WATER TEMPERATURE

INTRODUCTION

The temperature is an important abiotic factor as it has effect in certain chemical and biological activities in the organism attributing in aquatic media. It is one of the most important physical parameter, which is directly influence some of the biochemical and physiological process in the aquatic organisms. Water temperature depends upon the depth of water column beside solar radiation, climate and topography. The water temperature range was considerable during the year. The water temperature difference was largely due to climatic influence. In Indian subcontinent, temperature in most of the water bodies ranges between $7.8^\circ$ C to $38.5^\circ$C Quadri and Yousuf (1980),Singhal et.al.(1986),Ghosh and George(1989). Low temperature favors the growths of phytoplankton were as high temperature favors the growth of chironomous larvae.

All metabolic and physiological activities of life processes such as feeding, reproduction and distribution of aquatic organisms and animals are greatly influenced by water temperature.

Water temperature is one of the important physical parameter. It is determining factor in seasonal distribution of organisms. It effects
the chemical and biological reactions in water. In general, water slightly warmer than optimum, provides better growth and food conversion than water with low temperature. Metabolic rate shows at the temperature below optimum for a particular species and increases as temperature rises above the optimum level at certain extent. The water temperature is determining factor of the distribution of aquatic organism started by Allern (1920), Prasad (1956) and Byars (1960). The variation in the water temperature may be due to different timing of collection and the influence of season Jayaraman et.al. (2003). Wetch (1952) stated that the temperature controls behavioral characteristics of organisms, solubility of gases and salts in water. No other factor has so much influence as temperature.

If the temperature increases beyond the optimum range, the metabolic rate continues to increase and every begins to get diverted from growth to maintain of the higher metabolic rate similarly. If the temperature reduces below the optimum range, metabolic activity completely stops and shows retorted growth. Temperature also greatly influences the sexual maturity, spawning and development of stages of life cycle of aquaculture species. The water temperature fluctuates due to change in atmospheric temperature and it shows diurnal as well
as seasonal variations. Moitra (1964) found that increase in surface temperature caused decrease in phytoplankton count in fishpond at Kayani.

MATERIAL AND METHOD

The water temperature is recorded in $0^\circ$C on field with the help of standard centigrade thermometer. The water temperature is measured in few seconds after taking the sample in a container.

RESULTS

In the present investigation the range of water temperature was found minimum $22.2^\circ$C in the month of January at station A as well as at station B in 2008-2009. The water temperature was minimum in the month of December 2009 at sampling station A & B while maximum water temp $30.8^\circ$C at B station in the month of May 2010.

The pattern of fluctuation of monthly water temperature at two sampling stations over a period of two years is shown in table No. 1 and graphically represented in figure No. 1.
Table No. 1 Monthly Variation of Water Temperature.

<table>
<thead>
<tr>
<th>Year</th>
<th>2008-2009 Station</th>
<th>2009-2010 Station</th>
</tr>
</thead>
<tbody>
<tr>
<td>Months</td>
<td>A</td>
<td>B</td>
</tr>
<tr>
<td>June</td>
<td>26.4</td>
<td>25.7</td>
</tr>
<tr>
<td>July</td>
<td>26.9</td>
<td>25.8</td>
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<tr>
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<td>25.1</td>
<td>25.2</td>
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<tr>
<td>September</td>
<td>26.8</td>
<td>25.9</td>
</tr>
<tr>
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<td>25.0</td>
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<tr>
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<tr>
<td>December</td>
<td>25.6</td>
<td>25.3</td>
</tr>
<tr>
<td>January</td>
<td>22.2</td>
<td>22.2</td>
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<tr>
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<td>28.8</td>
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<tr>
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<td>28.0</td>
<td>28.6</td>
</tr>
<tr>
<td>May</td>
<td>30.0</td>
<td>30.4</td>
</tr>
</tbody>
</table>

All values are expressed in °C
In the present investigation the water temperature was observed minimum in the month of October and January and maximum in the month of May in the year 2008-2009 while the minimum water temperature was observed in the month of December and maximum water temperature recorded in the month of May in the year of 2009-2010 due to the change in atmospheric temperature at different time and different sampling stations of water.

DISCUSSION

Danilov (1963) worked on Giligiche reservoir. He reported that the seasonal changes were mainly dependent on the water temperature. Minimum crop of phytoplankton in winter and maximum in summer in the lake of Kashmir was observed by Vyas and Zusthi (1997). Upadhya and Ray (1982) reported water temperature in the river studied on river of Kathmandu valley and found water temperature 15°C to 30°C. Rauthan Shashikant and Grover (1992) studied yearly variations in certain physico-chemical parameters of a pond at Eastern Doon valley and mentioned that the water temperature varies considerably during different months. It was minimum as 16°C in December and maximum as 28°C in July. Moitra and Bhattacharya

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(1965) found that increase in temperature of surface water caused decrease in plankton count in fishpond in Kalyani. However, Varma and Shukla (1970) did not find any correlation between water temperature and biota.

Bohra (1977) worked on Padam sagar and Ranisagar lake. During his study he found that water temperature fluctuates according to the atmospheric temperature. Verma (1967) on Dal sagar lake, Shrinivasan (1962) on Bhavini Sagar Lake, Hussainy (1967) on Vihar lake Bombay also noted similar observations.

Pulle et.al. (2005) worked on ground water quality of Nanded city and found that the water temperature ranges between 24.8\(^0\)c to 28.6\(^0\)c, 26.2\(^0\)c to 30.5\(^0\)c and 27.8\(^0\)c to 31.2\(^0\)c at three different sites. He observed the lowest water temperature during winter season and highest during summer season.

Singh and Saha (1981) during the study on diurnal cycle of a biotic parameter of Ramsar well at Bhagalpur (Bihar), observed the water temperature between 22\(^0\)c to 24\(^0\)c having diurnal range of 2\(^0\)c.

Das et.al. (1992) reported the water temperature between 17.5\(^0\)c to 28.0\(^0\)c in river Brahmputra at Tejpur. Pandey et.al. (1993) studied on the physico-chemical quality of water in the river Koshi at purnia
(Bihar) and reported 19.5\(^o\)C to 30.5\(^o\)C fluctuation in water temperature due to seasonal changes. *Chatterjee (1994)* observed that the water temperature ranges between 21\(^o\)C to 35\(^o\)C in Nandakan Lake.

*Yogesh Shastri (2003)* studied physico-chemical characteristics of river Mosam at Malegaon, Nashik (M.S.) and found the minimum water temperature of 18\(^o\)C in the month of December and maximum of 29\(^o\)C in the month of May. *Khan and Chaudhary (1994)* studied physical and chemical limnology of Kapati lake Bangladesh and reported water temperature in the range of 23\(^o\)C to 31\(^o\)C. *Swarnalatha and Narsing Rao (1998)* recorded water temperature between 24\(^o\)C to 33\(^o\)C in Banjara lake. *Shukla, Tripathi and Chaturvedi (1992)* worked at the river Ganga at Gharipur and recorded minimum water temperature 19.7\(^o\)C in winter and maximum of 31.7\(^o\)C in summer.

*Narsimha Rao and Jaya Raju (2001)* worked on sewage fed fishpond at Nambur (A.P.) and the range of water temperature was recorded between 28\(^o\)C to 36\(^o\)C. *Prakasan and Joseph (2000)* studied on water quality of Sasthamcotta lake (Kerala) and observed the water temperature in the range of 27.8\(^o\)C to 32.2\(^o\)C. *Kaushal and Sharma (2001)* while working on limnology and productivity of Badkhl lake, Haryana observed minimum water temperature of 15\(^o\)C.
during winter, maximum of 31.2\textdegree{}c during post monsoon and moderate in 28.0\textdegree{}c summer respectively.

_Singh (2000)_ studied physico-chemical parameters in an Ox-bow lake and observed that water temperature ranged from 16.1\textdegree{}c to 33.2\textdegree{}c and 15.0\textdegree{}c to 34.0\textdegree{}c. During two years of study period, he reported the minimum water temperature in January and maximum in June. _Jha et.al. (2003)_ worked on comparatively study of limnochemistry and primary productivity of some fish ponds in north district of West Bengal (India) and observed that the water temperature ranges between 16.0\textdegree{}c to 28.0\textdegree{}c at Pudung, 25.0\textdegree{}c to 32.0\textdegree{}c at Rani nagar, 26.0\textdegree{}c to 33.0\textdegree{}c at Gojole pond. He concluded that the lower water temperature may also be influenced by the cool spring water.

_Min, Radhika and Ganga Devi (2003)_ worked on hydrological studies of Vammanapuram River, Thiravnanrhpura and Kerela. They reported that during their study period of one year from February 1999 to January 2000, the water temperature fluctuated in the range of 18\textdegree{}c to 36\textdegree{}c. The similar observations were reported in Khandepar River by _Desai et.al. (1995)_ . _Zingade (1981)_ observed seasonal
changes in the water temperature co-relate with similar changes of atmospheric temperature.

*Sedamkar and Angadi (2003)* observed the water temperature ranging between 20.10°c to 24.60°c in Jagat tank and 21.2°c to 31.9°c in Pala tank. In water quality studies on Karamana River, Thiruvananthapuram District and South Kerala, *Jayaraman et al. (2003)* noticed that the minimum and maximum annual average value of water temperature was 26.7°c and 28.9°c at station 1 and station 5 respectively and seasonal value of water temperature ranges from 25°c at station 1 during post monsoon and 30.6°c at station 6 during pre-monsoon. *Freeda et al. (2003)* studied on the drinking water quality characteristics of five rural places in and around Thittagudi, Tamilnadu (India) and observed the water temperature as 35°c.

*Radhika et al. (2004)* studied the abiotic parameters of tropical fresh water, Vallayani Lake, Thiruvananthpuram district and Kerala and observed that the seasonal water temperature of surface water varied from 30.0°c to 31.5°c, 28.5°c to 31°c and 28.5°c to 30.2°c during pre monsoon, monsoon and postmonsoon respectively. *Suryawanshi et al. (2004)* studied the ground water characteristics of industrial zone of ground water as 27°c in the month of October and
minimum temperature as $22^0\text{C}$ in the month of December. Patil and Hande (2004) studied the Physico-chemical aspects of Patalganga tank and Arbian sea of Raigad and observed the water temperature ranging between $29.1^0\text{c}$ to $29.4^0\text{c}$.

Tiwari et.al. (2004) observed the maximum water temperature of $31.5^0\text{c}$ in May and the minimum water temperature of $22^\circ\text{c}$ in August at all the three sampling stations in Shahapura lake Bhopal. Nair et.al (2005) observed the average water temperature as $17.3^0\text{c}$ of ground water of North East Libya. Khan et.al. (2005) studied on the physico-chemical parameters of drinking water in Delhi and reported the water temperature in the range of $20-26^0\text{c}$. Gupta, Savita Dixit and Suchi Tiwari (2005) studied surface water of lower Lake Bhopal and observed maximum temperature of $33.5^0\text{c}$ in the month of June and minimum of $18^0\text{c}$ in the month of January. The temperature of water bodies ranged from as low as $16.55^0\text{c}$ in winter season to as high as $28.73^0\text{c}$ in rainy season in different water bodies of Hanumangarh and Sri Ganga Nagar District of Rajsthan Sutar et.al. (2005).

Anita et.al. (2005) while working on limnological studies on Mir Alam Lake, Hyderabad, and reported monthly variation in temperature ranging from minimum $21^0\text{c}$ and $38^0\text{c}$ at different sites
selected for investigation. Surve et al. (2005) reported the temperature ranges from 22.2°C to 33°C, 22°C to 32.9°C and 22.3°C to 33°C respectively at site I, site II and site III of Baruldam. Chavan et al. (2005) reported the water temperature fluctuating in the range of 20°C to 32.5°C in Manjra project water reservoir, District Beed. Shashikant and Anik Raina (1990) studied limnology of two ponds in Jammu and reported close similarity between atmospheric temperature and water temperature due to shallow depth of two ponds and also due to small amount of macrophytic vegetations. The same pattern was observed for natural ponds and lake by Saad (1973) and Mishra et al. (1975). Masood Ahmed and R. Krishnamurathi (1990), Singh (1998) studied the primary production in Govindsagar reservoir (H.P.) and observed the water temperature varies between 17.0°C and 31.0°C in 1986-87 and 16°C to 29°C in 1987-88.

Ramchandra and Sreekantha (2006) reported the water temperature in four tanks, Ullura tank, Kapadi tank, Govaturu tank and Nagara tank ranging between 26°C and 27°C, 26°C and 27°C, 28°C and 29°C, 27°C and 28°C respectively. Water temperature ranges between minimum 21.1°C, 21.0°C and 21.5°C and maximum 35.8°C and 34.5°C at station I, II and III respectively in Bellal lake of Bodhan.
(A.P.) which was reported by Venkata Ramana Solanki et.al. (2006). Gawas et.al. (2006) worked on physico-chemical parameter of surface water in the Mahad industrial area. The minimum value of water temperature of all sampling point was recorded 25\(^0\)C during November while maximum value was found 27.5\(^0\)C during September. Jha et.al. (2003) worked on comparatively study of limnochemistry and primary productivity of some fish ponds in the northern district of West Bengal (India) and observed that the water temperature ranges between 16\(^0\)C and 28.0\(^0\)C, at Pundung, 25\(^0\)C and 32.0\(^0\)C, at Raninagar, 26.0\(^0\)C to 33.0\(^0\)C at Samashpur and 27.0\(^0\)C to 35.0\(^0\)C at Gajole pond. He concluded that the lower water temperature may also be influenced by the cool spring water. All metallic and physiological activities and life process such as feeding, reproduction, movement and distribution of aquatic organisms are greatly influenced by water temperature. Anita Jhojhria (2003) studied on prospects of aquaculture in a fresh water pond of Jodhpur in relation to its limnology and observed that the water temperature ranges between from 14.6\(^0\)C to 28.5\(^0\)C. She stated that the water temperature showed negative co-relation with dissolved oxygen (r =0.470).
Agrawal et al. (2004) studied on physico-chemical variation in Pani Ki Dharamshala Jhasi, (India) and observed that the water temperature ranges between 18.0°C to 31.0°C. He stated that the seasonal values of water temperature recorded highest in rainy season while lowest temperature in winter season. Raginaa and Nabi (2004) worked on physico-chemical characterization of Cauvery and Bhavani river at the confluence point Kooduthurai River and observed that the water temperature varied between 29.0°C to 31.0°C. She stated that the temperature is more or less constants (30°C) because of thermal power station near the investigation area. The gradual increase of temperature during the summer and decrease in the winter might be due to the low water level low velocity, atmospheric condition and greater solar radiation. Awasthi and Twiari (2004) studied on seasonal trends in abiotic factors of lentic habitat, Govindgarh Lake, Rewa (M.P.) India and observed that the water temperature ranges from 16.0°C to 32.4°C. He stated that the water temperature was inversely related with dissolved oxygen.

Afroz and Srivastava (2005) worked on Khajua Lake at Mubarakpur, Azamgarh (U.P.) and observed that the water temperature ranged between 18.0°C to 29.5°C. He reported that the
trend of fluctuation is possibly due to various chemical reactions occurring among the pollutants discharged at this zone. *Surve et.al. (2005)* reported that the water temperature ranged from 23.2\(^0\)c to 32.6\(^0\)c at S1, 22.0\(^0\)c to 32.9\(^0\)c at S2 and 22.0\(^0\)c to 32.5\(^0\)c at S3 in Derla Dam water, Nanded. *Tiwari (2005)* reported that the water temperature in different months of the year followed the seasonal variation in atmospheric temperature. *Ramdas et.al. (2005)* reported that the water temperature varied between 22.0\(^0\)c to 27.0\(^0\)c in Tungabhadra River water. *Suresh et.al. (2005)* studied on ecological characteristics of Chilur Pond, Karnataka and observed the water temperature as 24.0\(^0\)c. *Chowdhary and Zaman (2005)* worked on limnological conditions of utricularial habitat and observed that the water temperature varied between 21.0\(^0\)c to 29.8\(^0\)c, 20.5\(^0\)c to 28.6\(^0\)c, 14.9\(^0\)c to 20.2\(^0\)c and 25.0\(^0\)c to 30.7\(^0\)c in the period of monsoon, post monsoon, winter and summer season respectively. *Shivanikar et.al. (1999)* worked on environmental temperature fluctuation which determine dissolved oxygen in Godavari river water and observed the water temperature ranges, between 26.4\(^0\)c to 35.7\(^0\)c at spot A, 26.9\(^0\)c to 36.2\(^0\)c at spot B and 26.8\(^0\)c to 36.0\(^0\)c at spot C in the year 1995-96. While in the year 1996-97 it was ranging between 27.2\(^0\)c to 36.8\(^0\)c at spot A, 27.6\(^0\)c to 37.2\(^0\)c
at spot B and 27.8°C to 36.7 at spot C. He stated that the maximum water temperature of Godavari River recorded in the month of May can be due to direct relationship between bright sunshine and air temperature. Ravikumar et.al. (2006) studied on physico-chemical characterization of Neelguanda tank near Harapanahalli, Davanagere and observed that the water temperature ranges between 25.0°C to 31.0°C. Veeresha Kumar and Shankar Hosmani (2006) studies on algal bio-diversity in fresh water temperature which ranges between 23.0°C to 31.0°C at Hunsur Lake and 23.0°C to 32.0°C at Daraga Lakeshe reported the minimum value of temperature in the month of January and maximum in the month of April in both the lakes.

Highest water temperature was recorded during summer season where at least was observed in winter season of Anjanapura reservoir near Shikarpur District Shimoga (Karnataka). Manajappa et.al. (2008) was recorded values of water temperature ranged from 28.5°C to 30.0°C in all the four stations. Gonajari and Patil (2008) recorded the temperature of the reservoir varies from 25.2°C to 28.5°C.

Jawale and Patil (2009) were recorded water temperature 21.0°C in December at site I and maximum 29.8°C in September and minimum 21.1°C in February at site II in Mangrul Dam District Jalgon
Ingole et al. (2009) were recorded water temperature fluctuate between 23.1°C to 31.0°C in Majalgaon Dam, Beed district (M.S.). Vasumathi Reddy et al. (2009) were recorded the water temperature ranges between 22.6°C to 32.0°C being minimum in winter and maximum in summer of Pakhal lake of Warangal district (A.P.). Jawale et al. (2009) was recorded seasonal variation in temperature ranged from 23.0°C to 32.0°C. It showed that temperature highest in summer and lowest in monsoon and winter season. The water temperature fluctuated according to atmospheric temperature.

Chandanshive et al. (2008) were recorded water temperature along the river ranged between 22.3°C to 31.5°C. The minimum value was recorded during winter and maximum during summer season at station B in river Mula-Mutha at Pune. Jayabhaye et al. (2008) investigated water temperature ranges from 22.0°C to 30.0°C and 22.3°C to 30.8°C in a minor reservoir Sawana, Hingoli District. The surface water temperature of Manar River ranged from 25.0°C to 30.0°C. It is evident that the surface temperature was recorded in May, Mane and Pawar (2007). Mishra Vidya et al. (2007) were recorded temperature ranged from 15.5°C to 34.5°C in Ulhas estuaries. Savle and Hiware (2007) were observed water temperature ranged from 23.0°C
to 30.0°c, seasonal analysis showed that it was high 30°c in summer and Lowers in monsoon and winter is 23.0°c in wanparakalpa reservoir Nagapur, Near Parali Vaijanth.

*Shastri et.al. (2008)* recorded the pond water temperature which largely influenced by local climate condition. It is recorded to be minimum 20.4°c in January and maximum 30.3°c was recorded in May and minimum temperature 25.1°c was recorded in October. *Narayana et.al. (2008)* were recorded water temperature varies from 24.7°c to 30.2°c.