Due to its considerable applied importance to mankind and to biologists for interesting research, biology of fish is a subject of relevance to a wide audience as suggested by Chonder (1999); Keivany and Soofiani (2004). As fish sustain in an watery habitat, they are constantly being exposed to a vast diversity of ever fluctuating and interacting physicochemical parameters. Fish culture has come forth as a developing industry worldwide. Recently the problems of contagious disease which affect nutritionally as well as economically are being faced by this industry (Aasjord and Slinde, 1994; Sugita et al., 2002). Moreover, the bulk of fish farm production with over 18 lakh ton is contributed by Indian major carps (FAO, 2003). The two factors of primary importance for successful pond cultural operations are maintenance of a fit aquatic surrounding and yielding of adequate life forms as fish food in ponds. The physicochemical parameters of inland waters related to mortality of fish and aquaculture investigation, has been studied by a number of workers like Alikiunhi and Rao (1948), Chacko and Srinivasan (1954), Thivy et al.(1948), Ganapati (1949), Ganapati and Chacko (1951).

## WATER QUALITY PARAMETER

Water sustains life of a human being directly or not directly and is intimately associated with him. Day by day, fresh water is going to be an inadequate resource and its quality has created a serious national concern. A great focus has been laid by MAB of UNESCO on the studies of impact of various human activities on water and other resources (Sharma et al., 1978). A necessity of superior water quality to retain the feasible aquaculture yield is well accepted in the ever-increasing aquaculture business (King, 1998). When water contains pollutants that can harm development, growth, reproduction or even cause mortality to the cultured species and the production gets reduced (Stone and Thormforde, 2003). Numerous of ecological parameters and administrative practices influence the growth and survival, both of which jointly determine the ultimate yield (Boyd and Tucker, 1998). The chemical, physical and biological traits of water mostly influence the best possible fish yield. Various physicochemical and biological factors like temperature, carbon dioxide, pH, nitrate, BOD and plankton quantity etc. to establish the grade of water. They may directly or not directly have an effect on its worth and accordingly its appropriateness for the allocation and yield of fish and other water animals (Moses, 1983 and Singh, 2017).

Reciprocal relationship of various physicochemical components like pH, alkalinity and hardness can affect water quality of fish pond. In general, it has been generally observed that a number of physical, abiotic and biotic factors have an effect on the body composition (Pradhan et al., 2012). The study of water quality of fish ponds has also been carried out to explain the factors responsible for the phenomenal growth of fish in a pond (Ganapati and Chacko 1951). Ponds from Uttar Pradesh have been analyzed by Upadhya (1964) and; the range and average for individual water quality for ponds has been given with high, average and poor productivity. Alteration in physicochemical parameters undergoes interrupting the aquatic life in pond. The surrounding water temperature easily influences fish as they are cold blooded animals and shows its effect on the body temperature, growth rate, food consumption and other metabolic function The temperature of surrounding water often affects the same of body of fish. Seasonal and environmental changes affect the immunity of vertebrate through neuroendocnrine system (Zapta and Cooper, 1990; Kime, 1998). The fish health is often affected by breeding period (Kestemont et al., 1999). Studies of Kortet et al. (2003) on seasonal change in factors related to immunology and physiology in the cyprinid, *Rutilus rutilus* throughout year revealed that the female had lower values than male.

The rich sources of inland water reservoirs of India contribute more than 30% of overall fish yield. Several fisheries biologists like Day (1878), Mishra (1959), Talwar and Jhingran (1991), Jayaram (2002) and Dwivedi and Pandey (2002) have carried out considerable studies on fish diversity from different fresh water bodies of India during past some decades.

**Weather Condition**

The situation of the atmosphere that describes the grade of hotness or coldness, wetness or dryness, clearness or cloudiness and calmness or storminess etc. is termed as weather condition. Indian weather is composed of three different seasons: winter, summer, and the rainy (Cook, 2009).

The diffusion rate of atmospheric oxygen decreases due to the high temperature of aquatic body, resulting in DO content and depletion of water (Idvis et al., 2003; Odhiambo, 2013). Investigations of Hossain et al. (2014) on mirror carp ( *Cyprinus carpio* var. *specularis*)in the culture ponds of Banbelgharia, Natore district, Bangladesh reveals that rate of growth of mirror carp and cultured carps of freshwater variety decreases during the low water temperature period.

**Water Temperature**

Temperature is defined as the degree of hotness or coldness in the body of a living organism either in water or on land (Lucinda and Martin, 1999). According to the temperature tolerance limits of body of the fish, they are recognized as cold water, cool water, warm water and tropical. Fish is a poikilothermal animal, thus its metabolic rate doubles for every rise of 10ºC. Boyd (1990) reported that 0.2ºC/minute can be tolerated by fish. Temperature controls the solubility of gases in water, and the reaction rate of chemicals, the toxicity of ammonia and chemotherapeutics to fish.

According to Delince (1992) 30-35ºC is bearable to fish (Bhatnagar and Devi, 2013). In the view of (Bhatnagar et al.2004) temperature range 28-32$^{o}$C is good for tropical major carps; < 20$^{o}$C is sub lethal for growth and survival for fishes and > 35$^{o}$C is lethal to maximum number of fish species. Santhosh and Singh (2007) recommended that appropriate temperature of water for carp culture is within 24-30$^{o}$C (Bhatnagar and Devi, 2013).

**Water colour**

The visible wavelength of light that an object reflect is called its color.

Pale, light green or green coloured water is favourable for pisciculture as per the investigation by National Agricultural Extension and research (1996). The aqueous colour is determined through great quantity of phytoplankton and zooplankton (Delince, 1992). Greenish, bluish greenish or greenish brown colour of water acts as a sign of fine population of plankton, hence fine for health of fish. Muddy and cloudy water is unattractive and hazardous for aquatic organisms and can dangerously reduce fish yield because of the reduced sunlight penetration, plankton production, DO generation, readiness of nourishment and visibility. The muddy rain water also leads to offensive flavour in food fish (Jhingran, 1991; Helfrich and Newcomb, 2009). Golden brown or reddish-brown color of water is described as average productive, light or bright green color as highly productive and dark green or blackish green color as low productive (Mane et al., 2017). Clear water is unproductive for fish/shrimp culture as it indicates very low or absence of biological production and not fertile enough and fish will not grow well in it (Mane et al., 2017).

**Turbidity**

Interference of the penetration of light occurs owing to the increase of turbidity of water. This will decline the worth of surface runoff water and also damage the life in water. There is an increase in the turbidity in the season of rain as a result of profound soil degradation and suspended materials from sewage which affect river and aquatic organism (Verma et al., 1984). Flow of water and turbidity are often related (EPA, 2012). Higher turbidity leads to less penetration of light to the lower levels of water and this decreases the plant productivity in the floor of water and subsequently dissolved oxygen of aquatic reserve (Perlman, 2014). Higher turbidity reduces the filter runs, which in its turn make pathogenic organisms to be more harmful to the human life. The natural movements and migrations of aquatic populations may disrupt by the solids in suspension (MDEQ, 2017).

For this reason, in the view of Sawyer et al. (1994 ) and De (2003 ) relying upon the processes applied for treatment of waste water, a maximum ranges are 2.5, 5 and 5 NTU as proposed by the WHO, BIS and ICMR respectively.

**pH**

The negative logarithm of hydrogen ion concentration of aquatic body is termed as pH. (Jhingran,1991). Generally aquatic bodies in India, particularly small and confined water holes, show alkaline nature (Sharma et al., 1981). The pH of water acts as a significant ecological factor for over all changes in hydro biological character of water and the soil substratum has an effect on it. pH<4 or >10.5 is fatal to fish and shellfish culture as recommended by Bhatnagar et al. (2004). The study of Santosh and Singh (2007) reveals that the appropriate pH range for fish culture is within 6.7- 9.5, whereas, the ideal pH level is within 7.5- 8.5.

Photosynthetic rate produces the pH values more than 8 in general water that requires more $CO_2$ than amounts produced by gas exchange and putrefaction (Wani and Subla, 1990). According to Kumar et al. (2014), pH was found to be maximum during monsoon and minimum during summer season. Being an acidic gas, concentration of carbon dioxide greatly influences the pH of normal water (Boyd, 1979 and Singh, 2017). The range of pH lies within 6.5 to 8.5 as per the standards recommended by WHO, CPCB, ICMR and BIS. pH values more than 8.5 bring the salty taste to water whereas water with pH of higher than 11 cause eye irritation and skin disorder (Gupta et al., 2017).

**Dissolved Oxygen (DO)**

The dissolved oxygen expresses the changes occur in the biological parameters as a result of aerobic or anaerobic phenomenon and specifies the state of the water for use of the life forms (Chang, 2005). Poor nutrition of fish, malnourishment, stunted growth along with higher rate of fish death are the result of depletion of oxygen in water body either directly or not directly (Bhatnagar and Garg, 2000). The key limiting water quality parameter in aquatic settings is low DO value (Boyd, 1995; Singh, 2017). The unit to express the water's oxygen concentration is ppm which is in equivalence with mg $l^{-1}$ (Boguski, 2006). The more cold the water is, more the dissolution of $O_2$ in water and therefore, high DO concentrations are noticed in winter in comparison to summer (Murphy, 2007). The key source of $O_2$ for respiration of fish is air of atmosphere and photosynthetic planktons. The pace of respiratory activity increases when the temperature get increased, activity and following feeding, but decreases with increasing mean weight (Singh, 2017).

Algal photosynthesis and wind that mixes the air with water are the prime cause of $O_2$ in ponds. Fish come under stress at $O_2$ concentration under 5 mg/l during optimum temperature for growth (Singh, 2017). The key limiting parameter of water quality of aquatic settings is low DO level (Boyd, 1995; Singh, 2017). Growth, nutrition and frequency of moulting can get reduced due to down DO values (Boyd, 1990). DO level >5 ppm is required to maintain great fish yield as suggested by Bhatnagar et al. (2004); Bhatnagar and Singh (2010); Singh (2017).

**Free $CO_2$**

The respiratory activity of animals contributes free $CO_2$ which is highly soluble gas in water (Talling, 2010). It can present in water in the form of bicarbonate or carbonates in soluble or bound state in crust of earth, in limestone and coral reef regions and it works as the primary source of carbon path way in the nature. Organic pollutants and faecal matters of human influence generate the high organic decomposition (Boralkar, 1981; Wagh and Kamat, 2014). In the view of Ekubo and Abowei (2011) fish of tropical region is able to bear $CO_2$ value above 100 mg/l. As suggested by Bhatnagar et al. (2004) 5-8 ppm is necessary to photosynthete; 12-15 ppm is nontoxic to fish and 50-60 ppm is toxic to fish. The free $CO_2$ should have a smaller value than 5 mg/l in water to support good fish population, as per the studies of Santhosh and Singh (2007).

**Total Alkalinity**

The capability of water in order to defend against alteration in pH is termed as alkalinity. It is an estimate of overall concentration of alkalis in aquatic reserve which includes bicarbonates, carbonates, hydroxides, phosphates and borates, dissolved calcium, magnesium, and other compounds in the water.

As suggested by Bhatnagar *et al.* (2004), 80-200 ppm is desirable for fish and >300 ppm is not desirable due to non-availability of $CO_2$. Alkalinity of 50-150 mg/l ($CaCO_3$) is recommended as required range by Stone and Thomfode (2004). Santhosh and Singh (2007) suggested the perfect level as 50 to 300 mg/l. Alkalinity is decreased or consumed by respiration; nitrification and sulphide oxidation (Stumm and Morgan, 1981; Glynn and Plummer, 2009; Thapa and Pal, 2014).This may be caused by seasonal effect, plankton population, bottom deposits and water current (Jhingran, 1991; Muniyellappa, 2018).

**Total Hardness**

The addition of temporary as well as permanent hardness is termed as total hardness. Temporary as well as permanent hardness are owing to the existence of bicarbonates and sulphate /chlorides of $Ca^{++}$ and $Mg^{++}$ respectively. Water with < 5.0 mg $l^{-1}$ $CaCO_3$ is not suitable for fish growth as suggested by Jhingran (1991). As per the suggestion of Bhatnagar et al. (2004) the desirable alkalinity is 80-200 ppm and undesirable value is >300 ppm in the absence of $CO_2$. Stagnation, low depth of waterbody, human and animal abuses are the causes of greater value of hardness during summer (Nayak, 1986; Naik, 2014).

Large concentration of magnesium and calcium along with nitrate and sulphate in the sewage inserted during monsoon, may lead to the upper reading of hardness during rain (Angadi et al., 2005). Sawyer et al. (2003); Suresh et al. (2014) classified total hardness of groundwater as CaCO3 equivalents, intom: TH < 75 as safe, 75–150 as moderate–hard, 150–300 as hard, > 300 as extremely hard.

**Calcium**

Calcium is regarded as important parameter as well as micronutrient in a water body. Its increase puts hardness in water making it unhealthy for use (Saxsena, 1987; Khanna and Singh, 2002). Naik (2014) found that calcium is lower in summer months, increases in rainy season, reduces again in winter and during late summer it gradually enhances.

As recommended by U. S. Environmental Protector Agency (U.S.EPA, 1986); Tafa and Assefa (2014) highest level of 10 mg $l^{-1}$ calcium in portable water is safe for human intake. WHO, International Standard for Drinking Water (1998) classified water into TH < 50 mg $l^{-1}$ as soft water, 52 to 150 mg $l^{-1}$ as moderately hard water and water hardness above 150 mg $l^{-1}$ as severely hard water and not fit for use (WHO, 2011).

**Nitrate-Nitrogen ($NO_3$-N)**

Nitrate concentration in ground as well as surface water increases due to diverse cultivation practices (Nas and Berktay, 2006). Rising in the levels of Nitrate-Nitrogen in surface water causes many problems such as decrease in level of oxygen in the water with resulting effects on the aquatic life, plants and algae (Davie, 2003). Nitrite and iron react with red blood corpuscle methemoglobin is created which stops oxygen level cause Blue baby syndrome disease in human body. Consumption of water polluted with nitrate mostly affects the kids who are under 1 year of age. Nyamangara et al. (2013) have noted the range of Nitrate-Nitrogen as 20, 45, 45 mg $L^{-1}$ as prescribed by ICMR, WHO and BIS respectively.

**Phosphate ($PO_4^{3-}$)**

The chief source of phosphate is the greatest use of fertilizer in cultivated or residential farm land which enters into surface run off waters with storm runoff (Nguyen, 2013). Presence of phosphates in industrial and sewage waste create the pollution which causes growth of nuisance for micro-organisms. Damage of muscle, respiratory problem and failure of kidney are caused due to maximum level of phosphate (Nyamangara et al., 2013). Eutrophication and lessening of DO concentrations are the result of the raise in phosphorus concentrations in the waterway (Davie, 2003). The maximum limit for phosphate and phosphorus is 0.1 mg $l^{-1}$ (USEPA, 1968).

**Chloride ($Cl^-$)**

Chloride concentration can be a significant parameter to detect the contamination by sewage (Padhy et al., 2018). Stone and Thomforde (2004) recommended the desirable range of Chlorides for commercial cat fish production is above 60 mg $l^{-1}$.

## PLANKTON

The surface layers of aquatic reservoirs are populated by the wandering microorganisms called planktons. They are aquatic forms of microscopic size which constitute the biotic population in ecosystem. Phytoplankton acts as the primary producers and represents the first level in the trophic chain for all aquatic organisms (Chaturvedi, 1999). Phytoplanktons are very responsive to the changes in nutrients, showing quick response to the rise in levels and so it is vital to study the development of the phytoplankton population to realize the biological functions fresh water ecosystem and detect the time wise alterations (Hotzel and Croome, 1999).

Ewing and Dorris (1970), Archibald (1972), Brown (1973), Munwar (1974), Green and Gran (1978), Frost et al., (1981), Greenwood (1982) and Goelet al. (1988) have studied the population dynamics, community structure, composition and variety of species of plankton. Formulation regarding the species diversity and diversity indices are being proposed diversely (Pattern, 1962; Wilham and Dorris, 1966), but extensively used index is of Shannon and Weiner (1963) which is supported by Joo et al. (2010) and Zohary et al. (2010).

A cyclical form of daily activity is shown by the plankton of water and there is a direct response of their vertical movements to the surface and to the change in intensity of light during day and night, (Agrawal, 1980, Patra and Nayak, 1982).

In summer plankton was measured in ponds of different depths. The numbers of zooplanktons were observed to be more in partially fertilized ponds having 5 to 6 ft water depth compared to the ponds having 3 to 3.5 ft of water. The concentrations of phytoplankton and zooplankton in the pond were more in summer (surface water temperature: 32 to 39°C) than monsoon (22-34°C) seasons. Their concentrations decreased in depth of the aquatic column in both the cases; however the decrease rate was not linear in almost all the time (ICAR-CIFA, 2017).

**Phytoplankton**

Eutrophic conditions are reflected from the large quantity of phytoplankton number. Out of the increased level of phosphorous and nitrogen, the first one acts as key limiting factor for the dense population of phytoplankton. It is due to the most rapid and common use of phosphorous by a vast majority of algae and the algal growth is affected when the phosphorous level is below the critical level (Jyothi et al., 1990 and Singh, 2017). The phytoplanktons in high quantity are also accompanied with increase of pH, alkalinity, calcium and magnesium concentration (Navakova and Puncochar, 1976). Rapid changes in individual organism, populations and communities are the outcome of the changes of environment due to pollution. So the characteristics of an algal community act as the indicator of the condition of water environment. As Bacillariophyceae can withstand organic pollution, they are rich in a crowded aquatic milieu (Rao and Rao, 1986). But according to Venkateswarlu (1986) polluted water body may either be dominated by Bacillariophyceae or by Cyanophyceae. Literature study of Ganapati et al. (1953), Bisht (1993), Khanna et al. (1993), Mohanto (2000), Fore and Graft (2002), Mukherjee et al. (2010), Giripunje *et al.* (2013), Naik (2014), Chatterjee *et al.*(2014), Arumugam et al. (2015), Brraich and Kaur (2015), Sarif et al. (2017) are helpful for study of phytoplankton.

Algae grow autotrophically in aquatic environment and play a substantial position in the structure and function of the aquatic ecosystem and provide food to the rest of the food chain. Algae, bacteria, protozoa, rotifers and fish are the foremost assemblies of organisms that have been used as biological indicators. But, Sarwar and Zutshi (1988) and Zohary et al. (2010) have concluded that phytoplankton serves as better indicator species. Because of an indirect result of an increased demand for water pollution alteration; phytoplankton is used as indicator species (Singh, 2017). The findings of Shannon index of Bhat et al. (2014) on Bhoj wetland states that Shannon index fluctuated between 0.96 and 3.75 and classified it as less diverse as Hs is >2. According to Mc Donald (2003), the index value between 1.5 and 3.5 has low diversity and value > 3.5 has high diversity and species richness.

**Zooplankton**

Major zooplankton groups are studied on the basis of their abundance and seasonal variation, periodicity and their vertical migration by Harvey et al. (1935), Odum (1971), Jacob (1978), Jyoti and Sehgal (1979), Smith et al. (1979), Sharma and Sakshena (1981), Datta et al. (1984), Nayak (1986), Harvey et al. (1935), Frost et al (1981), Srivastava and Srivastava (2013).

McDonald (2003) stated that the reading of Sannon index is ranging from 1.5 to 3.4 while value above 3.5 has high diversity and richness of species.

**Primary productivity**

The productivity of saline water and fresh water habitation which includes the fishing ground had been inspected by several investigators viz. Nasar and DattaMunshi (1975), Pandey and Singh (1978), Mahajan el al. (1980), Sunderaraj and Krishnamoorthy (1981), Nayak and Patra(1982), and Sharma and Sarang in 2004.

The measurement of primary productivity apart from giving information about production of organic-substance in a region per unit time, also, gives some idea about the useful aspect of ecosystem (Odum, 1971). The accurate nature of ecosystem, its existing conditions, assessment, its trophic status, and availability of energy for secondary producer has been displayed by Clarke (1954). The primary productivity of different habitation of water has been studied by Mathew (1977), Nair and Prabhoo (1980), Saha and Singh(1981), Nayak (1986), Sinha et al.(1990), Singh and Singh (1999), Salathia et al. (2001), Howarth and Michaels (2000), Singh and Sahai 2007), Mishra and Tripathy (2008), Lehman (2007), Dash *et al.* (2011), Mishra *et al.* (2012), Naik (2014).

**MORPHOMETRIC FEATURES**

Topmost importance is given to the understanding on biology of fish, mainly morphometry, relationship of length with weight, condition factor, GaSI, HSI, breeding behaviour, food and feeding habit in advancing the management strategy of fish production (Evans, 2000; Russel and Yonge, 2002; Das et al., 2014). Rajaguru (1992) calculated the GaSI and HSI in order to examine the monthly variation in intensity of feeding in *Cynoglossus* sp. for correlation of these differences with breeding cycles. The GaSI and the gut contents of *Labeo calbasu* harvested from river Ganga, Yamuna and Kali are recorded by Kumar and Siddhique (1989). During rainy season a minimum intensity of feeding was found due to ripening of gonads but it was increased in October and active feeding was recorded till February.

The diet and dietary practices of silver pomfret were investigated by Dadzie et al. (2008). As per the analysis of the month wise differences in stomach fullness of specimen, they also displayed that intensity of food intake is oscillated across the year with a low value during August to September corresponding to spawning period. Food preference and activity patterns of Brownface butterfly fish *Chaetodon larvatus* in southern Red sea was investigated by Zakeria and Videlad (2003).

As per the data observed regarding weight of the body, the adult female fish attained highest body weight during breeding period. The body weight gradually attained the maximum in October, as revealed by Lone and Hussain (2009). Again it was noticed that during spawning because of the enlargement of the ovaries the adult female fish attained the highest body weight.

Gradual raise in the morphometric features like total and standard length was shown as regards the age, growth and maturity of fish. The study of comparative size in maturation stage in P. obscura reveals that maturity of fish depends on the growth (Odo et al., 2012). This view has been supported by the information that females of *C.catla, L.rohita, C.mrigala* and *C. carpio* in the fish farm at Gwalior gained weight at a faster rate with respect to its length. Illustration of significant variation between the 3 maturity stages in female *L. rohita* was given by the correlation of length with weight during different maturation stages. In order to check the relationship of length with weight during various stages of maturity (immature, maturing and mature), correlation tests in *C. lida* were made showing significant differences between 3 maturity stages of females (Rajaguru, 1992). Weight of mature ovaries provides the significantly more body wt to female *L. rohita* in spawning season. In contrast, it is a well established fact that during the period of maturation of gonad the feeding activity of fish ceases and lows down to a large measure at the time of spawning (Alkahem et al., 2002).

A negative relation between GaSI/HSI and spawning period of female *C. arel* was demonstrated with lowest values observed during peak-spawning in January (Rajaguru, 1992).This points towards the detail that gut/liver energy reserves may be used for gonadial recrudescence. Similar observation in *Mystus cavasius* showed that the feeding intensity of fish decreases for the duration of the spawning which may be caused by big size of gonads which successively allows comparatively less space for the stomach (Chaturvedi and Saksena, 2013). Analysis of the value of comparative intestinal length; shape and size of the gill rackers could also develop an idea of the carnivorous, omnivorous or herbivorous nature of the finfish (Soranganba and Saxena, 2007).

GaSI of C. *punctatus* varied normally from 1.1-3.5 (Chonder, 1999). According to Parameswaran (1975) higher feeding activity of fish (matured) are encountered during February-April. As per the statement of Pillay (1954), the spawning season of Liza tade may begin in May-June till September. Taking 'K' value into account the female again show little higher fecundity than matured ones. Little higher fecundity was shown in matured females than the young ones. Similar opinion has been put forward by Dasgupta (2004). As mentioned by Rehman et al., (2002), the GaSI value (1.48) in *Liza parsia* (35 g) was much higher than the value (0.45 g). Generally the GaSI remains low all through the reproductive season of fish species (Rehman et al., 2002). In the period prior to spawning in *Colisa fasciatus*; Sarkar and Deepak (2009) observed a gradual enhancement in GSI value and it hit the highest point in the period of spawning period.

Das and Patra (2013) are of the opinion that a firm statement cannot be made about the spawning season of the fish, if not the fish are analysed for condition factor of gonads and parameters like GaSI, gonadosomatic index and condition factor for a uninterrupted period of twelve months.

The effect of below-lethal level of methanol in five varied concentrations on the feeding rate, growth and reproduction of *Oreochromis mossambicus* was studied by Kaviraj et al. (2004), the trial illustrated that with these concentrations GaSI and the fecundity of male as well as female fish changes significantly. Hatikakoty (2002) made the morphological studies of gonad of *Oreochromis mossambicus* and revealed the existence of six stages of maturity in the fish. It is indicated through GSI that the reproductive period expanded from March-October. However, as per the study of Keivany and Soofiani (2004) on stomach contents, egg diameter, relative and absolute fecundity in the Zagros tooth carp, the gonadosomatic ratio and condition of ovary revealed that the breeding season is between March-June with an apex in April.

Prusty et al. (2007) performed a feeding trial of two month to verify the influence of dietary amine on growing process and health condition of *Labeo rohita* in which he found the hepatosomatic value of control group as more than the group under experimentation.

Desai (1970) compared the analysis of gonadosomatic and histosomatic index of some riverine fish to recognize their reproductive periods. According to some authors, it is suggested that GSI may become a useful device in identifying nature of ovaries in small sized multiple breeding fish. Studies of Coates (1990) were focused on the fecundity, egg diameter and GSI of *Ambopssis* sp.

According to some authors GSI and condition factor are correlated significantly and a negative correlation was noticed between GSI and GaSI of the species. In order to study the effect of estrogen on fish collected from two contaminated riverine sites of Osaka city, Japan, Hussain et al (2002) examined the GSI and histological study of testes of fully grown common carp. GSI and testis weight of controlled fish were significantly lesser than eight fish collected from Ishizu River, such a result clearly implies that the estrogenic chemical is adversely affecting the testis development of fish.

The GSI and flesh productivity of *Scorpaena* sp. were investigated by Koca (2002). A maximum value of GSI is found in June and a minimum value in September. Studies of Kamanga et al. (2002) explain the effect of temperature on GSI of *Oreochromis karongae*. Mature female specimen of grey mullets was examined by Rehman et al. (2002) for the study of fecundity and gonadosomatic study. The reading was noted 126812 numbers in average. It was found that the fish have two spawning highest points, one in December and the other is February as indicated by the peak of GSI.

Reproductive study of *Pagellus erythrinus* was conducted by Valdes et al. (2004) from south-east coast region of Spain. The gonadosomatic indices of this species was adequately interpreted and attempted with an intention to establish its relationship with the maturity stages of fish, physiological condition and GSI of the fish in different water level .The highest gonadial development occurred in low level water.

The change in GSI and condition factor in Atlantic salmon under control and continuous light condition was examined by Peterson and Harmon (2005). In accordance to the association between condition factor and GSI, it was recommended that salmon of both the sexes must possess condition factor greater than 1.3 percent in early summer for early maturation development. An important role in the biology of fish is played by ovarian weight and related indices like GSI, fecundity, egg maturity and spawning season. Measurement of the GSI of both the sexes as well as the spermatozoon index in the males helped to assess the yearly gonadial cycle of *Barbus longiceps* (Stoumboudi et al., 2005). The fish had the highest GSI in the month of March. In the view of authors, the highest spermatozoon index actually represents the highest point of the reproductive season of the fish. The factors influencing reproduction in the common perch were tried to be identified by Wang et al. (2006) and they suggested that the reproductive cycle is dependent on photoperiod and variation in temperature annually. At the moment of the experiment, sampling of the fish was done and it was found that GSI value was higher when females were applied to small increase of temperature reduction and an early decline in photoperiod. To study the reproductive activity of *Poecilia latipinna* in Riyadh, Saudi Arabia, Alakel et al (2007) have incorporated parameter like GSI, developmental stages of gonads and absolute fecundity. As per the recorded values of GSI, it was shown that first phase of egg laying for the fish may start in June and extend till July. An acute decline in the GSI readings occurred during December-January. The morphometric features of black pomfret in the Kuwaiti water of Arabian Gulf was analysed by Dadzie et al. (2008); concurrent analysis of condition factor and GSI signified that spawning in black pomfret *Apolectis niger* peaks in May-June.

The external morphology of major carps had been described by Day (1878), Shaw and Shebbeare (1937), Alikunhi (1956) and its sex recognition and external characters differentiating sex of breeder, has been studies by Khan and Hussain (1945).The length and weight relationship of *Labeo sp.* in the river Ganga was analysed by Jhingran (1952).

Numerous factors including food, space, temperature, season, physical activity influence the fish growth. Fish are positively controlled by the fluctuation in their ambient medium as they are poikilothermic creatures and live completely submerged in water (Weatherly and Gill 1987). The nourishment and dietary habit of fish fluctuate from season to season. Temperature changes in accord with season not only influence food consumption and rate of digestion, but also qualitative and quantitative value of obtainable foods. Studies on diet and dietary habits of fish were reported by Menon and Chacko (1956) and Natarajan and Jhingran (1961).

Al Hussaini (2007) examined the studies of functional morphology regarding difference in the habits of food intake *Gobio* sp., *Cyprinus* sp. and *Rufilu* sp. A similar study of the food and alimentary canal of milkfish *Chanos chanos* has been carried out by Chacko (1945), Strum (1978). LeCren (1951) conducted study upon biological features of *Scomberomorus maculatus* and *Perca fluviatilis* respectively. Study of the food habit, length-weight relationship, stomach contents, GaSI and condition factor of *Macrognathus pancalus* was conducted by Suresh et al. (2006). Rajaguru (1992) calculated the GaSI and HSI to observe monthly variation in intensity of nourishing in *Cynoglossus* sp. and to compare these differences with reproduction cycles. The gastrosomatic indices and gut contents of *Labeo calbasu* gathered from rivers Ganga, Yamuna and Kali were recorded by Kumar and Siddiqui (1989); lowered intensity of feeding was detected during period of rain owing to the ripening of gonads. Increased intensity of ingestion was observed in October and active feeding was recorded upto February. Literature study of Ona (1990), Koutrakis and Tsikliras (2003) and Islamet al. (2012) are helpful for the inquiry of metamorphic features of fish.

**BIOCHEMICAL ANALYSIS**

The most crucial risk to mankind is the food problem for the increasing population of the world in several ways. Fish serves a primary role among the different animal foods in nutrition of human beings. On taking nutrition into account several characteristics of the fish flesh that are more or less completely separate from other sources, give a unique position to the fish. Milroy (1908) was one of the pioneers to record notable variation in the fat and water content of various tissues relating to feeding and spawning cycle. Further Bruce (1924) illustrated that at any given stage of sexual maturity, the fat content of herring muscle was increased by age.

Tilik (1932) was of the view that Salmon suffer a vast amount of depletion of lipid during spawning season.

Kukucz (1962) brought the fact to light that proximate composition is affected by sex, season and spawning migration. According to Damberg (1963) chemical composition of fish fluctuates in relation to age, size, sex, diet and maturity conditions. It is clearly stated by Love (1970) that achievement of enhanced size as well as sexual maturity can cause modifications in the biochemistry of fish. Different fishery biologists had witnessed wide variation in the proportion of different fatty acids in the lipid of oil sardine in relation to season and sexual maturity. The work of Nargis (2006) in the chemical composition of *Anabas testudineus* had given the proof that biocomposition fluctuated season wise in relation to the reproductive cycle. Islam and Joddar (2005) drew attention to the impact of season and sex on biochemical composition of *G. giruris* (Ham.).

In spite of the nutritional significance of fish, the utilization of fish in diet is quite low across the world. Water, lipid, ash and protein are included in the main body compositions (proximate composition) of fish. Although carbohydrates and compounds other than protein are also vital constituent, due to their small amount, they are usually overlooked during analysis (Love et al., 1968). Fish flesh includes four basic components such as water, protein, fat, ash and other nutrients like minerals and vitamin. Carbohydrate does not constitute a major component of fish and thus generally ignored due to their negligible amount (Eliott, 1976; Caulton and Bursell, 1977; Salam and Davies, 1994).

Besides the huge economics and health benefits of research of fish biochemistry, the academic understanding of the emergence of an advance class of vertebrate from its chordate ancestor is the other important cause that this group has attracted the attention of researchers from the beginning. Like other animal groups the proximate composition of fish is also subject to changes under the influence of numerous factors including genetics, anatomical, morphological, physiological, ecological, seasonal and sex. Job (1940), Jafri and Khawaja (1964), Love(1970), Elliot (1976), Carlow (1979), Takaoka et al.(1998), Weatherly and Gill (1987), Siddiqui and Nassem (1979), McBride et al.(1959), Hassan (1996) are among the earlier workers in the field. Some researchers like Lovern and Wood (1937), Stansby (1954), Tiwari and Srivastava (1962), Hille (1982) and Jorgensen et al. (1997) have tried to relate modifications in composition of to seasonal variables. According to reports, although knowledge of seasonal changes of fish of standard size may be essential, it will be only of limited value when a population is growing constantly.

Analysis of fishery biologists like Cui and Wootton (1988), studied the thermal impact on the composition of body. According to Love (1960), the effect of frequency of feeding on body composition has been demonstrated by that of diet composition. It has been observed by Elliot (1976) that there is a definite influence of body, size or age, also body composition.

Physiological and biochemical indices have been regarded as indicator of the state of fish under different habitat conditions. The environment has a direct influence the metabolisms. The most important external factor is certainly food, because its amount often limits different aspects of their vital activity as well as the organism uses food to build itself (Vlaminget al.,1978).

The principal fish body contents such as water, protein, lipid and lesser amount of carbohydrate with minerals are almost similar to those of other animals (Weatherly and Gill 1987). Typically the live weight of the fish comprises roughly of 70-80, 20-30 and 2-12 percent of water, protein and lipid respectively (Love 1970), alternatively, these values vary noticeably within as well as between species, sexual condition, size, season of active feeding and activity, where as other important component, protein is likely to differ minutely in fish having good health (Weatherly and Gill 1987). Due to its higher protein and lipid value of fish meat and the content of lipid is highly related to season, fish meat is having edge over the livestock meat. According to (Love 1970) lipid is considered as one of the leading food reserves contributing to size and condition and this had bring about the use of fat indices. On the other hand, a markedly variation of fat content in fish muscle occurs with the size of fish. During the monitoring of fluctuation in body size and condition in ecological studies, relation between percentages of water and fat is used to estimate the lipid content of animal. Such estimates are basically applied because the measurement of water is easy and quick. Damberg (1964) observed that maximum value of the protein content in the muscle of the Novascotia inshore cod was reached in October and November month. Afterwards, it was progressively lessened to arrive at minimum in May. According to Love (1970), modifications in the chemistry of the fish condition can be originated by the increase in size and sexual maturity. Ramachandra Nair and Gopakumar (1981) have recorded variability in the fatty acid and in the lipid of oil sardine with respect to season and sexual maturity condition: but their observation was remained quiet about sex, maturity condition of the sample fish. Biochemical compositions of some freshwater fish were analyzed by Jafri and Khawaja (1964) and proximate composition of *Catla catla* were reported.

Alteration in the fat and water content of various tissues relating feeding and spawning cycle were recorded by Milory (1908). Afterward Johnstone (1918), Bruce (1924) authenticated and extended his work further and showed that at any given stage of sexual maturity the fat content of herring muscle was raised with age. Tilik (1932) stated the Salmon suffers reduction during the spawning period, losing about 99 percent lipid, 72 percent of protein and 63 percent of ash. However, there is increase of moisture content. Tarr (1959) has reviewed the significance of physiological and bio-chemical composition of salmon and herring. Kukucz (1962) drew attention to the fact that proximate composition is affected by sex, season and spawning migration. Kandemir and Polat (2007) examined monthly fluctuation in the amount of overall fatty acid and lipid in the liver and muscle of rainbow trout and they reported a higher level of fatty acid in summer. Nargis (2006) investigated seasonal variation in chemical composition flesh of *Anabas testudineus*.

The indices of physiology and biochemical study have been regarded as the indicators of the state of fish under different habitat condition.