.45 with t-test=0.01 * (table no.34). Average length=15.2 average weight=45.0, regression equation W= 54.9 L 2.47 with t-test=0.01 * (table no. 35). Average length=9.5 average weight=10.0, regression equation W= 56.8 L 2.042 with t-test=0.01 *.(Table no.36).

Turkmen *et al.* (2001) has argued the exponent b in fish differ according to the species, sex, age, season and fish feeding. While, Moutopoulos and Stergiou (2002) attributed the variation in exponent b from its expected cubic value to differences in the number of specimen examined to area or season and differences in the observed length ranges of the specimen caught.

Darveau *et al.* (2002) however argued that, the positive correlation exponents can show deviation from universal exponents depending upon the state of the organism leading to an additive effect of allometric cascades. Their point was severely criticized by West *et al.* (2003) and Banavar *et al.* (2003).

In the length-weight relationship study exponent b show a normal distribution on both sides of the cubic value with little deviation. Peck *et al.* (2005) has shown the effect of ontogenic changes on the possitive corelation of mass and length relationship in a fish *Sprattus sprattus*. We, however, suspect that the major factor, which affects the exponent *b* in *Channa gachua* , could be the degree of sexual maturity of the fish, and found value at 2.234, Figure 43 (a) is an additive effect of high variation in gonad weight during various stages of sexual maturity. To substantiate this argument we plotted the exponent *b* for the data of one year, Figure 43 (b). If the weight scaled as cube of length in post spawning seasons, it will scale more than cube in pre-spawning and spawning period, due to the weight of the gonads. This may lead to hampered moment of fish, as the streamline structure of the fish will be distorted. Thus, the adaptation of the fish to a smaller exponent during the post-spawning months not only renders it rapid moments in post-spawning months but also with the advent of the pre-spawning and spawning period. The exponent approached cube or slightly more than the cube, making it possible that the fish maintains streamline body for the upstream migration during spawning. as the scale of the body increases the relationship depicting change in lengths of two tissues should show an exponent of one and the relationship depicting change in length versus weight should show an exponent of 1/3 or 0.33, in Euclidian geometry.

These isometric relationships suggest that tissues are not under the pressure of selection for maximum reproductive efficiency, the relationships can follow Euclidian geometry. To study the scaling laws during reproductive phase of the fish, 100 gravid fully ripped females were considered. The length-weight relationship of these females had an exponent of more than 3 as per our expectation figure 43 (b).

The length-weight relationship was given by the equation logW= 2.234logL2.876, r = 0.8217. If it is assumed that, the eggs are tightly packed in the ovary and have a constant volume Veg., then the total volume of the ovary Vo will be equal to, Vo = Veg. × F, where, F is the fecundity. The observed relation is F = 2.4058Wo 3.011 Figure 44 (a), r = 0.5536, $p < 0.01$, SEE 0.1020) which is statistically different from unity.

Most interestingly, the literature survey on the relation of F and Wo in other fish showed marked deviation from the unity. Such information found suitable while calculating the gross estimate of fecundity.

In the present study, it can argue that the deviation of exponent from unity in this relationship probably could be attributed to the error incorporated during this sub-sampling method. It is less likely that, lower than unity exponent in this relationship is an outcome of selection. If we expect that the ovary grow in proportion to the body growth, isometry suggests that Wo should scale as cube of L (length) and as unity with W (weight). However, the found relationships are Wo = 0.5933×10 – 6L2.931, Figure 44 (b), r = 0.8818, p < 0.001, SEE 1.2240) and Wo = o.2969W 2.245 Figure 44 (c), r = 0.8497, p < 0.001, SEE 0.2208).

These relations further observed among the relationship between F, L and W by the equations F = 0.7324×10–8 L 2.767, Figure 44 (d), r = 0.511, p < 0.001, SEE 0.6023) and F = 0.3584 W 50.52 (Figure 44 (e), r = 0.698, p < 0.001, SEE 0.7234). The non-isometric growth of ovary as compared to somatic tissues can have evolutionary significance. Our relationship concludes that the weight of ovary scales 1.400 times the weight of the body. That is, with increment of ovary unit in body weight and increase in ovary weight is drastic. This arrangement suggests that the fish devotes its entire abdominal space for the growing ovary. We suspect that; adaptation could be an outcome of maximization of fitness in terms of reproductive output, because with unit increment in the body weight the weight of ovary that is carried by the female increases by a factor 1.2., such adaptations will not give universal scaling exponent because each fish will differ in its reproductive cycle and r and K selection during respective seasons. The scaling exponent for relationship between F and L or F and W is variable in different fish species. Their inferences are based mainly on the relationship between metabolic rate and body mass and the factorial like geometry of the organisms (West *et al.* 1997).Along with other reports of deviation from allometric relationships that the positive correlation can show deviations from universal exponents (Peck *et al.* 2005). Furthermore, Kozlowski and Konarzewski (2005) have criticized the single cause explanation a pluralistic approach to scaling, founded-on the life history theory, can explain the scaling relationships. Our findings supports Kozlowski and Konarzewski’s (2005), claim by suggesting that the scaling exponent are subject to change from isometry depending on the reproductive cycle, r and K selection and the selection pressure on characters from the point of view of maximizing reproductive outcome. Positive correlation will be subject to selection especially if it is directly relevant for the reproductive efficiency of the organism.

In study, it is observed that isometric relationship, which could be fairly constant, between parameters, which are not directly relevant in the reproduction of the fish. Interestingly we observed a non-isometric exponent in the relationship between L and W. In *Channa gachua* that migrate up-streams for the reproduction, maintaining the streamline structure is an essential and thus the non-isometric exponent could be an adaptation as described before. In case of other gonadal tissues that are associated with the reproductive behavior of the fish, observed a non-isometric exponents, which are also not universal in other fish species. The relationship between Wo and L that gives extraordinary high deviation from the cubic value clearly indicates that the gonadal tissues are subject for selection towards high reproductive efficiency. Further more, a relationship showed isometric exponent reproduction and related parameters could be between Wo and F suggests all parameters are under the same selection pressure.

3.2 Meristic characteristics of *Channa gachua* (Ham. 1822)

Lateral Lines	:	1 Interrupted
Scales on lateral line	:	30 - 35
On lower limb	:	16-22
On upper limb	:	6 – 9
Total	:	22-31

Fins:

Dorsal fin(s):		
Attributes	:	no striking attributes
Fins number	:	2
Dorsal	:	0-0
Finlets No.	:	Ventral 0-0
Spines total	:	8-8
Soft-rays total	:	9 – 9
Adipose fin	:	Absent
Caudal fin:		
Attributes	:	Forked; more or less normal
Fins number	:	5
Spines total	:	5 – 7
Soft-rays total	:	7-7

Paired fins;		
Pectoral -	:	Spines 0
	:	Soft-rays15-17
	:	Attributes more or less normal
Position thoracic before origin of D1 Pelvics		
	:	Spines 1
Soft-rays	:	5 -5

Table: 1 Length-Weight Relationship in *Channa Gachua* January -2008 Growth of Fish, *Channa Gachua* in Terms of Length-Weight Relationship During First Circannual Cycle 2007-2008

Length of fish cm X)	weight of fish gm Y	X	Y	XY	Log/L	Log/W	r-value	Regression equation.
12	30	144	900	360	1.07918	1.4771	0.55	W=2.00L3.00
12	30	144	900	360	1.07918	1.4771	0.55	W=2.00L3.01
12	30	144	900	360	1.07918	1.4771	0.55	W=2.00L3.02
12	30	144	900	360	1.07918	1.4771	0.55	W=2.00L3.03
12	30	144	900	360	1.07918	1.4771	0.55	W=2.00L3.04
12	30	144	900	360	1.07918	1.4771	0.55	W=2.00L3.05
12	30	144	900	360	1.07918	1.4771	0.55	W=2.00L3.06
12	30	144	900	360	1.07918	1.4771	0.55	W=2.00L3.07
12	30	144	900	360	1.07918	1.4771	0.55	W=2.00L3.08
12	30	144	900	360	1.07918	1.4771	0.55	W=2.00L3.09
12	30	144	900	360	1.07918	1.4771	0.55	W=2.00L3.10
12.5	14	156.25	196	175	1.09691	1.1461	0.55	W=2.00L3.11
12.5	14	156.25	196	175	1.09691	1.1461	0.55	W=2.00L3.12
12.5	14	156.25	196	175	1.09691	1.1461	0.55	W=2.00L3.13
12.5	14	156.25	196	175	1.09691	1.1461	0.55	W=2.00L3.14
12.5	14	156.25	196	175	1.09691	1.1461	0.55	W=2.00L3.15
12.5	14	156.25	196	175	1.09691	1.1461	0.55	W=2.00L3.16
12.5	14	156.25	196	175	1.09691	1.1461	0.55	W=2.00L3.17
12.5	14	156.25	196	175	1.09691	1.1461	0.55	W=2.00L3.18
12.5	14	156.25	196	175	1.09691	1.1461	0.55	W=2.00L3.19
12.8	26.3	163.84	691.69	336.64	1.10721	1.42	0.55	W=2.00L3.20
12.8	26.3	163.84	691.69	336.64	1.10721	1.42	0.55	W=2.00L3.21
12.8	26.3	163.84	691.69	336.64	1.10721	1.42	0.55	W=2.00L3.22
12.8	26.3	163.84	691.69	336.64	1.10721	1.42	0.55	W=2.00L3.23
12.8	26.3	163.84	691.69	336.64	1.10721	1.42	0.55	W=2.00L3.24
12.8	26.3	163.84	691.69	336.64	1.10721	1.42	0.55	W=2.00L3.25
12.8	26.3	163.84	691.69	336.64	1.10721	1.42	0.55	W=2.00L3.26
12.8	26.3	163.84	691.69	336.64	1.10721	1.42	0.55	W=2.00L3.27
12.8	26.3	163.84	691.69	336.64	1.10721	1.42	0.55	W=2.00L3.28
13	33.7	169	1135.7	438.1	1.11394	1.5276	0.55	W=2.00L3.29
13	31	169	961	403	1.11394	1.4914	0.55	W=2.00L3.30
13	33.7	169	1135.7	438.1	1.11394	1.5276	0.55	W=2.00L3.31
13.088	24.5206	171.01	644.51	323.817	1.11686	1.3895	0.55	W=2.00L3.32
13.126	24.5187	171.97	644.02	324.935	1.11814	1.3895	0.55	W=2.00L3.33
13.164	24.5168	172.92	643.53	326.053	1.1194	1.3895	0.55	W=2.00L3.34
13.203	24.5148	173.88	643.05	327.17	1.12067	1.3894	0.55	W=2.00L3.35
13.241	24.5129	174.83	642.56	328.288	1.12193	1.3894	0.55	W=2.00L3.36
13.279	24.511	175.79	642.07	329.406	1.12318	1.3894	0.55	W=2.00L3.37
13.318	24.509	176.74	641.58	330.523	1.12443	1.3893	0.55	W=2.00L3.38
13.356	24.5071	177.7	641.1	331.641	1.12568	1.3893	0.55	W=2.00L3.39

Avg. Length=12.0 Avg. Weight= 29.4 t-test=0.05 *

Table: 2 Length-Weight Relationship in *Channa Gachua* February -2008

Length of fish cm X	weight of fish gm Y	X	Y	XY	Log/L	Log/W	r-value	Regression equation
12.2	15.8	148.84	249.64	192.76	1.08636	1.1987	0.65	W=2.00L3.93
12.2	15.8	148.84	249.64	192.76	1.08636	1.1987	0.65	W=2.00L3.94
12.2	15.8	148.84	249.64	192.76	1.08636	1.1987	0.65	W=2.00L3.95
12.2	15.8	148.84	249.64	192.76	1.08636	1.1987	0.65	W=2.00L3.96
12.2	15.8	148.84	249.64	192.76	1.08636	1.1987	0.65	W=2.00L3.97
12.2	15.8	148.84	249.64	192.76	1.08636	1.1987	0.65	W=2.00L3.98
12.2	15.8	148.84	249.64	192.76	1.08636	1.1987	0.65	W=2.00L3.99
12.2	15.8	148.84	249.64	192.76	1.08636	1.1987	0.65	W=2.00L3.100
12.2	15.8	148.84	249.64	192.76	1.08636	1.1987	0.65	W=2.00L3.101
12.2	15.8	148.84	249.64	192.76	1.08636	1.1987	0.65	W=2.00L3.102
12.5	18.5	156.25	342.25	231.25	1.09691	1.2672	0.65	W=2.00L3.103
12.5	18.5	156.25	342.25	231.25	1.09691	1.2672	0.65	W=2.00L3.104
12.5	18.5	156.25	342.25	231.25	1.09691	1.2672	0.65	W=2.00L3.105
12.5	18.5	156.25	342.25	231.25	1.09691	1.2672	0.65	W=2.00L3.106
12.5	18.5	156.25	342.25	231.25	1.09691	1.2672	0.65	W=2.00L3.107
12.5	18.5	156.25	342.25	231.25	1.09691	1.2672	0.65	W=2.00L3.108
12.5	18.5	156.25	342.25	231.25	1.09691	1.2672	0.65	W=2.00L3.109
12.5	18.5	156.25	342.25	231.25	1.09691	1.2672	0.65	W=2.00L3.110
12.5	18.5	156.25	342.25	231.25	1.09691	1.2672	0.65	W=2.00L3.111
12.5	18.5	156.25	342.25	231.25	1.09691	1.2672	0.65	W=2.00L3.112
13.3	20	176.89	400	266	1.12385	1.301	0.65	W=2.00L3.113
13.3	20	176.89	400	266	1.12385	1.301	0.65	W=2.00L3.114
13.3	20	176.89	400	266	1.12385	1.301	0.65	W=2.00L3.115
13.3	20	176.89	400	266	1.12385	1.301	0.65	W=2.00L3.116
13.3	20	176.89	400	266	1.12385	1.301	0.65	W=2.00L3.117
13.3	20	176.89	400	266	1.12385	1.301	0.65	W=2.00L3.118
13.3	20	176.89	400	266	1.12385	1.301	0.65	W=2.00L3.119
13.3	20	176.89	400	266	1.12385	1.301	0.65	W=2.00L3.120
13.3	20	176.89	400	266	1.12385	1.301	0.65	W=2.00L3.121
13.3	20	176.89	400	266	1.12385	1.301	0.65	W=2.00L3.122
13.9	16.4	193.21	268.9	227.96	1.14301	1.2148	0.65	W=2.00L3.123
13.9	12.9	193.21	166.41	179.31	1.14301	1.1106	0.65	W=2.00L3.124
13.9	16.4	193.21	268.9	227.96	1.14301	1.2148	0.65	W=2.00L3.125
13.9	12.9	193.21	166.41	179.31	1.14301	1.1106	0.65	W=2.00L3.126
13.9	16.4	193.21	268.9	227.96	1.14301	1.2148	0.65	W=2.00L3.127
13.9	12.9	193.21	166.41	179.31	1.14301	1.1106	0.65	W=2.00L3.128
13.9	16.4	193.21	268.9	227.96	1.14301	1.2148	0.65	W=2.00L3.129
13.9	12.9	193.21	166.41	179.31	1.14301	1.1106	0.65	W=2.00L3.130
13.9	16.4	193.21	268.9	227.96	1.14301	1.2148	0.65	W=2.00L3.131
13.9	12.9	193.21	166.41	179.31	1.14301	1.1106	0.65	W=2.00L3.132

Avg. Length= 13.8 Avg. Weight= 20.6 t-test=0.05 *

Table: 3 Length-Weight Relationship in *Channa Gachua* March-2008

Length of fish cm X	weight of fish gm Y	X	Y	XY	Log/L	Log/W	r-value	Regression equation.
13.9	42.95	193.21	1844.7	597	1.14301	1.633	0.75	W=2.00L2.00
13.9	42.95	193.21	1844.7	597	1.14301	1.633	0.75	W=2.00L2.01
13.9	42.95	193.21	1844.7	597	1.14301	1.633	0.75	W=2.00L2.02
13.9	42.95	193.21	1844.7	597	1.14301	1.633	0.75	W=2.00L2.03
13.9	42.95	193.21	1844.7	597	1.14301	1.633	0.75	W=2.00L2.04
13.9	42.95	193.21	1844.7	597	1.14301	1.633	0.75	W=2.00L2.05
13.9	42.95	193.21	1844.7	597	1.14301	1.633	0.75	W=2.00L2.06
13.9	42.95	193.21	1844.7	597	1.14301	1.633	0.75	W=2.00L2.07
13.9	42.95	193.21	1844.7	597	1.14301	1.633	0.75	W=2.00L2.08
15	26.2	225	686.44	393	1.17609	1.4183	0.75	W=2.00L2.09
15	46	225	2116	690	1.17609	1.6628	0.75	W=2.00L2.10
15	26.2	225	686.44	393	1.17609	1.4183	0.75	W=2.00L2.11
15	46	225	2116	690	1.17609	1.6628	0.75	W=2.00L2.12
15	26.2	225	686.44	393	1.17609	1.4183	0.75	W=2.00L2.13
15	46	225	2116	690	1.17609	1.6628	0.75	W=2.00L2.14
15	26.2	225	686.44	393	1.17609	1.4183	0.75	W=2.00L2.15
15	46	225	2116	690	1.17609	1.6628	0.75	W=2.00L2.16
15	26.2	225	686.44	393	1.17609	1.4183	0.75	W=2.00L2.17
15	26.2	225	686.44	393	1.17609	1.4183	0.75	W=2.00L2.18
15	46	225	2116	690	1.17609	1.6628	0.75	W=2.00L2.19
15	26.2	225	686.44	393	1.17609	1.4183	0.75	W=2.00L2.20
15	46	225	2116	690	1.17609	1.6628	0.75	W=2.00L2.21
15	26.2	225	686.44	393	1.17609	1.4183	0.75	W=2.00L2.22
15	46	225	2116	690	1.17609	1.6628	0.75	W=2.00L2.23
15	26.2	225	686.44	393	1.17609	1.4183	0.75	W=2.00L2.24
15	46	225	2116	690	1.17609	1.6628	0.75	W=2.00L2.25
16	42.2	256	1780.8	675.2	1.20412	1.6253	0.75	W=2.00L2.26
16	42.2	256	1780.8	675.2	1.20412	1.6253	0.75	W=2.00L2.27
16	42.2	256	1780.8	675.2	1.20412	1.6253	0.75	W=2.00L2.28
16	42.2	256	1780.8	675.2	1.20412	1.6253	0.75	W=2.00L2.29
16	42.2	256	1780.8	675.2	1.20412	1.6253	0.75	W=2.00L2.30
16	42.2	256	1780.8	675.2	1.20412	1.6253	0.75	W=2.00L2.31
16	42.2	256	1780.8	675.2	1.20412	1.6253	0.75	W=2.00L2.32
16	42.2	256	1780.8	675.2	1.20412	1.6253	0.75	W=2.00L2.33
16	42.2	256	1780.8	675.2	1.20412	1.6253	0.75	W=2.00L2.34
17	63.9	289	4083.2	1086.3	1.23045	1.8055	0.75	W=2.00L2.35
17	63.9	289	4083.2	1086.3	1.23045	1.8055	0.75	W=2.00L2.36
17	63.9	289	4083.2	1086.3	1.23045	1.8055	0.75	W=2.00L2.37
17	63.9	289	4083.2	1086.3	1.23045	1.8055	0.75	W=2.00L2.38
17	63.9	289	4083.2	1086.3	1.23045	1.8055	0.75	W=2.00L2.39
17	63.9	289	4083.2	1086.3	1.23045	1.8055	0.75	W=2.00L2.40

Avg. Length= 16.7 Avg. Weight=51.3 t-test=0.01* *

Table: 4 Length-Weight Relationship in *Channa Gachua* April-2008

Length of fish cm X	weight of fish gm Y	X	Y	XY	Log/L	Log/W	r-value	Regression equation.
12	38	144	1444	456	1.07918	1.5798	0.66	W=12.00L2.00
12	35	144	1225	420	1.07918	1.5441	0.66	W=12.00L2.01
12	38	144	1444	456	1.07918	1.5798	0.66	W=12.00L2.02
12	35	144	1225	420	1.07918	1.5441	0.66	W=12.00L2.03
12	38	144	1444	456	1.07918	1.5798	0.66	W=12.00L2.04
12	35	144	1225	420	1.07918	1.5441	0.66	W=12.00L2.05
12	38	144	1444	456	1.07918	1.5798	0.66	W=12.00L2.06
12	35	144	1225	420	1.07918	1.5441	0.66	W=12.00L2.07
12	38	144	1444	456	1.07918	1.5798	0.66	W=12.00L2.08
12	35	144	1225	420	1.07918	1.5441	0.66	W=12.00L2.09
12	38	144	1444	456	1.07918	1.5798	0.66	W=12.00L2.10
12	35	144	1225	420	1.07918	1.5441	0.66	W=12.00L2.11
12	38	144	1444	456	1.07918	1.5798	0.66	W=12.00L2.12
12	35	144	1225	420	1.07918	1.5441	0.66	W=12.00L2.13
12	38	144	1444	456	1.07918	1.5798	0.66	W=12.00L2.14
12	35	144	1225	420	1.07918	1.5441	0.66	W=12.00L2.15
12	38	144	1444	456	1.07918	1.5798	0.66	W=12.00L2.16
12	35	144	1225	420	1.07918	1.5441	0.66	W=12.00L2.17
12	38	144	1444	456	1.07918	1.5798	0.66	W=12.00L2.18
12	35	144	1225	420	1.07918	1.5441	0.66	W=12.00L2.19
12.9	40	166.4	1600	516	1.11059	1.6021	0.66	W=12.00L2.20
12.9	40	166.4	1600	516	1.11059	1.6021	0.66	W=12.00L2.21
12.9	40	166.4	1600	516	1.11059	1.6021	0.66	W=12.00L2.22
12.9	40	166.4	1600	516	1.11059	1.6021	0.66	W=12.00L2.23
12.9	40	166.4	1600	516	1.11059	1.6021	0.66	W=12.00L2.24
12.9	40	166.4	1600	516	1.11059	1.6021	0.66	W=12.00L2.25
12.9	40	166.4	1600	516	1.11059	1.6021	0.66	W=12.00L2.26
12.9	40	166.4	1600	516	1.11059	1.6021	0.66	W=12.00L2.27
12.9	40	166.4	1600	516	1.11059	1.6021	0.66	W=12.00L2.28
12.9	40	166.4	1600	516	1.11059	1.6021	0.66	W=12.00L2.29
13	40	169	1600	520	1.11394	1.6021	0.66	W=12.00L2.30
13	40	169	1600	520	1.11394	1.6021	0.66	W=12.00L2.31
13	40	169	1600	520	1.11394	1.6021	0.66	W=12.00L2.32
13	40	169	1600	520	1.11394	1.6021	0.66	W=12.00L2.33
13	40	169	1600	520	1.11394	1.6021	0.66	W=12.00L2.34
13	40	169	1600	520	1.11394	1.6021	0.66	W=12.00L2.35
13	40	169	1600	520	1.11394	1.6021	0.66	W=12.00L2.36
13	40	169	1600	520	1.11394	1.6021	0.66	W=12.00L2.37
13	40	169	1600	520	1.11394	1.6021	0.66	W=12.00L2.38
13	40	169	1600	520	1.11394	1.6021	0.66	W=12.00L2.39

Avg. Length=14.2 Avg. Weight=45 t-test=0.05 *

Table: 5 Length-Weight Relationship in *Channa Gachua* May-2008

Length of fish cm X	weight of fish gm Y	X	Y	XY	Log/L	Log/W	r-value	Regression equation.
11.2	70	125.4	4900	784.06	1.04922	1.8451	0.56	w= 51.9 L 2.03
11.2	70	125.4	4900	784.06	1.04922	1.8451	0.56	w= 51.9 L 2.04
11.2	70	125.4	4900	784.06	1.04922	1.8451	0.56	w= 51.9 L 2.05
11.2	70	125.4	4900	784.06	1.04922	1.8451	0.56	w= 51.9 L 2.06
11.2	70	125.4	4900	784.06	1.04922	1.8451	0.56	w= 51.9 L 2.07
11.2	70	125.4	4900	784.06	1.04922	1.8451	0.56	w= 51.9 L 2.08
11.2	70	125.4	4900	784.06	1.04922	1.8451	0.56	w= 51.9 L 2.09
11.2	70	125.4	4900	784.06	1.04922	1.8451	0.56	w= 51.9 L 2.10
11.2	70	125.4	4900	784.06	1.04922	1.8451	0.56	w= 51.9 L 2.11
11.2	70	125.4	4900	784.06	1.04922	1.8451	0.56	w= 51.9 L 2.12
14.5	70.6	210.2	4984.3	1023.7	1.16137	1.8488	0.56	w= 51.9 L 2.13
14.5	70.6	210.2	4984.3	1023.7	1.16137	1.8488	0.56	w= 51.9 L 2.14
14.5	70.6	210.2	4984.3	1023.7	1.16137	1.8488	0.56	w= 51.9 L 2.15
14.5	70.6	210.2	4984.3	1023.7	1.16137	1.8488	0.56	w= 51.9 L 2.16
14.5	70.6	210.2	4984.3	1023.7	1.16137	1.8488	0.56	w= 51.9 L 2.17
14.5	70.6	210.2	4984.3	1023.7	1.16137	1.8488	0.56	w= 51.9 L 2.18
14.5	70.6	210.2	4984.3	1023.7	1.16137	1.8488	0.56	w= 51.9 L 2.19
14.5	70.6	210.2	4984.3	1023.7	1.16137	1.8488	0.56	w= 51.9 L 2.20
14.5	70.6	210.2	4984.3	1023.7	1.16137	1.8488	0.56	w= 51.9 L 2.21
14.5	70.6	210.2	4984.3	1023.7	1.16137	1.8488	0.56	w= 51.9 L 2.22
16	70.9	256	5026.8	1134.4	1.20412	1.8506	0.56	w= 51.9 L 2.23
16	70.9	256	5026.8	1134.4	1.20412	1.8506	0.56	w= 51.9 L 2.24
16	70.9	256	5026.8	1134.4	1.20412	1.8506	0.56	w= 51.9 L 2.25
16	70.9	256	5026.8	1134.4	1.20412	1.8506	0.56	w= 51.9 L 2.26
16	70.9	256	5026.8	1134.4	1.20412	1.8506	0.56	w= 51.9 L 2.27
16	70.9	256	5026.8	1134.4	1.20412	1.8506	0.56	w= 51.9 L 2.28
16	70.9	256	5026.8	1134.4	1.20412	1.8506	0.56	w= 51.9 L 2.29
16	70.9	256	5026.8	1134.4	1.20412	1.8506	0.56	w= 51.9 L 2.30
16	70.9	256	5026.8	1134.4	1.20412	1.8506	0.56	w= 51.9 L 2.31
16	70.9	256	5026.8	1134.4	1.20412	1.8506	0.56	w= 51.9 L 2.32
16.9	61	285.6	3721	1030.9	1.22789	1.7853	0.56	w= 51.9 L 2.33
16.9	61	285.6	3721	1030.9	1.22789	1.7853	0.56	w= 51.9 L 2.34
16.9	61	285.6	3721	1030.9	1.22789	1.7853	0.56	w= 51.9 L 2.35
16.9	61	285.6	3721	1030.9	1.22789	1.7853	0.56	w= 51.9 L 2.36
16.9	61	285.6	3721	1030.9	1.22789	1.7853	0.56	w= 51.9 L 2.37
16.9	61	285.6	3721	1030.9	1.22789	1.7853	0.56	w= 51.9 L 2.38
16.9	61	285.6	3721	1030.9	1.22789	1.7853	0.56	w= 51.9 L 2.39
16.9	61	285.6	3721	1030.9	1.22789	1.7853	0.56	w= 51.9 L 2.40
16.9	61	285.6	3721	1030.9	1.22789	1.7853	0.56	w= 51.9 L 2.41
16.9	61	285.6	3721	1030.9	1.22789	1.7853	0.56	w= 51.9 L 2.42
17.5	64	306	4096	1120	1.24304	1.8062	0.56	w= 51.9 L 2.43

Avg. Length=16.1 Avg. Weight=60 t-test=0.05 *

Table: 6 Length-Weight Relationships in *Channa Gachua* June-2008

Length of fish cm X	weight of fish gm Y	X	Y	XY	Log/L	Log/W	r-value	Regression equation.
15	55	225	3025	825	1.1761	1.7404	0.65	w= 57.3 L 2.02
15	55	225	3025	825	1.1761	1.7404	0.65	w= 57.3 L 2.03
15	55	225	3025	825	1.1761	1.7404	0.65	w= 57.3 L 2.04
15	55	225	3025	825	1.1761	1.7404	0.65	w= 57.3 L 2.05
15	55	225	3025	825	1.1761	1.7404	0.65	w= 57.3 L 2.06
16	60.2	256	3624	963.2	1.2041	1.7796	0.65	w= 57.3 L 2.07
16	48	256	2304	768	1.2041	1.6812	0.65	w= 57.3 L 2.08
16	60.2	256	3624	963.2	1.2041	1.7796	0.65	w= 57.3 L 2.09
16	48	256	2304	768	1.2041	1.6812	0.65	w= 57.3 L 2.10
16	60.2	256	3624	963.2	1.2041	1.7796	0.65	w= 57.3 L 2.11
16	48	256	2304	768	1.2041	1.6812	0.65	w= 57.3 L 2.12
16	60.2	256	3624	963.2	1.2041	1.7796	0.65	w= 57.3 L 2.13
16	48	256	2304	768	1.2041	1.6812	0.65	w= 57.3 L 2.14
16	60.2	256	3624	963.2	1.2041	1.7796	0.65	w= 57.3 L 2.15
16	48	256	2304	768	1.2041	1.6812	0.65	w= 57.3 L 2.16
17	60	289	3600	1020	1.2304	1.7782	0.65	w= 57.3 L 2.17
17	60	289	3600	1020	1.2304	1.7782	0.65	w= 57.3 L 2.18
17	60	289	3600	1020	1.2304	1.7782	0.65	w= 57.3 L 2.19
17	60	289	3600	1020	1.2304	1.7782	0.65	w= 57.3 L 2.20
17	60	289	3600	1020	1.2304	1.7782	0.65	w= 57.3 L 2.21
18	65	324	4225	1170	1.2553	1.8129	0.65	w= 57.3 L 2.22
18	70	324	4900	1260	1.2553	1.8451	0.65	w= 57.3 L 2.23
18	65	324	4225	1170	1.2553	1.8129	0.65	w= 57.3 L 2.24
18	70	324	4900	1260	1.2553	1.8451	0.65	w= 57.3 L 2.25
18	65	324	4225	1170	1.2553	1.8129	0.65	w= 57.3 L 2.26
18	70	324	4900	1260	1.2553	1.8451	0.65	w= 57.3 L 2.27
18	65	324	4225	1170	1.2553	1.8129	0.65	w= 57.3 L 2.28
18	70	324	4900	1260	1.2553	1.8451	0.65	w= 57.3 L 2.29
18	65	324	4225	1170	1.2553	1.8129	0.65	w= 57.3 L 2.30
18	70	324	4900	1260	1.2553	1.8451	0.65	w= 57.3 L 2.31
18.2	70	331.24	4900	1274	1.2601	1.8451	0.65	w= 57.3 L 2.32
18.2	70	331.24	4900	1274	1.2601	1.8451	0.65	w= 57.3 L 2.33
18.2	70	331.24	4900	1274	1.2601	1.8451	0.65	w= 57.3 L 2.34
18.2	70	331.24	4900	1274	1.2601	1.8451	0.65	w= 57.3 L 2.35
18.2	70	331.24	4900	1274	1.2601	1.8451	0.65	w= 57.3 L 2.36
18.5	60	342.25	3600	1110	1.2672	1.7782	0.65	w= 57.3 L 2.37
18.5	60	342.25	3600	1110	1.2672	1.7782	0.65	w= 57.3 L 2.38
18.5	60	342.25	3600	1110	1.2672	1.7782	0.65	w= 57.3 L 2.39
18.5	60	342.25	3600	1110	1.2672	1.7782	0.65	w= 57.3 L 2.40
18.5	60	342.25	3600	1110	1.2672	1.7782	0.65	w= 57.3 L 2.41

Avg. Length= 17.2 Avg. Weight=65 t-test=0.05 *

Table: 7 Length-Weight Relationships in *Channa Gachua* July-2008

Length of fish cm X	weight of fish gm Y	X	Y	XY	Log/L	Log/W	r-value	Regression equation.
11	15	121	225	165	1.0414	1.1761	0.7	w=67.9 L 2.8
11	15	121	225	165	1.0414	1.1761	0.7	w=67.9 L 2.9
11	15	121	225	165	1.0414	1.1761	0.7	w=67.9 L 2.10
11	15	121	225	165	1.0414	1.1761	0.7	w=67.9 L 2.11
11	15	121	225	165	1.0414	1.1761	0.7	w=67.9 L 2.12
11	15	121	225	165	1.0414	1.1761	0.7	w=67.9 L 2.13
11	15	121	225	165	1.0414	1.1761	0.7	w=67.9 L 2.14
11	15	121	225	165	1.0414	1.1761	0.7	w=67.9 L 2.15
11	15	121	225	165	1.0414	1.1761	0.7	w=67.9 L 2.16
11	15	121	225	165	1.0414	1.1761	0.7	w=67.9 L 2.17
12	22	144	484	264	1.0792	1.3424	0.7	w=67.9 L 2.18
12	22	144	484	264	1.0792	1.3424	0.7	w=67.9 L 2.19
12	22	144	484	264	1.0792	1.3424	0.7	w=67.9 L 2.20
12	22	144	484	264	1.0792	1.3424	0.7	w=67.9 L 2.21
12	22	144	484	264	1.0792	1.3424	0.7	w=67.9 L 2.22
12	22	144	484	264	1.0792	1.3424	0.7	w=67.9 L 2.23
12	22	144	484	264	1.0792	1.3424	0.7	w=67.9 L 2.24
12	22	144	484	264	1.0792	1.3424	0.7	w=67.9 L 2.25
12	22	144	484	264	1.0792	1.3424	0.7	w=67.9 L 2.26
12	22	144	484	264	1.0792	1.3424	0.7	w=67.9 L 2.27
12.5	22	156.25	484	275	1.0969	1.3424	0.7	w=67.9 L 2.28
12.5	22	156.25	484	275	1.0969	1.3424	0.7	w=67.9 L 2.29
12.5	22	156.25	484	275	1.0969	1.3424	0.7	w=67.9 L 2.30
12.5	22	156.25	484	275	1.0969	1.3424	0.7	w=67.9 L 2.31
12.5	22	156.25	484	275	1.0969	1.3424	0.7	w=67.9 L 2.32
12.5	22	156.25	484	275	1.0969	1.3424	0.7	w=67.9 L 2.33
12.5	22	156.25	484	275	1.0969	1.3424	0.7	w=67.9 L 2.34
12.5	22	156.25	484	275	1.0969	1.3424	0.7	w=67.9 L 2.35
12.5	22	156.25	484	275	1.0969	1.3424	0.7	w=67.9 L 2.36
12.5	22	156.25	484	275	1.0969	1.3424	0.7	w=67.9 L 2.37
13	24	169	576	312	1.1139	1.3802	0.7	w=67.9 L 2.38
13	25	169	625	325	1.1139	1.3979	0.7	w=67.9 L 2.39
13	24	169	576	312	1.1139	1.3802	0.7	w=67.9 L 2.40
13	25	169	625	325	1.1139	1.3979	0.7	w=67.9 L 2.41
13	24	169	576	312	1.1139	1.3802	0.7	w=67.9 L 2.42
13	25	169	625	325	1.1139	1.3979	0.7	w=67.9 L 2.43
13	24	169	576	312	1.1139	1.3802	0.7	w=67.9 L 2.44
13	25	169	625	325	1.1139	1.3979	0.7	w=67.9 L 2.45
13	24	169	576	312	1.1139	1.3802	0.7	w=67.9 L 2.46
13	25	169	625	325	1.1139	1.3979	0.7	w=67.9 L 2.47
13	24	169	576	312	1.1139	1.3802	0.7	w=67.9 L 2.48
13	25	169	625	325	1.1139	1.3979	0.7	w=67.9 L 2.49

Avg. Length=13.0 Avg. Weight=25.0 t-test=0.05 *

Table: 8 Length-Weight Relationships in *Channa Gachua* August-2008

Length of fish cm X	weight of fish gm Y	X2	Y2	XY	Log/L	Log/W	r-value	Regression equation.
13.7	40.3	187.69	1624.09	552.11	1.1367	1.6053	0.58	w=67.9 L 2.009
13.7	40.3	187.69	1624.09	552.11	1.1367	1.6053	0.58	w=67.9 L 2.010
13.7	40.3	187.69	1624.09	552.11	1.1367	1.6053	0.58	w=67.9 L 2.011
13.7	40.3	187.69	1624.09	552.11	1.1367	1.6053	0.58	w=67.9 L 2.012
13.7	40.3	187.69	1624.09	552.11	1.1367	1.6053	0.58	w=67.9 L 2.013
13.7	40.3	187.69	1624.09	552.11	1.1367	1.6053	0.58	w=67.9 L 2.014
13.7	40.3	187.69	1624.09	552.11	1.1367	1.6053	0.58	w=67.9 L 2.015
13.7	40.3	187.69	1624.09	552.11	1.1367	1.6053	0.58	w=67.9 L 2.016
13.7	40.3	187.69	1624.09	552.11	1.1367	1.6053	0.58	w=67.9 L 2.017
13.7	40.3	187.69	1624.09	552.11	1.1367	1.6053	0.58	w=67.9 L 2.018
16	29.6	254	876.16	473.6	1.2041	1.4713	0.58	w=67.9 L 2.019
16	29.6	254	876.16	473.6	1.2041	1.4713	0.58	w=67.9 L 2.020
16	29.6	254	876.16	473.6	1.2041	1.4713	0.58	w=67.9 L 2.021
16	29.6	254	876.16	473.6	1.2041	1.4713	0.58	w=67.9 L 2.022
16	29.6	254	876.16	473.6	1.2041	1.4713	0.58	w=67.9 L 2.023
16	29.6	254	876.16	473.6	1.2041	1.4713	0.58	w=67.9 L 2.024
16	29.6	254	876.16	473.6	1.2041	1.4713	0.58	w=67.9 L 2.025
16	29.6	254	876.16	473.6	1.2041	1.4713	0.58	w=67.9 L 2.026
16	29.6	254	876.16	473.6	1.2041	1.4713	0.58	w=67.9 L 2.027
16	29.6	254	876.16	473.6	1.2041	1.4713	0.58	w=67.9 L 2.028
17	36.1	289	1303.21	613.7	1.2304	1.5575	0.58	w=67.9 L 2.029
17	36.1	289	1303.21	613.7	1.2304	1.5575	0.58	w=67.9 L 2.030
17	36.1	289	1303.21	613.7	1.2304	1.5575	0.58	w=67.9 L 2.031
17	36.1	289	1303.21	613.7	1.2304	1.5575	0.58	w=67.9 L 2.032
17	36.1	289	1303.21	613.7	1.2304	1.5575	0.58	w=67.9 L 2.033
17	36.1	289	1303.21	613.7	1.2304	1.5575	0.58	w=67.9 L 2.034
17	36.1	289	1303.21	613.7	1.2304	1.5575	0.58	w=67.9 L 2.035
17	36.1	289	1303.21	613.7	1.2304	1.5575	0.58	w=67.9 L 2.036
17	36.1	289	1303.21	613.7	1.2304	1.5575	0.58	w=67.9 L 2.037
17	36.1	289	1303.21	613.7	1.2304	1.5575	0.58	w=67.9 L 2.038
18.5	49	342.25	2401	906.5	1.2672	1.6902	0.58	w=67.9 L 2.039
18.5	49	342.25	2401	906.5	1.2672	1.6902	0.58	w=67.9 L 2.040
18.5	49	342.25	2401	906.5	1.2672	1.6902	0.58	w=67.9 L 2.041
18.5	49	342.25	2401	906.5	1.2672	1.6902	0.58	w=67.9 L 2.042
18.5	49	342.25	2401	906.5	1.2672	1.6902	0.58	w=67.9 L 2.043
18.5	49	342.25	2401	906.5	1.2672	1.6902	0.58	w=67.9 L 2.044
18.5	49	342.25	2401	906.5	1.2672	1.6902	0.58	w=67.9 L 2.045
18.5	49	342.25	2401	906.5	1.2672	1.6902	0.58	w=67.9 L 2.046
18.5	49	342.25	2401	906.5	1.2672	1.6902	0.58	w=67.9 L 2.047
18.5	49	342.25	2401	906.5	1.2672	1.6902	0.58	w=67.9 L 2.048
19.5	76	350.25	5698	1497.6	1.29	1.8808	0.58	w=67.9 L 2.049

Avg. Length=20.0 Avg. Weight=80.0 t-test=0.05 *

Table: 9 Length-Weight Relationships in *Channa Gachua* September-2008

Length of fish cm X	weight of fish gm Y	X2	Y2	XY	Log/L	Log/W	r-value	Regression equation.
11.9	25.1	141.6	630	298.6	1.0755	1.3997	0.67	w = 543.L 2.08
11.9	25.1	141.6	630	298.6	1.0755	1.3997	0.67	w = 543.L 2.09
11.9	25.1	141.6	630	298.6	1.0755	1.3997	0.67	w = 543.L 2.10
11.9	25.1	141.6	630	298.6	1.0755	1.3997	0.67	w = 543.L 2.11
11.9	25.1	141.6	630	298.6	1.0755	1.3997	0.67	w = 543.L 2.12
11.9	25.1	141.6	630	298.6	1.0755	1.3997	0.67	w = 543.L 2.13
11.9	25.1	141.6	630	298.6	1.0755	1.3997	0.67	w = 543.L 2.14
11.9	25.1	141.6	630	298.6	1.0755	1.3997	0.67	w = 543.L 2.15
11.9	25.1	141.6	630	298.6	1.0755	1.3997	0.67	w = 543.L 2.16
11.9	25.1	141.6	630	298.6	1.0755	1.3997	0.67	w = 543.L 2.17
12.1	25.4	146.4	595.3	307.3	1.0828	1.4048	0.67	w = 543.L 2.18
12.1	25.4	146.4	595.3	307.3	1.0828	1.4048	0.67	w = 543.L 2.19
12.1	25.4	146.4	595.3	307.3	1.0828	1.4048	0.67	w = 543.L 2.20
12.1	25.4	146.4	595.3	307.3	1.0828	1.4048	0.67	w = 543.L 2.21
12.1	25.4	146.4	595.3	307.3	1.0828	1.4048	0.67	w = 543.L 2.22
12.1	25.4	146.4	595.3	307.3	1.0828	1.4048	0.67	w = 543.L 2.23
12.1	25.4	146.4	595.3	307.3	1.0828	1.4048	0.67	w = 543.L 2.24
12.1	25.4	146.4	595.3	307.3	1.0828	1.4048	0.67	w = 543.L 2.25
12.1	25.4	146.4	595.3	307.3	1.0828	1.4048	0.67	w = 543.L 2.26
12.1	25.4	146.4	595.3	307.3	1.0828	1.4048	0.67	w = 543.L 2.27
12.2	40	148.8	1600	488	1.0864	1.6021	0.67	w = 543.L 2.28
12.2	40	148.8	1600	488	1.0864	1.6021	0.67	w = 543.L 2.29
12.2	40	148.8	1600	488	1.0864	1.6021	0.67	w = 543.L 2.30
12.2	40	148.8	1600	488	1.0864	1.6021	0.67	w = 543.L 2.31
12.2	40	148.8	1600	488	1.0864	1.6021	0.67	w = 543.L 2.32
12.2	40	148.8	1600	488	1.0864	1.6021	0.67	w = 543.L 2.33
12.2	40	148.8	1600	488	1.0864	1.6021	0.67	w = 543.L 2.34
12.2	40	148.8	1600	488	1.0864	1.6021	0.67	w = 543.L 2.35
12.2	40	148.8	1600	488	1.0864	1.6021	0.67	w = 543.L 2.36
12.2	40	148.8	1600	488	1.0864	1.6021	0.67	w = 543.L 2.37
12.2	40	148.8	1600	488	1.0864	1.6021	0.67	w = 543.L 2.38
12.3	22.3	151.29	497.2	274.2	1.0899	1.3483	0.67	w = 543.L 2.39
12.3	22.3	151.29	497.2	274.2	1.0899	1.3483	0.67	w = 543.L 2.40
12.3	22.3	151.29	497.2	274.2	1.0899	1.3483	0.67	w = 543.L 2.41
12.3	22.3	151.29	497.2	274.2	1.0899	1.3483	0.67	w = 543.L 2.42
12.3	22.3	151.29	497.2	274.2	1.0899	1.3483	0.67	w = 543.L 2.43
12.3	22.3	151.29	497.2	274.2	1.0899	1.3483	0.67	w = 543.L 2.44
12.3	22.3	151.29	497.2	274.2	1.0899	1.3483	0.67	w = 543.L 2.45
12.3	22.3	151.29	497.2	274.2	1.0899	1.3483	0.67	w = 543.L 2.46
12.3	22.3	151.29	497.2	274.2	1.0899	1.3483	0.67	w = 543.L 2.47
12.3	22.3	151.29	497.2	274.2	1.0899	1.3483	0.67	w = 543.L 2.48

Avg. Length=13.2 Avg. Weight=19.4 t-test=0.05 *

Table: 10 Length-Weight Relationships in *Channa Gachua* Octomber-2008

Length of fish In (cm) X	Weight of fish In(gm)Y	X2	Y2	XY	Log/L	Log/W	r-value	Regression equation.
5.5	1.6	30.25	256	8.8	0.7404	0.2041	0.65	w = 56.8 L 2.88
5.5	1.6	30.25	256	8.8	0.7404	0.2041	0.65	w = 56.8 L 2.89
5.5	1.6	30.25	256	8.8	0.7404	0.2041	0.65	w = 56.8 L 2.90
5.5	1.6	30.25	256	8.8	0.7404	0.2041	0.65	w = 56.8 L 2.91
5.5	1.6	30.25	256	8.8	0.7404	0.2041	0.65	w = 56.8 L 2.92
5.5	1.6	30.25	256	8.8	0.7404	0.2041	0.65	w = 56.8 L 2.93
5.8	9.2	81.5	84.64	85.5	0.7634	0.9638	0.65	w = 56.8 L 2.94
5.8	9.2	81.5	84.64	85.5	0.7634	0.9638	0.65	w = 56.8 L 2.95
5.8	9.2	81.5	84.64	85.5	0.7634	0.9638	0.65	w = 56.8 L 2.96
5.8	9.2	81.5	84.64	85.5	0.7634	0.9638	0.65	w = 56.8 L 2.97
5.8	9.2	81.5	84.64	85.5	0.7634	0.9638	0.65	w = 56.8 L 2.98
5.8	9.2	81.5	84.64	85.5	0.7634	0.9638	0.65	w = 56.8 L 2.99
5.9	11	79.21	121	107.8	0.7709	1.0414	0.65	w = 56.8 L 2.100
5.9	11	79.21	121	107.8	0.7709	1.0414	0.65	w = 56.8 L 2.101
5.9	11	79.21	121	107.8	0.7709	1.0414	0.65	w = 56.8 L 2.102
5.9	11	79.21	121	107.8	0.7709	1.0414	0.65	w = 56.8 L 2.103
5.9	11	79.21	121	107.8	0.7709	1.0414	0.65	w = 56.8 L 2.104
5.9	11	79.21	121	107.8	0.7709	1.0414	0.65	w = 56.8 L 2.105
6.5	1.8	34.81	3.24	10.62	0.8129	0.2553	0.65	w = 56.8 L 2.106
6.5	1.82	34.81	3.24	10.62	0.8129	0.2601	0.65	w = 56.8 L 2.107
6.5	1.8	34.81	3.24	10.62	0.8129	0.2553	0.65	w = 56.8 L 2.108
6.5	1.82	34.81	3.24	10.62	0.8129	0.2601	0.65	w = 56.8 L 2.109
6.5	1.2	34.81	3.24	10.62	0.8129	0.0792	0.65	w = 56.8 L 2.110
6.5	1.82	34.81	3.24	10.62	0.8129	0.2601	0.65	w = 56.8 L 2.111
7.3	3.3	42.25	4	13	0.8633	0.5185	0.65	w = 56.8 L 2.112
7.3	3.3	42.25	4	13	0.8633	0.5185	0.65	w = 56.8 L 2.113
7.3	3.3	42.25	4	13	0.8633	0.5185	0.65	w = 56.8 L 2.114
7.3	3.3	42.25	4	13	0.8633	0.5185	0.65	w = 56.8 L 2.115
7.3	3.3	42.25	4	13	0.8633	0.5185	0.65	w = 56.8 L 2.116
7.3	3.3	42.25	4	13	0.8633	0.5185	0.65	w = 56.8 L 2.117
7.3	3.3	42.25	4	13	0.8633	0.5185	0.65	w = 56.8 L 2.118
8	6	53.29	10.89	24.09	0.9031	0.7782	0.65	w = 56.8 L 2.119
8	9	81	10	90	0.9031	0.9542	0.65	w = 56.8 L 2.120
8	6	53.29	10.89	24.09	0.9031	0.7782	0.65	w = 56.8 L 2.121
8	9	81	10	90	0.9031	0.9542	0.65	w = 56.8 L 2.122
8	6	53.29	10.89	24.09	0.9031	0.7782	0.65	w = 56.8 L 2.123
8	9	81	10	90	0.9031	0.9542	0.65	w = 56.8 L 2.124
8	6	53.29	10.89	24.09	0.9031	0.7782	0.65	w = 56.8 L 2.125
8	9	81	10	90	0.9031	0.9542	0.65	w = 56.8 L 2.126
8	6	53.29	10.89	24.09	0.9031	0.7782	0.65	w = 56.8 L 2.127
8	9	81	10	90	0.9031	0.9542	0.65	w = 56.8 L 2.128

Avg. Length=7.1 Avg. Weight=8.2 t-test=0.05 *

Table: 11 Length-Weight Relationships in *Channa Gachua* November-2008

Length of fish In (cm) X	Weight of fish In(gm)Y	X2	Y2	XY	Log/L	Log/W	r-value	Regression equation.
5.5	3.3	72.25	34.81	21	0.7404	0.5185	0.67	w = 32.7L 2.8
5.5	4	64	18.889	17.6	0.7404	0.6021	0.67	w = 32.7L 2.9
5.5	3.3	72.25	34.81	21	0.7404	0.5185	0.67	w = 32.7L 2.10
5.5	4	64	18.889	17.6	0.7404	0.6021	0.67	w = 32.7L 2.11
5.5	3.3	72.25	34.81	21	0.7404	0.5185	0.67	w = 32.7L 2.12
5.5	4	64	18.889	17.6	0.7404	0.6021	0.67	w = 32.7L 2.13
5.5	3.3	72.25	34.81	21	0.7404	0.5185	0.67	w = 32.7L 2.14
5.5	4	64	18.889	17.6	0.7404	0.6021	0.67	w = 32.7L 2.15
5.9	1.8	34.81	3.24	10.62	0.7709	0.2553	0.67	w = 32.7L 2.16
5.9	1.8	34.81	3.24	10.62	0.7709	0.2553	0.67	w = 32.7L 2.17
5.9	1.8	34.81	3.24	10.62	0.7709	0.2553	0.67	w = 32.7L 2.18
5.9	1.8	34.81	3.24	10.62	0.7709	0.2553	0.67	w = 32.7L 2.19
5.9	1.8	34.81	3.24	10.62	0.7709	0.2553	0.67	w = 32.7L 2.20
6.3	4.3	37.21	25	22.77	0.7993	0.6335	0.67	w = 32.7L 2.21
6.3	4.3	37.21	25	22.77	0.7993	0.6335	0.67	w = 32.7L 2.22
6.3	4.3	37.21	25	22.77	0.7993	0.6335	0.67	w = 32.7L 2.23
6.3	4.3	37.21	25	22.77	0.7993	0.6335	0.67	w = 32.7L 2.24
6.5	3	72.25	9	19.5	0.8129	0.4771	0.67	w = 32.7L 2.25
6.5	3	72.25	9	19.5	0.8129	0.4771	0.67	w = 32.7L 2.26
6.5	3	72.25	9	19.5	0.8129	0.4771	0.67	w = 32.7L 2.27
6.5	3	72.25	9	19.5	0.8129	0.4771	0.67	w = 32.7L 2.28
6.5	3	72.25	9	19.5	0.8129	0.4771	0.67	w = 32.7L 2.29
6.9	3.2	39.67	16	42.25	0.8388	0.5051	0.67	w = 32.7L 2.30
6.9	7	65.61	37.21	22.08	0.8388	0.8451	0.67	w = 32.7L 2.31
6.9	3.2	39.67	16	42.25	0.8388	0.5051	0.67	w = 32.7L 2.32
6.9	7	65.61	37.21	22.08	0.8388	0.8451	0.67	w = 32.7L 2.33
6.9	3.2	39.67	16	42.25	0.8388	0.5051	0.67	w = 32.7L 2.34
6.9	7	65.61	37.21	22.08	0.8388	0.8451	0.67	w = 32.7L 2.35
6.9	3.2	39.67	16	42.25	0.8388	0.5051	0.67	w = 32.7L 2.36
6.9	7	65.61	37.21	22.08	0.8388	0.8451	0.67	w = 32.7L 2.37
7	3	49	16	28	0.8451	0.4771	0.67	w = 32.7L 2.38
7	6.9	72.25	18.49	50	0.8451	0.8388	0.67	w = 32.7L 2.39
7	3	49	16	28	0.8451	0.4771	0.67	w = 32.7L 2.40
7	6.9	72.25	18.49	50	0.8451	0.8388	0.67	w = 32.7L 2.41
7	3	49	16	28	0.8451	0.4771	0.67	w = 32.7L 2.42
7	6.9	72.25	18.49	50	0.8451	0.8388	0.67	w = 32.7L 2.43
7	3	49	16	28	0.8451	0.4771	0.67	w = 32.7L 2.44
7	6.9	72.25	18.49	50	0.8451	0.8388	0.67	w = 32.7L 2.45
8	5.9	64	34.81	47.2	0.9031	0.7709	0.67	w = 32.7L 2.46
8	5	30.25	8.41	40	0.9031	0.699	0.67	w = 32.7L 2.47

Avg. Length=8.0 Avg. Weight=5.0 t-test=0.05 *

Table: 12 Length-Weight Relationships in *Channa Gachua* December-2008

Length of fish In (cm) X	Weight of fish In(gm)Y	X2	Y2	XY	Log/L	Log/W	r-value	Regression Equation.
8.9	10.1	100	102.1	101	0.9494	1.0043	0.7	w = 56.8 L 2.133
8.9	10.1	100	102.1	101	0.9494	1.0043	0.7	w = 56.8 L 2.134
8.9	10.1	100	102.1	101	0.9494	1.0043	0.7	w = 56.8 L 2.135
8.9	10.1	100	102.1	101	0.9494	1.0043	0.7	w = 56.8 L 2.136
8.9	10.1	100	102.1	101	0.9494	1.0043	0.7	w = 56.8 L 2.137
8.9	10.1	100	102.1	101	0.9494	1.0043	0.7	w = 56.8 L 2.138
8.9	10.1	100	102.1	101	0.9494	1.0043	0.7	w = 56.8 L 2.139
9	10	100	106.04	102	0.9542	1	0.7	w = 56.8 L 2.140
9	10	100	106.04	102	0.9542	1	0.7	w = 56.8 L 2.141
9	10	100	106.04	102	0.9542	1	0.7	w = 56.8 L 2.142
9	10	100	106.04	102	0.9542	1	0.7	w = 56.8 L 2.143
9	10	100	106.04	102	0.9542	1	0.7	w = 56.8 L 2.144
9	10	100	106.04	102	0.9542	1	0.7	w = 56.8 L 2.145
9	10	100	106.04	102	0.9542	1	0.7	w = 56.8 L 2.146
9.2	10.2	64	81	72	0.9638	1.0086	0.7	w = 56.8 L 2.147
9.2	10.2	64	81	72	0.9638	1.0086	0.7	w = 56.8 L 2.148
9.2	10.2	64	81	72	0.9638	1.0086	0.7	w = 56.8 L 2.149
9.2	10.2	64	81	72	0.9638	1.0086	0.7	w = 56.8 L 2.150
9.2	10.2	64	81	72	0.9638	1.0086	0.7	w = 56.8 L 2.151
9.2	10.2	64	81	72	0.9638	1.0086	0.7	w = 56.8 L 2.152
9.2	10.2	64	81	72	0.9638	1.0086	0.7	w = 56.8 L 2.153
9.3	10	64	36	48	0.9685	1	0.7	w = 56.8 L 2.154
9.3	10	64	36	48	0.9685	1	0.7	w = 56.8 L 2.155
9.3	10	64	36	48	0.9685	1	0.7	w = 56.8 L 2.156
9.3	10	64	36	48	0.9685	1	0.7	w = 56.8 L 2.157
9.3	10	64	36	48	0.9685	1	0.7	w = 56.8 L 2.158
9.3	10	64	36	48	0.9685	1	0.7	w = 56.8 L 2.159
9.3	10	64	36	48	0.9685	1	0.7	w = 56.8 L 2.160
9.5	10.9	90.25	118.81	103.55	0.9777	1.0374	0.7	w = 56.8 L 2.161
9.5	10.9	90.25	118.81	103.55	0.9777	1.0374	0.7	w = 56.8 L 2.162
9.5	10.9	90.25	118.81	103.55	0.9777	1.0374	0.7	w = 56.8 L 2.163
9.5	10.9	90.25	118.81	103.55	0.9777	1.0374	0.7	w = 56.8 L 2.164
9.5	10.9	90.25	118.81	103.55	0.9777	1.0374	0.7	w = 56.8 L 2.165
9.5	10.9	90.25	118.81	103.55	0.9777	1.0374	0.7	w = 56.8 L 2.166
9.5	10.9	90.25	118.81	103.55	0.9777	1.0374	0.7	w = 56.8 L 2.167
9.8	9	79.21	81	80.1	0.9912	0.9542	0.7	w = 56.8 L 2.168
9.8	9	79.21	81	80.1	0.9912	0.9542	0.7	w = 56.8 L 2.169
9.8	9	79.21	81	80.1	0.9912	0.9542	0.7	w = 56.8 L 2.170
9.8	9	79.21	81	80.1	0.9912	0.9542	0.7	w = 56.8 L 2.171
9.8	9	79.21	81	80.1	0.9912	0.9542	0.7	w = 56.8 L 2.172

Avg. Length=8.2 Avg. Weight= 10.0 t-test=0.05 *

Growth of Fish, *Channa Gachua* in Terms of Length-Weight Relationship During First Circannual Cycle 2008-2009

Table: 13 Length-Weight Relationships in *Channa Gachua* January 2009

Length of fish cm X	Weight of fish gm Y	X2	Y2	XY	Log/L	Log/W	r-value	Regression equation.
12	13	144	169	156	1.0792	1.1139	0.56	W=3.00L3.00
12	13	144	169	156	1.0792	1.1139	0.56	W=3.00L3.01
12	13	144	169	156	1.0792	1.1139	0.56	W=3.00L3.02
12	13	144	169	156	1.0792	1.1139	0.56	W=3.00L3.03
12	13	144	169	156	1.0792	1.1139	0.56	W=3.00L3.04
12	13	144	169	156	1.0792	1.1139	0.56	W=3.00L3.05
12	13	144	169	156	1.0792	1.1139	0.56	W=3.00L3.06
12	13	144	169	156	1.0792	1.1139	0.56	W=3.00L3.07
12	13	144	169	156	1.0792	1.1139	0.56	W=3.00L3.08
12	13	144	169	156	1.0792	1.1139	0.56	W=3.00L3.09
12	13	144	169	156	1.0792	1.1139	0.56	W=3.00L3.10
12.1	13	146.4	169	157.3	1.0828	1.1139	0.56	W=3.00L3.11
12.1	13	146.4	169	157.3	1.0828	1.1139	0.56	W=3.00L3.12
12.1	13	146.4	169	157.3	1.0828	1.1139	0.56	W=3.00L3.13
12.1	13	146.4	169	157.3	1.0828	1.1139	0.56	W=3.00L3.14
12.1	13	146.4	169	157.3	1.0828	1.1139	0.56	W=3.00L3.15
12.1	13	146.4	169	157.3	1.0828	1.1139	0.56	W=3.00L3.16
12.1	13	146.4	169	157.3	1.0828	1.1139	0.56	W=3.00L3.17
12.1	13	146.4	169	157.3	1.0828	1.1139	0.56	W=3.00L3.18
12.1	13	146.4	169	157.3	1.0828	1.1139	0.56	W=3.00L3.19
12.1	13	146.4	169	157.3	1.0828	1.1139	0.56	W=3.00L3.20
12.2	14	148.8	196	170.8	1.0864	1.1461	0.56	W=3.00L3.21
12.2	14	148.8	196	170.8	1.0864	1.1461	0.56	W=3.00L3.22
12.2	14	148.8	196	170.8	1.0864	1.1461	0.56	W=3.00L3.23
12.2	14	148.8	196	170.8	1.0864	1.1461	0.56	W=3.00L3.24
12.2	14	148.8	196	170.8	1.0864	1.1461	0.56	W=3.00L3.25
12.2	14	148.8	196	170.8	1.0864	1.1461	0.56	W=3.00L3.26
12.2	14	148.8	196	170.8	1.0864	1.1461	0.56	W=3.00L3.27
12.2	14	148.8	196	170.8	1.0864	1.1461	0.56	W=3.00L3.28
12.2	14	148.8	196	170.8	1.0864	1.1461	0.56	W=3.00L3.29
12.2	14	148.8	196	170.8	1.0864	1.1461	0.56	W=3.00L3.30
12.5	15	156.25	225	187.5	1.0969	1.1761	0.56	W=3.00L3.31
12.5	15	156.25	225	187.5	1.0969	1.1761	0.56	W=3.00L3.32
12.5	15	156.25	225	187.5	1.0969	1.1761	0.56	W=3.00L3.33
12.5	15	156.25	225	187.5	1.0969	1.1761	0.56	W=3.00L3.34
12.5	15	156.25	225	187.5	1.0969	1.1761	0.56	W=3.00L3.35
12.5	15	156.25	225	187.5	1.0969	1.1761	0.56	W=3.00L3.36
12.5	15	156.25	225	187.5	1.0969	1.1761	0.56	W=3.00L3.37
12.5	15	156.25	225	187.5	1.0969	1.1761	0.56	W=3.00L3.38
12.5	15	156.25	225	187.5	1.0969	1.1761	0.56	W=3.00L3.39
12.5	15	156.25	225	187.5	1.0969	1.1761	0.56	W=3.00L3.40
13.1	15	171.6	225	196.5	1.1173	1.1761	0.56	W=3.00L3.41

Avg. Length=13.1 Avg. Weight=19.5 t-test=0.05 *

Table: 14 Length-Weight Relationships in *Channa Gachua* February 2009

Length of fish cm X	Weight of fish gm Y	X2	Y2	XY	Log/L	Log/W	r-value	Regression equation
11	15	121	225	165	1.0414	1.1761	0.56	W=3.00L3.100
11	15	121	225	165	1.0414	1.1761	0.56	W=3.00L3.101
11	15	121	225	165	1.0414	1.1761	0.56	W=3.00L3.102
11	15	121	225	165	1.0414	1.1761	0.56	W=3.00L3.103
11	15	121	225	165	1.0414	1.1761	0.56	W=3.00L3.104
11	15	121	225	165	1.0414	1.1761	0.56	W=3.00L3.105
11	15	121	225	165	1.0414	1.1761	0.56	W=3.00L3.106
11	15	121	225	165	1.0414	1.1761	0.56	W=3.00L3.107
11	15	121	225	165	1.0414	1.1761	0.56	W=3.00L3.108
11	15	121	225	165	1.0414	1.1761	0.56	W=3.00L3.109
11	15	121	225	165	1.0414	1.1761	0.56	W=3.00L3.110
11	15	121	225	165	1.0414	1.1761	0.56	W=3.00L3.111
11	15	121	225	165	1.0414	1.1761	0.56	W=3.00L3.112
11	15	121	225	165	1.0414	1.1761	0.56	W=3.00L3.113
11	15	121	225	165	1.0414	1.1761	0.56	W=3.00L3.114
11	15	121	225	165	1.0414	1.1761	0.56	W=3.00L3.115
11	15	121	225	165	1.0414	1.1761	0.56	W=3.00L3.116
11	15	121	225	165	1.0414	1.1761	0.56	W=3.00L3.117
11	15	121	225	165	1.0414	1.1761	0.56	W=3.00L3.118
11	15	121	225	165	1.0414	1.1761	0.56	W=3.00L3.119
11.2	16	125.4	256	179	1.0492	1.2041	0.56	W=3.00L3.120
11.2	15.5	125.4	140.2	173.6	1.0492	1.1903	0.56	W=3.00L3.121
11.2	16	125.4	256	179	1.0492	1.2041	0.56	W=3.00L3.122
11.2	15.5	125.4	140.2	173.6	1.0492	1.1903	0.56	W=3.00L3.123
11.2	16	125.4	256	179	1.0492	1.2041	0.56	W=3.00L3.124
11.2	15.5	125.4	140.2	173.6	1.0492	1.1903	0.56	W=3.00L3.125
11.2	16	125.4	256	179	1.0492	1.2041	0.56	W=3.00L3.126
11.2	15.5	125.4	140.2	173.6	1.0492	1.1903	0.56	W=3.00L3.127
11.2	16	125.4	256	179	1.0492	1.2041	0.56	W=3.00L3.128
11.2	15.5	125.4	140.2	173.6	1.0492	1.1903	0.56	W=3.00L3.129
11.2	16	125.4	256	179	1.0492	1.2041	0.56	W=3.00L3.130
11.2	15.5	125.4	140.2	173.6	1.0492	1.1903	0.56	W=3.00L3.131
11.2	16	125.4	256	179	1.0492	1.2041	0.56	W=3.00L3.132
11.2	15.5	125.4	140.2	173.6	1.0492	1.1903	0.56	W=3.00L3.133
11.2	16	125.4	256	179	1.0492	1.2041	0.56	W=3.00L3.134
11.2	15.5	125.4	140.2	173.6	1.0492	1.1903	0.56	W=3.00L3.135
11.2	16	125.4	256	179	1.0492	1.2041	0.56	W=3.00L3.136
11.2	15.5	125.4	140.2	173.6	1.0492	1.1903	0.56	W=3.00L3.137
11.2	16	125.4	256	179	1.0492	1.2041	0.56	W=3.00L3.138
11.2	15.5	125.4	140.2	173.6	1.0492	1.1903	0.56	W=3.00L3.139
11.5	14.5	132.2	210.2	166.7	1.0607	1.1614	0.56	W=3.00L3.140

Avg. Length=12.1 Avg. Weight=18.8 t-test=0.05 *

Table: 15 Length-Weight Relationships in *Channa Gachua M*arch 2009

Length of fish cm X	Weight of fish gm Y	X2	Y2	XY	Log/L	Log/W	r-value	Regression equation
13.7	29	187.69	841	397.3	1.1367	1.4624	0.65	W=2.96L2.00
13.7	29	187.69	841	397.3	1.1367	1.4624	0.65	W=2.96L2.01
13.7	29	187.69	841	397.3	1.1367	1.4624	0.65	W=2.96L2.02
13.7	29	187.69	841	397.3	1.1367	1.4624	0.65	W=2.96L2.03
13.7	29	187.69	841	397.3	1.1367	1.4624	0.65	W=2.96L2.04
13.7	29	187.69	841	397.3	1.1367	1.4624	0.65	W=2.96L2.05
13.7	29	187.69	841	397.3	1.1367	1.4624	0.65	W=2.96L2.06
13.7	29	187.69	841	397.3	1.1367	1.4624	0.65	W=2.96L2.07
13.7	29	187.69	841	397.3	1.1367	1.4624	0.65	W=2.96L2.08
13.7	29	187.69	841	397.3	1.1367	1.4624	0.65	W=2.96L2.09
14.2	32.2	201.64	1036.8	457.2	1.1523	1.5079	0.65	W=2.96L2.10
14.2	32.2	201.64	1036.8	457.2	1.1523	1.5079	0.65	W=2.96L2.11
14.2	32.2	201.64	1036.8	457.2	1.1523	1.5079	0.65	W=2.96L2.12
14.2	32.2	201.64	1036.8	457.2	1.1523	1.5079	0.65	W=2.96L2.13
14.2	32.2	201.64	1036.8	457.2	1.1523	1.5079	0.65	W=2.96L2.14
14.2	32.2	201.64	1036.8	457.2	1.1523	1.5079	0.65	W=2.96L2.15
14.2	32.2	201.64	1036.8	457.2	1.1523	1.5079	0.65	W=2.96L2.16
14.2	32.2	201.64	1036.8	457.2	1.1523	1.5079	0.65	W=2.96L2.17
14.2	32.2	201.64	1036.8	457.2	1.1523	1.5079	0.65	W=2.96L2.18
14.2	32.2	201.64	1036.8	457.2	1.1523	1.5079	0.65	W=2.96L2.19
14.5	33.2	210.25	1102.2	481.4	1.1614	1.5211	0.65	W=2.96L2.20
14.5	33.2	210.25	1102.2	481.4	1.1614	1.5211	0.65	W=2.96L2.21
14.5	33.2	210.25	1102.2	481.4	1.1614	1.5211	0.65	W=2.96L2.22
14.5	33.2	210.25	1102.2	481.4	1.1614	1.5211	0.65	W=2.96L2.23
14.5	33.2	210.25	1102.2	481.4	1.1614	1.5211	0.65	W=2.96L2.24
14.5	33.2	210.25	1102.2	481.4	1.1614	1.5211	0.65	W=2.96L2.25
14.5	33.2	210.25	1102.2	481.4	1.1614	1.5211	0.65	W=2.96L2.26
14.5	33.2	210.25	1102.2	481.4	1.1614	1.5211	0.65	W=2.96L2.27
14.5	33.2	210.25	1102.2	481.4	1.1614	1.5211	0.65	W=2.96L2.28
14.5	33.2	210.25	1102.2	481.4	1.1614	1.5211	0.65	W=2.96L2.29
14.7	33	216.09	1089	485.1	1.1673	1.5185	0.65	W=2.96L2.30
14.7	33	216.09	1089	485.1	1.1673	1.5185	0.65	W=2.96L2.31
14.7	33	216.09	1089	485.1	1.1673	1.5185	0.65	W=2.96L2.32
14.7	33	216.09	1089	485.1	1.1673	1.5185	0.65	W=2.96L2.33
14.7	33	216.09	1089	485.1	1.1673	1.5185	0.65	W=2.96L2.34
14.7	33	216.09	1089	485.1	1.1673	1.5185	0.65	W=2.96L2.35
14.7	33	216.09	1089	485.1	1.1673	1.5185	0.65	W=2.96L2.36
14.7	33	216.09	1089	485.1	1.1673	1.5185	0.65	W=2.96L2.37
14.7	33	216.09	1089	485.1	1.1673	1.5185	0.65	W=2.96L2.38
14.7	33	216.09	1089	485.1	1.1673	1.5185	0.65	W=2.96L2.39
14.9	34	222.01	1156	506.6	1.1732	1.5315	0.65	W=2.96L2.40

Avg. Length= 15.8 Avg. Weight= 39.1 t-test=0.05 *

Table: 16 Length-Weight Relationships in *Channa Gachua April* 2009

Length of fish cm X	Weight of fish gm Y	X2	Y2	XY	Log/L	Log/W	r-value	Regression equation
11.9	21.41	141.61	458.3	234.7	1.0755	1.3306	0.65	W=2.96L2.100
11.9	21.41	141.61	458.3	234.7	1.0755	1.3306	0.65	W=2.96L2.101
11.9	21.41	141.61	458.3	234.7	1.0755	1.3306	0.65	W=2.96L2.102
11.9	21.41	141.61	458.3	234.7	1.0755	1.3306	0.65	W=2.96L2.103
11.9	21.41	141.61	458.3	234.7	1.0755	1.3306	0.65	W=2.96L2.104
11.9	21.41	141.61	458.3	234.7	1.0755	1.3306	0.65	W=2.96L2.105
11.9	21.41	141.61	458.3	234.7	1.0755	1.3306	0.65	W=2.96L2.106
11.9	21.41	141.61	458.3	234.7	1.0755	1.3306	0.65	W=2.96L2.107
11.9	21.41	141.61	458.3	234.7	1.0755	1.3306	0.65	W=2.96L2.108
11.9	21.41	141.61	458.3	234.7	1.0755	1.3306	0.65	W=2.96L2.109
12	21.91	144	480	262.9	1.0792	1.3406	0.65	W=2.96L2.110
12	21.5	144	462.25	258	1.0792	1.3324	0.65	W=2.96L2.111
12	20	144	400	240	1.0792	1.301	0.65	W=2.96L2.112
12	21.91	144	480	262.9	1.0792	1.3406	0.65	W=2.96L2.113
12	21.5	144	462.25	258	1.0792	1.3324	0.65	W=2.96L2.114
12	20	144	400	240	1.0792	1.301	0.65	W=2.96L2.115
12	21.91	144	480	262.9	1.0792	1.3406	0.65	W=2.96L2.116
12	21.5	144	462.25	258	1.0792	1.3324	0.65	W=2.96L2.117
12	20	144	400	240	1.0792	1.301	0.65	W=2.96L2.118
12	21.91	144	480	262.9	1.0792	1.3406	0.65	W=2.96L2.119
12	21.5	144	462.25	258	1.0792	1.3324	0.65	W=2.96L2.120
12	20	144	400	240	1.0792	1.301	0.65	W=2.96L2.121
12	21.91	144	480	262.9	1.0792	1.3406	0.65	W=2.96L2.122
12	21.5	144	462.25	258	1.0792	1.3324	0.65	W=2.96L2.123
12	20	144	400	240	1.0792	1.301	0.65	W=2.96L2.124
12	21.91	144	480	262.9	1.0792	1.3406	0.65	W=2.96L2.125
12	21.5	144	462.25	258	1.0792	1.3324	0.65	W=2.96L2.126
12	20	144	400	240	1.0792	1.301	0.65	W=2.96L2.127
12	21.91	144	480	262.9	1.0792	1.3406	0.65	W=2.96L2.128
12	21.5	144	462.25	258	1.0792	1.3324	0.65	W=2.96L2.129
12	20	144	400	240	1.0792	1.301	0.65	W=2.96L2.130
12	21.91	144	480	262.9	1.0792	1.3406	0.65	W=2.96L2.131
12	21.5	144	462.25	258	1.0792	1.3324	0.65	W=2.96L2.132
12	20	144	400	240	1.0792	1.301	0.65	W=2.96L2.133
12	21.91	144	480	262.9	1.0792	1.3406	0.65	W=2.96L2.134
12	21.5	144	462.25	258	1.0792	1.3324	0.65	W=2.96L2.135
12	20	144	400	240	1.0792	1.301	0.65	W=2.96L2.136
12	21.91	144	480	262.9	1.0792	1.3406	0.65	W=2.96L2.137
12	21.5	144	462.25	258	1.0792	1.3324	0.65	W=2.96L2.138
12	20	144	400	240	1.0792	1.301	0.65	W=2.96L2.139

Avg. Length=14.8 Avg. Weight=45.7 t-test=0.05 *

Table: 17 Length-Weight Relationships in *Channa Gachua* May 2009

Length of fish cm X	Weight of fish gm Y	X2	Y2	XY	Log/L	Log/W	r-value	Regression equation.
15.5	41.6	256	1723.1	596.7	1.1903	1.6191	0.75	W=2.96L2.01
15.5	62.5	306.2	3906.2	654.1	1.1903	1.7959	0.75	W=2.96L2.02
15.5	41.6	256	1723.1	596.7	1.1903	1.6191	0.75	W=2.96L2.03
15.5	62.5	306.2	3906.2	654.1	1.1903	1.7959	0.75	W=2.96L2.04
15.5	41.6	256	1723.1	596.7	1.1903	1.6191	0.75	W=2.96L2.05
15.5	62.5	306.2	3906.2	654.1	1.1903	1.7959	0.75	W=2.96L2.06
15.5	41.6	256	1723.1	596.7	1.1903	1.6191	0.75	W=2.96L2.07
15.5	62.5	306.2	3906.2	654.1	1.1903	1.7959	0.75	W=2.96L2.08
15.5	41.6	256	1723.1	596.7	1.1903	1.6191	0.75	W=2.96L2.09
15.8	44.4	256	1971.3	598.8	1.1987	1.6474	0.75	W=2.96L2.10
15.8	44.4	256	1971.3	598.8	1.1987	1.6474	0.75	W=2.96L2.11
15.8	44.4	256	1971.3	598.8	1.1987	1.6474	0.75	W=2.96L2.12
15.8	44.4	256	1971.3	598.8	1.1987	1.6474	0.75	W=2.96L2.13
15.8	44.4	256	1971.3	598.8	1.1987	1.6474	0.75	W=2.96L2.14
16	51.7	306.2	5672.8	710.4	1.2041	1.7135	0.75	W=2.96L2.15
16	43.8	268.9	1918.4	664	1.2041	1.6415	0.75	W=2.96L2.16
16	41.5	256	1722.2	665.6	1.2041	1.618	0.75	W=2.96L2.17
16	51.7	306.2	5672.8	710.4	1.2041	1.7135	0.75	W=2.96L2.18
16	43.8	268.9	1918.4	664	1.2041	1.6415	0.75	W=2.96L2.19
16	41.5	256	1722.2	665.6	1.2041	1.618	0.75	W=2.96L2.20
16	51.7	306.2	5672.8	710.4	1.2041	1.7135	0.75	W=2.96L2.21
16	43.8	268.9	1918.4	664	1.2041	1.6415	0.75	W=2.96L2.22
16	41.5	256	1722.2	665.6	1.2041	1.618	0.75	W=2.96L2.23
16	51.7	306.2	5672.8	710.4	1.2041	1.7135	0.75	W=2.96L2.24
16	43.8	268.9	1918.4	664	1.2041	1.6415	0.75	W=2.96L2.25
16	41.5	256	1722.2	665.6	1.2041	1.618	0.75	W=2.96L2.26
16	51.7	306.2	5672.8	710.4	1.2041	1.7135	0.75	W=2.96L2.27
16	43.8	268.9	1918.4	664	1.2041	1.6415	0.75	W=2.96L2.28
16	41.5	256	1722.2	665.6	1.2041	1.618	0.75	W=2.96L2.29
16.3	38.5	240	1482.2	707.4	1.2122	1.5855	0.75	W=2.96L2.30
16.3	42.2	240	1780.8	614.5	1.2122	1.6253	0.75	W=2.96L2.31
16.3	38.5	240	1482.2	707.4	1.2122	1.5855	0.75	W=2.96L2.32
16.3	42.2	240	1780.8	614.5	1.2122	1.6253	0.75	W=2.96L2.33
16.3	38.5	240	1482.2	707.4	1.2122	1.5855	0.75	W=2.96L2.34
16.3	42.2	240	1780.8	614.5	1.2122	1.6253	0.75	W=2.96L2.35
16.3	38.5	240	1482.2	707.4	1.2122	1.5855	0.75	W=2.96L2.36
16.3	42.2	240	1780.8	614.5	1.2122	1.6253	0.75	W=2.96L2.37
16.3	38.5	240	1482.2	707.4	1.2122	1.5855	0.75	W=2.96L2.38
16.5	58.2	327.6	3387.2	718.4	1.2175	1.7649	0.75	W=2.96L2.39
16.5	58.2	327.6	3387.2	718.4	1.2175	1.7649	0.75	W=2.96L2.40
16.5	58.2	327.6	3387.2	718.4	1.2175	1.7649	0.75	W=2.96L2.41

Avg. Length= 15.5 Avg. Weight= 35.0 t-test=0.01* *

Table: 18 Length-Weight Relationships in *Channa Gachua* June 2009

Length of fish cm X	Weight of fish gm Y	X2	Y2	XY	Log/L	Log/W	r-value	Regression equation
11.9	26.65	169	710.4	346.45	1.0755	1.4257	0.7	W=2.96L2.101
11.9	26.65	169	710.4	346.45	1.0755	1.4257	0.7	W=2.96L2.102
11.9	26.65	169	710.4	346.45	1.0755	1.4257	0.7	W=2.96L2.103
11.9	26.65	169	710.4	346.45	1.0755	1.4257	0.7	W=2.96L2.104
11.9	26.65	169	710.4	346.45	1.0755	1.4257	0.7	W=2.96L2.105
11.9	26.65	169	710.4	346.45	1.0755	1.4257	0.7	W=2.96L2.106
11.9	26.65	169	710.4	346.45	1.0755	1.4257	0.7	W=2.96L2.107
11.9	26.65	169	710.4	346.45	1.0755	1.4257	0.7	W=2.96L2.108
11.9	26.65	169	710.4	346.45	1.0755	1.4257	0.7	W=2.96L2.109
12	21.41	141.6	458.3	254.7	1.0792	1.3306	0.7	W=2.96L2.110
12	21.91	144	480	262.9	1.0792	1.3406	0.7	W=2.96L2.111
12	21.41	141.6	458.3	254.7	1.0792	1.3306	0.7	W=2.96L2.112
12	21.91	144	480	262.9	1.0792	1.3406	0.7	W=2.96L2.113
12	21.41	141.6	458.3	254.7	1.0792	1.3306	0.7	W=2.96L2.114
12	21.91	144	480	262.9	1.0792	1.3406	0.7	W=2.96L2.115
12	21.41	141.6	458.3	254.7	1.0792	1.3306	0.7	W=2.96L2.116
12	21.91	144	480	262.9	1.0792	1.3406	0.7	W=2.96L2.117
12	21.41	141.6	458.3	254.7	1.0792	1.3306	0.7	W=2.96L2.118
12	21.91	144	480	262.9	1.0792	1.3406	0.7	W=2.96L2.119
12	21.41	141.6	458.3	254.7	1.0792	1.3306	0.7	W=2.96L2.120
12	21.91	144	480	262.9	1.0792	1.3406	0.7	W=2.96L2.121
12	21.41	141.6	458.3	254.7	1.0792	1.3306	0.7	W=2.96L2.122
12	21.91	144	480	262.9	1.0792	1.3406	0.7	W=2.96L2.123
12	21.41	141.6	458.3	254.7	1.0792	1.3306	0.7	W=2.96L2.124
12	21.91	144	480	262.9	1.0792	1.3406	0.7	W=2.96L2.125
12	21.41	141.6	458.3	254.7	1.0792	1.3306	0.7	W=2.96L2.126
12	21.91	144	480	262.9	1.0792	1.3406	0.7	W=2.96L2.127
13	46.07	225	2122.4	691.05	1.1139	1.6634	0.7	W=2.96L2.128
13	21.5	143	462.25	256	1.1139	1.3324	0.7	W=2.96L2.129
13	46.07	225	2122.4	691.05	1.1139	1.6634	0.7	W=2.96L2.130
13	21.5	143	462.25	256	1.1139	1.3324	0.7	W=2.96L2.131
13	46.07	225	2122.4	691.05	1.1139	1.6634	0.7	W=2.96L2.132
13	21.5	143	462.25	256	1.1139	1.3324	0.7	W=2.96L2.133
13	46.07	225	2122.4	691.05	1.1139	1.6634	0.7	W=2.96L2.134
13	21.5	143	462.25	256	1.1139	1.3324	0.7	W=2.96L2.135
13	46.07	225	2122.4	691.05	1.1139	1.6634	0.7	W=2.96L2.136
13	21.5	143	462.25	256	1.1139	1.3324	0.7	W=2.96L2.137
13	46.07	225	2122.4	691.05	1.1139	1.6634	0.7	W=2.96L2.138
13	21.5	143	462.25	256	1.1139	1.3324	0.7	W=2.96L2.139
13	46.07	225	2122.4	691.05	1.1139	1.6634	0.7	W=2.96L2.140
13	21.5	143	462.25	256	1.1139	1.3324	0.7	W=2.96L2.141

Avg. Length=12.2 Avg. Weight= 23.0 t-test=0.05 *

Table: 19 Length-Weight Relationships in *Channa Gachua* July 2009

Length of fish cm X	Weight of fish gm Y	X2	Y2	XY	Log/L	Log/W	r-value	Regression equation
12.5	30.23	156.25	1794.4	377.8	1.0969	1.4804	0.78	W=0.1L2.11
12.5	30.23	156.25	1794.4	377.8	1.0969	1.4804	0.78	W=0.1L2.12
12.5	30.23	156.25	1794.4	377.8	1.0969	1.4804	0.78	W=0.1L2.13
12.5	30.23	156.25	1794.4	377.8	1.0969	1.4804	0.78	W=0.1L2.14
12.5	30.23	156.25	1794.4	377.8	1.0969	1.4804	0.78	W=0.1L2.15
12.5	30.23	156.25	1794.4	377.8	1.0969	1.4804	0.78	W=0.1L2.16
12.5	30.23	156.25	1794.4	377.8	1.0969	1.4804	0.78	W=0.1L2.17
12.5	30.23	156.25	1794.4	377.8	1.0969	1.4804	0.78	W=0.1L2.18
12.5	30.23	156.25	1794.4	377.8	1.0969	1.4804	0.78	W=0.1L2.19
12.5	30.23	156.25	1794.4	377.8	1.0969	1.4804	0.78	W=0.1L2.20
13	34.54	169	1876.6	449	1.1139	1.5383	0.78	W=0.1L2.21
13	34.54	169	1876.6	449	1.1139	1.5383	0.78	W=0.1L2.22
13	34.54	169	1876.6	449	1.1139	1.5383	0.78	W=0.1L2.23
13	34.54	169	1876.6	449	1.1139	1.5383	0.78	W=0.1L2.24
13	34.54	169	1876.6	449	1.1139	1.5383	0.78	W=0.1L2.25
13	34.54	169	1876.6	449	1.1139	1.5383	0.78	W=0.1L2.26
13	34.54	169	1876.6	449	1.1139	1.5383	0.78	W=0.1L2.27
13	34.54	169	1876.6	449	1.1139	1.5383	0.78	W=0.1L2.28
13	34.54	169	1876.6	449	1.1139	1.5383	0.78	W=0.1L2.29
13	34.54	169	1876.6	449	1.1139	1.5383	0.78	W=0.1L2.30
13	34.54	169	1876.6	449	1.1139	1.5383	0.78	W=0.1L2.31
13.5	31.6	182.25	985.9	423.9	1.1303	1.4997	0.78	W=0.1L2.32
13.5	31.6	182.25	985.9	423.9	1.1303	1.4997	0.78	W=0.1L2.33
13.5	31.6	182.25	985.9	423.9	1.1303	1.4997	0.78	W=0.1L2.34
13.5	31.6	182.25	985.9	423.9	1.1303	1.4997	0.78	W=0.1L2.35
13.5	31.6	182.25	985.9	423.9	1.1303	1.4997	0.78	W=0.1L2.36
13.5	31.6	182.25	985.9	423.9	1.1303	1.4997	0.78	W=0.1L2.37
13.5	31.6	182.25	985.9	423.9	1.1303	1.4997	0.78	W=0.1L2.38
13.5	31.6	182.25	985.9	423.9	1.1303	1.4997	0.78	W=0.1L2.39
13.5	31.6	182.25	985.9	423.9	1.1303	1.4997	0.78	W=0.1L2.40
13.5	31.6	182.25	985.9	423.9	1.1303	1.4997	0.78	W=0.1L2.41
14	42.04	196	1193	588.5	1.1461	1.6237	0.78	W=0.1L2.42
14	42.04	196	1193	588.5	1.1461	1.6237	0.78	W=0.1L2.43
14	42.04	196	1193	588.5	1.1461	1.6237	0.78	W=0.1L2.44
14	42.04	196	1193	588.5	1.1461	1.6237	0.78	W=0.1L2.45
14	42.04	196	1193	588.5	1.1461	1.6237	0.78	W=0.1L2.46
14	42.04	196	1193	588.5	1.1461	1.6237	0.78	W=0.1L2.47
14	42.04	196	1193	588.5	1.1461	1.6237	0.78	W=0.1L2.48
14	42.04	196	1193	588.5	1.1461	1.6237	0.78	W=0.1L2.49
14	42.04	196	1193	588.5	1.1461	1.6237	0.78	W=0.1L2.50
14	42.04	196	1193	588.5	1.1461	1.6237	0.78	W=0.1L2.51

Avg. Length=13.5 Avg. Weight= 35.2 t-test=0.01* *

Table: 20 Length-Weight Relationships in *Channa Gachua* August 2009

Length of fish cm X	Weight of fish gm Y	X2	Y2	XY	Log/L	Log/W	r-value	Regression equation
12.5	28.02	156.25	813.3	360.2	1.0969	1.4597	0.8	W=25.1L2.21
12.5	28.12	156.25	813.3	360.2	1.0969	1.4597	0.8	
12.5	28.22	156.25	813.3	360.2	1.0969	1.4597	0.8	W=25.1L2.22
12.5	28.82	156.25	813.3	360.2	1.0969	1.4597	0.8	
12.5	28.82	156.25	813.3	360.2	1.0969	1.4597	0.8	W=25.1L2.23
12.5	28.82	156.25	813.3	360.2	1.0969	1.4597	0.8	
12.5	28.82	156.25	813.3	360.2	1.0969	1.4597	0.8	W=25.1L2.24
12.5	28.82	156.25	813.3	360.2	1.0969	1.4597	0.8	
12.5	28.82	156.25	813.3	360.2	1.0969	1.4597	0.8	W=25.1L2.25
12.5	28.82	156.25	813.3	360.2	1.0969	1.4597	0.8	
13.3	28.52	176.89	2024.1	379.3	1.1239	1.4551	0.8	W=25.1L2.26
13.3	28.52	176.89	2024.1	379.3	1.1239	1.4551	0.8	
13.3	28.52	176.89	2024.1	379.3	1.1239	1.4551	0.8	W=25.1L2.27
13.3	28.52	176.89	2024.1	379.3	1.1239	1.4551	0.8	
13.3	28.52	176.89	2024.1	379.3	1.1239	1.4551	0.8	W=25.1L2.28
13.3	28.52	176.89	2024.1	379.3	1.1239	1.4551	0.8	
13.3	28.52	176.89	2024.1	379.3	1.1239	1.4551	0.8	W=25.1L2.29
13.3	28.52	176.89	2024.1	379.3	1.1239	1.4551	0.8	
13.3	28.52	176.89	2024.1	379.3	1.1239	1.4551	0.8	W=25.1L2.30
13.3	28.52	176.89	2024.1	379.3	1.1239	1.4551	0.8	
13.3	28.52	176.89	2024.1	379.3	1.1239	1.4551	0.8	W=25.1L2.31
13.5	63.51	289	914.4	1079.6	1.1303	1.8028	0.8	
13.5	63.51	289	914.4	1079.6	1.1303	1.8028	0.8	W=25.1L2.32
13.5	63.51	289	914.4	1079.6	1.1303	1.8028	0.8	
13.5	63.51	289	914.4	1079.6	1.1303	1.8028	0.8	W=25.1L2.33
13.5	63.51	289	914.4	1079.6	1.1303	1.8028	0.8	
13.5	63.51	289	914.4	1079.6	1.1303	1.8028	0.8	W=25.1L2.34
13.5	63.51	289	914.4	1079.6	1.1303	1.8028	0.8	
13.5	63.51	289	914.4	1079.6	1.1303	1.8028	0.8	W=25.1L2.35
13.5	63.51	289	914.4	1079.6	1.1303	1.8028	0.8	
13.5	63.51	289	914.4	1079.6	1.1303	1.8028	0.8	W=25.1L2.36
13.5	31.6	182.25	985.9	423.9	1.1303	1.4997	0.78	W=0.1L2.32
14.8	54.01	256	2367.7	864.16	1.1703	1.7325	0.8	W=25.1L2.37
14.8	54.01	256	2367.7	864.16	1.1703	1.7325	0.8	
14.8	54.01	256	2367.7	864.16	1.1703	1.7325	0.8	W=25.1L2.38
14.8	54.01	256	2367.7	864.16	1.1703	1.7325	0.8	
14.8	54.01	256	2367.7	864.16	1.1703	1.7325	0.8	W=25.1L2.39
14.8	54.01	256	2367.7	864.16	1.1703	1.7325	0.8	
14.8	54.01	256	2367.7	864.16	1.1703	1.7325	0.8	W=25.1L2.40
14.8	54.01	256	2367.7	864.16	1.1703	1.7325	0.8	
14.8	54.01	256	2367.7	864.16	1.1703	1.7325	0.8	W=25.1L2.41

Avg. Length=14.4 Avg. Weight=35.0 t-test=0.01* *

Table: 21 Length-Weight Relationships in *Channa Gachua* September 2009

Length of fish cm X	Weight of fish gm Y	X2	Y2	XY	Log/L	Log/W	r-value	Regression eq.
14.8	54.01	256	2367.7	864.16	1.1703	1.7325	0.74	W=23.9L243
14.8	54.01	256	2367.7	864.16	1.1703	1.7325	0.74	W=23.9L244
15	43.32	225	2088.5	644.8	1.1761	1.6367	0.74	W=23.9L245
15	43.32	225	2088.5	644.8	1.1761	1.6367	0.74	W=23.9L246
15	43.32	225	2088.5	644.8	1.1761	1.6367	0.74	W=23.9L247
15	43.32	225	2088.5	644.8	1.1761	1.6367	0.74	W=23.9L248
15	43.32	225	2088.5	644.8	1.1761	1.6367	0.74	W=23.9L249
15	43.32	225	2088.5	644.8	1.1761	1.6367	0.74	W=23.9L250
15	43.32	225	2088.5	644.8	1.1761	1.6367	0.74	W=23.9L251
15	43.32	225	2088.5	644.8	1.1761	1.6367	0.74	W=23.9L252
15	43.32	225	2088.5	644.8	1.1761	1.6367	0.74	W=23.9L253
15	43.32	225	2088.5	644.8	1.1761	1.6367	0.74	W=23.9L254
15.1	54.42	228	830.5	825.7	1.179	1.7358	0.74	W=23.9L255
15.1	54.42	228	830.5	825.7	1.179	1.7358	0.74	W=23.9L256
15.1	54.42	228	830.5	825.7	1.179	1.7358	0.74	W=23.9L257
15.1	54.42	228	830.5	825.7	1.179	1.7358	0.74	W=23.9L258
15.1	54.42	228	830.5	825.7	1.179	1.7358	0.74	W=23.9L259
15.1	54.42	228	830.5	825.7	1.179	1.7358	0.74	W=23.9L260
15.1	54.42	228	830.5	825.7	1.179	1.7358	0.74	W=23.9L261
15.1	54.42	228	830.5	825.7	1.179	1.7358	0.74	W=23.9L262
15.1	54.42	228	830.5	825.7	1.179	1.7358	0.74	W=23.9L263
15.1	54.42	228	830.5	825.7	1.179	1.7358	0.74	W=23.9L264
15.2	48.66	219.04	2701.9	720.6	1.1818	1.6872	0.74	W=23.9L265
15.2	51.98	231.04	2961.5	790	1.1818	1.7158	0.74	W=23.9L266
15.2	48.66	219.04	2701.9	720.6	1.1818	1.6872	0.74	W=23.9L267
15.2	51.98	231.04	2961.5	790	1.1818	1.7158	0.74	W=23.9L268
15.2	48.66	219.04	2701.9	720.6	1.1818	1.6872	0.74	W=23.9L269
15.2	51.98	231.04	2961.5	790	1.1818	1.7158	0.74	W=23.9L270
15.2	48.66	219.04	2701.9	720.6	1.1818	1.6872	0.74	W=23.9L271
15.2	51.98	231.04	2961.5	790	1.1818	1.7158	0.74	W=23.9L272
15.2	48.66	219.04	2701.9	720.6	1.1818	1.6872	0.74	W=23.9L273
15.2	51.98	231.04	2961.5	790	1.1818	1.7158	0.74	W=23.9L274
15.2	48.66	219.04	2701.9	720.6	1.1818	1.6872	0.74	W=23.9L275
15.2	51.98	231.04	2961.5	790	1.1818	1.7158	0.74	W=23.9L276
15.2	48.66	219.04	2701.9	720.6	1.1818	1.6872	0.74	W=23.9L277
15.2	51.98	231.04	2961.5	790	1.1818	1.7158	0.74	W=23.9L278
15.2	48.66	219.04	2701.9	720.6	1.1818	1.6872	0.74	W=23.9L279
15.2	51.98	231.04	2961.5	790	1.1818	1.7158	0.74	W=23.9L280
15.2	48.66	219.04	2701.9	720.6	1.1818	1.6872	0.74	W=23.9L281
15.2	51.98	231.04	2961.5	790	1.1818	1.7158	0.74	W=23.9L282
15.2	48.66	219.04	2701.9	720.6	1.1818	1.6872	0.74	W=23.9L283

Avg. Length = 15.2 Avg. Weight=48.1 t-test=0.01* *

Table: 22 Length-Weight Relationships in *Channa Gachua October* 2009

Length of fish cm X	Weight of fish gm Y	X2	Y2	XY	Log/L	Log/W	r-value	Regression equation
11	15.0	121	225	165	1.0414	1.1761	0.77	W=35.2L 2.02
11.5	15.0	132.2	225	172.5	1.0607	1.1761	0.77	W=35.2L 2.03
11.5	16.0	132.2	256	184	1.0607	1.2041	0.77	W=35.2L 2.04
11.9	15.1	141.6	228	179.7	1.0755	1.179	0.77	W=35.2L 2.05
11.9	15.5	141.61	240.2	184.6	1.0755	1.1903	0.77	W=35.2L 2.06
12	19.2	144	368.6	230.4	1.0792	1.2833	0.77	W=35.2L 2.07
12	15.5	144	240.2	186	1.0792	1.1903	0.77	W=35.2L 2.08
12.3	19.0	151.2	361	233.7	1.0899	1.2788	0.77	W=35.2L 2.09
12.5	15.5	156.2	240	193.7	1.0969	1.1903	0.77	W=35.2L 2.10
12.9	20.0	166.4	400	258	1.1106	1.301	0.77	W=35.2L 2.11
13	16.0	169	256	208	1.1139	1.2041	0.77	W=35.2L 2.12
13	18.0	169	324	234	1.1139	1.2553	0.77	W=35.2L 2.13
13.5	17.0	169	289	221	1.1303	1.2304	0.77	W=35.2L 2.14
14	27.0	196	1369	518	1.1461	1.4314	0.77	W=35.2L 2.15
14	40.0	196	1600	560	1.1461	1.6021	0.77	W=35.2L 2.16
14	86.0	196	841	406	1.1461	1.9345	0.77	W=35.2L 2.17
14	80.o	196	784	392	1.1461	1.9031	0.77	W=35.2L 2.18
14	29.0	198	856.6	409.3	1.1461	1.4624	0.77	W=35.2L 2.19
14	28.0	368.6	8836	1804.8	1.1461	1.4472	0.77	W=35.2L 2.20
14	28.2	225	795.2	432	1.1461	1.4502	0.77	W=35.2L 2.21
14	22.8	201.6	519.8	323.7	1.1461	1.3579	0.77	W=35.2L 2.22
14.02	19.2	400	8930	1890	1.1467	1.2833	0.77	W=35.2L 2.23
14.2	22.0	196	484	308	1.1523	1.3424	0.77	W=35.2L 2.24
14.5	38.2	210.2	1459.2	553.9	1.1614	1.5821	0.77	W=35.2L 2.25
14.5	35.1	216.2	1232	508.9	1.1614	1.5453	0.77	W=35.2L 2.26
15	22.5	225	625	375	1.1761	2.3522	0.77	W=35.2L 2.27
15	17.3	182.2	299.2	233.5	1.1761	1.238	0.77	W=35.2L 2.28
15.3	28.9	234	833.2	442.1	1.1847	1.4609	0.77	W=35.2L 2.29
16	39.2	256	1536.6	627.2	1.2041	1.5933	0.77	W=35.2L 2.30
16	45.1	256	2034	721.6	1.2041	1.6542	0.77	W=35.2L 2.31
16	39.0	256	1521	624	1.2041	1.5911	0.77	W=35.2L 2.32
16	38.0	256	1444	608	1.2041	1.5798	0.77	W=35.2L 2.33
16	38.1	256	1451.6	609.6	1.2041	1.5809	0.77	W=35.2L 2.34
16	28.0	256	784	448	1.2041	1.4472	0.77	W=35.2L 2.35
16	30.2	256	912	483.2	1.2041	1.48	0.77	W=35.2L 2.36
16	60.2	272.2	3624	9933	1.2041	1.7796	0.77	W=35.2L 2.37
16	60.0	256	3600	960	1.2041	1.7782	0.77	W=35.2L 2.38
16	60.2	272.2	3624	9933	1.2041	1.7796	0.77	W=35.2L 2.39
16	60.0	256	3600	960	1.2041	1.7782	0.77	W=35.2L 2.40
16.2	30.2	262.4	912	489.2	1.2095	1.48	0.77	W=35.2L 2.41
16.2	30.2	262.4	912	489.2	1.2095	1.48	0.77	W=35.2L 2.41

Avg. Length=15.4 Avg. Weight= t-test=0.01* *

Table: 23 Length-Weight Relationships in *Channa Gachua* November 2009

Length of fish cm X	Weight of fish gm Y	X2	Y2	XY	Log/L	Log/W	r-value	Regression equation
10.1	12.1	104.4	146.41	122.51	1.0043	1.0828	0.79	W=24.6L 2.09
10.1	12.1	106.09	146.41	121.3	1.0043	1.0828	0.79	W=24.6L 2.10
10.1	12.1	114.04	166.41	121.2	1.0043	1.0828	0.79	W=24.6L 2.11
10.1	12	102.01	144	121.2	1.0043	1.0792	0.79	W=24.6L 2.12
10.1	12.1	102.01	146.41	122.21	1.0043	1.0828	0.79	W=24.6L 2.13
10.1	12.1	102.01	146.41	129.89	1.0043	1.0828	0.79	W=24.6L 2.14
10.2	12.3	104.04	151.29	125.46	1.0086	1.0899	0.79	W=24.6L 2.15
10.2	12.49	110.25	156	131.42	1.0086	1.0966	0.79	W=24.6L 2.16
10.2	12.11	102.01	146.6	123.62	1.0086	1.0831	0.79	W=24.6L 2.17
10.2	12.12	104.04	146.89	125.46	1.0086	1.0835	0.79	W=24.6L 2.18
10.2	12.01	102.01	144.24	123.62	1.0086	1.0795	0.79	W=24.6L 2.19
10.2	12.51	110.25	155	131.04	1.0086	1.0973	0.79	W=24.6L 2.20
10.2	12.1	104.04	146.41	123.42	1.0086	1.0828	0.79	W=24.6L 2.21
10.2	12.21	104.04	149.08	124.54	1.0086	1.0867	0.79	W=24.6L 2.22
10.2	12.47	108.16	155.5	131.7	1.0086	1.0959	0.79	W=24.6L 2.23
10.3	12.23	106.09	149.57	125.96	1.0128	1.0874	0.79	W=24.6L 2.24
10.3	12.5	110.25	156.25	124.63	1.0128	1.0969	0.79	W=24.6L 2.25
10.3	12.2	106.09	148.84	125.66	1.0128	1.0864	0.79	W=24.6L 2.26
10.3	12.2	106.09	148.84	125.6	1.0128	1.0864	0.79	W=24.6L 2.27
10.3	12.49	108.16	156	136.5	1.0128	1.0966	0.79	W=24.6L 2.28
10.4	12.37	108.16	153.01	128.36	1.017	1.0924	0.79	W=24.6L 2.29
10.4	12.34	108.16	152.2	128.33	1.017	1.0913	0.79	W=24.6L 2.30
10.4	12.3	104.04	151.29	128.96	1.017	1.0899	0.79	W=24.6L 2.31
10.4	12.45	110.25	155.5	125.46	1.017	1.0952	0.79	W=24.6L 2.32
10.4	12.43	108.16	154.5	129.27	1.017	1.0945	0.79	W=24.6L 2.33
10.4	12	102.01	144	126.99	1.017	1.0792	0.79	W=24.6L 2.34
10.4	12.12	104.04	146.89	131.25	1.017	1.0835	0.79	W=24.6L 2.35
10.5	12.47	110.25	155.5	130.93	1.0212	1.0959	0.79	W=24.6L 2.36
10.5	12.4	110.25	153.76	130.2	1.0212	1.0934	0.79	W=24.6L 2.37
10.5	12.45	110.25	155	130.72	1.0212	1.0952	0.79	W=24.6L 2.38
10.5	12.4	108.16	153.76	131.25	1.0212	1.0934	0.79	W=24.6L 2.39
10.5	12.9	114.49	144	131.25	1.0212	1.1106	0.79	W=24.6L 2.40
10.5	12	102.01	156.23	131.35	1.0212	1.0792	0.79	W=24.6L 2.41
10.5	12.5	110.25	156.5	130.72	1.0212	1.0969	0.79	W=24.6L 2.42
10.5	12.49	110.25	156	131.14	1.0212	1.0966	0.79	W=24.6L 2.43
10.5	12.5	110.25	156.25	131.25	1.0212	1.0969	0.79	W=24.6L 2.44
10.5	12.5	110.25	156.25	121.2	1.0212	1.0969	0.79	W=24.6L 2.45
10.5	12.33	106.09	152.02	140.38	1.0212	1.091	0.79	W=24.6L 2.46
10.5	12.55	110.25	157.5	131.71	1.0212	1.0986	0.79	W=24.6L 2.47
10.5	12.5	110.25	156.25	139.12	1.0212	1.0969	0.79	W=24.6L 2.48
10.5	13.25	116.25	175.56	139.12	1.0212	1.1222	0.79	W=24.6L 2.49

Avg. Length= Avg. Weight= t-test=0.01* *

Table: 24 Length-Weight Relationships in *Channa Gachua* December 2009

Length of fish In (cm) X	Weight of fish In(gm)Y	X2	Y2	XY	Log/L	Log/W	r-value	Regression equation
13.7	40.3	187.69	1624.1	552.11	1.1367	1.6053	0.72	W= 43.2 L 2.5
13.7	40.3	187.69	1624.1	552.11	1.1367	1.6053	0.72	W= 43.2 L 2.6
13.7	40.3	187.69	1624.1	552.11	1.1367	1.6053	0.72	W= 43.2 L 2.7
13.7	40.3	187.69	1624.1	552.11	1.1367	1.6053	0.72	W= 43.2 L 2.8
13.7	40.3	187.69	1624.1	552.11	1.1367	1.6053	0.72	W= 43.2 L 2.9
13.7	40.3	187.69	1624.1	552.11	1.1367	1.6053	0.72	W= 43.2 L 2.10
13.7	40.3	187.69	1624.1	552.11	1.1367	1.6053	0.72	W= 43.2 L 2.11
13.7	40.3	187.69	1624.1	552.11	1.1367	1.6053	0.72	W= 43.2 L 2.12
16	29	256	876.16	473.6	1.2041	1.4624	0.72	W= 43.2 L 2.13
16	29	256	876.16	473.6	1.2041	1.4624	0.72	W= 43.2 L 2.14
16	29	256	876.16	473.6	1.2041	1.4624	0.72	W= 43.2 L 2.15
16	29	256	876.16	473.6	1.2041	1.4624	0.72	W= 43.2 L 2.16
16	29	256	876.16	473.6	1.2041	1.4624	0.72	W= 43.2 L 2.17
16	29	256	876.16	473.6	1.2041	1.4624	0.72	W= 43.2 L 2.18
16	29	256	876.16	473.6	1.2041	1.4624	0.72	W= 43.2 L 2.19
16	29	256	876.16	473.6	1.2041	1.4624	0.72	W= 43.2 L 2.20
16	29	256	876.16	473.6	1.2041	1.4624	0.72	W= 43.2 L 2.21
17	36.1	289	1303.2	613.7	1.2304	1.5575	0.72	W= 43.2 L 2.22
17	36.1	289	1303.2	613.7	1.2304	1.5575	0.72	W= 43.2 L 2.23
17	36.1	289	1303.2	613.7	1.2304	1.5575	0.72	W= 43.2 L 2.24
17	36.1	289	1303.2	613.7	1.2304	1.5575	0.72	W= 43.2 L 2.25
17	36.1	289	1303.2	613.7	1.2304	1.5575	0.72	W= 43.2 L 2.26
17	36.1	289	1303.2	613.7	1.2304	1.5575	0.72	W= 43.2 L 2.27
17	36.1	289	1303.2	613.7	1.2304	1.5575	0.72	W= 43.2 L 2.28
17	36.1	289	1303.2	613.7	1.2304	1.5575	0.72	W= 43.2 L 2.29
18.5	49	342.25	2401	906.5	1.2672	1.6902	0.72	W= 43.2 L 2.30
18.5	49	342.25	2401	906.5	1.2672	1.6902	0.72	W= 43.2 L 2.31
18.5	49	342.25	2401	906.5	1.2672	1.6902	0.72	W= 43.2 L 2.32
18.5	49	342.25	2401	906.5	1.2672	1.6902	0.72	W= 43.2 L 2.33
18.5	49	342.25	2401	906.5	1.2672	1.6902	0.72	W= 43.2 L 2.34
18.5	49	342.25	2401	906.5	1.2672	1.6902	0.72	W= 43.2 L 2.35
18.5	49	342.25	2401	906.5	1.2672	1.6902	0.72	W= 43.2 L 2.36
18.5	49	342.25	2401	906.5	1.2672	1.6902	0.72	W= 43.2 L 2.37
19.04	67.9	343.6	27398	1949.34	1.2796	1.8319	0.72	W= 43.2 L 2.38
19.5	76	350.25	5698	1497.6	1.29	1.8808	0.72	W= 43.2 L 2.39
19.5	76	350.25	5698	1497.6	1.29	1.8808	0.72	W= 43.2 L 2.40
19.5	76	350.25	5698	1497.6	1.29	1.8808	0.72	W= 43.2 L 2.41
19.5	76	350.25	5698	1497.6	1.29	1.8808	0.72	W= 43.2 L 2.42
19.5	76	350.25	5698	1497.6	1.29	1.8808	0.72	W= 43.2 L 2.43
19.5	76	350.25	5698	1497.6	1.29	1.8808	0.72	W= 43.2 L 2.43

Avg. Length= 17.8 Avg. Weight=54.0 t-test=0.05 *

Growth of Fish, *Channa Gachua* in Terms of Length-Eight Relationship during First Circannual Cycle 2009-2010

Table: 25 Length-Weight Relationship in *Channa Gachua* January 2010

Length of fish In(cm) X	Weight of fish In (gm) Y	X2	Y2	XY	Log/L	Log/W	r-value	Regression equation
7.5	10.9	90.25	118.81	103.55	1.037426	1.037	0.73	W=24.4 L 2.09
5.5	1.6	30.25	256	8.8	0.740363	0.204	0.73	W=24.4 L 2.10
5.8	9.2	81.5	84.64	85.5	0.763428	0.963	0.73	W=24.4 L 2.11
5.9	11	79.21	121	107.8	0.770852	1.041	0.73	W=24.4 L 2.12
5.9	11	79.21	121	107.8	0.770852	1.041	0.73	W=24.4 L 2.13
5.9	11	79.21	121	107.8	0.770852	1.041	0.73	W=24.4 L 2.14
6.5	2.82	34.81	3.24	10.62	0.812913	0.450	0.73	W=24.4 L 2.15
6.5	1.92	34.81	3.24	10.62	0.812913	0.283	0.73	W=24.4 L 2.16
6.5	1.82	34.81	3.24	10.62	0.812913	0.260	0.73	W=24.4 L 2.17
7	4	81	100	90	0.845098	0.602	0.73	W=24.4 L 2.18
7.3	3.3	42.25	4	13	0.863323	0.518	0.73	W=24.4 L 2.19
7.3	3.3	42.25	4	13	0.863323	0.518	0.73	W=24.4 L 2.20
7.3	3.3	42.25	4	13	0.863323	0.518	0.73	W=24.4 L 2.21
7.5	6	49	16	28	0.875061	0.778	0.73	W=24.4 L 2.22
7.5	7	81	100	90	0.875061	0.845	0.73	W=24.4 L 2.23
8	6	53.29	10.89	24.09	0.90309	0.778	0.73	W=24.4 L 2.24
8	9	81	10	90	0.90309	0.954	0.73	W=24.4 L 2.25
8	7.9	67.25	64	65.6	0.90309	0.897	0.73	W=24.4 L 2.26
8	8	64	62.41	63.2	0.90309	0.903	0.73	W=24.4 L 2.27
8	6	53.29	10.89	24.09	0.90309	0.778	0.73	W=24.4 L 2.28
8	9	81	10	90	0.90309	0.954	0.73	W=24.4 L 2.29
8	6	53.29	10.89	24.09	0.90309	0.778	0.73	W=24.4 L 2.30
8	9	81	10	90	0.90309	0.954	0.73	W=24.4 L 2.31
8.2	8	56.25	36	45	0.913814	0.903	0.73	W=24.4 L 2.32
8.9	10.1	100	102.1	101	0.94939	1.004	0.73	W=24.4 L 2.33
8.9	10.1	100	102.1	101	0.94939	1.004	0.73	W=24.4 L 2.34
8.9	10.1	100	102.1	101	0.94939	1.004	0.73	W=24.4 L 2.35
8.9	10.1	100	102.1	101	0.94939	1.004	0.73	W=24.4 L 2.36
8.9	10.1	100	102.1	101	0.94939	1.004	0.73	W=24.4 L 2.37
8.9	10.1	100	102.1	101	0.94939	1.004	0.73	W=24.4 L 2.38
9	10	100	106.04	102	0.954243	1.000	0.73	W=24.4 L 2.39
9	10	84.64	104.04	93.84	0.954243	1.000	0.73	W=24.4 L 2.40
9	10	64	64	64	0.954243	1.000	0.73	W=24.4 L 2.41
9	10	100	106.04	102	0.954243	1.000	0.73	W=24.4 L 2.42
9	10	100	106.04	102	0.954243	1.000	0.73	W=24.4 L 2.43
9	10	84.64	104.04	93.84	0.954243	1.000	0.73	W=24.4 L 2.44
9	10	64	64	64	0.954243	1.000	0.73	W=24.4 L 2.45
9	10	100	106.04	102	0.954243	1.000	0.73	W=24.4 L 2.46
9	10	100	106.04	102	0.954243	1.000	0.73	W=24.4 L 2.47
9	10	84.64	104.04	93.84	0.954243	1.000	0.73	W=24.4 L 2.48
9	10	64	64	64	0.954243	1.000	0.73	W=24.4 L 2.49

Avg. Length= 8.5 Avg. Weight=9.4 t-test=0.01* *

Table: 26 Length-Weight Relationships in *Channa Gachua* February 2010

Length of fish cm X	Weight of fish gm Y	X2	Y2	XY	Log/L	Log/W	r-value	Regression equation
11	13.8	121	190.4	151.8	1.041393	1.139879	0.65	W= 34.9 L .02
11.9	21.4	141.61	458.3	234.7	1.075547	1.330617	0.65	W= 34.9L 2.03
12	13.5	144	182.2	162	1.079181	1.130334	0.65	W= 34.9L 2.04
12	21.9	144	480	262.9	1.079181	1.340642	0.65	W= 34.9L 2.05
12	21.5	144	462.25	258	1.079181	1.332438	0.65	W= 34.9L 2.06
12	20	144	400	240	1.079181	1.30103	0.65	W= 34.9L 2.07
12	13.5	144	182.2	162	1.079181	1.130334	0.65	W= 34.9L 2.08
12.5	28.8	156.25	813.3	360.2	1.09691	1.459694	0.65	W= 34.9L 2.09
12.5	28.8	156.25	813.3	360.2	1.09691	1.459694	0.65	W= 34.9L 2.10
12.5	28.8	156.25	813.3	360.2	1.09691	1.459694	0.65	W= 34.9L 2.12
12.5	28.8	156.25	813.3	360.2	1.09691	1.459694	0.65	W= 34.9L 2.13
13	26.7	169	716.2	346.45	1.113943	1.425697	0.65	W= 34.9L 2.14
13	27.1	169	2856.1	352.3	1.113943	1.432969	0.65	W= 34.9L 2.15
13.3	28.5	176.89	2024.1	379.3	1.123852	1.45515	0.65	W= 34.9L 2.16
13.3	28.5	176.89	2024.1	379.3	1.123852	1.45515	0.65	W= 34.9L 2.17
13.3	28.5	176.89	2024.1	379.3	1.123852	1.45515	0.65	W= 34.9L 2.18
13.3	28.5	176.89	2024.1	379.3	1.123852	1.45515	0.65	W= 34.9L 2.19
13.3	28.5	176.89	2024.1	379.3	1.123852	1.45515	0.65	W= 34.9L 2.20
13.5	63.5	289	914.4	1079.6	1.130334	1.802842	0.65	W= 34.9L 2.21
13.5	63.5	289	914.4	1079.6	1.130334	1.802842	0.65	W= 34.9L 2.22
13.5	63.5	289	914.4	1079.6	1.130334	1.802842	0.65	W= 34.9L 2.23
13.5	63.5	289	914.4	1079.6	1.130334	1.802842	0.65	W= 34.9L 2.24
13.5	63.5	289	914.4	1079.6	1.130334	1.802842	0.65	W= 34.9L 2.25
14.5	22.9	210.2	524.41	332	1.161368	1.359835	0.65	W= 34.9L 2.26
14.8	54	256	2367.7	864.16	1.170262	1.732474	0.65	W= 34.9L 2.27
14.8	54	256	2367.7	864.16	1.170262	1.732474	0.65	W= 34.9L 2.28
14.8	54	256	2367.7	864.16	1.170262	1.732474	0.65	W= 34.9L 2.29
14.8	54	256	2367.7	864.16	1.170262	1.732474	0.65	W= 34.9L 2.30
14.8	54	256	2367.7	864.16	1.170262	1.732474	0.65	W= 34.9L 2.31
14.8	54	256	2367.7	864.16	1.170262	1.732474	0.65	W= 34.9L 2.32
15	43.3	225	2088.5	644.8	1.176091	1.636688	0.65	W= 34.9L 2.33
15	43.3	225	2088.5	644.8	1.176091	1.636688	0.65	W= 34.9L 2.34
15	43.3	225	2088.5	644.8	1.176091	1.636688	0.65	W= 34.9L 2.35
15	43.3	225	2088.5	644.8	1.176091	1.636688	0.65	W= 34.9L 2.36
15	46.1	225	2122.4	691.05	1.176091	1.663418	0.65	W= 34.9L 2.37
15	43.3	225	2088.5	644.8	1.176091	1.636688	0.65	W= 34.9L 2.38
15.1	54.4	228	830.5	825.7	1.178977	1.735759	0.65	W= 34.9L 2.39
15.1	54.4	228	830.5	825.7	1.178977	1.735759	0.65	W= 34.9L 2.40
15.1	54.4	228	830.5	825.7	1.178977	1.735759	0.65	W= 34.9L 2.41
15.1	54.4	228	830.5	825.7	1.178977	1.735759	0.65	W= 34.9L 2.42

Avg. Length=13.9 Avg. Weight=38.1 t-test=0.05 *

Table: 27 Length-Weight Relationship in *Channa Gachua* March 2010

Length of fish cm X	Weight of fish gm Y	X2	Y2	XY	Log/L	Log/W	r-value	Regression equation
18.1	50.2	327.6	2520	908.6	1.257679	1.700704	0.74	W= 36.1 L 2.1
18.1	50.1	327.6	2510	906.8	1.257679	1.699838	0.74	W= 36.1 L 2.2
18.1	50.5	327.6	2520	908.6	1.257679	1.703291	0.74	W= 36.1 L 2.3
18.1	50.2	327.6	2520	908.6	1.257679	1.700704	0.74	W= 36.1 L 2.4
18.1	50.2	327.6	2520	908.6	1.257679	1.700704	0.74	W= 36.1 L 2.5
18.2	50.5	331.2	2550	919.1	1.260071	1.703291	0.74	W= 36.1 L 2.6
18.2	50.5	331.2	2550	919.1	1.260071	1.703291	0.74	W= 36.1 L 2.7
18.2	50.8	331.2	2580.6	919.1	1.260071	1.705864	0.74	W= 36.1 L 2.8
18.2	50.9	331.2	2590.8	924.5	1.260071	1.706718	0.74	W= 36.1 L 2.9
18.2	50.9	331.2	2590.8	926.3	1.260071	1.706718	0.74	W= 36.1 L 2.10
18.2	50.9	331.2	2590.8	926.3	1.260071	1.706718	0.74	W= 36.1 L 2.11
18.3	50.5	334.8	2550.2	933.3	1.262451	1.703291	0.74	W= 36.1 L 2.12
18.3	50.5	334.8	2550.2	924.1	1.262451	1.703291	0.74	W= 36.1 L 2.13
18.3	50.5	334.8	2550.2	924.1	1.262451	1.703291	0.74	W= 36.1 L 2.14
18.3	50.5	334.8	2530	924.1	1.262451	1.703291	0.74	W= 36.1 L 2.15
18.3	50.3	334.8	2590.8	924.1	1.262451	1.701568	0.74	W= 36.1 L 2.16
18.3	50.9	334.8	2601	920.4	1.262451	1.706718	0.74	W= 36.1 L 2.17
18.3	51	334.8	2601	931.4	1.262451	1.70757	0.74	W= 36.1 L 2.18
18.3	50.2	334.8	2520	933.3	1.262451	1.700704	0.74	W= 36.1 L 2.19
18.4	51	338.5	2601	936.5	1.264818	1.70757	0.74	W= 36.1 L 2.20
18.4	51	338.5	2601	938.4	1.264818	1.70757	0.74	W= 36.1 L 2.21
18.4	51.6	338.5	2662.5	938.4	1.264818	1.71265	0.74	W= 36.1 L 2.22
18.4	51	338.5	2601	938.4	1.264818	1.70757	0.74	W= 36.1 L 2.23
18.4	51.1	338.5	2652.2	938.4	1.264818	1.708421	0.74	W= 36.1 L 2.24
18.4	51.5	338.5	2662.5	938.4	1.264818	1.711807	0.74	W= 36.1 L 2.25
18.4	51	342.2	2550.2	938.4	1.264818	1.70757	0.74	W= 36.1 L 2.26
18.5	51.6	342.2	2621.4	954	1.267172	1.71265	0.74	W= 36.1 L 2.27
18.5	51.2	342.2	2601	954	1.267172	1.70927	0.74	W= 36.1 L 2.28
18.5	51	342.2	2601	947.2	1.267172	1.70757	0.74	W= 36.1 L 2.29
19	52	361	2704	988	1.278754	1.716003	0.74	W= 36.1 L 2.30
19	52	361	2704	988	1.278754	1.716003	0.74	W= 36.1 L 2.31
19	53	361	1849	817	1.278754	1.724276	0.74	W= 36.1 L 2.32
19	53	368.6	2809	1617.6	1.278754	1.724276	0.74	W= 36.1 L 2.33
19	52.3	361	2735.2	993.7	1.278754	1.718502	0.74	W= 36.1 L 2.34
19	52	361	2704	988	1.278754	1.716003	0.74	W= 36.1 L 2.35
19	53	368.6	2809	1017.6	1.278754	1.724276	0.74	W= 36.1 L 2.36
19.1	53.1	364.8	2814.3	1013.2	1.281033	1.724685	0.74	W= 36.1 L 2.37
19.2	53.1	368.6	2819.6	1819.5	1.283301	1.725095	0.74	W= 36.1 L 2.38
19.2	53.1	368.6	2819.6	1819.5	1.283301	1.725095	0.74	W= 36.1 L 2.39
19.2	52.5	361	2757.2	997.5	1.283301	1.720159	0.74	W= 36.1 L 2.40
19.2	53.5	368.6	2862.2	1627.2	1.283301	1.728354	0.74	W= 36.1 L 2.41

Avg. Length=18.5 Avg. Weight=50.0 t-test=0.01* *

Table: 28 Length-Weight Relationships in *Channa Gachua* April 2010

Length of fish cm X	Weight of fish gm Y	X2	Y2	XY	Log/L	Log/W	r-value	Regression equation
12	30	144	900	360	1.079181	1.477121	0.78	W=54.2 L 2.1
12	30	144	900	360	1.079181	1.477121	0.78	W=54.2 L 2.2
12	30	144	900	360	1.079181	1.477121	0.78	W=54.2 L 2.3
12	30	144	900	360	1.079181	1.477121	0.78	W=54.2 L 2.4
12.5	14	156.25	196	175	1.09691	1.146128	0.78	W=54.2 L 2.5
12.5	14	156.25	196	175	1.09691	1.146128	0.78	W=54.2 L 2.6
12.5	14	156.25	196	175	1.09691	1.146128	0.78	W=54.2 L 2.7
12.5	14	156.25	196	175	1.09691	1.146128	0.78	W=54.2 L 2.8
12.8	26.3	163.84	691.69	336.64	1.10721	1.419956	0.78	W=54.2 L 2.9
12.8	26.3	163.84	691.69	336.64	1.10721	1.419956	0.78	W=54.2 L 2.10
12.8	26.3	163.84	691.69	336.64	1.10721	1.419956	0.78	W=54.2 L 2.11
12.8	26.3	163.84	691.69	336.64	1.10721	1.419956	0.78	W=54.2 L 2.12
13	33.7	169	1135.7	438.1	1.113943	1.52763	0.78	W=54.2 L 2.13
13	31	169	961	403	1.113943	1.491362	0.78	W=54.2 L 2.14
13	33.7	169	1135.7	438.1	1.113943	1.52763	0.78	W=54.2 L 2.15
13	31	169	961	403	1.113943	1.491362	0.78	W=54.2 L 2.16
13	31	169	961	403	1.113943	1.491362	0.78	W=54.2 L 2.17
13	33.7	169	1135.7	438.1	1.113943	1.52763	0.78	W=54.2 L 2.18
13	31	169	961	403	1.113943	1.491362	0.78	W=54.2 L 2.19
13	33.7	169	1135.7	438.1	1.113943	1.52763	0.78	W=54.2 L 2.20
13.3	28.5	176.89	2024.1	379.3	1.123852	1.45515	0.78	W=54.2 L 2.21
13.5	63.5	289	914.4	1079.6	1.130334	1.802842	0.78	W=54.2 L 2.22
14	23.4	196	547.56	327.6	1.146128	1.369216	0.78	W=54.2 L 2.23
14	23.4	196	547.56	327.6	1.146128	1.369216	0.78	W=54.2 L 2.24
14.2	32.2	201.64	1036.8	457.24	1.152288	1.507856	0.78	W=54.2 L 2.25
14.2	32.2	201.64	1036.8	457.24	1.152288	1.507856	0.78	W=54.2 L 2.26
14.2	32.2	201.64	1036.8	457.24	1.152288	1.507856	0.78	W=54.2 L 2.27
14.2	32.2	201.64	1036.8	457.24	1.152288	1.507856	0.78	W=54.2 L 2.28
14.5	38.2	210.25	1459.2	542.44	1.161368	1.582063	0.78	W=54.2 L 2.29
14.5	38.2	210.25	1459.2	542.44	1.161368	1.582063	0.78	W=54.2 L 2.30
14.5	38.2	210.25	1459.2	542.44	1.161368	1.582063	0.78	W=54.2 L 2.31
14.5	38.2	210.25	1459.2	542.44	1.161368	1.582063	0.78	W=54.2 L 2.32
14.8	54	256	2367.7	864.16	1.170262	1.732474	0.78	W=54.2 L 2.33
14.9	34	222.01	1156	506.6	1.173186	1.531479	0.78	W=54.2 L 2.34
14.9	34	222.01	1156	506.6	1.173186	1.531479	0.78	W=54.2 L 2.35
14.9	34	222.01	1156	506.6	1.173186	1.531479	0.78	W=54.2 L 2.36
14.9	34	222.01	1156	506.6	1.173186	1.531479	0.78	W=54.2 L 2.37
15.1	54.4	228	830.5	825.7	1.178977	1.735759	0.78	W=54.2 L 2.38
15.2	48.7	219.04	2701.9	720.6	1.181844	1.687172	0.78	W=54.2 L 2.39
15.2	52	231.04	2961.5	790	1.181844	1.715836	0.78	W=54.2 L 2.40
16.3	38.6	265.6	1489	4489	1.212188	1.586587	0.78	W=54.2 L 2.41

Avg. Length= 14.5 Avg. Weight= 33.1 t-test=0.01* *

Table: 29 Length-Weight Relationships in *Channa Gachua* May 2010

Length of fish cm X	Weight of fish gm Y	X2	Y2	XY	Log/L	Log/W	r-value	Regression equation
17.5	52.7	306.2	2776	922	1.721728	1.721728	0.56	W= 23.1 L 2.1
17.5	52.7	306.2	2777.1	922.2	1.721802	1.721802	0.56	W= 23.1 L 2.2
17.5	52.7	306.2	2777.1	922	1.721802	1.721802	0.56	W= 23.1 L 2.3
17.5	52.7	306.2	2776.2	922	1.721728	1.721728	0.56	W= 23.1 L 2.4
17.5	52.7	306.2	2776.2	922	1.721728	1.721728	0.56	W= 23.1 L 2.5
17.5	52.7	306.2	2776.9	922.1	1.721786	1.721786	0.56	W= 23.1 L 2.6
17.5	52.7	306.2	2776.3	922	1.721736	1.721736	0.56	W= 23.1 L 2.7
17.5	52.7	306.2	2776.3	922	1.721736	1.721736	0.56	W= 23.1 L 2.8
17.5	52.7	306.2	2775.1	921.9	1.721646	1.721646	0.56	W= 23.1 L 2.9
17.5	52.7	306.2	2777.2	922.2	1.721811	1.721811	0.56	W= 23.1 L 2.10
17.5	52.7	306.2	2776.2	922	1.721728	1.721728	0.56	W= 23.1 L 2.11
17.5	52.7	306.2	2777	922.2	1.721794	1.721794	0.56	W= 23.1 L 2.12
17.5	52.7	306.2	2777	922.2	1.721794	1.721794	0.56	W= 23.1 L 2.13
17.5	52.7	306.2	2777	922.2	1.721794	1.721794	0.56	W= 23.1 L 2.14
17.5	52.7	306.2	2775.1	921.6	1.721646	1.721646	0.56	W= 23.1 L 2.15
17.6	52.7	309.7	2776.5	927.3	1.721753	1.721753	0.56	W= 23.1 L 2.16
17.6	52.7	309.7	2777.1	927.5	1.721802	1.721802	0.56	W= 23.1 L 2.17
17.6	52.7	309.7	2776	927.3	1.721712	1.721712	0.56	W= 23.1 L 2.18
17.6	52.7	309.7	2776.5	927.3	1.721753	1.721753	0.56	W= 23.1 L 2.19
17.6	52.7	309.7	2776.5	927.3	1.721753	1.721753	0.56	W= 23.1 L 2.20
17.6	52.7	309.7	2777.1	927.5	1.721802	1.721802	0.56	W= 23.1 L 2.21
17.6	52.7	309.7	2777.1	927.5	1.721802	1.721802	0.56	W= 23.1 L 2.22
17.6	52.7	309.7	2778.3	927.5	1.721802	1.721802	0.56	W= 23.1 L 2.23
17.6	52.7	309.7	2778.3	927.6	1.721893	1.721893	0.56	W= 23.1 L 2.24
17.6	52.7	309.7	2778.3	927.6	1.721893	1.721893	0.56	W= 23.1 L 2.25
17.6	52.7	309.7	2778.3	927.6	1.721893	1.721893	0.56	W= 23.1 L 2.26
17.6	52.7	309.7	2778.3	927.6	1.721893	1.721893	0.56	W= 23.1 L 2.27
17.7	52.7	313.2	2777	932.7	1.721794	1.721794	0.56	W= 23.1 L 2.28
20.4	89.1	420.2	7974.4	1830.6	1.949878	1.949878	0.56	W= 23.1 L 2.29
20.4	89.1	416.1	7938.8	1817.6	1.949878	1.949878	0.56	W= 23.1 L 2.30
20.4	89.1	416.1	7921	1815.6	1.949878	1.949878	0.56	W= 23.1 L 2.31
20.4	89	416.1	7927	1815.6	1.94939	1.94939	0.56	W= 23.1 L 2.32
20.4	89	416.1	7921	1815.6	1.94939	1.94939	0.56	W= 23.1 L 2.33
20.4	89	416.1	7921	1815.6	1.94939	1.94939	0.56	W= 23.1 L 2.34
20.4	89	416.1	7921	1815.6	1.94939	1.94939	0.56	W= 23.1 L 2.35
20.4	89	424.3	8100	1854	1.94939	1.94939	0.56	W= 23.1 L 2.36
20.4	89.3	416.1	7921	1815.6	1.950851	1.950851	0.56	W= 23.1 L 2.37
20.4	89	416.1	7938.8	1817.6	1.94939	1.94939	0.56	W= 23.1 L 2.38
20.4	89.1	416.1	7921	1817.6	1.949878	1.949878	0.56	W= 23.1 L 2.39
20.4	89.1	416.1	7921	1817.6	1.949878	1.949878	0.56	W= 23.1 L 2.40
20.4	89.1	416.1	7921	1813.5	1.949878	1.949878	0.56	W= 23.1 L 2.41

Avg. Length=18.2　　Avg. Weight= 74.1　　t-test=0.05 *

Table: 30 Length-Weight Relationships in *Channa Gachua* June 2010

Length of fish cm X	Weight of fish gm Y	X2	Y2	XY	Log/L	Log/W	r = value	Regression equation
12	17.1	144	292.4	205.2	1.079181	1.232996	0.78	W= 32.1 L 2.34
12	17.1	144	292.4	205.2	1.079181	1.232996	0.78	W= 32.1 L 2.35
12	17.1	144	292.4	205.2	1.079181	1.232996	0.78	W= 32.1 L 2.36
12	17.1	144	292.4	205.2	1.079181	1.232996	0.78	W= 32.1 L 2.37
12	17.2	144	292.4	205.2	1.079181	1.235528	0.78	W= 32.1 L 2.38
12	17.2	144	295.8	205.2	1.079181	1.235528	0.78	W= 32.1 L 2.39
12	17.2	144	295.8	205.2	1.079181	1.235528	0.78	W= 32.1 L 2.40
12	17.2	144	295.8	205.2	1.079181	1.235528	0.78	W= 32.1 L 2.41
12	17	146.4	295.8	204	1.079181	1.230449	0.78	W= 32.1 L 2.42
12	17	144	289	204	1.079181	1.230449	0.78	W= 32.1 L 2.43
12	17	144	289	204	1.079181	1.230449	0.78	W= 32.1 L 2.44
12	17	144	289	204	1.079181	1.230449	0.78	W= 32.1 L 2.45
12	17	144	289	204	1.079181	1.230449	0.78	W= 32.1 L 2.46
12	17	144	289	204	1.079181	1.230449	0.78	W= 32.1 L 2.47
12	17	144	289	204	1.079181	1.230449	0.78	W= 32.1 L 2.48
12	17	144	289	204	1.079181	1.230449	0.78	W= 32.1 L 2.49
12.1	17.5	148.8	306.2	213.5	1.082785	1.243038	0.78	W= 32.1 L 2.50
12.1	17.2	146.4	306.2	208.1	1.082785	1.235528	0.78	W= 32.1 L 2.51
12.1	17.2	146.4	295.8	208.1	1.082785	1.235528	0.78	W= 32.1 L 2.52
12.1	17.2	146.4	295.8	208.1	1.082785	1.235528	0.78	W= 32.1 L 2.53
12.1	17.1	146.4	295.8	206.9	1.082785	1.232996	0.78	W= 32.1 L 2.54
12.1	17.1	146.4	292.9	206.9	1.082785	1.232996	0.78	W= 32.1 L 2.55
12.1	17.2	146.4	292.9	208.1	1.082785	1.235528	0.78	W= 32.1 L 2.56
12.2	17.5	144	295.8	213.5	1.08636	1.243038	0.78	W= 32.1 L 2.57
12.2	17.5	148.8	306.2	213.5	1.08636	1.243038	0.78	W= 32.1 L 2.58
12.2	17.5	148.8	306.2	213.5	1.08636	1.243038	0.78	W= 32.1 L 2.59
12.2	17.5	148.8	306.2	213.5	1.08636	1.243038	0.78	W= 32.1 L 2.60
12.2	17.5	148.8	306.2	213.5	1.08636	1.243038	0.78	W= 32.1 L 2.61
16.6	45	275.5	2025	747	1.220108	1.653213	0.78	W= 32.1 L 2.62
16.6	45	275.5	2025	747	1.220108	1.653213	0.78	W= 32.1 L 2.63
16.6	45	275.5	2079.3	747	1.220108	1.653213	0.78	W= 32.1 L 2.64
16.6	45	275.5	2025	747	1.220108	1.653213	0.78	W= 32.1 L 2.65
16.6	45	275.5	2025	747	1.220108	1.653213	0.78	W= 32.1 L 2.66
16.6	45	275.5	2025	747	1.220108	1.653213	0.78	W= 32.1 L 2.67
16.6	44.9	278.8	2016	745.3	1.220108	1.652246	0.78	W= 32.1 L 2.68
16.6	45.9	275.5	2016	745.3	1.220108	1.661813	0.78	W= 32.1 L 2.69
16.6	45.1	275.5	2016	748.6	1.220108	1.654177	0.78	W= 32.1 L 2.70
16.7	45.1	278.8	2034	753.1	1.222716	1.654177	0.78	W= 32.1 L 2.71
16.7	45	278.8	2025	751.5	1.222716	1.653213	0.78	W= 32.1 L 2.72
16.7	45	278.8	2025	751.5	1.222716	1.653213	0.78	W= 32.1 L 2.73
16.7	45	278.8	2025	751.5	1.222716	1.653213	0.78	W= 32.1 L 2.74

Avg. Length= 15.1 Avg. Weight=35.1 t-test=0.01* *

Table: 31 Length-Weight Relationships in *Channa Gachua* July 2010

Length of fish cm X	Weight of fish gm Y	X2	Y2	XY	Log/L	Log/W	r-value	Regression equation
14	34.2	196	1169.6	478.8	1.146128	1.534026	0.72	W= 36.2 L 2.10
14	34.1	196	1162.8	477.4	1.146128	1.532754	0.72	W= 36.2 L 2.11
14	34.2	196	1169.6	478.8	1.146128	1.534026	0.72	W= 36.2 L 2.12
14	34.3	196	1176.4	480.2	1.146128	1.535294	0.72	W= 36.2 L 2.13
14	34	196	1156	474.6	1.146128	1.531479	0.72	W= 36.2 L 2.14
14	33.9	196	1149.2	474.6	1.146128	1.5302	0.72	W= 36.2 L 2.15
14	33.7	196	1149.2	474.6	1.146128	1.52763	0.72	W= 36.2 L 2.16
14	33.9	196	1149.2	474.6	1.146128	1.5302	0.72	W= 36.2 L 2.17
14	33.8	196	1142.4	473.2	1.146128	1.528917	0.72	W= 36.2 L 2.18
14	34.1	196	1162.8	477.4	1.146128	1.532754	0.72	W= 36.2 L 2.19
14.1	34.5	198.8	1190.2	486.4	1.149219	1.537819	0.72	W= 36.2 L 2.20
14.1	34.5	198.8	1190.2	486.4	1.149219	1.537819	0.72	W= 36.2 L 2.21
14.1	34.5	198.8	1190.2	483.6	1.149219	1.537819	0.72	W= 36.2 L 2.22
14.1	34.3	198.8	1176.4	482.2	1.149219	1.535294	0.72	W= 36.2 L 2.23
14.1	34.2	198.8	1169.6	485	1.149219	1.534026	0.72	W= 36.2 L 2.24
14.1	34.4	198.8	1169.6	476	1.149219	1.536558	0.72	W= 36.2 L 2.25
14.1	36.5	198.8	1332.2	514.6	1.149219	1.562293	0.72	W= 36.2 L 2.26
14.1	34.3	198.8	1176.4	483.6	1.149219	1.535294	0.72	W= 36.2 L 2.27
14.1	34.2	198.8	1169.6	482.2	1.149219	1.534026	0.72	W= 36.2 L 2.28
14.1	34.1	198.8	1162.5	480.8	1.149219	1.532754	0.72	W= 36.2 L 2.29
14.1	34.2	198.8	1169.6	482.2	1.149219	1.534026	0.72	W= 36.2 L 2.30
14.1	34.1	198.8	1162.5	480.8	1.149219	1.532754	0.72	W= 36.2 L 2.31
14.2	34.5	201.6	1190.2	489.9	1.152288	1.537819	0.72	W= 36.2 L 2.32
14.2	35	201.6	1225	587.5	1.152288	1.544068	0.72	W= 36.2 L 2.33
14.2	34.9	201.6	1218	211.5	1.152288	1.542825	0.72	W= 36.2 L 2.34
14.2	34.1	201.6	1162.8	484.2	1.152288	1.532754	0.72	W= 36.2 L 2.35
14.3	34.1	204.9	1162.8	487.6	1.155336	1.532754	0.72	W= 36.2 L 2.36
14.3	34.3	204.4	1176.4	490.4	1.155336	1.535294	0.72	W= 36.2 L 2.37
14.4	38.2	207.3	1459.2	556.8	1.158362	1.582063	0.72	W= 36.2 L 2.38
14.4	37.2	207.3	1316.4	535.6	1.158362	1.570543	0.72	W= 36.2 L 2.39
14.4	37.1	207.3	1376.4	534.2	1.158362	1.569374	0.72	W= 36.2 L 2.40
14.4	37.1	210.2	1376.4	534.2	1.158362	1.569374	0.72	W= 36.2 L 2.41
14.4	37.1	210.2	1383.8	534.2	1.158362	1.569374	0.72	W= 36.2 L 2.42
14.4	37.2	210.2	1436.4	535.6	1.158362	1.570543	0.72	W= 36.2 L 2.43
14.4	38.3	207.3	1482.2	551.5	1.158362	1.583199	0.72	W= 36.2 L 2.44
14.4	38.5	207.3	1369	554.4	1.158362	1.585461	0.72	W= 36.2 L 2.45
14.4	37	207.3	1369	532.8	1.158362	1.568202	0.72	W= 36.2 L 2.46
14.5	38.4	210.2	1474.5	556.8	1.161368	1.584331	0.72	W= 36.2 L 2.47
14.5	38.1	210.2	1451.6	552.4	1.161368	1.580925	0.72	W= 36.2 L 2.48
14.5	38.1	210.2	1451.6	552.4	1.161368	1.580925	0.72	W= 36.2 L 2.49
14.5	38.2	213.1	1459.2	553.9	1.161368	1.582063	0.72	W= 36.2 L 2.50

Avg. Length= 14.3   Avg. Weight= 35.0   t-test=0.01 **

Table: 32 Length-Weight Relationships in *Channa Gachua* August 2010

Length of fish cm X	gm	X2	Y2	XY	Log/L	Log/W	r-value	Regression equation
14	34.3	196	1176.4	480.2	1.146128	1.535294	0.87	W= 54.5 L 2.61
14	34.3	196	1176.4	480.2	1.146128	1.535294	0.87	W= 54.5 L 2.62
14	34	196	1156	474.6	1.146128	1.531479	0.87	W= 54.5 L 2.63
14	33.9	196	1149.2	474.6	1.146128	1.5302	0.87	W= 54.5 L 2.64
14	33.7	196	1149.2	474.6	1.146128	1.52763	0.87	W= 54.5 L 2.65
14	33.9	196	1149.2	474.6	1.146128	1.5302	0.87	W= 54.5 L 2.66
14	33.8	196	1142.4	473.2	1.146128	1.528917	0.87	W= 54.5 L 2.67
14	34	196	1156	474.6	1.146128	1.531479	0.87	W= 54.5 L 2.68
14	33.9	196	1149.2	474.6	1.146128	1.5302	0.87	W= 54.5 L 2.69
14	33.7	196	1149.2	474.6	1.146128	1.52763	0.87	W= 54.5 L 2.70
14	33.9	196	1149.2	474.6	1.146128	1.5302	0.87	W= 54.5 L 2.71
14	33.8	196	1142.4	473.2	1.146128	1.528917	0.87	W= 54.5 L 2.72
14	34	196	1156	474.6	1.146128	1.531479	0.87	W= 54.5 L 2.73
14	33.9	196	1149.2	474.6	1.146128	1.5302	0.87	W= 54.5 L 2.74
14	33.7	196	1149.2	474.6	1.146128	1.52763	0.87	W= 54.5 L 2.75
14	33.9	196	1149.2	474.6	1.146128	1.5302	0.87	W= 54.5 L 2.76
14	33.8	196	1142.4	473.2	1.146128	1.528917	0.87	W= 54.5 L 2.77
14.1	36.5	198.8	1332.2	514.6	1.149219	1.562293	0.87	W= 54.5 L 2.78
14.1	34.3	198.8	1176.4	483.6	1.149219	1.535294	0.87	W= 54.5 L 2.79
14.1	34.2	198.8	1169.6	482.2	1.149219	1.534026	0.87	W= 54.5 L 2.80
14.1	34.1	198.8	1162.5	480.8	1.149219	1.532754	0.87	W= 54.5 L 2.81
14.1	34.2	198.8	1169.6	482.2	1.149219	1.534026	0.87	W= 54.5 L 2.82
14.1	34.1	198.8	1162.5	480.8	1.149219	1.532754	0.87	W= 54.5 L 2.83
14.1	36.5	198.8	1332.2	514.6	1.149219	1.562293	0.87	W= 54.5 L 2.84
14.1	34.3	198.8	1176.4	483.6	1.149219	1.535294	0.87	W= 54.5 L 2.85
14.1	34.2	198.8	1169.6	482.2	1.149219	1.534026	0.87	W= 54.5 L 2.86
14.1	34.1	198.8	1162.5	480.8	1.149219	1.532754	0.87	W= 54.5 L 2.87
14.1	34.2	198.8	1169.6	482.2	1.149219	1.534026	0.87	W= 54.5 L 2.88
14.1	34.1	198.8	1162.5	480.8	1.149219	1.532754	0.87	W= 54.5 L 2.89
14.1	34.5	198.8	1190.2	486.4	1.149219	1.537819	0.87	W= 54.5 L 2.90
14.1	34.5	198.8	1190.2	486.4	1.149219	1.537819	0.87	W= 54.5 L 2.91
14.1	34.5	198.8	1190.2	483.6	1.149219	1.537819	0.87	W= 54.5 L 2.92
14.1	34.3	198.8	1176.4	482.2	1.149219	1.535294	0.87	W= 54.5 L 2.93
14.1	34.2	198.8	1169.6	485	1.149219	1.534026	0.87	W= 54.5 L 2.94
14.1	34.4	198.8	1169.6	476	1.149219	1.536558	0.87	W= 54.5 L 2.95
14.1	34.5	198.8	1190.2	486.4	1.149219	1.537819	0.87	W= 54.5 L 2.96
14.1	34.5	198.8	1190.2	486.4	1.149219	1.537819	0.87	W= 54.5 L 2.97
14.1	34.5	198.8	1190.2	483.6	1.149219	1.537819	0.87	W= 54.5 L 2.98
14.1	34.3	198.8	1176.4	482.2	1.149219	1.535294	0.87	W= 54.5 L 2.99
14.1	34.2	198.8	1169.6	485	1.149219	1.534026	0.87	W= 54.5 L 2.100
14.1	34.4	198.8	1169.6	476	1.149219	1.536558	0.87	W= 54.5 L 2.101

Avg. Length=14.0 Avg. Weight= 32.8 t-test=0.01* *

Table: 33 Length-Weight Relationships in *Channa Gachua September* 2010

Length of fish cm X	Weight of fish gm Y	X2	Y2	XY	Log/L	Log/W	r-value	Regression equation
11.7	23	136.8	529	269.1	1.068186	1.361728	0.61	W= 21.1 L 2.03
11.7	22.9	139.2	529	267.9	1.068186	1.359835	0.61	W= 21.1 L 2.04
11.7	23	136.8	529	269.1	1.068186	1.361728	0.61	W= 21.1 L 2.05
11.7	22.9	139.2	529	267.9	1.068186	1.359835	0.61	W= 21.1 L 2.06
11.8	23.2	139.2	538.2	273.7	1.071882	1.365488	0.61	W= 21.1 L 2.07
11.8	23.2	139.2	538.2	272.5	1.071882	1.365488	0.61	W= 21.1 L 2.08
11.8	23.1	139.2	533.6	277.5	1.071882	1.363612	0.61	W= 21.1 L 2.09
11.8	23.1	139.2	533.6	272.5	1.071882	1.363612	0.61	W= 21.1 L 2.10
11.8	23.1	139.2	533.6	272.5	1.071882	1.363612	0.61	W= 21.1 L 2.11
11.8	23.1	139.2	533.6	272.5	1.071882	1.363612	0.61	W= 21.1 L 2.12
11.8	23.1	136.8	533.6	272.5	1.071882	1.363612	0.61	W= 21.1 L 2.13
11.8	22.9	139.2	524.4	267.9	1.071882	1.359835	0.61	W= 21.1 L 2.14
11.8	23.1	141.6	533.6	272.5	1.071882	1.363612	0.61	W= 21.1 L 2.15
11.8	23.1	139.2	529	271.4	1.071882	1.363612	0.61	W= 21.1 L 2.16
11.8	23	139.2	529	271.4	1.071882	1.361728	0.61	W= 21.1 L 2.17
11.8	23	139.2	549	271.4	1.071882	1.361728	0.61	W= 21.1 L 2.18
11.8	23	139.2	549	272.5	1.071882	1.361728	0.61	W= 21.1 L 2.19
11.8	23	139.2	533.6	276	1.071882	1.361728	0.61	W= 21.1 L 2.20
11.8	23.2	139.2	538.2	273.7	1.071882	1.365488	0.61	W= 21.1 L 2.21
11.8	23.2	139.2	538.2	272.5	1.071882	1.365488	0.61	W= 21.1 L 2.22
11.8	23.1	139.2	533.6	277.5	1.071882	1.363612	0.61	W= 21.1 L 2.23
11.8	23.1	139.2	533.6	272.5	1.071882	1.363612	0.61	W= 21.1 L 2.24
11.8	23.1	139.2	533.6	272.5	1.071882	1.363612	0.61	W= 21.1 L 2.25
11.8	23.1	139.2	533.6	272.5	1.071882	1.363612	0.61	W= 21.1 L 2.26
11.8	23.1	136.8	533.6	272.5	1.071882	1.363612	0.61	W= 21.1 L 2.27
11.8	22.9	139.2	524.4	267.9	1.071882	1.359835	0.61	W= 21.1 L 2.28
11.8	23.1	141.6	533.6	272.5	1.071882	1.363612	0.61	W= 21.1 L 2.29
11.8	23.1	139.2	529	271.4	1.071882	1.363612	0.61	W= 21.1 L 2.30
11.8	23	139.2	529	271.4	1.071882	1.361728	0.61	W= 21.1 L 2.31
11.8	23	139.2	549	271.4	1.071882	1.361728	0.61	W= 21.1 L 2.32
11.8	23	139.2	549	272.5	1.071882	1.361728	0.61	W= 21.1 L 2.33
11.8	23	139.2	533.6	276	1.071882	1.361728	0.61	W= 21.1 L 2.34
11.9	23.4	141.6	547.5	270.4	1.075547	1.369216	0.61	W= 21.1 L 2.35
11.9	23.4	141.6	547.5	278.4	1.075547	1.369216	0.61	W= 21.1 L 2.36
11.9	23.3	141.6	542.8	277.2	1.075547	1.367356	0.61	W= 21.1 L 2.37
11.9	23.3	149.6	542.8	277.2	1.075547	1.367356	0.61	W= 21.1 L 2.38
11.9	23.2	141.6	538.2	276	1.075547	1.365488	0.61	W= 21.1 L 2.39
11.9	23.2	141.6	538.2	276	1.075547	1.365488	0.61	W= 21.1 L 2.40
11.9	23.2	141.6	538.2	276	1.075547	1.365488	0.61	W= 21.1 L 2.41
11.9	23.2	139.2	533.6	274.8	1.075547	1.365488	0.61	W= 21.1 L 2.42
11.9	23.1	139.2	533.6	274.8	1.075547	1.363612	0.61	W= 21.1 L 2.43

Avg. Length=11.5 Avg. Weight=23.1 t-test=0.05 *

Table: 34 Length-Weight Relationships in *Channa Gachua* October 2010

Length of fish cm X	Weight of fish gm Y	X2	Y2	XY	Log/L	Log/W	r-value	Regression equation
12	27	144	729	324	1.079181	1.431364	0.57	W= 54.2 L 2.5
12	27	144	729	324	1.079181	1.431364	0.57	W= 54.2 L 2.6
12	27	144	729	324	1.079181	1.431364	0.57	W= 54.2 L 2.7
12	27	144	729	324	1.079181	1.431364	0.57	W= 54.2 L 2.8
12	27	144	729	324	1.079181	1.431364	0.57	W= 54.2 L 2.9
12	27	144	729	324	1.079181	1.431364	0.57	W= 54.2 L 2.10
12	27.1	144	734.4	325.2	1.079181	1.432969	0.57	W= 54.2 L 2.11
12	27.1	144	734.4	325.2	1.079181	1.432969	0.57	W= 54.2 L 2.12
12.1	27.9	146.4	778.4	337.5	1.082785	1.445604	0.57	W= 54.2 L 2.13
12.1	27.9	146.4	778.4	337.5	1.082785	1.445604	0.57	W= 54.2 L 2.14
12.1	27.9	146.4	778.4	337.5	1.082785	1.445604	0.57	W= 54.2 L 2.15
12.1	27.9	146.4	778.4	337.5	1.082785	1.445604	0.57	W= 54.2 L 2.16
12.1	27.9	146.4	778.4	337.5	1.082785	1.445604	0.57	W= 54.2 L 2.17
12.1	27.9	146.4	778.4	337.5	1.082785	1.445604	0.57	W= 54.2 L 2.18
12.4	28.2	153.7	784	347.2	1.093422	1.450249	0.57	W= 54.2 L 2.19
12.4	27.1	153.7	784	349.6	1.093422	1.432969	0.57	W= 54.2 L 2.20
12.4	27.1	153.7	795.2	336	1.093422	1.432969	0.57	W= 54.2 L 2.21
12.4	28	153.7	734.4	336	1.093422	1.447158	0.57	W= 54.2 L 2.22
12.4	28	153.7	734.4	347.2	1.093422	1.447158	0.57	W= 54.2 L 2.23
12.4	27.4	153.7	789.6	345.9	1.093422	1.437751	0.57	W= 54.2 L 2.24
12.4	27.4	153.7	778.4	345.9	1.093422	1.437751	0.57	W= 54.2 L 2.25
12.4	27.4	153.7	778.4	345.9	1.093422	1.437751	0.57	W= 54.2 L 2.26
12.4	27.4	153.7	778.4	345.9	1.093422	1.437751	0.57	W= 54.2 L 2.27
12.4	27.4	153.7	778.4	345.9	1.093422	1.437751	0.57	W= 54.2 L 2.28
12.5	27.2	156.2	852	362.5	1.09691	1.434569	0.57	W= 54.2 L 2.29
12.5	28	156.2	846.8	363.7	1.09691	1.447158	0.57	W= 54.2 L 2.30
12.5	28	156.2	884	350	1.09691	1.447158	0.57	W= 54.2 L 2.31
12.5	28	156.2	784	350	1.09691	1.447158	0.57	W= 54.2 L 2.32
12.5	28.1	156.2	784	350	1.09691	1.448706	0.57	W= 54.2 L 2.33
12.5	28.1	156.2	784	351.2	1.09691	1.448706	0.57	W= 54.2 L 2.34
12.5	28.1	156.2	789.6	351.2	1.09691	1.448706	0.57	W= 54.2 L 2.35
12.5	28.1	156.2	789.6	345.9	1.09691	1.448706	0.57	W= 54.2 L 2.36
13.2	33.7	174.2	1135.6	444.8	1.120574	1.52763	0.57	W= 54.2 L 2.37
13.2	33.2	174.2	1102.2	438.2	1.120574	1.521138	0.57	W= 54.2 L 2.38
13.2	33.5	174.2	1122.5	442.2	1.120574	1.525045	0.57	W= 54.2 L 2.39
13.2	33.5	174.2	1122.5	442.2	1.120574	1.525045	0.57	W= 54.2 L 2.40
13.2	33.5	174.2	1122.5	442.2	1.120574	1.525045	0.57	W= 54.2 L 2.41
13.2	33.5	174.2	1122.5	442.2	1.120574	1.525045	0.57	W= 54.2 L 2.42
13.2	33.2	174.2	1122.5	438.2	1.120574	1.521138	0.57	W= 54.2 L 2.43
13.4	33.9	179.5	1149.2	454.2	1.127105	1.5302	0.57	W= 54.2 L 2.44
13.4	33.9	179.5	1149.2	454.2	1.127105	1.5302	0.57	W= 54.2 L 2.45

Avg. Length=12.9 Avg. Weight=28.8 t-test=0.05 *

Table: 35 Length-Weight Relationships in *Channa Gachua* November 2010

Length of fish cm X	Weight of fish gm Y	X2	Y2	XY	Log/L	Log/W	r-value	Regression equation
15.2	48.5	231	2323.2	737.2	1.181844	1.685742	0.91	W= 54.9 L 2.07
15.2	48.5	231	2323.2	737.2	1.181844	1.685742	0.91	W= 54.9 L 2.08
15.2	48.5	231	2323.2	735.6	1.181844	1.685742	0.91	W= 54.9 L 2.09
15.2	48.4	231	2342.2	735.6	1.181844	1.684845	0.91	W= 54.9 L 2.10
15.2	48.4	231	2342.2	735.6	1.181844	1.684845	0.91	W= 54.9 L 2.11
15.2	48.4	231	2342.2	735.6	1.181844	1.684845	0.91	W= 54.9 L 2.12
15.2	48.4	231	2342.2	734.1	1.181844	1.684845	0.91	W= 54.9 L 2.13
15.2	48.3	231	2332.8	734.1	1.181844	1.683947	0.91	W= 54.9 L 2.14
15.2	48.3	231	2332.8	734.1	1.181844	1.683947	0.91	W= 54.9 L 2.15
15.2	48.3	231	2332.8	735.6	1.181844	1.683947	0.91	W= 54.9 L 2.16
15.2	48.4	231	2342.2	741.7	1.181844	1.684845	0.91	W= 54.9 L 2.17
15.2	48.8	231	2381.4	731.1	1.181844	1.68842	0.91	W= 54.9 L 2.18
15.2	48.1	231	2313.6	741.7	1.181844	1.682145	0.91	W= 54.9 L 2.19
15.2	48.8	231	2381.4	737.2	1.181844	1.68842	0.91	W= 54.9 L 2.20
15.2	48.5	231	2323.2	737.2	1.181844	1.685742	0.91	W= 54.9 L 2.21
15.2	48.5	231	2323.2	737.2	1.181844	1.685742	0.91	W= 54.9 L 2.22
15.2	48.5	231	2323.2	735.6	1.181844	1.685742	0.91	W= 54.9 L 2.23
15.2	48.4	231	2342.2	735.6	1.181844	1.684845	0.91	W= 54.9 L 2.24
15.2	48.4	231	2342.2	735.6	1.181844	1.684845	0.91	W= 54.9 L 2.25
15.2	48.4	231	2342.2	735.6	1.181844	1.684845	0.91	W= 54.9 L 2.26
15.2	48.4	231	2342.2	734.1	1.181844	1.684845	0.91	W= 54.9 L 2.27
15.2	48.3	231	2332.8	734.1	1.181844	1.683947	0.91	W= 54.9 L 2.28
15.2	48.3	231	2332.8	734.1	1.181844	1.683947	0.91	W= 54.9 L 2.29
15.2	48.3	231	2332.8	735.6	1.181844	1.683947	0.91	W= 54.9 L 2.30
15.2	48.4	231	2342.2	741.7	1.181844	1.684845	0.91	W= 54.9 L 2.31
15.2	48.8	231	2381.4	731.1	1.181844	1.68842	0.91	W= 54.9 L 2.32
15.2	48.1	231	2313.6	741.7	1.181844	1.682145	0.91	W= 54.9 L 2.33
15.2	48.8	231	2381.4	737.2	1.181844	1.68842	0.91	W= 54.9 L 2.34
15.2	48.5	231	2323.2	737.2	1.181844	1.685742	0.91	W= 54.9 L 2.35
15.2	48.5	231	2323.2	737.2	1.181844	1.685742	0.91	W= 54.9 L 2.36
15.2	48.5	231	2323.2	735.6	1.181844	1.685742	0.91	W= 54.9 L 2.37
15.2	48.4	231	2342.2	735.6	1.181844	1.684845	0.91	W= 54.9 L 2.38
15.2	48.4	231	2342.2	735.6	1.181844	1.684845	0.91	W= 54.9 L 2.39
15.2	48.4	231	2342.2	735.6	1.181844	1.684845	0.91	W= 54.9 L 2.40
15.2	48.4	231	2342.2	734.1	1.181844	1.684845	0.91	W= 54.9 L 2.41
15.2	48.3	231	2332.8	734.1	1.181844	1.683947	0.91	W= 54.9 L 2.42
15.2	48.3	231	2332.8	734.1	1.181844	1.683947	0.91	W= 54.9 L 2.43
15.2	48.3	231	2332.8	735.6	1.181844	1.683947	0.91	W= 54.9 L 2.44
15.2	48.4	231	2342.2	741.7	1.181844	1.684845	0.91	W= 54.9 L 2.45
15.2	48.8	231	2381.4	731.1	1.181844	1.68842	0.91	W= 54.9 L 2.46
15.2	48.1	231	2313.6	741.7	1.181844	1.682145	0.91	W= 54.9 L 2.47

Avg. Length=15.2 Avg. Weight=45.0 t-test=0.001 ***

Table: 36 Length-Weight Relationships in *Channa Gachua* December 2010

Length of fish cm X	Weight of fish gm Y	X2	Y2	XY	Log/L	Log/W	r-value	Regression equation
8.9	10.1	100	102.1	101	0.94939	1.004321	0.62	W= 56.8 L 2.002
9.8	9	79.21	81	80.1	0.991226	0.954243	0.62	W= 56.8 L 2.003
5.9	11	79.21	121	107.8	0.770852	1.041393	0.62	W= 56.8 L 2.004
6.5	1.8	34.81	3.24	10.62	0.812913	0.255273	0.62	W= 56.8 L 2.005
7.3	3.3	42.25	4	13	0.863323	0.518514	0.62	W= 56.8 L 2.006
9.5	10.9	90.25	118.81	103.55	0.977724	1.037426	0.62	W= 56.8 L 2.007
5.8	9.2	81.5	84.64	85.5	0.763428	0.963788	0.62	W= 56.8 L 2.008
10	2.5	33.64	6.25	14.5	1	0.39794	0.62	W= 56.8 L 2.009
8.9	10.1	100	102.1	101	0.94939	1.004321	0.62	W= 56.8 L 2.010
9.8	9	79.21	81.00	80.1	0.991226	0.954243	0.62	W= 56.8 L 2.011
5.9	11	79.21	121	107.8	0.770852	1.041393	0.62	W= 56.8 L 2.012
6.5	1.8	34.81	3.24	10.62	0.812913	0.255273	0.62	W= 56.8 L 2.013
7.3	3.3	42.25	4	13	0.863323	0.518514	0.62	W= 56.8 L 2.014
9.8	9	79.21	81	80.1	0.991226	0.954243	0.62	W= 56.8 L 2.015
9.5	10.9	90.25	118.81	103.55	0.977724	1.037426	0.62	W= 56.8 L 2.016
9.3	10	64	36	48	0.968483	1	0.62	W= 56.8 L 2.017
9.2	10.2	64	81	72	0.963788	1.0086	0.62	W= 56.8 L 2.018
9.8	9	79.21	81	80.1	0.991226	0.954243	0.62	W= 56.8 L 2.019
9.5	10.9	90.25	118.81	103.55	0.977724	1.037426	0.62	W= 56.8 L 2.020
9.3	10	64	36	48	0.968483	1	0.62	W= 56.8 L 2.021
9.2	10.2	64	81	72	0.963788	1.0086	0.62	W= 56.8 L 2.022
9.8	9	79.21	81	80.1	0.991226	0.954243	0.62	W= 56.8 L 2.023
9.5	10.9	90.25	118.81	103.55	0.977724	1.037426	0.62	W= 56.8 L 2.024
9.3	10	64	36	48	0.968483	1	0.62	W= 56.8 L 2.025
9.2	10.2	64	81	72	0.963788	1.0086	0.62	W= 56.8 L 2.026
9.8	9	79.21	81	80.1	0.991226	0.954243	0.62	W= 56.8 L 2.027
9.5	10.9	90.25	118.81	103.55	0.977724	1.037426	0.62	W= 56.8 L 2.028
9.3	10	64	36	48	0.968483	1	0.62	W= 56.8 L 2.029
9.2	10.2	64	81	72	0.963788	1.0086	0.62	W= 56.8 L 2.030
9.8	9	79.21	81	80.1	0.991226	0.954243	0.62	W= 56.8 L 2.031
9.5	10.9	90.25	118.81	103.55	0.977724	1.037426	0.62	W= 56.8 L 2.032
9.3	10	64	36	48	0.968483	1	0.62	W= 56.8 L 2.033
9.2	10.2	64	81	72	0.963788	1.0086	0.62	W= 56.8 L 2.034
9.8	9	79.21	81	80.1	0.991226	0.954243	0.62	W= 56.8 L 2.035
9.5	10.9	90.25	118.81	103.55	0.977724	1.037426	0.62	W= 56.8 L 2.036
9.3	10	64	36	48	0.968483	1	0.62	W= 56.8 L 2.037
9.2	10.2	64	81	72	0.963788	1.0086	0.62	W= 56.8 L 2.038
8	5	30.25	8.41	40	0.90309	0.69897	0.62	W= 56.8 L 2.039
5.5	4	64	18.889	17.6	0.740363	0.60206	0.62	W= 56.8 L 2.040
6.3	4.3	37.21	25	22.77	0.799341	0.633468	0.62	W= 56.8 L 2.041
6.9	3.2	39.67	16	42.25	0.838849	0.50515	0.62	W= 56.8 L 2.042

Avg. Length= 9.5 Avg. Weight=10.0 t-test=0.05 *

Table: 37 Annual Length-Weight Relationships in Freshwater Fish *Channa Gachua* During 2007-2008

Months	Length of fish cm X	weight of fish gm Y	X	Y	XY	Log/L	Log/W	r-value	Regression equation
January	12.5	14	156.25	196	175	1.09691	1.1461	0.55	W=2.00L3.16
February	13.3	20	176.89	400	266	1.12385	1.301	0.65	W=2.00L3.122
March	15	26.2	225	686.44	393	1.17609	1.4183	0.75	W=2.00L2.09
April	16	42.2	256	1780.8	675.2	1.20412	1.6253	0.75	W=2.00L2.26
May	17	63.9	289	4083.2	1086.3	1.23045	1.8055	0.75	W=2.00L2.35
June	16.9	61	285.6	3721	1030.9	1.22789	1.7853	0.56	w= 51.9 L 2.34
July	17	63.9	289	4083.2	1086.3	1.23045	1.8055	0.75	W=2.00L2.35
August	18	65	324	4225	1170	1.2553	1.8129	0.65	w= 57.3 L 2.22
September	19.5	76	350.25	5698	1497.6	1.29	1.8808	0.58	w=67.9 L2.049
October	8.9	10.1	100	102.1	101	0.9494	1.0043	0.7	w =56.8L2.133
November	11.9	25.1	141.6	630	298.6	1.0755	1.3997	0.67	w = 543.L 2.08
December	9.5	10.9	90.25	118.81	103.55	0.9777	1.0374	0.7	w = 56.8L166

Avg. Length= 15.5   Avg. Weight=55.0   t-test=0.05 *

Table: 38 Annual Length-Weight Relationships in Freshwater Fish *Channa Gachua* During 2008-2009

Months	Length of fish cm X	weight of fish gm Y	X	Y	XY	Log/L	Log/W	r-value	Regression equation
January	12	13	144	169	156	1.0792	1.1139	0.56	W=3.00L3.00
February	11.2	15.5	125.4	140.2	173.6	1.0492	1.1903	0.56	W=3.00L3.123
march	14.5	33.2	210.25	1102.2	481.4	1.1614	1.5211	0.65	W=2.96L2.27
April	12	21.5	144	462.25	258	1.0792	1.3324	0.65	W=2.96L2.114
May	15.5	41.6	256	1723.1	596.7	1.1903	1.6191	0.75	W=2.96L2.09
June	13	21.5	143	462.25	256	1.1139	1.3324	0.7	W=2.96L2.131
July	13.5	31.6	182.25	985.9	423.9	1.1303	1.4997	0.78	W=0.1L2.32
August	13.5	31.6	182.25	985.9	423.9	1.1303	1.4997	0.78	W=0.1L2.32
September	15.2	48.66	219.04	2701.9	720.6	1.1818	1.6872	0.74	W=23.9L265
October	16	39.2	256	1536.6	627.2	1.2041	1.5933	0.77	W=35.2L 2.30
November	10.5	12.5	110.25	156.25	121.2	1.0212	1.0969	0.79	W=24.6L 2.45
December	18.5	49	342.25	2401	906.5	1.2672	1.6902	0.72	W= 43.2L 2.30

Avg. Length= 16.5 Avg. Weight=45.0 t-test=0.05 *

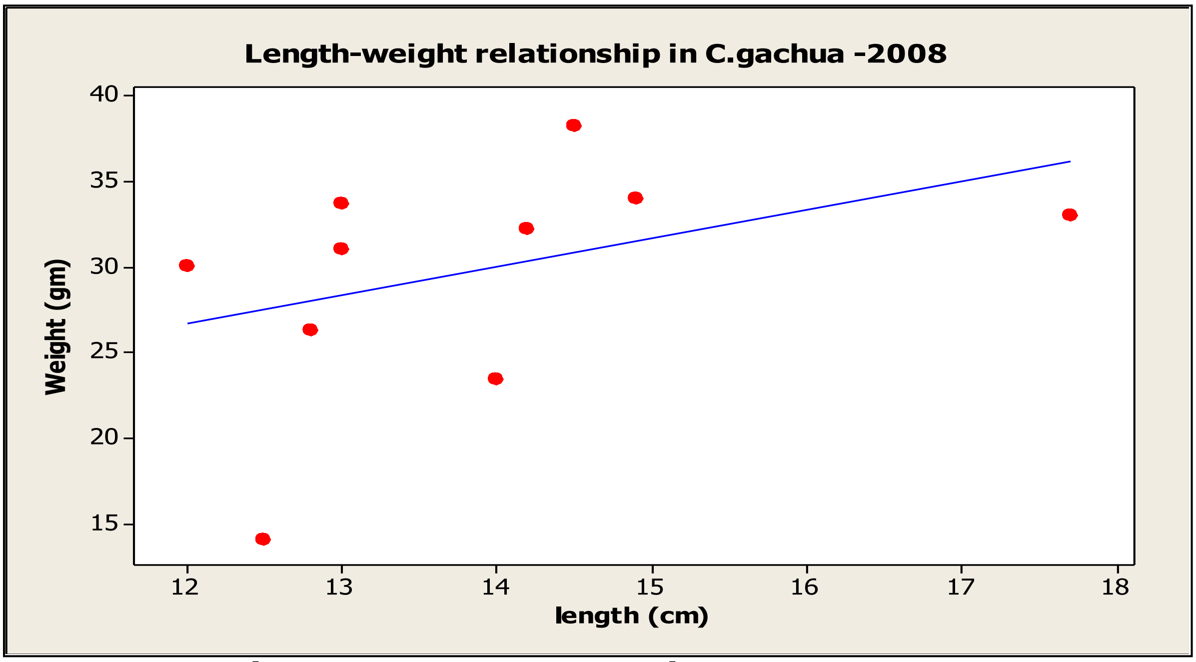
Table: 39 Annual Length-Weight Relationships in Freshwater Fish *Channa Gachua* During 2009-2010

Months	Length of fish cm X	weight of fish gm Y	X	Y	XY	Log/L	Log/W	r-value	Regression equation
January	7.5	7	81	100	90	0.875061	0.845	0.73	W=24.4L2.23
February	14.8	54	256	2367.7	864.16	1.170262	1.7324	0.65	W= 34.9L .30
march	14.5	33.2	210.2	1102.2	481.4	1.1614	1.5211	0.65	W=2.96L2.27
April	18.5	51	342.2	2601	947.2	1.267172	1.70757	0.74	W=36.1L2.29
May	14.8	54	256	2367.7	864.16	1.170262	1.7324	0.78	W=54.2L2.33
June	20.4	89.1	420.2	7974.4	1830.6	1.949878	1.9498	0.56	W=23.1L2.29
July	16.6	45	275.5	2025	747	1.220108	1.6532	0.78	W=32.1L2.62
August	14.4	38.2	207.3	1459.2	556.8	1.158362	1.5820	0.72	W=36.2L2.38
September	14.1	36.5	198.8	1332.2	514.6	1.149219	1.5622	0.87	W=54.5L2.78
October	11.8	23.1	139.2	533.6	272.5	1.071882	1.3636	0.61	W=21.1L2.26
November	12.4	27.4	153.7	778.4	345.9	1.093422	1.4377	0.57	W=54.2L2.26
December	15.2	48.3	231	2332.8	734.1	1.181844	1.6839	0.91	W=54.9L .15

Avg. Length= 18.5 Avg. Weight=65.0 t-test=0.05 *

Growth of Fish, *Channa Gachua* in Terms of Length-Weight Relationship During First Circannual Cycle 2007-2008

Fig. 1 Length-Weight Relationship in *Channa Gachua* January -2008



Avg. Length=15.0 Avg. Weight= 29.4 t-test=0.05 *

Fig. 2 Length-Weight Relationship In *Channa Gachua* February -2008

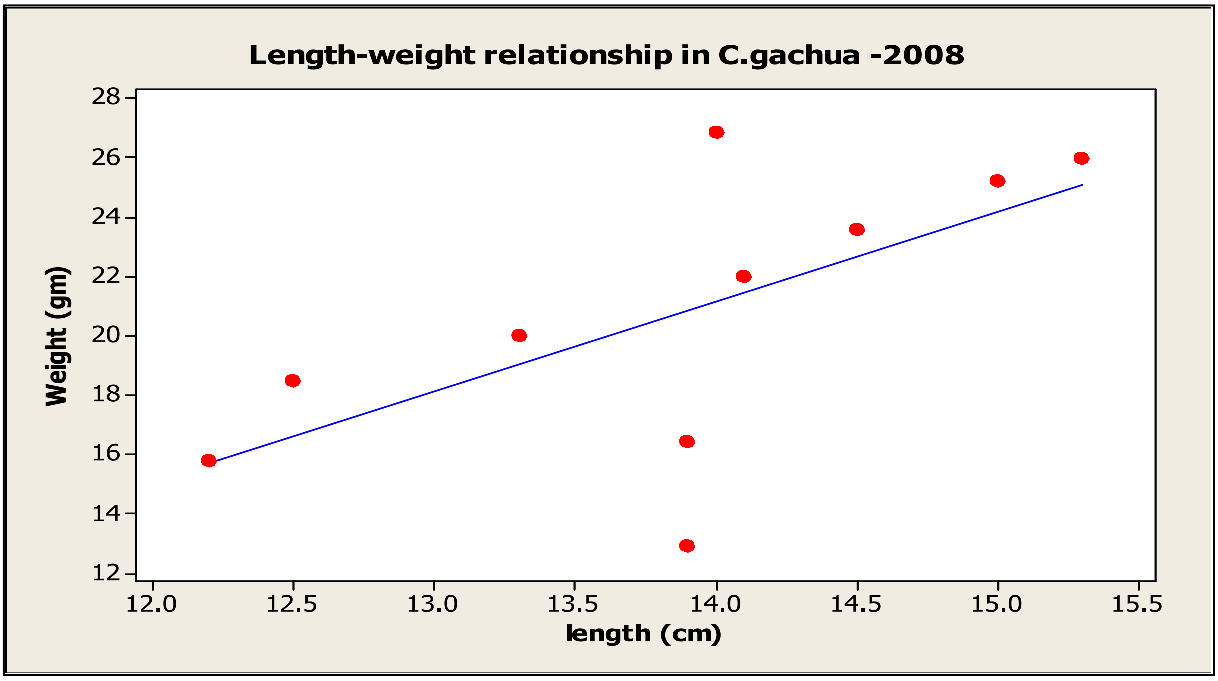
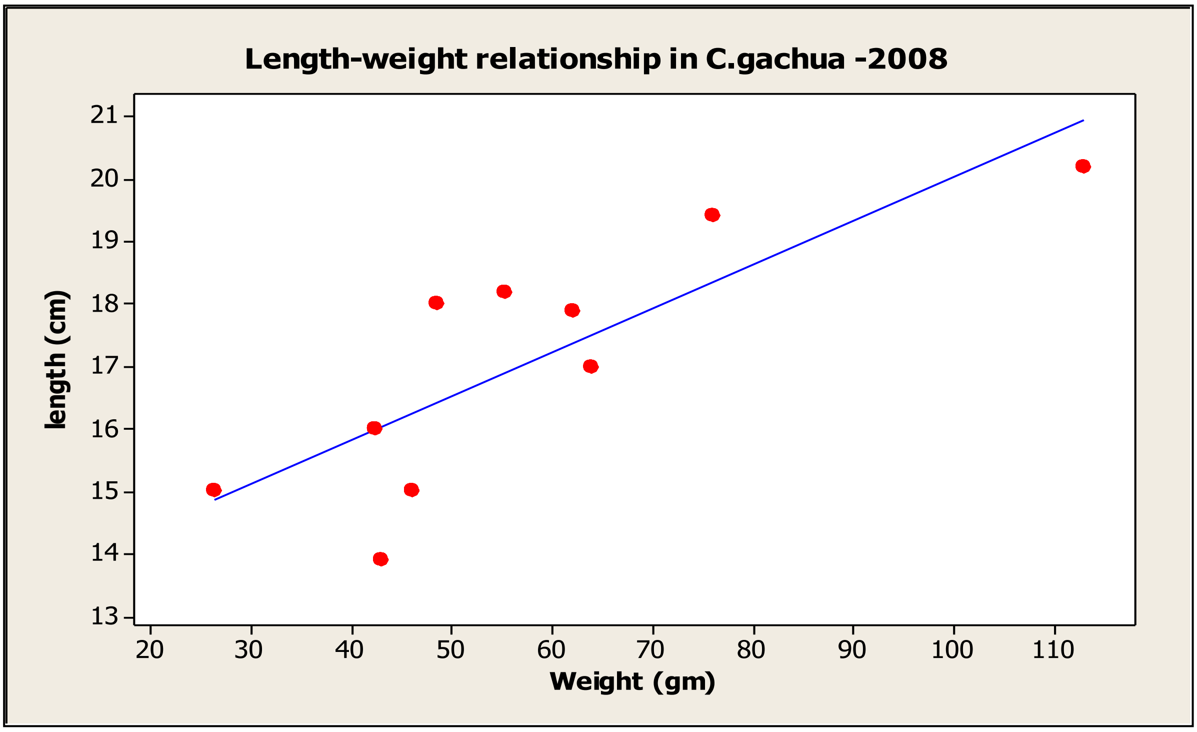
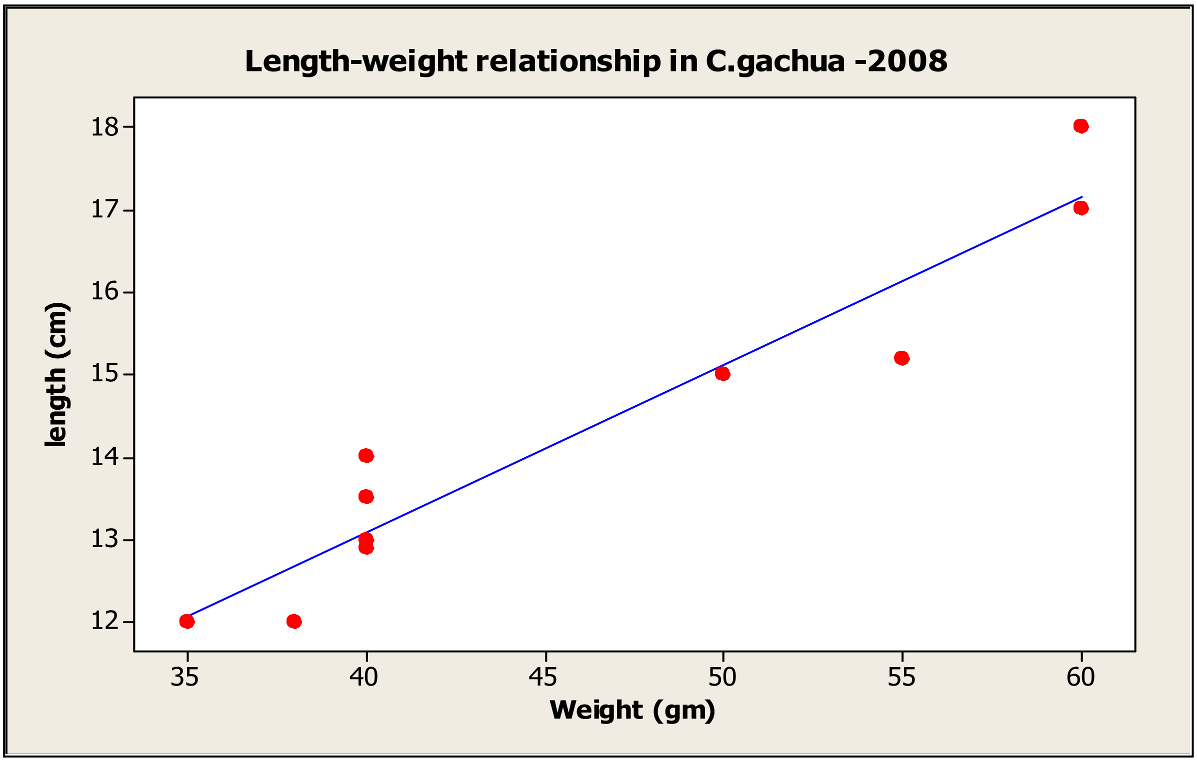


Fig. 3 Length-Weight Relationship in *Channa Gachua* March -2008



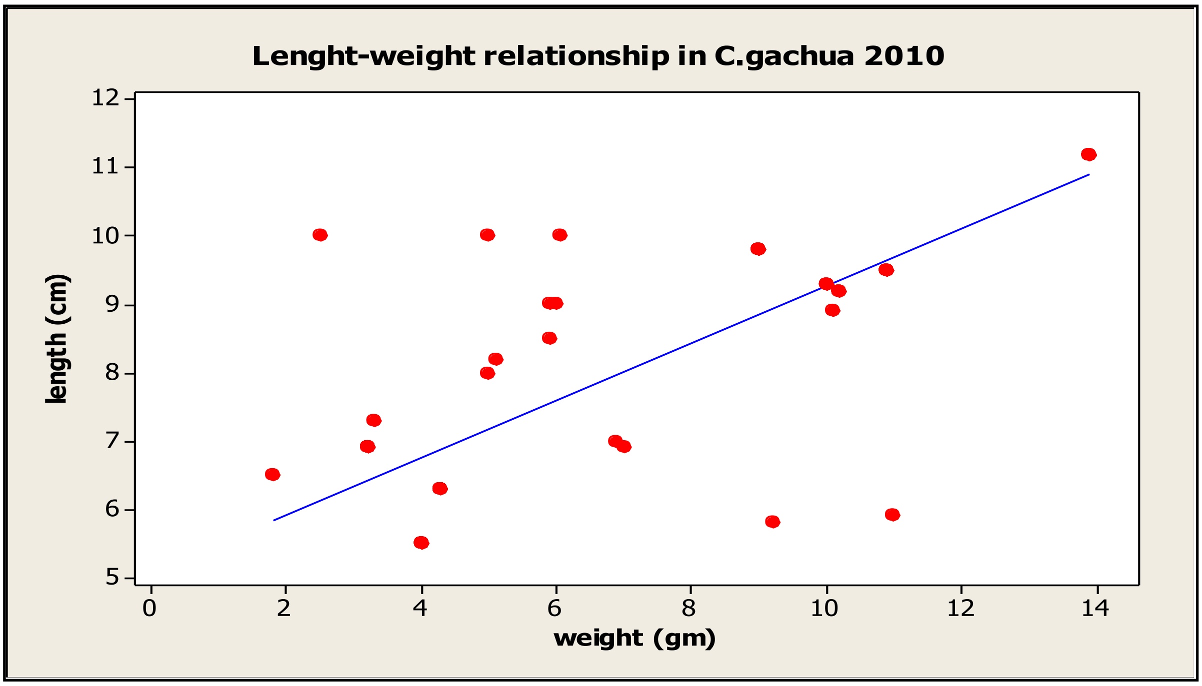
Avg. Length= 19.7 Avg. Weight=51.3 t-test=0.01* *

Fig. 4 Length-Weight Relationship in *Channa Gachua* April -2008



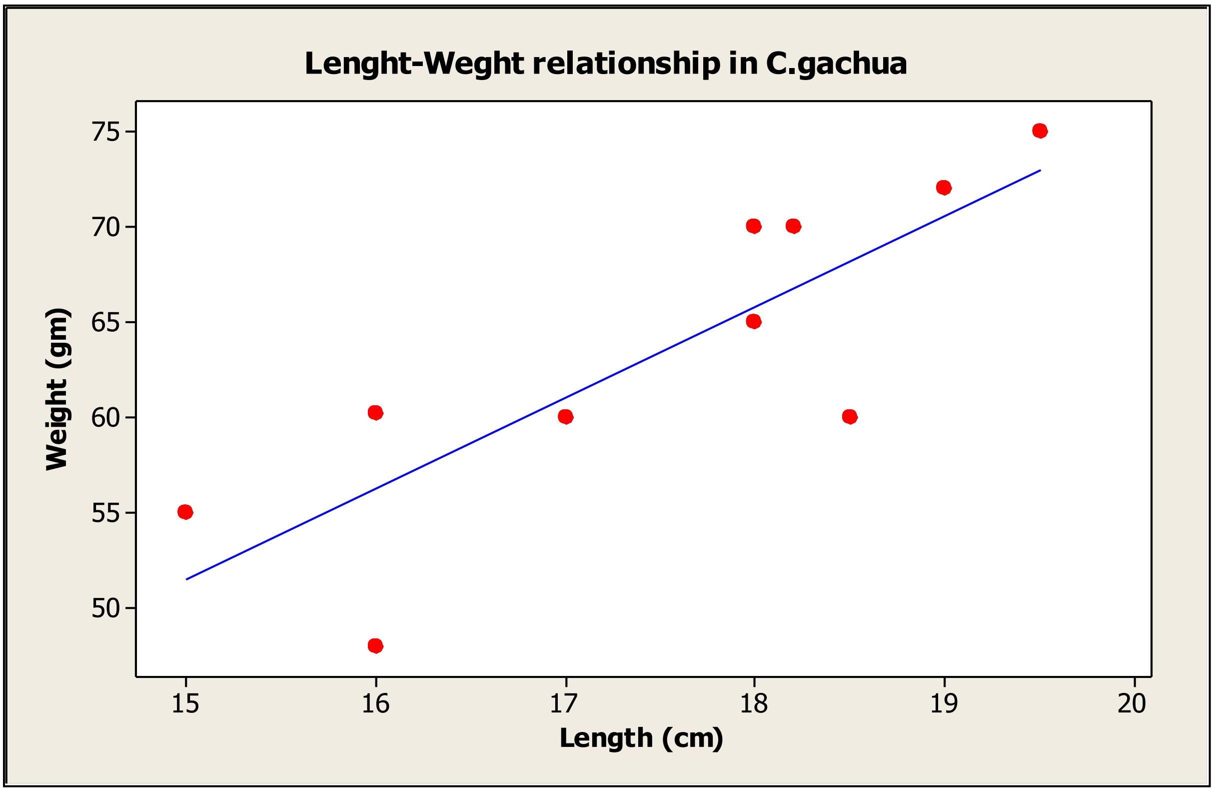
Avg. Length=12.2 Avg. Weight=60 t-test=0.05 *

Fig. 5 Length-Weight Relationship in *Channa Gachua* May -2008



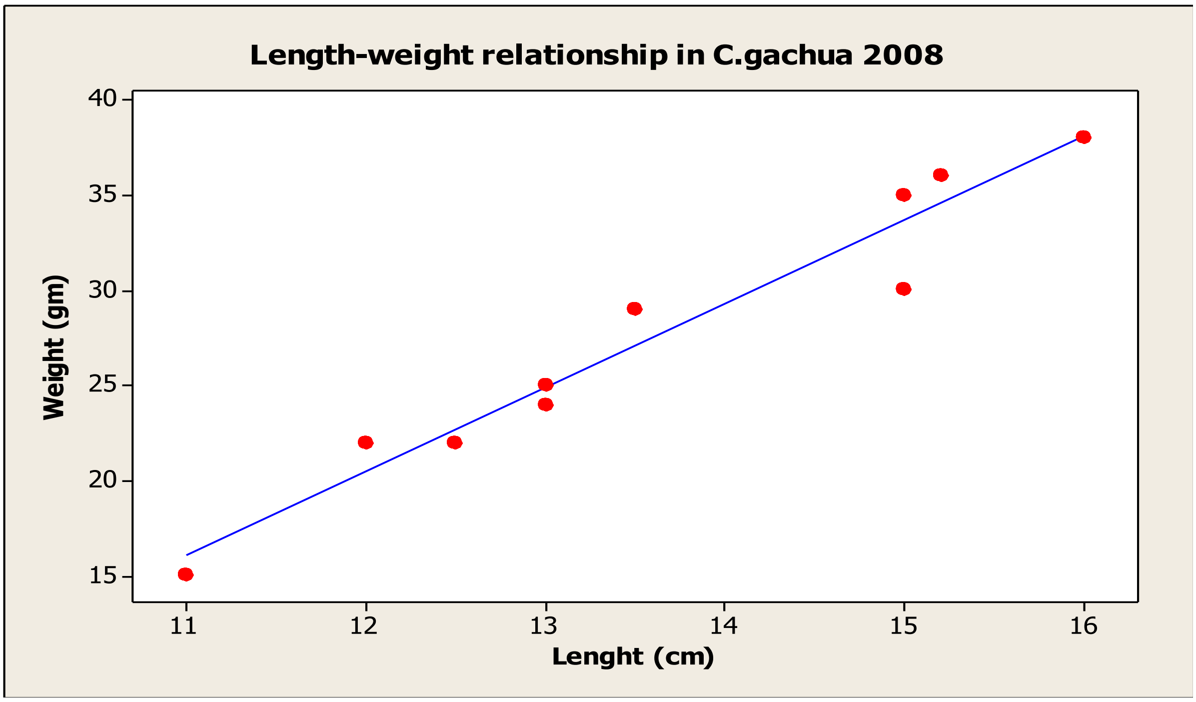
Avg. Length=5.1 Avg. Weight=11.0 t-test=0.05 *

Fig. 6 Length-Weight Relationship in *Channa Gachua* June -2008



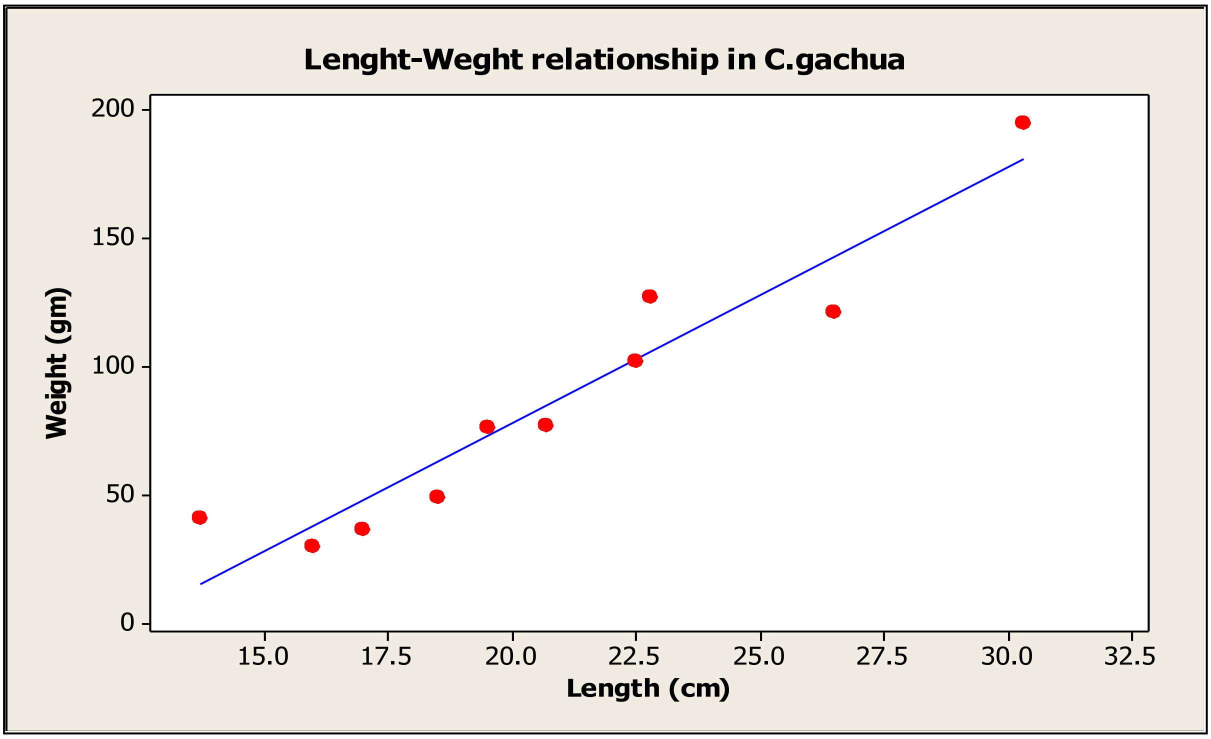
Avg. Length=15.1 Avg. Weight=65.0 t-test=0.05 *

Fig. 7 Length-Weight Relationship in *Channa Gachua* July -2008



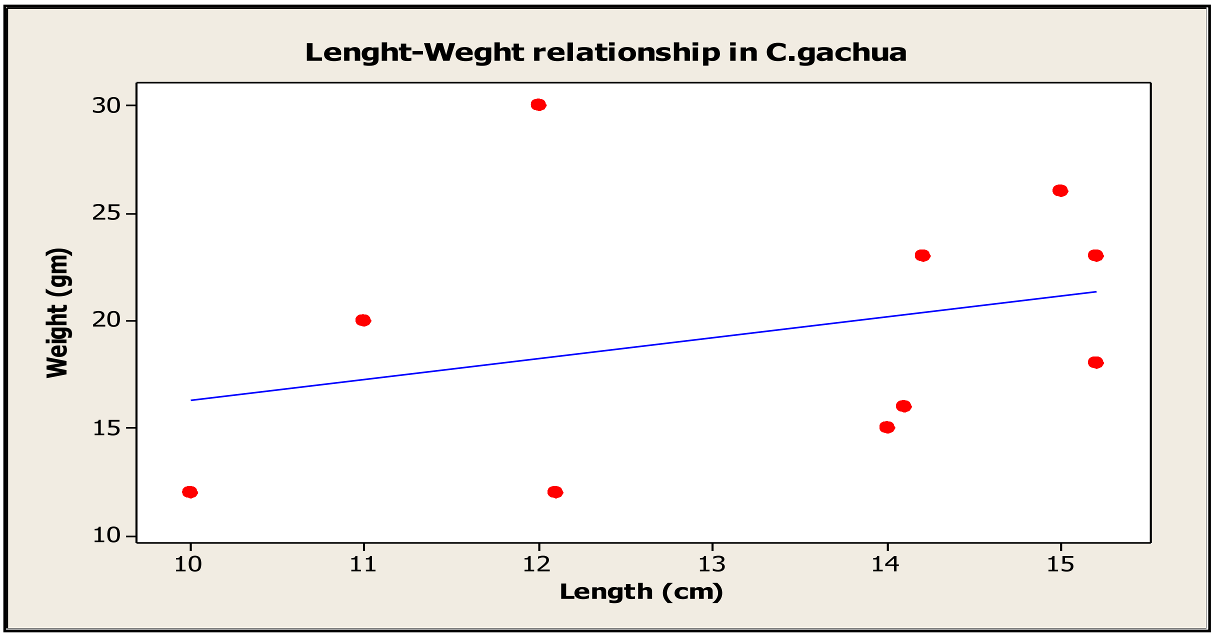
Avg. Length=11.1 cm Avg. Weight=16.0 gm t-test=0.05 *

Fig. 8 Length-Weight Relationship in *Channa Gachua* August-2008



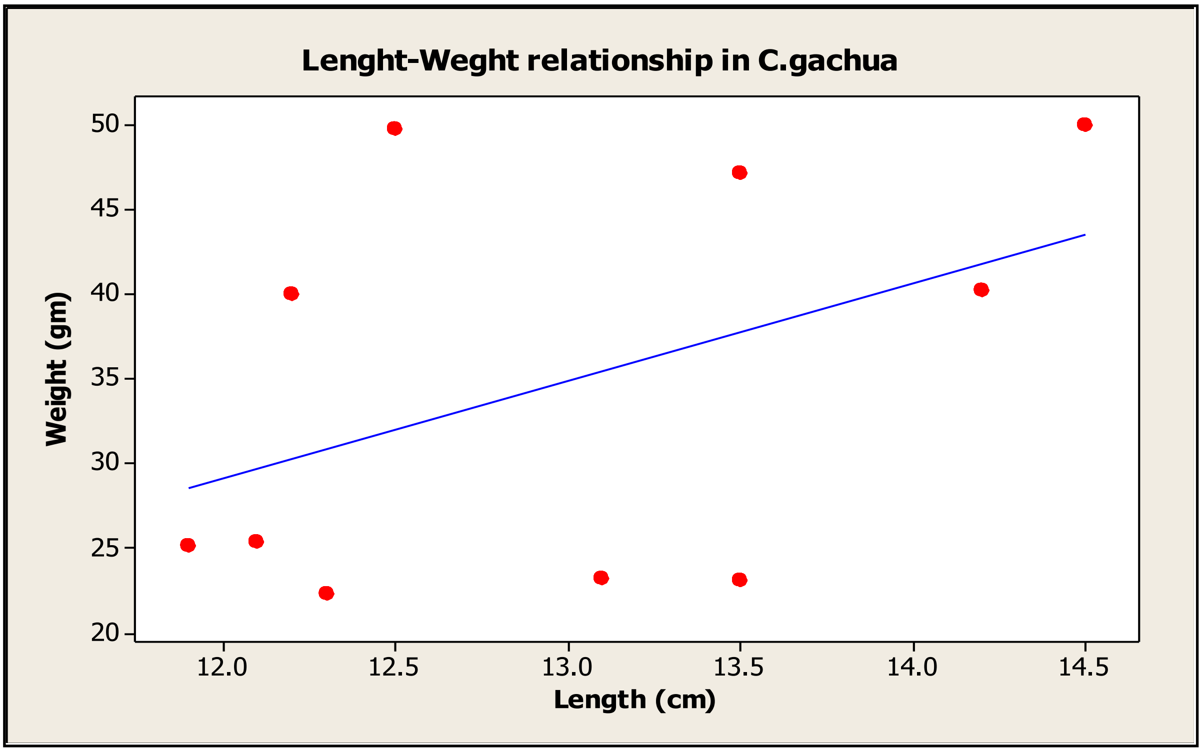
Avg. Length=10.1 Avg. Weight=160.0 t-test=0.05 *

Fig. 9 Length-Weight Relationship in *Channa Gachua* September - 2008



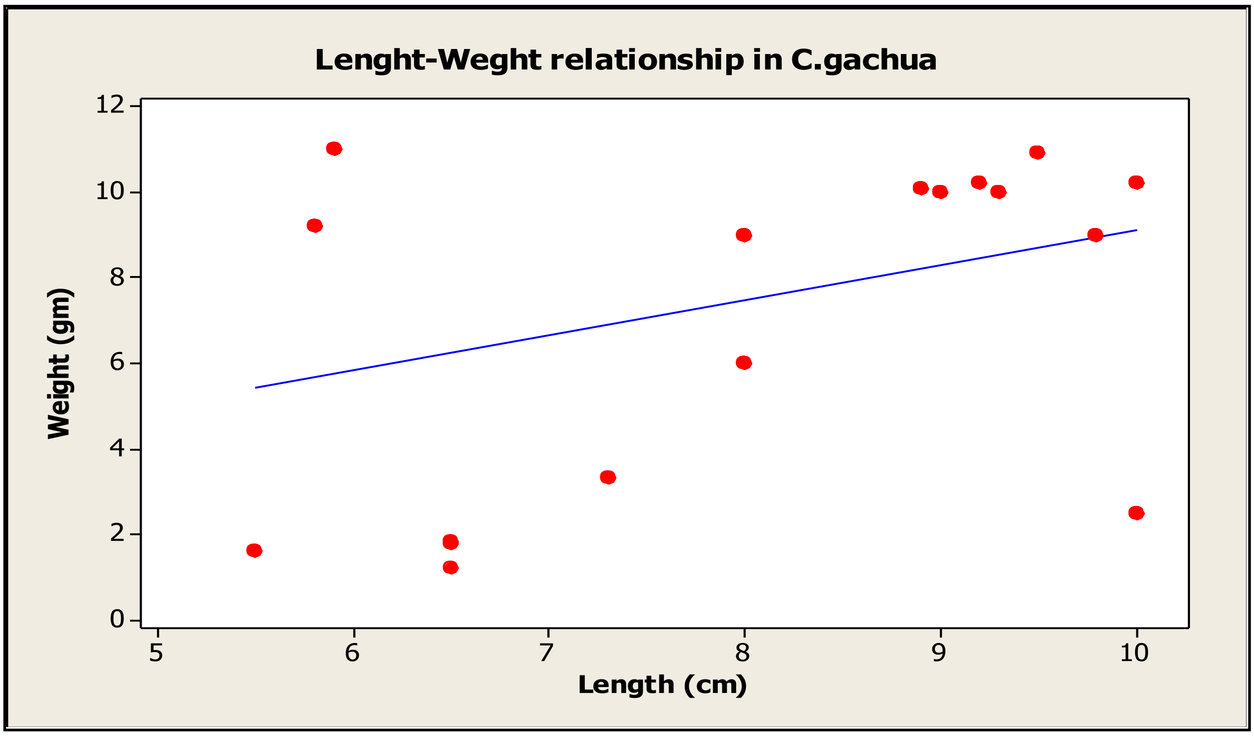
Avg. Length=14.5.0 Avg. Weight= 28.4 t-test=0.01 *

Fig. 10 Length-Weight Relationship in *Channa Gachua* October -2008



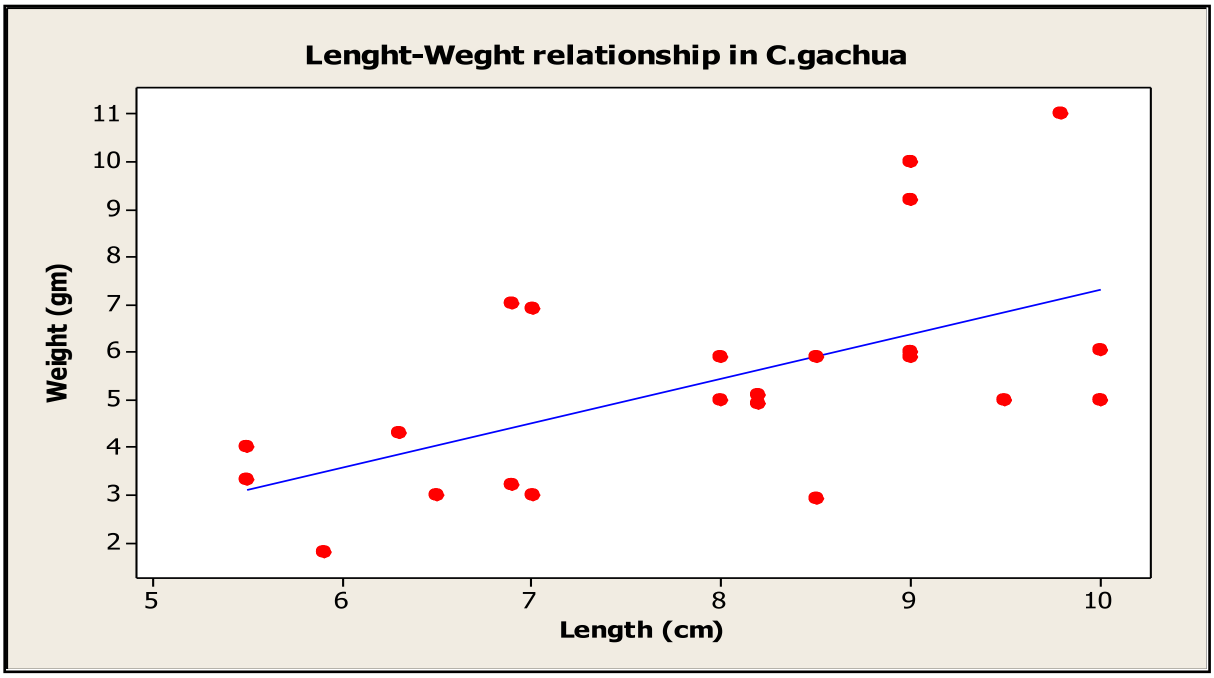
Avg. Length=13.5 Avg. Weight= 35.0 t-test=0.01 *

Fig. 11 Length-Weight Relationship in *Channa Gachua*
November -2008



Avg. Length=8.7 Avg. Weight= 10.4 t-test=0.05 *

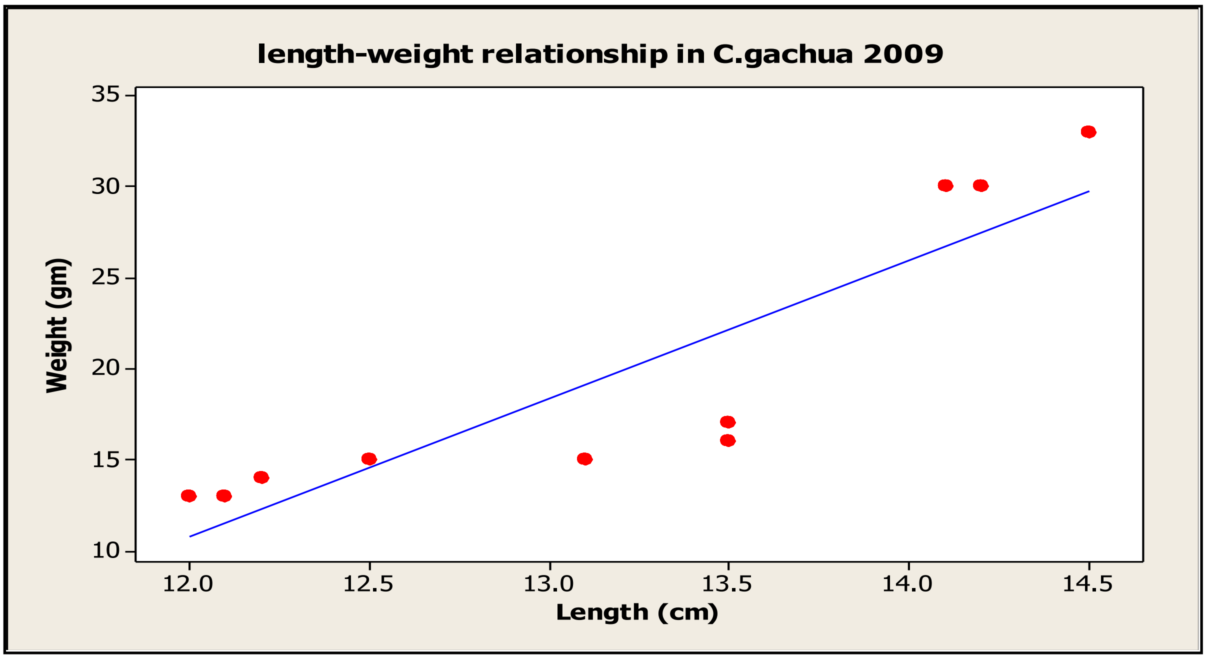
Fig. 12 Length-Weight Relationship in Channa Gachua
December -2008



Avg. Length=8.0 Avg. Weight= 8.4 t-test=0.05 *

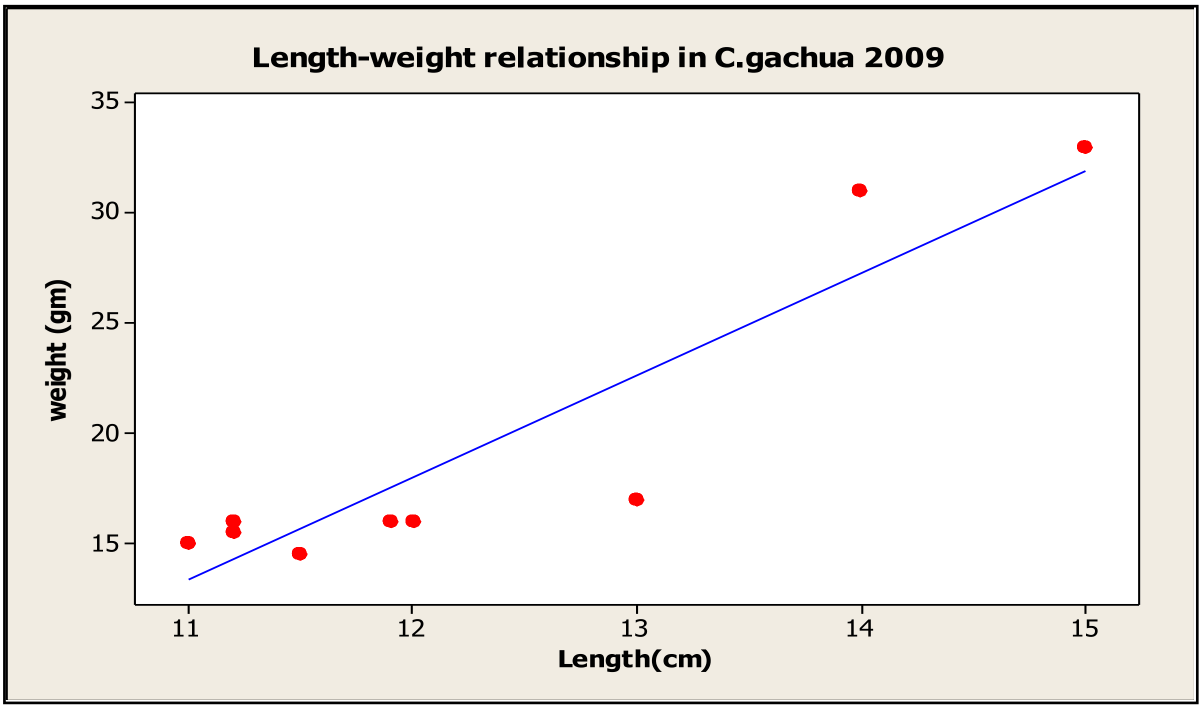
Fig. 13 Length-Weight Relationship in *Channa Gachua* January -2009

Growth of Fish, *Channa Gachua* in Terms Of Length-Weight Relationship During First Circannual Cycle 2008-09



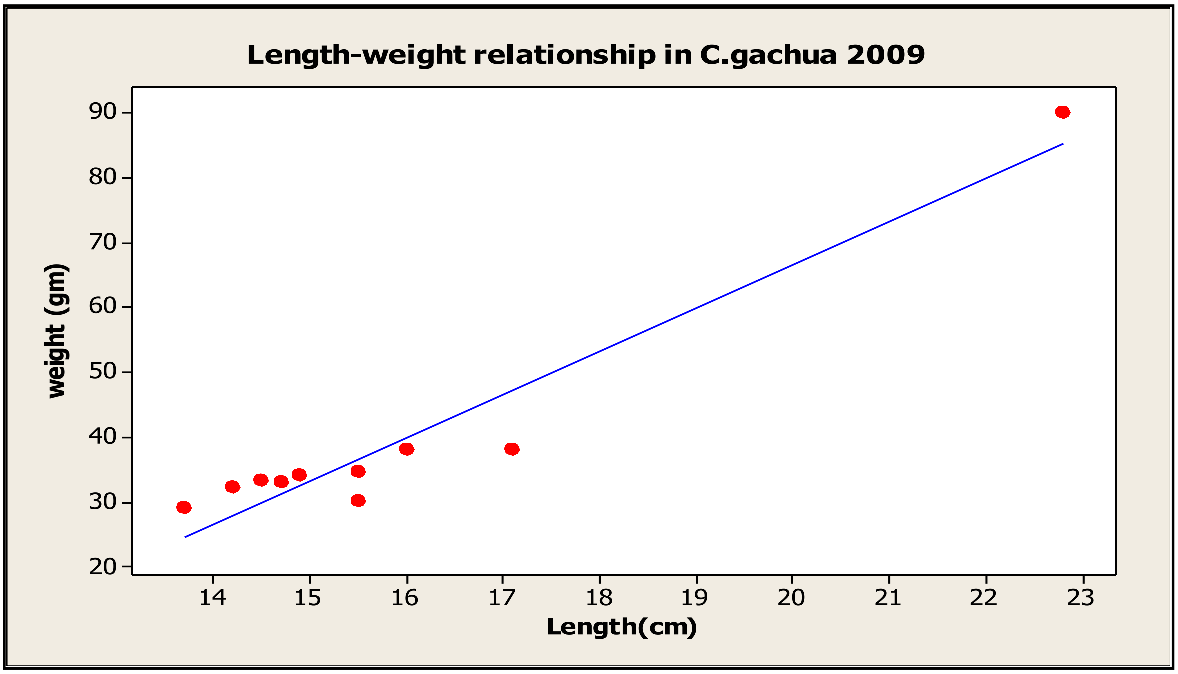
Avg. Length=13.0 Avg. Weight= 23.4 t-test=0.05 *

Fig. 14 Length-Weight Relationship in *Channa Gachua* February -2009



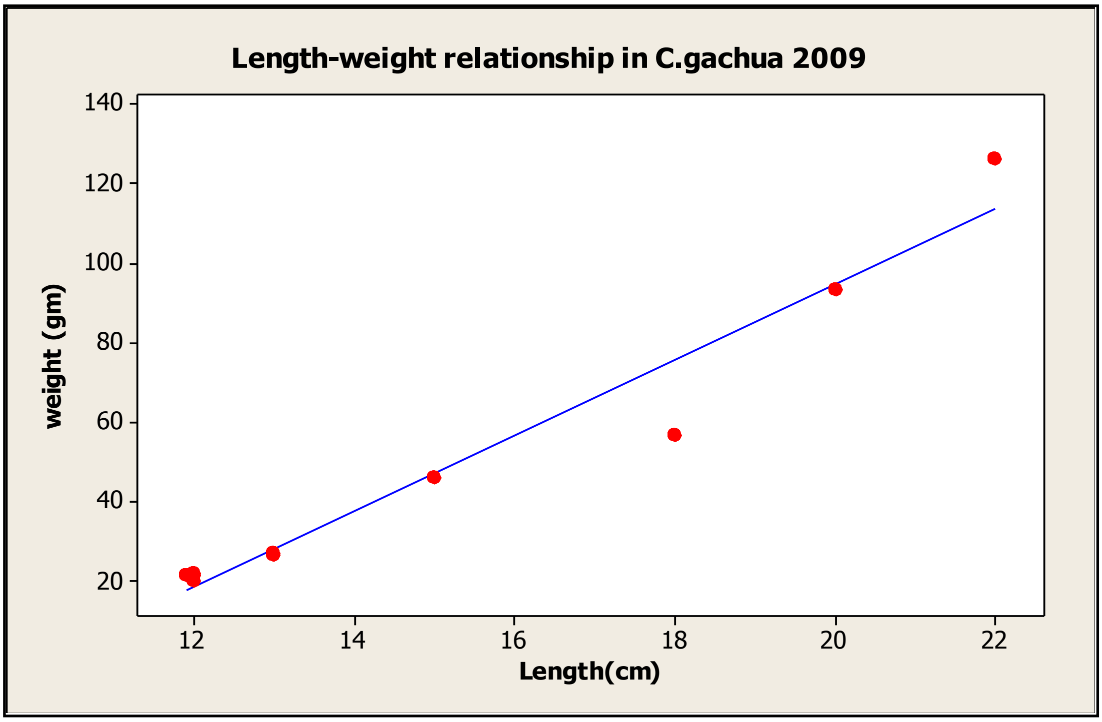
Avg. Length=13.5 Avg. Weight= 24.4 t-test=0.05 *

Fig. 15 Length-Weight Relationship in *Channa Gachua* March -2009



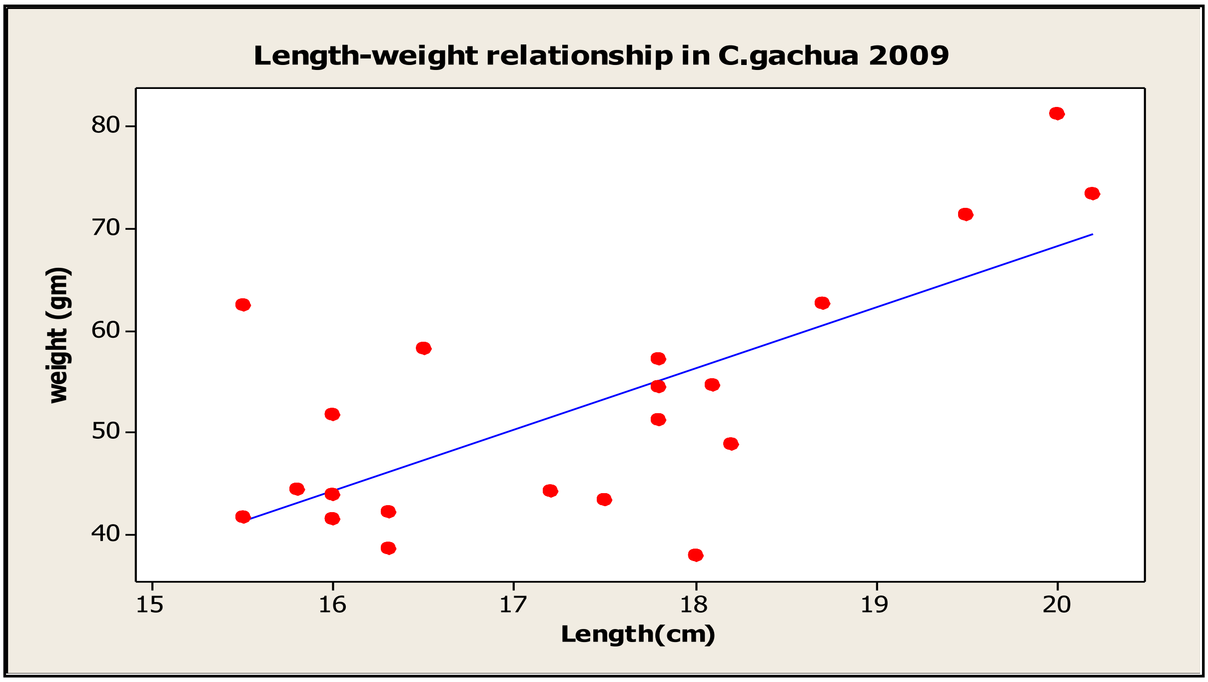
Avg. Length=20.0 Avg. Weight= 40.0 t-test=0.001 *

Fig. 16 Length-Weight Relationship in *Channa Gachua* April -2009



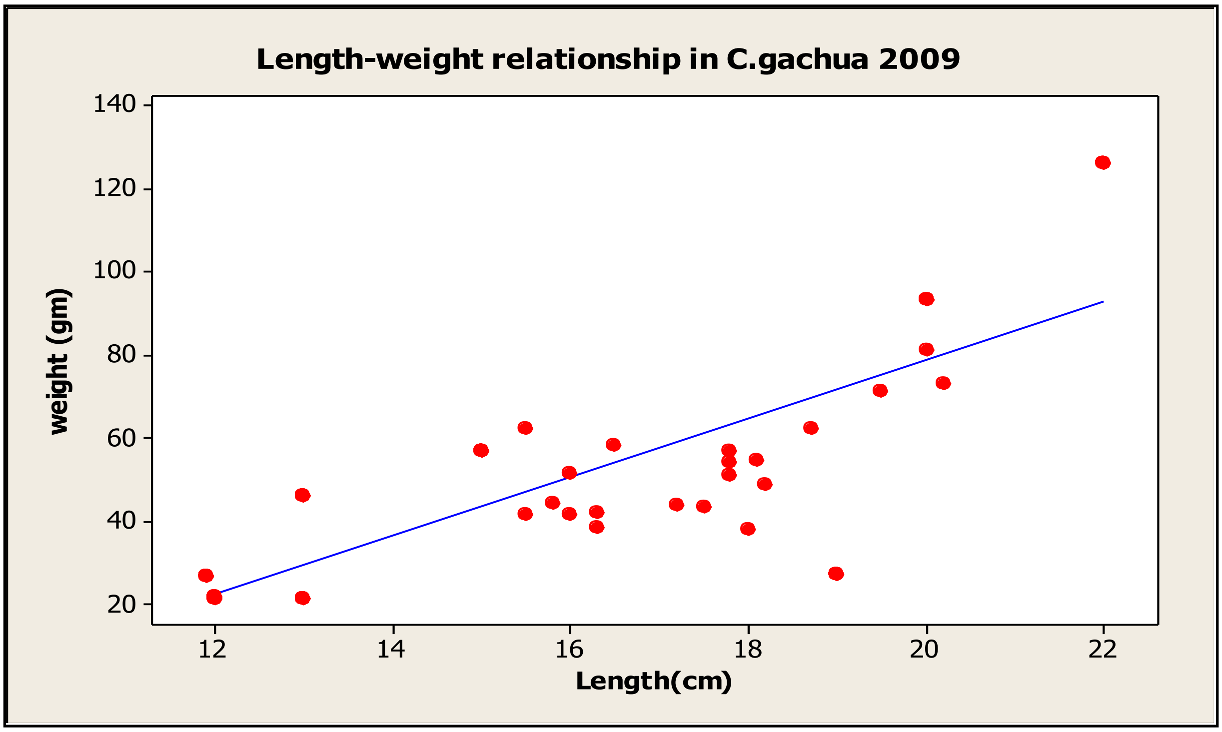
Avg. Length=20.0 Avg. Weight= 65.4 t-test=0.05 *

Fig. 17 Length-Weight Relationship in *Channa Gachua* May-2009



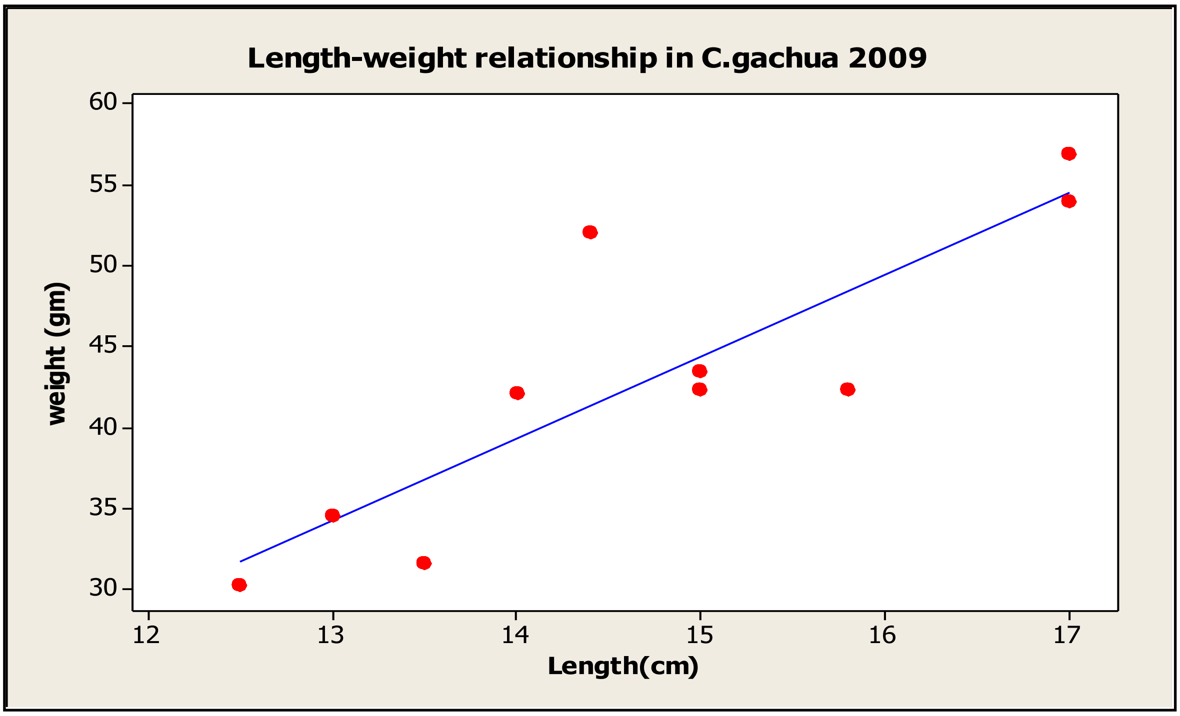
Avg. Length=18.5 Avg. Weight= 62.4 t-test=0.05 *

Fig. 18 Length-Weight Relationship in *Channa Gachua* June -2009



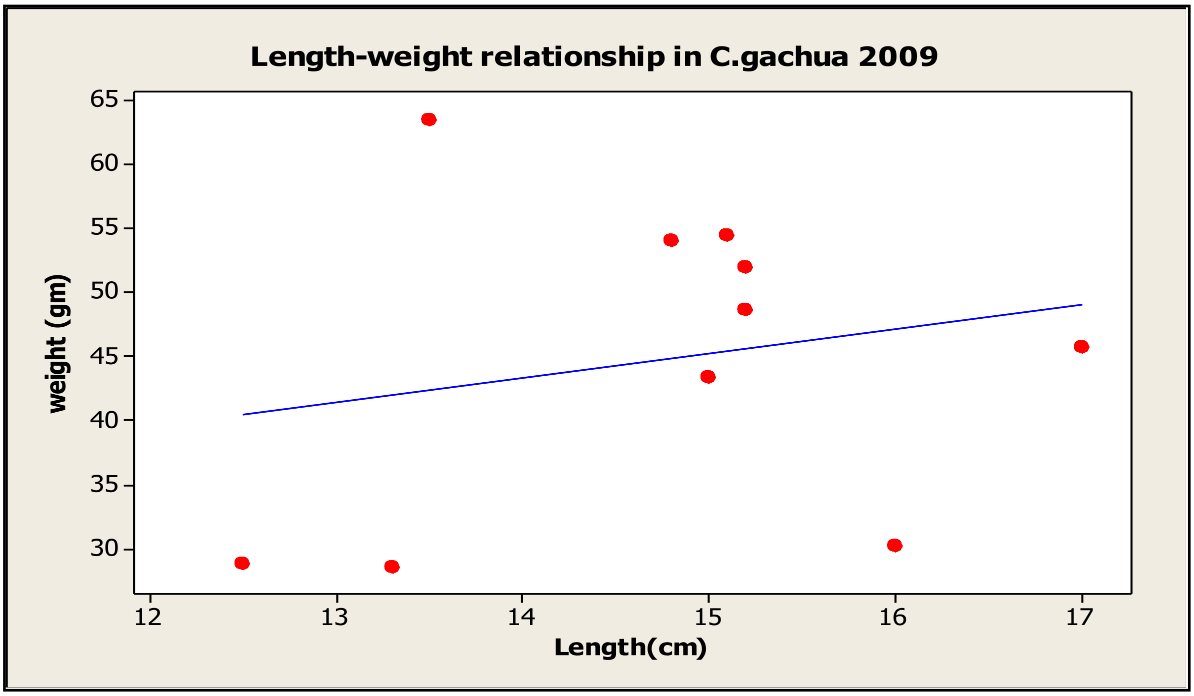
Avg. Length=18.0 Avg. Weight= 60.0 t-test=0.001 *

Fig. 19 Length-Weight Relationship in *Channa Gachua* July -2009



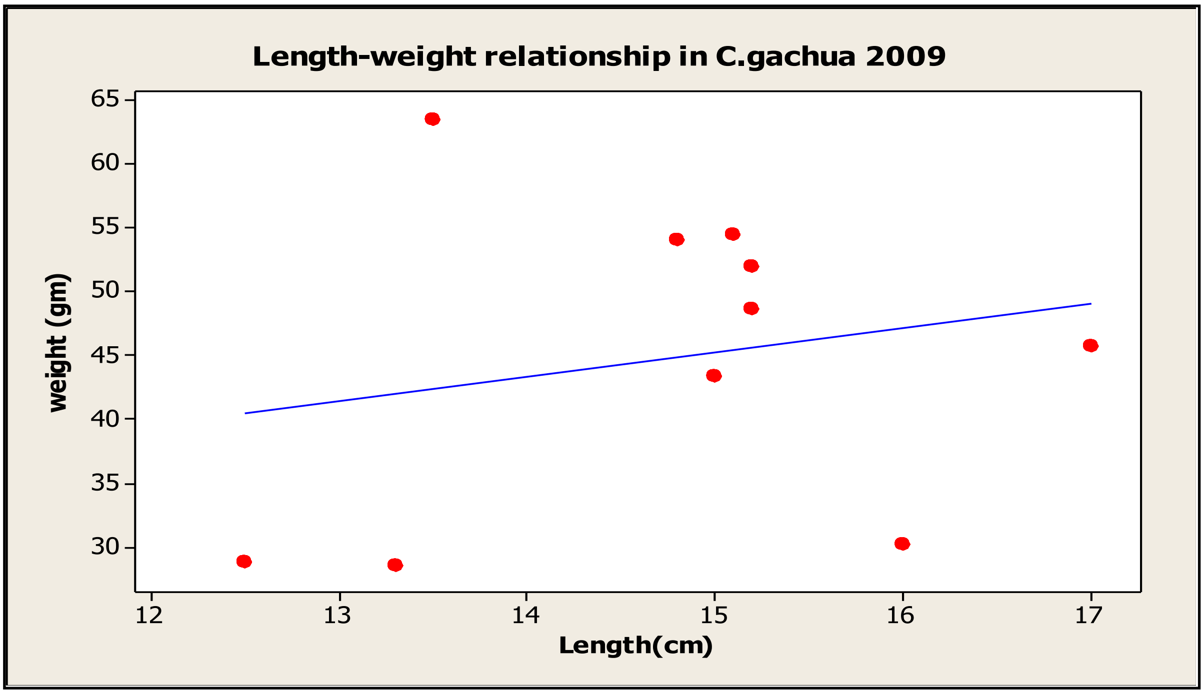
Avg. Length=15.0 Avg. Weight= 45.4 t-test=0.001 *

Fig. 20 Length-Weight Relationship in *Channa Gachua* August -2009



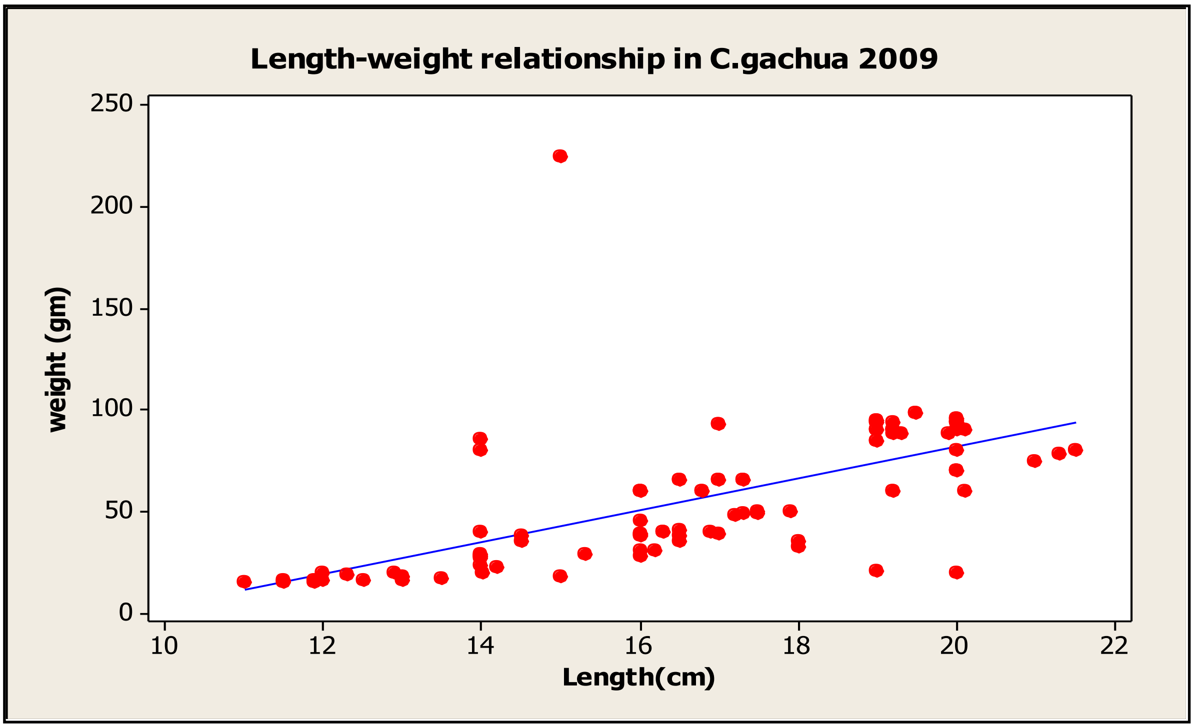
Avg. Length=14.5 Avg. Weight= 35.0 t-test=0.001 ***

Fig. 21 Length-Weight Relationship in *Channa Gachua* September -2009



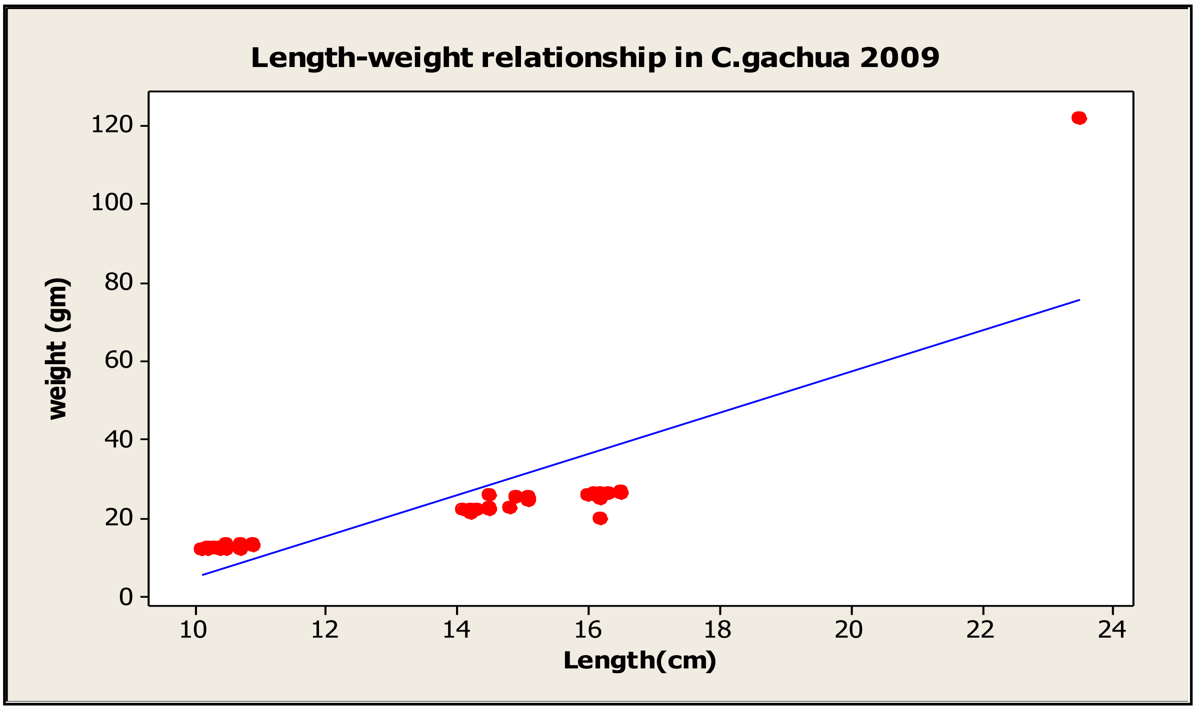
Avg. Length=14.0 Avg. Weight= 40.0 t-test=0.001** *

Fig. 22 Length-Weight Relationship in *Channa Gachua* October -2009



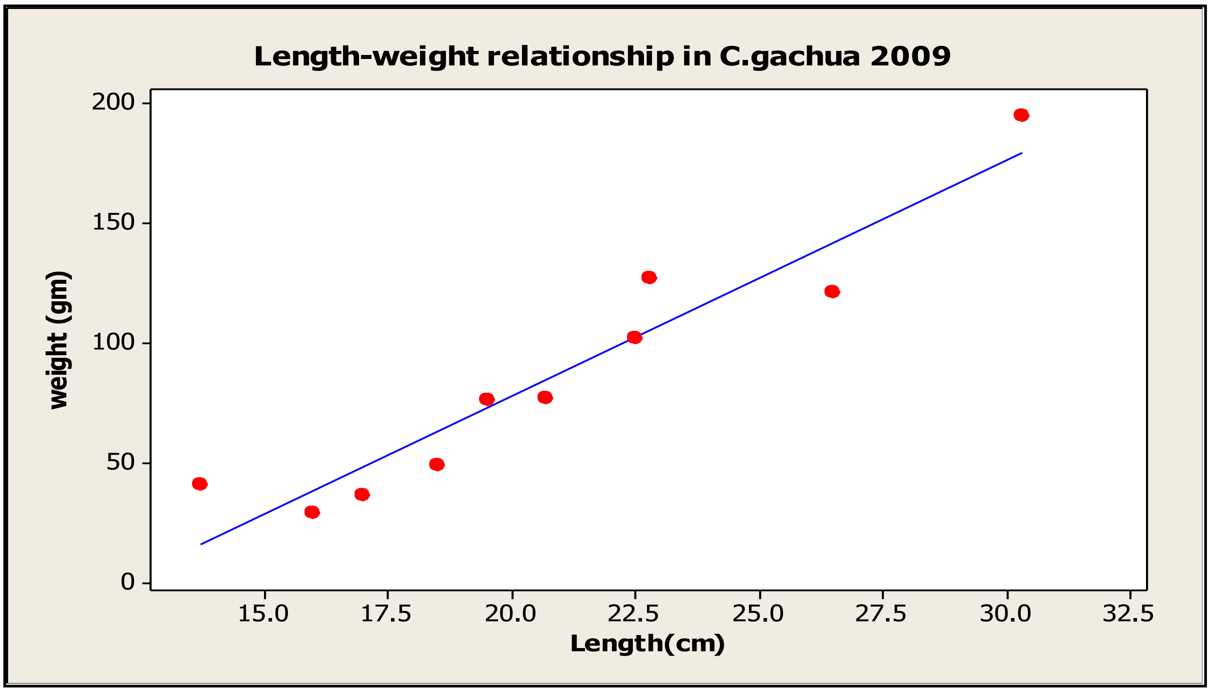
Avg. Length=18.0 Avg. Weight= 50.0 t-test=0.001** *

Fig. 23 Length-Weight Relationship in *Channa Gachua* November -2009



Avg. Length=15.0 Avg. Weight= 30.0 t-test=0.01 *

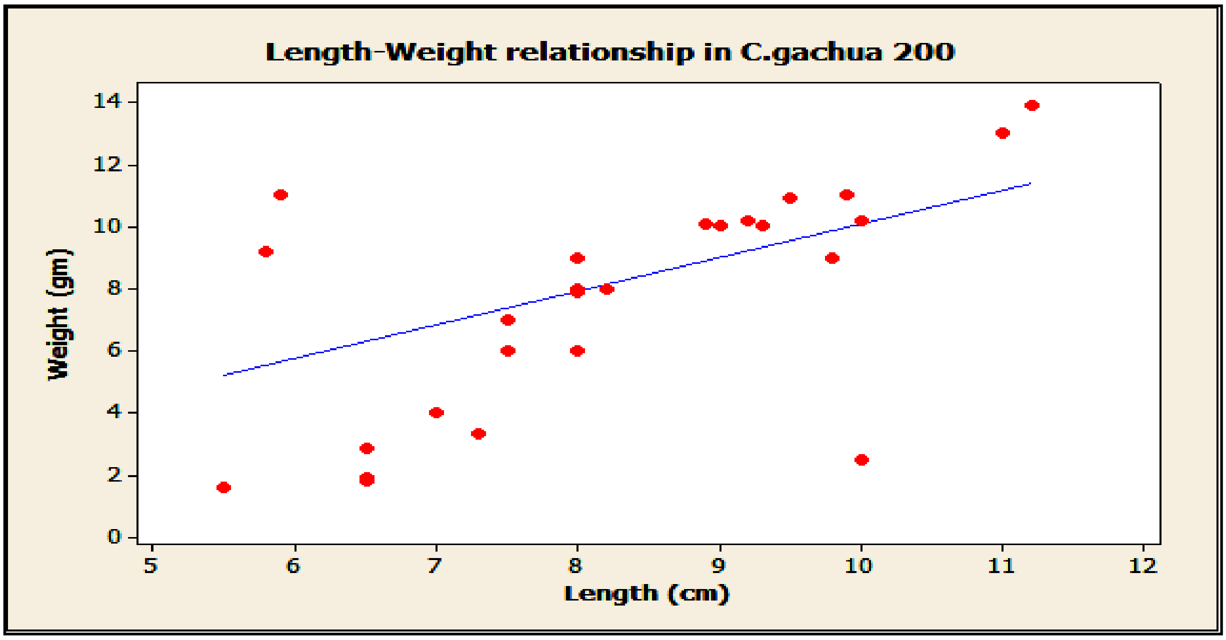
Fig. 24 Length-Weight Relationship in *Channa Gachua* December -2009



Avg. Length=25.0 Avg. Weight= 125.4 t-test=0.001** *

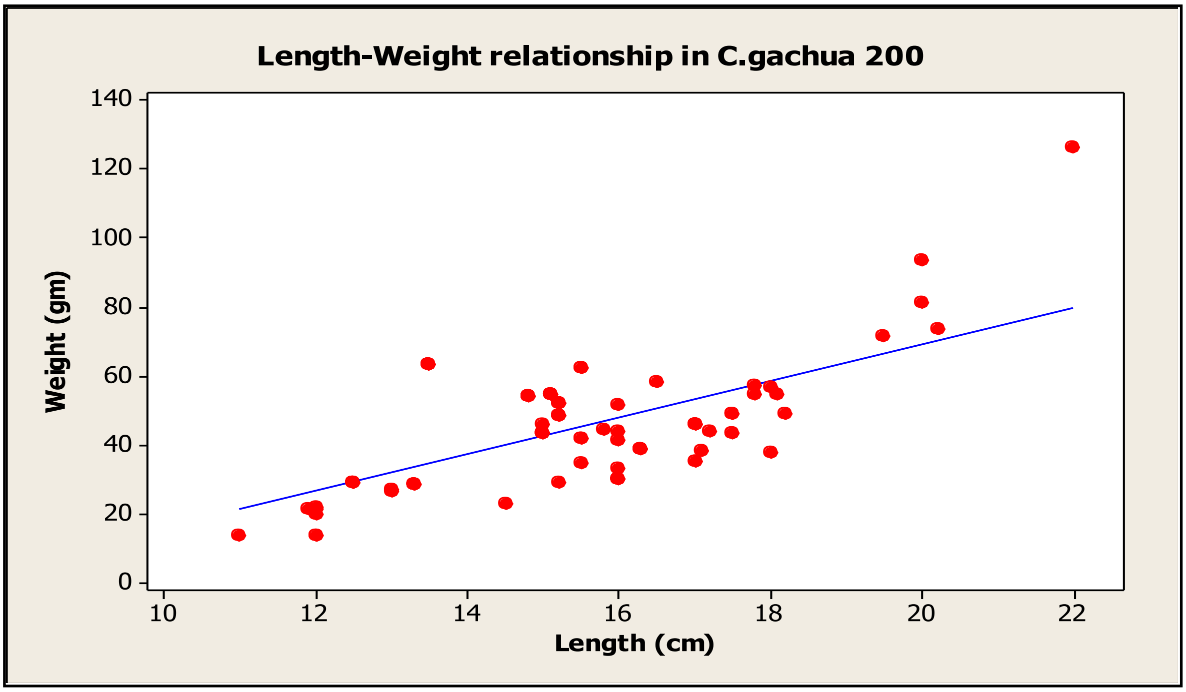
Fig. 25 Length-Weight Relationship in *Channa Gachua* January -2010

Growth of Fish, *Channa Gachua* in Terms of Length-Weight Relationship During First Circannual Cycle 2009-2010



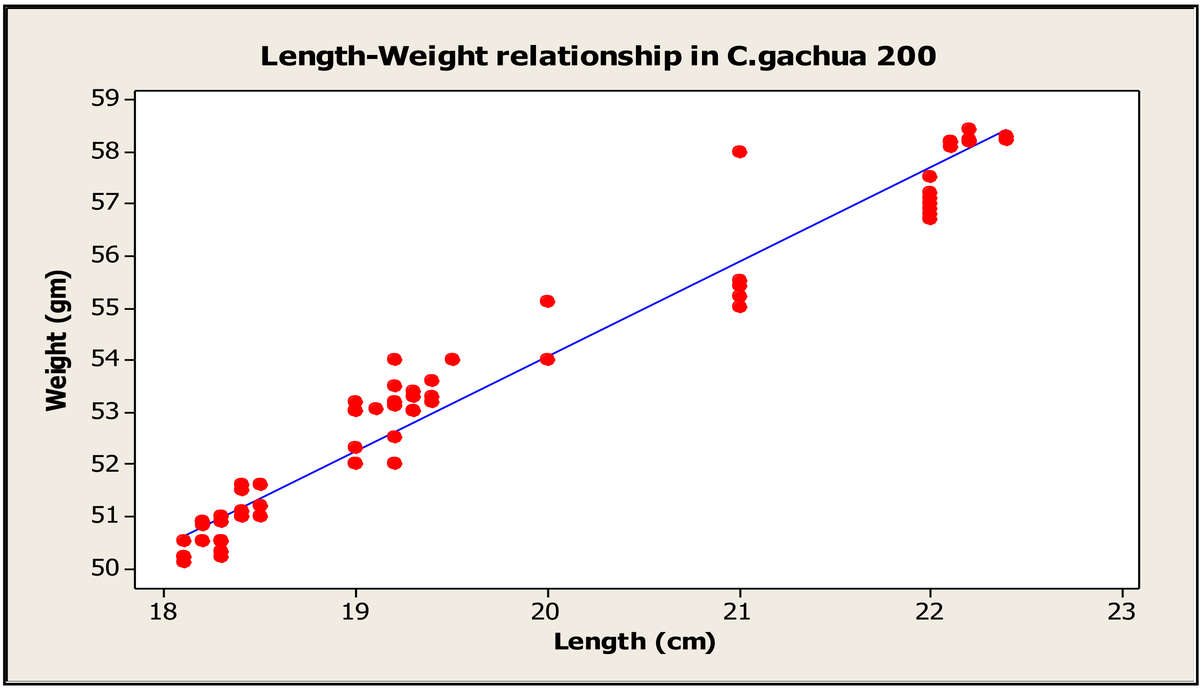
Avg. Length=9.5   Avg. Weight= 12.0   T-Test=0.05 *

Fig. 26 Length-Weight Relationship in *Channa Gachua* February -2010



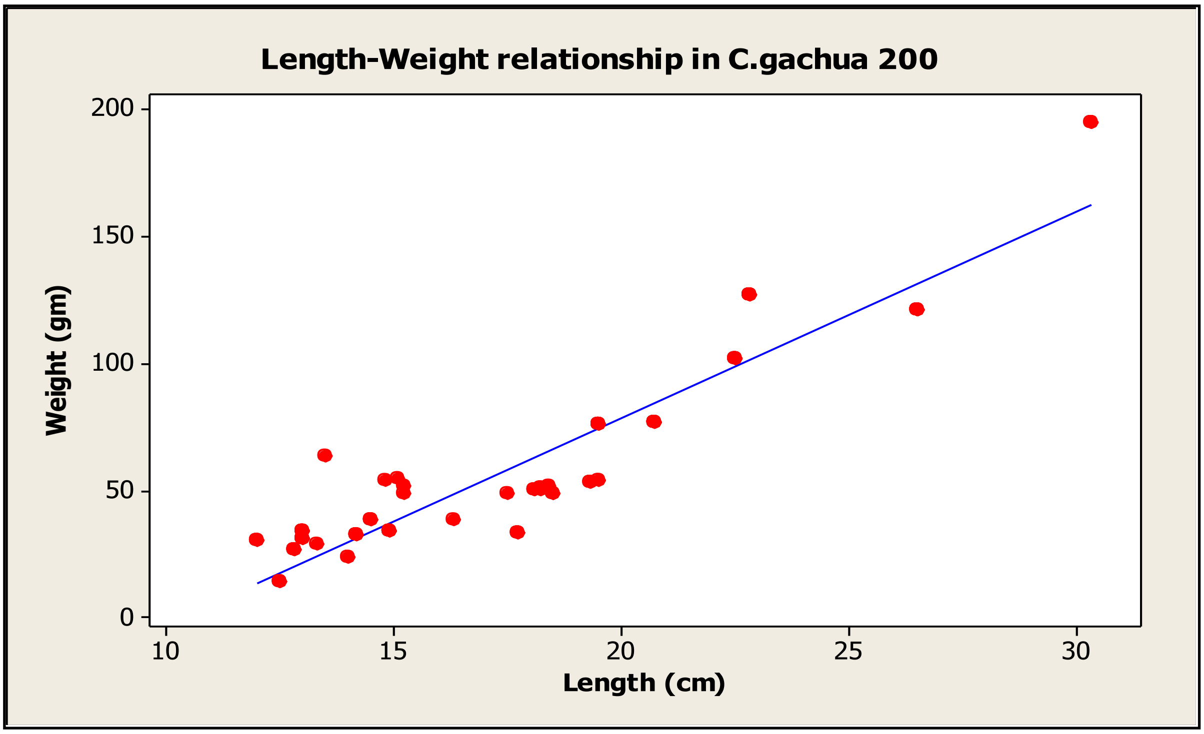
Avg. Length=16.5   Avg. Weight= 60.0   t-test=0.001** *

Fig. 27 Length-Weight Relationship in *Channa Gachua* March -2010



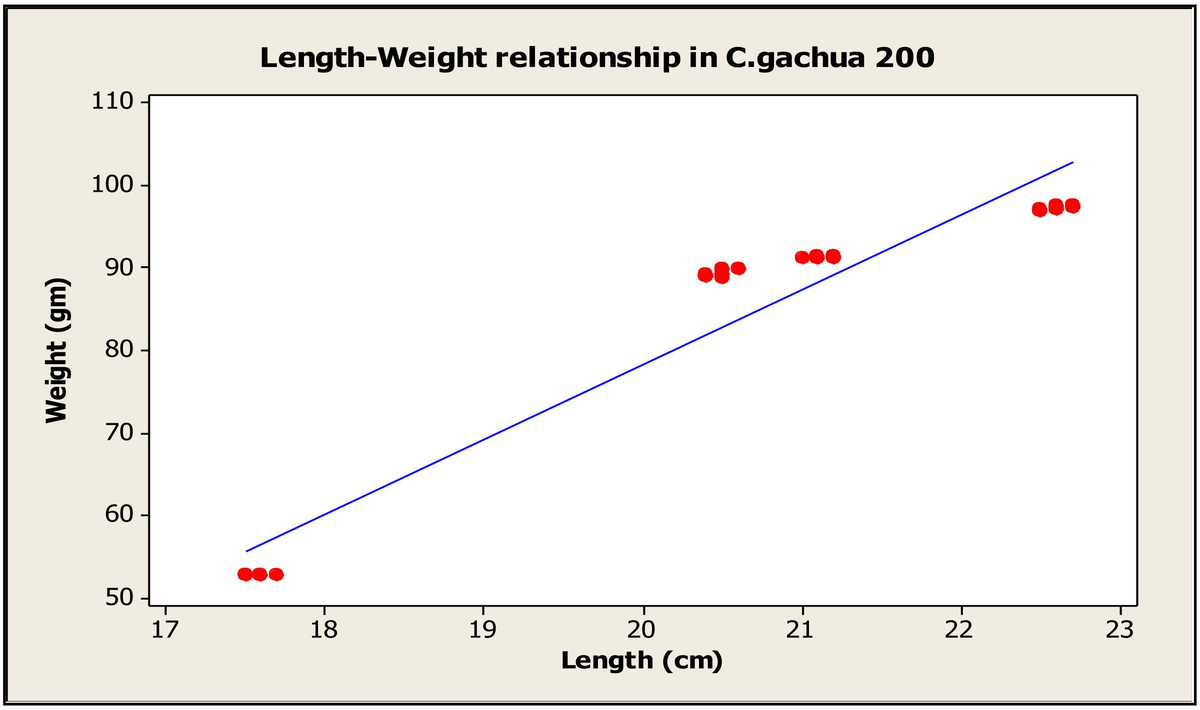
Avg. Length=20.0 Avg. Weight= 60.0 t-test=0.001** *

Fig. 28 Length-Weight Relationship in *Channa Gachua* April -2010



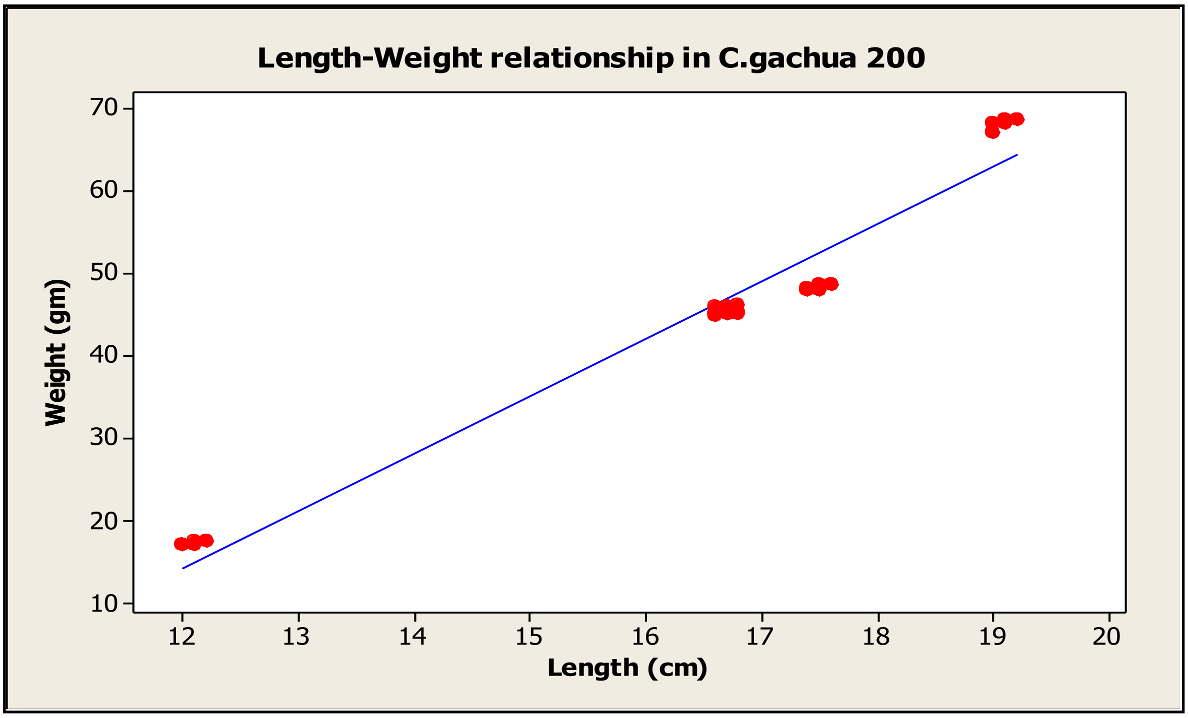
Avg. Length=20.0 Avg. Weight= 65.4 t-test=0.001*

Fig. 29 Length-Weight Relationship in *Channa Gachua* May -2010



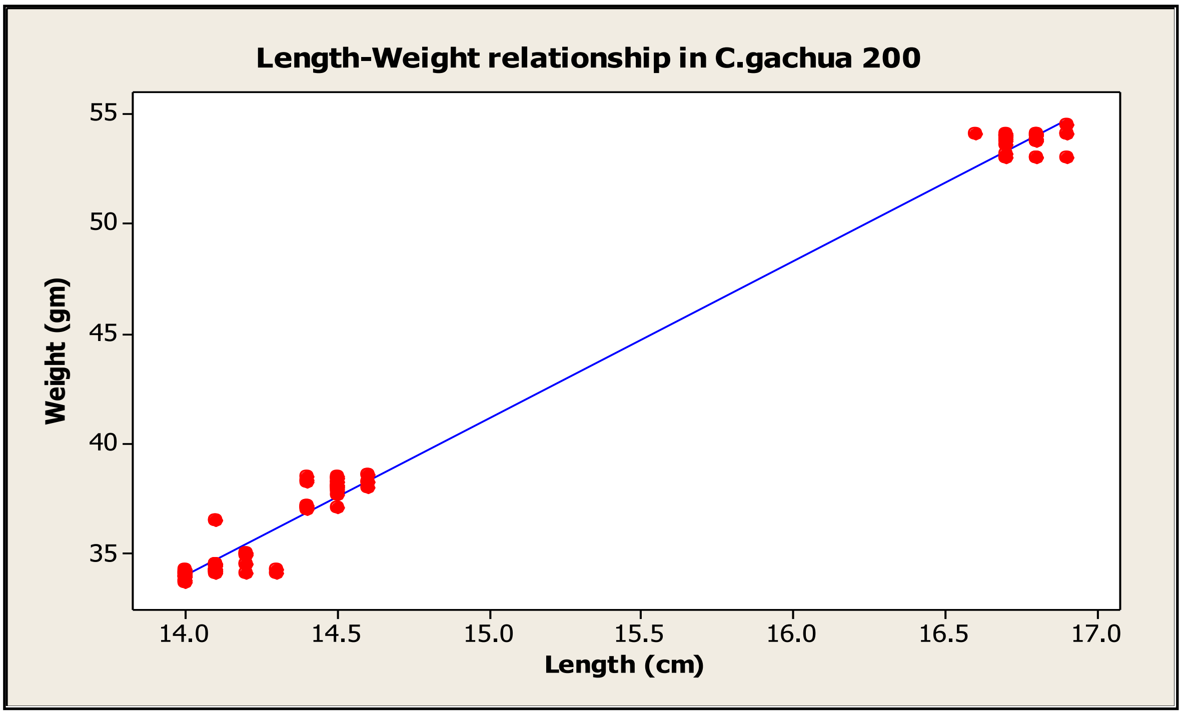
Avg. Length=20.0 Avg. Weight= 90.0 t-test=0.001 *

Fig. 30 Length-Weight Relationship in *Channa Gachua* June-2010



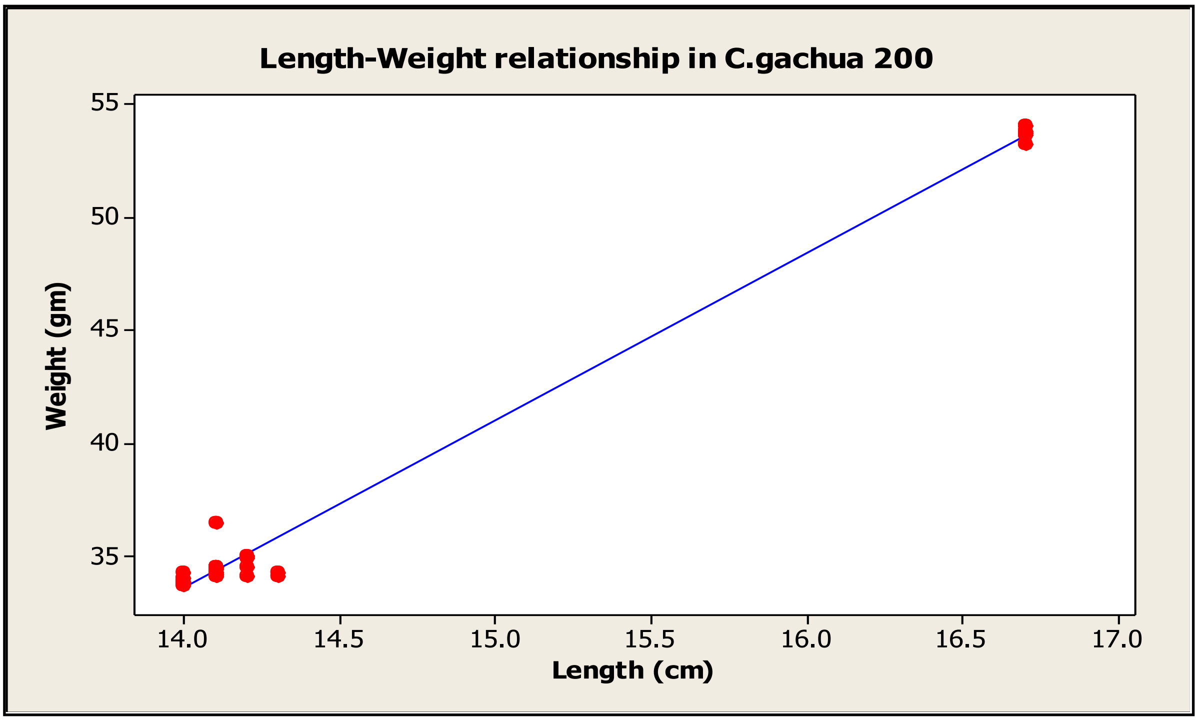
Avg. Length=16.0 Avg. Weight=45.0 t-test=0.01 *

Fig. 31 Length-Weight Relationship in *Channa Gachua* July -2010



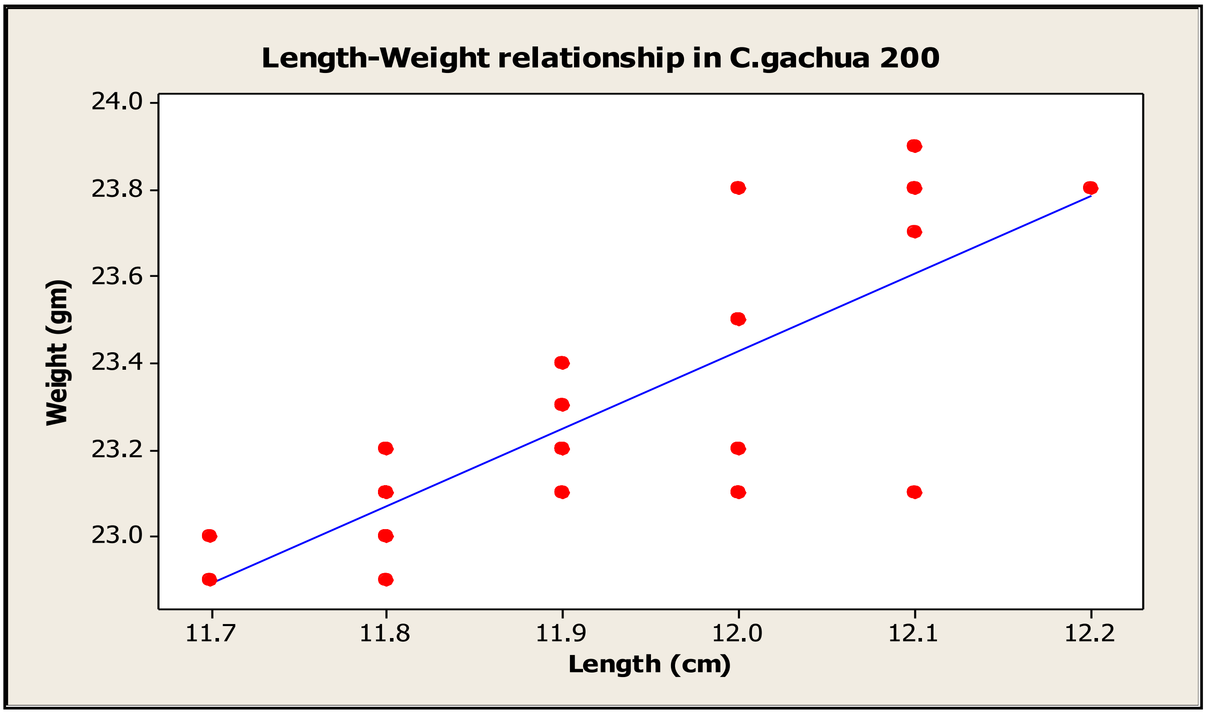
Avg. Length=15.5 Avg. Weight= 35.5 t-test=0.01 *

Fig. 32 Length-Weight Relationship in *Channa Gachua* August-2010



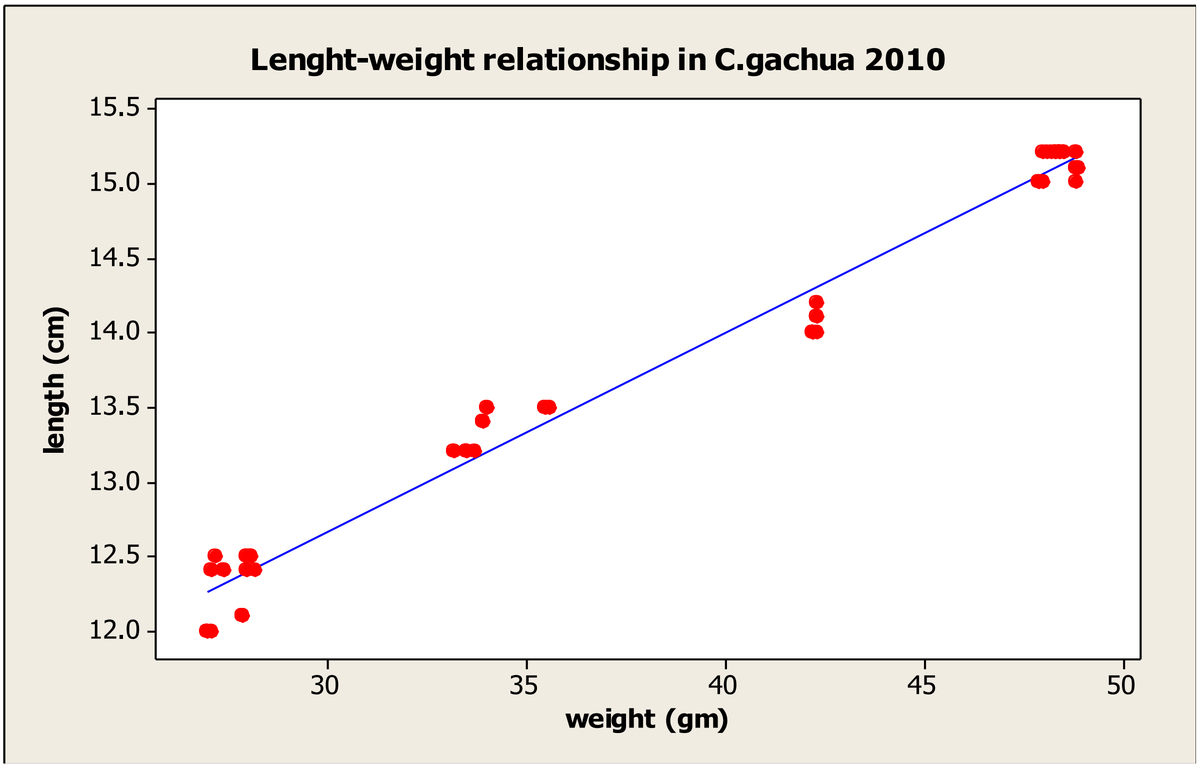
Avg. Length=15.0 Avg. Weight= 35.0 T-Test=0.05 *

Fig. 33 Length-Weight Relationship in *Channa Gachua* September -2010



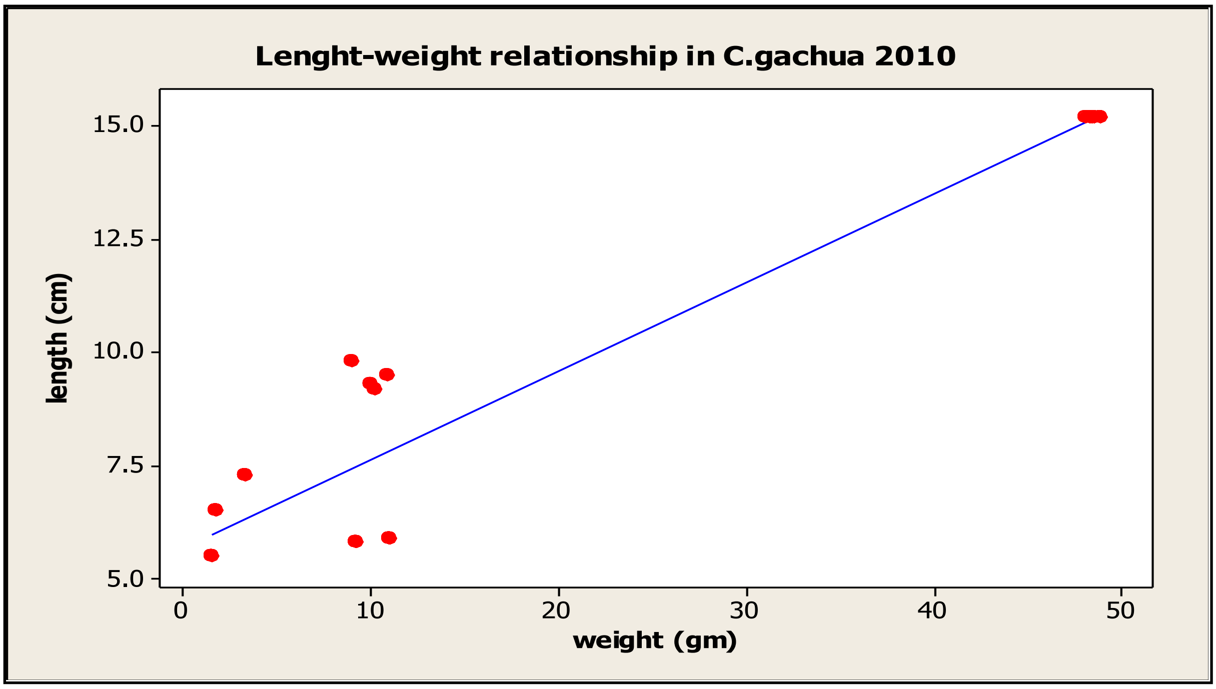
Avg. Length=11.5 Avg. Weight= 22.2 t-test=0.05 *

Fig. 34 Length-Weight Relationship in *Channa Gachua* October-2010



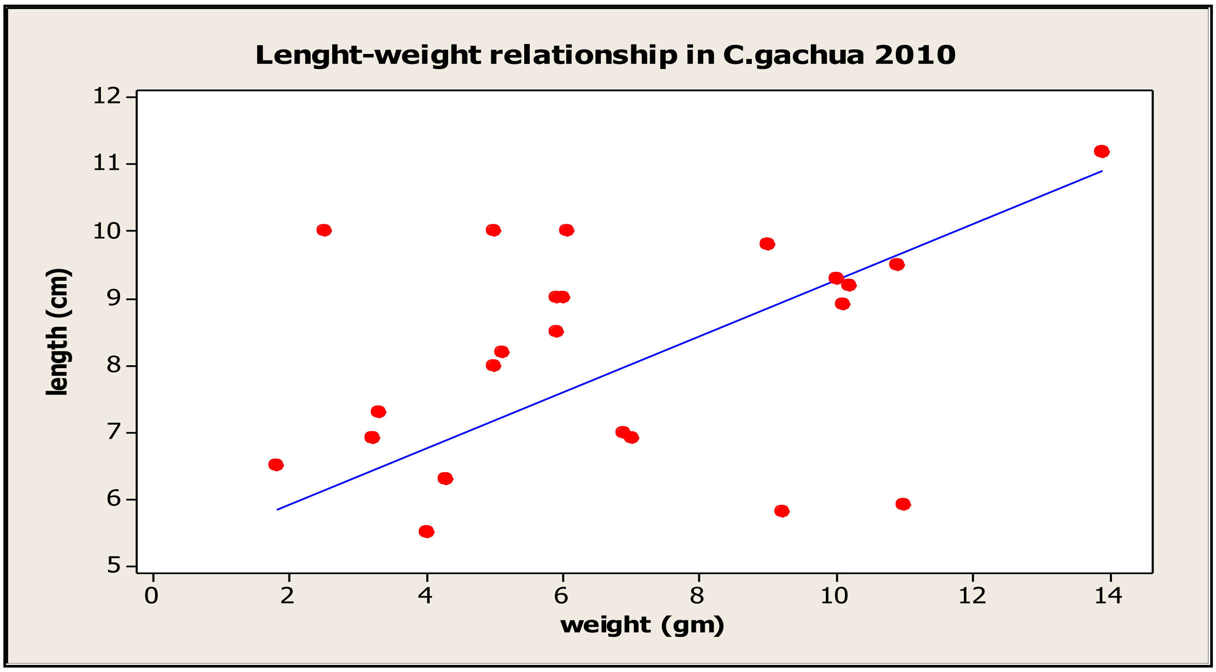
Avg. Length=15.0 Avg. Weight= 40.0 t-test=0.05 *

Fig. 35 Length-Weight Relationship In *Channa Gachua* November-2010



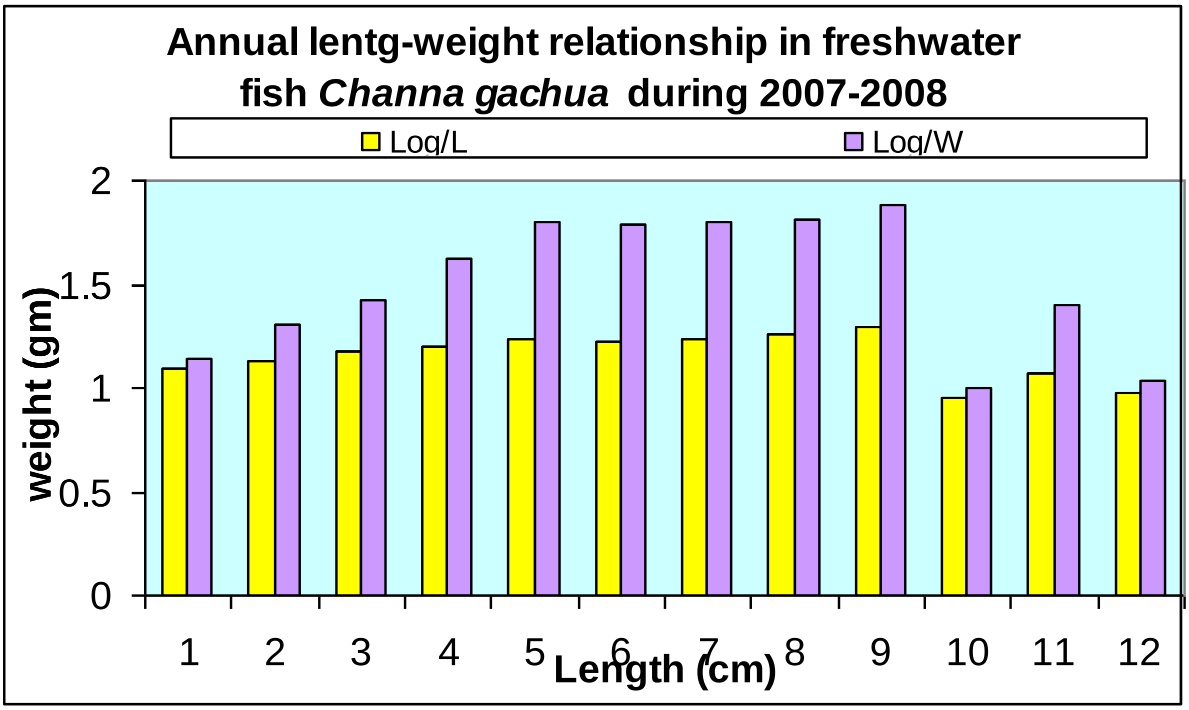
Avg. Length=10.0 Avg. Weight= 12.4 t-test=0.05 *

Fig. 36 Length-Weight Relationship in *Channa Gachua* December-2010



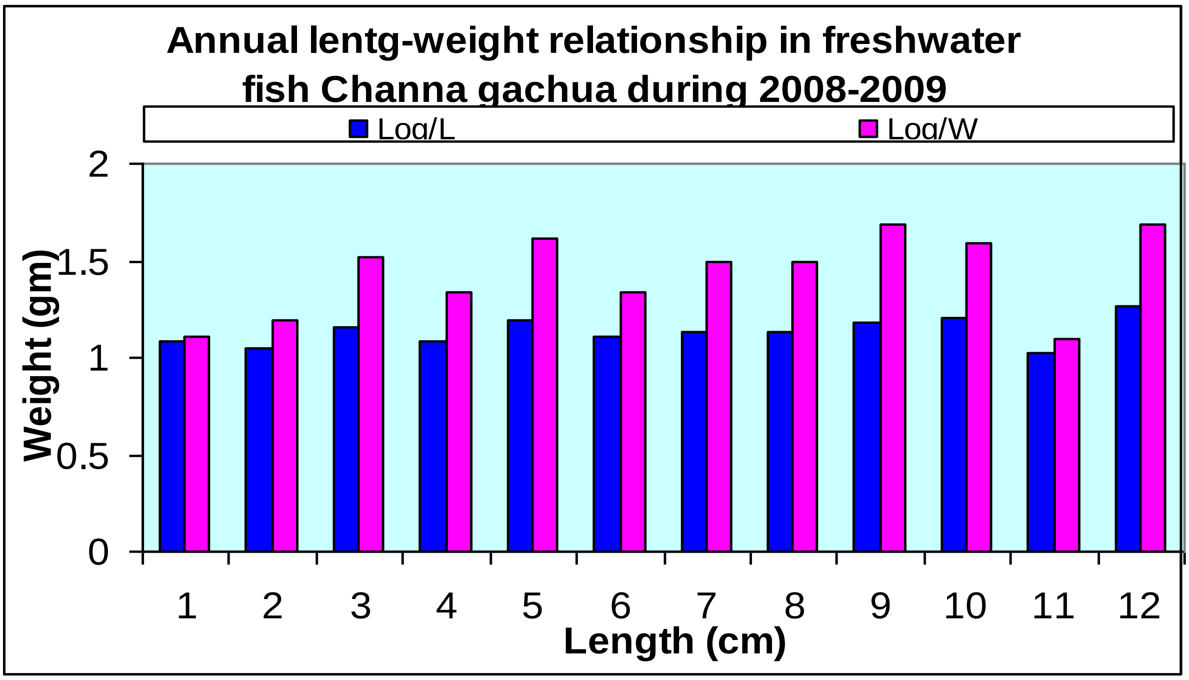
Avg. Length=8.5 Avg. Weight= 10.0 t-test=0.05 *

Fig. 37 Length-Weight Relationships in Freshwater Fish *Channa Gachua* During 2007-2008



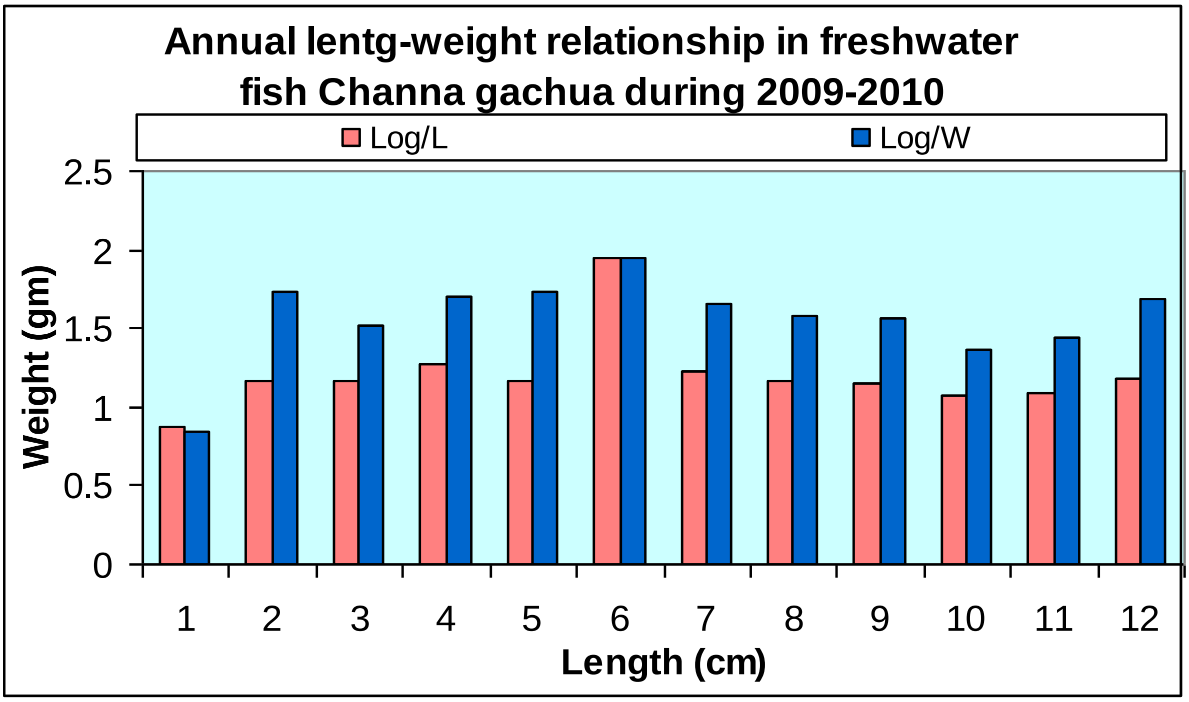
Avg. Length= 15.5 Avg. Weight=55.0 t-test=0.05 *

Fig 38 Length-weight relationships in Freshwater fish *Channa gachua* during 2008-2009



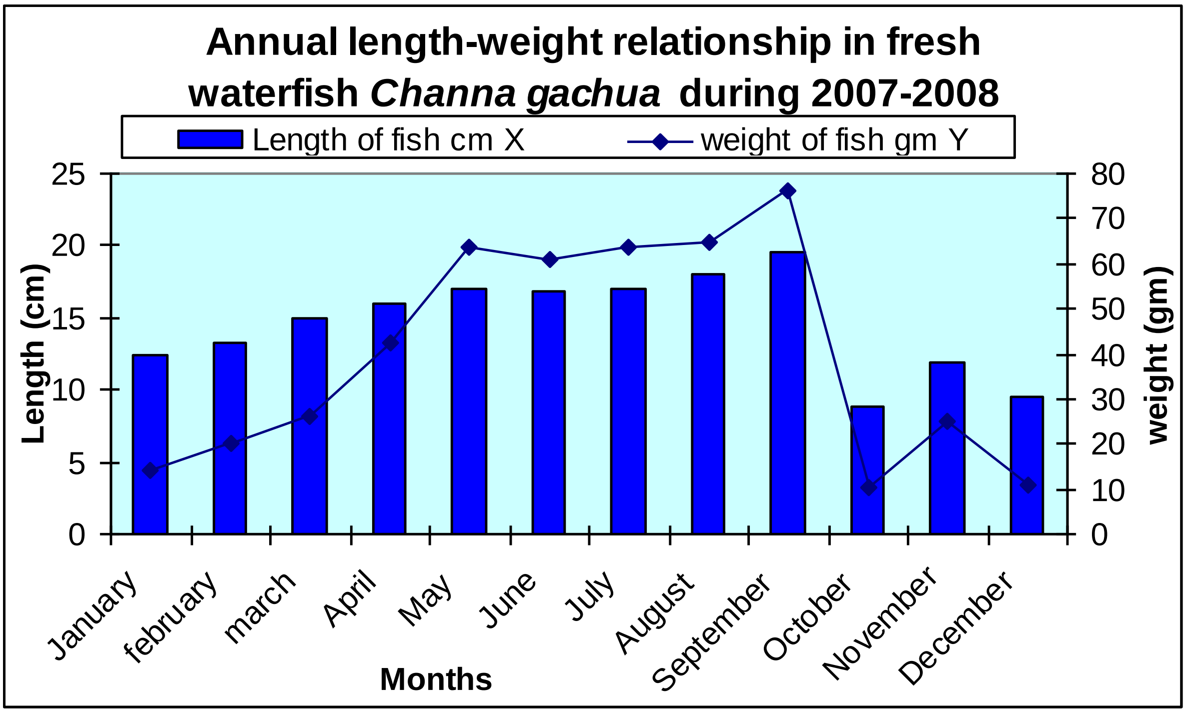
Avg. Length= 16.5 Avg. Weight=45.0 t-test=0.05 *

Fig 39 Annual Length-Weight Relationships in Freshwater Fish *Channa Gachua* During 2009-2010



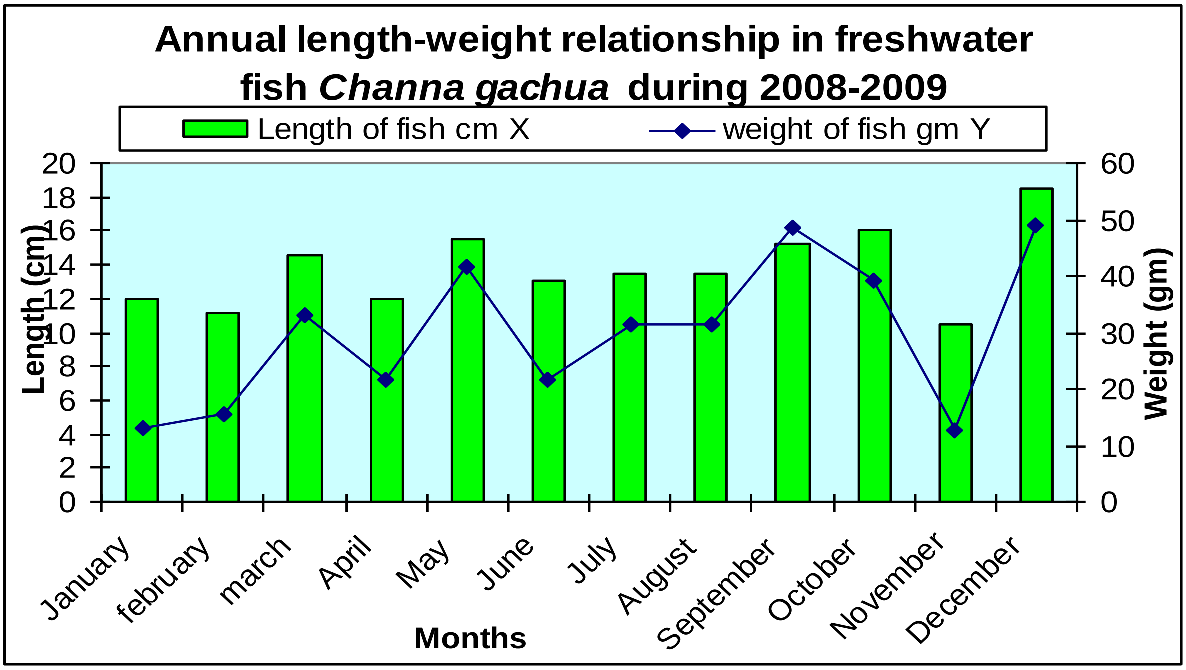
Avg. Length= 18.5 Avg. Weight=65.0 t-test=0.05 *

Fig. 40 Histogram for Annual Study of Meristic and Metric Measurements During 2007-2008



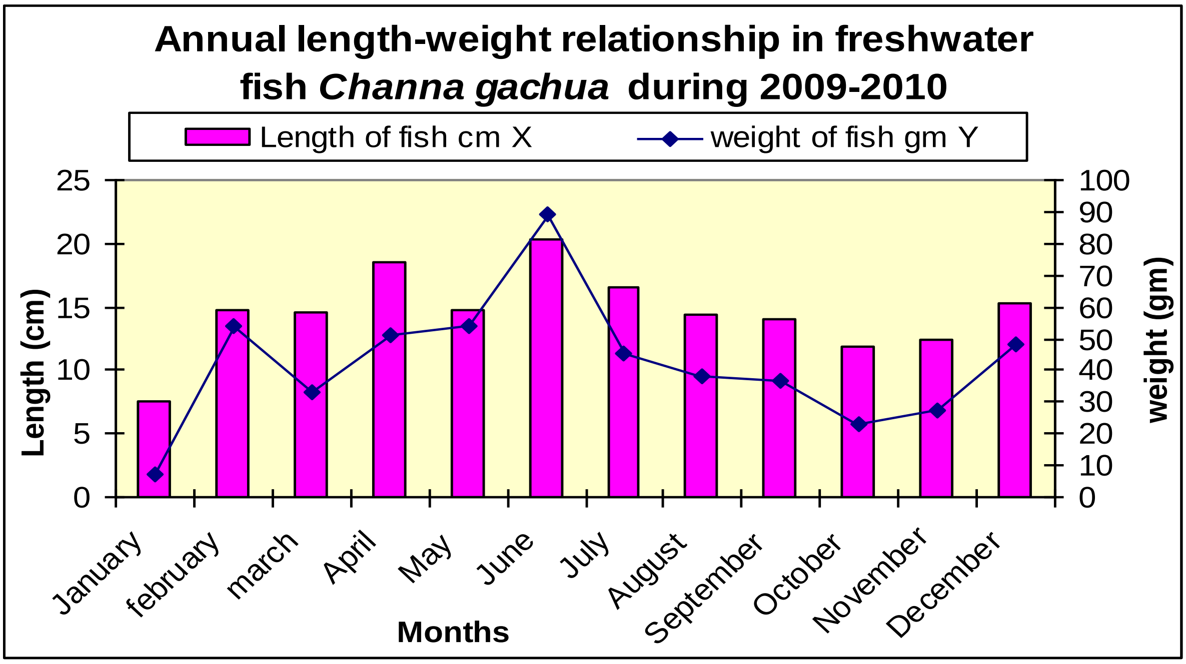
Avg. Length= 15.5 Avg. Weight=55.0 t-test=0.05 *

Fig. 41 Histogram for Annual Study of Meristic and Metric Measurements During 2008-2009



Avg. Length= 16.5 Avg. Weight=45.0 t-test=0.05 *

Fig. 42 Histogram for Annual Study of Meristic and Metric Measurements During 2009-2010



Avg. Length= 18.5 Avg. Weight=65.0 t-test=0.05 *

Chapter 4

Development of Supporting Cells in Gonads

Testes undergo- cyclic changes and show variations in its appearance due to varied maturity stages. Several workers have studied cyclic changes in testis Craig, (1931) in Gesterosteus aculeatus, and James (1946) in Blue gill *Lepbinfs macrochirus* and *Hurosalnzoides*. Swarup (1958) has considered the pigmentations as the sign of ripeness of the testes during breeding season**.** Ovary undergoes cyclic changes throughout the year, there being variations in its appearance and development. Several workers have studied seasonal ovarian cycle in teleosts on its cellular changes, morphologically and histologically. Ghosh *et al.* (1952) in *Heteropneustes*, *fossilis* classified the annual ovarian activity into three distinct phases viz. Preparatory, active and quiescent. Gokhale (1957), Beach (1959) described the atretic vitellogenic eggs as pre-ovulatory corpora lutea or corpora atretica in fishes. Most of the studies on reproductive biology of teleosts have been described through development changes of gonads and maturity, of ovum Kesteven, (1960); Nikolsky (1963,). Follicular atresia has been described in *Heteropneustus fossils* and in *clarrus batrachus*, Hoar, (1969) Reporter that, the atretic follicles in fish can be designated on the changes of Corpora lutea as it develops from theca and follicle cells. Gopal *et al*., (1969) have studied new crop of oocytes in *Anabas scandens*. Jorgenson (1972) confirmed that, the atretic follicles in fish may dovelop due to lack of sufficient endogenous gonadotropin. Gopal and Govindan (1975) reported that, the precursors of yolk first appears as minute granules in the peripheral ooplasm and later grow in size and extend to the entire ooplasm as a centripetal manner in *Anabas scandens*. Ruby *et al*, (1970) in *Eucalia inconstans* and Grerick (1973) in Oryzias reported that, the interlobular space was occupied by blood vessels, nerve fibers.

Joshi and Joshi (1989) histologically studied the seasonal changes in testicular activity in association with the interstitial cells in Puntius dukai. They further reported that, interstitial cells showed changes with advancement of spermatogenesis but the number is less during post-spawning and markedly increase with advancement of spermatogenesis. Testes are also divided into various stages on the basis of maturity.

Testis of freshwater fish, *Channa gachua.* **(Plate no. IV-VIII):** *Channa gachua*, Showed development of testis and ovary **(**Plate no. II-VII**)** but testes is difficult to categorize into stages because maturation of sperm tissue does not occur in distinct steps, but as a gradual change in the relative proportion of spermatocytes, spermatids and spermatozoa. There can also be considerable variation in the appearance of the sperm tissue for each staging category. For instance, in some ripe testes the tissue was dominated by late stage sperm in the peripheral sperm sinuses and outer regions of the gonad, while, in others the late stage sperm dominated the inner regions and central sperm sinus. Staging of testes is therefore more prone to error than is the staging of ovaries, the immature (fig.M1) and immature developing stages has lowest reproductive status. A developing stage is not recognized in males because there is no clear demarcation in the transition from the mature resting (M2) to the mature ripe stage. For similar reasons, a spent stage is not recognized. The ripe stage is the background state of the testis during the reproductive period, with peaks in reproductive status during spawning however, the testis holds no evidence to identify whether a particular male is just about to or has recently spawned only that it is in the process of doing so.

Leydig's Cells: (Plate no. V- VIII): Although the lobule boundary cells, according to Marshall & Lofts (1956), often occur in testes of fishes not having typical interstitial cells (Leydig cells), ultrastructural observations clearly indicates that there are some species whose testes appear to have both interstitial and lobule boundary cells Guraya, (1976); Nakagama *et al.*, (1982). These cells seem to participate as well as in spermatozoa phagocytosis, mainly during the regression stage of testis development, but while this process is sometimes mentioned, its details have not yet been presented Mattei *et al.*, (1993); Romagosa *et al.*, (2000); Weltzien *et al.*, (2002).

Sertoli Cells And Germ Cell: (Plate- IV-VIII): Entire Semniferus tibule with sertoli cell and germ cells (Fig. no.46), developing Srtoli cells was seen in semniferus tibule (Fig. 50.), semniferus tibule with numerus spermatocytes was seen in maturing stage of male testis (Fig. 44), (Fig. 46) Shows developing Srtoli cells in mature stage. Developing Srtoli cells and Ledig's cells in mature stage of male *Channa gachua* was obsedved (Fig. 46). Developed Srtoli cells and ledig's cells in mature stage of male *Channa gachua* were also observed (Fig. 47).

The term "lobule boundary cells" was first introduced by Marshall *et al* (1956), followed by O'Halloran *et al*, (1970), who considered these cells homologous with the mammalian Leydig cells. However, the lobule boundary cells seem to be more accurately homologous to Sertoli cells, since they are separated from the interlobular space by a basal lamina Billard *et al*, (1982); Grier, (1975); Grier *et al*, (1977); Mattei *et al*, (1982),1993; Nakagama,(1983); Nicholls *et al*, (1972) and, as in mammals, present follicle-stimulating hormone (FSH) receptors Schulz *et al.*, (2001); Weltzien *et al.*, (2002). The function of Sertoli cells in fish is not well established, but the ultrastructural morphology demonstrates the presence of spherical mitochondria with parallel crystae and lipid deposits in the cytoplasm Billard *et al.*, (1972);

Cruz *et al*, 1984; Grier, 1975; Mattei *et al.*, (1982), which are characteristics of steroid-producing cells, suggesting a possible role in steroid synthesis, or at least locations where these hormones are stocked Grier & Linton, (1977); Cruz-Höfling *et al*, (1984); Mattei *et al.*, (1982). However, knowledge about endocrine control of spermatogenesis in teleost fish has mostly been drawn from measurements of hormone levels in the peripheral blood, injection of pituitary extracts, gonadotropins, and steroids into either intact or hypophysectomized specimens Billard *et al.*, (1972); Fostier *et al*, (1983); Schulz*et al.*, (2001); Weltzien *et al.*, 2002), in such a way the exactly local of control of the hormone-producing is unknown.

In most teleost fishes studied, testis growth coincides with increase in plasma levels of 11-ketotestosterone (11-KT) and to a lesser extent, testosterone (T) Norberg *et al.*, (2001) and Weltzien *et al.*, (2002). The sex steroid levels in fish are also influenced by behavior, e.g., social modulation Oliveira *et al.*, (2002). The presence of cholesterol-(positive lipids) in Sertoli cell homologues seems be an insufficient criterion to identify it as steroid-producing cells Cruz *et al*, (1984). A histological and ultrastructural investigation of Sertoli cell development in the testes of *Channa gachua* was made for the purpose to clarify the role of these cells in teleost fishes with a seasonal reproductive cycle.

In higher vertebrates, survival and development of germ cell critically depend on the Sertoli cells in the vertebrate testis. Fish is different from mammals as they show a cystic type of spermatogenesis were a single germ cell clone is enclosed by and accompanied through the different stages of spermatogenesis with group of Sertoli cells (plate IV-VIII). Sertoli cell proliferation in *C.gachua* occurs primarily during spermatogonial proliferation, allowing the cyst-forming Sertoli cells to provide space to growing germ cell clone. In this regard, dramatic increase in cyst volume and number of germ cells per cyst, in *Channa gachua,* was strikingly increased from primary spermatogonia to spermatocyte cysts. In *Channa gachua,* Sertoli cell proliferation is strongly reduced when germ cells have proceeded into meiosis, and stops in postmeiotic cysts. Hence it can be said that, Sertoli cell proliferation is primary factor helps in spermatogesis.

Ovary Of Freshwater Fish, *Channa Gachua*. **(Plate no. VII-IX):** Developing follicles and Ledig's cells in mature stage of female *Channa gachua* ovary was observed (Fig. 49). Developed follicles and grown Ledig's cells in mature stage of female *Channa gachua* were (Fig. 50).

Virgin gonad has relatively low reproductive status. Similar to resting stage, within the period of reproductive activity, as marked due to matured ovaries, the reproductive status is relatively high. This is followed by a drop in reproductive status during the post-spawning stage back to the developed stage. However, if repeat spawning occurs over a short period of time (e.g. on consecutive days), then several peaks in reproductive status will be overlaid.

Table: 37 Shows growth of sertoli during three successive cycles in *Channa gachua* (Ham. 1822)

Fish Species	Circannual Cycle	Pre-mature (µm)		Mature (µm)		Spent (µm)	
		Testis	Ovary	Testis	Ovary	Testis	Ovary
Channa gachua	**2008**	1-2	---	2-5	----	4	----
	2009	1-2	---	2-5	----	4	----
	2010	1-3	---	2-8	----	5	----

All values in (µm)

Table 38: **Shows growth of Ledig's cells during three successive cycles in *Channa gachua* (Ham. 1822)**

Fish Species	**Circannual Cycle**	**Pre-mature (µm)**		**Mature (µm)**		**Spent (µm)**	
Channa gachua		Testis	Ovary	Testis	Ovary	Testis	Ovary
	2008	0.5-0.8	0.5-0.9	0.6-0.9	0.7-0.1	0.4-0.7	0.6-.08
	2009	0.4-0.7	0.5-0.8	0.5-0.1	0.4-0.9	0.4-0.8	0.4-.08
	2010	0.6-0.9	0.7-0.9	0.4-0.1	0.7-0.9	0.5-0.9	0.5-.08

All values in (µm)

Chapter 5

Biochemical Studies of Supporting Cells in Fishes

5.1 Protein Profile in Serum

Due to prime role in immune response, much of the recent attempts on fish plasma proteins continued to focus on immunoglobulin study (Scapigliati *et al.,* (1997). In some fish species serum albumin may exist in minute quantities, while sera of other fish species may entirely lack of it De Smet *et al*., (1998). Reports on identification and characterization of fish serum albumin are scanty (Jabeen *et al*, 2001; Hasnain *et al*., 2004,). Trace metabolites, a recent proteomic study has identified up to 81 components in human plasma Park *et al*., (2006). Blood serum in addition to globulin and albumin like components constitute approximately 60-97% of total serum proteins (Ahmed. *et al*, 2008, Chen *et al*., 2008). From evolutionary perspective, quantitative and qualitative status of several identified proteins in lower vertebrates needs explanations. Haptoglobin (Hp), is traceable in class Pisces.The β-globulin group of serum protein is polymorphic pure transferrins in *Channa punctata* and had been identified by several biochemical criteria Nabi *et al*., (2007). The heptaglobin (Hp) as hemoglobin binding protein as appears in mammals. In view of persistent significance of transferrin, albumin and immunoglobulins in genomix. We are interested in identification and distribution of serum proteins in *Channa gachua*. Present findings describe the distribution, identification and occurrence of serum protein which are partially purified by ammonium sulfate (AS) fractions.

5.2 Result and Discussion

The total protein present was estimated by Lowry method (1951) and was found 820±0.435 mg/ml. 20µl and 40 µl of serum sample were resolved on 10% Native-PAGE, the total number of protein bands were visually counted as eleven.

The slow migrating bands designated as *Cg*-1, has molecular weights 154.20 KDa and moderate migrating bands i.e. *Cg*-2, *Cg*-3, *Cg*-4, *Cg*-5, *Cg*-6, *Cg*-7, *Cg*-8, *Cg*-9 have molecular weights 71.61, 63.13, 58.61 56.70, 54.09, 45.29, 42.24 and 35.62 KDa respectively. The presence of moderately molecular weight proteins like of β-globulins, haptoglobins, transferrins and albumin like protein in *Channa punctata* blood serum were earlier reported by Riaz Ahmad *et al.* (2008). The results in the present study support these findings. Remaining two fast migrating bands i.e. Cg-10 and Cg-11 have low molecular weights i.e. 16.15 and 14.79 KDa respectively. The respective Rf values of all migrating bands was depicted in Table. 1. Furthermore Rf values of standard molecular weight marker also depicted in table 1.

On 12% SDS-PAGE with reducing agent, 2-mercaptoethanol these proteins showed similar migration pattern with eleven bands suggesting that, these protein consist of single polypeptide chains (Fig. 2 c).

Fig. 41 Showing banding pattern of 10, 20 and 30 µl in lane 1 ,2 and lane 3 by PAGE (Native)electrophoresis of fish male serum with standard molecular weight mark in fish *Channa gachua*

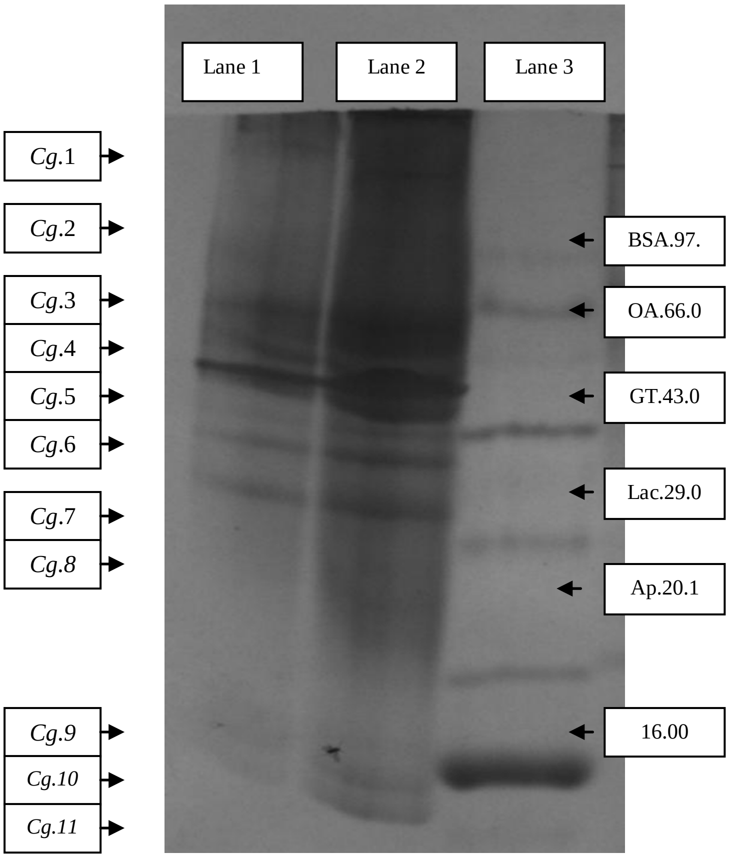
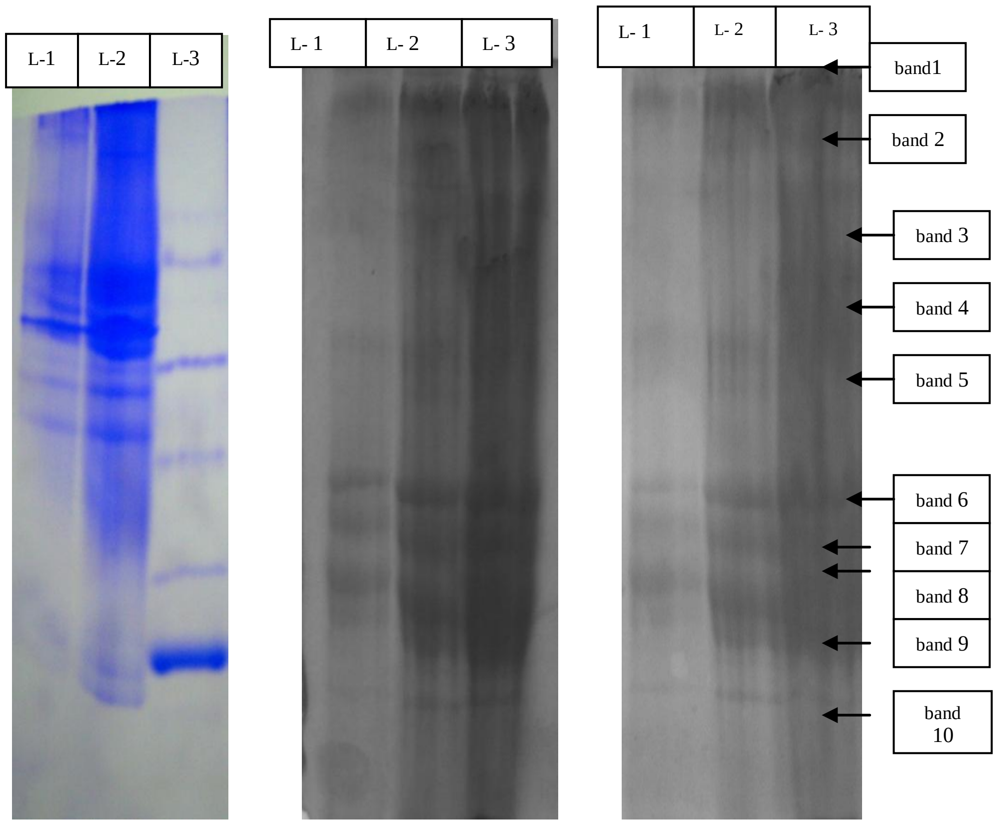


Fig.42 Showing banding pattern of 10, 20 and 30 µl in lane 1 , 2 and lane 3 of marker protein sample by PAGE (Native) electrophoresis of fish male serum with standard molecular weight marker in lane 3.

(a) (b) (c)



Native-Page Non-reducing SDS-PAGE Reducing SDS-PAGE
(Denaturing protein) (Without 2-Mercaptoethanol)

Table 37. Showing molecular weight of different protein bands by Alphalnnotech in fish serum

Band no.	Molecular weight (Da)	R.f. values	Characterization	Stander protein	Standard protein molecular weights (Da)	R.f. values
Band-1	154.40	0.130	High molecular weight	Bovine serum albumin	97.4	0.234
Band 2	71.61	0.279	High molecular weight	Ovalbumin	66.0	0.289

Band 3	63.13	0.302	High molecular weight	Glutathione S-tranceferase	43.0	0.397
Band 4	58.61	0.324	High molecular weight	Lactoglobuline	26.0	0.504
Band 5	54.09	0.345	Moderate	Aprotin	18.4	0.624
Band 6	45.29	0.380	Moderate	---	65.0	0.289
Band 7	42.24	0.382	Moderate	---	---	---
Band 8	35.62	0.403	Moderate	---	---	---
Band 9	43.00	0.453	Moderate	---	---	---
Band 10	16.15	0.686	Fast moving	---	---	---
Band 11	14.79	0.717	Fast moving	---	---	---

KDa—KiloDalton unit

Table 38- Biochemical contain in male and female gonad of Fish *Channa gachua* mg/ g wet weight of tissue.(2007-2008)

Phase	Pre-mature		Mature		Spent	
	Ovary	Testis	Ovary	Testis	Ovary	Testis
Lipid	650±0.55	580±0.95	860±0.87	740±0.89	453±0.97	450±0.86
Glycogen	540±0.45	523±0.77	760±0.32	840±0.44	421±0.45	400±0.99
Protein	569±0.34	600±0.92	771±0.45	800±0.56	400±0.83	403±0.76

Table 39- Biochemical contain in male and female gonad of Fish *Channa gachua* mg/ g wet weight of tissue. (2008- 2009)

Phase	Pre-mature		Mature		Spent	
	Ovary	Testis	Ovary	Testis	Ovary	Testis
Lipid	610±0.87	560±0.67	830±0.67	710±0.55	423±0.66	410±0.33
Glycogen	550±0.54	553±0.98	740±0.6	840±0.65	431±0.99	410±0.77
Protein	555±0.56	610±0.88	740±0.81	600±0.81	420±0.65	400±0.34

Table 40- Biochemical contain in male and female gonad of Fish *Channa gachua* mg/ g wet weight of tissue.(2009- 2010)

Phase	Pre-mature		Mature		Spent	
	Ovary	Testis	Ovary	Testis	Ovary	Testis
Lipid	710±0.80	660±0.60	930±0.09	610±0.66	400±0.44	510±0.24
Glycogen	651±0.56	580±0.98	820±0.6	800±0.22	412±0.12	510±0.23
Protein	655±0.56	560±0.82	748±0.61	630±0.80	450±0.60	420±0.45

5.3 Steroids in Freshwater Fish

In the early 1990s, British researchers noticed that, male fish fed on sewage had testes laden with eggs had turned in to hermaphrodites.

Like higher vertebrates, quantity of sex steroids in freshwater fish has been studied by using enzyme assay based Chemoluminescence technology.FSH is a heterodimeric glycoprotein synthesized and secreted by the anterior pituitary gland is involved in the regulation of essential vertebrate reproductive processes such as gametogenesis and follicular growth. Deleterious effects on gonadal development may confirm by a dramatic reduction of the gonadosomatic index due to high concentration of testosterone in female Blázquez. *et al*., (2001). In addition, around the first year of age, growth was significantly depressed in all groups. The testosterone is the major circulating sex hormone of the male and serves as the prototype for the androgens, the anabolic agents, and androgen antagonists. The endogenous androgens are biosynthesized from cholesterol in various tissues in the body.

Majority of the circulating androgens are produced in the testes under the stimulation of the gonadotropin luteinizing hormone (LH). The reduction of testosterone to dihydrotestosterone is necessary for the androgenic actions of testosterone.In many androgen target tissues such as the prostate; the oxidation of testosterone by the enzyme aromatase produces estrogens Brueggemeier (2003). The glycoprotein hormones are structurally and functionally conserved in various vertebrates and have been identified in most lineages of actinopterygian (bony) fish Park *et al*. (2005). Gonadal steroid hormones are produced by the testes and the ovaries, the two most important are testosterone and estradiol. These compounds are under tight biosynthetic control, with short and long negative feedback loops that regulate the secretion of follicle stimulating hormone (FSH) and luteinizing hormone (LH) by the pituitary and gonadotropin releasing hormone (GnRH) by the hypothalamus. Low levels of circulating sex hormone reduce feedback inhibition on GnRH synthesis (the long loop), leading to a elevated FSH and LH. The biosynthetic pathway to sex hormones in male and female gonadal tissue includes the production of the androgens, and rostenedione and dehydroepi and rosterone. Testes and ovaries contain an additional enzyme, a 17β-hydroxysteroid dehydrogenase that enables androgens to be converted to testosterone.

Testosterone is an androgen, male sex hormone synthesized in the testes, responsible for secondary male sex characteristics, produced from progesterone. Estradiol is an estrogen, principal female sex hormone, produced in the ovary, responsible for secondary female sex characteristics Cortisol is dominant glucocorticoid in humans, synthesized from progesterone in the zona fasciculata of the adrenal cortex, involved in stress adaptation, elevates blood pressure and Na^{+} uptake, numerous effects on the immune system.

Testosterone is one of the anabolic steroidal hormones secreted in large amounts by the testes in males, and to a lesser extent, by the adrenal cortex and ovaries in females. Testosterone is an androgen which has masculinizing effects on individuals. Testosterone exerts its effects right from the perinatal period through puberty and adulthood. It is also related to a variety of social behaviors including aggression, power, sexual behavior, and social dominance. Although females have just about 1/7th the testosterone levels as men, apparently, testosterone still plays a role. In pubescent females, testosterone effects are more subtle but equally important for proper musculo-skeletal development, general anabolic activity, and libido. In both sexes, testosterone enhances aerobic metabolism and increases protein synthesis.

Total testosterone: commonly measured using chemilumine scence immunoassay or radioimmunoassay; gold standard is liquid chromatography tandem mass spectrometry (LC-MS). LC-MS is especially helpful in cases of low Testosterone concentration, for example in females and pre-pubertal individuals, as the immunoassays perform poorly at low Testosterone concentrations Wang (2004). Bioavailable testosterone represents biologically active Testosterone, includes both free Testosterone and albumin-bound Testosterone and calculated based on the binding of Testosterone to SHBG and albumin, also, measured directly by the ammonium sulfate precipitation method, which precipitates SHBG and SHBG-bound Testosterone. Free testosterone gold standard is direct measurement by equilibrium dialysis, can also be calculated based on total Testosterone and SHBG using method validated by Vermeulen (1999). DHEAS, biologically inert steroid produced by the adrenals that becomes active after being converted to androstenedione and then Testosterone in the periphery.

Measured with chemiluminescence immunoassay, radioimmunassay, or LC-MS.LH and FSH, workers measured using chemiluminescence immunoassay or radioimmunoassay. Highly sensitive and selective microplate chemiluminescence enzyme immunoassay for the determination of free thyroxine in human serum developed Wang ey al, (2007). Studies were carried out to determine whether the anabolic steroids 17α-methyltestosterone, 11-ketotestosterone, 4-chloro-testosterone acetate, testosterone, oxymetholone and progesterone can promote an increase in body weight when incorporated McBride *et al.* (2009).In males, LH binds to Leydig cells, stimulating production of the principal Leydig cell hormone, testosterone. Testosterone is secreted to the plasma and also carried to Sertoli cells by androgen binding protein (ABP). In Sertoli cells the double bond of testosterone is reduced, producing dihydrotestosterone. Testosterone and dihydrotestosterone are carried in the plasma, and delivered to target tissue, by a specific gonadal-steroid binding globulin (GBG). In a number of target tissues, testosterone can be converted to dihydrotestosterone (DHT). DHT is the most potent of the male steroid hormones, with an activity that is 10 times that of testosterone. Because of its relatively lower potency, testosterone is sometimes considered to be a prohormone.

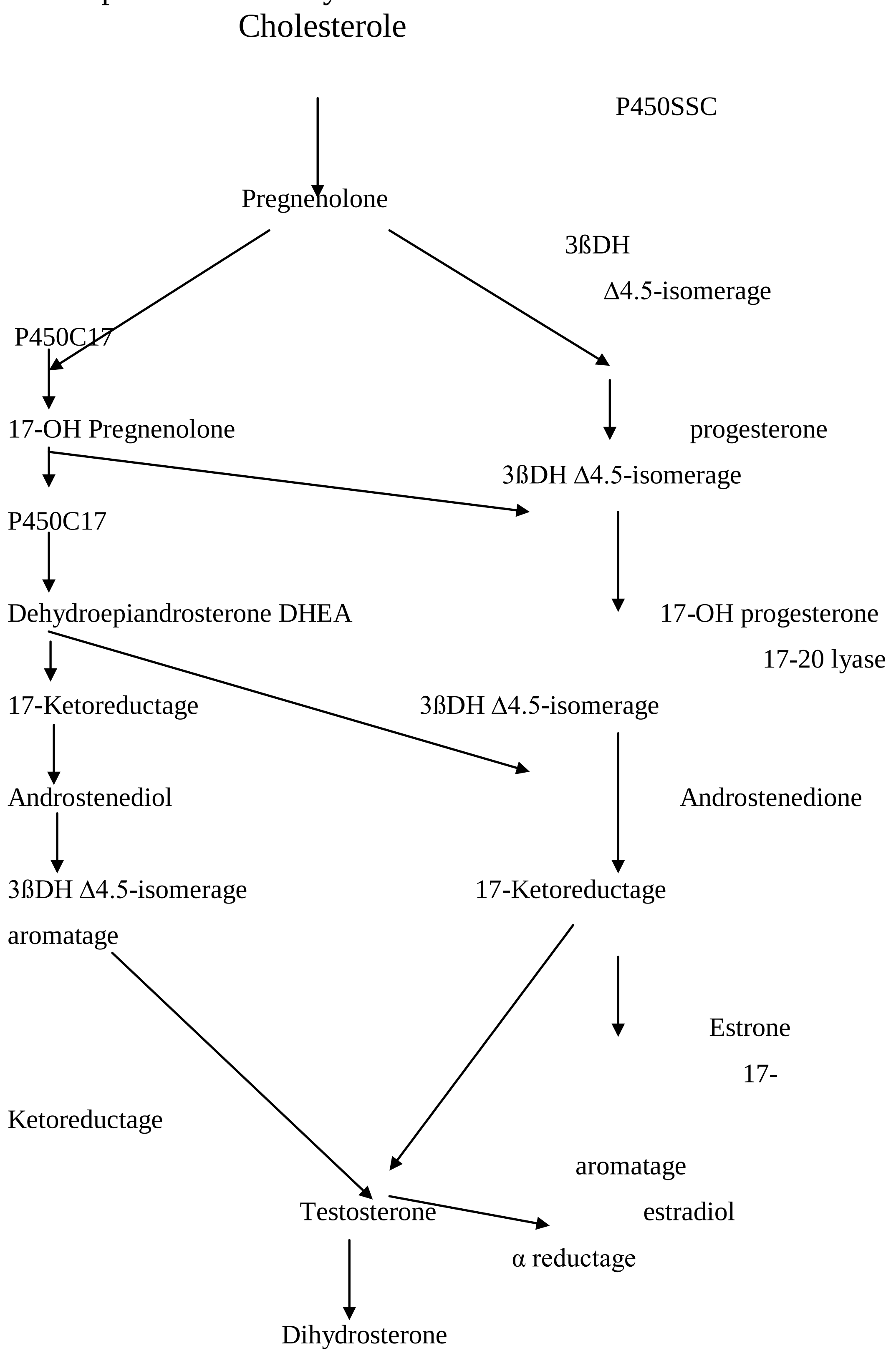
A hormone is a chemical substance. It’s secreted by one tissue and travels by way of body fluids to affect another tissue in body. In essence, hormones are "chemical messengers." Many hormones, especially those affecting growth and behavior, are significant to animal. The amount and levels of hormones change daily. The sex hormones, estrogen and testosterone, are secreted in short bursts and pulses. Dehydroxyepineprine **(**DHEA) is a steroid hormone which is structurally similar to other steroid hormones (such as estrogen, progesterone and testosterone), but which possesses its own spectrum of biologic effects.

Scientists have known for years that DHEA is secreted by the adrenal gland and that this is a greater quantity of this hormone produces than any other adrenal steroid. In both humans and animals, the decline of DHEA production with aging is associated with immune depression, loss of sleep, decreased feelings of well-being, and increased mortality.

Estrogen is an entire class of related hormones. They include estriol, estradiol, and estrone. Estradiol is made from the placenta. It's produced during pregnancy. Estradiol is the primary sex hormone of spawning fishes and also in higher vertebrates. It is formed from developing ovarian follicles. Estradiol is responsible for female characteristics and sexual functioning. Also, estradiol is important to female bone health and condiotion. Estradiol contributes to most gynecologic problems such as endometriosis and fibroids and even female cancers in human being. Estrone is widespread throughout the body of anima. It is the only one of the estrogens that's present in any amount in female after ovulation. The principles of chemiluminescence and the application of chemiluminescent labels and substrates in immunoassays are reviewed Rongen *et al.* (2010).

Normal Testosterone and Estrogen levels in higher vertebrates, it would surprise to know that, male don't have a monopoly on testosterone. Testosterone belongs to a class of male hormones called androgens. But, female also have testosterone level. The ovary produces both testosterone and estrogen. Relatively small quantity of testosterone is released into bloodstream by the ovaries and adrenal glands. In addition to being produced by the ovary, estrogen is also produced by fat tissue in the body. These sex hormones are involved in the growth, maintenance, and repair of reproductive tissues. But that's not all; they influence other body tissues and bone mass as well.

Schematic representation of synthesis of male sex hormone



5.4 Material and Method for Steroids

Live freshwater male and female fishes, during premature, mature and spawning period were collected from Godavari River near Aurangabad. Disposable syringes (2ml) were used to suck the blood from the caudal vein. Serum was obtained using centrifuge matching at 3000 rpm. The red color pigmentations were removed by using activated charcoal (black). Method and apparatus for improved luminescence assays using particle concentration chemiluminescence detection, Massey et al., (2002).

Chemiluminescence technology: Chemiluminescence is the generation of electromagnetic radiation as light by the release of energy from a chemical reaction. Serum was further used for photo-detector in Chemiluminicence. Different tracers and signaling reagents were used to carry out luminescence reactions for hormones. Standardization of chemilumnisence apparatus for detection and quantification of freshwater fish sex hormone from serum. Standardization was done each time for total hormones using standard markers from USA.

Immunoassay: Testosterone (17â-hydroxyandrost-4-ene-3-one) is a C19 steroid with an unsaturated bond between C-4 and C-5, a ketone group in C-3 and a hydroxyl group in the position at C-17. This steroid hormone has a molecular weight of 288.4. Testosterone is the most important androgen secreted into the blood. In males, testosterone is secreted primarily by the Leydig cells of the testes; in females ca. 50% of circulating testosterone is derived from peripheral conversion of androstenedione, ca. 25% from the ovary and ca. 25% from the adrenal glands. Testosterone is responsible for the development of secondary male sex characteristics and its measurements are helpful in evaluating the hypogonadal states.

In higher vertebrate female, high levels of testosterone are generally found in hirsutism and virilization, polycystic ovaries, ovarian tumors, adrenal tumors and adrenal hyperplasia. In men, high levels of testosterone are associated to the hypothalamic pituitary unit diseases, testicular tumors, congenital adrenal hyperplasia and prostate cancer.

5.5 Principle of the Test

The Testosterone Chemiluminescence Immunoassay is based on the principle of competitive binding between Testosterone in the test specimen and Testosterone-HRP conjugate for a constant amount of rabbit anti-Testosterone. In the incubation, goat anti rabbit IgG-coated wells are incubated with 10 µl of Testosterone standards, controls, patient samples, 100 µl Testosterone-HRP conjugate reagent and 50 µl rabbit anti-Testosterone reagent at 37°C for 90 minutes. During the incubation, a fixed amount of HRP-labeled Testosterone competes with the endogenous Testosterone in the standard, sample, or quality control serum for a fixed number of binding sites of the specific Testosterone antibody. Thus, the amount of Testosterone peroxidase conjugate immunologically bound to the well progressively decreases as the concentration of Testosterone in the specimen increases. Unbound Testosterone peroxidase conjugate is then removed and the wells washed. Next, A solution of chemiluminescent substrate is then added and read relative light units (RLU) with a Luminometer. The intensity of the emitting light is proportional to the amount of enzyme present and is inversely related to the amount of unlabeled TESTOSTERONE in the sample. By reference to a series of T Testosterone standards assayed in the same way, the concentration of testosterone in the unknown sample is quantified.

Materials provided with Test Kit: Goat Anti-Rabbit IgG-coated microtiter wells, 96 wells. Testosterone Reference Standards: 0, 0.1, 0.5, 2.0, 6.0 and 18.0 ng/ml. Liquids, 0.50 ml each, ready to use. Rabbit Anti-Testosterone Reagent (pink color), 7.0 ml Testosterone-HRP Conjugate Reagent (blue color), 12 ml 20x Wash Buffer, 30 ml Chemiluminescence Reagent A, 6.0 ml. Chemiluminescence Reagent B, 6.0 ml. Distilled water. Precision pipettes: 0.01ml, 0.05ml, 0.10ml.Disposable pipette tips.Glass tube or flasks to mix Reagent A and B., Microtiter well luminometer, Vortex mixer or equivalent, Absorbent paper and Graph paper.

Reagent Preparation: To prepare substrate solution, make an 1:1 mixing of Reagent A with Reagent B right before use. Mix gently to ensure complete mixing. Discard excess after use. Prepare the washing solution by diluting 1 part of the 20X PBS concentrate to 19 parts of distilled water.

Assay Procedure: Secure the desired number of coated wells in the holder. Dispense 10 µl of standards, specimens and controls into appropriate wells. Dispense 100 µl of Testosterone-HRP Conjugate Reagent into each well. Testosterone standards assayed in the same way, the concentration of testosterone in the unknown sample is quantified. Similar test was carried for DHEAS, Testosterone, estradiol, progesterone, cortisol, luteinizing hormone and follicular stimulating hormone.

The estimation of hormones can be done with an ultraviolet spectrophotometric method presented for the quantitative estimation of steroids which are in concentrations of more than 1.25 µ/ml. Estradiol-17β, progesterone, and testosterone were used in these studies.

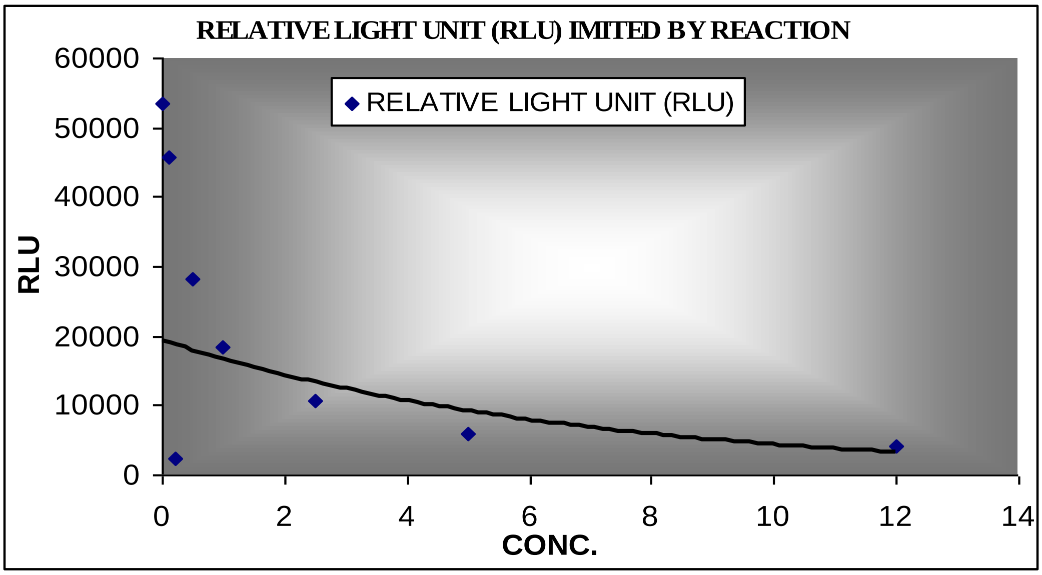
Based on UV light absorption at 230 nm for estradiol and progesterone, and at 240 nm for testosterone, the relative concentration of each steroid could be estimated. This method is very simple and rapid. It is economical, requires no sophisticated instruments, and is very practical for estimating steroids in pharmaceutical preparations, chemicals, or biological specimens Khayam H**.** (2004).

Result for steroids

Table37. Standardization of Chemolumnisence Apparatus for Detection and Quantification of Freshwater Fish Sex Hormone Testosterone from Serum.

Wells.	**Id of Wells**	**Relative Light Unit (Rlu)**	**Concentration**
1	C1	53546	0.0
2	C2	45873	0.1
3	C3	28334	0.5
4	C4	18534	1.0
5	C5	10825	2.5
6	C6	5965	5.0
7	C7	4057	12.0
9	1 (SAMPLE)	2450	0.2

Fig. 41 relative light unites emitted by antibody (hormone molecule) and antigen (tracer used) in reaction.



Hormones detected and quantified during premature, mature and spawning in *Channa gachua*. The growth of freshwater fish *Channa gachua* was isometric, the levels of sex hormones quantity are in very minute tress. In premature fish having length (12cm) and weight (30 gm), quantities of testosterone 0.11 ng/ml in male, estradiol 0.24 pg/ml in female, progesterone 3.01 ng/ml in female (dehydroepiandrosterone) DHEAS in male 0.001 µg/ml, 0.006 µg/ml in female.Luteinizing hormone (LH) 0.15 IU/ml in female follicle stimulating hormone (FSH) 0.41 in female. In mature fish having length (15cm) and weight (35gm),, level of testosterone 0.24 ng/ml in male and 0.04 ng/ml in female, estradiol 0.004 pg/ml in male and in female 2.4 pg/ml, progesterone 3.001 ng/ml in female.

DHEAS 0.2 µg/ml in male and in female 0.2 µg/ml. Lutinizing hormone, (LH)0.2 IU/ml in male and 0.6 IU/ml in female.Follicle stimulating hormone (FSH) 32.7 µg/ml in female.

Thus, in spawning having length (15cm) and weight (35gm), quantity of testosterone 0.04 ng/ml in male and -0.89 ng/ml in female, estradiol in male -0.4 pg/ml and in female 0.4 pg/ml, progesterone in male -2.01 ng/ml and 2.01 ng/ml in female DHEAS 0.002 µg/ml in male and in female 0.009 µg/ml) Lutinizing hormone (LH) in male 0.02 mIU/m0 and in female.0.2 IU/ml l. Follicle stimulating hormone (FSH) -3.87 µg/ml in male and in female 0.01 µg/ml. Has been recorded significantly.

Table 38.Hormones detected and quantified during premature, mature and spawning in male *Ophiocaephalus striatus*. (Ham)

Hormones	Premature	Mature	Spawning
Dheas	0.001 µg/ml, (±0.17) *	0.2 µg/ml (±o.12)**	0.002 µg/ml (±0.11)*
Testosterone	0.11 ng/ml (±0.13)*	0.24 ng/ml (±0.34)**	0.04 ng/ml (±0.23)*
Estradiol	NA	0.004 pg/ml(±0.53)*	NA
Progesterone	NA	NA	NA
Coratisole	NA	NA	NA
Lutinizing Hormone (Lh)	NA	NA	NA
Folicle Stimulating Hormone(Fsh)	NA	NA	NA

* Significant ** moderate ***highly significant

NA indicates that there is no reactivity of tracers in serum so no hormone present.

Table: 39 Hormones detected and quantified during premature, mature and spawning in female *Channa gachua* (Ham)

Hormones	Premature	Mature	Spawning
Dheas	0.006 µg/ml (±0.68)*	0.2 µg/ml (±0.78)**	0.009 µg/ml (±6.75)*
Testosterone	NA	0.04 ng/ml (±0.69)*	NA
Estradiol	0.24 pg/ml (±0.68)*	2.4 pg/ml (±0.85)**	0.4 pg/ml (±0.60)*
Progesterone	3.01 ng/ml (±0.92)**	NA	2.01 ng/ml (±0.74)*
Cortisole	NA	NA	NA

Luteinizing Hormone	0.15 mIU/ml (±0.75)*	0.6 mIU/ml (±0.66)**	0.2 mIU/ml (±0.76)*
Folicle Stimulating Hormone	0.41 µg/ml (±0.64)*	32.7 µg/ml (±0.99)***	0.01 µg/ml (±0.68)*

* Significant ** moderate ***highly significant

NA indicates that there is no reactivity of tracers in serum so no hormone present.

5.6 Discussion

The advanced and sensitive chemolumnicence technology is useful to trace out minute quantity of biomolecules, i.e. antibody-antigen bonding which liberates photons and trapped by photodetecter and relative light unit (RLU) recorded in CLIA. The specific functions of FSH in fish are not yet clearly understood. In this study, we show that FSH increases the secretion rates of estradiol E_2 and testosterone 11-KT in females and males, respectively. This similar findings in other species; FSH and LH of salmon have been found to be equally present in stimulating estradiol E_2 secretion from the vitellogenic ovary of *amago* and *coho* salmon, but FSH was less potent in stimulating secretion of 17α, 20β, dihydroxy-4-pregnen-3–1 from post-vitellogenic oocytes Suzuki K. (1988); Swanson P. (1991).There is a growing body of evidence on the regulation and patterns of gonadotropin gene expression (reviewed by Yaron *et al*. (2001). Our understanding of the unique biological functions of the two gonadotropins in fish is still incomplete primarily because of a lack of purified hormones, particularly FSH. We demonstrate the production of a biologically active FSH and its use as a tool for revealing the biological relevance of FSH in *Ophiocaephalus stritus* in serum. In other study Methyltestosterone (MT) enhanced the chemiluminescence of potassium permanganate sodium thiosulphate system in sulphuric acid medium, and this was used as the basis of a novel flow-injection chemiluminescence method for the determination of methyltesterone. Xie *et al.,*. (2005)

FSH also increased estradiol E_2 levels in common carp. Atlantic *halibu*t Weltzien *et al.* (2003), and *Japanese eel* Wong *et al.* (2006). FSH has been reported to stimulate the incorporation of vitellogenin into the ovaries of rainbow trout, which is cooperated by the surge of FSH concomitant with the new generation of vitellogenic oocytes in trout and in tilapia Levavi *et al*., (2006).

5.7 Conclusion

Like other vertebrates, fishes also produce hormones and released in blood. Lutinizing (LH) hormone and follicular stimulating hormones (FSH) found at peak during mature period but progesterone and estradiol are vice-versa level in spawning. There was low level of progesterone as compared to estradiol in female fish. During study, testosterone which synthesized by gonad cell was detected along with progesterone precursors produced by follicular cell and estradiol in vice-versa level. The hormones are present significant quantity in matured fish.

In the fecundity studies, the average number of eggs obtained per female was 1,048 while the number of eggs in each mature ovary varied from 604 to 2 173. The result obtained in this study is lower than that observed by other workers for *S. galilaeus.* Adebisi (1987) obtained a fecundity of 1 452 for a female specimen with total length of 28.4cm. Fagade *et al.* (1984) reported a fecundity range of 598 and 3 960 for *S. galilaeus* whose body length ranged from 13.4cm and 24.1cm in IITA lake in Ibadan. Ben-Tuvia (1960) reported *Tilapia galilaea* whose body length was 32cm as having a fecundity of 1090.

In this study, fish specimens of the same length or weight had variable fecundities. Bagenal (1957) asserted that fish species exhibit wide fluctuations in fecundity among fish of the same species, size and age. Fagade *et al.* (1984) suggested that variation in fecundity may be due to differential abundance of food. The wide fluctuations observed in the fecundity of *S. galilaeus* from Opa reservoir may be attributed to differential feeding success within the members of the population.The occurrence of eggs of varying sizes is also an indication of multiple spawning by this species.

The total protein, total lipid and glycogen of male testis found increased at mature stage. In female ovary, the total protein, total lipid and glycogen found increased at mature stage compare to pre-mature and spent. Hormones level was found increased in mature stage in both male and female fishes. Like other vertebrates, fishes also produce hormones and released in blood. Lutinizing hormone and follicular stimulating hormones found at peak during mature period but progesterone and estradiol are vice-versa level in spawning, there was low level of progesterone as compared to estradiol in female fish.

During study, testosterone which synthesized by gonad cell was detected along with progesterone precursors produced by follicular cell and estradiol in vice-versa level. All hormones are present significant quantity in matured fish.

The slow migrating bands designated as *Cg*-1, has molecular weights 154.20 KDa and moderate migrating bands i.e. *Cg*-2, *Cg*-3, *Cg*-4, *Cg*-5, *Cg*-6, *Cg*-7, *Cg*-8, *Cg*-9 have molecular weights 71.61, 63.13, 58.61 56.70, 54.09, 45.29, 42.24 and 35.62 KDa respectively. The presence of moderately molecular weight proteins like of β-globulins, haptoglobins, transferrins and albumin like protein in *Channa punctata* blood serum were earlier reported by Riaz Ahmad *et al.* (2008). The results in the present study support these findings. Remaining two fast migrating bands i.e. Cg-10 and Cg-11 have low molecular weights i.e. 16.15 and 14.79 KDa respectively. The respective Rf values of all migrating bands was depicted in Table.1

The histological investigation of the changes of Sertoli cells during the male reproductive cycle in *Channa gachua* was made on ultrastructure. The results showed that the Sertoli cell development is closely related with germ cell maturation. During the development of testis sertoli cell proliferates and nurses to germ cell. Therefore, these cells may have some role in germ cell maturation during the reproductive cycle of this fish species, whether in forming a tissue framework for the developing spermatogenic cysts, aiding in testes reorganization for a new reproductive cycle. Leydi'g cell localization was found among semniferus tubules in male. In female Leydig's cells were observed instead of sertoli cell. In most teleost fish studied, testis growth and development coincide with increased plasma levels of 11-ketotestosterone (11-KT) and to a lesser extent, testosterone (T) Norberg *et al.*, (2001); Weltzien *et al.*, (2002).

The sex steroid levels in fish are also influenced by behavior, e.g., social modulation Oliveira *et al.*, (2002). The presence of cholesterol-positive lipids in Sertoli cell homologues seems be an insufficient criterion by which to identify them as steroid-producing cells Cruz *et al*, (1984). A histological and ultrastructural investigation of Sertoli cell development in the testes of *Channa gachua* was made for the purpose of contributing the clarification of the role of these cells in teleost fishes with a seasonal reproductive cycle. This species presents local ecological importance and, through artificial breeding, may prove to be significant economically for riverine people.

Estradiol controls female reproductive function in all classes of vertebrates and is responsible for vitellogenesis in oviparous species, it is not surprising that together with increased plasma estradiol, enhanced ovarian growth was noted in catfish. As estradiol increases plasma ovarian steroid level, the observed general increase in more mature fish (Nagayama, 1994).

In the present study, it can argue that the deviation of exponent from unity in this relationship probably could be attributed to the error incorporated during this sub-sampling method. It is less likely that, lower than unity exponent in this relationship is an outcome of selection. If we expect that the ovary grow in proportion to the body growth, isometry suggests that Wo should scale as cube of L (length) and as unity with W (weight). However, the found relationships are Wo = 0.5933×10 –6L2.931 (Figure 4c, r = 0.8818, $p < 0.001$, SEE 1.2240) and Wo = o.2969W 2.245 (Figure 4d, r = 0.8497, $p < 0.001$, SEE 0.2208). These relations further observed among the relationship between F, L and W by the equations F = 0.7324×10–8 L 2.767(Figure 4e, r = 0.511, $p < 0.001$, SEE 0.6023) and F = 0.3584 W 50.52 (Figure 4f, r = 0.698, $p < 0.001$, SEE 0.7234).

The non-isometric growth of ovary as compared to somatic tissues can have evolutionary significance. Our relationship concludes that the weight of ovary scales 1.400 times the weight of the body. That is, with increment of ovary unit in body weight and increase in ovary weight is drastic. This arrangement suggests that the fish devotes its entire abdominal space for the growing ovary. We suspect that; adaptation could be an outcome of maximization of fitness in terms of reproductive output, because with unit increment in the body weight the weight of ovary that is carried by the female increases by a factor 1.2., such adaptations will not give universal scaling exponent because each fish will differ in its reproductive cycle and r and K selection during respective seasons. The scaling exponent for relationship between F and L or F and W is variable in different fish species. Their inferences are based mainly on the relationship between metabolic rate and body mass and the factorial like geometry of the organisms (West *et al.* 1997). Along with other reports of deviation from allometric relationships that the positive correlation can show deviations from universal exponents (Peck *et al.* 2005),. Furthermore, Kozlowski and Konarzewski (2005) have criticized the single cause explanation a pluralistic approach to scaling, founded-on the life history theory, can explain the scaling relationships. Our findings supports Kozlowski and Konarzewski's (2005), claim by suggesting that the scaling exponent are subject to change from isometry depending on the reproductive cycle, r and K selection and the selection pressure on characters from the point of view of maximizing reproductive outcome. Positive correlation will be subject to selection especially if it is directly relevant for the reproductive efficiency of the organism. In our study, it is observed that isometric relationship, which could be fairly constant, between parameters, which are not directly relevant in the reproduction of the fish. In the case relationship between AL versus L and AL versus W we observed isometric relationship. Interestingly we observed a non-isometric exponent in the relationship between L and W.

In *Channa gachua* that migrates up-streams for the reproduction, maintaining the streamline structure is an essential and thus the non-isometric exponent could be an adaptation as described before. In case of other gonadal tissues that are associated with the reproductive behavior of the fish, observed a non-isometric exponents, which are also not universal in other fish species. The relationship between Wo and L that gives extraordinary high deviation from the cubic value clearly indicates that the gonadal tissues are subject for selection towards high reproductive efficiency. Furthermore, a relationship showed isometric exponent reproduction and related parameters could be between Wo and F suggests all parameters are under the same selection pressure.

The cystic arrangement of the trahira testis was similar to that found in most teleosts Billard (1986), Miura 1999, Grier *et. al.,* (2000) and its histology corresponded to the description given by Marques *et. al,.* (2000). The seminiferous tubule arrangement is of the anastomosing lobular type Parenti *et. al.,* (2004) in which the germinal compartment does not end in the testis periphery but forms highly branched loops or tubules. The number of germinal cells supported by the Sertoli cell is a good indication of the functional efficiency of this somatic cell Matta *et al.,* (2002). The ratio spermatids.Sertoli cells in the trahira of the present work was very similar to that of the teleost, Nile tilapia *Oreochromisniloticus* Matta *et al.*, (2002). Our findings corroborated the statement that the teleost cystic arrangement is more efficient than that of mammals in which the Sertoli cells are dispersed in the seminiferous epithelium Matta *et al.* (2002); Vilela *et al.* 2003). In the Nile tilapia, approximately 2.5 spermatids are formed from each primary spermatocyte, which represents less than 40% of cell lossMatta *et al.* (2002). In trahira, cell loss reached a higher value being slightly above 50%. In mammals, apoptosis of germinal cells is part of the physiological spermatogenesis activity, occurring spontaneously in several stages of cell development Roosenrunge (1977).

In the guppy, a species of internal fertilization, 14 spermatogonial divisions are necessary to produce primary spermatocytes Billard (1986). Concerning primary spermatocytes, approximately 50% of the trahira cysts contained a number of cells derived from, at least, eight mitotic divisions; in the remaining cysts such numbers were either nine or ten. It is still not clear whether the number of mitotic divisions is environment-con-trolled and/or an inherent property of stem-spermatogonia Miura (1999). Determination of the spermatogenic efficiency in different groups of fish would be valuable to better understand their reproductive strategies and related ecological issues. It plays an important role in homeostasis during the spermatogenic process leading to spermatic production characteristics of different animal groups Franca *et.al.,* (1998); Chaves *et. al*., (2005).The occurrence of apoptosis in primary spermatocyte cysts of the trahira raises the question, not addressed in this paper, of its role the spermatogenic process of this teleost. Knowledge of the number of spermatogonial generations is essential to better understand the regulatory mechanisms of spermatogenesis De Rooji *et.at.,* (2000). In mammals, from two to six mitotic divisions are necessary to produce primary spermatocytes Franca *et.al.,* (1998). Studies of teleosts with external fertilization indicate that the process takes five to ten generations of spermatogonia to produce primary spermatocytes Miura *et al.* (1991);Miura (1999), , Ando *et al.* (2000), Matta *et. al*, (2002); Sasso *et al*. (2006).

Testis of freshwater fish, *Channa gachua,* Showed development of testis and ovary **(**Plate no. II-VII**)** but testes is difficult to categorize into stages because maturation of sperm tissue does not occur in distinct steps, but as a gradual change in the relative proportion of spermatocytes, spermatids and spermatozoa. There can also be considerable variation in the appearance of the sperm tissue for each staging category.

For instance, in some ripe testes the tissue was dominated by late stage sperm in the peripheral sperm sinuses and outer regions of the gonad, while, in others the late stage sperm dominated the inner regions and central sperm sinus. Staging of testes is therefore more prone to error than is the staging of ovaries, the immature and immature developing stages has lowest reproductive status. A developing stage is not recognized in males because there is no clear demarcation in the transition from the mature resting to the mature ripe stage. For similar reasons, a spent stage is not recognized. The ripe stage is the background state of the testis during the reproductive period, with peaks in reproductive status during spawning however, the testis holds no evidence to identify whether a particular male is just about to or has recently spawned only that it is in the process of doing so. Although the lobule boundary cells, according to Marshall & Lofts (1956), often occur in testes of fishes not having typical interstitial cells (Leydig cells), ultrastructural observations clearly indicate that there are some species whose testes appear to have both interstitial and lobule boundary cells Guraya, (1976); Nakagama *et al.*, (1982). These cells seem to participate as well as in spermatozoa phagocytosis, mainly during the regression stage of testis development, but while this process is sometimes mentioned, its details have not yet been presented Mattei *et al.*, (1993); Romagosa *et al.*, (2000); Weltzien *et al.*, (2002).Entire Semniferus tibule with sertoli cell and germ cells (Fig. no.42), developing Srtoli cells was seen in semniferus tibule (Fig. 43.), semniferus tibule with numerus spermatocytes was seen in maturing stage of male testis (Fig. 44), (Fig. 45) Shows developing Srtoli cells in mature stage. Developing Srtoli cells and Ledig's cells in mature stage of male *Channa gachua* was obsedved (Fig. 46). Developed Srtoli cells and ledig's cells in mature stage of male *Channa gachua* were also observed (Fig. 47).

The term "lobule boundary cells" was first introduced by Marshall *et al* (1956), followed by O'Halloran *et al*, (1970), who considered these cells homologous with the mammalian Leydig cells. However, the lobule boundary cells seem to be more accurately homologous to Sertoli cells, since they are separated from the interlobular space by a basal lamina Billard *et al*, (1982); Grier, (1975); Grier *et al*, (1977); Mattei *et al*, (1982), 1993; Nakagama,(1983); Nicholls *et al*, (1972) and, as in mammals, present follicle-stimulating hormone (FSH) receptors Schulz *et* *al.*, (2001); Weltzien *et al.*, (2002). The function of Sertoli cells in fish is not well established, but the ultrastructural morphology demonstrates the presence of spherical mitochondria with parallel crystae and lipid deposits in the cytoplasm Billard *et al.*, (1972); Cruz *et al*, 1984; Grier, 1975; Mattei *et al.*, (1982), which are characteristics of steroid-producing cells, suggesting a possible role in steroid synthesis, or at least locations where these hormones are stocked Grier & Linton, (1977); Cruz-Höfling *et al*, (1984); Mattei *et al.*, (1982). However, knowledge about endocrine control of spermatogenesis in teleost fish has mostly been drawn from measurements of hormone levels in the peripheral blood, injection of pituitary extracts, gonadotropins, and steroids into either intact or hypophysectomized specimens Billard *et al.*, (1972); Fostier *et al*, (1983); Schulz*et al.*, (2001); Weltzien *et al.*, 2002), in such a way the exactly local of control of the hormone-producing is unknown.

In most teleost fishes studied, testis growth coincides with increase in plasma levels of 11-ketotestosterone (11-KT) and to a lesser extent, testosterone (T) Norberg *et al.*, (2001) and Weltzien *et al.*, (2002). The sex steroid levels in fish are also influenced by behavior, e.g., social modulation Oliveira *et al.*, (2002).

The presence of cholesterol-(positive lipids) in Sertoli cell homologues seems be an insufficient criterion to identify it as steroid-producing cells Cruz *et al*, (1984). A histological and ultrastructural investigation of Sertoli cell development in the testes of *Channa gachua* was made for the purpose to clarify the role of these cells in teleost fishes with a seasonal reproductive cycle.

In higher vertebrates, survival and development of germ cell critically depend on the Sertoli cells in the vertebrate testis. Fish is different from mammals as they show a cystic type of spermatogenesis were a single germ cell clone is enclosed by and accompanied through the different stages of spermatogenesis with group of Sertoli cells (plate V-VII). Sertoli cell proliferation in *C.gachua* occurs primarily during spermatogonial proliferation, allowing the cyst-forming Sertoli cells to provide space to growing germ cell clone. In this regard, dramatic increase in cyst volume and number of germ cells per cyst, in *Channa gachua,* was strikingly increased from primary spermatogonia to spermatocyte cysts. In *Channa gachua,* Sertoli cell proliferation is strongly reduced when germ cells have proceeded into meiosis, and stops in postmeiotic cysts. Hence it can be said that, Sertoli cell proliferation is primary factor helps in spermatogesis. Even though, it requires focusing more on molecular level and specific functioning of different gonadal cell for more confine study in fish gonad and their reproduction.

Chapter 6

Summary and Conclusion

Like other vertebrates, fishes also produce hormones and released in blood. Lutinizing (LH) hormone and follicular stimulating hormones (FSH) found at peak during mature period but progesterone and estradiol are vice-versa level in spawning. There was low level of progesterone as compared to estradiol in female fish. During study, testosterone which synthesized by gonad cell was detected along with progesterone precursors produced by follicular cell and estradiol in vice-versa level. The hormones are present significant quantity in matured fish.

In the fecundity studies, the average number of eggs obtained per female was 1,048 while the number of eggs in each mature ovary varied from 604 to 2 173. The result obtained in this study is lower than that observed by other workers for *S. galilaeus.* Adebisi (1987) obtained a fecundity of 1 452 for a female specimen with total length of 28.4cm. Fagade *et al.* (1984) reported a fecundity range of 598 and 3 960 for *S. galilaeus* whose body length ranged from 13.4cm and 24.1cm in IITA lake in Ibadan. Ben-Tuvia (1960) reported *Tilapia galilaea* whose body length was 32cm as having a fecundity of 1090.

In this study, fish specimens of the same length or weight had variable fecundities. Bagenal (1957) asserted that fish species exhibit wide fluctuations in fecundity among fish of the same species, size and age. Fagade *et al.* (1984) suggested that variation in fecundity may be due to differential abundance of food. The wide fluctuations observed in the fecundity of *S. galilaeus* from Opa reservoir may be attributed to differential feeding success within the members of the population. The occurrence of eggs of varying sizes is also an indication of multiple spawning by this species.

The total protein, total lipid and glycogen of male testis found increased at mature stage. In female ovary, the total protein, total lipid and glycogen found increased at mature stage compare to pre-mature and spent. Hormones level was found increased in mature stage in both male and female fishes. Like other vertebrates, fishes also produce hormones and released in blood. Lutinizing hormone and follicular stimulating hormones found at peak during mature period but progesterone and estradiol are vice-versa level in spawning, there was low level of progesterone as compared to estradiol in female fish.

During study, testosterone which synthesized by gonad cell was detected along with progesterone precursors produced by follicular cell and estradiol in vice-versa level. All hormones are present significant quantity in matured fish.

The slow migrating bands designated as *Cg*-1, has molecular weights 154.20 KDa and moderate migrating bands i.e. *Cg*-2, *Cg*-3, *Cg*-4, *Cg*-5, *Cg*-6, *Cg*-7, *Cg*-8, *Cg*-9 have molecular weights 71.61, 63.13, 58.61 56.70, 54.09, 45.29, 42.24 and 35.62 KDa respectively. The presence of moderately molecular weight proteins like of β-globulins, haptoglobins, transferrins and albumin like protein in *Channa punctata* blood serum were earlier reported by Riaz Ahmad *et al.* (2008). The results in the present study support these findings. Remaining two fast migrating bands i.e. Cg-10 and Cg-11 have low molecular weights i.e. 16.15 and 14.79 KDa respectively. The respective Rf values of all migrating bands was depicted in Table.1

The histological investigation of the changes of Sertoli cells during the male reproductive cycle in *Channa gachua* was made on ultrastructure. The results showed that the Sertoli cell development is closely related with germ cell maturation. During the development of testis sertoli cell proliferates and nurses to germ cell. Therefore, these cells may have some role in germ cell maturation during the reproductive cycle of this fish species, whether in forming a tissue framework for the developing spermatogenic cysts, aiding in testes reorganization for a new reproductive cycle. Leydi'g cell localization was found among semniferus tubules in male. In female Leydig's cells were observed instead of sertoli cell. In most teleost fish studied, testis growth and development coincide with increased plasma levels of 11-ketotestosterone (11-KT) and to a lesser extent, testosterone (T) Norberg *et al.*, (2001); Weltzien *et al.*, (2002).

The sex steroid levels in fish are also influenced by behavior, e.g., social modulation Oliveira *et al.*, (2002). The presence of cholesterol-positive lipids in Sertoli cell homologues seems be an insufficient criterion by which to identify them as steroid-producing cells Cruz *et al*, (1984). A histological and ultrastructural investigation of Sertoli cell development in the testes of *Channa gachua* was made for the purpose of contributing the clarification of the role of these cells in teleost fishes with a seasonal reproductive cycle. This species presents local ecological importance and, through artificial breeding, may prove to be significant economically for riverine people.

Estradiol controls female reproductive function in all classes of vertebrates and is responsible for vitellogenesis in oviparous species, it is not surprising that together with increased plasma estradiol, enhanced ovarian growth was noted in catfish. As estradiol increases plasma ovarian steroid level, the observed general increase in more mature fish (Nagayama, 1994).

In the present study, it can argue that the deviation of exponent from unity in this relationship probably could be attributed to the error incorporated during this sub-sampling method. It is less likely that, lower than unity exponent in this relationship is an outcome of selection. If we expect that the ovary grow in proportion to the body growth, isometry suggests that Wo should scale as cube of L (length) and as unity with W (weight).

In study, it is observed that isometric relationship, which could be fairly constant, between parameters, which are not directly relevant in the reproduction of the fish. Interestingly we observed a non-isometric and isometric exponent in the relationship between L and W. In *Channa gachua* that migrate up-streams for the reproduction, maintaining the streamline structure is an essential and thus the non-isometric exponent could be an adaptation as described before. In case of other gonadal tissues that are associated with the reproductive behavior of the fish, observed a non-isometric exponents, which are also not universal in other fish species. The relationship between Wo and L that gives extraordinary high deviation from the cubic value clearly indicates that the gonadal tissues are subject for selection towards high reproductive efficiency. Furthermore, a relationship showed isometric exponent reproduction and related parameters could be between Wo and F suggests all parameters are under the same selection pressure.

In the present investigation, an attempt has been made to correlate the developmental changes in supporting cells of gonads with the maturity.

Changes concomitant with the gonad maturity and correspond to different maturity stages. Spawning is the process of emission of gametes (eggs and milt) from the body of fishes to exterior where the process of fertilization takes place. Determination of spawning potential in the lifespan, spawning season in the year and frequency of in the season of a fish is essential to assess the reproductive ability of population of the fishes. Spawning is confined to short spells of time (late summer) in most of the fishes inhabiting temperate waters with accurate level of temperature. Where as in tropical and sub-tropical waters with relatively minor temperature fluctuations, the spawning period is usually prolonged, extending almost throughout the year, but of course with one or two peaks of profuse spawning. Physical and chemical parameters, quality of water, external environment and internal biological conditions, such as feeding and growth in addition to migration, influences spawning in fishes. Breeding biology of a number of fresh water fishes, estuarine and marine have been reported through literature. Moreover, establishment of extensive databases on reproductive parameters with corresponding on abiotic factors enables the study of causal relationships between reproductive potential and environmental variables. This leads to better understanding reproductive output and enhances ability to estimate ovarian recruitment Kraus *et al,* (2002).There is essential role of gonadal cells to nourish and develop the gonads of the fish.

The Italian scientist, Enrico Sertoli, first described the cells that bear his name in 1865 and with primitive morphological evidence alone he proclaimed that these large branched cells were “linked to the production of spermatozoa.” Since 1865, the “cells of Sertoli” have provoked the curiosity and interest of reproductive scientists and have stimulated efforts to elaborate on the original proclamation by Sertoli. The National Library of Medicine (Medline) database reveals that in 1970 there were about 60 scientific reports that included the term “Sertoli” in the subject. Since 1970 the annual number has doubled every decade to where the first few years of the new millennium saw 500 to 700 Sertoli-related publications per year. The early studies on Sertoli cells focused on increasingly sophisticated structural observations but in the 1970s the techniques for culture of primary Sertoli cells from rats were developed and perfectedin the laboratories of Anna. The ability to maintain relatively pure preparations of primary Sertoli cells in culture was the advancement that led to subsequent molecular and genetic studies on endocrine response and gene expression. Most of these earlier functional studies on cultured

Sertoli cells were dedicated to the mechanisms by which Sertoli cells support germ cells and spermatogenesis. These studies revealed a number of the gene products made and secreted by Sertoli cells and speculated on the implications. In addition, many studies focused on the response of Sertoli cells to follicle-stimulating hormone (FSH), testosterone or other growth factors. The molecular and genetic glimpse we have received into the function of Sertoli cells has made it very clear that they have a dual role in male reproduction. The original assertion of Enrico Sertoli that Sertoli cells are "linked to the production of spermatozoa" has been confirmed.

As in other species of fishes, the Sertoli cell ultrastructure contains in the cytoplasm many lipid droplets and spherical mitochondria with parallel crystae. This morphology has led some authors to propose a possible role of these cells in steroid synthesis, or to suggest that they may be the storage place of these hormones, since the synthetic machinery of the cells does not appear to be very active . Nevertheless, at least in this study, there was no evidence of exogenous substance uptake. The possibility that Sertoli cells accumulate non-hormonal lipids, as energy sources for the germ cell consumption during maturation, has not been raised here. But this could be the case. If so, these cells could have a role homologous to that of adipose tissue in mobilizing triglycerides. Whatever the function of the Sertoli cells, the present morphological data show a close relationship between these cells and the spermatogenesis cycles. In some species of fish, spermiogenesis, orpart of the process, occurs outside the cysts, but in *Ophidion* sp., the mature germ cells complete spermiogenesis individually, and are not linked through cytoplasm bridges to the testes lumen Mattei *et al.*, (1993). According to this author, this semi-cystic type of spermatogenesis has also been observed in *Neoceratis spinifer*, *Lepadogaster lepadogaster*, and various species of Blenniidae. In *P. mesopotamicus*, spermatogenesis is of the cystic type, since it occurs entirely within the cysts. The Sertoli cells are closely relation with germ cell maturation, since they are more developed when the testes are in maximum spermiogenic activity, or Stage II. In that phase, these cells enclose the already developing cysts and also fill the spaces among them, thus giving rise to the framework tissue that sustains them in the seminiferous tubule. When the testes have developed completely and are filled with mature spermatozoa, the Sertoli cells begin their reabsorption activity, which is more evident in the regression phase. This phagocytosis or reabsorptive activity of spermatozoa, and even of earlier maturing phases of germ cells, by the Sertoli cells is very poorly studied in fishes, but it has already been briefly described for some species or at least mentioned (Mattei *et al.*, 1993; Romagosa *et al.*, 2000; Weltzien *et al.*, 2002). Nakaghi *et al.* (2003) reported that the Sertoli cells of *Colossoma macropomum* (tambaqui) were found at the periphery of the cysts of germinative lineage cells and the nuclei were shown to be smaller as these cells develop, bigger in the resting period, and smaller and flat in the Maturation period due to the lipids droplets that fill the Sertoli cell cytoplasm.

In female ovary shows follicles with different zones, the zona pellucida of the oocytes of teleosts is a complex structure, generally consisting of two layers crossed by pores or canals containing oocyte microvilli and follicular cell processes Guraya (1996).In other teleosts the zona pellucida of Bryconops begins to be formed in the previtelogenic oocyte, with its outer layer being formed through electron-dense material deposition between microvilli of the oocyte and/or follicular cells Anderson, (1967); Abraham *et al*., (1984); Rizzo (1991); Cruz *at al.,* 1993). In the present study, histological analysis showed that follicular cells were first pavimentous, then cubic, and finally became prismatic at the end of oogenesis. Ultrastructural analysis revealed that electron-dense globules associated to the zona pellucida were responsible for the change in shape observed at light microscopy. The origin of the zona pellucida of teleosts is still a controversial issue, yet it is postulated that the oocyte, follicularcells and hepatic cells may play a role in the formation of this structure Oppen-Berntsen *et al*., (1992) and that the specializations associated to it may originate from follicular cells Guraya, (1996). Protuberances of several sizes and shapes, such as called here, globose specializations, attached to the zona pellucida, occur in different groups of teleosts, probably as a result of egg adherence to different substrata Riehl *at. al.,*(1998). In higher vertebrates, survival and development of germ cell critically depend on the Sertoli cells in the vertebrate testis. Fish is different from mammals as they show a cystic type of spermatogenesis were a single germ cell clone is enclosed by and accompanied through the different stages of spermatogenesis with group of Sertoli cells (plate IV-VIII). Sertoli cell proliferation in *C.gachua* occurs primarily during spermatogonial proliferation, allowing the cyst-forming Sertoli cells to provide space to growing germ cell clone. In this regard, dramatic increase in cyst volume and number of germ cells per cyst, in *Channa gachua*, was strikingly increased from primary spermatogonia to spermatocyte cysts. In

Channa gachua, Sertoli cell proliferation is strongly reduced when germ cells have proceeded into meiosis, and stops in postmeiotic cysts. Hence it can be said that, Sertoli cell proliferation is primary factor helps in spermatogesis.

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About the Author

Dr. Milind Vitthal Gaikwad, UGC- Rajiv Gandhi National Scheme Senior Research Fellow,UGC-(RGNS) and completed B.Sc. Degree in Ist Divission from Pandit Javaharlal Nehru College Parli Vaijnath Under Dr. Babasaheb Ambedkar Marathwada Unniverity Aurangabad,2005 and M.Sc., Zoology in Ist Divission from Department of Zoology, Dr. Babasaheb Ambedkar Marathwada Unniverity Aurangabad,2007.He has presented papers during many national level conferences. He has actively participated in many national and international conferences across India. He has delivered invited talk also during 98th Indian Science Congress SRM University, Near Madras on the behalf of Aurangabad chapter. Presently he has been working as Assistant Professor, Head of Department, Department of Zoology, Late Ku. Durga K. Banmeru Science College Lonar,Tq. Lonar, Dist. Buldhana, Maharashtra, where there the world famous high velocity impact created Lonar Crater "The Knowledge House for researchers" is just 1 km nearer to Institute.

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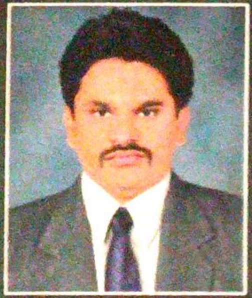

Name : Mr. Balasaheb Uddhavrao Kale.
Qualification : M.Sc. Chemistry, NET-JRF, GATE.
Designation : Assistant Professor, Department of Chemistry, Shri Vyankatesh Arts, Commerce & Science College, Deulgaon Raja, Dist.Buldana.
Teaching Experience : 04 Years.
Area of Specialization : Organic Chemistry.
Research Publications : Published research papers in various international journals.

Name : Mr. Suryakant Bhanudas Borul.
Qualification : M.Sc. Chemistry, M.Phil.
Designation : Head & Assistant Professor, Department of Chemistry, Late Ku.Durga K. Banmeru Science College, Lonar, Dist.Buldana.
Teaching Experience : 09 Years.
Area of Specialization : Organic Chemistry.
Research Publications : Published research papers in various international journals.

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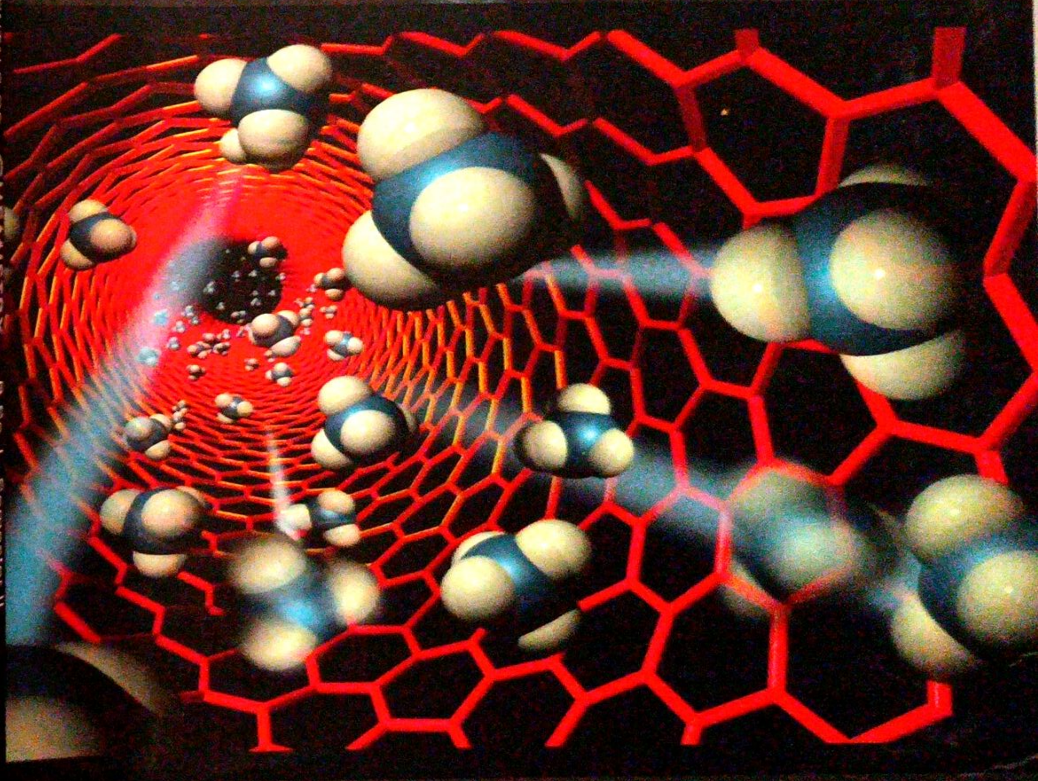

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Mr. Balasaheb U. Kale
Assistant Professor
Department of Chemistry,
Shri Vyankatesh Arts, Commerce & Science College,
Deulgaon Raja, Dist.Buldana

Mr. Suryakant B. Borul
Assistant Professor & Head
Department of Chemistry,
Late Ku.Durga K. Banmeru Science College,
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Contents

Contributors' List

1- **E.Sharada, K.Y.Karuna and Dr.Veerabathini Manohar**

Lecturer in Chemistry,

Government Degree and P.G College, Siddipet (Autonomous),Telangana-502103

2- **Mr. Sharique S. Shaikh**

Head and Assistant Professor

Department of Physics

Late Ku. Durga K. Banmeru Science College, Lonar , Dist. Buldana

M.S – 443302

3- **Dr.Suresh Namdeo Gawai**

(M.Com.,M.Phil., Ph.D.)

ShriShivaji Science and Arts College, Chikhli

4- **Jayshree**

p. more Gilani science college Ghatangi

5 **Dr. Mahvish Anjum**

Assistant Professor

Department of Geography

Prof. Rajendra Singh (Rajju Bhaiya) University, Prayagraj

6- **Dr. Prakash Sannakkanavar**

Assistant Professor and Research Guide

Department of Studies in Education

Karnataka State Akkamahadevi Women's University

Jnanashakti Campus, Torvi, VIJAYAPURA-586108

7- **Balram Singh***

Assistant Professor,Maharana Pratap Govt. P.G. College, Hardoi

8- Bodising Narah

Assistant Professor, Department of Education

Purbanchal College, Silapathar, Assam (India)

Publisher

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Chapter-2

Gender Equality: Issues And Challenges

Mr. sharique S. Shaikh

Head and Assistant Professor

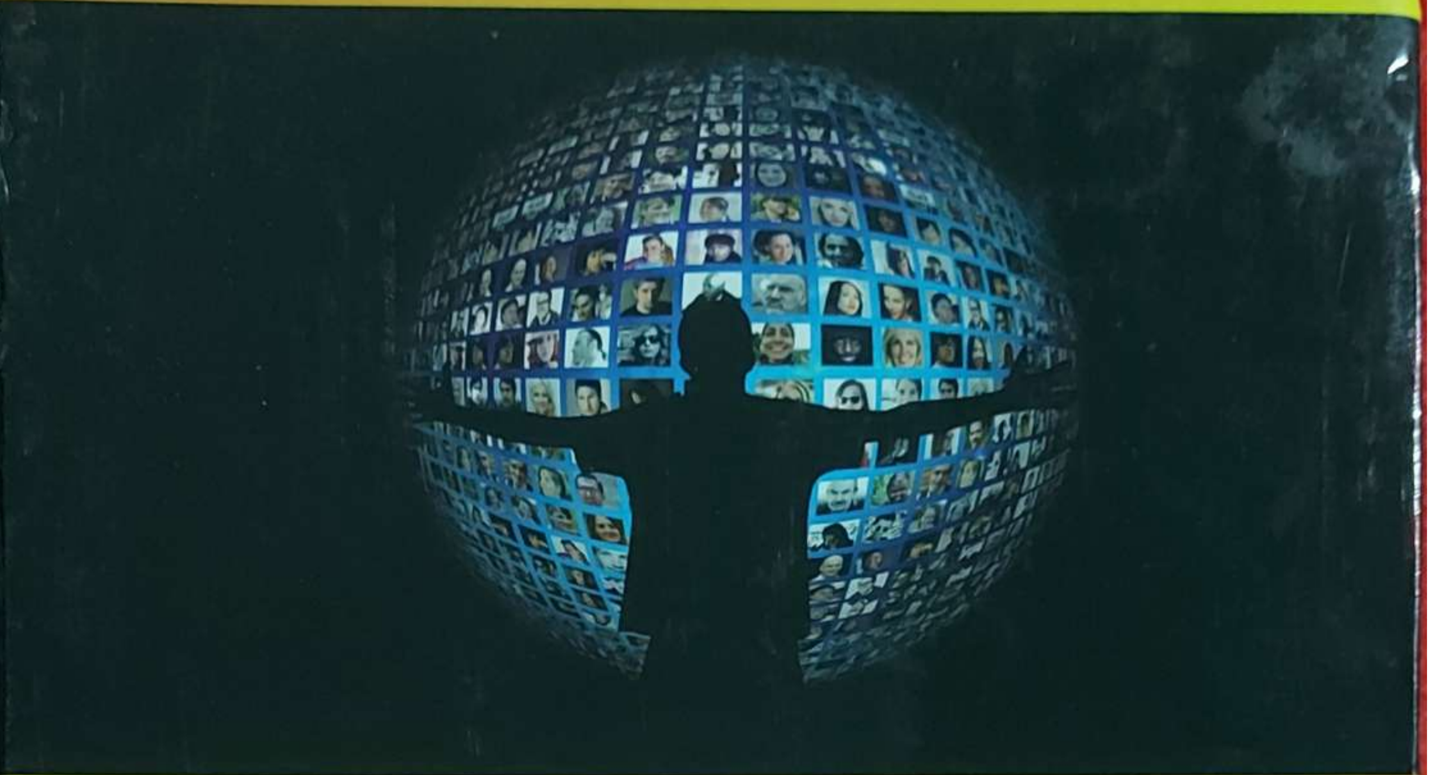
Department of Physics

Late Ku. Durga K. Banmeru Science College, Lonar ,
Dist,Buldana M.S – 443302

History :- Gender equality, also known as sexual equality or equality of the sexes, is the state of equal ease of access to resources and opportunities regardless of gender, including economic participation and decision-making; and the state of valuing different behaviors, aspirations and needs equally, regardless of gender.

Gender equality is the goal, while gender neutrality and gender equity are practices and ways of thinking that help in achieving the goal. Gender parity, which is used to measure gender balance in a given situation, can aid in achieving gender equality but is not the goal in and of itself. Gender equality is more than equal representation; it is strongly tied to women's rights, and often requires policy changes. As of 2017, the global movement for gender equality has not incorporated the proposition of genders besides women and men, or gender identities outside of the gender binary.

UNICEF says gender equality "means that women and men, and girls and boys, enjoy the same rights, resources, opportunities and protections. It does not require that girls and boys, or women and men, be the same, or that they be treated exactly alike



Environmental Social Issues Problems and Continuous Development

Dr. Dilip Barsagade

Dr. A. Venkatesan working as an Assistant Professor in the Department of Physics Annai College of Arts and Science has about 7 years of teaching experience in UG and PG level. He received his B.Sc degree in Physics with first-class from Government Arts College, Dharmapuri and M.Sc degree in Physics with first-class from Annamalai University, Chidambaram. He received Ph.D. degree in Physics from Annamalai University, Chidambaram, Tamil Nadu. He has published more than 15 research papers in reputed journals and more than 30 research papers in the proceedings of various national and international conferences. He has published book "Engineering Physics-III" in Scientific International Publishing House. He has actively presented as oral paper at various national and international conferences and workshops. His areas of research include Nanoscience and Spectroscopy. He is an active member in Physics of ACAS.

Mr. B. Sreenivas working as an Assistant Professor in the Department of Physics, Kakatiya Government College, Hanamkonda, has about 09 years of teaching experience. He received his M.Sc degree in Physics with first class from Kakatiya University, Warangal. He is pursuing Ph.D degree in Osmania University, Hyderabad, Telangana state. He has published 5 research papers in refereed international journals. His areas of research include nano materials and glasses. He is a life member of IAPT.

Dr. N. Srinivasan Arunsankar is working as an Associate Professor in the Department of Physics, Sri Sai Ram Engineering College, Chennai, Tamilnadu. He received his Ph.D. degree from Anna University in the field of Nanotechnology. He has possessed 18.8 years of teaching experience and 10 years of research experience. He is an active member of ISTE, IPA, and IEEE society. He presented his research work in various National/International Conferences. He has received the best paper presentation award two times in the International Conference. He has published 9 research articles in reputed journals. His area of research is Crystal growth, Nanomaterials, Nanocomposites and their Environmental applications.

Dr. Sharique S. Shaikh is working as an Assistant Professor in the Department of Physics, Late Ku. Durga K. Banmeru Science College, Lonar, Dist. Buldana, Maharashtra, India, has 13 years of Teaching experience. He received his M.Sc. Degree in Physical science from Dr. Babasaheb Ambedkar Marathwada University, Aurangabad. He received Ph. D degree in Physical Science from Kalinga University, Raipur, (C.G), He has published 05 research papers in refereed international and National journals. He has received Multi-Talented Teacher Avishkar Achievers Award -2022 form Avishkar Foundation. His area of research includes Nanotechnology and Bio-Physics. He is an Active Member of AUPTA, Amravati University, He also working as IQAC and NAAC coordinator in his Institute.

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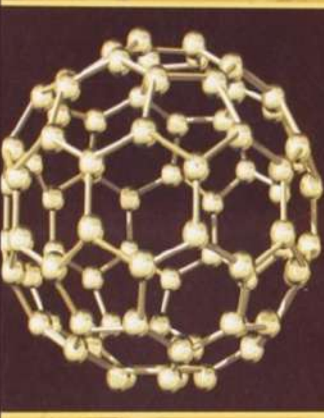

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This book entitled Fundamental of Solid Waste Management is designed as a basic book for the undergraduate and postgraduate level courses in the field of Science, Engineering and Technology. The feature of the book is that it is written with highly interdisciplinary approach to enrich the knowledge of the students of various courses such as Environmental studies, Environmental Science, Chemistry, Environmental chemistry, Environmental Engineering of UG and PG. This books also very much useful researcher for in environmental projects, research. This book divides into five chapters included introduction, definition, classification, factor affecting, generation sources of wastes, composition, physical, chemical, biological characteristics, impact of solid waste on human health, on birds, animals and environment, collection, storage, transportation, and solid waste treatment and disposal techniques. The rapid industrial & developmental activities, improving standard of living and economic status of family, population explosion etc has resulted in generation of huge volume of solid waste.

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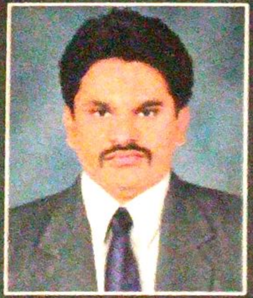
About Authors



Name : Mr. Balasaheb Uddhavrao Kale.
Qualification : M.Sc. Chemistry, NET-JRF, GATE.
Designation : Assistant Professor, Department of Chemistry, Shri Vyankatesh Arts, Commerce & Science College, Deulgaon Raja, Dist.Buldana.

Teaching Experience : 04 Years.
Area of Specialization : Organic Chemistry.
Research Publications : Published research papers in various international journals.

Name : Mr. Suryakant Bhanudas Borul.
Qualification : M.Sc. Chemistry, M.Phil.
Designation : Head & Assistant Professor, Department of Chemistry, Late Ku.Durga K. Banmeru Science College, Lonar, Dist.Buldana.

Teaching Experience : 09 Years.
Area of Specialization : Organic Chemistry.
Research Publications : Published research papers in various international journals.

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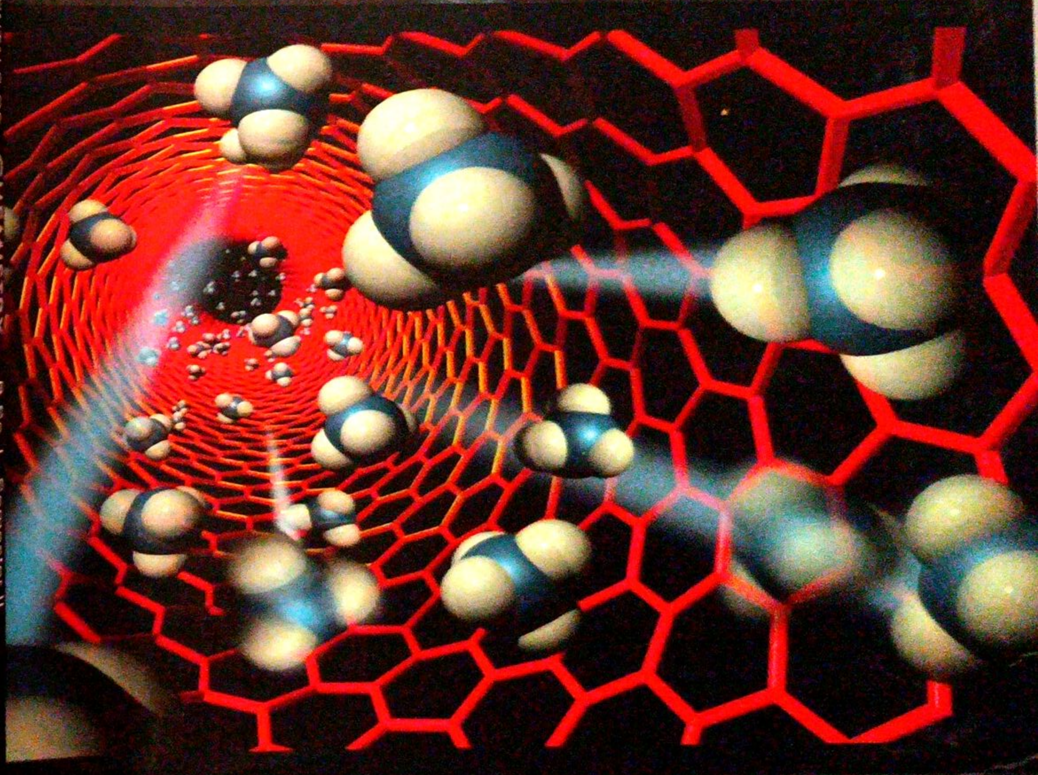

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- AUTHORS -

Mr. Balasaheb U. Kale
Assistant Professor
Department of Chemistry,
Shri Vyankatesh Arts, Commerce & Science College,
Deulgaon Raja, Dist.Buldana

Mr. Suryakant B. Borul
Assistant Professor & Head
Department of Chemistry,
Late Ku.Durga K. Banmeru Science College,
Lonar, Dist.Buldana.

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