AN INTRODUCTION TO LONAR CRATER LAKE

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Preface

The books deals with limnological studies and the faunal diversity of lonar crater is an impact crater situated in Buldhana district of Maharshtra state India. It ranks amongst the five largest craters in the world and is world's largest impact crater in basalt rock formed about 50,000 years ago. It represents a typical saline water ecosystem at the basin of the crater with alkaline pH and three perennial fresh water streams originating from north-eastern side in the preipheri with neutral pH, each with its own flora and fauna. The loanr crater lake is an assemblage of about six different ecosystems at one place.

The present book is an original research on the topic entitled "Study on ecological characteristics and the fauna of Lonar Lake."

I am very much thankful to Dr. H.S. Kshirsagar, my research guide. I am also very much thankful to my parents and my wife Dr. Deshpande Vaishali Vinayakrao and my son master Arnish Rekukadas Deshpande and my all family members. I am also very much thankful to Mr. Umbarkar without his efforts it is not possible to publish this book.

- Dr. Deshpande Renukadas Prabhakarrao

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Chapter - I

TOPOGRAPHY AND CLIMATIC CONDITIONS

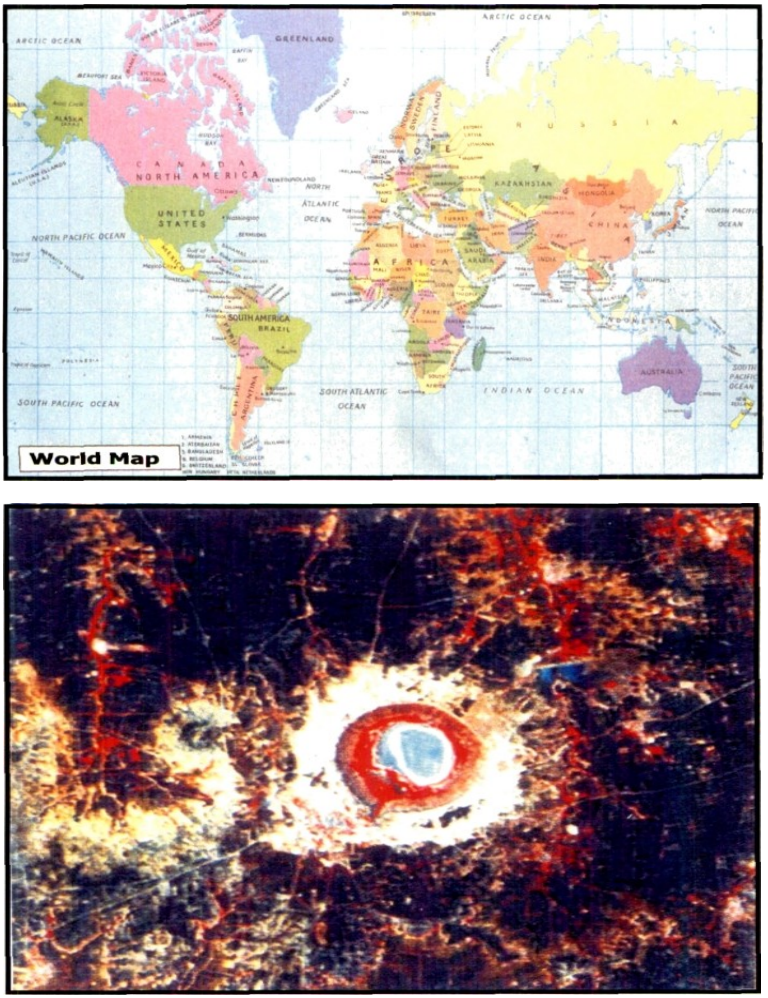
TOPOGRAPHY:

World geography is full of wonders and one of them is the famous Lonar Lake. It is situated in the district of Buldhana in Vidarbha region of Maharashtra State, India (Plate -II). It is considered as one of the most excellent meteoritic impact craters of the world. The Lake is exactly located at latitude 19”58’ North and Longitude 76 31 East. There is a distance of about 1 km between the town of Lonar and the Lake, which is situated in the south western side. The spot is well connected from all sides and is 125 km away from Parbhani city. It is a natural wonder full of bio-geographical peculiarities. The Lonar Lake ranks third among the five largest meteorite impact craters of this kind in the world (Plate - I) having the diameter of 1830 meters. The first ranking meteoritic crater in the world is “Bosumtwi”. (Ghana- Africa) having diameter 10, 500 meters and second ranking “Lambredor” (Canada) having the diameter 3, 500 meters. Lonar crater was formed about 50 to 52 thousand years ago in the basalt rock of the Deccan Plateau, which is the only crater of its kind formed by a hypervelocity natural meteorite impact in the world with saline water ecosystem (Plate III).

CLIMATIC CONDITIONS:

This region can be distinctly marked in to three seasons, namely Summer (Feb. to Nay), Monsoon (June to Sept.) and Winter (Oct. to Jan.). During summer the sky is clear, there is high intensity of sunlight and the days are of longer duration. In monsoon the sky is cloudy, moderate

to high temperature with more humidity. During winter the sky is clear, low temperature and the days are of shorter duration.



World Map and Satellite view of Lonar lake

Because of fluctuations in the atmospheric temperature and rainfall seasonal studies were carried out.

Atmospheric temperature (”C):

The values of the atmospheric temperature at different sampling stations were recorded with the help of the mercury filled Celsius thermometer during the study period. An atmospheric temperature was found to vary between 20 to 39 at spots A and D. During first year of the study period Feb. 2000 to Can. 2001, it was minimum (24) at spot "D" in the month of Nov. 2000 and maximum (37) at spot "A" in the month of May 2000. During second year of the study period Feb. 2001 to Jan. 2002, it was minimum (20) at spot "D" in the month of Dec. 2001 and maximum (39) at spot "A" in the month of May 2001 as shown in table 1.2.1.1 and Fig. 1. The mean annual values of atmospheric temperature at spot A and D are 31.08 and 30.25 during 2000-2001, while 30.75 and 29.16 during 2001-2002 respectively.

In summer season the seasonal mean values of atmospheric temperature at spot A and D are 33.75 and 32.25 during summer I, while

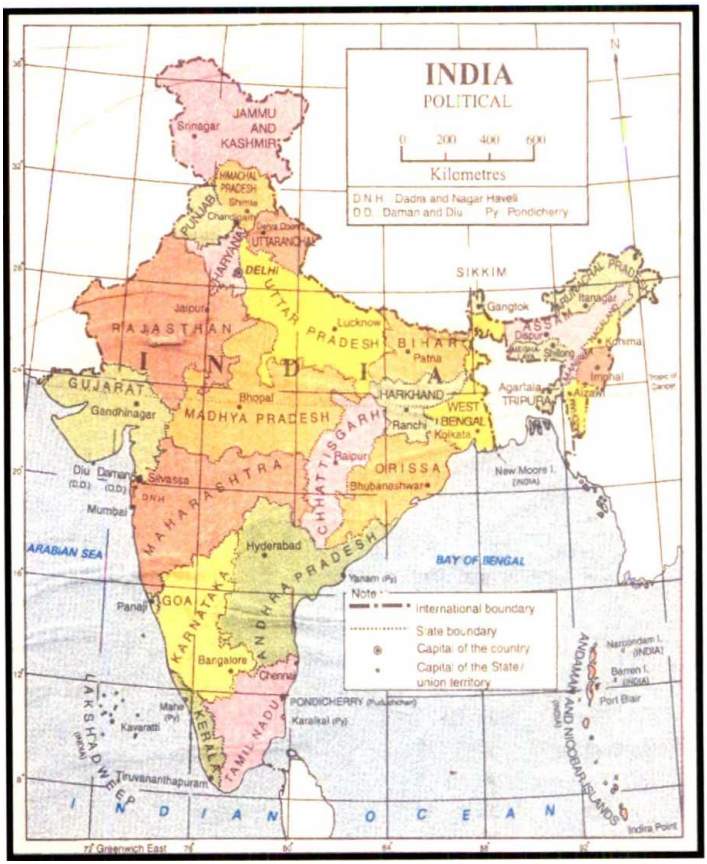
33.25 and 32.75 during summer II respectively. In monsoon the seasonal mean values of atmospheric to.mperature at spot A and D are

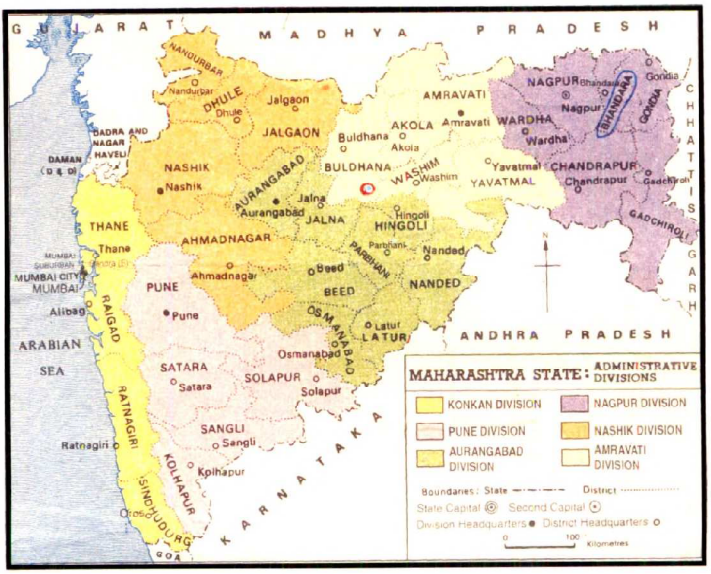
31.75 and 31.00 during monsoon I, while 31 and 30.25 during monsoon II respectively. In winter season the seasonal mean values of atmospheric temperature at spot A and D are 27.75 and 27.50 during winter I, while 28 and 24.50 during winter II respectively.

The values of atmospheric temperature were found to vary between 22 to 40 at spots B and C. During first year of the study period Feb. 2000 to Jan. 2001, it was minimum (23) at spot "B" in the month of Dec. 2000 while maximum was (37) at spot "C" in the month of May 2000.

During second year of the study period Feb. 2001 to Jan 2002, it was minimum (22) at “C” spot in the month of Nov. 2001 and maximum (40) at spot “B” in the month of May 2001 as shown in table 1.2.1.2 and Fig. 2. The yearly mean values of atmospheric temperature at spot B and C are 29.25 and 29.41 during 2000-2001, while 30.16 and 29.58 during 2001-2002 respectively.

Plate - II





India and Maharashtra State

Table 1.2.1.1:
Atmospheric Temperature (0C)

Season		Summer				Monsoon				Winter			
Nonth		Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan
Spot													
Feb 2000 to Jan 2001	A	33	31	34	37	36	32	30	29	28	26	28	29
	D	31	29	33	36	34	29	30	31	27	24	28	31
Feb 2001 to Jan 2002	A	28	31	35	39	35	31	29	29	27	28	25	32
	D	29	32	33	37	31	29	32	29	25	23	20	30

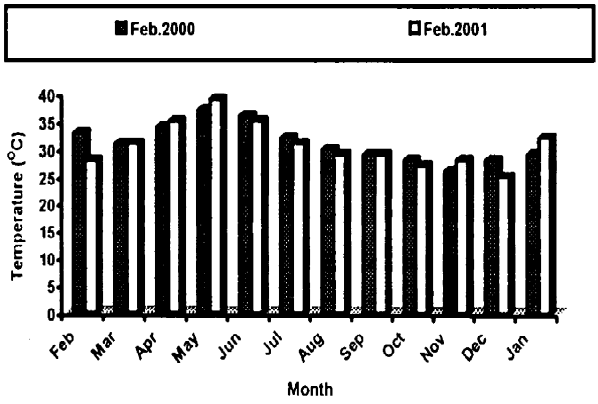


Fig. 1 : Monthly atmospheric temperature values at Spot A during Feb. 2000 to Jan. 2002

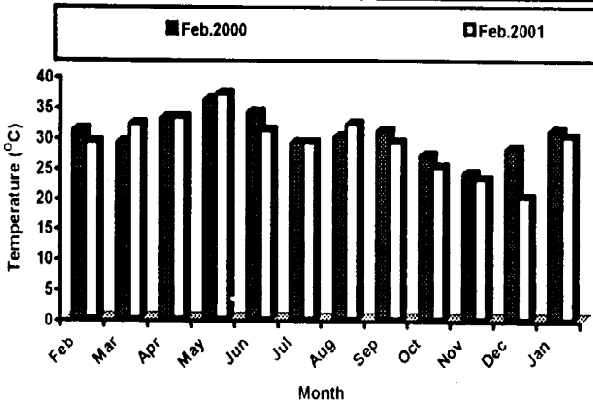


Fig. 1 : Monthly atmospheric temperature values at Spot D during Feb. 2000 to Jan. 2002

Table. 1.2.1.2 :
Atmospheric temperature (0C)

Season		Summer				Monsoon				Winter			
Month		Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan
spot													
Feb 2000	B	29	34	31	35	32	29	28	31	26	24	23	29
3an 2001	C	30	32	29	37	30	30	30	29	28	26	25	27
Feb 2001	B	31	30	33	40	36	29	28	30	26	23	25	31
3an 2002	C	30	28	35	38	33	31	29	27	24	22	26	32

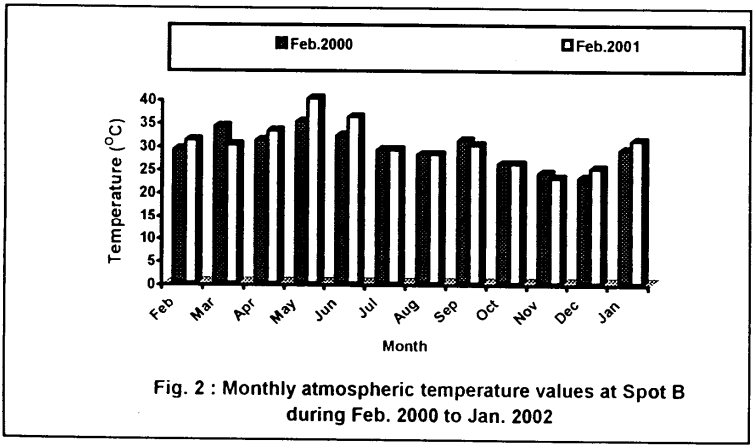


Fig. 2 : Monthly atmospheric temperature values at Spot B during Feb. 2000 to Jan. 2002

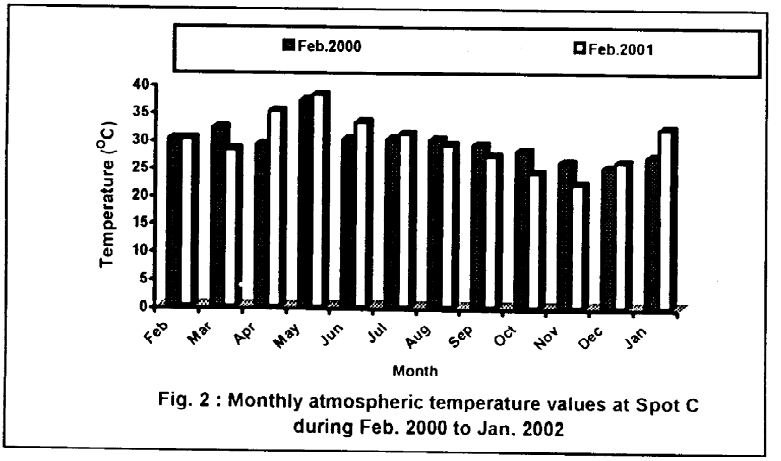


Fig. 2 : Monthly atmospheric temperature values at Spot C during Feb. 2000 to Jan. 2002

In summer season the seasonal mean values of atmospheric temperature at spot B and C are 32.25 and 32.00 during summer I, while

33.50 and 32.75 during summer II respectively. In monsoon season the seasonal mean values of the atmospheric temperature at spot B and C are 30.00 and 29.75 during Monsoon I, while 30.75 and 30.00 during monsoon II respectively. During winter the seasonal mean values of atmospheric temperature at spot B and C are 25.50 and 26.50 in winter I, where as 26.25 and 26.00 in winter II respectively.

Rainfall (mm):

During the present investigation monthly as well as yearly rainfall data, which plays an important role in altering an ecological characteristics of Lonar Lake, is collected from the Office of the Department of Irrigation, Govt. of Maharashtra at Lonar, Dist. Buldhana, and the Office of the Collector, Dist. Buldhana.

As per data monthly rainfall values ranged between 0 to 419. During first year of the study period Feb. 2000 to Can. 2001, it was minimum (0) in the months Narch, April,

November and December 2000 and Maximum (232) in the month of August 2000 at Lonar. During second year of the study period Feb. 2001 to Jan. 2002, it was minimum

(0) in the months February, March, April, November and December 2001 and maximum (419) in the month of Aug. 2001 at Lonar, as shown in table 1.2.2.1 and Fig. 3. The yearly mean value of rainfall is 56.91 during 2000-2001, where as 103 during 2001-2002 at Lonar.

During summer the seasonal mean value of rainfall at Lonar is 18 in summer I, while 6.75 in summer II respectively. During monsoon the seasonal mean value of rainfall at Lonar is 16L75 in monsoon I, where as 235 in monsoon II respectively. During winter the seasonal mean value of rainfall at Lonar is 2.5 in winter I, while 67.25 in winter II respectively.

With certain exceptions, besides monsoon season in rest of the two seasons in a year an average rainfall is very negligible, hence the data given in table 1.2.2.2 is the only average of four months (Monsoon season June to Sept. of the respective year) since 1980 to 2003. In last 24 years the minimum rainfall recorded at Lonar is 407.4 in the year 1985 and maximum rainfall recorded is 1851.6 in the year 1998 as shown in Fig. 4.

Table. 1.2.2.1 :

Monthly Rainfall (mm) values at Lonar during Feb. 2000 to Jan. 2002.

Season		Summer				Monsoon				Winter			
Nonth		Feb	Mar	Apr	May	3un	Jul	Aug	Sep	Oct	Nov	Dec	Jan
Feb 2000	Lonar	22	00	00	50	184	212	232	23	04	00	00	06
Feb 2001	Lonar	00	27	00	00	213	182	419	126	245	00	00	24

Source: Office of the Irrigation Department. Govt.of Maharashtra (Tq. Lonar Dist. Buldhana).

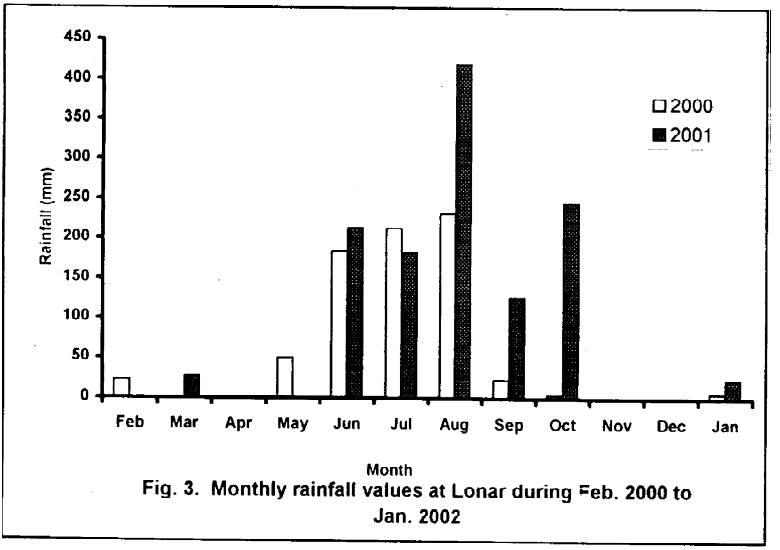


Fig. 3. Monthly rainfall values at Lonar during Feb. 2000 to Jan. 2002

During summer the seasonal mean value of rainfall at Lonar is 18 in summer I, while 6.75 in summer II respectively. During monsoon the seasonal mean value of rainfall at Lonar is 162.75 in monsoon I, where as 235 in monsoon II respectively. During winter the seasonal mean value of rainfall at Lonar is 2.5 in winter I, while 67.25 in winter II respectively.

With certain exceptions, besides monsoon season in rest of the two seasons in a year an average rainfall is very negligible, hence the data given in table 1.2.2.2 is the only average of four months (Monsoon season June to Sept, of the respective year) since 1980 to 2003. In last 24 years the minimum rainfall recorded at Lonar is 407.4 in the year 1985 and maximum rainfall recorded is 1851.6 in the year 1998 as shown in Fig. 4.

Table 1.2.2.2
Yearly rainfall data of Lonar

Sr. No.	Year	Rainfall (mm)
1	1980	648.0
2	1981	793.6
3	1982	696.0
4	1983	908.0
5	1984	699.0
6	1985	407.4
7	1986	570.0
8	1987	1086.0
9	1988	1193.0
10	1989	896.0
11	1990	1379.0
12	1991	670.0
13	1992	809.0
14	1993	712.0
15	1994	543.0
16	1995	767.0
17	1996	815.0
18	1997	543.0
19	1998	1851.6

20	1999	950.0
21	2000	653.0
22	2001	1185.0
23	2002	1033.0
24	2003	491.0

Source: Office of the Irrigation department. Govt. of Maharashtra (Tq. Lonar Dist. Buldhana)

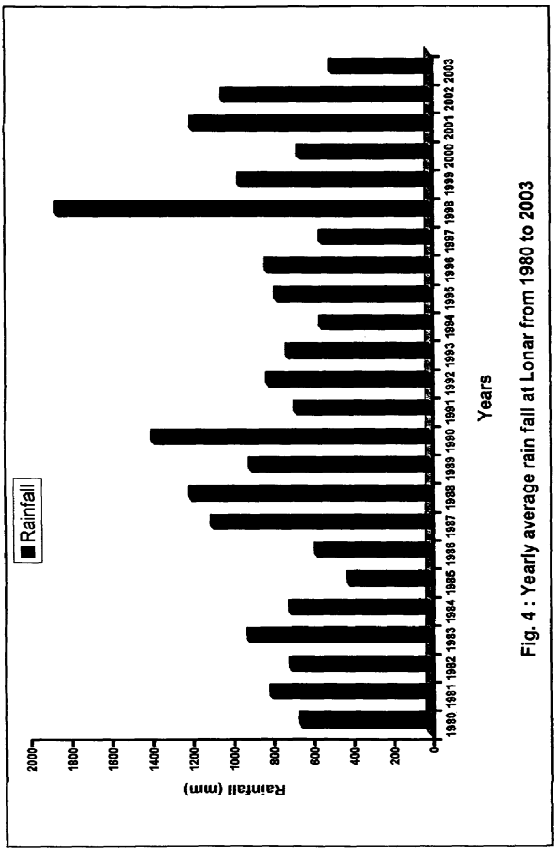
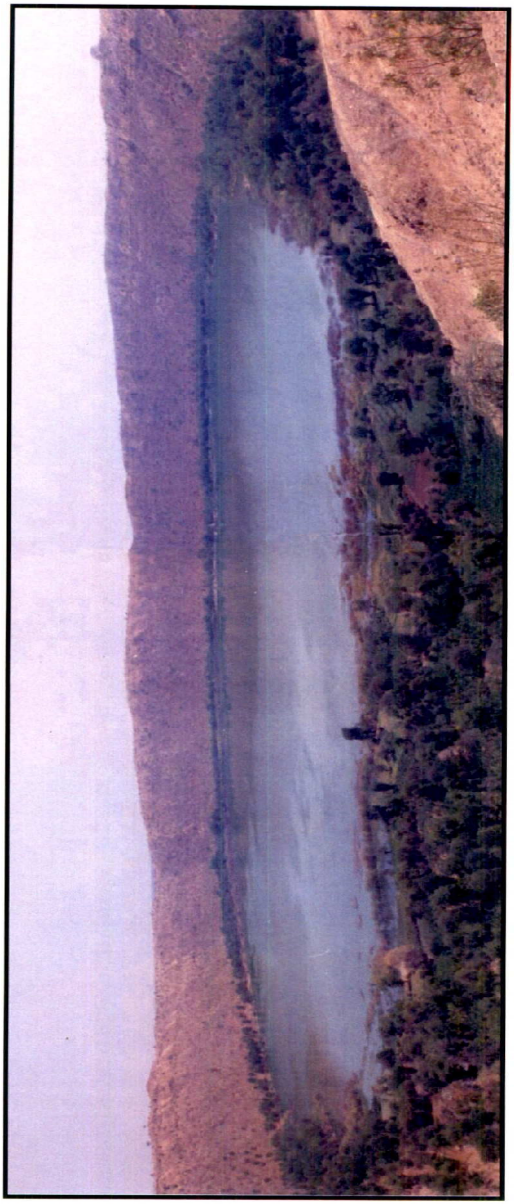


Fig. 4 : Yearly average rain fall at Lonar from 1980 to 2003

Plate III



Chapter-II

About The Lake

Physical set-up:

Millions of meteorites have hit the Earth in its life so far. Most of them probably would have fallen into the ocean as it covers nearly 71 % of the global surface. Some of the meteorites have created permanent impacts upon the crest of the Earth while some of the meteorites, though created impacts in former times, it is not possible for us to trace the exact effects because of the ravages of the time. Only about 140 impact craters have been recorded on the Earth so far. Lonar being the only one in basalt rock is unique. Such meteors normally create circular depression on the surface of the planet upon which they are attracted. Falling of meteor upon the Deccan plateau 52,000 years ago is one of a great land marks in the History of Earth. Meteor was 60 meters long weighing about 20 lac tons and its speed was 25 kms per second. It created the largest crater in the country with diameter of 1830 meters and a depth of 170 meters. Universally unique deep saline Lake has been formed at the bottom and a number of natural fresh water springs have been originated which constantly flow towards the basin.

The ecosystems of the Lake at Lonar and their investigation is the prime purpose of our study and which can be further differentiated into saline water ecosystem and fresh water ecosystem. The osystems are surrounded on all sides by a steeply rising escarpment in a nearly circular manner to an even height of 150 meters above the Lake except a creek on Southern part (Plate IV — d). The circumference of the lake is 6 kms on the top and along its

inner rim 3.5 kms with a deep saline Lake occupying most of its floor. There are fresh water streams of unknown origin on the North-Eastern side of the crater basin. The salty Lake water and the fresh water streams do not mix with each other having the pH 9.25 to 10.58 and 5.5 to 7.75 respectively containing the distinct flora and fauna.

The Lake is closed one without any outlet and unique due to its high salinity, alkalinity and biodiversity. Life came into existence in the lake water. Water is the most vital abiotic component of the Lake ecosystem. From about last two decades there is considerable increase in water level of the Lake. However between 1970 to 1985 the Lake water dried every year in summer and in rainy season the water accumulated. In 1985 the water level in the Lake was so less that a great extent of the Lake basin got exposed along with encrustation of salt (R.M. Badve et al. 1993).

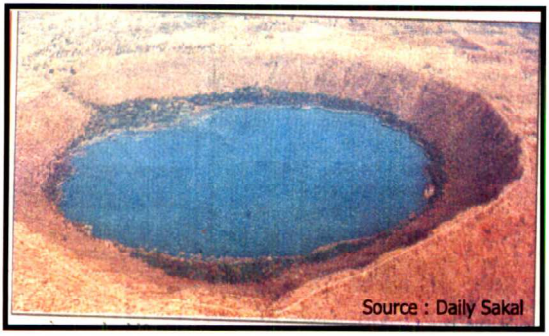
The following geological characteristics of the Lake at Lonar are clearly distinct.

1. It has an almost perfectly circular shape with five clearly distinguishable zones.
2. The outer most ejecta blanket.
3. The Lake basin.
4. The rim resulted due to the upward lifting of rock beds.
5. The slopes of the Lake.
6. The Lake formed by the accumulation of water in the lower parts of the basin.

Due to hypervelocity impact of a huge meteorite the basalt rocks from the site of the Lonar Lake show effect in the manner of conversion into molten lava or material which then got ejected and thrown all round the depression, and later on formed the present day ejecta blanket (Plate IV —a). On an average about 1350 meters

from the Lake rim a continuous ejecta blanket extends outwards and slopes gendy (20 to 60) away from the Lake. The ejected material of crushed fragments along with some large stones has been found as long as 2 km from the Lake (Plate - VI — c). The ejecta blanket has mild slopes, which finally merges into the surrounding area.

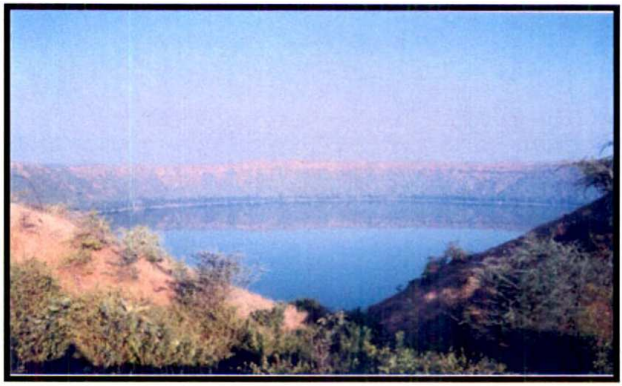
Plate – IV



a) Arial view of Lonar crater showing an Ejecta blanket

b) Forest around Lonar lake inside the crater Eastern side

c) Forest around Lonar lake inside crater Southern side



d) View of creek in the Southern part of the Lonar crater

The Lake basin is a ponder, flat and mainly consists of (i) slightly raised up plains and mild slopes between the shores of the Lake.

The edges of the saline water LAke and (iii) the saline water Lake ecosystem. Some where the mild slopes are raised up into barren plains while some other places

they are covered with dense forests (Plate - IV - b, c). 52 acres of land on the northeastern side of the Lake is under cultivation. The basin is intervened by the three perennial and a number of seasonal springs running down the rim slopes (Plate - V-c). Because of the low level of the Lake from the surface area, it serves as a percolation basin. It is considered that a good share of the Lake water is to be derived from the percolation streams supposed to be present at the bottom of the Lake particularly towards south near Kamalaja Devi temple.

The fresh water streams present in the Lake basin contain a few percentage of salts. Years together the Lake basin without any outlet is filled with natural waters along with salts. Due to continuous evaporation of water and deposition of salts in the Lake basin, the present day unique saline Lake of the world with very high salinity and alkalinity has been formed.

Due to very high salinity and alkalinity the Lake has evoked much scientific attention from time to time and a number of theories have been postulated to explain its salinity and alkalinity.

La Touche (1912) has proposed that the presence of sodium salts in the Lake is because of (i) Leaching of trap rocks by percolating streams giving rise to sodium salts (ii) the chloride present may be wind borne from Arabian Ocean in the form of sodium chloride.

In this respect to know the nature of underground water in the villages surrounding Lonar, an intensive survey of wells has been performed within a radius of 3 miles. It has been observed that in Lonar town there are about 12 wells where the water is brackish and the degree of salinity differs from one to another. Out of 12 wells very few are completely unpotable, while others are having different percentage of alkalinity. In surrounding villages it

has been observed that there is at least one well with unpotable water.

The presence of feeder streams at the bottom is not confirmed till today but it cannot be ruled out completely. Due to the alkaline nature of an environment, soft, sticky soil in the bed, the floor of the basin has become extremely colloidal and resulted in the formation of swampy conditions. Under these conditions it is verY difficult to observe the presence of any feeder streams at the bottom of the Lake. As per the information from the local inhabitants, there are two extremely deep portions in the southwestern side of the Lake bask, which are called “Aris”.

Plat V

a) Largest fresh water stream - Dhara

b) Fresh water stream - Sita Nahani

c) Seasonal fresh water streams in the vicinity of the Lake

d) Fresh water stream - Ramgaya

According to previous observations about the wells and the underground water sources from surrounding area, it shows that the surrounding water contains considerable amounts of chlorine, carbonate, bicarbonate, sodium, sulphate, calcium and magnesium. The elements like sulphate, calcium and magnesium are absent in the Lake water.

The alkalinity of the Lake may be due to underground springs feeding the Lake. Continuous evaporation for years together and interactions of the salts in the Lake along with addition of inorganic compounds through rain and wind and the biomass existing in the Lake water are other causes for the present high salinity and alkalinity.

Nainly four fresh water streams are present in the Lonar Lake which are continuously flowing. It is one of the major unsolved mysteries in relation to the origin of water in these streams coming from a relatively dry region. Even in the month of Nay the streams are flowing normally with a very little effect of the summer season. The largest of all streams is the “Dhara” present at the top of the Ghat on the north eastern side of the Lake (Plate - V - a). The stream of the “Dhara” is fed by a number of small streams out of which only two are perennial. The yield of Dhara is quite solid in two seasons and even in summer it is sufficient to fulfill the need of drinking water of nearly fifty percent habitation in the town.

The second fresh water stream is commonly known as Sita-Nahani, which is present about 200 feet lower from the Dhara (Plate - V - b). The third fresh water stream is present about 60 feet apart from the Dhara on the top of the Ghat which flows for about eight months in a year. The fourth fresh water stream is present just about 30 feet apart from Ramgaya temple towards the eastern side,

I‹xated within the present forest nursery (Plate - V - d). A little tank is constructed near this stream which is fed with the same potable stream water.

As the Lonar Lake area is scanty for potable water the local inhabitants and constantly visiting devotees normally use stream water for drinking purpose. Although there is a constant supply of fresh water through natural streams, it is specifically noted that the flowing water is not at all mixed with the saline Lake but is used for the agriculture purposes.

It is interesting to note that whenever a pit is dug on the southern edge of the saline Lake, fairly fresh and quite potable water soon gathers which is normally ranging between a pH of 6.5 to 7. 5. Local inhabitants create small pits known as “Chhua” in summer around the Lake in order to get potable water for themselves and for the domestic animals (Rate - VI - a). There is a big permanent pit in front of Kamalaja Devi temple yielding potable water throughout the year. The water level in this pit is almost at the same level as that of the Lake. From last three years due to the continuous increase in the water level of the Lake the said pit is completely submerged in the Lake itself.

By not only studying the previous literature but also by discussions made with a number of senior citizens living in the vicinity of the Lake an interesting thing was disclosed. There is a well, known as “Saasu-Soona chi Barav” about 50 feet inside the Lake in front of Kamalaja Devi temple quite ahead of the pit. The well has fresh potable water on the side of the temple while on the opposite side the water is totally brackish. The well is not having any specific divider, which means the well having two sections without any partition wall. The presence of fresh water towards Devi temple and brackish water towards the saline water body of the Lake in a single well

is an unimaginable truth. However the constantly increasing water level of the saline Lake has first of all taken this typical well into its grip much before it captured the previously mentioned pit and at present nothing can be told about the specific quality of water which the well had in the former times. The existence of the underground fresh water springs can logically be taken in to account as the Chhua pits and the said “Saasu —Soona Chi 8arav” having fresh potable water different from that of the Lake.

Plate VI

a) Man made pit -chhua towards Kamalaja Devi temple during summer containing potable water

b) Papad khar from Lonar lake before 25 years – used for eating purpose

c) Rock samples collected in the vicinity of Lonar lake (Collection Bugdane S.T.)

d) Papad khar from Lonar lake before 25 years - used for washing purpose

Origin:

As per the available literature there are mainly three opinions regarding the origin of the Lake. First attributing the origin of crater to an extinct volcano. Second attributing that the hollow was caused on account of the collapse of the roof of a large blister, elevated by the inrush of vapour or molten lava and the third suggesting that the Lake is formed by hypervel‹x:ity meteoritic impact and the gigantic explosion followed by it. The origin of crater appears to be explosive, subsidence or impact.

Nedlicott and Blanford (1879) suggested that the depression originated by a singularly violent volcanic explosion, unaccompanied by the eruption of lava and the hollow had been made by denudation.

G. K. Gilbert (1896) the famous geologist showed Lonar Lake's similarity with "Barringer" crater. He proposed two opinions for Barringer crater's origin, to be volcanic and meteoritic. Based on primary tests he refused meteoritic origin and declared it to be a volcanic one.

T.H.D. La Touche (1912) is a strong supporter of the subsidence theory. He suggested a systematic series of borings to find out the actual cause.

N.C. Nandy and V.B. Deo (1961) have sugqested that the Lake must have been originated from a crypto-volcanic explosion as there is absence of pyroclastic material and effusion of lava.

Eugene.C. Lafond and Robest S. Dietz (1964) suggested that the Lake has been an impact crater and originated some fifty thousand years ago. They observed that the crater is highly circular in diameter and has a characteristic depth to diameter ratio of an impact crater.

V.K. Nayak (1972) observed glassy objects at Lonar Lake site of varying size from 1 mm to more than two inches, which can be formed by melting and fusion of

rocks during an impact. In drilled out material he observed breccia with shocked metamorphosis.

K. Fredrikson, D.J. Milton, A. Dube and M.S. Balsundaram (1973) discovered breccia with shatter cones and material containing maskelynite. Fredrikson e/ a/. (1979) found that the geological material of Lonar Lake is very similar to the samples of rock brought from impact craters created on the surface of the moon.

The presence of glassy objects from 1 mm to more than two inches, breccia with shocked features, broken and twisted plagioclase, feldspars, strongly oxidised basalt, breccia with shatter cones, maskelynite, all these are the features of shock metamorphosis associated with rock that receives an hypervelocity impact. For the formation of maskelynite a very high pressure is required. The pressure required is approximately 4 lakh times more than the average atmospheric pressure on the earth. Maskelynite formation is impossible due to volcanic activity. All these evidences along with near perfect circularity of Lonar Lake proves the meteoritic impact origin. Based on this Geological survey of India erected a stone one the edge of Lonar crater showing its meteoritic origin in 1975 (Plate - XIII — a). Thus the origin of Lonar Lake proved to be of meteoritic impact in 1973.

Sengupta e/ a/., (1997) based on the properties of impact glasses found at the Lake site, estimated an age of Lonar Lake to be about fifty two thousand years.

Plate VII

a) Dcityasudan Temple in Lonar Town

b) Beautiful carvings on the temple like "Khajuraho"

c) An Idol of the Daityasudan

d) An Idol of the lying Hanuman showing the effect jof magnetic field

A) Daityasudan Temple in Lonar Town
B) Beautiful carvings on the temple like “Khajuraho”

Mythology and Historical Importance:

According to Ghanekar (1996) the references of the Lonar Lake are available in the Skand Purana and the Padma Purana (Viraj Mahatmya Adhaya 14 Shloka 11-19). Lonar is referred as Vishnu Gaya in the Padma Purana (Adhaya 18 page 1755 edition of 1894 by Chi Anandshram). There are amusing stories about the origin of the Lake and the same are included in the Lonar Mahatmya. Besides this the references are also found in the Anand Ramayan - Yadnakand (Adhaya 8 shloka 10-13); Lila Charitra (Part 1-2-3 by Nene), Ratnamala stotra by Keshiraj Vyas and Mahanubhav Rukmini Swamyamwar. The Lake is known as Viraj tirtha especially in the ancient literature.

In Buldhana district Gazetteer 1976 a very interesting story is given from the Skanda Purana which is as follows.

“Once there was a demon called “Lonasura” who lived in an underground place and often troubled God and fought with them. Lord Vishnu assuminq the form of Daityasudana took the help of Lavanasura’s sisters and buried him in a pit and finally killed him. The pit was created by lord Vishnu with applying the force from his toe and a Idrge lid from the ground was thrown about 36 miles south west of Lonar, the spot presently known as Datephal. The water of the Lake is nothing but the blood of the dead demon and the salt present, is supposed to be his decomposed flesh”.

Lonar Mahatmya contains the other amusing story about Lake’s origin. It informs that Kashyapa gave birth to a son named Lavanasura. He was a hearty worshipper of Lord Shiva and the God accepted his worship. At the same

time a voice from the sky said that a two-year-old child would be responsible for his death. In search of his future killer Lavanasura wandered on the Earth, the Heaven and the Hell. Because of the Lavanasuras fear other Gods ran to Vishnu for help, who promised to destroy Lavanasura. Vishnu assuming the form of a handsome youth "Daityasudana", killed Lavanasura by Bking Demon's sisters help. Later on Vishnu set free the two sisters of the Demon and completed the last wish of Lavanasura that after his death the spot should become a place of pilgrimage and the water in the Lake be beneficial to cure the diseases of the people.

Besides these, there are numerous mythological stories about the origin of the temples located in and around Lonar Lake. For example it is believed that Sita-Nahani of today is created by the Goddess Parvati. The name Sita Nahani is because of the reason that Sila bathed in the Lalita tirtha during the return journey from Lanka to Ayodhya. In this way Lonar Mahatmya mentions all religious spots of Lonar. According to Ghanekar (1996) the Adiparva in the Mahabharata also gives an interesting story about Lonar Lake (Adiparva, Adhaya 20 Shloka 2). In Puranas Lonar is also known as Bairaj Thirtha or Panchaspar.

A number of historical references through out the country are available in various documents. As per the historical account Lonar is the most ancient town in the district Vardha. The socio-economic and religious references are found only after the 12" century. The complete area was a part of the Ashoka's Empire. It was also a part of Chalukya and Rashtrakuta Empires. During the rule of the Moghals, Yadavas, Nizams and the British Lonar was an important trade centre along with a well-known religious spot.

Limited information is found in literature of the Nahanubhava sect, as well as in "Anie-Akbari" chronicles. In the past this town was reputed for it's glass, soap and salt. As per the information available in Anie-Akbari, in Lonar the raw material required to make glass were richly available. There was a glass factory named "Onama" in the period of Emperor Akbar in which the salts from Lonar Lake were used in the preparation of glass. In Akbar nama it has been quoted that Emperor Akbar liked the soap from Lonar because it was useful for skin diseases.

Plate VIII

a) Agricultural activities towards North-Eastern side of Lonar lake (Arial view)

b) Cash crop Banana from the Lonar lake

c) A young child engaged in the activity of deforestration inside the Lonar lake

d) Effect of Deforestation

The salt industry in this region was very famous. The water of the Lake evdporates leaving behind salts, classified into three catagories (a) Papadi, (b) Bhukshi and (c) UIIa, with variable cost depending upon the purity of the salts (Rate - VI - b, d). Revenue record showed a variable amount of an income from the sale of salt, of Lonar Lake.

Peshawa Raja Chandumal, the Minister of the Nizam of Hyderabad, considering the religious importance of Lonar presented "Lying Hanuman" to the religious trust. Nany great historical personalities like Emperor Akbar, Emperor Shahanjahan, Nanasaheb Peshwa etc. had visited the Lonar Lake.

Temples:

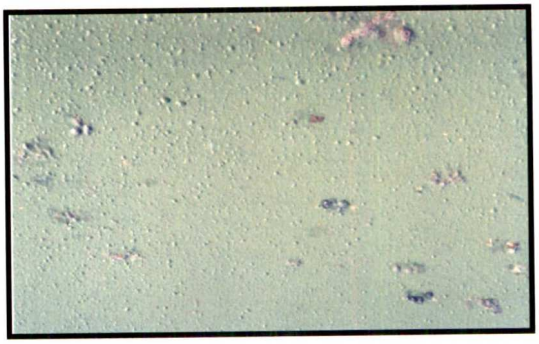
It is believed that the temple architecture in Maharashtra begins from the 11" century A.D. The Temples built in the Yadavas period are known as Hemadpanti temples. The temples in Lonar are Hemadpanti. There are thirty-two temples, seventeen monuments, thirteen kundas and four inscriptions at Lonar. Besides saline Lake another striking feature of Lonar is the presence of Hemadpanti temples. These temples have attracted researchers working in the field of History and Archeology. As compared to other temples, Daityasudana temple located in Lonar town is very well preserved temple (Plate — VII - a, c). It's main attraction is the beautiful carvings in the stone showing erotic sculpture like "Khajuraho" (Plate - VII — b). The temples around the Lake are also attractive but are damaged.

Plate IX

a) Water level of the Lonar lake before four years

b) Increased water level of the Lonar lake after four years

c) An Idol of the Kamalaja Devi inside the temple



d) Dense algal development inside the Lonar lake

One more addition to the uniqueness of Lonar is the temple of Lying Hanuman just near the Amber Lake. An Idol inside the temple measuring about 7 feet long is made up of porous stone in a lying position and shows the effect of magnetic field (Plate - VII - d}. The pointer showing north south directions in Mariner's compass is deflected.

Out of thirty-two, sixteen different temples are located inside the Lake at various places. Nost of them are in a damaged condition. The list of temples is as follows.

Ramgaya temple (This group has three temples) Vishnu temple, Wagh Mahadev temple, Mora Mahadev temple, Goddess Kamalaja Devi temple, Ambarkhana Mahadev temple, Mungla Mahadev temple, Chopda Mahadev temple and group of four temples at Dhara or Ghat. Out of all these temples maximum are of Lord Shiva' (Seven temples). Besides these there are the temples of Lord Ganesha, Jagadamba, Kamalaja Devi, Vishnu and other Gods. Of all, the most important and most frequently visited temples are Kamalaja Devi Temple, Dhar group of temples and Ramgaya temples. Remaining all are the permanent abodes of animals like Bat, varanus etc. Plenty webs of funnel shaped spiders are found at the angles of many temples. Due to constant flow of Devotees through out the year and especially during the Navaratri festival Kamalaja Devi temple is fairly well maintained (Plate - IX - c).

Amber Lake:

There is circular depression in Lonar about 700 meters apart from the main Lake towards north side, which is known as Amber Lake. The diameter of this depression is about 340 meters and the rim raises about 6 meters from the ground level. According to Kardile Sujata (2002), S. Master has thought that the Amber Lake is believed to have been caused by the impact of a smaller piece of the meteor which splited from the main body before it hit the ground. This crater is filled with fresh water forming a Lake. In 1973 Fredrikson thought that the fragment formed the Ambar Lake, ejected from Lonar Crater. Till today no major geological research has been performed to confirm its origin. The Amber Lake gets dried for a longer period in a year since 2000 (Plate — XI - c).

Human Hazards:

As the land is well fed with fresh water streams, the

underground water level inside the Lake basin is high and the soil is enriched with minerals and other nutrients required for good yielding of cultivated crops. About 52 acres of land towards northeastern side from the Lonar Lake basin is under cultivation where agricultural activities are done (Plate - VIII -a). The cultivated crops include vegetables, Bananas, papayas, cotton, wheat etc. (Plate - VIII - b).

The agricultural land under cultivation in Lonar Lake basin is responsible for an adverse impact on Lonar Lake altering the ecological conditions of Lake Ecosystem. Now a days the cultivation of cash crops using modern techniques and introducing chemicals, pesticides, insecticides, fertilizers etc. in the said cultivated land is becoming very harmful. The agricultural land in the Lake basin is very ancient. The owners' (66} of the agricultural land dwells in Lonar town and there is no residence of any owner inside the Lake. As per the revenue records there is no evidence explaing the transfer of land to private owners by the government. However their ownership was confirmed in 1940.

Alongwith the farming, some other activites are also practiced in the Lake premises which include deforestation (Plate - VIII - c), grazing of domestic animals, collection of fire wood, collection of minor forest product, hunting etc. The problems of deforestation, grazing of domestic animals, and hunting have been increased because of the simple fact that the owners of the agricultural land spend their whole daytime inside the Lake. The toxic and biodegradable traces of chemicals used are also threatening the specially adapted micro flora and fauna of the Lake. All these activities cause drastic imbalance of the ecosystems (Plate - VIII - d). In order to save the unique ecosystem, it is strongly recommended to the Government

of India to any how confiscate the private lands in the Lake premises and to prohibit the aforesaid activities with iron hand as immediate as possible.

Plate X

a) Spot "A" fresh water

b) Spot “B” saline water

c) Spot“C” saline water

d) Spot“D” fresh water

The Lake area is a well-known tourist spot and recently declared as "A" grade tourist spot by the Government (15 Feb. 2001). It is also a place of pilgrimage. There is a continuous flow of devotees and other visitors. The devotees perform their Puja in the temples surrounding the Lake, however some of them throw unwanted waste material like papers, carry bags, plastic bottles, cartoons etc. any where in the Lake premises which form the large piles of garbage. The Intensity of this problem increases at the time of "Yatra" period. Most of these substances are non-biodegradable and if they are submerged in the Lake water, they change the quality of water.

Being selfish, Human being play w important role in disturbing the natural habitats of other organisms. The problem is greatly enhanced due to hunting (Plate XVIII b), throwing stones at birds and monkeys etc., breaking branches of trees, all resulting into unreparable loss.

The other major problem to the Lake ecosystem is due to water pollution. Here also human beings play an important role. In addition to sewage the domestic wastes flow along with the stream water and finally dumped into the Lake. The streams like, Dhara, Sita Nahani and

Ramgaya are greatly polluted by people practicing the activities like, bathing, washing domestic animals, cloths washing and by laying faecal matters every day (Plate - XI - d). The water pollution is basically due to a constant flow of wastewater in side the Lake from northern side. Due to the scarcity of water in the surrounding area I‹xaI inhabitants have been using the stream water for carrying garbage.

The role of soaps, detergents, in the process of water pollution is considerable one, which are used by the people constantly. Conventional soaps are relatively biodegradable and the detergents have a longer toxic effect.

The pollution load is highest in the Lake basin, which directly affects the biodiversity of Lonar Lake ecosystems. The best solution to avoid all this is to ban the followinq human interventions:- (i) The use of chemical fertilizers, inside the Lake agricultural land, (ii) The use of soaps, detergents at the fresh water streams inside the Lake, (iii) prevent the flow of waste water inside the Lake, (iv) Addition of garbage through water streams by the local inhabitants and (v) Encourage peoples for the use of modern toilets.

In south western direction about 2 kilometers apart from the Lonar Lake site, in Deulgaon — Kundapal village a small percolation dam is constructed in 1984 by the Department of Minor Irrigation (Plate — XX - d). The total impounding capacity of the tank is 2.8 NCFT with an irrigation capacity of 250 acres. The water level of the main Lake has been considerably increasing. In a span of about five years there has been considerable increase in the water level, which can be attributed to high precipitation during monsoon for last four years (1989-1992). The water level has distinctly been increased by about 4 m (Badve et

al. 1993). During the present work it has been observed that in a span of about four years the increase in water level of the main Lake is also considerable one. From (1999-2003) the water level has been increased up to 6 feet (Plate - IX - a, b). As per the available literature the increase in water level has been observed since 1985 the year when the construction of the dam was completed. The increase in water level can be attributed partially due to the percolation tank, which is constructed near the Lake. There is a great chance of percolation due to the difference in the height of the water level in the dam ard the Lonar Lake site. Such a percolation is quite possible due to meteoritic impact origin. Continuous increasing water level in Lake is responsible for changing the ecological characteristics of Lonar Lake.

Limnology is a young science in India under which all types of fresh and saline water ecosystems are studied. When considered about the limnology of Lonar Lake it has been observed that very little work has been performed. Basically it remained unnoticed due to the naive faith that the biomass present in the Lake is very common as observed in other ecosystems, except the microbial flora of Lake. This ultimately neglect:s the unique ecological conditions established due to the unusual origin and the characters of the Lake. The ecological potential of Lonar Lake in a very unique geo-morphological and hydrobgical condition should be studied separately. Lonar Lake is reputedly the only worlds largest terrestrial impact crater formed by hypervelocity meteorite in basaltic terrain with an unique water body whose salinity and alkalinity is very high and in a span of thousands of years together the life evolved in it.

There are great changes for organisms to grow in different directions due to the availability of several kinds of

ecosystems resulting into bio-diversity. The huge depth of Lonar Lake isolates the organisms growing within it from the surrounding ecological nitches leading to the evolutionary aspects. Considering all the facts, the present work has been undertaken.

Plate XI

a) Dr. Kshirsagar H.S. (Research guide), Dr. Kulkarni S.A., research student Deshpande R.P. and the Lake

b) Mr. Bugdane, S.T. explaining about rock samples collected from Lonar crater

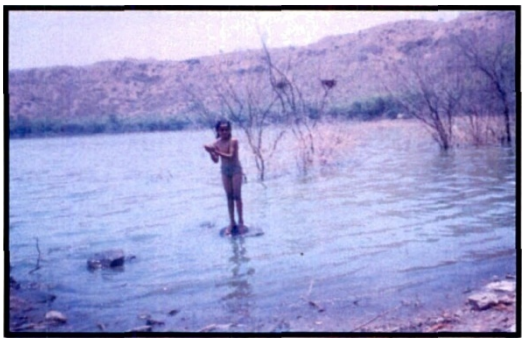
c) Amber Lake

d) Human interference

Plate XII

Swimming activity inside the Loner lake
lake Spot “c”

Bathing activity inside the Lonar



Bathing activity inside the Lonar lake Spot “C”

Bathing activity under Dhara stream

Chapter – III

REVIEW OF LITERATURE

Blanford W.T. (1868) travelled on the route from Poona to Nagpur via Ahmednagar, Jalna, Lonar, Yeotmahal, bengali and Hingunghat. He visited Lonar lake Nedlicott and Blanford W.T. (1879) suggested that the depression originated by a singularly violent volcanic explosion, un-accompanied by the eruption of lava, and the hollow had been made by denudation. G.K. Gilbert (1896) for the first time pointed out the similarity between the Lonar and the Barringer Crater in Arizona. He took some primary tests and rejected the meteoritic origin of the Barringer Crater and declared it as a volacanic one.

T.H.D. La Touche and Christie W.A.K. (1912) worked on the geology of the Lonar Lake. La Touche was a strong supporter of the subsidence theory, which was firstly proposed by Orlebar A.B. and suggested to work on a systematic series of borings to find out the actual cause for the origin of the Lonar Lake. Pruthi, H.S. (1933) worked on the bionomics of fresh water in India, seasonal changes in physical and chemical conditions of the water of the tank in Indian museum compound.

Chaco e/ a/. (1949) worked on some observations on the Adyar River with references to its hydro-biological conditions. Jhingran

A.G. and Rao V.K. (1958) carried out their research on the Lonar Lake and its salinity. Beals C.S. et al. (1960) tried to search fossils of meteorite craters. Nandy N.C. and Deo D.B. (1961) worked on the origin of Lonar Lake and its salinity. Arogyaswami R.N.P. (1962) worked on the Lonar

Lake. Lafond E.C. and Dietz R.S. (1964) carried out their work with respect to the origin of Lonar Lake and suggested that the Lake might have been an impact craters and originated some fifty thousand years ago. Venkatesh V. (1965) studied the geochemical evidences for the origin of Lonar crater. Arora, H.C. (1966) has worked on Indian Rotifera. Hawkes, H.E. (1966) carried out his work with respect to the Geo- chemical evidence for the origin of the Lonar crater. Venkatesh V. (1967a and 1967b) described geochemical data of Lonar crater and once again described about geology and origin of Lonar crater.

Nayak V.K. (1972) recognized glassy objects resembling impact glasses for the first time from Lonar crater. He has described physical, chemical and optical properties of glasses collected from Lonar Lake whose data provides possible evidence to support an explosive meteoritic impact origin of Lonar crater. Fredrikson K. ed a/. (1973) discovered breccia with shatter cones and material containing maskelynite from Lonar Lake. He proved the origin of Lonar Lake for the first time beyond doubt, to be of meteoritic impact. Gazetteer of India (1976) of Buldhana district in Maharashtra State narrates an Interesting story about the origin of Lonar Lake. Schaal, R.B. (1976) worked on the shock metamorphism in basalt from Lonar crater, India and six Lunar micro craters.

Kieffer S.W. et a/. (1976) worked on shocked basalt from Lonar impact crater and it's experimental analogues. R.F. Fudali et a/. (1978) worked on gravity reconnaissance at Lonar crater. Chowdhury

A.N. and Handa B.K. (1978) carried out their studies on geochemistry of Lonar Lake water. According to them the composition of Lonar Lake water is of the Na - CO3 - HCO>CI type with pH around 10, the absolute concentrations of these ions varying with season. Attempts

have been made by them to explain the contrast in the chemical composition of the Lake water and that of the influent springs. Fredrikson K. el: al. (1979) discovered firstly about the similarities of material collected from Lonar Lake with that of the material from lunar impact craters. He worked on the petrology, mineralogy and distribution of Lonar and Lunar breccias and glasses. Fudali R.F. et al. (1980) worked on the morphology of Lonar crater and discussed comparisons and implications about Lake.

Crawford A.R. (1983) worked on the mantle convection pattern under India: relevance to Lonar crater, Girnar node and peri Indian volcanism. Subrahmanyam B. (1985) worked on the geological aspect of Lonar Lake. Murali A.V. et al. (1987). Firstly observed tektite like bodies from Lonar crater site. Mishra, S.P. (1987) worked on the Lonar Lake and co-linear carbonatites of western India. Fudali R.F. and Fredrikson K. (1992) carried out their work on the tektite like bodies from Lonar crater and concluded that the tektite like bodies are in fact high sodium (up to 22 ^/ Na2O) artificial glasses and so need not be explained by unrealistic natural mixing models. Subbamma D.V., Rama Sarma, D.V. (1992) carried out their work on the water quality characteristics of a temple pond near Machilipatham. Nathew Varghese e/ a/. (1992) has worked on hydrobiologically polluted Tropical pond-I physico-chemical characteristics.

Badve R.M. et a/. (1993) worked on the Eutrophication of Lonar Lake. For the first time he pointed out considerable increase in water level of Lonar Lake in recent years. He studied the phytoplanktons of Lonar Lake consisting of eight genera of which three are dominant as viz. Spirulina, Arthrospira and oscillotoria. He suggested that spirulina present in Lonar Lake, as being a protein rich blue green alga, could be commercially exploited, there by

giving proper status to this neglected inland salt water Lake. Jindal R. and Kumar R. (1993) have worked on limnology of a fresh water pond of Nalagarh. Paul Hodge (1994) published a paper about meteorite craters and Impact structures of Earth.

Maharashtra in which he studied the temples of Lonar. Agrawal studied Archaeology of Western India in which much information is available about Lonar. Norwanchikar and Vyas studied ancient and historical remnants of Lonar in detail (Ph. D. thesis) Bramhanand Deshpande has also worked on the Lonar Lake. Literature is also found in Marathi Vishwakosh. Vijay Paranjape worked on Lonar crater and emphasized it to be a unique, hypervelocity meteorite impact crater in basalt. Marathi Vidnyan Parished Pune published a booklet “Lonar-meteoritic crater, a scientific Introduction. E.M.R.C. Pune University prepared a documentary film on Lonar Lake. An article is present in MTDC’s month!Y magazine “Pathik” about Lonar Lake.

Sengupta et a/ (1997) worked on the age of Lonar crater. Based on the thermoluminescence studies on impact produced glasses collected from Lonar they reported an absolute dating of this crater. According to them the formation age of Lonar crater is about 52,000 to 60,000 years. Kanekar P.P. ed a/. (1997) worked on the alkaliphilic salt tolerant bacteria isolated from Lake of the Lonar. Dabhade D.S. et al. (1998) worked on Lonar Lake, and suggested a unique saline water body. of ecological interest. Nalu R.A. et al. (1998) worked on morphometry, biodiversity, evaluation and creation of computerized data bank on Lonar crater. Econet Pune (1999) prepared a report on rapid environmental assessment, conservation and management plan for Lonar crater.

Kanekar, P.P. (1999) worked on the Bioremediation

of phenol by alkaliphilic bacteria isolated from alkaline Lake of the Lonar. Malu R.A. (1999) for the first time tried to include this Lake in the list of Ramsar site, for protection and conservation. Nalu R.A. et a/. (2000) has identified three species of the genus Branchionus, and mentioned the total absence of cladocera and copepoda the other two major groups of zcoplanktons. Sharma Dushyant and Jain Renu (2000) have worked on physico-chemical analysis of Gopalpura Tank.

Datta S.P.S. et al. (2001) has worked on hydrobiological studies on river Basantar samba. Sumati K. Sampemane (2001) published an article entitled, “The Hole Truth: Lonar a unique crater”, and pointed out that it has an exclusive ecosystem hance it must be developed in a tourist spot of high attraction and further a potential resource for scientific research. Mahajan A.D. (2001) worked on the biological studies of Lonar Lake. He concluded that Lonar crater is a geological mystery and astronomical curiosity. It is a natural Lake with high pH and salinity possesses terrestrial and aquatic biodiversity, which is undergoing eutrophication and suggested multidisciplinary approach for its exploration. Mohmmad Plusaddiq et a/. (2001) worked on the microbial diversity and ecology of Lonar Lake. According to them very high salinity due to chlorides and high alkalinity dv to an interaction between sodium chloride, calcium carbonate and water over a long period of time characterize the Lake water. Kule Vishwanath (2001) prepared a documentary under the guidance of Jayant Narlikar on Lonar Lake.

P.P. Kanekar e/ a/. (2002) worked on Ehe optimization of protease activity of alkaliphilic bacteria isolated from an alkaline Lake in India. Sujata Kardile (3.002) published a book “Care Lonar”, the only hypervelocity impact crater in basaltic rock. S.S.

Nilegaonkar et a/. (2002) worked on the prcduction, Isolation and characterization of extracellular protease of an alkaliphilic strain of Arthobacter ramosus, MCM B-351. S.T.

Mythological references are available in Viraj Nahatmya about Lonar Lake. Chi anandshram's padma puranas later volume refers Lonar Lake as Vishnu gaya. Besides that mythological references are also present in Anand Ramayan - Yadnakand, Lila Charitra (Nene) Ratnamala Stotra (Keshiraj Vyas), Nahanubhava's Rukmini Swayamwar and an Interesting story is present in Adiparva. Limited information is also found in the Aine Akbari chronicle.

S.T. Bugdane has published three booklets about Lonar crater as (1) Lonar The largest meteoritic crater in basaltic rock in India, (2} Beautiful crater Lonar and (3) Lonar dooms eyewitness. All these booklets are the out come of Nr. Bugdane's lifelong devotion for the study of Lonar Crater and focus on the information of the Lonar lake in various angles.

Chapter-IV

PHYSICO-CHEMICAL ANALYSIS OF WATER

Introduction:

Study on ecological characteristics of fresh and saline water ecosystems such as Lakes, reservoirs, streams, ponds, marshes, etc physico-chemically and biologically are studied in Liwnology. It is the young science in India. It is started as experimental ecology of fresh waters. F.A. Forel (1841 — 1912) is considered as the founder of modern limnology after his classic work entitled “Le Lamane”. Later on number of scientists worked on the study of fresh water abroad including, G.E. Hutchinson (1975), Welch (1952) and others. In India Swell, Pruthi (1933) were the pioneers in the field of Limnology, these were followed by Chacko (1949), Kodarkar (1998) and Trivedy (1998) are the major contributors in the field of limnology for about last 67 years.

Limnology is the study of all types of fresh and saline water ecosystems. It has major three aspects to study physical, chemical and biological status of water body. The physical .study includes, physiography, morphometry, Bathymetry, Temperature, conductivity, water volumn, water current etc. The chemical study includes, pH, dissolved oxygen, dissolved carbon dioxide, alkalinity, chlorides, salinity, hardness, sodium, potassium, Iron, nitrates, phosphates, silicates, ammonia and trace elements. Biological study includes planktons, nektons, zoobenthos, pendons and microorganisms such as bacteria, protozoa, fungi and also macro flora and fauna.

Besides the qualitative studies quantitative studies are also in limnology. These studies help to understand the co-relation between different groups of organisms and physico-chemical parameters. Thus Limnology is multidisciplinary branch of science.

Water is not only the most common liquid on the earth but it is the basic habitat for life. Water molecule is an inorganic compound formed with one oxygen and two hydrogen atoms, which are covalently bonded. In water adjacent water molecules are weaMy bonded that makes the water, “The liquid crystal”, providing anusual appearance to the water with unique properties. Water is an ’Universal solvent”, because of its unique properties it acts as a media for different living organisms. Water has another term in the field of ’Life sciences’, as ‘Liquid of life’, because of its major role in the formation of protoplasm in the cell which is the basic fundamental unit of life. About 65 to 70 per cent of the body of any organism is made of water Arora (1992).

Properties of water are —

The high density of water allows it to serve as bouyant medium for biota.

The water shows non-linear relationship between temperature and density, which helps for stratification of fresh and saline water Lakes.

The dynamic viscosity of water applies active resistance during swimming.

The viscosity of water also helps to reduce the exchange rate of gases, and ions between organisms and water.

High specific heat of water protects the living organisms from instant changes in the temperature of the water.

High dielectric constant makes water the best

solvent for inorganic substances and organic molecules.

The total absorption of long wavelength is responsible for surface heating of the water.

Physico - chemical characteristics of fresh and saline water ecosystem affect the abundance, species composition, stability, productivity and physiological conditions of aquatic organism populations. About 71 O/o part of earth Planet is occupied by water, out of which only 2.6 o/o accounts for fresh water and marine water habitat occupies a relatively large portion on earth surface.

Natural water along with rain water always contains certain quantities of impurities. Hence it is said that pure water does not exist in nature. But whatever quality exhibited by the water, suitable for any natural ecosystem is to be maintained. Any major as well as minor alteration in the quality of water directly affects on the biomass of that particular aquatic ecosystem. Any alteration in the physical, chemical properties of water leads to the health hazards or decreases the utility of water Trivedy (1998). Pollution is responsible for any alteration in the quality of any aquatic ecosystem. Basically two kinds of pollution occur, the natural and the artificial. An acid rain is the example of natural pollution of water. An artificial pollution of any water body causes due to, mixing of agricultural runoff, disposal of untreated sewage, addition of industrial wastes, addition of domestic wastes, human faeces etc. and other human activities in the vicinity of particular water body. The pollution invariable alters water quality, in turn influencing diversity of biomass and survival of biotic communities Chandrasekhar (S.V.A. 1996). This has resulted in the new concept of biological assessment and study of bio-indicators of water quality, in environment assessment of aquatic ecosystem.

Compared to extensive work done in relation to an

around research on aquatic environment in developed countries, the picture in developing countries is quite different. In developing countries majority of aquatic ecosystems still remained to be fully investigated and thus there is a vast scope to researchers in this field.

In India water bodies are mainly subjected to an adverse impact from three major factors; these are (i) Fertilizers and pesticides based intensive modern agriculture (ii) Industrialization and (iii) Population explosion. The influence of these factors varies in the magnitude depending on geographical location. In .the recent years environmental monitoring through regular assessment of water quality has become a crucial factor in the conservation of aquatic resources. Taking into consideration threats to the natural water bodies and biotic factors inhibiting in and around them. The rapid development of limnology tried to seize the know(edge and acted for the monitoring of quality of aquatic environment and behaviour of aquatic ecosystems through assembling work on biological components and their coaction with each other and their environment.

Material and Methods:

The techniques used during the present study are from American Public Health Association (1998). Standard methods for the examination of water and waste water (20 Edition) and from the book by Kodarkar (1998) : Nethodology for water analysis Indian Association of Aquite Biologists Publication, Hyderabad.

For the limnological study of Lonar Lake, to get an overall idea about seasonal fluctuations in the physico-chemical parameters of water, analysis of saline water as well as fresh water was done. The study was done with continuous and periodic records for complete two years (February 2000 to January2001 and February 2001 to

January 2002). To get an overall limnological picture of the water body physico-chemical parameters were studied at four sampling stations two each of fresh and saline wdter. Sampling stations were decided by considering possibilities of easy efficient visits, utilization of water and impact of human activities. Sampling stations were named as Spot A (fresh water), Spot B (saline water), spot C (saline water) and Spot D (Fresh water).

Spot A (Fresh water)

Spot “A“ is of fresh water. It is hated near Eastern side of the Lonar lake. Spot “A“ contains running water. The water at this spot is coming from a fresh water spring of unknown origin known as Ramgaya. The water from this spring is being used by the local inhabitants as well as visitors for various purposes like drinking, irrigation etc. (Plate — X —a).

Spot B (Saline water):

Spot “B” is of saline water. It is located near Eastern side of the lake. It is a stagnant water body. The water at this spot is being used by the people for bathing (Plate — XII -b) as one of the remedial measures concerned with skin diseases and also as a faith (Plate — X — b).

Spot C (Saline water):

Spot “C” is of saline water. It is located near Kamalaja Devi temple towards southern side of the lake. It is a stagnant water body. The water at this spot is being used by the people for swimming (Plate — XII —a) as well as bathing (Plate — XII -c) purposes. (Plate — X — c).

Spot D (Fresh water):

Spot “D” is of fresh water. It is located near Northern side of the lake. Spot D contains running water. The water at this spot is coming from fresh water streams of unknown origin like Dhara and Sita Nahani (mixture).

From these two fresh water streams; main fresh water stream known as Dhara contributes a lot. The water from these stream is being used by the local inhabitants, visitors and devotees for various purposes. One of them is the faith to take a bath (Plate — XII — d) under Dhara stream. (Plate — X — d).

The water sample collection for physico-chemical parameters of water was done early in the morning once in a month for complete two years from February 2000 to January 2001 and February 2001 to January 2002. Nost of the physico-chemical parameters like, colour, odour, taste, temperature, pH, hardness were recorded on the spot during visit to the Lake at the four sampling stations with the help of portable water analysis kit Kodarkar (1998). Samples for remaining parameters were collected in acid washed opaque glass container of one liter from the desired depth. Separate samples were collected for dissolved oxygen in half liter glass container (Reagent bottles) and treated with Winkler's solutions to get the accurate value. The samples were carried to the laboratory for further analysis.

To study the Limnology APHA (1998) provides the basic methodology for the analysis of physico-chemical and biological parameters of fresh and saline water.

Observations and Results:

The results of different physico-chemical parameters of fresh and saline water of Lonar Lake samples, collected and recorded at the time of sampling from four sampling stations like spot A, spot B, spot C and Spot D are presented in tabular forms. As previously decided during February 2000 to January 2001 and February 2001 to January 2002, are presented separately of fresh and saline water in the tables

4.3.1.1 — 13 and 4.3.2.1 — 15, respectively.

Figures in the table 4.3.1.1 to 13 show monthly values of two sampling stations spot A and D for fresh water from February 2000 to January 2001 and February 2001 to January 2002. While figures in the Table 4.3.2.1 to 15 shows monthly values of two sampling stations spot B and C for saline water from February 2000 to January 2001 and February 2001 to January 2002. Table 4.3.1.14 and

4.3.2.16 shows yearly mean values of different physico-chemical

parameters of fresh and saline water respectively (complete two years). Table 4.3.1.15 and 4.3.1.16 shows all parameters at a glance of fresh water for complete two years. Figures in the Table 4.3.2.17 and 4.3.2.18 shows all parameters at a glance of saline water for complete two years. Table 4.3.1.17 and 4.3.2.19 shows seasonal mean values of physico- chemical parameters of fresh water spot "A and D" and saline water spot "B and C" for complete two years respectively. The results of the analysis of fresh water compared with earlier workers are shown in tabular form Table 4.3.1.18. The results of the analysis of saline water compared with earlier workers are shown in the tabular form Table 4.3.2.20.

Fresh water

Colour:

In the present investigation of Lonar Lake the colour of fresh water at spot A & D was recorded. It is between colourless to soil mixed colouration during first and second year of the study period February 2000 to January 2001 and February 2001 to January 2002 as shown in table 4.3.1.1. It was colourless throughout the year except in the months of July and August when rainfall occurs. The colour becomes soil mixed due to addition of runoff rainwater in the stream water. Colour of the water directly affects on light penetration through water surface.

Odour:

In the present investigation the odour of fresh water at spot A and D was found totally odour free during the complete study period (February 2000 to January 2001 and February 2001 to January 2002) as shown in table 4.3.1.2. It was found odour free throughout the study period because it is running water of stream without any chance of becoming stagnant water.

MONTHLY PHYSICO-CHEMICAL PARAMETERS OF FRESH WATER OF LONAR LAKE DURING FEB. 2000 TO JAN. 2002

Fresh Water Spot A & D

Table. 4.3.1.1 : Colour (Naked Eyes)

Season		Summer				Monsoon				Winter			
Nonth / Spot		Feb	Mar	Apr	Nay	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan
Feb 2000	A	Colour less	Colour less	Colour less	Colour less	Colour less	Soil mixed colour	Soil mixed colour	Colour less	Colour less	Colour less	Colour less	Colour less
Jan 2001	D	Colour less	Colour less	Colour less	Colour less	Colour less	Soil mixed colour	Soil mixed colour	Colour less	Colour less	Colour less	Colour less	Colour less
Feb 2001	A	Colour less	Colour less	Colour less	Colour less	Colour less	Soil mixed colour	Soil mixed colour	Colour less	Colour less	Colour less	Colour less	Colour less
Jan 2002	D	Colour less	Colour less	Colour less	Colour less	Colour less	Soil mixed colour	Soil mixed colour	Colour less	Colour less	Colour less	Colour less	Colour less

Table. 4.3.1.2 : Odour

Season		Summer				Monsoon				Winter			
Nonth / Spot		Feb	Nar	Apr	day	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Can
Feb 2000	A	Odour Free	Odour Free	Odour Free	Odour Free	Odour Free	Odour Free	Odour Free	Odour Free	Odour Free	Odour Free	Odour Free	Odour Free
Jan 2001	D	Odour Free	Odour Free	Odour Free	Odour Free	Odour Free	Odour Free	Odour Free	Odour Free	Odour Free	Odour Free	Odour Free	Odour Free

Feb 2001	A	Odour Free	Odour Free	Odour Free	Odour Free	Odour Free	Odour Free	Odour Free	Odour Free	Odour Free	Odour Free	Odour Free	Odour Free
Jan 2002	D	Odour Free	Odour Free	Odour Free	Odour Free	Odour Free	Odour Free	Odour Free	Odour Free	Odour Free	Odour Free	Odour Free	Odour Free

Temperature (0C):

In the present investigation the water temperature was found to vary between 18 to 32 at spots A and D. During first year of the study period February 2000 to January 2001, it was minimum (25) at spot "A" in the month of August 2000 and maximum (31) at spot "A" in the months of April and May 2000. During second year of the study period February 2001 to January 2002, it was minimum (18) at spot "D" in the month of December 2001 and maximum (32) at spot "A" in the month of May 2001 as shown in table 4.3.1.3 and Fig. S. The yearly mean values of water temperature at spot A and D are 28.41 and 28.29 during 2000- 2001, while 26.91 and 26.25 during 2001-2002 respectively, as shown in table 4.3.1.14. During winter the seasonal mean values at spot A and D are 27.75 and 27.87 (Winter I), while 23.5 and 22 (Winter II) respectively. During summer the seasonal mean values are 29.25 and 28 (Summer I), where as 29.25 and 29 (Summer II) at Spot A and D respectively. Where as during Monsoon the seasonal mean values of temperature at spot A and D are 28.25 and 29 (Monsoon I), while 28 and 27.75 (Monsoon II) at Spot A and D respectively, as shown in table 4.3.1.17.

Taste:

In the present investigation the taste of the water sample at both spots A and D was found to be sweet in the taste, throughout the study period from February 2000 to January 2001 and February 2001 to January 2002. It does

not show any variation in the taste as shown in table 4.3.1.4. As the crater area is scanty for potable water, local inhabitants and visitors normally use stream water for drinking and other purposes.

Table. 4.3.1.3 : Temperature (0C)

Season		Summer				Monsoon				Winter			
Month		Feb	Nar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan
	Spot												
Feb 2000	A	28	27	31	31	30	29	25	29	30	28	26	27
3an 2001	D	29	27	26	30	30	28	29	29	29	27	26	29
Feb 2001	A	26	29	30	32	28	30	29	25	24	22	19	29
Jan 2002	D	27	29	31	29	26	28	31	26	21	21	18	28

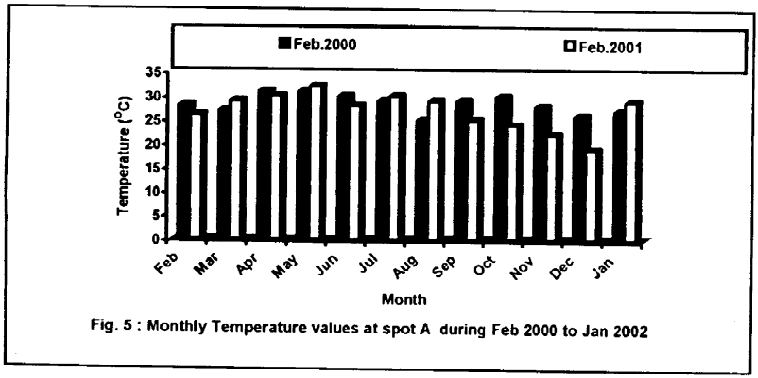


Fig. 5 : Monthly Temperature values at spot A during Feb 2000 to Jan 2002

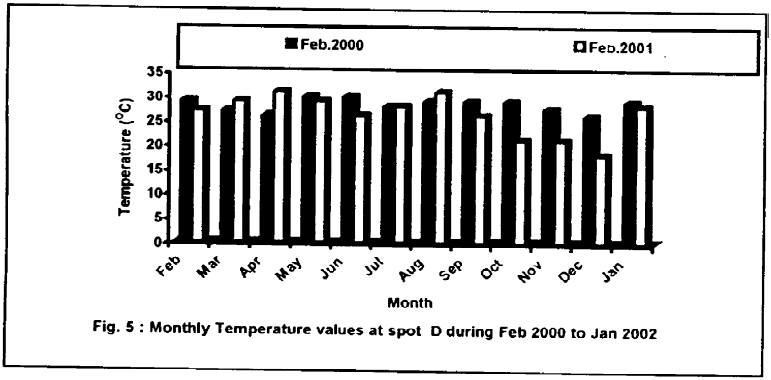


Fig. 5 : Monthly Temperature values at spot D during Feb 2000 to Jan 2002

Table. 4.3.1.4 : Taste

Season		Summer				monsoon				Winter			
Nonth		Feb	Nar	Apr	day	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Can
	Slot												
Feb 2000	A	Sweet	Sweet	Sweet	Sweet	Sweet	Sweet	Sweet	Sweet	Sweet	Sweet	Sweet	Sweet
Jan 2001	D	Sweet	Sweet	Sweet	Sweet	Sweet	Sweet	Sweet	Sweet	Sweet	Sweet	Sweet	Sweet
Feb 2001	A	Sweet	Sweet	Sweet	Sweet	Sweet	Sweet	Sweet	Sweet	Sweet	Sweet	Sweet	Sweet
Jan 2002	D	Sweet	Sweet	Sweet	Sweet	Sweet	Sweet	Sweet	Sweet	Sweet	Sweet	Sweet	Sweet

Hardness (mg/lit):

Originally, water hardness is understood to be a measure of the capacity of water to precipitate soap. Soap is precipitated chiefly by the calcium and magnesium ions present in the water.

In the present investigation of hardness, it was found that the values at spot A and D ranged between 212 to 405. In the first year of the study period Feb. 2000 to 3an. 2001 it was minimum (272) at spot “A” in the month of Jul. 2000 and maximum (405) at Spot “D” in the month of Jun 2000. During second year of the study period Feb 2001 to Jan 2002, it was minimum (212) at Spot “D” in the month of Nov. 2001 and maximum (386) at Spot “D” in the month Jun 2001 as shown in table and Fig. 6. Yeady mean vaues of hardness at spot A and D during the study period are 292.41 and 345.58 (2000-2001), while 293.16 and 291.33 (2001 — 2002) respectively, as shown in table 4.3.1.14.

In summer season the seasonal mean values of hardness at spot A and D are 298.25 and 336 during summer I, while 309.25 and 298.75 during summer II

respectively. In monsoon season the seasonal mean values at spot A and D are 285.75 and 337.5 during mons‹›on I, while 281.75 and 304.75 during monsoon II respectively. In winter season the seasonal mean values at spot A and D are 293.25 and 365.25 during winter I, where as 288.5 and 270.5 during winter II respectively, as shown in table 4.3.1.17.

Table. 4.3.1.5 : Hardness (mg/lit)

Season		Summer				Monsoon				Winter			
I Month		Feb	mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan
	Spot												
Feb 2000	A	301	297	305	290	300	272	278	293	295	290	292	296
Jan 2001	D	326	338	325	35S	405	280	330	335	367	369	386	331
Feb 2001	A	305	314	320	298	257	251	323	296	271	278	307	298
3an 2002	D	309	290	289	307	386	279	256	298	288	212	267	315

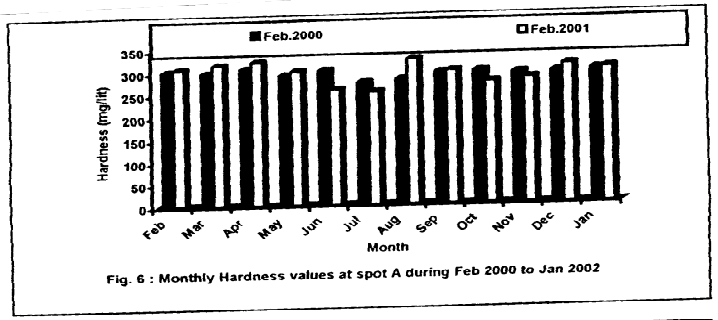


Fig. 6 : Monthly Hardness values at spot A during Feb 2000 to Jan 2002

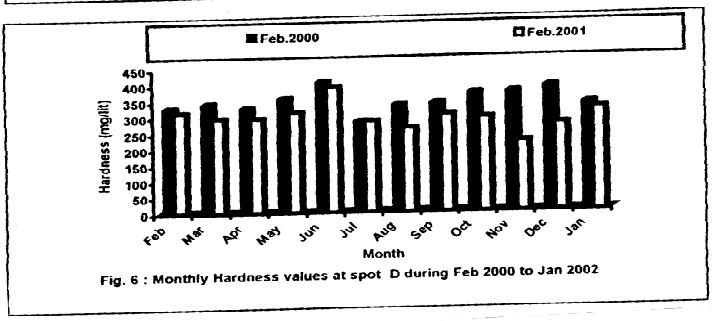


Fig. 6 : Monthly Hardness values at spot D during Feb 2000 to Jan 2002

Hardness has a great effect on biotic diversity and biomass in an ecosystem. Hardness also affects on the utility of perticular water for various purposes. Hard water is unsuitable for cooking, washing and bathing.

pH:

In the present investigation of pH, it has been found that the pH of water sample at spot A and D varies between 5.5 to 7.75. During first year of the study period Feb 2000 to Jan 2001, it was minimum (5.75) at spot A in the month of Nar. 2000 and maximum (7.5) at spots A and D in the month of June and August 2000 respectively. During second year of the study period Feb. 2001 to Jan. 2002, it was minimum (5.5) at spot A in the month of Jul. 2001 and maximum (7.75) at spot A in the month of May 2001 as shown in table 4.3.1.6 and Fig. 7. Yearly mean values of pH at spots A and D are 6.62 and 6.60 during 2000-2001, while 6.62 and 6.5 during 2001-2002 respectively, as shownin table 4.3.1.14.

In summer the seasonal mean values of pH at spot A and D are 6.18 and 6.43 during summer I, where as 7 and 7 during summer II respectively. During monsoon the seasonal mean values of pH are 6.93 and 6.75 during mons‹›on I, while 6.06 and 6.31 during monsoon II at spots A and D respectively. During winter the seasonal mean values are 6.75 and 6.62 during winter I, whereas 6.81 and 6.18 during winter II at spots A and D respectively, as shown in table 4.3.1.17.

Table. 4.3.1.6 : pH (pH scale)

Season		Summer				Nonsoon				Winter			
Nonth		Feb	Nar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan
	Spot												
Feb 2000	A	6.5	S.75	6.0	6.5	7.5	7.0	6.75	6.5	7.0	6.5	7.0	6.5
Jan 2001	D	6.5	6.75	6.5	6.0	6.S	6.S	7.5	6.5	6.75	6.5	6.5	6.75
Feb 2001	A	6.25	6.75	7.25	7.75	6.0	5.5	5.75	7.0	6.5	6.75	7.5	6.S
Jan 2002	D	6.5	7.5	7.5	6.S	5.75	5.75	6.25	7.5	6.0	5.75	6.5	6.5

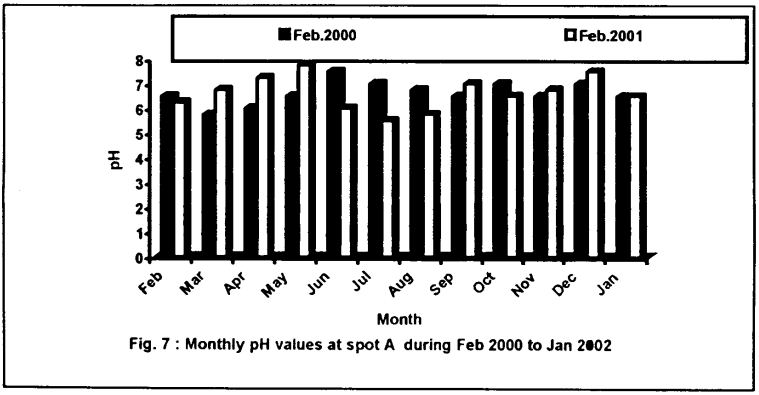


Fig. 7 : Monthly pH values at spot A during Feb 2000 to Jan 2002

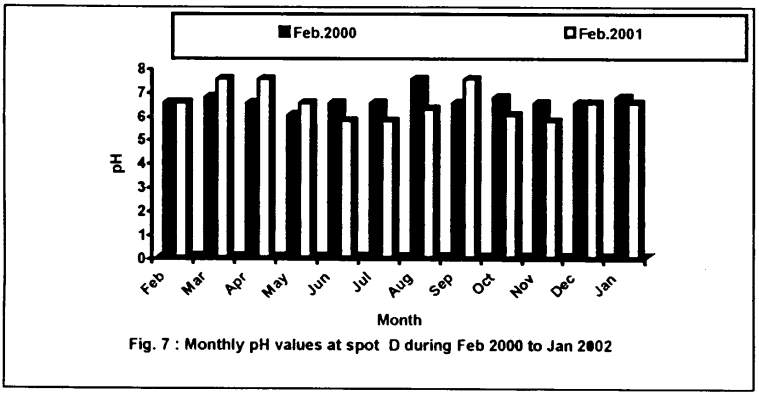


Fig. 7 : Monthly pH values at spot D during Feb 2000 to Jan 2002

Dissolved oxygen (mg/lit):

In the present investigation of dissolved oxygen, it has been found that the dissolved oxygen contents of water sample at spots A and D ranges between 01.19 to 08.4. During first year of the study period Feb. 2000 to 3an. 2001, it was minimum (1.19) at spot "D" in the month of Feb. 2000 and maximum (8.4) at spot "A" in the month of Apr. 2000. During second year of the study period Feb. 2001 to 3an 2002, it was minimum (1.47) at spot "D" in the month of Oct. 2001 and maximum (5.25) at spot "D" in the month of Aug. 2001 as shown in table 4.3.1.7 and Fig. 8. Yearly mean values of dissolved oxygen at spots A and D are 03.44 and 03.22 during 2000-2001, while 2.51 and 2.96 during 2001- 2002 respectively, as shown in table 4.3.1.14.

During summer the seasonal mean values of dissolved oxygen at spot A and D are 4.47 and 5.21 during summer I, while 2.31 and 2.57 during summer II respectively. During monsc›on the seasonal mean values are 2.60 and 1.99 in Monsoon I, where as 2.69 and 3.72 in monsoon II at spot A and D respectively. During winter the seasonal mean values are 3.26 and 2.47 in winter I, while 2.53 and 2.59 in winter II at spot A and D respectively, as shown in table 4.3.1.17.

Dissolved carbon dioxide (Free CO2) (mg/lit)»:

In the present investigation of dissolved dioxide (Free COz). it has been observed that the value ranged between 0 to 116 at spots A and D. During first year of the study period Feb. 2000 to Jan. 2001, it was minimum 0 at spot "A" in the months of April, July September and December and at spot "D" in the Nonth of April 2000 and maximum (108) in the month of Nay 2000 at spot "D". During second year of the study period Feb. 2001 to Can. 2002, it was minimum (20) at spot "A" in the month of Oct.

2001 and maximum (116) at Spot "D" in the month of Jun. 2001 as shown in table 4.3.1.8 and Fig. 9. Yearly mean values of dissolved carbon dioxide at spot A and D are 32.58 and 74.62 during 2000-2001, while 58.33 and 78 during 2001-2002 respectively, as shown in table 4.3.1.14.

Table. 4.3.1.7 : Dissolved oxygen (mg/lit)

Season		Summer				Monsoon				Winter			
Month		Feb	Mar	Apr	Nay	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan
	Spot												
Feb 2000	A	1.75	4.27	8.4	3.46	2.52	1.75	2.17	3.99	2.17	3.75	5.32	1.82
Jan 2001	D	1.19	7.98	8.26	3.43	1.82	1.54	1.54	3.08	1.86	2.5	3.5	2.03
Feb 2001	A	1.96	2.45	1.54	3.29	4.13	1.68	2.03	2.94	2.38	2.52	2.73	2.52
Jan 2002	D	2.17	2.31	3.15	2.66	3.43	2.24	5.25	3.99	1.47	1.89	2.38	4.62

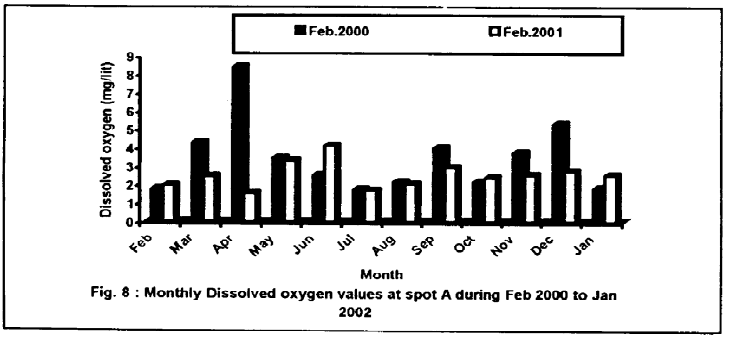


Fig. 8 : Monthly Dissolved oxygen values at spot A during Feb 2000 to Jan 2002

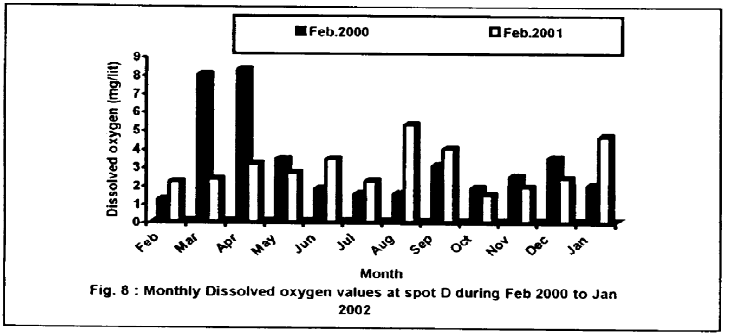


Fig. 8 : Monthly Dissolved oxygen values at spot D during Feb 2000 to Jan 2002

Table. 4.3.1.8 : Dissolved (free) carbon dioxide (mg/lit)

Season		Summer					Monsoon			Winter			
Nonth		Feb	Nar	Apr	Nay	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan
	Spot												
Feb 2000	A	84	84	Ab.	100	44	Ab	16	Ab	12	15	Ab	36
Jan 2001	D	98	92	Ab	108	100	88	84	72	105	64.5	24	60
Feb 2001	A	28	60	72	52	76	84	48	68	20	32	92	68
can 2002	D	76	100	108	84	116	72	48	88	28	36	68	112

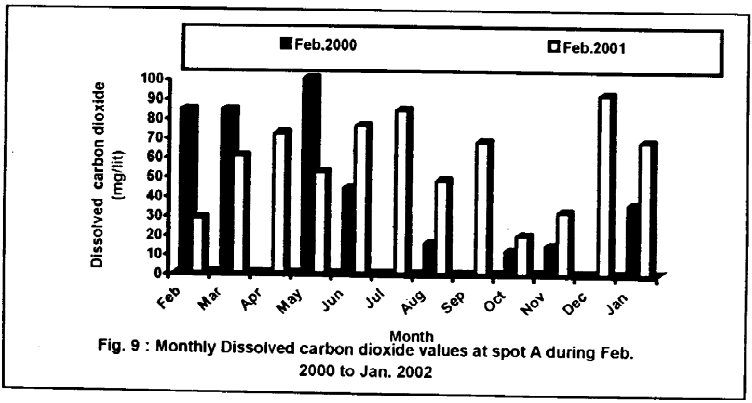


Fig. 9 : Monthly Dissolved carbon dioxide values at spot A during Feb. 2000 to Jan. 2002

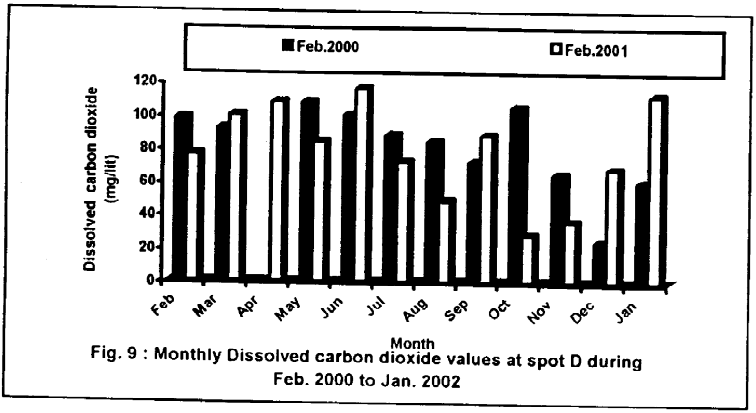


Fig. 9 : Monthly Dissolved carbon dioxide values at spot D during Feb. 2000 to Jan. 2002

In summer the seasonal mean values of dissolved carbon dioxide at stations A and D are 67 and 74.5 during summer I, where as 53 and 92 during summer II respectively. In monsoon season the seasonal mean values are 15 and 86 during monsoon I, while 69 and 81 during monsoon II at spot A and D respectively. In winter season the seasonal mean values are 15.75 and 63.37 during winter I, whereas 53 and 61 during winter II at spots A and D respectively, as shown in table 4.3.1.17.

Carbonate Alkalinity (mg/lit):

Carbonate alkalinity at spots A and D, has been found ranging between 4 to 44. During first year of the study period Feb. 2000 to Jan. 2001, it was minimum (4) at spot A in the month of Mar. 2000 and maximum (24) at spot "D" in the month of Jan. 2001. During second year of the study period Feb. 2001 to Jan. 2002, it was minimum (06) at spot "A" in the month of Feb. 2001 and maximum (44) at spot "D" in the month of I day 2001 as shown in table 4.3.1.9 and Fig. 10. Yearly mean values of carbonate alkalinity at spot A and D are 10.04 and 10.37 during 2000-2001, while 25 and 26.41 during 2001-2002 respectively, as shown in table 4.3.1.14.

Table. 4.3.1.9 : Carbonate Alkalinity (mg/lit)

Season		Summer				Monsoon				Winter			
Month		Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan
	Spot												
Feb 2000	A	4.5	04	13	10	10	10.01	09	16	11	10	09	14
Jan 2001	D	05	04	12	10	12	08	16	12.5	09	07	05	24
Feb 2001	A	06	30	34	26	38	24	30	18	28	36	22	08
Jan 2002	D	20	32	38	44	36	26	24	12	18	26	34	07

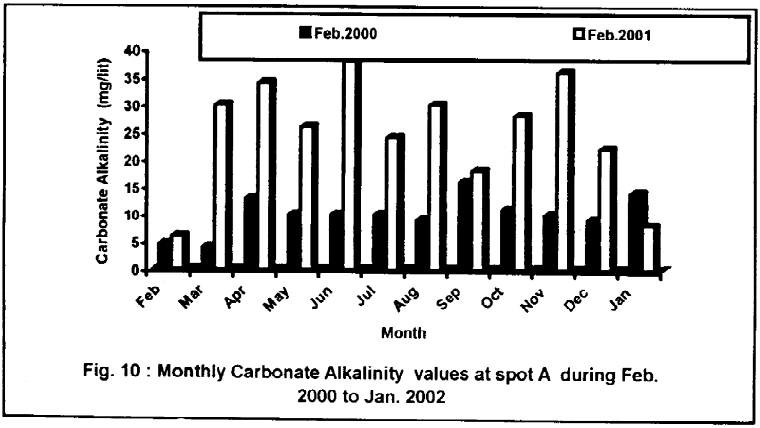


Fig. 10 : Monthly Carbonate Alkalinity values at spot A during Feb. 2000 to Jan. 2002

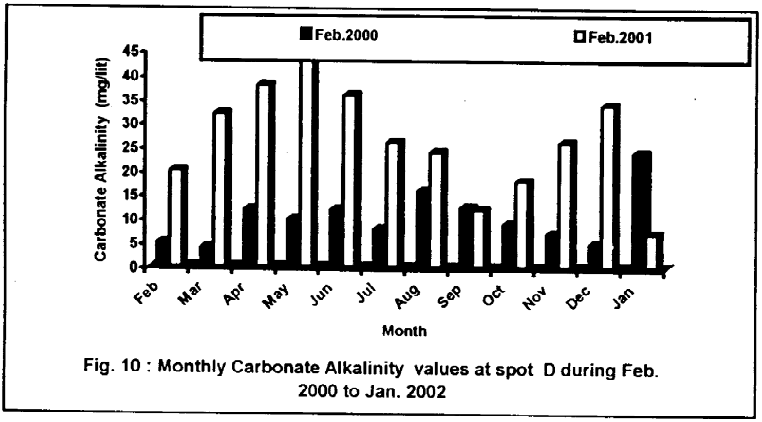


Fig. 10 : Monthly Carbonate Alkalinity values at spot D during Feb. 2000 to Jan. 2002

In summer the seasonal mean values of carbonate alkalinity at spot A and D are 7.87 and 7.75 during summer I, while 24 and 33.5 during summer II respectively. During monsoon the seasonal mean values at spot A and D are 11.25 and 12.12 in monsoon I and 27.5 and 24.5 in monsoon II respectively. In winter season the seasonal mean values at spot A and D are 11 and 11.25 during winter I, while 23.5 and 21.25 during winter II respectively, as shown in table 4.3.1.17.

Bicarbonate Alkalinity (mg/lit):

Najor part of the total alkalinity is due to bicarbonate alkalinity. Present study reveals that

bicarbonate alkalinity at spot A and D ranged between 50 to 246. During first year of the study period Feb. 2000 to Jan. 2001, it was minimum (54) at spot A in the month of Jan. 2001 and maximum (246) at spot A in the month of Sep. 2000. During second year of the study period Feb. 2001 to Jan. 2002, it was minimum (50) at spot A in the month of Jun. 2001 and maximum (182) at spot “D” in the month of Jan. 20 2 as shown in table 4.3.1.10 and Fig. 11. Yearly mean values of bicarbonate alkalinity at spots A and D are 160.33 and 147.41 during 2000-2001, while 76.83 and 91 during 2001-2002 respectively, as shown in table 4.3.1.14.

The seasonal mean values of bicarbonate alkalinity at spots A and D in summer are 171.75 and 188.5 during summer I, where as 65.5 and 79.5 during summer II respectively. During monsoon the seasonal mean values at spots A and D are 182.25 and 130.5 during monsoon I, while 66 and 91.5 during monsoon II respectively. During winter the seasonal mean values of bicarbonate alkalinity at spots A and D are 127 and 123.25 in winter I, while 99 and 102 in winter II respectively , as shown in table 4.3.1.17.

Table. 4.3.1.10 : Bicarbonate Alkalinity (HCO3) (mg/lit)

Season		Summer				Monsoon				Winter			
Month		Feb	Nar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan
	Spot												
Feb 2000	A	164	178	205	140	182	123	178	246	173	118	163	54
Jan 2001	D	173	190	201	190	125	131	136	130	136	109	182	66
Feb 2001	A	62	56	76	68	50	78	54	82	86	76	58	176
Jan 2002	D	52	78	86	102	98	106	90	72	82	70	74	182

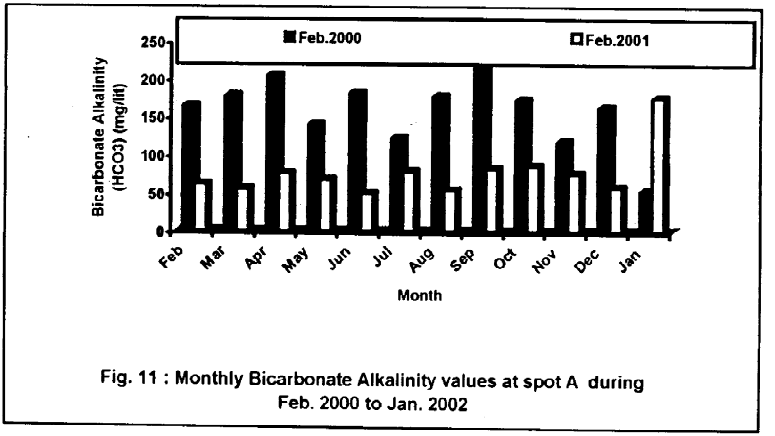


Fig. 11 : Monthly Bicarbonate Alkalinity values at spot A during Feb. 2000 to Jan. 2002

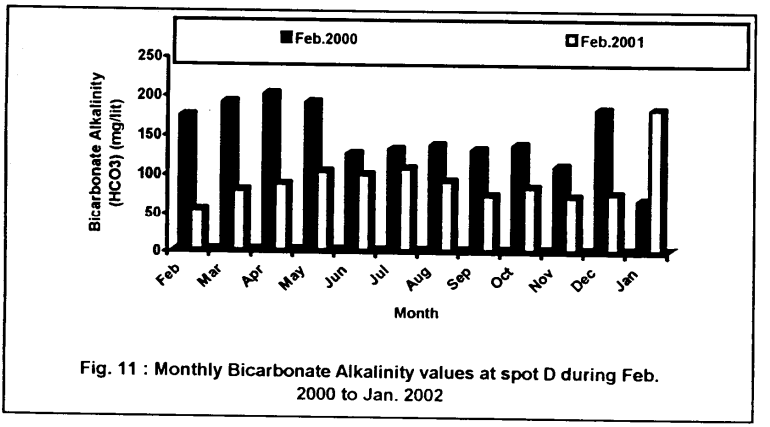


Fig. 11 : Monthly Bicarbonate Alkalinity values at spot D during Feb. 2000 to Jan. 2002

Chlorides (mg/lit):

In the present investigation of chlorides at spot A and D, it has been found that the chloride value ranged between 35.45 to 148.89. During first year of the study period Feb. 2000 to Jan. 2001, it was minimum (49.63) at spot "A" in the month of Aug. 2000 and maximum (148.89) at spot A and D in the month of Feb. and Narch 2000 respectively. During second year of the study period Feb.

2001 to Jan. 2002, it was minimum (35.45} at spot “D” in the month of Sep. 2001 and maximum (148.89) at spot “A” in the month of Oct. 2001 as shown in table 4.3.1.11 and Fig. 12. Yearly mean values of chlorides at spot A and D are 103.39 and 107.53 during 2000-2001, while 99.85 and 104.57 during 2001-2002 respectively, as shown in table 4.3.1.14.

The seasonal mean values of chlorides at spot A and D in summer season are 118.75 and 119.64 during summer I, where as 101.03 and 127.62 during summer II respectively. In monsoon season the seasonal mean values at spot A and D are 79.76 and 93.94 during monsoon I, while 85.08 and 97.48 during monsoon II respectively. The seasonal mean values of chlorides at sampling station A and D are 111. 66 and 109 during winter I, where as 113.44 and 88.62 during winter II respectively, as shown in table 4.3.1.17.

Chloride in the form of chloride (Cl-) ion is one of the major inorganic anions in the water and wastewater. The salty taste produced by chloride concentration is variable and deperdent on the chemical composition of water. High chloride content in water may be harmful for growing plants. For drinking purpose the permissible limit of chloride in water is 250, though higher concentrations up to 600 are not directly harmful to the body.

Table. 4.3.1.11 : Chlorides (cl) (mg/lit)

Season		Summer				Monsoon				Winter			
Nonth		Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan
	Spot												
Feb 2000	A	148.89	113.44	134.71	77.99	85.08	92.17	49.63	92.17	106.35	120.53	134.71	85.08
Jan 2001	D	131.16	148.89	113.44	85.08	63.81	77.99	120.53	113.44	92.17	109.89	127.62	106.35

Feb 2001	A	99.26	77.99	120.53	106.35	63.81	77.99	92.17	106.35	148.89	127.62	113.44	63.81
Jan 2002	D	113.44	99.26	134.71	163.07	134.71	92.17	127.62	35.45	63.81	49.63	127.62	113.44

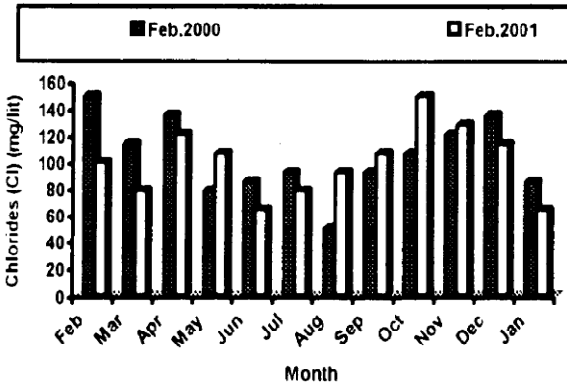


Fig. 12 : Monthly Chloride values at spot A during Feb. 2000 to Jan. 2002

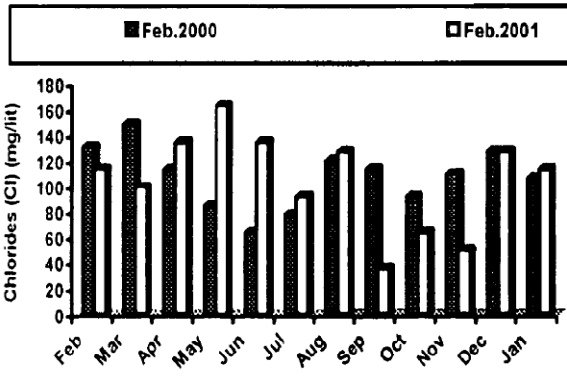


Fig. 12 : Monthly Chloride values at spot D during Feb. 2000 to Jan. 2002

Salinity (mg/lit):

In the present investigation of salinity at spots A and D, it has been found that the values ranged between 65.05 to 273.21. During first year of the study period Feb. 2000 to Jan. 2001, it was minimum (91.07) at spot A in the month of Aug.2000 and maximum (273.21) at spots A and D in the month of Feb and Narch 2000, respectively. During second year of the study period Feb. 2001 to Jan 2002, it was minimum (65.05) at spot D in the month of Sep. 2001 and maximum (273.21) at spot "A" in the month of Oct. 2001 as shown in table 4.3.1.12 and Fig.13. Yearty mean values of salinity at spots "A and D" are 189.72 and 197.31 during 2000-2001, while 183.22 and 191.88 during 2001-2002 respectively, as shown in table 4.3.1.14.

During summer season the seasonal mean values of salinity at spots A and D are 217.90 and 219.53 in summer I, while 185.39 and 234.18 in summer II respectively. During monsoon season the seasonal mean values of salinity at spots A and D are 146.35 and 172.37 in monsoon I, while 156.12 and 178.87 in monsoon II respectively. Where as in winter season the seasonal mean values are 204.89 and 200.01 during winter I, while 208.16 and 162.61 during winter II at spots A and D respectively, as shown in table 4.3.1.17.

Table. 4.3.1.12 : Salinity (mg/lit)

Season		Summer				Monsoon				Winter			
month		Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan
	Spot												
Feb 2000	A	273.21	208.16	247.19	143.11	156.12	169.13	91.07	169.13	195.15	221.17	247.19	156.12
Jan 2001	D	240.68	273.21	208.16	156.12	117.09	143.11	221.17	208.16	169.13	201.65	234.18	195.15
Feb 2001	A	182.14	143.11	221.17	195.15	117.09	143.99	169.13	195.15	273.21	234.18	208.16	117.08

can 2002	D	208.16	182.14	247.19	299.23	247.19	169.13	234.18	65.05	117.09	91.07	234.18	204.78

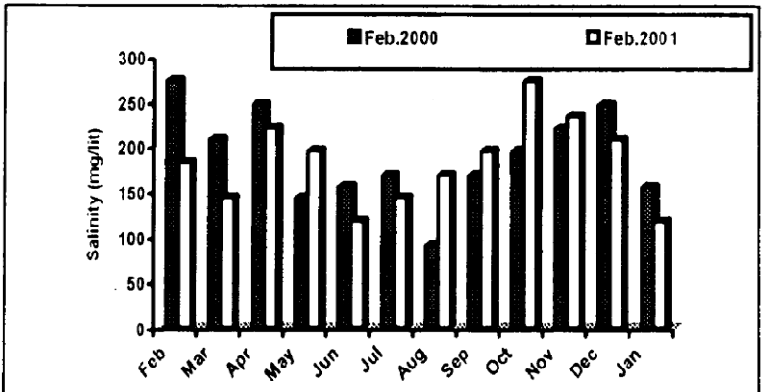


Fig. 13 : Monthly Salinity values at spot A during Feb. 2000 to Jan. 2002

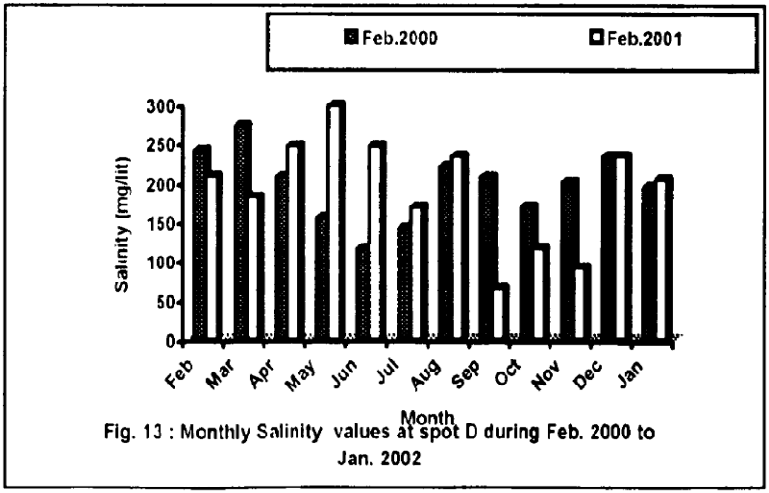


Fig. 13 : Monthly Salinity values at spot D during Feb. 2000 to Jan. 2002

Increasing salinity of the irrigated soil is a major problem for agriculture.

Sodium (ppm):

In the present investigation of sodium at spots "A" and "D", it has been observed that the value ranged between 05 to 18. During first year of the study period Feb. 2000 to Jan. 2001, it was minimum (06) at spot "D" in the month of Jan. 2001 and maximum (18) at spot "A" in the month of Jun. 2000. During the second year of study period Feb. 2001 to Jan. 2002, it was minimum (05) at spot "A", in the month of Feb. 2001 and Jan. 2002 respectively. And maximum (15) at spot A and D in the month of Nov. and May 2001 respectively as shown in table 4.3.1.13 and Fig. 14. Yearly mean values of sodium at spots A and D are 11.33 and 9.5 during 2000-2001, while 10.5 and 9.58 during 2001-2002 respectively, as shown in table 4.3.1.14.

In summer the seasonal mean values of sodium at spots A and D are 12.5 and 10.5 during summer I, while 9.25 and 11.25 during summer II respectively. In monsoon the seasonal mean values are 12.25 and 10.5 during monsoon I, whereas 11.5 and 9.25 during monsoon II at spots A and D respectively. In winter the seasonal mean values at spots A and D are 9.25 and 7.5 during winter I, while 10.75 and 8.25 during winter II respectively, as shown in table 4.3.1.17.

The ratio of sodium to total cations is important in agriculture and human physiology. In large concentrations it may affect persons with cardiac difficulties. The US EPA advisory limit for sodium in drinking water is 20 mg/lit

Table. 4.3.1.13 : Sodium (ppm)

Season		Summer				Plonsoon				Winter			
Month		Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan
	Spot												
Feb 2000	A	10	15	13	12	18	11	13	07	09	10	11	07
Jan 2001	D	09	11	12	10	14	12	10	06	07	09	08	06
Feb 2001	A	05	10	13	09	11	14	12	09	13	15	10	05
Jan 2002	D	09	11	10	15	13	11	08	05	08	10	07	08

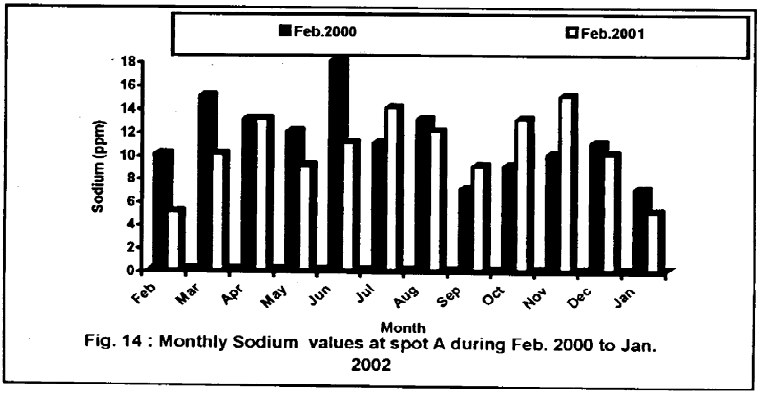


Fig. 14 : Monthly Sodium values at spot A during Feb. 2000 to Jan. 2002

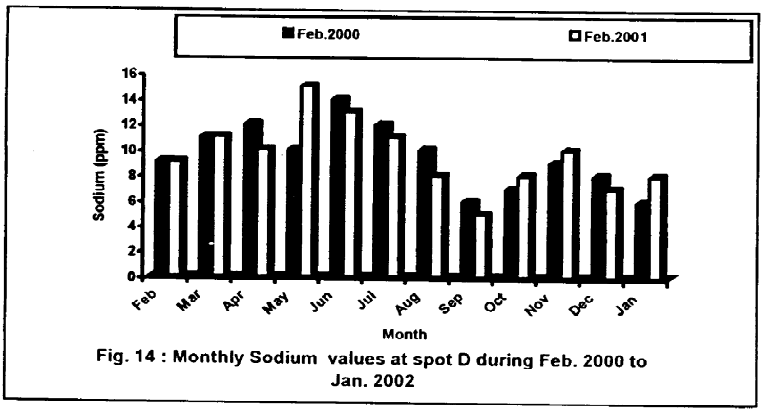


Fig. 14 : Monthly Sodium values at spot D during Feb. 2000 to Jan. 2002

Saline water:

Colour:

In the present investigation of colour at spots B and C, it has been observed that the colour varies between pale yellowish green to dark green during complete study period (Feb. 2000 to Jan 2001 and Feb 2001 to Jan 2002) as shown in table 4.3.2.1. It was pale yellowish green in winter season during complete study period, while dark green to pale green in the remaining part of the year during complete study period. Taking into consideration yearly water colouration, it has been found that the colouration remained pale yellowish green through out the study period as shown in table 4.3.2.16.

During summer season the colouration is pale green in summer I and summer II. During monsoon it is dark green in monsoon I and monsoon II. Where as during winter it is pale yellowish green in winter I and winter II at spots B and C respectively, as shown in @ble 4.3.2.19.

The colour of water directly affects its transparency, light penetration and productivity of water column. The present water body remained coloured due to the abundance of algal material in it pre- dominating spirulina algae along with stagnancy of water column.

Odour:

As we know that any stagnant water body has piculear type of odour according to the stagnancy. In the present work it has been found that the odour to the samples at spot B and C varies between odour free to an offensive one, durinq complete sNdy period from Feb. 2000 to Jan. 2001 and Feb. 2001 to Jan. 2002 as shown in table 4.3.2.2. Taking in to the consideration yearly water odour, it was revealed that the odour to the water sample remained slight offensive throughout the study period, as shown in table 4.3.2.16.

During summer the odour at spots B and C is an offensive in summer I and in summer II. During monsc›on the spots B and C is an odour free in monsoon I and in monsoon II. During winter the odour at spots B and C is slight offensive in winter I and in winter II as shown in table 4.3.2.19.

An odour is to be considered as one of the quality-testing factor of any aquatic ecosystem. Most of the organic and inorganic substances are responsible for developing an odour to the water column, which may be originated from various sources like municipal, industrial waste discharges, decomposition of biotic factors within a water body and the microbial activity.

Temperature (0C):

In the present investigation of temperature at spots B and C, it has been observed that the temperature varied between 18 to 32. In the first year of the study period Feb. 2000 to Jan. 2001, it was minimum (19) at spot “B” in the months of Nov. and Dec. 2000 and maximum (30) at spots B and C in the month of June 2000 respectively. During second year of the study period Feb. 2001 to Jan. 2002, it was minimum (18) at spot “B” in the month of Nov. 2001 and maximum (32) at spot “C” in the month of Nay 2001 as shown in table 4.3.2.3 and Fig. 15. Yearly mean values at spot B and C are 25.45 and 26.91 during 2000- 2001, while 25.91 and 26 during 2001-2002 at spots B and C respectively, as shown in table 4.3.2.16.

During summer season the seasonal mean values of temperature at spots B and C are 26.37 and 27.75 in summer I, while 28.5 and 28.5 in summer II respectively. In monsoon season the seasonal mean values of temperature at spots B and C are 27 and 28 during Nonsc›on I, where as 26.75 and 27 during monsoon II respectively. In winter season the seasonal mean values at

spots B and C are 23 and 25 during winter I, while 22.5 and 22.5 during winter II respectively, as shown in table 4.3.2.19.

Season		Summer				Monsoon				Winter			
Month		Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan
	Spot												
Feb 2000	B	98	28.5	24	25	30	26	25	27	29	19	19	25
3an 2001	C	29	28	28	26	30	27	26	29	29	24	21	26
Feb 2001	B	27	28	29	30	29	27	25	26	24	18	19	29
Jan 2002	C	25	26	31	32	29	25	26	28	21	21	19	29

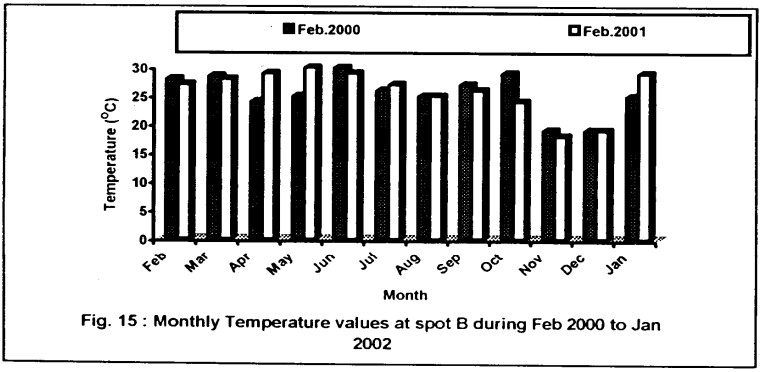


Fig. 15 : Monthly Temperature values at spot B during Feb 2000 to Jan 2002

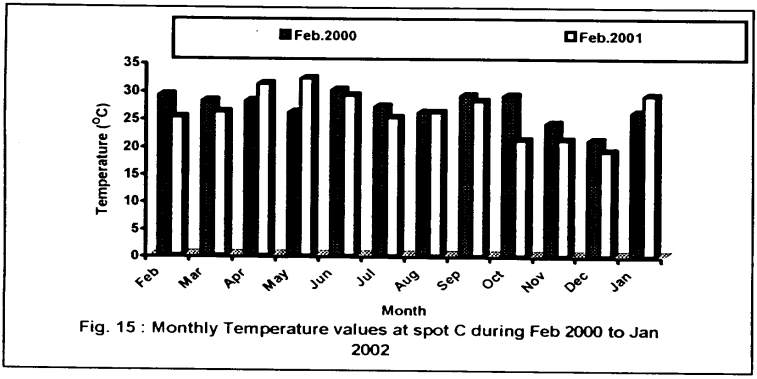


Fig. 15 : Monthly Temperature values at spot C during Feb 2000 to Jan 2002

Taste:

The taste of sample at both spots B and C has been found to be salty throughout the study period of Feb. 2000 to Jan. 2001 and Feb. 2001 to Jan. 2002, and it dose not show any variation as shown in table 4.3.2.4.

The salty taste to the water sample at spots B and C is because of very high contents of the salts. Due to an offensive odour and salty taste to the water in the Lake it is unsuitable for drinking and other purposes like irrigation. 4.3.US Hardness (mg/lit)

In the present investigation of hardness of water at spots B and C, it has been found that the hardness value ranged between 95 to 129. In the first year of the study period Feb. 2000 to Jan. 2001, it was minimum (95) at spot "C" in the month of July 2000 and maximum (125) at spots B and C in the month of Play and Jun. 2000 respectively. During second year of the study period Feb. 2001 to 3an. 2002, it was minimum (95) at spot "8" in the month of Oct. 2001 and maximum (129) at spot "B" in the month of Jun 2001 as shown in Bble 4.3.2.5 and Fig. 16. Yearly mean values of hardness at spots B and C are 109.41 and 109.33 during 2000-2001, while 112. 83 and 110.83 during 2001-2002 respectively, as shown in table 4.3.2.16.

Season		Summer				Nonsoon				Winter			
Month		Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan
	Spot												
Feb 2000	B	107	119	121	125	115	97	105	105	102	107	103	107
Jan 2001	C	109	112	114	118	125	95	109	107	107	104	101	111
Feb 2001	B	121	123	126	125	129	105	110	99	95	107	104	110
3an 2002	C	120	115	119	118	122	109	112	101	105	103	102	104

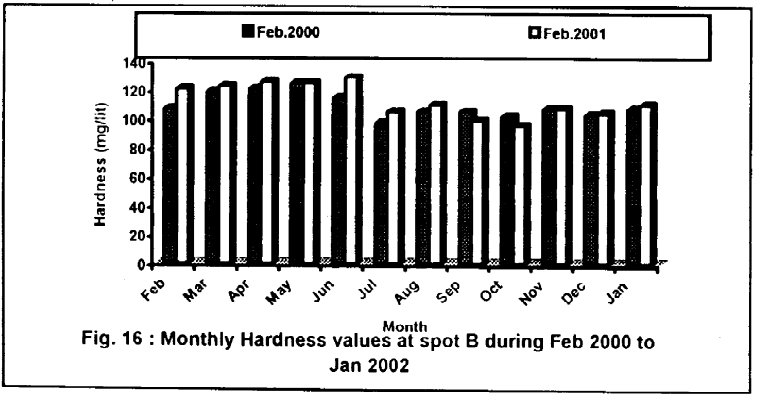


Fig. 16 : Monthly Hardness values at spot B during Feb 2000 to Jan 2002

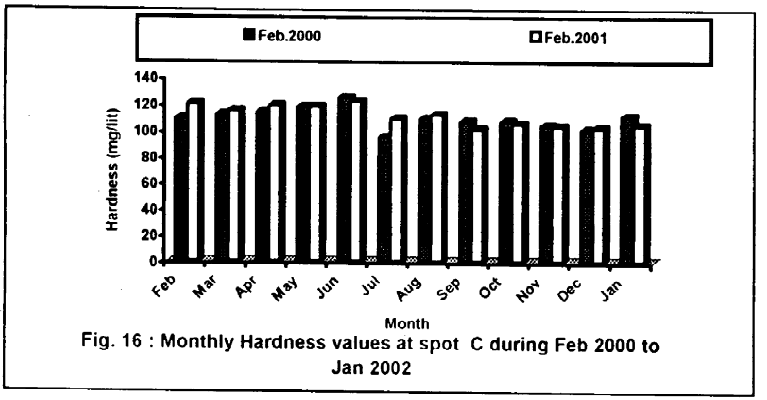


Fig. 16 : Monthly Hardness values at spot C during Feb 2000 to Jan 2002

During summer the seasonal mean values of hardness at spots B and C are 118 and 113.25 in summer I, where as 123.75 and 118 in summer II respectively. During monsoon season the seasonal mean values of hardness at spots B and C are 105.5 and 109 in monsoon I, while 110.75 and 111 in monsoon II respectively. During winter season the seasonal mean values of hardness at spots B and C are 104.75 and 105.75 in winter I, while 104 and 103.5 in winter II respectively, as shown in table 4.3.2.19.

pH:

In the present investigation of pH at spots B and C, it has been observed that the value ranged between 09.25 to 10.58. During first year of the study period Feb. 2000 to Jan. 2001, it was minimum (09.25) at spot "B" in the month

of Aug. 2000 and maximum (10.58) at spot "B" in the month of Nay 2000. During second year of the study period Feb. 2001 to Jan. 2002 it was minimum (09.35) at spots B and C in the month of Sep. 2001 and maximum (10.50) in the month of June 2001 at spots B and C as shown in table 4.3.2.6 and Fig. 17. Yearly mean values of pH at spots B and C are 9.97 and 9.97 during 2000-2001, while 9.84 and 9.85 during 2001-2002 respectively, as shown in table 4.3.2.16.

Table. 4.3.2.6 : pH (pH Scale)

Seasons		Surnuw				Monsoon				Winter			
Month		Feb	Mar	Apr	Hay	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan
	Spot												
Feb 2000	B	10.02	10.18	10.26	10.58	10.36	09.75	09.25	09.59	09.75	09.85	10.05	10.10
Jan 2001	C	10.04	10.12	10.29	10.52	10.43	9.65	9.38	9.50	9.72	9.90	10.10	10.10
Feb 2001	g	10.15	10.05	9.85	9.80	10.5	9.75	9.50	9.35	9.70	9.75	9.90	9.80
Jan 2002	C	10.15	10.06	9.85	9.80	IO.5	9.75	9.50	9.3S	9.70	9.75	9.90	9.85

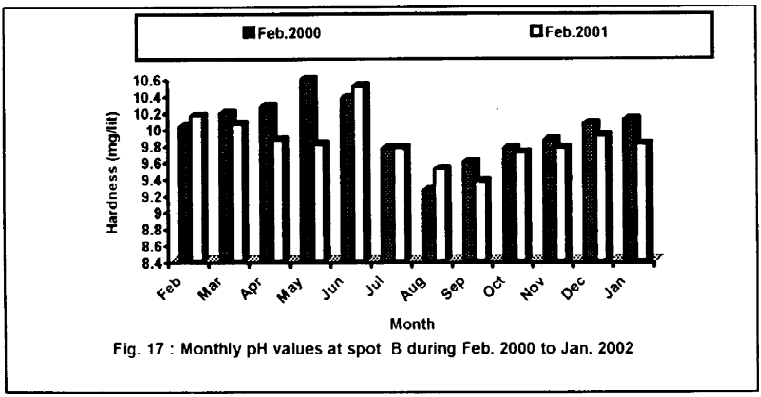


Fig. 17 : Monthly pH values at spot B during Feb. 2000 to Jan. 2002

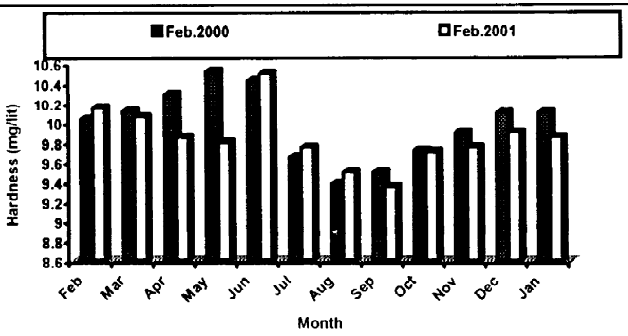


Fig. 17 : Monthly pH values at spot C during Feb. 2000 to Jan. 2002

During summer season the seasonal mean values of pH at spots B and C are 10.26 and 10.24 in summer I, while 9.96 and 9.96 in summer II respectively. In monsoon season the seasonal mean values of pH at spots B and C are 9.73 and 9.74 during monsoon I, while 9.77 at both spots during monsoon II respectively. In winter season the seasonal mean values are 9.93 and 9.95 during winter I, where as 9.78 and 9.8 during winter II at spots B and C respectively, as shown in table 4.3.2.19. The pH of the present water body is highly alkaline one.

Dissolved oxygen (mg/lit):

Any natural or wastewater ecosystem's dissolved oxygen level depends upon the physical, chemical and biological activities within it. Determination of dissolved oxygen level is a key test in water pollution and wastewater treatment.

In the present investigation of dissolved oxygen at spots B and C, it has been observed that the values ranged between 0.59 to 4.55. During first year of the study period Feb. 2000 to Jan. 2001, it was minimum (0.59) at spot "C" in the month of Nar 2000 and maximum (4.55) at spot "B" in the month of May 2000. During second year of the study period Feb. 2001 to Jan. 2002, it was minimum

(1.45) at spot "B" in the month of Nay 2001 and maximum (3.45) at spot "C" in the months of Nar. and July 2001 respectively as shown in table 4.3.2.7 and Fig. 18. Yearly mean values of dissolved oxygen at spots B and C are 2.23 and 2.38 during 2000-2001, while 2.24 and 2.46 during 2001-2002 respectively, as shown in table 4.3.2.16.

Table. 4.3.2.7 : Dissolved oxygen (mg/lit)

Season		Summer				Nonsoon				Winter			
Nonth		Feb	far	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan
	Spot												
Feb 2000	B	1.96	0.91	1.68	4.55	2.8	1.47	3.01	1.96	2.45	2.24	2.03	1.70
Jan 2001	C	3.71	0.59	3.71	3.43	1.61	1.4	2.66	2.38	2.03	2.00	2.31	2.80
Feb 2001	B	2.50	3.05	2.50	1.45	1.96	2.40	1.96	2.45	2.38	2.00	2.24	2.1
Jan 2002	C	1.96	3.45	2.77	2.66	2.00	3.45	1.61	2.55	2.30	2.05	2.20	2.6

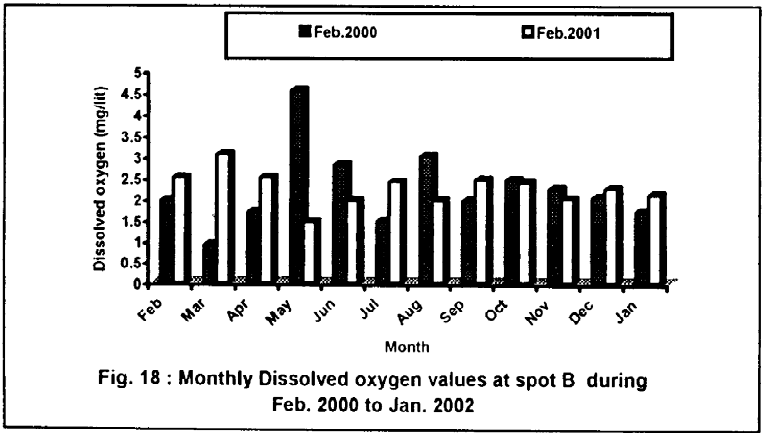


Fig. 18 : Monthly Dissolved oxygen values at spot B during Feb. 2000 to Jan. 2002

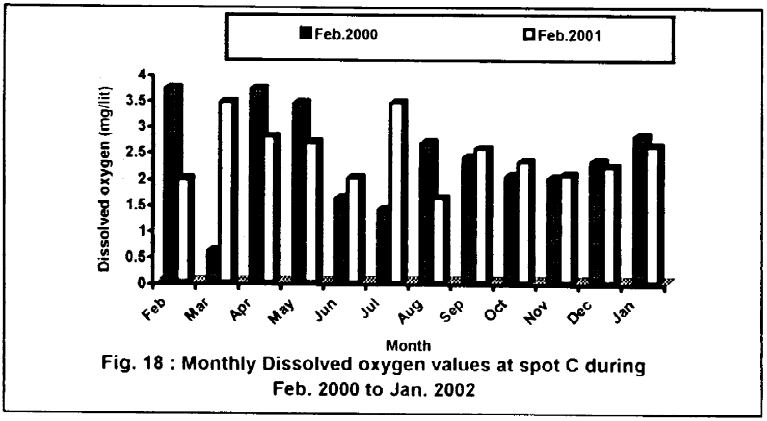


Fig. 18 : Monthly Dissolved oxygen values at spot C during Feb. 2000 to Jan. 2002

During summer season the seasonal mean values of dissolved oxygen at spots B and C are 2.27 and 2.86 during summer I, while 2.37 and 2.71 during summer II respectively. During monsoon season the seasonal mean values at spots B and C are 2.31 and 2.01 in monsoon I, where as 2.19 and 2.40 in monsoon II respectively. During winter season the seasonal mean values of dissolved oxygen at spots B and C are 2.10 and 2.28 during winter I while 2.18 and 2.31 during winter II respectively, as shown in table 4.3.2.19.

Dissolved carbon dioxide (Free COC) (mg/lit):

Depending up on pH and other biological conditions of an aquatic ecosystem the carbon dioxide is found in any of the three forms like free CO2, CO3 and HCO3. I"ree CO2 usually combines with water to form carbonic acid changing the pH to acidic. When pH ranges between

6.35 to 10.33 the carbon is found in the form of bicarbonates and when the pH is between 10.33 to 14 the carbon is found in the form of carbonates.

In the present investigation of dissolved (free) carbon dioxide at spots B and C it has been found that free carbon dioxide is totally absent through out the study period Feb.

2000 to Jan. 2001 and Feb. 2001 to 3an. 2002 as shown in table 4.3.2.8. Development of pink colour after the addition of few drops of an indicator (phenolphthalein) indicates the absence of free CO2. pH of water sample at spots B and C also indicates the absence of free CO2.

Carbonate Alkalinity (mg/lit):

In the present investigation of carbonate alkalinity at spots B and C, it has been observed that the values ranged between 220 to 802. During first year of the study period Feb. 2000 to Jan. 2001, it was minimum (220) at spot “B” in the month of Aug. 2000 and maximum (802) at spot “C” in the month of May 2000. During second year of the study period Feb. 2001 to Jan. 2002, it was minimum (255) at spot “C” in the month of Oct. 2001 and maximum (701) at spot “B” in the month of Nay 2001 as shown in table 4.3.2.9 and Fig. 19. Yearly mean values of carbonate alkalinity at spots B and C are 429.5 and 432.66 during 2000- 2001, while 383.58 and 396.41 during 2001-2002 respectively, as shown in table 4.3.2.16.

During summer season the seasonal mean values of carbonate alkalinity at spots B and C are 592 and 543.75 in Summer I, while 401.75 and 399 in Summer II respectively. In monsc›on season the seasonal mean values are 378.62 and 460.25 during monsoon I, where as 470 and 461 during monsoon II at spots B and C respectively. During winter the seasonal mean values are 317.87 and 294 in winter I, while 279 and 329.25 in winter II at spots B and C respectively, as shown in table 4.3.2.19.

Bicarbonate Alkalinity (mg/iit):

In the present investigation of bicarbonate alkalinity at spots B and C, it has been found that the values ranged between 460 to 1301. During first year of the study period Feb. 2000 to Jan. 2001, it was minimum (460) at spot “B”

in the month of Aug. 2000 and maximum (1301) at spot "B" in the month of May 2000. During second year of the study period Feb. 2001 to 3an. 2002, it was minimum (480) at spot "B" in the month of Oct. 2001 and maximum (1290) at spot "B" in the month of May 2001 as shown in table 4.3.2.10 and Fig. 20. Yearly mean values of bicarbonate alkalinity at spots B and C are 773.12 and 809.91 during 2000-2001, while 741.41 and 777.5 during 2001-2002 respectively, as shown in table 4.3.2.16.

Season		Summer				Nonsoon				Winter			
Month		Feb	Nar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan
	Spot												
Feb 2000	B	465	349	783	771	565	410	220	319.5	419	338.5	258	256
Jan 2001	C	243	348	782	802	560	501	388	392	397	225	279	275
Feb 2001	B	305	276	325	701	665	410	390	415	275	319	280	242
Jan 2002	C	295	290	321	690	650	393	392	409	255	310	290	462

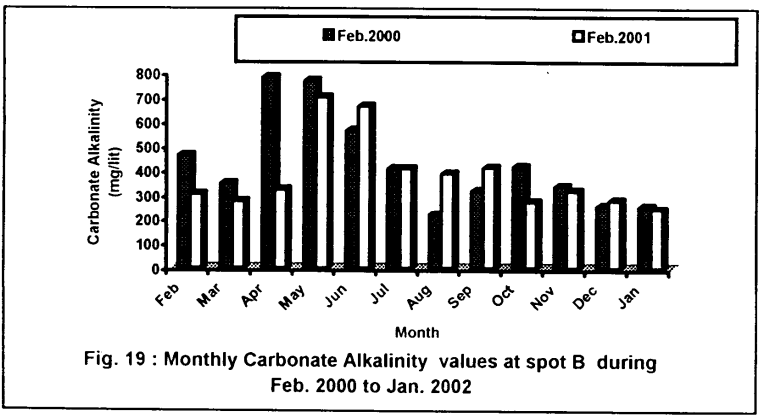


Fig. 19 : Monthly Carbonate Alkalinity values at spot B during Feb. 2000 to Jan. 2002

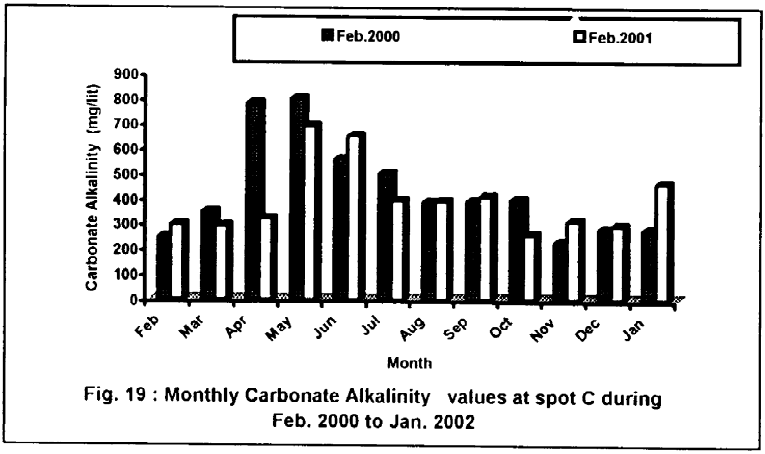


Fig. 19 : Monthly Carbonate Alkalinity values at spot C during Feb. 2000 to Jan. 2002

Table. 4.3.2.10 : Bicarbonate Alkalinity (HCO3) (mg/lit)

Season		Summer				Nonsoon				Winter			
Nonth		Feb	Nar	Apr	Nay	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan
	Spot												
Feb 2000	B	645	S04	1081	1301	892	970	460	726	992	759.5	527	470
3an 2001	C	646	614	1090	1268	850	904	1010	923	829	S10	565	510
Feb 2001	B	620	S65	670	1290	1120	845	S90	965	480	595	547	610
Jan 2002	C	611	585	665	1265	1230	825	796	980	540	580	620	633

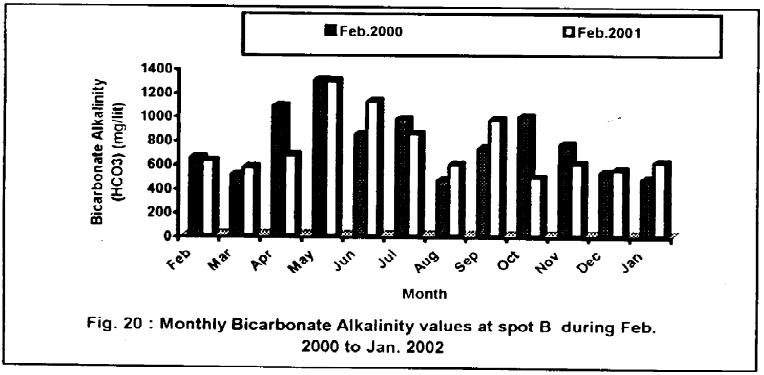


Fig. 20 : Monthly Bicarbonate Alkalinity values at spot B during Feb. 2000 to Jan. 2002

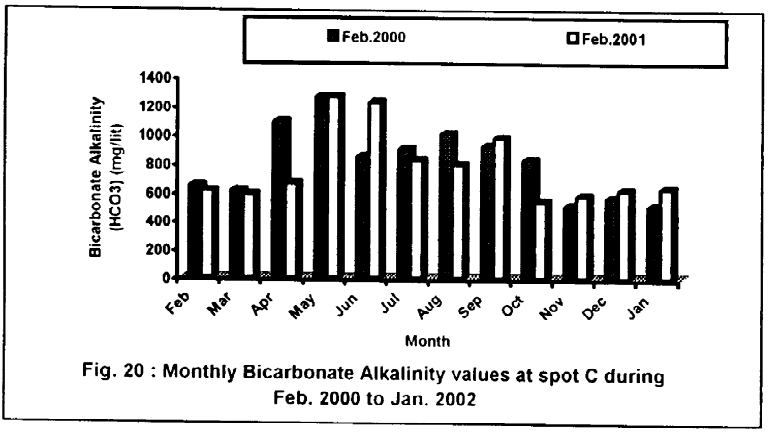


Fig. 20 : Monthly Bicarbonate Alkalinity values at spot C during Feb. 2000 to Jan. 2002

During summer season the seasonal mean values of bicarbonate alkalinity at spots B and C are 882.75 and 904.5 in summer I, while 786.25 and 781.5 in summer II respectively. In monsoon season the seasonal mean values at spots B and C are 749.5 and 921.75 during monsoon I, where as 880 and 957.5 during monsoon II respectively. In winter season the seasonal mean values at spots B and C are 687.12 and 603.5 during winter I, while 558 and 593.25 during winter II respectively, as shown in table 4.3.2.19.

A11 Chlorides (mg/lit):

In the present investigation of chlorides at spots B and C, it has been found that the chlorides value ranged between 2006.47 to 3374.84. During first year of the study period Feb. 2000 to 3an. 2001, it was minimum (2006.47) at spot "B" in the month of Oct. 2000 and maximum (3247.22) at spot "C" in the month of Sep. 2000. During second year of the study period Feb. 2001 to Jan. 2002, it was minimum (2268.8) at spot "B" in the month of Oct. 2001 and maximum (3374.84) at spot "C" in the month of May 2001 as shown in table 4.3.2.11 and Fig. 21.

Table. 4.3.2.11: Chlorides (Cl) (mg/lit)

Season		Summer				Monsoon				Winter			
Month		Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan
	Spot												
Feb 2000	B	2793.46	2906.9	2913.99	2821.82	2921.08	3062.88	1900.12	2836.00	2006.47	2492.13	2977.8	2736.74
Jan 2001	C	2793.46	2892.72	2991.98	2694.2	2942.38	2963.62	2651.66	3247.22	2105.73	2984.00	3006.16	2921.08
Feb 2001	B	2765.1	2793.46	2935.26	3084.15	3233.04	3105.42	2991.98	2524.04	2268.8	2672.93	2828.91	2641.02
Jan 2002	C	3084.15	2821.82	3140.87	3374.84	3034.52	3240.13	2913.99	3084.15	2694.2	2899.81	3041.61	2836

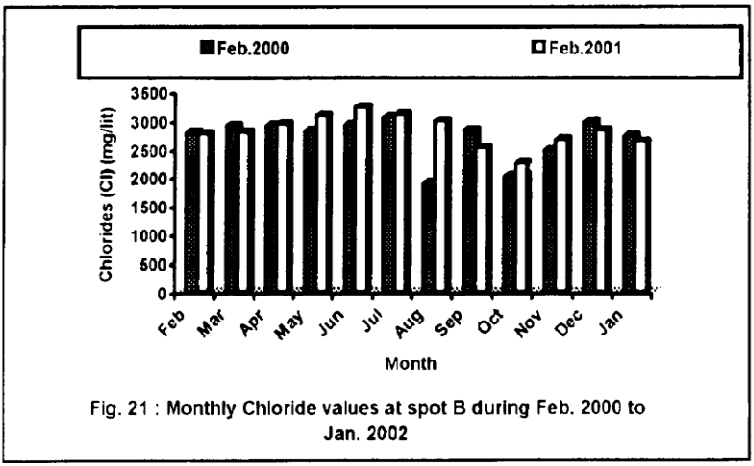


Fig. 21 : Monthly Chloride values at spot B during Feb. 2000 to Jan. 2002

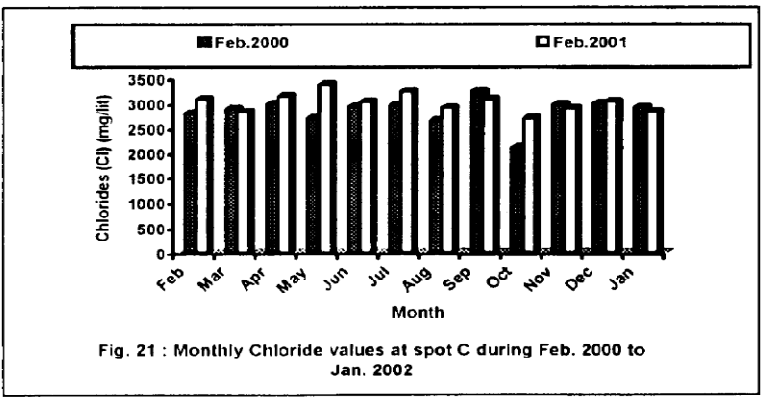


Fig. 21 : Monthly Chloride values at spot C during Feb. 2000 to Jan. 2002

The yearly mean values of chlorides at spots B and C are 2697.44 and 2849.51 during 2000-2001, while 2820.34 and 3013.84 during 2001-2002 respectively, as shown in table 4.3.2.16.

During summer season the seasonal mean values of chlorides at spots B and C are 2859.04 and 2843.09 in summer I, where as 2894.49 and 3105.42 in summer II respectively. In monsoon season the seasonal mean values at spots B and C are 2680.02 and 2951.22 during monsoon I, while 2963.62 and 3068.19 during monsoon II respectively. In winter season the seasonal mean values are 2553.28 and 2754.24 during winter I, where as 2602.91 and 2867.90 during winter II at spots B and C respectively, as shown in table 4.3.2.19.

The present water body contains very much high values of chloride which is responsible for high salinity, developing a total saline water ecosystem in Lonar Lake. The salty taste produced by chloride concentrations is variable and dependent on the chemical composition of water.

High chloride content in water is harmful to the growing plants. For drinking purposes of water the permissible limit of chlorides in water is 250, though higher concentrations up to 600 are not directly harmful to the txxly. But the present water body has much more chloride concentration values than the recommended permissible values, hence not suitable for drinking and irrigation purposes.

Salinity (mg/lit):

In the present investigation of salinity at spots B and C, it has been found that the salinity values ranged between 3486.72 to 6192.83. During first year of the study period Feb. 2000 to Jan. 2001, it was minimum (3486.72) at spot "B" in the month of Aug. 2000 and maximum

(5958.64) at spot "C" in the month of Sep. 2000. During second year of the study period Feb. 2001 to Jan. 2002, it was minimum (4163.24) at spot "B" in the month of Oct. 2001 and maximum (6192.83) at spot "C" in the month of May 2001 as shown in table 4.3.2.12 and Fig. 22.

The yearly mean values of salinity at spots B and C are 4949.80 and 5228.85 during 2000-2001, while 5117.32 and 5530.39 during 2001-2002 respectively, as shown in table 4.3.2.16.

During summer season the seasonal mean values of salinity at spots B and C are 5246.33 and 5217.07 in summer I, where as 5311.38 and 5698.44 in summer II respectively. In monsoon season the seasonal mean values at spots B and C are 4917.83 and 5415.48 during monsoon I, while 5438.24 and 5630.12 during monsoon II respectively. In winter season the seasonal mean values of salinity at spots B and C are 4685.26 and 5054.03 during winter I, where as 4776.33 and 5262.59 during winter II respectively, as shown in table 4.3.2.19.

Sodium (ppm):

Sodium is the third element in-group IA of the periodic table. It is very soluble and its monovalent ion Na” can reach concentrations as high as 15000 mg/lit in equilibrium with sodium bicarbonate. In the present investigation of sodium at spots B and C, it has been found that the values ranged between 2122 to 8800.

Table. 4.3.2.12 : Salinity (mg/lit)

Season		Summer				Monsoon				Winter			
Month		Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan
	Spot												
Feb 2000	B	5125.99	5334.16	5347.17	5178.03	5360.18	5620.38	3486.72	5204.06	3681.87	4S73.06	5464.26	5021.91
Jan 2001	C	5125.99	5308.14	5490.28	4943.85	5399.21	5438.24	4865.79	S958.64	3864.01	4690.01	5516.30	5360.18
Feb 2001	B	5073.95	5125.99	5386.20	5659.46	5932.62	5698.44	5490.28	4631.61	4163.24	4904.82	5191.04	4846.82
Jan 2002	C	5659.41	5178.03	5763.49	6192.83	5568.34	5945.63	5347.17	5659.41	4943.85	5321.15	5581.35	5109.51

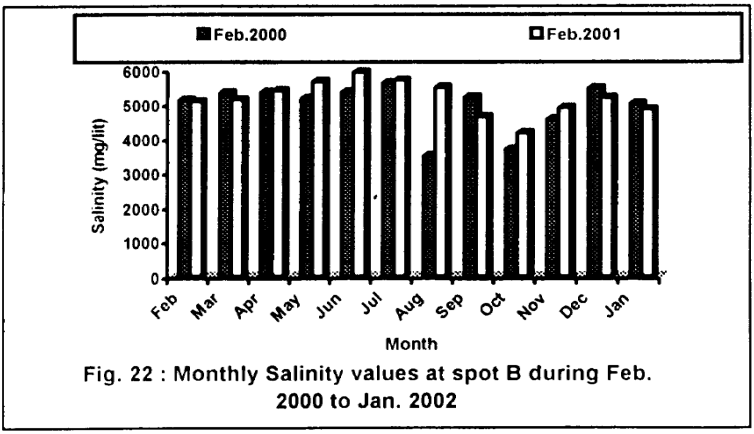


Fig. 22 : Monthly Salinity values at spot B during Feb. 2000 to Jan. 2002

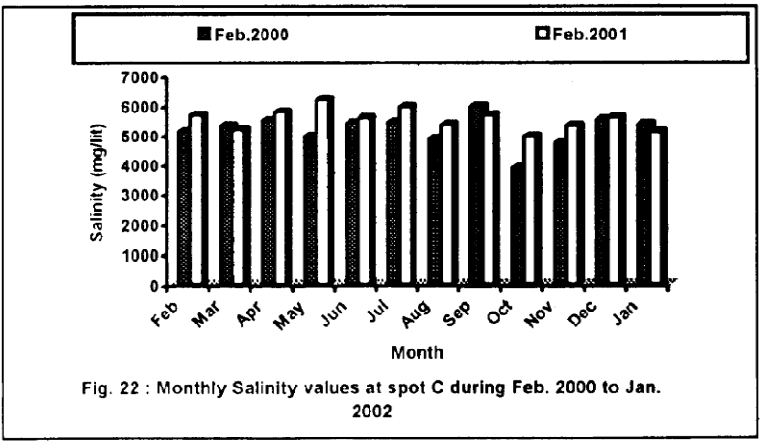


Fig. 22 : Monthly Salinity values at spot C during Feb. 2000 to Jan. 2002

Table. 4.3.2.13 : Sodium (ppm)

Season		Summer				Monsoon				Winter			
Month		Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan
	Spot												
Feb 2000	B	7200	5800	6200	6000	5800	5200	6400	6700	5400	6300	6320	3800
2001	C	5400	4200	4600	2122	8800	8000	7900	6600	6500	6983	6720	4000
Feb 2001	B	6000	5700	6300	5900	6300	5400	6800	6200	5500	6900	5800	4000
Jan 2002	C	5500	5900	6100	5800	6500	5700	6400	6700	6100	6700	6720	3900

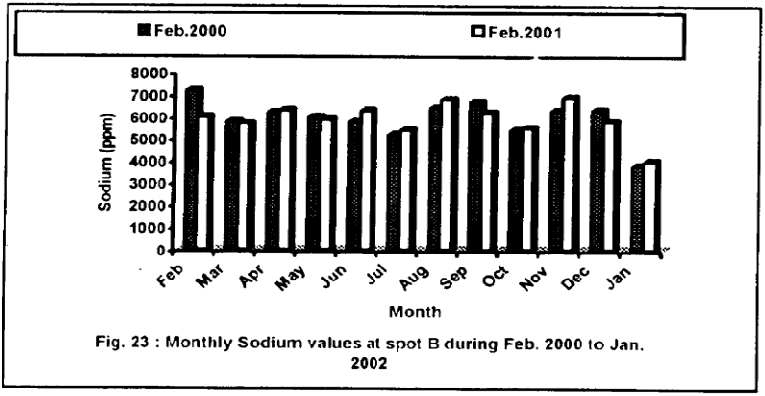


Fig. 23 : Monthly Sodium values at spot B during Feb. 2000 to Jan. 2002

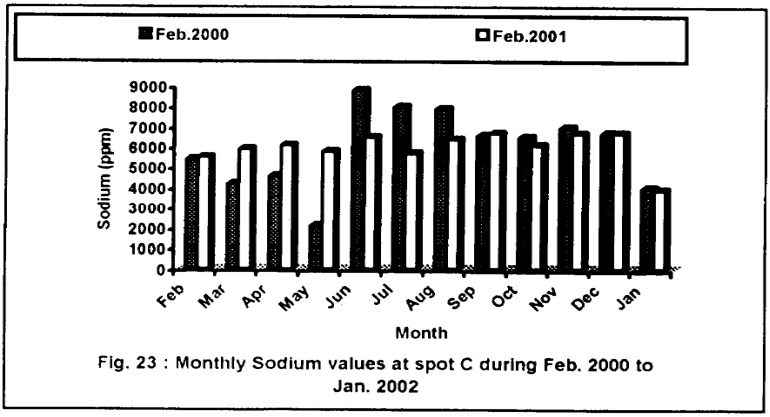


Fig. 23 : Monthly Sodium values at spot C during Feb. 2000 to Jan. 2002

During first year of the study period Feb. 2000 to Jan. 2001, it was minimum (2122) at spot "C" in the month of Nay 2000 and maximum (8800) at spot "C" in the month of Jun. 2000. During second year of the study period Feb. 2001 to Jan. 2002, it was minimum (3900) at spot "C" in the month of Jan. 2002 and maximum (6900) at spot "B" in the month of Nov. 2001 as shown in table 4.3.2.13 and Fig. 23. The yearly mean values of sodium at spots B and C are 5926.66 and 5985.41 during 2000- 2001, while 5900 and 6001.66 during 2001-2002 respectively, as shown in table 4.3.2.16.

During summer season the seasonal mean values of sodium at spots B and C are 6300 and 4080.5 in summer I, while 5975 and 5825 in summer II respectively. In monsoon season the seasonal mean values at spot B and C are 6025 and 7825 during monsoon I, where as 6175 and 6325 during monsoon II respectively. In winter season the seasonal mean values of sodium at spots B and C are 5455 and 6050.75 during winter I, while 5550 and 5855 during winter II respectively, as shown in table 4.3.2.19.

Potassium (ppm):

Potassium is the fourth element in-group IA of the periodic table. Potassium is an essential element in both plant and animal nutrition. It occurs in natural waters as a result of mineral dissolution from decomposing plant material and from agricultural runoff.

In the present investigation of potassium at spots B and C, it has been observed that the values ranged between 04 to 19. In the first year of the study period Feb. 2000 to Jan. 2001, it was minimum. (04) at spot "B" in the month of Nay and July 2000 and maximum (19) at Spot "B" in the month of Sep. 2000. In the second year of the study period Feb. 2001 to Jan. 2002, it was minimum (07) at spots B and C

in the months of Apr. 2001 and Jan. 2002 respectively. And maximum (18) at spot "B" in the month of Aug. 2001 as shown in table 4.3.2.14 and Fig. 24. Yearly mean values of potassium at spots B and C are 10.91 and 8.33 during 2000-2001, while 12.66 and 10.41 during 2001-2002 respectively, as shown in table 4.3.2.16.

Table. 4.3.2.14 : Potassium (ppm)

Season		Summer				Monsoon				Winter			
Month		Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan
	Spot												
Feb 2000	B	10	11	06	04	15	04	11	19	14	15	14	08
Jan 2001	C	07	09	07	12	07	07	05	11	11	09	10	05
Feb 2001	B	12	13	07	14	16	10	18	13	15	12	11	11
Jan 2002	C	09	08	11	10	12	14	11	09	13	08	13	07

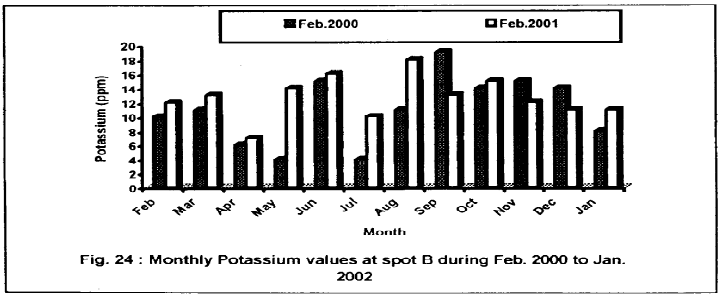


Fig. 24 : Monthly Potassium values at spot B during Feb. 2000 to Jan. 2002

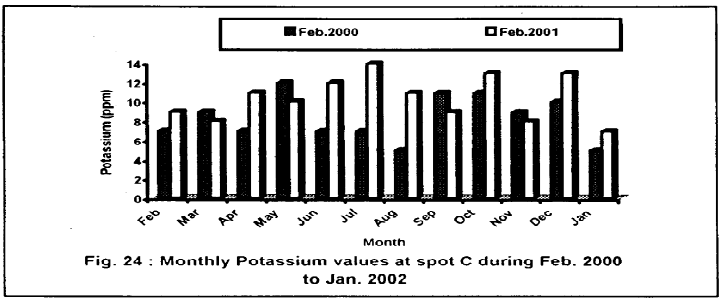


Fig. 24 : Monthly Potassium values at spot C during Feb. 2000 to Jan. 2002

During summer season the seasonal mean values of potassium at spots B and C are 7.75 and 8.75 in summer I, where as 11.5 and 9.5 in summer II respectively. In monsoon season the seasonal mean values of potassium at spots B and C are 12.25 and 7.5 during monsoon I, while 14.25 and 11.5 during monsoon II respectively. In winter season the seasonal mean values of potassium at spots B and C are 12.75 and 8.75 during winter I, while 12.25 and 10.25 during winter II respectively, as shown in table 4.3.2.19.

Iron (ppm):

Iron is the fifth element in-group VIII of the periodic table. In the present investigation of Iron at spots B and C it has been found that the values ranged between 0.21 to 0.68. During first year of the study period Feb. 2000 to Jan. 2001, it was minimum (0.21) at spot "C" in the month of Oct 2000 and maximum (0.65) at spot "B" in the month of July 2000. During second year of the study period Feb. 2001 to Jan 2002, it was minimum (0.25) at spot "B" in the month of Aug. 2001 and maximum (0.68) at spot "B" in the month of Jul. 2001 as shown in table 4.3.2.15 and Fig. 25. Yearly mean values of Iron at spot B and C are 0.42 and 0.34 during 2000-2001, while 0.43 and 0.42 during 2001-2002 respectively, as shown in table 4.3.2.16.

Table. 4.3.2.15 : Iron

Season		Summer				Monsoon				Winte			
Nonth		Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan
	Spot												
Feb 2000	B	0.35	0.6	0.4	0.45	0.48	0.65	0.28	0.22	0.28	0.58	0.46	0.36
Jan 2001	C	0.6	0.3S	0.38	0.26	0.38	0.35	0.25	0.29	0.21	0.3S	0.31	0.42
Feb 2001	B	0.41	0.5	0.46	0.48	0.60	0.68	0.25	0.29	0.34	0.37	0.59	0.3
Jan 2002	C	0.38	0.42	0.48	0.32	0.31	0.49	0.58	0.52	0.33	0.27	0.62	0.4

During summer season the seasonal mean values of Iron at spots B and C are 0.45 and 0.39 in summer I, where as 0.46 and 0.40 in summer II respectively. In monsoon season the seasonal mean values of Iron at spots B and C are 0.40 and 0.31 during monsoon I, where as 0.45 and 0.47 during monsoon II respectively. In winter season the seasonal mean values of Iron at spots B and C are 0.42 and 0.32 during winter I, while 0.40 at both spots during winter II respectively, as shown in table 4.3.2.19.

Discussion:

The Lonar Lake ecosystem has two distinct components. A marshy habitat developed along the northeastern margin having fresh water ecosystem and the saline water ecosystem in the crater basin. There are three main perennial, fresh water springs, which bring fresh water in to the basin besides few seasonal springs. The main perennial springs are Liz. Dhara, Sita-Nahahi and Ramgaya, which collectively forms the fresh water ecosystem in the crater basin. For fresh water analysis, “Ramgaya” stream and “Dhara” stream in which the stream of Sita- Nahani also merges is considered. For the analysis of the saline water naturally the main Lake is considered. It has been observed that the physico-chemical environment of a given water body is responsible for deciding the biodiversity.

In the following discussion except the temperature QC), pH (pH scale), sodium, potassium and Iron (ppm) all the remaining para meters are expressed in mg/lit.

The water temperature is an important factor and plays an important role in deciding the water acidity. The solar radiation through the ambient temperature alters the water temperature particularly the water body reacts by the thermal stratification. Particularly in shallow water bodies the water shows close relation with temperature as they

react quickly with change in atmospheric temperature Welch (1952). The temperature is an important parameter, which affect the biological reactions in water and chemical and biochemical reaction in the organisms in the water Trivedy e¿ a/., (1998). In Lonar Lake ecosystems the water temperature followed the same pattern of seasonal changes according to the atmospheric temperature. The water temperature of fresh water was ranged between 18 to 32 which indicates the said pattern as shown in table 4.3.1.15 and 4.3.1.16.

The hdrdness is due to the presence of major cations like calcium, magnesium that are imparting hardness along with anions like sulphates, chlorides, bicarbonates and carbonates. According to Trivedy

R.K. (1998) Hardness is not detritus to health although it has been supposed to be playing some role in heart diseases. The hardness of fresh water was ranged between 212 to 405 as shown in table, 4.3.1.15 and 4.3.1.16 which is somewhat higher when compared with tap water. Hardness also has great effect on biodiversity.

The pH of fresh water was in the ranqe of 5.5 to 7.75 which is around neutral as shown in table 4.3.1.15 and 4.3.1.16. pH denotes the acidity or alkalinity of water by strenqth of hydrc›gen with range between 1 to 14 on logarithmic scale Jacob Kalff (2002). It is an important parameter of a solvent which is defined as negative logarithm of hydrogen ion concentration (pH = -log 10 (H*). Thus pH scale ranges from 0 to 14 with 7 as neutral. The pH of a solvent below 7 is being acidic and above it is alkaline. Natural waters are normally slight alkaline in nature due to the presence of high concentrations of carbonates and bicarbonates, considerable changes in pH are observed in natural waters because of exposure to air and biological activities with the respective water bodies.

When total alkalinity is constant pH changes are proportionate to CO2 change therefore pH is a useful indication of community metabolism Odum (1975). Ganerally slight alkaline conditions are favourable for growth of phytoplankton species in lotic systems Welch (1952}. Similar trends were observed by Subbamma er a/. (1992), Jindal et al. (1993), Dushyant Sharma (2000) and Datta S.P. et al. (2001).

The dissolved oxygen content of fresh water was ranged between 01.19 to 08.4 as shown in table 4.3.1.15 and 4.3.1.16. According to Jacob Kalff (7002) the concentration of dissolved oxygen reflects the balance of o 2 supply from the atmosphere and photosynthesis in the water body. At a given point parameters like, temperature, transparency, nutrient load, biomass determines dissolved oxygen. Chandrasekhar S.V.A. (1996). Dissolved oxygen content in a water body is one of the most important abiotic components in an aquatic ecosystem, which determines the biodiversity. Oxygen rich contents are very essential for the faunal diversity. Dissolved oxygen content is mainly concerned with its diffusion from atmosphere and photosynthetic activity in a given water column.

The dissolved carbon dioxide (free) value of fresh water was ranged between 0 to 116 as shown in table 4.3.1.15 and 4.3.1.16. The dissolved carbon dioxide content in the water body is mainly due to diffusion from air, from inflow ground waters, due to decomposition of organic matters, respiration of organisms inhibiting Welch (1952). According to Jacob Kalff (2002) it is now evident that most lakes in world are saturated with CO2 due to the partial pressure which is three times that of the atmosphere. Dissolved carbon dioxide (free) in water is source of carbon that can be assimilated and incorporated in to the living matters of the aquatic atmosphere

Hutchinson (1957). Like oxygen dissolved carbon dioxide (free) content in a water body is another most important abiotic component in an aquatic ecosystem which also determines the biodiversity. Carbon dioxide contents in a water body are very essential for the photosynthetic activities of biotic communities, which are the main producers and play an important role in the establishment of a steady state aquatic ecosystem.

The carbonate alkalinity value of fresh water was ranged between 4 to 44 as shown in table 4.3.1.15 and 4.3.1.16. Total alkalinity is because of relative abundance of carbonates, bicarbonates and hydroxides Trivedy et a/. (1998). According to Chandrashekar S.V.A. (1996) it is found that in general alkaline water is more productive and supports diversity of aquatic life. Vast majority of the best studied fresh water is with higher pH reflecting bicarbonate ions Jacob Kalff (2002). During present investigation carbonate as well as bicarbonate alkalinity was observed which collectively shows the total alkalinity of the water The bicarbonate alkalinity value of fresh water was ranged between 50 to 246 as shown in table 4.3.1.15 and 4.3.1.16. It is found that compared to the carbonate alkalinity of respective water body, bicarbonate alkalinity values are more. The concentration of bicarbonates may be attributed to the influent springs running through the rocks. Total alkalinity of a water body is its acid neutrilizing capacity.

The chloride value of fresh water was ranged between 35.45 to 148.89 as shown in table 4.3.1.15 and 4.3.1.16. Chloride in the form of chloride ions is naturally occurring in all kinds of water at varying percentage. According to Trivedy ed a/. (1998) in spite of naturally occurring chlorides, they are also added to natural water due to addition of domestic sewage, leaching from natural

rocks. According to Mathew Varghese (1992) the higher level of chlorides in natural water is the indication of pollution from domestic sewage. The present fresh water is within the permissible limit as per the norms for drinking purpose.

The salinity value of fresh water was ranged between 65.05 to 273.21 as shown in table 4.3.1.15 and 4.3.1.16. The sweet and salty taste to the water sample is dependent on the amount of chloride in respective water sample which determines the salinity. Salinity also plays an important role in the biodiversity of aquatic ecosystems. The salinity of fresh water is very negligible as compared to the saline water at both spots.

The sodium value of fresh water was ranged between 5 to 18 as shown in table 4.3.1.15 and 4.3.1.16. The ratio of sodium to total cations is important in agriculture and human physiology. In large concentrations it may affect persons with cardiac difficulties. The US EPA

advisory limit for sodium in drinking water is 20 mg /lit (APHA 1998). It is found that the present fresh water is within permissible limits for purpose drinking.

An attempt has been made to compare the results of the different authors with our findings about fresh water in Lonar Lake as depected in table 4.3.1.18. The pH values are similar to the Chowdhury et a/. (1978). Among the anions bicarbonates, chlorides and carbonates are dominating respectively during present investigation. The findings are very similar to the Chaudhury et al. (1978) with slight changes in the values of bicarbonates at both spots. The chloride value is more at Ramgaya when compared with Chawdhury ed a/. (1978). Observed sodium values are less when compared with Chowdhury et al. (1978).

An examination of water analysis of Lake Water shows that it is highly alkaline and saline as shown in table

4.3.2.17 and 4.3.2.18. The water temperature of saline water was ranged between 18 to 32 as shown in table 4.3.2.17 and 4.3.2.18.

The hardness of saline water was ranged between 95 to 129 as shown in table 4.3.2.17 and 4.3.2.18. The hardness of saline water shows very negligible seasonal changes. In the present investigation of pH, it was ranged between 9.25 to 10.58 as shown in table 4.3.2.17 and 4.3.2.18. The high pH caused by the formation of ammonia has directly affected the CO3-HCOa equilibria and precipitation of calcium and magnesium Chowdhury et al. (1978). When compared with the pH values of fresh water during present investigation, it has Leen observed that the pH of saline water is highly alkaline.

The dissolved oxygen value of saline water was ranged between 0.59 to 4.55 as shown in table 4.3.2.17 and 4.3.2.18. The present study revealed that the saline water of Lonar Lake is poor with respect to the oxygen content as compared to the fresh water which indicates the anacrobic conditions towards the bottom of the Lake.

In the present investigation of dissolved (free) carbon dioxide in the saline Lake, it has been found that it is totally absent throughout the study period. In the absence of free CO2 soluble bicarbonates which are in higher percentage may be converted in to free CO2 and insoluble carbonates. This free COC may be then utilized by the producers present in the Lake for the process of photosynthesis.

During the present study period carbonate alkalinity of saline was ranged between 220 to 802 as shown in table 4.3.2.17 and 4.3.2.18. The present study revealed that the carbonate contents are very high as compared to the fresh water from Lonar Lake. The values of bicarbonate alkalinity are also high and ranged between

460 to 1301. These contents in the Lake water are responsible for the high alkaline nature of the water boxy.

Chloride value of saline water was ranged between 2006.47 to 3374.84 as shown in table 4.3.2.17 and 4.3.2.18. The salinity value of saline water was ranged between 3486.72 to 6192.83 making the lake water brackish as shown in table 4.3.2.17 and 4.3.2.18. The sweet and salty taste to the water sample is dependent on the amount of chloride in respective water sample, which determines the salinity. The present study revealed that Lonar lake water is highly saline. Salinity of water also plays an important role in the biodiversity of aquatic ecosystems.

The salinity of saline water from Lonar lake is very high compared to the fresh water at both spots. Amongst the anions chlorides, bicarbonates and carbonates are dominating respectively. Besides these in the Lake water sodium ions are dominant, followed by potassium ions which are less and the least are the iron ions. During the present study sodium, potassium and Iron values of saline water were ranged between 2122 to 8800, 04 to 19 and 0.21 to 0.68 respectively as shown in table 4.3.2.17 and 4.3.2.18. Thus the Lonar Lake water is described as Na-CI-CO3-NCOs type water.

An attempt has been made to compare the results of the different authors with the present findings about saline water as depected in table 4.3.2.20. The findings are very close to the values given by Chowdhury and Handa (1978) except the values of carbonate and bicarbonates. The values of carbonate and bicarbonate are less due to the average value of the year and constant increase in the water level. The salinity of water is given by Musaddiq et a/. (2001). When compared with it the observed salinity is less being average value of the year.

The dissolved oxygen content values given by Musaddiq et a/. (2001) are less compared to the present values. The values are somewhat higher and may be attributed to increase in photosynthetic activity which in turn results in the increase in the aerobic mode of life.

According to Badve et.al. (1993) there is considerable increase in water level, which is attributed to high precipitation during monsoon since 1989 onwards. The increase in water level is perhaps the highest, increasing the water level by 4 meters since 1985. Today the water level has been further increased by about 2 meters. This continuous increase in water level after 1985 may be correlated to percolation of water stored in minor irrigation dam, which is completed in the year 1984.

An immediate effect of rise in water level of the Lake is responsible for change in water quality, which has a direct bearing on the life in the Lake ecosystem. The reduced values of physico-chemical parameters can be attributed to the continuous increase in water level. There is very little seasonal variation in the chemical composition of saline water. The present study revealed that due to very high contents of sodium, chlorides, carbonates and bicarbonates in the Lake water, it is unsuitable for drinking as well as irrigation purposes.

Chapter - V
BIODIVERSITY

Introduction:

The term "Ecology" is of recent origin. It was firstly proposed by the Germen bidogist Ernst Haeckel in 1869. According to Odum (1983), although an ecology remains strongly 'rooted in biology, it has emerged from biology as an essentially new integrative discipline that links physical and biological processes and forms a bridge between the natural sciences and the social sciences. The word "Ecology" is derived from Greek word Oikos means "household", and logos means "study". Thus literally ecology means the study of "Life at home", with emphasis on "the pattern of relations between organisms and their environment.

In a broad sense on Earth planet basically four main spheres are present as; Hydrosphere, Lithosphere Atmosphere and Biosphere. In first three spheres the last sphere is flourishing since time immemorial. Biosphere is the largest and most nearly self sufficient biological system which includes all the earth's living organisms interacting with the physical environment as a whole to maintain a steady state system intermediate in the flow of energy between the input of the sun and the thermal sink of space.

Ecology was of practical interest early in human history. The writings of Hippocrates, Aristotle and other philosophers of ancient Greece clearly contain references to ecological topics (Odum 1971). For the survival every living organism is dependent on its surrounding as well as internal environment. Slight changes in the environmental conditions may be lethal to the organism. Leaving behind

this truth human beings for the benefit are regularly disturbing the natural environmental conditions with the technological achievements. All this causes drastic imbalance in the ecological conditions changing the biodiversity of the world. According to Odum (1983), our survival depends on knowledge and intelligent action to preserve and enhance environmental quality by means of harmonious rather than disruptive technology.

Biodiversity in simple sense is the variety of all living organisms throughout the world. According to Kotwal and Banerjee (2002) biodiversity is defined as, “The variety and variability of organisms and ecosystems is referred as biological diversity“. In this view, as per the data available about the number of worldwide species belonging to different taxonomic groups are as follows:- Bacteria 3600, Blue green algae 1700, Fungi 46983, Bryophytes 17000, Gymnosperms 750, Angiosperms 250000, Insects 750000, Sponges 5000, Crustaceans 9000, Molluscs 38000, Star fishes, 50,000, Pisces, 6100, Amphibians 19056, Reptiles 6300, Birds 9036 and Mammals 4008 as shown in table 5.1.1. India contributes a lot in the biodiversity of the world and ranks 6 amongst the 12 mega biodiversity countries of the world. In India an estimated number of species which belongs to different taxonomic groups are; Bacteria 850, Fungi 23000, Algae 2500, Reridophyta 1022, Gymnosperms 64, Angiosperms 15000, Insects 53430, Nollusca 5050, Pisces 2546, Amphibia 204, Reptilia 446, Aves, 1228, Mammalia 372 as shown in table 5.1.2. According to (MOEF 1994) the faunal wealth of India consists of 81000 different species, which belong to different phylas viz. fñollusca 5000, Arthropoda 57000, Pisces 2546, Amphibians 204, Reptiles 428 Aves 1228 and Mammals 372.

India is occupying a special status in terms of

ecosystem, genetic and species diversity because of its location in the tropical zone, physical features and eco-climatic conditions. The Indian sub continent consists of three major bio-geographic realms; Indo - Nabyan which is richest in the biodiversity, the Eurasian and the Afro-tropical. Indian wildlife Institute has divided the country in to 10 bio-geographic regions, namely, Trans Himalayan, Himalayan, Indian desert, Semi arid region, Western ghats, Deccan Plateau, Gangetic plain, North-East India, Islands and Costal Regions. The forest area of India is 19.47 per cent of the land area (MOEF 1994). According to Rodgers and Panwar (1988) in India there are 75 National parks and 421 sanctuaries and there is a proposal to increase the protected areas to 148 National parks and 503 sanctuaries. Besides this 21 wetlands, 15 mangroves and 4 coral reef areas have been identified for conservation. In India there are six Ramsar sites viz. Harike, Wullar, Loktak, Keoladeo, Sambhar, and chilka. Besides these there are many more areas in India whose inclusion is necessary under various categories of protection for the conservation of biodiversity flourishing at particular areas. One of such sites whose protection and conservation is necessary is the Lonar Lake, which is the Heritage of the World. According to Nalu (1999) Lonar Lake is an ecologically interesting site with full of flora and fauna and should be protected as Ramsar site.

Table 5.1.1. Estimated number of species worldwide

Sr. No.	Taxonomic group	No. of species
1	Bacteria	3600
2	Blue green algae	1700
3	Fungi	46983
4	Bryophytes	17000
5	Gymnosperms	750
6	Angiosperms	250000
7	Insects	750000
8	Sponges	5000
9	Custaceans	9000
10	molluscs	38000
11	Star fishes	50000
12	Fishes	6100
13	Amphibians	19056
14	Reptiles	6300
15	Birds	9036
16	Mammals	4008

Source: Kotwal and Banerjee (2002)

Table 5.1.2 Estimated number of species in India

Sr. No.	Taxonomic group	No. of species
1	Bacteria	850
2	Fungi	23000
3	Algae	2500
4	Reriodophyta	1022
5	Gymnosperm	
6	Angiosperm	15000
7	Insecta	53430
8	Mollusca	5050
9	Pisces	2546
10	Amphibia	204

11	Reptilia	446
12	Aves	1228
13	Mammalia	372

Source: Kotwal and Banerjee (2002)

Different Environmental Conditions:

In 1935, Tansley A.G firstly proposed the term ecosystem. It is derived from two words, namely eco and system. Eco refers to environment and system means a complex coordinated unit. It consists of biotic and abiotic factors. An ecosystem is defined as the community and the non-living environment functioning together. The ecosystem is the basic functional unit of Ecology, since it includes both organisms and abiotic environment, each influencing the properties of the other and both necessary for maintenance of life as we have it on the earth. According to Odum (1983), “Any unit that includes all the organisms that function together in a given area interacting with the physical environment so that a flow of energy leads to clearly defined biotic structures and cycling of materials between living and non living parts is an ecosystem”.

In terms of ecology biosphere is the major ecosystem. It is formed with the help of four mega ecosystems like marine ecosystem, limnic ecosystem, Terrestrial ecosystem and Industrial ecosystem. According to Arumugam (1988) Limnic ecosystem includes all fresh water ecosystems like ponds, pools, lakes, rivers, streams. Terrestrial ecosystem includes the ecosystems of air, forests, grasslands, deserts etc. and Industrial ecosystems include man made ecosystems like cropland, city, town etc. Limnic ecosystems contain full of floating and submerged aquatic vegetation. Based on the nature of water (Stagnant or running) in limnic ecosystem it is again

sub divided in to two categories viz. Lentic (Stagnant water) and lotic (running water) ecosystem. Lentic ecosystem is also referred as wetland ecosystem. It is usually frequented by aquatic birds like ducks lapwings, cools, moorhen etc.

In terrestrial ecosystems forest ecosystem represents a special ecosystem which has evolved and flourished within a span of millions of years together. Grassland ecosystem is the area localized in between forests and deserts. According to Arumugam (1988) caves are natural hallows on the earth which may be present on the surface of the earth or in the sides of hills, mountains and rocks etc.

In Lonar crater about 6 different ecosystems assemblage is available to the researchers working in the field of ecology. Different ecosystems of Lonar crater include lentic ecosystem, lotic ecosystem, forest ecosystem, grassland ecosystem, arboreal ecosystem and man made cropland ecosystem. Apart from these mentioned ecosystems, especially different ecological niche has been developed on the edges of lentic ecosystem inside the crater.

Depending upon environmental conditions of an ecosystem, the composition of biotic community differ accordingly. In this respect in Lonar crater a great variety of organisms are flourishing since millions of years, which ultimately resulted in the present days highly diversified biotic communities. All this resulted in the great biodiversity of Lonar crater which has been shown in table 5.2.1.

Table. 5.2.1 : Faunal diversity in Lonar lake

Sr. No.	Group	Number of fauna observed in				Total
		In the lake water	Fresh waster	On the lake water	Around the lake	
1	Protozoa	05	01			06
2	Rotifera	04				04
3	Arthropoda	10	07		04	21
4	Mollusca		02		02	04
5	Pisces		01			01
6	Amphibia		01			01
7	Reptilia				04	04
8	Avea			08	36	44
9	Mammalia				09	09
	Total	19	12	08	55	94

Material and Methods:

To get an over all idea about the faunal diversity in and around Lonar Lake following methodology is used as per the groups of animals observed and collected.

In aquatic ecosystems planktonic biomass is low and even patchy and thaws why large volumes of sample is filtered during each visit at four sampling stations through a plankton net Kodarkar (1998) (Silk No. 25 with aperture size 64 micron) of uniform mesh size to sort out planktons. Initially to the plankton net a glass test tube with an appropriate size is fixed for the collection of filtered material. Now plankton net is introduced in the water

column at a desired depth and pulled through the water column horizontally with an uniform speed for several times. The filtered material is then transfered in 100 ml plastic bottles and carried to the laboratory for further processing. For the study of planktonic biomass the collected samples are kept for 24 hrs for sedimentation. Then the supernatant is removed with the help of pipette and the sample is diluted by adding distilled water. The samples are preserved in lugol's iodine / 4 % formalin solution. By using standard methods permanent slides were prepared.

Like planktons benthos particularly zoobenthos are collected by scrapping and from mud. The sample is filtered through a another mesh with appropriate size into an enamel trey filled with water, the organisms floating on the surface will be picked up and preserved in 4 % formalin / 70 % alcohol. Different kinds of small sized animals in and around the Lake are collected and preserved in 4 % formalin and the larger animals like birds, mammals, reptiles amphibians etc. were observed and the points were recorded at the time of observation. Observations are made with the help of binocular and the animals are photographed with the help of telelense camera as per the conditions.

In the present work unidentified fauna collected during the study period is sent towards Head Quarter of Zoological survey of India at Kolkata for their identification. Unidentified animal's name will be incorporated at the time of publication.

Faunal Diversity in Lonar Lake

Phylum Protozoa

Paramecium

Field characters - It has been collected from Lonar Lake during the study period. Body elongated, slipper

shaped in appearance. Body covered with cilia, usually longer cilia towards posterior end. Peristomial groove ventral, median, cytostome right of median line. Cytopharynx long, two contractile vacuoles, binucleated organism. It is very easily distinguishable due to its unique body shape and other characters. It has been extensively used in experimental studies by the researchers.

Amoeba:

Field characters - It has been observed from fresh water of the Lonar Lake during the present study. It is a very common protozoan animal abundantly found in fresh water habitats. Body is transparent. The animal is constantly changing its body shape by amoeboid movements. Lobopodia are with hemispherical tips and usually with hyaline caps. Out of two one lobopodium is dominating at any one time. One contractile vacuole is present. Single large nucleus is present.

Prorodon:

Field characters - It has been observed in saline water of the Lonar Lake during the present study. It is a one kind of ciliate protozoan. It is free living ciliate. Body ciliature is uniform and simple. Body ellipsoidal in shape and somewhat asymmetrical in outlook. Cytostome is present near the surface of the body.

Cyclidium:

Field characters - It has been observed in saline water of Lonar Lake during the present study. Body of this ciliate is very small, oval in shape with refractile pellicle. Peristomial groove is extending two third of the body length which is wider posteriorly. Single contractile vacuole is present posteriorly. Two nuclei are present, macronucleus is spherical in shape with an adjacent micronucleus. Right peristomial margin encloses small oral groove. Left peristomial margin bears free cilia.

Euplotes:

Field characters - It has been observed in saline water of the Lonar Lake during the present study. It is also a kind of protozoan ciliate. Body is transparent dorsoventrally flattened, oval in shape. Contractile vacuole is single and posteriorly situated. It is a binucleate animal in which macronucleus is band shaped and curved in appearance. The micronucleus is placed adjecent to the macronucleus. Peristome is sickle shaped. Adoral zone membranelles are well developed on anterior and left margin of peristome.

Oxitricha:

Field characters - It has been observed in saline water of Lonar Lake during the present study. It is also a kind of protozoan ciliate. Body is ellipsoidal in shape. It is flexible, ventrally flat while dorsally convex.

Peristome is large and adoral zone of cirri is well developed anteriorly along the left peristomal margin. Single contractile vacuole is present. Number of macronudei are two nearby which micronucleus lies.

In present investigation the identification of Protozoans is done with the help of “Fresh Water Zooplankton of India”, by S.K. Battish (1992).

Plate XIII

a) Lonar crater with an erected stone by the Geological Survey of India in April, 1975

b) Natural foam formation inside the Lake water

c) Carcinus

d) Gazella

Phylum Rotifera:

Branchionus:

Field characters - It is a heavily loricate form. It has been collected from saline water of Lonar Lake during the study period. Lorica is broad and covers the trunk completely, may be one piece when it continues around the body or two pieces united through flexible cuticle. Dorsal plate is arched ornamented in some species, where as ventral piece is relatively flat. Lorica in some species is stippled, antero dorsal edge always with even number of spines, antero ventral edge rigid or flexible but may be wavy or smooth with 'V' or 'U' shaped notch. Postero-lateral spines are present or absent depending upon the species. Postero median spines are mostly present and flank the foot, anterior portion of the body projects from lorica in the form of coronal disc which is bearing a circlet of cilia and three prominances covered with cilia of larger size. Foot is slender annubted with two toes with no spine. It is a cosmopolitan genus, and includes' 19 species.

Philodina:

Field characters - It has been collected from saline water of Lonar Lake during the study period. Body elongated; cuticle of trunk quite thin and flexible. Body divisible in to smaller head, cervical and foot segments telescopically retractile in to larger and longer trunk segm.ents. Corona with two trochal discs and cingulum. Cingulum is collar like with smaller cilia. Foot is segmented and less than half-total body length with two short spurs and four toes. Dorsal antenna well developed while postero lateral antennae absent. Stomach with definite ciliated lumen. It includes about 40 species.

Testudinella:

Field characters - It has been observed in the saline water of the Lonar Lake during the present study. The lorica of this animal is thin, flexible and without spines.

It is dorso-ventrally flattened, circular and formed with the help of dorsal and ventral plates, which are laterally fused. In live specimens corona is projecting through gap towards anterior end of the lorica. Corona is encircled with marginal cilia. Two frontal eyes are present. Foot is annulated and greatly retractile foot ends commonly in a ciliated cup, which is without spines.

Myilina:

Field characters - It has been observed in the saline water of the Lonar Lake during the present study. Body of this animal is somewhat barel shaped with one piece heavy lorica. Dorsolateral and posterolateral plates may project anteriorly as well as posteriorly in the form of spines. Lorica is one piece because dorsolaterals and ventral plate is firmly fused. Foot is with two well-developed toes and without spine. Foot along with toes is shorter than lorica.

Identification of Rotifers is done with the help of books written by following authors.

Dhanapathi, M.V.S.S.S. (2000) and S.K. Battish (1992).

Phylum Arthropoda

Agelena Funnel spider

Field characters - Thousands of spiders are building regularly funnel shaped webs around Lonar Lake on rock and vegetation. The percentage is more in summer season. The spider builds a flat sheet web from which runs a tubular retreat, the whole very similar to a wide — mouthed funnel, hence the common name funnel spider. It is a large long — legged hairy spider with four eyes. The spider lies inside the funnel and waits for its prey. As any insect falls on to the sheet part of the web the spider immediately comes out to catch the prey (Plate - XIV —a, b, c, d).

Notonecta Back Swimmer

Size - Small insect

Field characters - It has been collected from the saline water of Lonar Lake during the study period. The body is streamlined with dorsal surface peaked like a roof

and ventral surface flat. It is swimming in the water column with the back down. The back region is similar to the ventral surface of fish and when observed from below it contrasts very little with the sky. The ventral topside is dark like a fish's back and when observed from above is difficult to see against the dark background of the water depth. Body consists of a pair of eyes, two pairs of wings, three pairs of legs of them the hind legs are long which row with powerful sweeping strokes. It usually feeds on the other aquatic insects and it is found below the water surface (Plate - XV - a).

Plate XIV

a) Observation and collection of funnel spider

b) Funnel spider web showing the hole inside the web of funnel

c) Well spread funnel spider web

d) The funnel spider

Coixa Water boatmen

Size - Small insect

Field Characters - It has been collected from the saline water of Lonar Lake during the study period. The animal is floating inside the water. Usually the animal has a tendency to remain anchored at the bottom with its gripping legs. In water boatmen a special ability is present which gives an advantage of taking off into the air from the water. It is usually feeding on algae with the help of paddle shaped legs. Besides algae it also consumes organic debries which has sunk to the bottom. It is the best

musician (Plate - XV - b).

Nepa Water scorpion

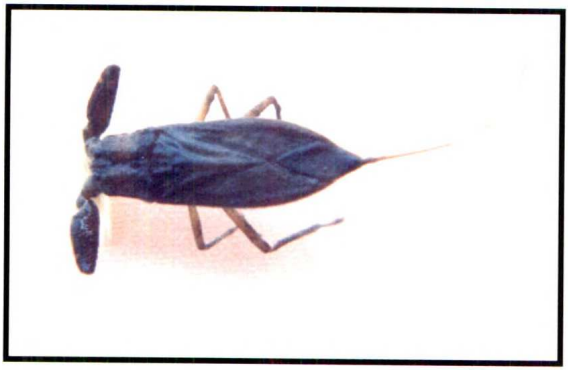
Size - 33 mm in length

Field characters - It has been collected from the underside of a large stone present submerged in saline water of Lonar Lake during the study period. Commonly it is known as water scorpion due to its quite painful bite with its stylet. Usually it remains submerged under the stones in the water column. It is usually difficult to distinguish due to its unique b‹xIy construction and colouration. Body is dorso-ventrally compressed measuring about 33 mm in length and 5 to 6 mm in width. Body colour is blackish in appearance. Body is divisible in to head, thorax and abdomen. One pair of leg that is fore leg is raptorial and thorax contains two pairs of walking legs. Abdominal appendages are jointed to form a breathing tube. It is predatory in habit. Head bears a pair of eyes, which are clearly distinguishable (Plate - XV - c).

Plate XV

a) Notonecta (Back swimmer)

b) Corixa (Water boatmen)



c) Nepa (Water scorpion)

d) Enhydrus (Water beetle)

Enhydrus Water beetle
Size - 13 mm in length

Field characters - It has been collected from the fresh water stream of

Dhara present in Lonar Lake during the study period. The animal is very lastly swimming in zig-zig motions on the surface of the water. Body is tapering at both ends. Body colouration is dark blackish with a somewhat shinning pattern. Body is divisible in to head, thorax and abdomen. Head consists of a pair of small eyes, which are located on the dorso- ventral side of the head. There is a pair of very small antennae present in front of eyes. Body dimensions are; 13 mm in length and 6 to 7 mm in width. There are three pairs of legs of which fore legs are much elongated while mid and hind legs smaller and are shaped like paddles used for swimming (Plate - XV - d).

Ground beetle
Size - 15 mm in length

Field characters - It has been collected from the ground area around Lonar Lake during the study period. The b‹xly dimensions are; 15 mm in length and 6 mm in width. Body colour is dark black mixed with golden yellow coloured patches of considerable size. Body is divisible in to head, thorax and atxlomen. There are three pairs of walking legs, all of which are golden yellow coloured in appearance. Legs are large sized and mainly used for walking on the ground. It bears 5 joints. Head consists of a pair of elongated antennae, which are segmented. A pair of large compound eyes is conspicuous. An elytra is showing clear straight lines running in the down ward direction (Plate - XVI - a).

Spirobolus Julus

Size - 55 mm in length

Field characters - It has been collected from the ground area around saline Lake during the study period. Large population has been observed only during monsoon season. It is commonly known as wireworm. Body is divisible in to head, thorax and abdomen. Body colour is reddish chestnut type. It is commonly found in damp places. It is measuring about 55 mm in length while 8 mm in width. Head consists of a pair of jointed antennae on the sides. Behind the antennae there is a pair of poorly developed eyes; actually they are the groups of ocelli. Thorax has four segments. Abdomen has fifty-four segments. Last three thorasic segments and all abdominal segments; each bear two pairs of walking legs. Animal is moving very slowly on the ground with the help of its paired walking legs. When it is disturbed immediately it gets rolled up. It is herbivorous in nature (Plate XVII - c).

Carcinus Rock Crab

Field characters - It has been observed among the rocks on the edges of fresh water stream at spot "A" during the present study period. Considerable population has been observed during the present study period. It is a common crab. It is commonly known as "Rock crab". Body is generally dorso-ventrally compressed and consists of a large and broad cephalothorax and a stumpy abdomen. Cephalothorax is broader than long. The carapace is fused with epistome at the sides and nearly always in the middle. Rostrum is absent. It is a specialized crustacean. Sockets of the carapace contains antennules and eye stalks. Antennules and antennae are small sized. Third maxillipedes are broad, flat, valve like covering the other mouth parts. Abdomen is reduced and fixed, which is bent under the cephalothorax because of this it remains hidden when viewed from dorsal side. Abdomen is narrow in male as compared to the female. Body consists of five pairs of

well-developed thorasic legs (Plate XIII c).

Dragon fly nymph

Size - 23 mm in length and 6 mm width

Field characters - It has been collected from the saline water of Lonar Lake during the present study period. It is a nymph of dragonfly, which belongs to the order ‹xlonata. The body is yellowish in colour with reddish tinge. Body is divisible in to head, thorax and atxlomen. Abdomen is somewhat elongated broader at the end point and possesses three caudal spines, one mid dorsal and two dorso-lateral in position. Head bears a pair of large sized dark tan coloured eyes. A pair of short antennae is present in front of eyes. There are three pairs of legs of which the hind legs are larger in size as compared to the fore and mid legs (Plate - XVII - d).

Chironomus Larva - Non biting midge

Size - 6-15 mm in length

Field characters - It has been collected from the saline water of Lonar Lake during the study period. The larvae are present in saline water, as well as in the muddy area of the Saline Lake shoreline remained intermingeled with mud under water surface. These collected larvae are very similar to the mosquito larvae. They are slender in shape and measured in between 6 to 15 mm in length. Body characters of; the species living in oxygen poor mud is red coloured. Body colour is due to presence of respiratory pigment which is found in RBCS of Vertebrates, that is haemoglobin dissolved in the blood plasma of brvae. Body consists of twelve segments of which the posterior body segment is bearing a pair of leg stumps. Head is clearly demarcated. According to the limnological condition with respect to the oxygen and nutrients content in water; the species of midges is differing. Hence midges have become quite an important organism in Limnological

research (Plate - XVIII — a).

Unidentified Arthropods

U-1 Size - 13 mm in length

Field characters - It has been observed and collected from the ground around Lonar Lake onJy during monsoon season on large scale. The animal is slowly walking on the ground with its four pairs of legs. Body colour is dark, very attractive velvet like. On an average body length is measuring about 13 mm and width 7 mm. Body has cephalothorax and abdomen jointed. From the mid-dorsal region of the body it shows peculiar small pits or small depressions. Nouth is present towards ventral side in the anterior region with a pair of small parallel-serrated edged mouth parts (hook like). From ventral side four pairs of legs are present two pairs near mouth and remaining two pairs just behind middle of the body. Each leg is bearing four joints. All legs are more or less equal sized. When animal gets disturbed it shows an appearance like a dead animal for few seconds. The animal is not found in the other two seasons {Plate - XVI - b).

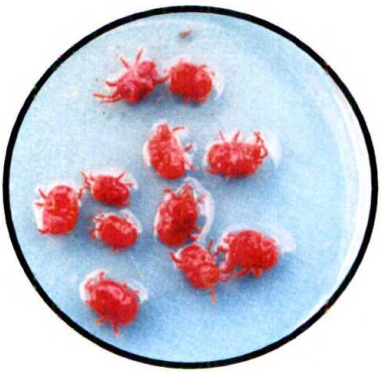
U-2 Size - 12 mm and 29 mm

Field characters - It has been observed and collected from fresh water spot A. It is a one kind of water insect. Body is slender, elongated measuring about 12 mm in length without legs while 29 mm including hind legs length and 4 mm in width. Body colour from dorsal side is blackish brown while from ventral side is silvery white. Body is divisible in to head, thorax and abdomen. Head consists of a pair of eyes, a pair of antennae and ventrally directed probosics. Two pairs of wings are present, of which hind wings are transparent. There are three pairs of legs, of which fore legs are smaller in size measuring about 8 mm in length while mid and hind legs are larger in size measuring about 23 mm in length. Animal is usually walking on water surface and also jumps showing jerky movements (Plate — XVI - c).

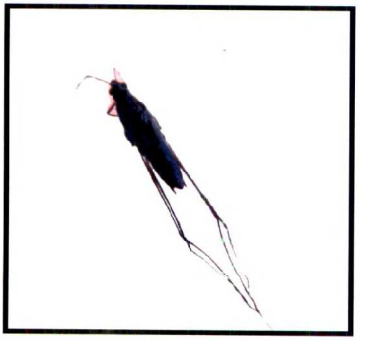
U-3 Size - 5 and 14 mm

Field characters - It has been collected from fresh water spot “A”. It is also a kind of water insect. Body is small, somewhat tapering towards anterior end and broader towards posterior end giving a triangular shape to the complete body. It is measuring about 5 mm in length without legs while 14 mm including length of hind legs and 2.5 mm in width. Body colour is blackish brown from above with brilliant design and silvery white below. Body is divisible in to head, thorax and alxlomen, alxlominal segments are clearly well marked. Wings are absent. Head consists of a pair of eyes and pair of antennae. Body consists of three pairs of legs of which fore legs are smaller sized measuring about 4 mm in length while mid and hind legs are larger in size measuring about 10 mm in length. It is also walking and jumping on the surface of water column (Plate — XVI - d).

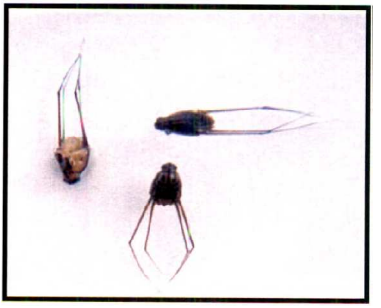
a) Ground Beetle



b) U-1



c) U-2



d) U-3

U-4 Size - 5 mm and 12 mm

Field characters - It has been collected from fresh water spot “D”. It is also a kind of water insect. Body is small dorso — ventrally compressed. Anterior end of the body is hammer shaped while posterior end is tapering but not pointed. Body length is measuring about 5 mm in length without hind legs while 13 mm including hind leg length and 2 mm in width. Body colour is silvery white from both the sides. From above presence of black markings in a distinct manner is providing beauty to the insect. Body is divisible into head, thorax and abdomen. Abdominal segments are easily recognizable. Head bears a pair of very small antennae; eyes indistinct. Body consists of three pairs of legs of which fore legs are very short measuring about 2.5 mm in length while mid and hind legs are long measuring about 9 mm in length. It is also capable to walk and jump on water surface easily with the help of its legs (Plate — XVII -a).

U- 5 Size - 15 to 19 mm in length

Field characters - It has been collected form saline water of Lonar Lake as well as from the edge of saline Lake water during their breeding season. Body is divisible in to head thorax and atxlomen. Abdominal segments are easily recognizable. Body colour is blackish brown from above with black spots at intervals and pale yellow towards lower side. Head consists of a pair of eyes and a pair of small thread like antennae. Body consists of two pairs of wings of which hind wings are thin transparent. There are three pairs of legs of, which fore and mid legs are smaller in size. While hind legs are larger in size curved and paddle like mainly used for swimming in water. Male and female individuals can be easily distinguished with the help of following characters. Female is larger in size having length 19 mm and width 8 mm. Male is smaller in size

having length 15 mm and width 7 mm. In female wings are somewhat shorter, while in male wings are more or less equal in size compared to the length of abdomen. In male fore legs bear small circular adhesive disc like structure at the tip which is absent in female (Plate — XVII - b).

U – 6 Size - 10 mm in length

Field characters - It has been collected from saline water of Lonar Lake at spots “B” and “C” for several times during the study period. It is a developmental stage of an arthropod. Body is measuring about 10 mm in length and 2 mm in width. Body is spindle shaped tapering at both ends. Body colour is yellow from above and pale yellow from below (whitish). In anterior part of body there is presence of three small pairs of legs towards ventral side. Behind legs from lateral side, up to the end of body there is presence of 7 pairs of hairy processes. There is one pair of hairy process in each body segment. Hairy processes are measuring about 2 to 4 mm in length (Plate — XVIII - c).

U – 7 Size - 17 mm with out tail in length tail 14 mm long

Field characters - It has been collected from saline water of Lonar Lake at spot “B” during study period. Body shape is cylinderical blunt towards anterior end, while it is pointed towards posterior end. Body colour is whitish somewhat transparent due to which internal organ system becomes visible up to a certain extent. It is measuring about 17 mm in length wil:h out tail and 4 mm in width. Tail is long, sharply pointed at the tip region measuring about 14 mm in length. Near the base of the tail in the posterior part towards ventral side of the body there is presence of a small stalk-bearing comb like structure with unequal size about 9 pairs of processes. Large processes are towards centre while small processes are towards outer side (Plate — XVIII - d).

U – 8 Size - 22 mm in length

Field characters - It has been collected from fresh water of Lonar Lake at spot “D” during the study period. Body is cylindrical and pointed at both the ends. Body colour has dark and faint yellow coloured patches from dorsal side, while pale yellow colour towards ventral side. Body length is measuring about 22 mm and width 2 mm. There are eleven segment:s present of which first three and last eleventh segments have no spine like projections. Starting from fourt:h to tenth segments, each one segment at the junction is bearing small spine like projections in the following manner; one dorsal pair, one lateral pair and two ventral pairs of spines. In this way each one segment consists of total eight spines like projections encircled around it self. At the junction point of tenth and eleventh segment towards ventral side there is a small outgrowth in the backward direction (Plate - XIX - a).

U – 9 Size - 8 to 9 mm in length

Field characters - It has been collected from saline water of Lonar Lake at spot “B” during the sutdy period. It is a developmental stage of an arthropod. Body is elongated lapering towards posterior end, while

broad towards anterior end. Body is divisible in to head, thorax and abdomen. Body colour is yellowish brown towards dorsal side with black coloured spots, while pale whitish towards ventral skle. On an average it is measuring about 8 to 9 mm in length and 1 to 1.5 mm in width. Head is dorso-ventrally compressed and consists of a pair of eyes; each one towards dorso lateral corner of head and two pairs of very small thread like mouth appendages. There are three pairs of long slender legs from the ventral side in front of the abdominal segments Complete body has eleven segments behind head region. Last abdominal segment bears a pair of small spiny processes (Plate XIX -

b).

U – 10 Size - 15 mm and 40 mm

Field characters - It has been collected from fresh water of Lonar Lake at spot “A” during the study period. It is a creeping organism. Body is pale yellow coloured, transparent due to which irternal organ system becomes visible up to a certain extent. Body is cvlindrical and sharply pointed toward posterior end. It is measuring about 15 mm in length without tail and 40 mm including length of tail while 3 mm in width. Body is worm like and consists of 7 pairs of small spiny projections towards ventral surface which are used for locomotion (Plate — XIX - c).

U – 11 Size - 11 mm in length

Field characters - It has been collected from saline water of Lonar Lake at spot “C” during the study period. Body colour is black from both the sides. It is measuring about 11 mm in length while 6 mm in width. 8ody is divisible in to head, thorax and abdomen. Head consists of a pair of small eyes and a pair of small thread like antennae. Body consists of a pair of wings, which are equal in size when compared with the abdominal length. Alxlomen is clearly segmented. There are three pairs of legs of which hind legs are longer and paddle like in appearance (Plate XIX - d). Identification of Arthropods is done with the help of books written by following authors. Rod and Ken Preston (1984), Grzimek (1969)., Stefferud Alfred (1976) and Kodarkar (1998).

Phylum Mollusca

Vaginulus Slug

Size - 3-4 inches

Field characters - It has been observed and collected only during monsoon season period from Lonar Lake. It is commonly known as “slug”. It is a shell less terrestrial gastropod. Body is blackish in colour. It has two

pairs of invaginable tentacles. It moves very slowly on the ground with the help of its foot leaving behind a special mark i.e. a somewhat shinning line on the ground which is actually the sticky substance secreted by the animal for easy locomotion (Plate -XX- a).

Thiara scabra

Field characters - It has been observed and collected from fresh water of Lonar Lake at spot "A" during the present study period. It is a fresh water gastropod. It has been observed that the animal is very slowly moving at the bottom of fresh water stream. Shell spire is elongated, shell is 23 mm in length and 8 mm in width towards one end only, while at opposite end it is pointed. In shell spire about 9 lines can be distinguishable. Shell is brownish in colour with dark chestnut marking at intervals (PlateXX b).

Helix Garden snail

Size - 3-4 inches

Field characters - It has been observed and collected only during monsoon season from area around Lonar Lake during the present investigation period. It is a common terrestrial, air breathing gastropod. It is commonly known as garden snail. Body consists of head, and visceral hump. Shell with prominent lines of growth. Head consists of two pairs of tentacles of which one pair is smaller and one is larger in size. Eyes at the tip of posterior tentacle pair.

Unidentified gastropod

Field characters - It has been collected from fresh water at spot "A" during the present study period for once only. It is a small sized gastropod. The shell is typically apple shaped with only three spire lines. The animal is present inside the shell. Shell mouth is 11 mm in width. Body consists of head, foot and visceral mass. Foot is elongated measuring about 13 mm in length and 6 mm in

width. Shell colour is whitish in appearance (Plate - XX - c).

Identification of molluscs is done with the help of books written by following authors.

Hyman, L.H. (1967), and Sedgwick Adum (1966).

Phylum Chordata

Pisces

P.1 Gambusia affinis Larvivorous fish

Size - 29 mm in length

Field characters- It has been collected from fresh water at spot “D” during study period. It is a one kind of exotic fish has been introduced in to warm waters throughout the world, for mosquito control. It is a small sized fish commonly found in warm, fresh or brackish water. It is a voracious feeder and can eat what ever is available. In these fishes ventral fins are abdominal. There is a single dorsal fin. Fins without spines. Lateral line is absent. Caudal fin homocircal. Body cylindrical, compressed and abdomen is rounded. Body divisible in to head, trunk and tail. It is measuring about 29 mm in length and 4 to 5 mm in width. Head short and snout is pointed. Mouth small, oblique and guarded with upper and lower jaws. Upper jaw smaller in size compared to the lower jaw, which is larger and slightly turned upwards. In male anal fin has a longer process, which distinguishes it from female and is known as gonopodium. Body covered with scales. Head bears a pair of dorso lateral large eyes (Plate — XXI —a).

Identification of genus Gambusia is done with the help of Day F. (1878).

Amphibians

Rana Frog

Size - 06 inches

Field characters - An anuran animal belonging to the genus Rana has been observed in the water of a well

(Chhua) on shoreline of saline Lake

in front of Kamalaja Devi temple. It is a common frog, which resides in fresh water habiat. This is an evidence of presence of fresh water under — ground resources in Lonar Lake area. Body size of this animal measures about 6 inches in length with body colour olive brown towards upper side with dark spots. Under parts are whitish in colour. Eyes pupil horizontal, fingers free characteristic of the genus and toes webbed. The skin of the back has a longitudinal golden line (Plate — XXI - b).

Voice - Male produces sound during breeding season.

Identifcaaon of genus Rana is done with the help of "CNH“ Vol. VIII by Harmer and Shipley (1968).

Reptiles

Varanus — Monitor Lizard

Size - 60 to 90 cm in length

Field characters - It has been observed in between the larger and smaller stones present towards eastern side of Lake rim. It is commonly known as monitor lizard. It usually leads a burrowing life. It is carnivorous in habit. Body colouration is brownish with black and orange coloured patches. Body measures about 1 */z feet in length. Body is divisible in to head, neck, trunk and tail, trunk region large elongated stout in appearance. Tail long thickened, neck longish, head triangular in shape with mouth gap wider possessing a bifid tongue which can be protruded out. Fore and hind limbs well developed and specially adapted for swift movements. Digits clawed.

Hemidactylus Wall lizard

Size - 4 to 5 inches

Field characters - It has been observed on the tree stems along the way in Lonar Lake during the study period. It is a widely distributed genus. Body colouration is adapted to

match the colour with the stem colour. The digits are dilated, inferiorly with two rows of lamellae. The clawed joints are slender and bent at an angle. The claws are rised from with in the extremity of the dilated portion. 8ody length is measuring about 3 to 4 inches. From the dorsal side body is covered with minute granules mixed with larger tubercles. Generally body is brown coloured above and white below. From above side darker spots are present. Tongue protrusible.

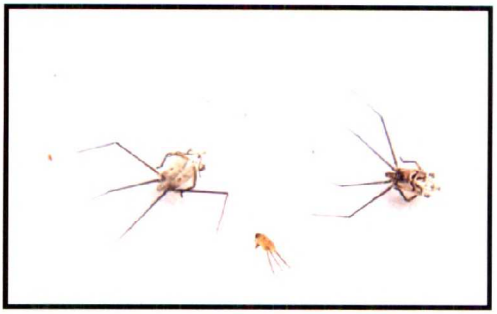
Voice - Very rarely produces sound

Mabuia Skink

Local name — Skink or sanp ki Ftosi Size - 3 to 4 inches

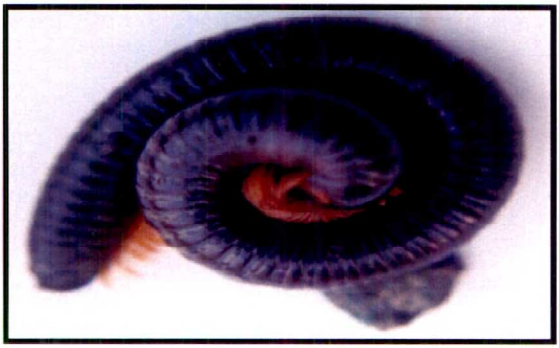
Field characters - There are about forty species, which belongs to the genus mabuia. During the present study period it has been observed that an animal showing peculiarities of the genus mabuia recorded on the ground. The body is specially adapted for burrowing life. It is commonly known as skink. Body colouration is reddish brown with covering of smooth scales. Body shape is vermi-form and divisible in to head, neck, trunk and tail. Head bears small eyes. Fore and hind limbs smaller in size with delicate toes. Tongue bears scale like papillae.

Plate XVII



a) U-4

b) U-5



c) Spirobolus (Julus)

d) Dragon Fly nymph

Plate XVIII

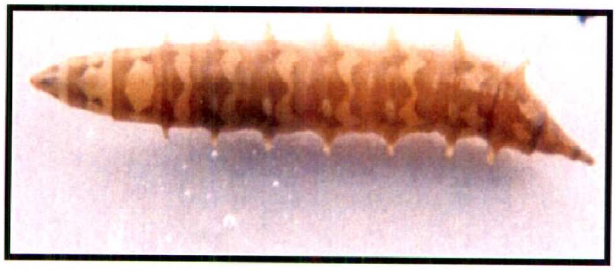
a) Chironomus larvae (Non-biting midge)

b) Hunting of Fauna from Lonar lake

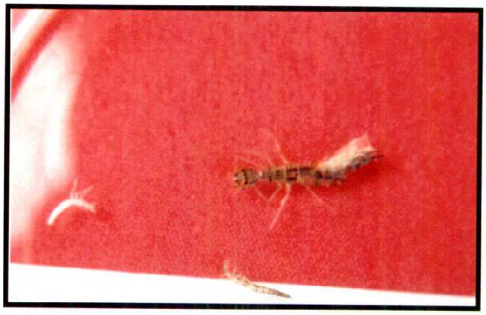
c) U-6

d) U-7

Plate XIX

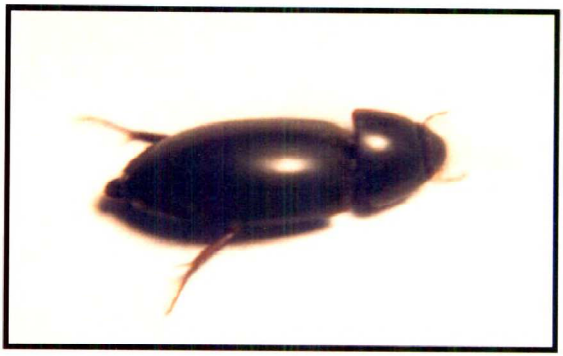


a) U-8



b) U-9

c) U-10



d) U-11

Naja Cobra

Size - 3 1/2 feels

Field characters - During the study period this type of snake has been observed in the forest nursery area of Lonar Lake. It is very easily recognized due to its unique character that is the presence of so called 10 mark on the dorsal surface of the hood. The specimen has measured about 3'/2 feels in length. The characters of the genus are; the pair of large and grooved poison fangs are separated by an inter space from one to three small faintly grooved teeth near the posterior end of the maxillaries. The scales are smooth and without pits. The neck region can be expanded in to a hood. Body colouration is yellowish to

dark brown with a black and white spectacle mark. It is a deadly poisonus snake.

Voice - It produces a hissing sound

Identification of Reptiles is done with the help of following book. CNH Vol. VIII by Harmer and Shipley (1968).

Aves (Birds)

Pava cristatus Indian peafowl

Local name - mor ♂, Landor ♀

Size - Domestic turkey

Field characters - Reputedly well known bird found in almost all parts of the Lonar Lake The characteristic feature of the bird is the presence of fan shaped crest on the head with tipped wire like feathers. The complete body is brilliantly coloured. The brightness of the neck and breast with glistening blue colour is unique.

The feathers are comprehensive with a metallic bronze green train on which an ocellated purplish black centered coppery eyespots are located. Lower side is light bronze - green coloured. The outer surface of the wings close barred with black and buff. Presence of a good deal of chestnut is observed in the wings. In wild state it is commonly found in moist and dry deciduous forests in the neighbourhood of streams. It is also found in the boundaries of village and cultivation in close association of man (Plate XXI-c).

Voice and calls - Normal "crow" of cock a loud and harsh metallic trumpet like may-awe shriked several times varying in pitch. Also a series of short Ka —an --- ka --- an repeated six to eight times.

Perdicula argoondah Deccan Rock bush quail

Local name - Lowwa

Size - Grey quail

Field characters - It is found in the drier areas

around the Lake. It is very similar to the jungle bush quail. But in this bush quail there is an absence of buff superciliary stripe, which is present in the jungle bush quail. Throat and under parts are pinkish buff coloured. Presence of a dull brick red throat patch characterizes the bird. About its food and voice nothing specially recorded.

Podiceps ruficollis Little grebe

Local name - Pandubi

Size - Tailless pegion

Field characters - It has been observed in the Lake water of Lonar. It is a small tailless aquatic bird. The legs are specially adapted for swimming and diving. Bill is pointed and short. The bird floats on the water column with posterior end lifted upwards and soft feathery stuff

coming out due to which a bluntly rounded effect is produced. According to the environmental conditions the bird shows its presence. Normally it is found in all types of inland waters. It is an excellent diver and under water swimmer. It prefers to live in separated pairs or small-scattered parties.

Voice and calls - The bird produces a shrilling sound. A sharp monosyllabic click is uttered repeatedly when gets disturbed. The bird also produces a short shrill cry like sound similar to an unoiled bicycle wheel.

Ardeola grayii Pond Heron

Local name - Bagla or Andha Bagla

Size - Country hen

Field characters - It is a type of water side bird observed during the study period. During flight the body colouration is predominantly snow- white. When the bird is at rest the body coloration is effectively earthy brown. The bill is long pointed, legs are also long slender stick like. It shifts accordingly with drought and flood conditions. The bird is commonly found near stream, ponds, Marshes,

village tanks, stagnant roadside ditches etc. Its method of hunting is typically heron like (Plate XXI-d).

Voice and calls - The bird in a nesting colony constantly utters a conversational wa-koo very human like. It produces a unfeeling croak sound when flushed.

Plate XXI

a) Gambusia fish

b) Rana (Frog)

c) Pavo (Indian Peafowl)

d) Ardeola (Pond heron)

Egretta garzetta Little Egret
Local name - Kilchia or Karchia bagla
Size - Village hen

Field characters - It is also another type of water side bird, tall, slim and snow — white in appearance observed during the study period. It shows similarity with cattle egrets but can be distinguished from it due to black u yellow bill, black and yellow coloured legs and feet respectively. The bird commonly found near inland waters, marshes, ponds, streams etc. The bird usually lives in flocks on the edges of water. The method of hunting is similar to the heron.

Voice and calls - Not recorded during the present study.

Ardea alba Large Egret

Local name — Malang Bagla or Bada Bagla Size - Grey Heron

Field characters - It has been observed that the bird is somewhat larger in size compared to the little egret. Bill is long, compressed and pointed in appearance. Body size is variable and deceptive. Wings are rounded, tail short and legs longer sticks like. It is commonly found near ponds, marshes, rivers etc. It shifts according to the water conditions. It has been observed that the bird is interested to live singly in a silent manner. The feeding habit is very similar to Grey heron.

Voice and calls — Very silent bird, the sound produced was not recorded during the present study. According to literature it produces an occasional throaty croak when one bird is displacing unfairly for example an encroaching competitor.

Ciconia episcopus White necked stork

Local name - Laglag or Bagula

Size - Goose

Field characters - It has been observed in the marshy area of Lonar Lake during the present study. Bill is long pointed, on the head black crown is present. It is a red legged black and white stork. The neck is completely white, long, due to which the common name white necked stork. Tail is short and legs are blood red coloured long sticks like. Except neck region remaining all body plumage is black glossed with purple or greenish blue. The bird is commonly found near flooded grasslands, irrigated Ploughed fields, banks of streams, marshes, deep forest marshes etc. (Plate - XXII-a, b).

Voice and cells — As per the available literature it is a silent bird except for a clattering of the mandibles with

neck bent over backwards and crown resting between the shoulders.

Phoenicopterus roseus Flamingo
Local name - Bog hans or Raj hans
Size - Vulture

Field characters - Small flocks of flamingo has been observed on the shoreline of saline Lake water ecosystem during the present study. It is a long legged, long necked bird. Bill is pink coloured massive and sharply down curved from about half of its length. Body plumage is rosy white with bright scarlet and black wings. The bird is coramonly found near large ponds, brackish Lakes, salt pans, estuaries md tidal mudflats.

Normally it is feeding in shallow water, usually brackish and even in concentrated brine with head inserted.

Voice and calls - The bird when feeds in company constantly produces a babbling sound. It is also producing a shrill sound like that of a goose.

Anas poecilorhyncha Spot bill duck
Order - Anseriformes
Local name - Garm pai or Gugral
Size - Domestic duck

Field characters - These ducks have been observed on the water line of saline Lake in the north eastern side of the Lonar Lake where agricultural activities are being practiced. It is a large sized duck whose body plumage is of scaly patterned buffy grey and dark brown in colouration. Bill is dark blackish with yellow coloured tip. The presence of two bulging orange-red coloured patches at the base of bill on each side of fore head is a diagnostic character. Due to these patches the common name is spot bill duck. The legs are bright coral-red coloured and

specially adapted for swimming. It is commonly found near vegetation covered ponds, shallow irrigation tanks etc. It is a non diving duck and commonly remains hidden from view.

Voice and calls - Very silent bird but occasionally produces a hoarse sound.

Anser indicus Bar headed goose
Local name - Hans or Sawan
Size - Grey lag goose

Field characters - It has been observed that the body of this bird is just similar to the Grey lag goose. The body is slender with longneck short tail and shorter yellow coloured legs. Body colouration is pale grey, brown and white. Bill is yellow coloured with a small black spot at the tip region. The presence of two black bars on the back part of the neck region, first larger in size extending from eye to eye and second smaller in size located just below the first is the diagnostic character. Hence the common name bar headed goose. The bird often cause considerable damage to the crops (Plate - XXIII-a).

Voice and calls - Similar to the Grey lags.
Tadorna ferruginea Brahminy duck
Local name — Chakwa or Sarza or Chakrawak
Size - Large domestic duck

Field characters - During the present study one more kind of large sized duck has been observed whose body is characterized by orange- brown colour of the plumage. The head and neck region is somewhat pale orange brown coloured. Brilliantly coloured wings and tail. During the flight orange brown coloured body, lower side of the wings white and large black coloured feathers are diagnostic characters of the bird. Bill is short somewhat hooked at tip. Wings are long and pointed, legs are

typically other duck like. It can walk well on the Lake margins.

Voice and calls — It produces a loud nasal, sharp and clear sound aang-aang repeatedly for several times.

Vanellus indicus Red Wattled lapwin9

Genus - Vanellus

Local name - Titwi

Size - Grey partridge

Field characters - It has been observed in the neighbourhood of saline Lake. It is a common leggy plover. The body is bronze brown coloured above and white below. Breast, head and neck region is black in colour. The characteristic feature of the bird is the presence of a fleshy red coloured frame work of wicker like structure in front of each eye, hence the name red waffled lapwing. On each side of the body just behind eyes there is a white broad band running downwardly, finally which joins with the white under parts. Bill is short pointed, legs are long pale yellow coloured. The bird is commonly found in the neighbourhood of water in open country and cultivation, deciduous forest etc (Plate - XXII-c).

Voice and calls — It produces a diagnostic did-ye-do-it calls.

Charadrius dubius Indian little ringed plover

Local name - Zirrea or Merwa

Size - Lesser sand plover

Field characters - It has been observed that the bird is smaller in size when compared with red wattled lapwing bearing certain peculiarities of its own. It is a typical little plover observed on the edges of the saline Lake. The body is characterized by a thick round black and white patterned head on the head fore crown is black separated from the sandy brown crown with a thin white line. Yellow- rimmed eyes are being encircled with a thin black band. There is a

presence of double collar on hind neck region, the upper white and lower black in colour. Bill is short pigeon like, legs are yellowish in colour. Upper parts of the body sandy brown coloured and under parts white. The bird is commonly found near banks of rivers, streams, wet grazing ground etc. (Plate - XXII-d).

Voice and calls - During flight it constantly utters a short single whistle phivor pheeoo.

Tringa hypoleucos Common sandpiper

Local name - Polte or Kottan

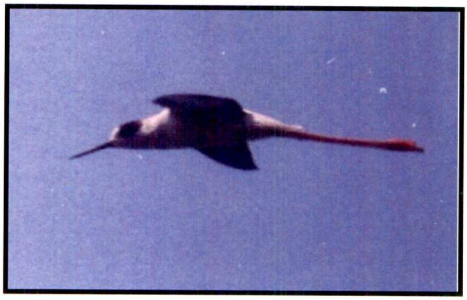
Size - Grey quail.

Field characters - This bird has been found near the inland waters. It is a small sized sandpiper. The body is characterized by the presence of a white stripe between wing shoulders and a dim obscure breasts band characterize the body. Upper sides of head and neck region ashy brown lined dark coloured. Rest of the upper parts have olive brown appearance along with white under parts and legs pale yellow coloured. Bill is somewhat shorter and highly pointed. Bird has been observed to take a stiffy vibrating jerky flight on the water column. It is usually observed running about at the water edge, picking up something.

Voice and calls - The shrill piping tee-tee-tee is a diagnostic character.

Plate XXII

a) Ciconia (White necked stork)



b) Ciconia (White necked stork) during flight

c) Vanellus (Red wattled lapwing)

d) Charadrius (Indian little ringed plover)

Circus aeruginosus Marsh Harrier
Local name — Kutar or safed sira.
Size - Kite

Field characters - It is a predominantly marsh frequenting harrier has been observed in the marshy area of the Lake. Body plumage is dark brown above and dark rufous below. Tail is silvery grey coloured, wings are long pointed and silvery grey coloured with a black tipped margin. Bill is weak and compressed, complete body is more heavily built with stronger legs. It is commonly found near ponds, marshes, flooded paddy fields etc. It spends a considerable time sitting about on the ground. During the flight the wings are held in a wide 'V' about the plane of the boby.

Voice and calls - Very silent
Elanus caeruleus Black winged kite
Local name - Kapassi
Size - House crow

Field characters - It has been observed in the deciduous forest region of the Lake area. It is a small beautiful grey and white coloured hawk. Crown, posterior part of neck, back, upper tail and rump ashy grey coloured, besides that remaining part of head, neck, under parts and tail pure white in colouration. Eyes are blood red coloured

with a unique black coloured eye brow type line. Tail is square shaped, wings extend beyond the tail in a resting position. Presence of black patches on the wing shoulder is the unique character. Bill is short curved, legs are strong specially adapted for capturing the prey. It is commonly found in dry deciduous forest and cultivated region.

Voice and calls - Normally silent, not recorded during the study period.

Accipiter badius Indian shikra
Local name — Shikra or cheepak
Size - House crow

Field characters - It has been observed in the deciduous forest of Lonar Lake. It is a type of hawk smaller in size when compared with black winged kite. Body plumage is brilliantly coloured. Upper parts are ashy blue grey coloured and under part white with rusty brown colour on breast. It shows close similarity with a sparrow hawk. Tail is long and multibanded extending beyond wing tips. Bill is short, powerful sharply curved, legs stouter in appearance. It is commonly found in open wooded county side, hill, plains, village areas and cultivation.

Voice and Calls - It produces a normal loud harsh and challenging call titu-titu similar to black drongo's.

Psittacula krameri Rose ringed parkeet
Local name - Tota or popat
Size - Myna

Field characters - It has been observed more abundantly in the neighbourhood of the Kamalaja Devi temple located in the southern part of the Lake. Commonly residing in holes present on the 'deep mala' near the temple. It is a very common well-known bird. Body is slim, grass green coloured with a typical short heavy deeply hooked red coloured bill. Wings are shorter, tail very long graduated. It is commonly occurring in moist and dry

deciduous forest, cultivation and in the neighbourhood of human habitation. k is a popular pet of the human beings.

Voice and calls - It produces a loud, shrill screaming kee-ak, some times quickly repeated several times.

Tyto alba Indian Barn owl

Local name —Ghubad

Size - House crow

Field characters- A typical Indian owl has been found in the

neighbourhood of unfrequented disturbed temples located around the saline Lake. Body plumage is golden buff and grey to silky white, usually spotted dark brown in appearance. Large round head with a ruff or stiff feathers surrounding white money like facial disk. Yellowish brown coloured plumage on shoulders and wings which are long and pointed. Bill is straight at base, compressed and slightly curved at the tip region. Legs are long, specially adapted for hunting. It is commonly found in the neighbourhood of cultivation, caves, ancient forts etc. nocturnal in habit.

Voice and Calls - It produces a variety of discordant long - drawn shrikes and chuckles and weird snoring and hissing notes.

Eudynamys scolopacea Indian Koel

Local name - Koel, or Kokil or Kokila

Size - House crow

Field characters - It has been found in the green vegetation surrounding Lonar Lake. The presence is very easily recognized due to its peculiar call producing habit kuoo-kuoo. Body plumage is glistening metallic black all over the body. Tail feathers and wing feathers are large sized. Yellowish-green coloured bil and crimson coloured eyes. It is commonly found among leafy trees, shrubs in

lightly wooded country, gardens, cultivated area and village etc. It flies very rapidly with swift flight and rapid wing beats.

Voice and calls — Very popular bird due to its calls. It produces different musical calls like, keoo-keoo, keoo, kuoo-kuoo, kuoo etc.

Centropus sinensis Common crow Pheasant
Local name — Nahoka or kuka or kumbhar kaola
Size - Jungle crow

Field characters - When compared to the house crow a large sized bird has been found in the present forest nursery located in the north eastern side of the Lonar Lake. Bird is easily recognized due to its long, broad, graduated black tail and unique deep reddish brown coloured wings. Rest of body plumage is glossy black coloured. Bill is yellowish green coloured deep, moderately Urge and curved. Eyes are crimson coloured and leg somewhat stronger when compared with koel. It is commonly occurs among deciduous scrub forests, tall grassland, cultivated area and gardens etc. It is sedentary parochial and largely terrestrial in habit. It stalks along ground like a pheasant, tail held horizontally, opened and shut from time to time occasionally thrown forward over the back.

Voice and calls - It produces a deep resonant coop-coop-coop sound quickly repeated for several times.

Dicrurus adsimilics Black Drongo
Local name — Kolsa or Ghosia totwal
Size - Bulbul

Field characters - This bird has been observed being perched on a partly deforested tree branch near the shoreline of Lake. Body is glossy jet black coloured slim and, with a long deeply forked tail. Other body features are bill shout, wings long and pointed, legs short. It is

commonly found near open deciduous forest and cultivated country. As per literature it is of great economic usefulness to agriculture in destroying vast quantities of insect pests.

Voice and calls - It produces a normal and most common ti-tiu, or also a harsh cheece - cheece — chichuk.

Lanius schach Rufous backed shrike

Local name - Kajala latora

Size - Bulbul

Field characters - It is a typical shrike. Body features are, head large, bill stout laterally compressed hook tipped, and tail long graduated. Body plumage is variously coloured. Crown, hind neck and upper back is grey coloured. There is a presence of broad black band on fore head running through eyes. Rest of upper parts is rufous black coloured. Towards the lower side of head and breast plumage is white. Wings are blackish in colouration. It is commonly found near openly wooded well watered country. Generally it glides down at an angle, swiftly and silendy to seize the prey in bill and bear it away.

Voice and calls - It produces a louci and noisy sound. The sound produced is similar to gerlek - gerlek.

Oriolus oriolus Golden oriole

Local name - Peelak or poshinul

Size - Myna

Field characters - It is a bright golden yellow coloured bird with black coloured wings and tail. Bill is pinkish in colour and it is in length as that of head. Wings are long and pointed, tail shorter and graduated. It is commonly found among well-wooded country, semi evergreen forest, gardens and villages etc. Generally it keeps it self singly or in loose association with other birds. As per literature it commonly baths by taking repeated flying dips at the surface of a water column.

Voice and cells - It produces a common harsh chee-ah. It also produces a pee-lo-lo, like melodious sound. Corvus macrorhynchos Jungle crow

Local name - Kala kowwa or jungli kowwa or Dam Kaula

Size - House crow

Field characters - It is a glossy jet black coloured crow. Heavy black bill with a deep throaty voice. Tail shorter than wing and slightly graduated or rounded at end. It can be easily distinguished from a common house crow due to its larger body size and the pecularities mentioned above. It is commonly found among well-wooded country, forest and villages etc. Larger gatherings can be observed according to the food aburdancy. It has the usual morning and evening flight.

Voice and calls - It produces a more hoarse and voice as compared to the common house crow. Commonly it produces kaa-kak- kaa-kak etc like musical croaks.

Turdoides malcolmi Large grey babbler

Local name - Ghogri or satbhai or kokatti

Size - Nyna

Field characters - Body plumage of this bird is variously coloured. Upper parts are greyish brown to dark brown in colouration along with fore head bearing pale ashy stalk layers. Tail faintly cross-barred graduated with whitish outer feathers is a unique feature. Towards the lower side body plumage creamy — buff coloured with a pinkish tinge on throat and breast. Eyes are yellow coloured, bill pointed and legs strong. It is commonly found near dry open babool and dhak forest, cultivation and villages etc. It has been commonly observed in association with other babblers feeding on ground and in low vegetation.

Voice and calls - It produces a common call kay-

kay-kay-kay etc.

Chrysomma sinenseYellow eyed babbler

Local name - Gulab - Chashm or Bulal-Chashm

Size - Bulbul

Field characters - It has been observed that body plumage of this babbler is brownish in colour with wings cinnamon coloured. Under parts white in colour with certain shadings. Bill is short, deep, black coloured, tail long graduated. Eyes are yellow coloured with an orange-yellow coloured eye margin. Hence the common name yellow eyed babbler. It is commonly found near scrubs grassy hillsides, etc. Its flight is commonly jerky and undulating

Voice and calls - It produces a normal call cheep — cheep — cheep, repeated for several times.

Acrocephalus stentoreus Great Reed warbler

Local name — Karkat or pan tiktiki

Size - Bulbul

Field characters - As the local name it has been observed among the tall grasses with hollow stems present in Lonar Lake forest. Body plumage is above plain olive brown, below throat and breast white and rest of under parts light yellow coloured. Bill is slender and nearly equal to the length of head. Tail is rounded or slightly graduated. It is normally found among tall grasses and tall bushes around Lake. According to the environmental conditions it normally moves about in close association with water.

Voice and calls - It produces very loud and harsh calls, karra — kareet —

kareet or prit-prit-pritik etc.

Prinia socialis Ashy wren Warbler

Local name — Phutki, Kali phutki

Size - Sparrow

Field characters - It is a very small bird like a

sparrow. It shows plumage colour combination in such a manner that the head, sides of neck and back dark ahsy grey coloured, under parts white and rest of above parts brownish coloured. Bill is pointed, tail long graduated with dull yellowish coloured tips. It has been observed that the tail is striked lightly up and down frequently. It is commonly found near grassland area and banks of streams in deciduous forest. Normally it is a restless bird.

Voice and calls - It produces a some what nasal tee-tee-tee sound and also produces a jimmy-jimmy-jimmy sound quickly repeated for several times.

Orthotomus sutorius Tailor bird

Local name - Darzee, phutki

Size - Sparrow

Field characters - It is also a very small restless yellowish green coloured sparrow like bird observed on the sides of the way to saline Lake. Under body parts are whitish in colour and crown rust coloured. Bill is broad, flat and its length equal to head. Wings are very short, tail pointed graduated and normally carried erect. It is commonly found in deciduous forest, cultivated area, scrub country and villages. Usually the bird is constantly moving from place to place with its tail striked lightly.

Voice and calls — It constantly utters a loud pit-pit-pit sound when it hops about in the bushes.

Rhipidura aureola Fan tailed flycatcher

Local name - Dao phari or nachan

Size - Bulbul

Field characters - It is also a restless bird whose tail is fan shaped. It is commonly known as flycatcher due to its unique habit. Body plumage is cheery and smokey brown above and forehead along with under parts white in colour. Wings are dark grey brown coloured. Tail is blackish in colour and longer than wings. Bill is large, about

double as long as wide at its base. It is commonly found in more open and drier regions. It is found in forests, wooded compounds, groves etc.

Voice and Calls – It produces a chee-chee-cheweechee-vi sound and also produces a normal call harsh chuck-chuck etc.

Rhipidura albicollis White spotted fan tailed flycatcher
Local name - Nachan or machharya
Size - Sparrow with a long tail

Field characters - One more fly catcher has been observed during the study period. Body plumage is dark brownish in colour with a unique white band on the throat region. Hence the name white spotted fan tailed flycatcher. Rest of the under parts mainly light yellow coloured and on breast white spots. Tail is fan shaped longer brownish in colour. It is commonly found near well-wooded areas, secondary forests etc. Usually it flies quickly tirelessly among the branches of the plantation, in search of food. It also attains a series of jerky twists and turns.

Voice and calls - It produces a normal harsh chuck - chuck or chuck — r chuck-r etc. sound. It also produces a sound tri-riri-riri etc.

Copsychus saularis Magpie Robin
Local name - Dhaiyal or Dhaiyar or Dominga
Size - Bulbul

Field characters - It has been observed in the forest region of the Lake. It is a long tailed black and white bird. Body plumage is glossy blue-black coloured on upper side and white on belly. Wings are bldckish brown with a large long white band. Throat and breast is blue- black coloured in appearance. Tail is blackish with outer margins white in colour. Bill is stout and straight. Normally tail is kept at right angles to the body. It is commonly found in dry — deciduous forest, neighbourhood of human habitations and

gardens etc. It usually hops about in gardens, forests etc and often perching on any substratum.

Voice and calls - It produces a call swee —se or swee — swee. It also produces a harsh chr-r

Nectarinia asiatica Indian purple sunbird

Local name - Kala pidda or chumka

Size - Sparrow

Field characters - It has been observed during the course of visit to saline Lake. It is a very small bird appearing totally metallic black coloured. Body plumage is metallic dark blue and purple coloured. Bill is much longer in size, strongly curved and pointed used during nectar collection. Tail is square shaped or slightly graduated shorter than wings. It is commonly found near semi deciduous forests, cultivation, gardens etc. Due to its nectar eating habit it plays an important role in cross - pollination.

Voice and calls - It produces cheewit — cheewit sound when excited repeated for several times.

Parus major Grey tit

Local name — Ramachakli or puttani kuruvi

Size - Sparrow like

Field characters - It has been found among smaller trees in the Lake area. Bird is similar to a sparrow but the body plumage is different. Upper parts of the back region has grey colour, hence the common name grey tit. Other body parts are variously coloured which includes crown black, sides of the face white, and throat black with a narrow black band, which extends up to the belly. Wings are weaker and brownish in colour, rest of the under parts white. Tail is shorter and blackish in colour. It commonly occurs in light deciduous forest, villages' etc. Bill is short and conical in appearance.

Voice and calls - It usually produces a musical

whistling song of wit wit - see see, wit wit --- see see.

Ploceus philippinus Indian Baya

Local name - Baya or son chiri

Size - Sparrow like

Field characters - Body plumage of this bird has been observed to show following peculiarities with certain body characters. Crown is yellow coloured and rest of upper paC dark brownish in colour which are lined with yellow markings. Throat and under parts area brownish in colour along with creamy or pale yellow colouration. Bill is thick, curved and longer than depth at base. Tail is short slightly rounded in appearance. It is commonly found in open cultivations, paddy fields, grassland etc. Usually it keeps in flocks and hops in the same manner as that of a common sparrow.

Voice and calls — It produces a sparrow like sound chit-chit chit-chit which is followed by a whistle chee-ee-ee.

Aegithina tiphia Iora

Local name Shaubeegi or cheroka

Size - Sparrow

Field characters - It is a small bird with body plumage fine black and yellow colouration. Head, hind neck and above all parts are black coloured in appearance. Throat, breast and rest of under parts are yellow coloured. Bill is longer pointed and pale black coloured. Wings are rounded with two white bars across the wings. Tail is short and square shaped in appearance. It is commonly found in open forests, forest near cultivation, scrub forests etc. It has been observed that the bird is usually hopping from branch to branch in search of food material.

Voice and Calls - It commonly produces a whistle piyou or peeou repeated for several times.

Motacilla caspica Grey wagtail
Local name – Khak dobbai, or balkatara
Size - Sparrow like with long tail.

Field characters – This bird has been found in the neighbourhood of the fresh water streams of Lonar Lake. Body plumage is grey coloured on head and upper parts of the body. Throat is dark brown coloured with two white bands on the side of the faces encircling the eyes, lower being prominent. Breast and under parts are bright yellow coloured. Wings are blackish brown in colour with white markings. Tail is long somewhat pointed in appearance. Bill is long and slender. It is commonly found near mountain streams with rocky banks, dry stony river beds etc. Flight undulating typical of the family.

Voice and Calls – It produces a sharp chi-cheep chi-cheep sound.

Tockus birostsis Grey hornbill
Local name – Dhanmar or Bhinas or Dhanesh
Size – kite

Field Characters – It has been recorded once during the jpresent study period, in the woody area of Lonar Lake. Bird can be easily recognized due to its badly built up body, with brownish grey colouration. Bill is strong and considerably curved, blackish in colour with a helmet like out growth on the upper side of the bill is a diagnostic character. Hence the common name grey hornbill. Tail is long graduated and blackish in colour. It is commonly confined to deciduous forest but some times may be found in the neighbourhood of cultivation, arboreal in nature.

Voice and Call – It normally produces a shill sound wheeee, which is frequently uttered. It also produces k-k-k-ka-e type sound.

Alcedo atthis Indian small blue king fisher
Local name - Chhota kilkila or khandya

Size - Sparrow like with long bill.

Field characters - It has been observed on the banks of fresh water streams flowing in Lonar Lake. It is a small bird like a sparrow with its unique characters like very long straight black bill, tail shorter than bill and stumped. Body plumage is brilliantly blue — greenish on upper parts and brick reddish on lower side with a small white patch on the throat region. Feets are very weak. It is commonly found near streams, canals, ditches, village ponds etc.

Voice and calls - It produces a shrill sound like chichee chickee or chichichee etc.

Merops orientalis Small green bee - eater

Local name - Patringa or veda raghu or pateri

Size - Sparrow like

Field characters - It has been observed that bird is hopping on branches in the neighbourhood of saline water in Lsnar Lake. It is a grass green coloured bird with bill long, slender, Oackish and slightly curved. Its other body characters are wings long and pointed, feeb weak and tail long pointed at the tip region. It commonly shows a reddish tinge on the head and upper parts of neck region. It is commonly found in open country forests cultivation and in the vicinity of water reserviors. It usually keeps in loose parties.

Voice and calls - It produces usually a tinkling sound tree tree tree or treep treep treep

Megalamia haemacephala Crimson breasted barbet

Local name - Chhota basanth or sonar

Size - Sparrow like bird

Field characters - It is a small stout grass — green coluored bird with richly deep red coloured breast and forehead. Hence the common name is crimson breasted barbet. Other body characters are throat yellowish green,

bill stout, wings rounded, tail short and lopped in appearance. It is commonly found among lightly wooded country, deciduous forests, gardens etc. It is arboreal in nature.

Fulica atra Coot

Local name - Dasari or Thekari

Size - Smaller than a duck

Field characters - It has been observed in water of Lonar Lake. It is a type of water bird similar to common ducks. Body plumage is blackish in colour with bill deep, compressed and whitish in colour. Body size is smaller and stouter in appearance. It is commonly found in Lakes, ponds, etc. It usually keeps in small flocks or parties.

Voice and calls - It produces a clear loud trumpet like cry.

Gallinula chloropus Indian moorhen

Local name - Jal murghi or pani murghi

Size - Grey partridge

Field characters - Another one kind of water bird has been recorded in water of Lonar Lake. Body of this bird is just similar to coot, but shows certain peculiarities like body plumage blackish grey coloured with whitish mark on the wings. Under tail bears white patches with a central black patch. Bill is moderate sized; legs are long greenish in colour. It is commonly found in Lakes, ponds, swamps etc. It usually keeps in small parties and spends most of its time in water.

Voice and calls - It usually produces a loud kirrik-krek-krek rek-rek sound.

Identification of Avifauna is done with the help of Hand book of the birds of India and Pakistan by Salim Ali and S. Dillon Ripley (1983).

Mammals

Funambulus Palm squirrel

Local name -Palm Squirrel, Gilahari

Field characters - It has been observed in the vicinity of the temples around Lonar Lake. It is very commonly occurring animal. It is found near trees, ground, mountains etc. It has been observed that it is a fast runner and feeds on fruits and seeds; also interested to feed on human beings food material whenever available. It is commonly known as Gilahari. From the dorsal side of the body three white and grey stripes are present which do not extend up to the neck. Ventral side of the body and limbs are covered with grey hairs smaller in size. Limbs are with five clawed digits. Tail is elongated bushy. Eyes large, ear pinnae well developed and on the mouth several moustaches are present. Incisor teeths are exposed, chisel like in appearance. Fore limbs are shorter in length as compared to hindlimbs. Body is divisible in to head, neck, trunk and tail.

Lepus Black naped Hare

Local name — Hare

Size - Large than rabbit

Field characters - It has been observed in the forest area of Lonar Lake during the studY period. The animal is very similar to common rabbit. In hare the fore feels are five toed, the hind feels are four toed. The hairy integument enters the mouth cavity and inside of the cheeks has a hairy covering. Usually body colouration is brown from dorsal side and white from ventral side. Head contains longer erect external ears. Fore limbs and hind limbs are more or less equal in length. It is a fast runner. It commonly inhibits fields, grasslands, and wooded country. It usually produces a cheet cheet cheet sound when observed any compotitor. Body is divisible in to head, neck, trunk and tail.

Voice - It produces cheet cheet cheet sound.

Semnopithecus Langur

Local name — Langur, Hanuman Langur

Field characters - It has been observed that a very large population of this genus being recorded during the study period in the Lonar Lake forest area. There are about thirty known species of this genus. The characteristic features of this genus are; Body slender, tail very long, cheek pouches are totally absent. Thumb is better developed but shorter. It is vegetarian in feeding habit. Face is completely black coloured, whie other body parts are pale yellowish white coloured with blakish tinge on fore limbs and hind limbs. Sexual dimorphism is clearly marked. Young once are being cared by the female parents (Plate - XXIII - b).

Voice - It produces chee chee chec and hoop hoop sound

Cynopterus Indian fruit bat

Local name - Flying fox, fruit bat

Size - Larger than rat

Field characters - It has been observed in the temples surrounding Lonar Lake during the study period. It is arboreal in habit. It usually lives in groups. Mainly it feeds on fruits, hence also known as frugivorous bats. They are also observed on the branches of trees surrounding the Lake in an inverted hanging position. Body is dark brown coloured in appearance. It is capable of true flight. In these animals the forelimbs are modified in to wings. Each wing is formed by a fold of skin known as patagium thai is supported by elongated fore limb and 2 to 5 fingers. Hind feels are small with sharp and curved claws. The genus has bituberculate canines. Ears are short somewhat oval to triangular in shape, eyes large. Animal is usually nocturnal in habit. Tail is very short stumpy in ap arance (Plate - XXIII - c).

Vesperugo Insectivorous bat
Local name - Insectivorous bat
Size - Smaller than fruit bat

Field characters - It has been observed mainly in the temples and other disturbed archaeological structures present around Lonar Lake during the study period. Body colour is blackish brown. It is also capable of flight with the help of wings developed along fore limbs. Tail is shorter than the head and body together. Ears are separate and moderate to short in size (Plate - XXIII - d).

Plate XXXII

a) Anser (Bar headed goose)

b) Semnopithecus (Indian Langur)

c) Cynopterus (Fruit bat)

d) Vesperugo (Bat)

Megaderma Carnivorous bat
Local name -carnivorous bat
Size - Smaller than fruit bat

Field characters - During the study period a another third kind of bat which is commonly known as Indian vampire bat has been observed. In this upper incisors are absent. Tail is absent, ears are large sized, nose leaf is well developed. Nainly it feeds on other animals.

Cervulus barking deer
Local name - Barking deer
Size - Larger than goat

Field characters - It has been observed in the forest around Lonar Lake during the study period. There are about two to three deers running in the dense forest region. In this genus the antlers are hardly larger in size along with a small anterior branch arising from near the pedicel. Body colouration is light brown to dark brown in appearance. First and second phalanges of the lateral digits are absent.

Gazella Antelope
Local name - Antelope
Size - Larger than goats / deers

Field characters - It has been observed in the vicinity of Lonar Lake during the study period. There are about 25 known different species of this genus. The genus is characterised by the small to moderate body size. Body colouration is sandy to reddish brown with white belly. There is presence of dark and light stripes on the face and flanks, in some species. The horns are usually present in both sexes. The horns are of fair length, ringed and of lyrate form. Short tail is present. The horns are somewhat curved in the backward direction towards neck (Plate-XIII-d).

Voice - It produces sound
Herpestes Mongoose
Local name - Mongoose
Size - Larger than cat

Field characters - It is commonly known as mongoose. It has been observed for several times during study period in the forest region of Lonar Lake. It is a burrowing animal, nocturnal in habit. Carnivorous in nature, complete body is covered with greyish fur. It has been

observed that the body is highly modified, elongated with tail longish and complete body is specially adapted for carnivorous feeding habits. Fore limbs and hind limbs have 5 digits with fussoral claws. It is usually killing the snakes with well-developed canines.Identification of mammals is done with the help of following books. Cambridge Natural History Vol. X by Harmer and Shipley (1968).

Discussion

Although the crater in itself is of immense interest as natural phenomenon, what makes it still more unique is the micro ecosystem, which has evolved within it (Malu et al. 1998). This consists of various ecotones inhabited by a wide range of plant and animal life. The Saline Lake, marshy areas around it, fresh water streams man made plantations, crop fields and the remnants of the original forest and scrub, all provide special niches for plants and animals.

The flora of the plateau, hill rocks, slopes and river basins around Lonar crater may be considered as broadly representing the general floristic pattern common throughout Marathwada and western Vidharbha region. It is said that a natural forest once covered the entire basin and the lower slopes of the crater. The elders in Lonar villaqe still recollect memories of the forest so dense as to appear dark even on sunny afternoon. It may have provided a place of natural Sanctuary to several species, which found it difficult to survive in the surrounding area.

As one begins to climb down the slope of the crater, one realizes that except for a few bushes and trees the area is quite bare compared to thick jungle existing once upon a time. The forest is remarkably different from the scruby vegetation common to the country site surrounding the crater. The forest is a mixed deciduous type, which contains evergreen components. The luxuriant

growth of vegetation is due to the abundance of ground water, high humidity resulting from the evaporation of Lake water, minimal wind blowing allowing a localized regulation of temperature and other parameters. The Lonar Lake ecosystem has two distinct categories, saline Lake and marshy habitat having fresh water component on east northern side of the Lake. There are prominent irregular zones all along the periphery of Lake water particularly northeastern regions supported by perennial spring water. The accumulation of nutrients and cow dung from the surrounding areas help plants and animals to thrive their population along the Lake margin. The alkalinity of the Lake water plays a dominant role in the overall food chain of Lake ecosystem. Though the salinity is induced as a result of increased inflow of water, enrichment of nutrients also has taken place simultaneously helping the increased production of blue green algae in the main Lake water body and growth of macrophytes at the periphery of the Lake. According to Badve et al. (1993) the blue green algae constitute the major planktm community and spirulina is the dominant algae, besides Arthrospira, oscillatoria and Dactylococcopsis. The blue green algae grow after the onset of monsoon and gradually decreases as the dry spell continues until June. The growth of spimlina is directly related to the growth of waterfowl population. The spirulina could be exploited for food supplements particularly in animal food industries because it has a very high protein content (upto 65 to 70 % on a dried basis). Increased inflow of water through precipitation followed by subsequent input from the perennial springs and human induced increase of nutrients in to the Lake due to farming are the probable causes of eutrophication. Several types of Diatoms, Bacteria and Protozoans also inhabits the Lake water which play the role of primary

consumers.

According to Mahajan A.D. (2001) ciliates are abundant along the Lonar Lake margin, however he has not given the list of ciliates. In the present investigation following Protozoans are observed /z. Paramecium, Amoeba, Prorodon, Cyciiidium, Euplotes and Oxitricha. According to Nalu et a/. (2000) the zooplankton community is represented by Rotifers only and that too only one genus Branchionus. They have recorded three species of Branchionus from Lonar Lake water. Occurrence of branchious species is definite indication of eutrophic water. The absence of other z‹›oplankon groups like cladocera and copepods many species of which normally feed on rotifers could be a reason for the numerical dominance of rotifer in Lonar Lake. During the present investigation Rotifera has been represented by four genera /z. Branchionus, Philodina, Testudinella and Nytilina. Rotifer species have long been identified as indicators of water quality (Arora, 1966). Some species flourish in highly eutrophic water because of their short life cycles, rotifers in general respond quickly to environmental changes and hence their standing crop and species composition indicates the quality of the water mass in which they are found (Chandrasekhar and Kodarkar 1995).

During the present investigation it has been observed that amongst invertebrates Arthropod fauna is dominating in and around Lonar Lake. During the study period Arthropod fauna has been represented by 9 genera viz. Apelena, Notonecfa, Corixa, Nepa, Enhydrus, spirobolus, carcinus, dragon fly nymph, Chironomus. Besides these there is 1 ground beetle and 11 unidentified arthropods. According to Ghanekar (1996) funnel spider and signature spider are found around Lonar Lake of which signature spider is not found during the present

investigation represents arthropod community. According to Mahajan A.D. (2001) the forest around Lonar Lake comparises insects like ants, varieties of butterflies and moths. Among invertebrates spiro lms and funnel spider was prominent. Among Molluscs four genera have been reported Liz. Vapinu/us, Tfiiara, He/ix and one unidentified gastropod during the present study period. From these Molluscs may/htm/as and Thiara are prominent. Mahajan A.D. (2001) has reported only vapinulus among molluscs.

During the present investigation among chordates Avifauna is predominant followed by mammalian reptilian and amphibian fauna and the least is pisces in and around Lonar Lake. Class pisces is represented by only one genus Gambusia from fresh water and the Lake water is characterized by the total absence of pisces and amphibians. Similarly amphibian fauna is represented by only one genus Rana. Reptilian fauna is represented by four genera viz. Varanus, Hemidactylus, Nabuai and Nama during the present study. According to Ghanekar (1996) the reptalian fauna is represented by only three genera viz. varanus, Hemidactylus and Nabuia. Nahajan A.D. (2001) has reported only one genus from Reptalian class, which belongs to the order lacertillia. According to Nalu R.A. (1999) among reptiles, the monitor lizard is most prominent, living among the ruins of the many temples, which dot the crater.

As mentioned earlier that amongsts Chordate avifauna is dominant in and around Lonar Lake. During the present investigation class aves has been represented by 43 different genera. The list of observed avifauna is as follows :- Pavo, perdicula, podiceps, Ardeola, Egretta, Arden, Ciconia, phoenicopterus, Anns, Anser, Tadorna, Kane/lms, charadrius, Trinpa, Circus, Elanus, ACClpiter, Psitfacula, Tyto, Eudynamys, centropus, Dicrurus, Lanius,

Oriolus, Corvus, Turdoides, Chrysomma, Acrocephalus, Prinia, Orthotomus, Rhipidura, Copsychus, Necfarinia, Parus, ploceus, Aegithina, Notacilla, Alcedo, Merops, Negalamia, Fulica and Gallinula. Except Ardea, Anser, Charadrius, Necfarinia and Alcedo the remaining all avian genera is also reported by Ghanekar (1996). According to Malu (1999) besides the peafowls an impressive list of migrant and resident birds include black winged stills, brahminy ducks, grebes, shellducks, shovellers, teal, herons, red wattled lapwings, rollers, baya weavers, parakeets, hoopoes, larks and sulallous could keep a retinue of bird watchers active for eons; Grater flamingos have also been reported. Thousands of peafowl live inside the crater. While the geography no doubt offers them natural protection. Mammalian fauna is found to be dominated by a primate belonging to the genus semnopithecus, besides that following genera have been observed during the study period. The observed genera include Funambulus, Lepus, Cynopterus, Vesperupo, Negaderma Cervulus, Gazella and Harpestes. Musk shrew reported by Ghanekar (1996) is not found during the study period. According to Nahajan A.D. (2001) the old temples around the Lake water harbour crowds of insectivorous bats. The present study revealed that the cave dwelling fauna inside the crater is dominated by different kinds of bats.

Thus the present study revealed that Lonar crater with an assemblage of about 6 different ecosystems is having a vast variety of fauna, flourishing in' and around Lonar Lake in different ecological conditions. The saline water ecosystem is characterised by the presence of protozoans, Rotifers from zooplankton community and absence of zooplankton groups like cladocera and copepoda. Total absence of Pisces and Amphibians from

the saline water is another striking feature of the saline water ecosystem of Lonar crater. Besides this Lonar Lake is providing very special ecological conditions to the varieties of aquatic birds and Phytoplanktons. Finally it is concluded that the Lonar crater a biologeographical natural wonder along with different ecological conditions is having a great Biodiversity and should by protected and conserved by the Government and NGO's.

Chapter - VI

SUMMARY

Lonar Lake is a bio-geographical natural wonder of India. It is the third ranking meteoritic crater among world's five largest craters of this kind. The Lonar Lake is present in Lonar town which is located at Latitude 19058' North and Longitude 76031' East. It is having the diameter 1830 meters and depth 170 meters. It is the only meteoritic crater formed about 52,000 years ago in basalt rock of the Deccan Plateau, which is with a unique saline water ecosystem towards the basin of the crater. When an idea has alarmed in the mind about Lonar lake ecology and bio-diversity; it has been observed that geological and archaeological investigations are more, and limnological and biological investigations are very less. Due to its overall unique characters and very less work about limnology and bio-diversity the present work has been undertaken with great efficiency.

The present work was carried-out at the P.G. Department of Zoology, Shri Shivaji College of Parbhani to study the ecological characteristics and the fauna of Lonar Lake. In the first two years of the study period Physico-chemical parameters of fresh as well as saline water ecosystem analysis was done. Physico-chemical parameters studied during the study period include colour, odour, Temperature, Taste, Hardness, pH, Dissolved oxygen, Dissolved carbon dioxide, carbonate alkalinity, bicarbonate alkalinity, chlorides, salinity, sodium, potassium and Iron. Physico-chemical parameters were worked out with the help of methodology adapted from APHA (1998) and Kodarkar (1998). In the next two years of the study period faunal diversity was studied. As per the

animal group respective methodology was adapted and the fauna was identified up to the generic level.

The present study about climatic conditions of Lonar revealed that this region is distinctly marked into three seasons namely summer (Feb. to Nay), monsoon (June to Sept.) and winter (Oct. to Jan.). An ambient temperature recorded at different sampling stations during the study period shows that it was ranged between 20OC to 39OC at spots A and D, where as 22OC to 40”C at spots B and C respectively. It is found that ambient temperature is playing important role in changing water temperature.

As per the data collected from the office of the Irrigation Department about yearly as well as monthly rainfall at Lonar. It is found that with certain exceptions, besides monsoon season in rest of the two seasons in a year an average rainfall is very negligible. The yearly rainfall data shows that in last 24 years the minimum rainfall recorded at Lonar is 407.4 mm in the year 1985 and maximum rainfall recorded is 1851.6 mm in the year 1998. As per data collected during the study period Feb. 2000 to Jan. 2002 the monthly rainfall values are ranged between 0 to 419 mm. The maximum rainfall is recorded in the month of Aug. 2001. Although rainfall is the only natural visible source for water accumulation in the crater basin; besides fresh water streams present inside the crater, but the present study revealed that continuos increasing in the water level of the lake is not the effect of rainfall only.

In the present work it is found that the presence of “Sasu- Soona Chi Barav“ about 50 feet inside the lake infront of Kamalaja Devi temple with fresh and brackish water. Presence of fresh water inside the man made pits or “Chhua” created by local inhabitants during summer

season on the southern edge of the saline lake clearly indicates some sort of underground fresh water resources. The present study also revealed that the presence of minor Irrigation dam in the vicinity of the Lonar crater also play in important role in continuous increasing water level of the Lonar lake. The observed increase in water level since 1999 is about 6 feet in the Lonar Lake.

Literature reviewed during the study period has shown that a lot of research work has been performed by different researchers with respect to the Lonar lake since 1823. But most of the research rotated around its origin. Although present study is not concerned with the origin of the lake however, as per the literature available, the origin of Lonar Lake is proved to be meteoritic beyond doubt. The present study revealed that besides the lot of efforts taken in search of literature, complete literature is not becoming available. There must be a special requirement in future to made it easily available to the researchers working in various disciplines on Lonar lake at present as well as in future.

The ecological study of fresh and saline water revealed that; the fresh water at spot A and D is colourless, odour free and sweet in taste and being used by local inhabitants for various purposes including drinking and Irrigation. The temperature values at spot A and D were ranged between 18 C to 32”C during the study period. The pH of fresh water is around neutral. Hardness of fresh water at spot “D” is somewhat more compared to the hardness at spot “A”. The dissolved oxygen and carbon dioxide contents are variable and ranged between 01.19 mg/lit to 08.4 mg/lit and 0 to 116 mg/lit at spot A and D respectively. The fresh water is characterised by somewhat more percentage of carbonates and bicarbonates less percentage of chlorides and sodium as

compared to the tap water but it is suitable for drinking as well as Irrigation purposes.

The saline water at spot B and C is pale yellowish green in colour slight offensive and salty in taste. The temperature values at spot B and C were also ranged between 18”C to 32”C during the study period. The pH of saline water is highly alkaline and ranged between 9.25 to 10.58 at spot B and C during the study period. The hardness values of saline water at spot B and C were ranged between 95 mg/lit to 129 mg/lit compared to the hardness of fresh water the hardness values of saline water are somewhat less. The present study revealed that the saline water of Lonar lake is poor with respect to the oxygen content as compared to the fresh water which indicates the anaerobic conditions towards the bottom of the lake. The presence of Chironomus larvae in the lake water also support the oxygen poor condition. Dissolved (free) carbon dioxide is totally absent from the saline water. The present study revealed that the chloride and salinity values of saline water at spot B and C are very high and ranged between 2006.47 mg/lit to 3374.84 mg/lit and 3486.72 mg/lit to 6192.83 mg/lit during the present study. This indicates clearly that the Lonar lake water is highly saline. During the present study sodium, potassium and Iron values of saline water were ranged between 2122 to 8800 ppm, 04 to 19 ppm and 0.21 to 0.68 ppm at spot B and C respectively. Thus the saline water from Lonar lake is characterised by very high contents of; sodium, chlorides, carbonates and bicarbonates because of which it is unsuitable for drinking as well as Irrigation purposes. But instead of this it is providing very special ecological conditions to flourish a vast variety of aquatic birds and Phytoplanktons. Among Phytoplanktons Spirulina is dominant. Thus the Lonar lake water is describe as Na-Cl-

CO_3-HCO_3 type water.

The present study revealed that an immediate effect of rise in water level of the lake is responsible for change in water quality, which has a direct bearing on the life in the lake ecosystem. The reduced values of physico-chemical parameters can be attributed to the continuous increase in water level. There is very little seasonal variation in the chemical composition of saline water. An attempt has been made to compare the present results with different authors which showed that the present parameter values are slight less than earlier workers which also supports the above said effect of increased water level.

The faunal diversity study revealed that Lonar crater with an assemblage of about 6 different ecosystems is having a vast variety of fauna, flourishing in and around Lonar lake in different ecological conditions. The saline water ecosystem is characterised by the presence of Protozoans and Rotifers from Zooplankton community. Firstly recorded Protozoans from Lonar lake include genera viz. paramecium, Amoeba, Prorodon, Cycfidium, Euplotes and Oxitficha. Among the Rotifers firstly recorded genera include Philodina, Testudinella and Mytilina. From the Zooplankton community other groups like Cladocera and Copepoda are totally absent.

During the present study it has been observed that amongst invertebrates Arthropod fauna is dominating in and around Lonar lake. Among Arthropods presence of huge number of funnel spiders and Spirobolus around Lonar lake is one of the specialty of Lonar crater. Of the 21 different Arthropods recorded from the Lonar crater 12 Arthropods remained unidentified and they are sent towards Head quarter ZSI at Kolkata for their identification. The unidentified arthropods include one ground beetle and

11 other arthropods, which are numbered serially from U-1 to U-11. Out of 21 arthropods remaining 9 are described which include genera viz., Agelena, Notonecta, Corixa, Nepa, Enhydrus, Spirobolus, Carcinus, Dragon fly nymph and Chironomus. From above all Arthropods, U-1 to U-11, one ground beetle and genera like Notonecta, Corixa, Nepa, Enhydrus, Carcinus, dragon fly nymph and Chironomus are firstly recorded from the Lonar crater.

During the present study it has been observed that among Molluscs only four genera have been recorded viz. Vaginulus, Thiara, Helix and one unidentified Gastropod genus. From above mentioned Molluscs genus Vaginulus is dominant. During the present study Gastropod genera like Helix, Thiara and One unidentified genus are firstly recorded from the Lonar crater. Although only one genus Gambusia from Pisces is recorded for the first time from fresh water of Lonar crater; besides that the total absence of Pisces and Amphibians from the saline water is another striking feature of saline water ecosystem of Lonar crater. Among Amphibians only one genus Rana is recorded for the first time from Lonar crater.

During the present study class Reptile is represented by four different genera of which genus Naja is recorded for the first time from Lonar crater. Among Avifauna 43 different genera are described of which 5 genera viz. Ardea, Anser, Charadrius, Nectarinia and Alcedo are firstly recorded from the Lonar crater. The present study revealed that Lonar lake water is providing very special ecological conditions to the varieties of aquatic birds and Phytoplanktons. Among Phytoplanktons Spirulina which is dominant and consist of very high protein content along with other nutritional substances like vitamins. Because of this Spirulina can be exploited for human as well as animal nutrition on a small scale.

Recently it is noticed that Spirulina is being used in the pharmaceutical works in the preparation of medicines. In this view also one can take an advantage of Lonar Lake on a small scale without disturbing the ecology. It is observed that mammalian fauna is found to be dominated by the genus Semnopithecus a Primate. Among mammals firstly recorded genus is Gazella from Lonar crater. Finally it is concluded that the Lonar crater a bio- geographical natural wonder along with different ecological conditions is having a great biodiversity. And it should be protected and conserved properly. The Govt. of India, Govt. of Maharashtra and many Non- Governmental Organizations (NGO's) should pay a special attention to achieve the aforesaid Besides this local inhabitants of the Lonar town, visitors Indian as well as Foreign, Local leaders and all the people should take care for its protection and conservation from all angles.

To protect and conserve the biodervisity of Lonar Lake, the following activities should be totally banned. The scheme should be seriously implemented as immediate as possible.

Agriculture activity inside the Lonar crater, which is the prime cause of human interference.

Use of chemical fertilizers, pesticides and Insecticides.

- Deforestation and collection of minor wood produce
- Hunting of fauna
- Over crowding of human population along with setting up shops, inside the crater during the Yatra.
- Leaving behind large quantities of ritual offerings along with non- biodegradable substance.
- Releasing sewage in fresh water streams, which ultimately enters in to the crater basin.
- Bathing / swimming, cloths washing activity of people and domestic animals interference like grazing.
- No dam should be constructed in the vicinity of the

lake. Such activity is responsible for altering the ecological conditions of the lake.

- All water pollution increasing activities inside the crater as well as in the vicinity of the crater.

The present work is the first ever attempt to study the ecological characteristics along with fauna of Lonar Lake.

Chapter-VII

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