ASSESMENT OF WATER QUALITY AND ALGAE IN RIVER TAPTI JALGAON DISTRICT (M.S.)

FINAL REPORT OF
MINOR RESEARCH PROJECT
SUBMITTED TO
UNIVERSITY GRANTS COMMISSION

BY

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BHUSAWAL ARTS & SCIENCE & P.O.NAHATA COMMERCE COLLEGE
BHUSAWAL DIST-JALGAON (MAHARASHTRA)

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MARCH 2011

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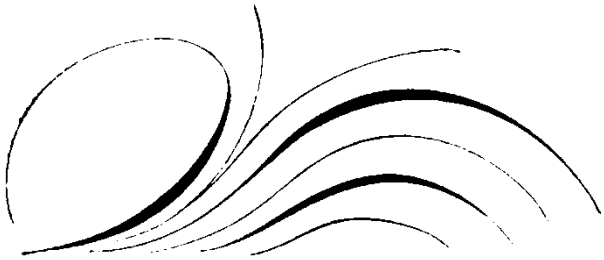
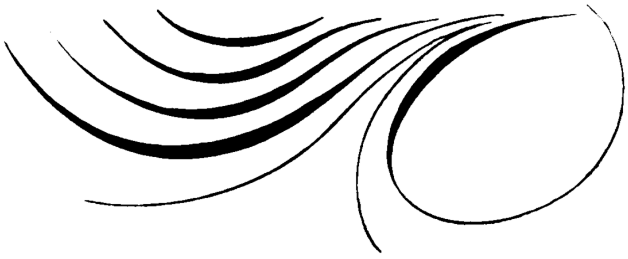


CHAPTER-1

INTRODUCTION



Introduction

Water is an essential component of an eco-system. It sustains life on earth. A community depends on water for its domestic, agriculture and industrial needs. Availability of water has been a factor in the development of various civilizations near lakes and rivers, how ever with increasing human activities its self purification power is diminished leading to water pollution problems.

Gross pollution of water is clearly an immediate hazard to many aquatic resources. The micro and macrophytic communities in a natural water body are in definite order and they play an important role keeping the water clean and acceptable for various purpose. However pollution of any kind may alter the aquatic environment and there by affect the aquatic life.

The Algae are affected by pollution in number of ways. They may be discouraged from growing as a result of being deprived of sunlight, the substance may be toxic or may be ecologically modify the physical or chemical environment sufficiently to retard or prevent the growth.

Certain Algae may be stimulated to increase growth and multiply. A change may also occur on the individual types or groups of organism, since algae may form blooms. The total algal population may be increased or decreased. The oxygen production and utilization of nutrient substances by algae may be greatly modified and color, odor or taste of the water. Algal constitute a part of food chain of aquatic life in the waters, they affect the population of zooplankton and other aquatic organisms.

Thus it requires a continuous monitoring and study of algal existing in waters of various a qualities in orders to determines the controls, the changes and uses which can be instituted for the benefit of human being.

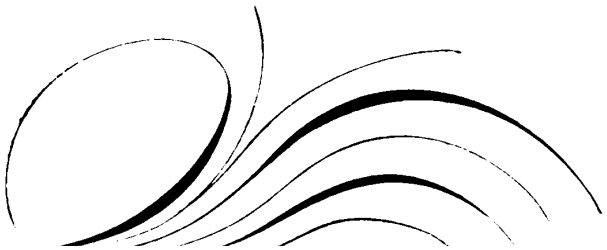
Since biota of any ecosystem reflects the condition existing in the environment, the biological data can be utilized for monitoring the level of pollution. Bio-monitoring method is considered as fairly reliable and less expensive since all categories of living organisms may be useful in study of pollution a brief consideration of selected groups of organism is deemed pertinent, among which algal are the most rapid detector of pollution. This is just becoming of their quick response to toxic and non-toxic chemicals water pollution is essentially a biological phenomenon. In the assessment of water quality both biological and chemical methods are necessary because biological indicators show the degree of ecological imbalance and the chemical methods measures the concentrations of pollutants. Therefore the study on the floristic pattern and ecology of polluted water algal is prime importance to understand the basic problems correlated on account of pollution and evaluation of its detrimental effects.

With the continuous increase in human population and its constant demands on the fresh water aquatic resource of the globe there has been a “compounding of the interrelationships between algae and man” (Jackson 1964). This relationship has become all the More complex and increased eutrophication of lakes and rivers. Problems of taste, odor, toxicity or obnoxious growth caused by algae are common. In order to explore these problems, it is necessary to have adequate basic knowledge of algal taxonomy, physiology and ecology (Jackson, 1964).

In phycology the major contributions to Indian workers were made by Ganapati and Chako(1951), Philipose(1960) , Zafar(1964), Venkateswarlu(1969) Rana & Kumar(1974) Kant & Kachroo(1974), Gunale(1978), Hosmani and Bharati(1980) , Nandan and Patel(1984).

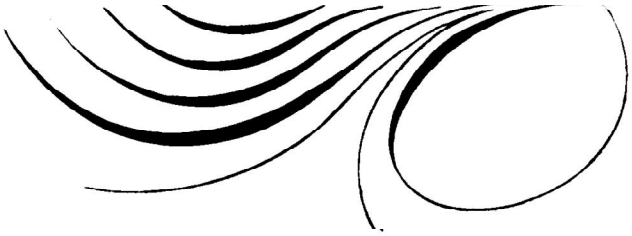
As in Maharashtra state very few workers have paid attentions on ecology of algae with relations to water pollution and assessment of water(Gunale and Balkrishnan, 1978, Patil & Nandan, 1994, Jagdale et. al , 1987 Trivedi 1990, Nandan and More, 1997) It was thought worth to carry out the study of assessment of water of river Tapti flowing through Jalgaon district .

The present investigation is the outcome of detailed studies on the assessment of water of river Tapti flowing through Jalgaon district.



CHAPTER-2

REVIEW OF LITERATURE



Review of Literature

Water quality, habitat structure, flow regime, energy source and biotic interactions are the major environmental factors that determine water resource integrity. The physical and chemical attributes of water are the critical components of water resources. They include temperature, dissolved oxygen, pH, hardness, turbidity, concentration of soluble and insoluble organic and inorganic, alkalinity, nutrients, heavy metals and an array of toxic substances which may have simple chemical properties or their dynamics may be complex and changing depending upon other constituents in the geological strata, soils and land use in the region. The human effects on biological processes can results in mortality or may shift balance among species of fishes an a result of subtle effects, such as reduced reproduction rates or changing competive ability and also effects other aquatic flora and fauna.

Ecological study on the distribution and periodicity of algae of ponds and lakes especially in relation to Physico-chemical composition of water is limited through a good deal of work has been carried out on rivers.

Assessment of water quality and algae in Abroad

O' Farrell & co-workers made an assessment of water quality in the lower Lujan River (Buenos Aires, Argentina) by studying phytoplankton and algal bioassays Tang T & his team carried out work on River continuum characteristics of Xiangxi River, China. Ye L et. al. studied special distribution of water quality in Xianxi river China. Cai Q et. al. carried out work on several research hot spots in river ecology. Bordalo et. al. carried out work on water quality & uses of the Bangpakong river, eastern Thailand. Tang T & co-workers showed the use of epileptic diatom communities to assess ecological condition of Xiangxi river

system. Hasan (2008) carried out work on water quality, physicochemical and biological characteristics of Tajan river in Iran. Ansari et.alcarried out study on Water quality in Kor river, west southern of Iran. Yesilirmak (2008) studied Water quality parameters of buyuk menderes river, Turkey.

Assessment of water quality and algae in India

Brij and Zutschi(1998) made a list past fifty years of hydrobiological research in India and they linked them with a historical perspective of the pre-independence studies. Patel and Patel (1993) made assessment of water quality in the rivers of western Orissa. Das and Sinha (1994) showed pollution status of river Ganga at Patana (Bihar) India. Haniffa et. al.(1994) carried out work on hydrobiological studies on the channels of river Tambaraparani for the assessment of water quality. Katariya(1994) made evalution of water quality of some of Mahanadi. Sharma et. al. (1994) showed pollution status of the Bharam river with special reference to Physico-chemical parameters. Chandra et. al. (1996) carried out work on monitoring the quality of river Ramganga waters at Bareilly Jameson and Rana (1996) showed pollution status of river complex Sabarmati of Kheda region of Gujarat Srivastava and Singh (1995) observed algal flora in relation to industrial pollution of Rapti river of Gorakhpur. Khanna and Chanrasia (1996) made report on assessment of enviro-ecological status and physical degradation of river Mandakini. Sivaramakrishana et. al. (1996) reported on biological assessment of Kaveri river catchment, South India. Chetana & Somasekhar (1997) carried out ecological study on the riverine ecosystem of Karanataka. Jain et. al. (1998) studied pollution status of Parbati river, Sehore, Ganguly et. al. (1999) made a report on assessment of water quality of Damodar river through comparative analysis of bio-indicators and Physico-chemical determinants. Shrivastava et. al. (2001) gave a brief review on river pollution in India. Kumar & Sharma (2002)

made a study on water quality of river Krishna with reference to biological characteristic and bio-indicators.

Sampoorani and co-workers (2002) carried out work on assessment of biota in the river Cauvery. In Maharashtra, Raghothaman and Jaiswal (1995) have studied hydrobiology of Tapti river from Jalgaon region with reference to phytoplankton only. More (1997) has made Limnological observations of Panzara dam and river with relation to algae. Amari Ziya (1997) studied on ecological aspects of algae of Mausam river flowing through Malegaon city, Nandan and More (1997, 2000) have made critical observations on Limnological studies of Indian rivers with relation to algae and carried hydro-biological study of algae of Panzara river.

Gopalswami and co-workers (2003) carried out a Study on the quality of water in the Bhavani river. Sivakumar et. al. (2003) have made a Studies on water quality of the river Ambarampalayam, Coimbatore district, Tamil Nadu.

Sawane and co-workers (2004) carried out Assessment of water quality of river Irai (Distt Chandrapur) on the basis of seasonal fluctuations in DO and BOD.

Vishnoi and Srivastava (2005) made a study of Seasonal pollution assessment through comparative hydrobiological studies in river Jojari at Salawas, Jodhpur. Dey Kallol et. al.(2005) carried out Assessment of water quality parameters of the river Brahmani at Rourkela. Tiwari et. al.(2005) carried out a study on Water quality assessment of Ganga river in Bihar region, India.

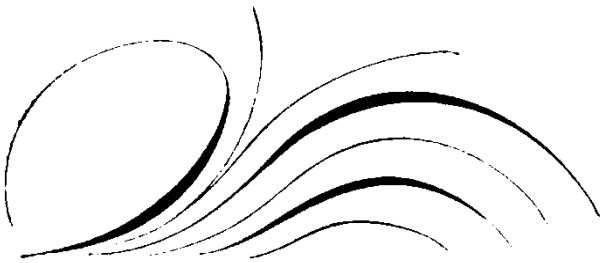
Sunil Kumar and co-workers (2006) made a study on Water quality assessment of river Tunga, Karnataka. Garg et.al. (2006) carried out work on Assessment of physico-chemical water quality of harsi reservoir, District Gwalior, Madhya Pradesh.

Deshmukh and Pingale (2007)carried out Hydrobiological study of Wilson dam water, District Ahmednagar (MS) . Srivastava et.al.(2007) carried out Assessment of water quality of a freshwater body, Ramgarh lake , Gorakhpur, U P,

Kushwaha et.al. carried out study on Water quality of river Umrar at Umaria municipality. Jayamati Devi (2008) carried out Investigation on water quality parameters on some selected freshwater bodies of Imphal district, Manipur. Suthar and co-workers made a study on Analysis of water quality from Ahmedabad city (Gujarat) using chemical parameters. Patil and others (2008) carried out Physico-chemical analysis of Pochampad Dam back water of Godavari river on Maharashtra and Andhra Pradesh border.Murali krishna et.al.(2008) studied on Water quality evaluation through application of chemometrics for Godavari river at Rajahmundry.

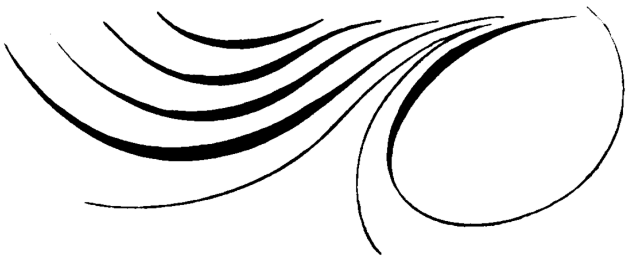
Deepak kumar and co-workers (2009) found out Water quality index of Falgu river in and around Gaya town.

Looking to the literature cited More work is carried out on ecology of algae and Physico-chemical characteristic of river water, More information is needed with reference to assessment of water in Maharashtra.



CHAPTER-3

MATERIALS & METHODS



Materials and Methods

A) General Geography and Climatology:

The Maharashtra state forms a major part of peninsular India with the Arabian Sea coast of its western side. It lies 16^0 4' to 22^0 1' North latitude and 72^0 6' to 80^0 9' East longitude. The boundaries of Maharashtra state are, Madhya Pradesh in north, Andhra Pradesh in the south east and Karnataka & Goa in the south. It has total area of 3,07,762 sq.km .

The district Jalgaon of Maharashtra state formally known as east Khandesh and is known as district from 1960. It lies between 20^0 to 21^0 north latitude and 74^0 55' to 76^0 28'east longitude. It is included today in North Maharashtra. It covers an area of 11,765 sq. km.

The climate of the district is generally dry and hot except monsoon season. The year is broadly divisible into 3 seasons. The characteristics of these weathers period during April 2008 to March 2010 were considered in present study. Diurnal changes occurred frequently in the air temperature during the summer. In monsoon season the rain was not continuous. The average rain fall in the district was 610 mm.

Study areas

The Tapti is the main river of Jalgaon District. It has its source in the state of Madhya Pradesh. It enters the district from the east & flows towards the west.

From Jalgaon district of North Maharashtra the following 3 stations of Tapti river were selected for the present project work

1. River Tapti at Changdev, Tal- Muktainagar. **(T - C)**

2. River Tapti at Deepnagar, Tal- Bhusawal **(T - D)**

3. River Tapti at Bhusawal, Tal- Bhusawal. **(T - B)**

i) **River Tapti at Changdev**:- The Changdev, is situated at the union of river Tapti and Purna, 8 k.m. from N.H.6 from Hartala fata ahead Varangaon, in Muktainagar Taluka. At this locality full back water of Hatnur Dam is observed through out the year. Lacs of people visits this holy place on Mahashivratri Yatra and Jestha shuddha saptami. They take bath and because of this water gets polluted.

ii) **River Tapti at Deepnagar** :- The Deepnagar, 21^{O}2'22" N 75^{o}50'45" E Here in BTPS-Bhusawal Thermal Power Station heat energy of coal is given to water and steam is generated. This generated steam is sent onto turbines which helps in rotation of turbines this turbines is connected to the generator through the shaft. Generator generates electricity. During this machinery parts get heated. Abundant water is required for cooling, Heated water in turn released in reservoirs and then into river water because of that temperature of water raises.

iii) **River Tapti at Bhusawal:-** The Bhusawal,Long.75^{o}45'00" Latt.21^{o}03'08" is important railway junction. Bhusawal railway waste water and municipal waste water is released very close to reservoir/pumping station from which raw water is pumped. This area is regularly contaminated by waste water. Moreover peoples visits this place, takes bath, washes their cloths. So the water gets polluted.

Field work

A) Collection of water sample

Water sample for analysis of Physico-chemical parameter were taken from 3 stations of river Tapti at Deepnagar, Bhusawal and Changdev from April

2008 to March 2010 the collection of water samples with 5 litres capacity from all stations of study areas.

For estimation of dissolved oxygen separate samples were collected in 250ml BOD glass bottles and fixed in the field where water temp of each site was recorded periodically by using mercury centigrade thermometer at depth of 4 to 6 cm from the surface layer of water, pH of water was examined using universal pH meter also checked by using digital pH meter.

B) Collection of algal samples

Algal samples were collected at monthly interval during April 2008 to March 2010. The attached epiphytic and floating forms of algal were collected separately in acid washed collection bottles and preserved in 4% formalin for further taxonomic investigations.

Laboratory work

Physico-chemical analysis of water:-

The Physico-chemical analysis of water samples from Changdev, Deepnagar and Bhusawal river were carried out by standards methods of APHA(1985) and Trivedy & Goal(1984). The parameter were selected of water analysis viz water temp. pH free co2, dissolved oxygen, bicarbonate, total alkalinity, chloride, hardness, calcium, magnesium, phosphate, nitrate, T.S, T.D.S & T.S.S were recorded from both site during April 2008 to March 2010. The methods for analysis of Physico-chemical parameters are shown in table-1.

1) Algal analysis:-

The algal sample of Changdev, Deepnagar and Bhusawal were collected at monthly intervals. The population of 4 groups of algal was estimated by Haemocytometer method (Whitton 1969) for quantitative study of algae viz. Chlorophyceae (Green algae), Cyanophyceae (Blue green algae), Bacillariophyceae (Diatoms), and Euglenineae (Euglenoides) was estimated at every month from April 2008 to March 2010.

For qualitative study of algae, algal samples were preserved in 4% formalin for further study and identification of algae. Line drawings of different forms of algae were made by camera lucida. The algae were identified by relevant monographs and recent available literature (Hustedt 1930, Pochman 1942, Huber pestalozzi 1955, Pringsheim 1956, Desikachary 1959, Randhwa 1959, Ramanathan 1964, Philipose 1967, Iyengar and Desikachary 1981, Gonzalves 1981, Sarode and Kamat 1984).

2) Pollution Index:-

The pollution tolerant genera and most pollution tolerant species of algal were recorded from stations at Deepnagar, Bhusawal and Changdev.

Algal pollution indices of Palmer (1969) based on genus and species were used in rating water samples for high organic pollutions. A list of all significant algae occurring in the samples was made for these three stations. Twenty most frequent genera were taken into account. A pollution index factor was assigned to each genus by determining the relative number of total points scored by each alga. For rating of water samples as high or low organically polluted, observations were made according to Palmer (1969), the following numerical value for the individual zones have been followed

00-10 suggests lack of organic pollution.

10-15 indicate moderate pollution.

15-20 indicate probable high organic pollution.

20 or more confirmed high organic pollution.

44 theoretical maximum (probably not attainable except under the most stringent artificial condition)

The lower figure below 15 indicates that: -

1) Organic pollution is not high.

2) Sample is not representative or

3) Some substance of factor interfering with algal persistence is present and active.

The pollution index was calculated for all 3 stations of Tapti river.

IV) TROPHIC STATE INDICES

Nyagaard's (1949) trophic indicates are used to determine trophic state of stations at Deepnagar , Bhusawal and Changdev. These indices are helpful for determining the nature of water. The values of index for different categories of algae for oligotrophic and eutrophic conditions were followed according to Nygaard (1949).

Nygaard's trophics state indices are as follows:

Index	Calculation	Oligotrophic	Eutrophic	
1 Myxophycean Desmideae	Myxophycean	0.0 - 0.4	0.1-3.0	(BGA)
2) Chlorophycean	Chlorophycean Desmideae	0.0 - 0.7	0.2 - 9.0	
3) Diatom	Centric diatom Pinnate diatom	0.0 - 0.3	0.0-1.75	
4) Euglenophyte	Euglenophyte Myxophycean	0.0 - 0.2	0.0 -1.0	
5) compound	Myxophycean &Chlorococcales +Centric diatom +Euglenophyta Desmideae	0.0 -1.0	1.2 - 2.5	

For determining the indices, the number of genera in each group of algae was determined upto species level for each sampling stations of rivers. The ratios of these groups were calculated and are used as biological index of water quality. From these values the degree of eutrophication is determined for all three stations of Tapti.

V) SAPROBITY INDEX

The Saprobity indices for three stations of river were calculated according to Pantle & Buck (1955)

$$M=\{S\} = \frac{s.h}{h}$$

Where, S = S is the main Saprobity index

s = s is the degree of Saprobity

h = h is frequency with which single species occurs

For the calculation, The following numerical degree are used.

Oligo-saprobic indicator organism ---------- S = 1

B-mesosaprobic indicator organism ----------S = 2

A-mesosaprobic indicator organism ----------S = 3

Poly m\esosaprobic indicator organism ----------S = 4

` Species found by chance ----------h = 1

Species found frequently ----------h = 3

Species occur in abundant ----------h = 5

The following numerical values for the individual zones have been followed:

1.0 – 1.5	denotes Oligo(o) saprobic zone
1.5 – 2.5	denotes B- mesosaprobic zone
2.5 – 3.5	denote A-mesosaprobic zone
3.5 – 4.0	denote Polysaprobic zone

The various Saprobitic organism included in Saprobitic levels of Kolkuitz & Marsson (1908) are listed from different stations of study areas.

VI) TAXONOMICAL STUDY

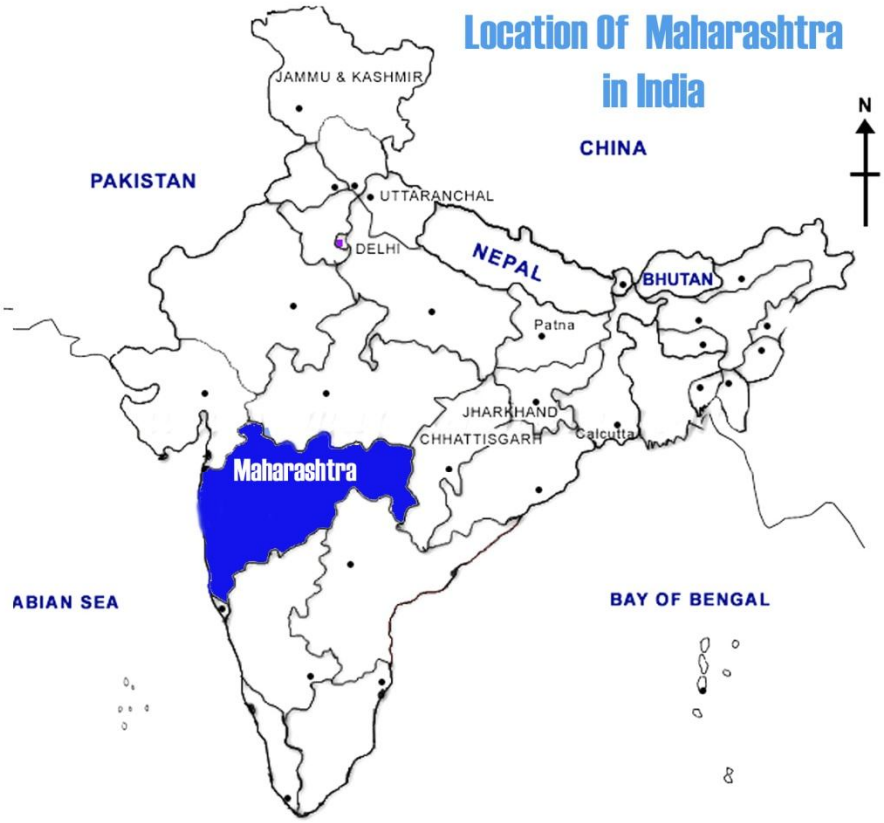
For Taxonomical study of algae, identification of various algae from the 3 stations of river Tapti was made with the help of standard monographs & literature. Certain forms were identified with the help of experts. Systematic account of all algal Taxa was made for four groups of algae namely

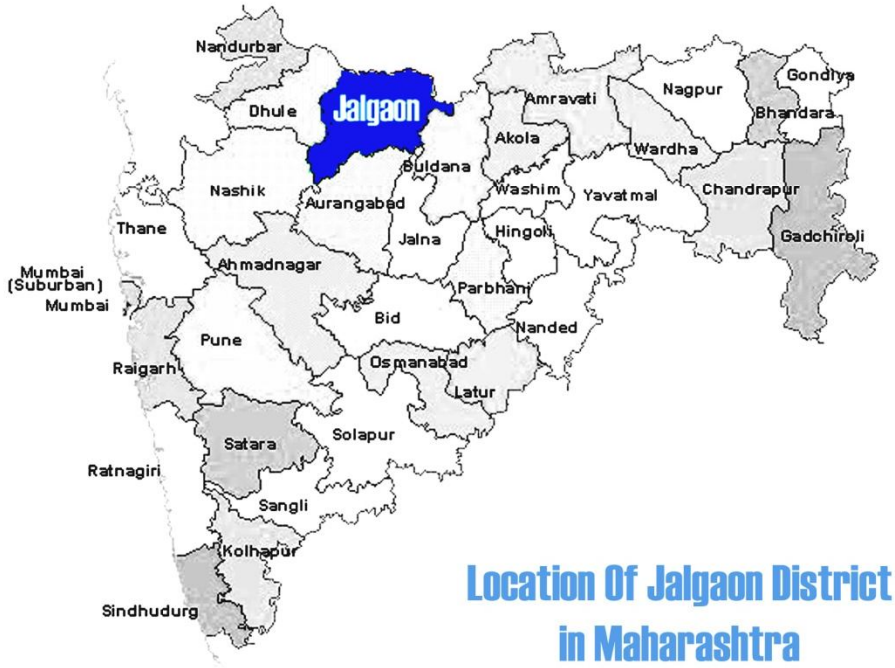
1) Chlorophyceae,

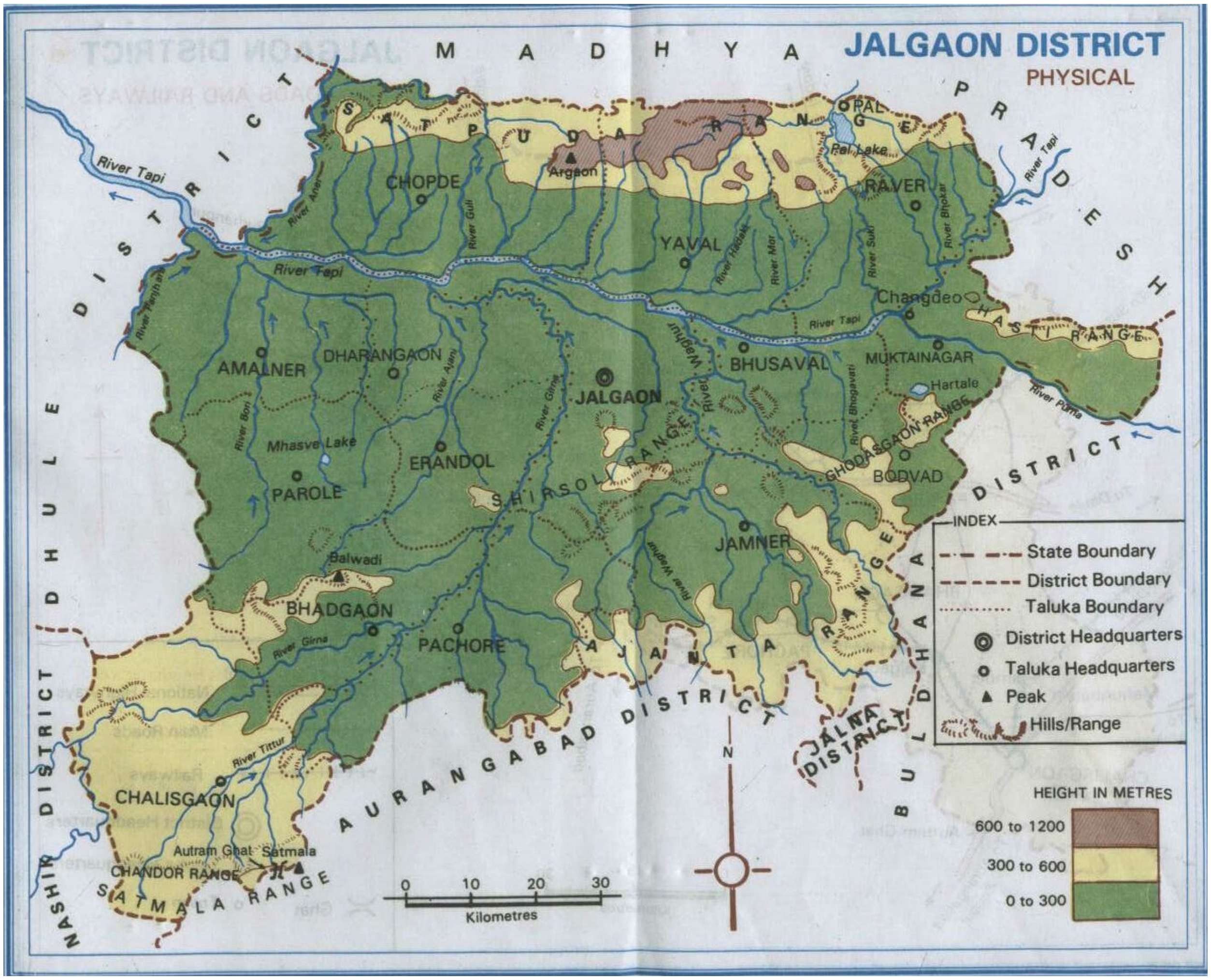
2) Cyanophyceae,

3) Bacillariophyceae,

4) Euglenineae.


Location Of Maharashtra
in India
JAMMU & KASHMIR
CHINA
N
PAKISTAN
UTTARANCHAL
DELHI
NEPAL
BHUTAN
Patna
JHARKHAND
CHHATTISGARH
Calcutta
Maharashtra
ABIAN SEA
BAY OF BENGAL


Nandurbar
Jalgaon
Dhule
Amravati
Nagpur
Gondiya
Bhandara
Akola
Wardha
Buldana
Nashik
Washim
Yavatmal
Chandrapur
Aurangabad
Thane
Hingoli
Gadchiroli
Jalna
Ahmadnagar
Mumbai
(Suburban)
Parbhani
Mumbai
Bid
Nanded
Pune
Raigarh
Osmanabad
Latur
Satara
Solapur
Ratnagiri
Sangli
Kolhapur
Sindhudurg
Location Of Jalgaon District
in Maharashtra



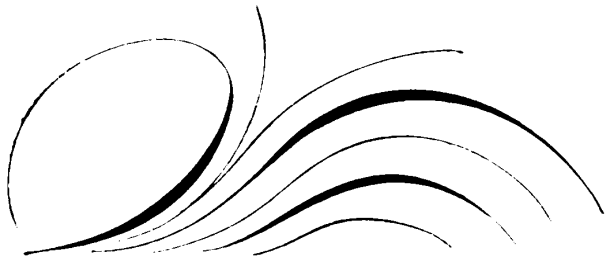
JALGAON DISTRICT
PHYSICAL
MADHYA PRADESH
SATPUDA RANGE
DHULE DISTRICT
NASHIK DISTRICT
AURANGABAD DISTRICT
JALNA DISTRICT
BULDHANA DISTRICT
River Tapi
CHOPDE
Argaon
PAL
Pal Lake
RAVER
YAVAL
Changdeo
HASTI RANGE
MUKTAINAGAR
BHUSAVAL
Hartale
River Purna
AMALNER
DHARANGAON
JALGAON
Mhasve Lake
ERANDOL
PAROLE
SHIRSOLI RANGE
GHODASGAON RANGE
BODVAD
JAMNER
Balwadi
BHADGAON
PACHORE
River Girna
AJANTA RANGE
CHALISGAON
River Tittur
Autram Ghat
Satmala
CHANDOR RANGE
SATMALA RANGE
N
0 10 20 30
Kilometres
INDEX
State Boundary
District Boundary
Taluka Boundary
District Headquarters
Taluka Headquarters
Peak
Hills/Range
HEIGHT IN METRES
600 to 1200
300 to 600
0 to 300

RIVER TAPTI

T - C CHANGDEV

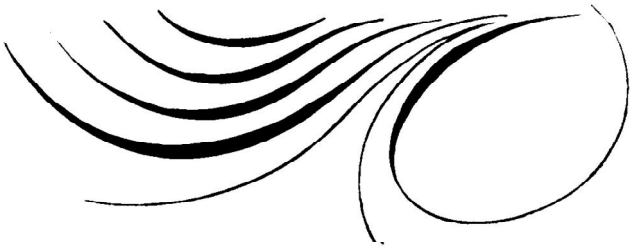
T - D DEEPNAGAR

T - B BHUSAWAL



CHAPTER-4

RESULTS



Physicochemical parameters of River Tapti.

1. Water Temperature

Surface water temperature was measured at all 3 stations of the river Tapti. The water temperature was lower than that of air temperature except few months of winter seasons. The minimum water temperature was recorded 18.5^0C in the month of December, 2008 and maximum water temperature was 33.0^0C in the month of April, 2009. There was no significant difference in average value of water temperature of both years for 3 stations of River Tapti (Table-2). At 3 stations temperature showed three distinct trends indicating winters seasons summer seasons and monsoon seasons. From November to February water temperature was lower indicating winter seasons and from March to June water temperature was higher indicating summer seasons and from July to October water temperature was in between lower and higher and disturbed due to rains indicating monsoon seasons .

2. pH

The pH values of 3 stations of Tapti were measured. There was no significant difference in the average values of pH at all 3 stations. The average pH value during second year of study period was slightly more than of first year of study (Table-2). The maximum pH value 8.9 was recorded in January, 2010 at T - D, While the minimum pH value 7.15 was recorded in February, 2009 at T - B. The pH of all the 3 stations of was greater than 7 indicating alkaline nature of water.

3. Free CO_2

The value of free CO_2 are ranged from 0.0 to 116.6 mg/l, 7.14 to 127.6 mg/l, & 11.0 to 74.8 mg/l, with an average value 51.14mg/l, 36.8mg/l and 33.73 mg/l at T - D, T - B & T - C respectively.(Table-3). The average value CO_2 was more at T - D as compare to that of T - B & T - C. The maximum CO_2 was 127.6 mg/l in December, 2008 at T - B, while free CO_2 was absent in January, 2010 at T - D (Table 3).

4. Dissolved Oxygen (DO)

The DO values of all 3 stations are shown in the Table -3. The maximum DO value was 34.08mg/l in January, 2010 at T - C. The minimum DO value was 7.14mg/l in April, 2008 at T - B in June 2005, July 2006 at T - C. The DO value ranged from 5.19 to 31.83 mg/l, 7.14 to 34.83 mg/l and 7.14 to 34.08 mg/l with an average value 13.37 mg/l, 13.15 mg/l & 13.09 mg/l at T - D, T - B, T - C respectively.

5. Carbonate & Bicarbonate

The carbonate were observed only in second years study, 90mg/l in February, 2010 at T - D, 30 mg/l in January 2010 at T - B, 40 mg/l in February 2010 at T - C (Table-4). The maximum concentrations of Bicarbonate was recorded 375 mg/l in March 2009 at T - D (Table- 4) and the minimum concentration of bicarbonate was recorded in 190 mg/l in April 2008 at T - B(Table–4). The value of bicarbonate range from 230 to 375 mg/l, 190 to 280 mg/l & 240 to195 mg/l with average value 319 mg/l, 248 mg/l, & 264 mg/l at T - D, T - B, T - C respectively (Table-4). It is observed that average value of bicarbonate at T - D is More to that T - B & T - C.

6. Total Alkalinity

The seasonal fluctuations of total alkalinity of 3 stations are represented in Table 4. The maximum total alkalinity was recorded 375 mg/l in March 2009 at T - D (Table-4) & minimum value was recorded 190 mg/l in April 2008 at T - B (Table-4). The total alkalinity values ranged from 230 to 375 mg/l, 190 to 280 mg/l & 240 to 295 mg/l at T - D, T - B & T - C respectively (Table- 4).

7. Calcium

The values of calcium for 3 stations of Tapti represented in table 5. It range from 28.86 to 38.48 mg/l, 24.85 to 36.07 mg/l & 28.06 to 37.67 mg/l with average value 35.58 mg/l, 30.50 mg/l & 33.57 mg/l at T - D, T - B & T - C respectively (Table-5) . The maximum value was 38.48 mg/l in June 2008 at T - D. The minimum value was 24.85 mg/l in December, 2008 at T - B (Table 5).

8. Calcium hardness

The value of calcium hardness for 3 stations of Tapti was calculated and represented Table 5. It ranged from 70.04 to 96.05 mg/l with average value 82.42 mg/l, 75.89 mg/l & 83.95 mg/l at T - D, T - B & T - C respectively (Table 5). The minimum value was 62.03 mg/l in December 2008 at T - B (Table 5).

9. Magnesium

The variations in the value of magnesium to each month for 3 stations of Tapti are represented in table 6. The value range from 2.19 to 24.38 mg/l, 11.21 to 14.14 mg/l & 9.15 to 12.68 mg/l with average value 17.35 mg/l, 12.26 mg/l & 11.72 mg/l at T - D, T - B & T - C respectively (Table - 6). The maximum concentration of magnesium was 24.38 mg/l in February 2009 at T - D while the minimum concentration of magnesium was 9.75 mg/l October 2009 & March 2010

at T - C. The average value at T - D is More as compared to T - B & T - C (Table-6).

10. Magnesium Hardness

The variation in the value of magnesium hardness was calculated & represented in table 6. The value range from 49.96 to 99.94 mg/l, 41.21 to 57.96 mg/l & 39.96 to 51.96 mg/l with average value 71.55 mg/l, 50.66 mg/l & 44.49 mg/l at T - D, T - B & T - C respectively (Table – 6). The maximum concentration of magnesium was 99.94 mg/l in February 2009 at T - D while the minimum concentration of magnesium was 31.96 mg/l October 2009 at T - C. The average value at T - D is More as compared to T - B & T - C (Table-6).

11. Total Hardness

The variations in the value of Total hardness to each month for 3 stations of Tapti are represented in table 7. The value range from 120 to 184 mg/l,112 to 146 mg/l & 110 to146 mg/l with average value 159.95 mg/l, 126.2 mg/l & 131.5 mg/l at T - D, T - B & T - C respectively(Table – 7). The maximum value of Total hardness was 184 mg/l in February 2009 at T - D while the minimum value of hardness was 110 mg/l March 2010 at T - C. The average value at T - D is More as compared to T - B &T - C.

12. Chloride

The variations in the value of Chloride for 3 stations of Tapti are represented in table-7. The value range from 24.14 to 49.07mg/l, 25.59 to 58.8 mg/l & 9.94 to 62.48 mg/l with average value 37.75 mg/l, 37.79 mg/l & 32.67 mg/l at T - D, T - B & T - C respectively (Table – 7). The maximum value was 62.48 mg/l in April &

May 2009 at T - C. The minimum value of stations T - C was less those of T - D & T - B (Table-7).

13. Phosphate

The seasonal fluctuations of phosphate were observed for 3 stations of Tapti are represented in table-8. The value range from 0.04 to 1.57mg/l, 0.01 to 0.33 mg/l & 0.01to 0.36 mg/l with average value 0.42 mg/l, 0.23 mg/l & 0.21 mg/l at T - D, T - B & T - C respectively (Table – 8). The average concentration of phosphate was More at T - D as compared to T - B & T - C. The maximum value was 1.57 mg/l in February 2010 at T - D. The minimum value was 0.01in March 2010 at T - B & March 2010 at T - C (Table-8).

14. Nitrate

The seasonal fluctuations of Nitrate were observed for 3 stations of Tapti are represented in table-8. The Nitrate value ranged from 2.8 to 6.2mg/l, 1.6 to 3.4 mg/l & 1.2 to 2.8 mg/l with average value 4.49 mg/l, 2.4 mg/l & 1.94 mg/l at stations T - D, T - B & T - C respectively (Table – 8). The maximum concentration of Nitrate 6.2 mg/lit was found in February 2010 at stations T - D while the minimum concentrations was 1.2 mg/lit was found in October 2009 & January 2010 at T - C.

15 Total Solids (TS)

The seasonal fluctuations of Total Solids were observed for 3 stations of Tapti are represented in table-9. The Total Solids value ranged from 620 to 4825mg/l, 800 to 2224 mg/l & 920 to 2400 mg/l with average value 3149 mg/l, 1420 mg/l & 1798 mg/l at stations T - D, T - B & T - C respectively (Table–9). The maximum value of TS was 4825 mg/l recorded in July 2008 at stations T - D

& The minimum value of TS was 800 mg/lit in August 2009 at stations T - B (Table-9).

16 Total Dissolved Solids (TDS)

The value of TDS for each month is represented in table-9. The ranged of TDS was 280 to 3365mg/l, 400 to 1490 mg/l & 540 to 1607 mg/l with average value 2029 mg/l, 902 mg/l & 1135 mg/l at stations T - D, T - B & T - C respectively (Table–9). The maximum value was 3365 mg/lit in August 2008 at stations T - D while the minimum value was 280 mg/lit in March 2010 at T - B (Table-9).

17. Total Suspended Solids (TSS)

The variations values of TSS were observed for 3 stations of Tapti (Table-9). The ranged of TSS was 200 to 2100 mg/l, 100 to 1060 mg/l & 300 to 1070 mg/l with average value 1140 mg/l, 663 mg/l & 661 mg/l at stations T - D, T - B & T - C respectively (Table-9). The average value of stations T - D was More compared to those of T - B and T - C (Table-9).

Biocenose of river Tapti

a) Algal Periodicity:-

Algal periodicity of 4 groups of algae found at 3 stations of Tapti showed continuous picture through out the investigation. The planktonic, benthic & epithelic algae were collected from three stations of Tapti viz. T - D, T - B, & T - C (Table 10). The density of 4 groups of algae viz. Chlorophyceae, Cyanophyceae, Bacillariophyceae & Euglenineae for three stations of Tapti was studied from April 2008 to March 2010.

The seasonal variations of 4 groups of algae for 3 different stations of Tapti by considering the monthly means of cells/ml x104 during two years of study are studied. There are two peaks of maximum population of algae was observed in November and March at T - D. At T - B the maximum population peaks were observed in January & March. At stations T - C were 2 peaks of maximum population of algae in November & March. The maximum population of algae was observed in March for at all 3 stations of Tapti.

The total population of 4 groups of algae for years April 2008 to March 2010 as shown in table- 11. The maximum population of Cyanophyceae was observed at all 3 stations of Tapti. The highest population of Cyanophyceae was recorded at T - D during October 2009 to March 2010 while the lowest population of group Euglenineae was observed at T - D during October 2009 to March 2010 September 2008 & October 2009 to March 2010 of Tapti is shown in table-11.

The range of Chlorophyceae was observed 25 to 75, 25 to 80 & 20 to 90 with average value 48.95, 52.71 & 55.98 cells/ at T - D, T - B & T - C respectively for 2 years study (Table 11). The maximum population of Chlorophyceae was observed in September 2009 at T - C and minimum population of Chlorophyceae was in June 2009 at T - C.

The range of Cyanophyceae was observed 30 to 115, 30 to 20 & 25 to 110 with average value 87.08, 82.25 & 77.29 cells/ at T - D, T - B & T - C respectively for 2 years study (Table- 11). The maximum population of Cyanophyceae was in March 2009, at T - D while minimum population of blue green in March 2010 at T - C The average population of blue green was maximum at T - D.

The range of Bacillariophyceae was 25 to 115, 25 to 105 & 25 to 100 with an average value 57.20, 71.49 cells/ at T - D, T - B& T - C respectively (table-11). The maximum population of diatoms was observed in September 2009 & March 2010 at all 3 stations of Tapti.

The range of Euglenineae was 00 to 10, 00 to 5 & 00 to 15 with average value 2.7, 2.91 & 3.74 cell/ $mlx10^4$ at for two years study (Table-11). Are for stations T - D, T - B & T - C respectively. The maximum population of Euglenineae was in September 2009 at T - C. While no population was observed in number of months at all 3 stations of river Tapti. Total population of Euglenineae was very less (0.5-3.03%) at 3 stations of Tapti as compared with other groups algae.

In the present study the population of Cyanophyceae was greater as compared to other groups of algae. The seasonal percentages of green algae were more in monsoon for both years. The population of Bacillariophyceae was less than Cyanophyceae and more than Chlorophyceae during the 2 years study. The population of Euglenineae was observed very less than that of other groups of algae during the 2 years study. The total population of 4 groups of algae more at T - D & was gradually decreased at stations T - B & T - C (Table-11).

b) Algal Composition

Algal composition of Tapti was somewhat constant through out the study. It was observed that, the members of Cyanophyceae, Bacillariophyceae & Euglenineae were dominated.

1. Chlorophyceae

This class mainly comprised by the order Chlorcoccales,Cladophorales & Zygnmatles *and* Desmids (Table-10).Chlorococcales mainly reprented by species viz., *Conococcus, Pediastrum, Hydrodictyon, Tetraedron, Oocystis*, *Coelastrum, Crucigenia* and *Scenedesmus.* Cladoprorales represented by *Cladophora* spp. Zygnematales comprises *Closterium, Cosmarium, Zygnema* and *Spirogyra.*

Most of the members of Chlorophyceae showed discontinuous periodicity. The members of Chlorococcales were found to be dominant as compared to other forms of green algae. The desmids were also variable in composition. In present investigation, Chlorophyceae members comprised by 83 taxa belonging to 21 genera.

2.Cyanophyceae(Blue green algae):

This class of algae mainly comprised of *Microcystis, Chroococcus, Gloeocapsa, Gloeotheca, Aphanotheca, Synechocystis, Merismopedia, Stichosiphon, Oscillatoria, Phormadium, Lyngbya, Schizothrix, Symploca, Microcoleus Nostoc, Anabaena, Raphidiopsis,Scytonema, Calothrix, Rivularia* and *Gloeotrichia* (Table- 10). In the present study , the coccoidal as well as filamentous forms of blue green algae were dominant. When the water temperature start to increase in summer season the blue greens were attained their maxima in the summer season. In the summer season the speicies of *Oscillatoria, Phormadium* and *Lyngbya* were commonly obsersed . While the species of *Calothrix ,Rivularia* and *Gloleotrichia* were observed in winter season. In summer and in the beginning of monsoon, the blooms of *Microcystis* were found to be luxuriant. The blue green algae flora of biotope comprised 89 taxa, belonging to 28 genera. In blue-greens the dominant genus *Oscillatoria* was observed with comprising 13 taxa.

3) Bacillariophyceae (Diatoms)

This class of algae mainly represented by the species of *Melosira, Cyclotella, Fragillaria, synedra, Gyrosigma, Pleurosigma, Calonies, Navicula, Pinnulari, Cymbella, Gomphonema, Nitzschnia* and *Surirella* (Table-10). Diatoms as whole were fairly abundant in winter and summer seasons. A few member like *Gomphonema* was epiphytic on the filamentous algae. Diatoms showed continuous picture of periodicity. The diatoms flora of biotope comprised 74 taxa belonging to 21 genera.

4) Euglenineae (Euglenoids)

This class consists of species of *Euglena, Entosiphon, Petalomonas, Phacus & Trachelomonas* (Table-10). As far as Euglenoids are concerned they showed discontinuous periodicity with low average percentage through out the study. Among 4 groups of algae euglenoids showed fourth rank in abundance of population. The dominant genus *Phacus* was observed with 16 taxa. The euglenoids comprised 24 taxa to 6 genera.

In present investigation, during the 2 years period of study, the diatoms & blue-green were the predominated member of Phyto-cenose in this biotope of 3 stations of Tapti, the blue-greens were More dominated and showed greater percentage of the total Phytoplankton population. Next to the blue-greens, diatoms were recorded for greater percentage of total phytoplankton.

The total composition of 4 groups of algae found in the of Tapti was 270 algal taxa belonging to 76 genera (Table-10).

c) Pollution Index (PI):

Pollution tolerant genera & species of 4 groups of algae from 3 stations of Tapti were observed & recorded (Tables-12 & 13). The most pollution tolerant species of *Navicula & Oscillatoria* are listed in Table-13. The pollution tolerant genera & species are listed in descending order according to Palmer (1969).

At all stations of Tapti 33 pollution tolerant genera were recorded. Out of 33 pollution tolerant genera,24, 25 & 26 genera were observed at T - D, T - B & T - C stations of Tapti respectively.

At all stations of Tapti 23 pollution tolerant algal species were recorded. Out of 23 pollution tolerant species were observed at of Tapti stations (Table-13). 10 species of diatoms, 2 species of blue-greens 11 species of green algae & 1 species of euglenoids were observed ., (Table-13). In this present investigation pollution tolerant species of *Oscillatoria* were recorded More compared to species of *Navicula.*

By using Palmer's Index of pollution for rating for water samples as far as high & low organically polluted at 3 stations of Tapti were examined. The results are shown in Table-14. Out of 20 genera 17, 16 & 15 genera were observed at stations T - D, T - B & T - C respectively (Table-14). The degree of organic pollution was decreased from T - D to T - C. The total score of each station was greater than 20 indicating the confirmed high organic pollution Stations T - D was highly organically polluted as compared to T - B & T - C (Table-14).

D) Trophic State indices:

Nygaard indices of different groups of algae viz. Myxophyceae, Chlorophyceae, Diatoms & Euglenophytes & compound are used to get a

meaningful evaluation of the extent of pollution in the water (Nygaard, 1979). Diatoms indices were the least sensitive in present study. Compound quotient which has the widest range was very sensitive and useful index of eutrophication. At certain limits Myxophyceae index was More useful in the assessment of eutrophication through it was not as sensitive as compound index.

The Nygaard's trophic state indices at 3 stations of Tapti are as shown in Table-15. The trophic state indices of Myxophyceae for 3 stations of Tapti indicated. Eutrophic nature of water. The trophic state indices of Chlorophyceae group of all stations of Tapti indicated eutrophic nature of water. Diatoms & Euglenophytes indices were quite independent. The trophic state indices of diatoms indicated oligotrophic nature of water at all stations. The trophic state indices of Euglenophytes at all stations were shown oligotrophic nature of water (Table-15). The compound trophic state indices of 3 stations of Tapti showed eutrophic nature of water (Table-15).

E) Saprobity Index (SI):

Kolkwitz & Marsson (1908) investigated the Saprobity index for assessment of biologically polluted waters of different habitats. Number of workers and attempted to arrange saprobionitic algae which are capable of tolerating various degrees of pollution, (Kolkwitz, 1950; Palmer 1969; Hortobagyi 1973). In present investigation the system of Kolkwitz & Marsson (1908) is followed to find out saprobity index.

The system of Kolkwitz & Marsson (1908) comprises 4 saprobic level - viz.

1. Very heavily contaminated-polysaprobic zone (p)

2. Heavily contaminated-Mesosaprobic zone (a)

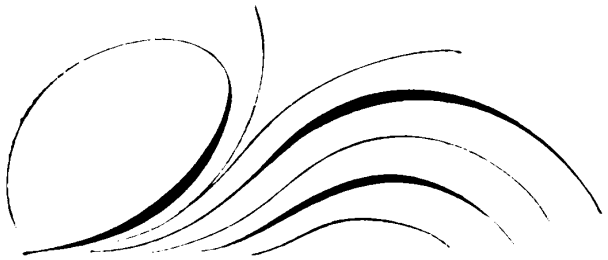
3. Moderately contaminated Mesosaprobic zone (b)

4. Scarcely contaminated-oligosaprobic zone (O).

The following algae were observed for 3 stations of Tapti & classified in above saprobic levels according to Kolkwitz & Marsson (1908) as under.

	T - D	T - B	T - C
1. Polysaprobian	Nil	Nil	Nil
2. a-Mesosaprobian	a) *Oscillatoria brevis* b) *O. formosa*	a)*Oscillatoria princes*	*a)Oscillatoria limosa*
3.b-Mesosaprobian	a *Pediastrum* b) *Trachelomonos*	a) *Pediastrum* b) *Trachelomnas*	*a)Pediastrum* *b)Trachelomonas*
4. Oligosprobian	a)*Cyclotella meneghiniana* b*) Phacus pyrum*	*a)Cyclotella meneghiniana*	

Saprobic index of 3 stations of Tapti are shown in Table-16. In present investigation, according to Saprobity index nature of Tapti water showed b-mesosaprobic.



CHAPTER-5

DISCUSSION

The ecological aspect of lotics environment in India has been discussed in respect of some Indian rivers. Algal periodicity & composition in both time & space are certain fundamental factors such as physical chemical and biological changes in water quality exert a selective action on the flora & fauna, which constitute the living population of water & effects produced in them can be used to establish biological indices of water quality.

In past, chemical, physical & bacteriological criteria were considered to be easier to evaluate and apply than biological indices which were through to relatively under developed. Chemical & physical measurement however tend to measure only the course of change in water quality while biological tests deal with permittivity with effects of the change. Simple, rapid & reliable methods of assessing the degree of purity or contamination of water samples have now been developed & these were used in present investigation for assessment of water of Tapti.

I. Meteorological condition:

The climatic condition of Tapti of Jalgaon District is More or less dry divided into 3 distinct seasons viz. winter, Summer & monsoon. Winter seasons records moderate temperature with cloudless sky.

Summer is characterized by high temperature, bright sunshine & hot climate. Moderate rainfall in monsoon seasons is recorded in Jalgaon District as compared to other places of Maharashtra.

In present investigation, air & water temperature go More or less hand in hand with respect to seasons. Similar observations have been recorded by Nandan & Patel (1984a), Patil (1995), More (1997) & De (1999). Generally this might be due to smaller the masses of water of lake & ponds. It is fact that the smaller the body of water More quickly it reacts to the change in the atmosphere temperature (Welch 1952).

II) Relationships between Physico-chemical parameters and Algal flora:

Water temperature plays an important role in controlling the occurrence & abundance of algal flora. In present investigation, high temperature favoured the growth of algal taxa specially Chlorococcales. Similar observations were made Philipose (1960).

Water temperature played an important role in the periodicity of blue-green algae as reported by earlier workers. Cyanophyceae were dominated during summer month. The same effect of water temperature on blue-green algae was reported during the late winter and summer seasons at all stations of Tapti. It was observed that the formation of water blooms of *Microcystis* in the late summer and early monsoon in Tapti tallied with the observation of earlier workers (Singh.P 1960, Nazneen, 1980, Nandan & Patel 1984 & More 1997).

It has been observed that temperature is the most important factor affecting the diatoms growth (Patrik 1968; Yoshitake & Imahori 1980; More 1997). In present study, diatoms were abundant in species composition at all water temperatures at all stations of study areas.

In present investigation, pH showed direct relationship with water temperature but no definite correlation could be ascertained between temperature and pH of water (Vyas & Kumar 1968). There is a considerable opinion regarding

the effect of pH on abundance of algal flora. The pH of water changed with changes in the climatological and vegetational factors as reported by Kant & Kachroo (1974).

George (1961) observed that the high pH value promoted the growth of algae which resulted in formation of algal blooms. Similar observations have been made Prescott & Vinyard (1965) & Nazneen (1980). All the stations of Tapti showed alkaline in nature through out the period of investigation.

Water rich in CO_2 were comparatively less alkaline where as water deficient in the CO_2 were more alkaline as observed at all stations as in present study (Plate 15-16). Similar observations have been made by Pearsall (1930), Zafar (1964a), More(1997).

The free CO_2 values for all stations were more, particularly in winter seasons, this might be due to high abundance of phytoplankton in the lakes as agreed with the views of Al-Saadi et.al.(1996).

In the present study free CO_2 directly related with dissolved O_2 at all stations of Tapti.

The DO content was higher in monsoon and winter seasons in the present investigation as agreed with the views of earlier workers. The phenomenon of reoxygenation of water during monsoon may be due to circulation and mixing by inflow after monsoon rains (Hannan 1979). The further progressed in winter, may be due to circulation by cooling and draw down of dissolved oxygen in water. Similar results have been obtained by Udash (1996) in Tamar lake. The correlation of dissolved oxygen was found highly positive with Chlorophyceae and Bacillariophyceae but found highly negative with present with Cyanophyceae in present study. It was observed that the concentration of DO was less in late

summer seasons for all the stations. This may be due to increasing water temperature. Similar observations were made by Singh & Singh (1994).

In present study dissolved O_2 inversely related with bicarbonate, total alkalinity and Calcium at all stations.

In present investigation, total alkalinity showed negligible seasonal variation at all stations except T - D of Tapti where comparatively high values of total alkalinity were observed. This is due to fact that, T - D stations of Tapti received ash water through rivulets coming from neighbouring area. Similar observations were made by Thomas & Abdul (2000).

In present investigation, bicarbonate showed direct correlation with total alkalinity, calcium, calcium hardness, magnesium, magnesium hardness & total alkalinity at all stations.

Calcium hardness was directly correlated with calcium & calcium values were sensitive to the temperature. In winter seasons the calcium values were less at all stations of Tapti. Where as the calcium values were increased in summer seasons. The similar observation were made by Al-Saadi et.al.(1996) at the Garmat Ali river of Iraq. In present study T - D of Tapti showed higher values of calcium and calcium hardness as compared to the other stations. This is because the water of these stations was highly contaminated with ash coming from surrounding areas.

In present study, calcium, calcium hardness, directly related with magnesium, magnesium hardness & total hardness and chloride.

The concentrations of magnesium hardness were directly correlated with magnesium concentrations. The maximum concentration of magnesium was observed in summer seasons. This might be due to increase of value of hardness

and calcium as observations recorded by Mathew Varghese et.al (1992) & More 1997. But in present investigation it was not tallied with the value of all stations.

In present investigation, the total hardness to all stations was more during the late summer. Higher values in summer may be due to higher temperature, which increase concentrations of salts by excessive evaporation. Similar observation was made by Bhatt et.al (1999). Total hardness was directly related with chloride and nitrate at all stations of river Tapti .

Concentrations of phosphate was more at T - D stations of river Tapti, this might be due to concentrations of ash water. In present study the populations of Bacillariophyceae and Cyanophyceae at T - D stations of Tapti was considerably increased with the increase of concentrations of phosphate. It was pointed out that the diatoms were capable to absorbing phosphate in larger quantities than their requirement (Ruttner, 1963). Such behaviour of diatoms towards phosphate was observed by Munawar (1970b). In present study the composition and population of diatoms was greater. It showed that phosphate directly related with diatoms (Philipose 1960).

In present study total solids showed direct correlations with total dissolved solids and total suspended solids at all stations of Tapti (Table 9). Among all stations, T - D stations of Tapti showed relatively greater values of T.S, T.D.S & T.S.S. This was due to contamination of ash water.

III. Algal periodicity & composition

In India, most of workers studied the algal composition and periodicity of algae in lotic ad lentic waters. There are two trends of opinions regarding the

development and growth of algae. One school suggested that total population of algae reached their maximum development during summer and minimum during winter (Chakrabarty et.al 1959; Philipose 1960; Nandan & Patel 1984a; & Patel 1995). On other hand, others showed the maximum algal development during post monsoon, winter and early summer (Roy 1955; Lakshminarayana 1965; Venkateswarlu 1969c). In present investigation the maximum population of green algae was found in post monsoon as compared to other seasons. Similarly the maximum populations of diatoms and blue greens were greater in winter and summer. Euglenoids showed more or less uniformity through out the study at all stations of rivers. This is because of significant pollution of rivers.

Earlier workers have given different views on ecological distribution of blue-green (Gonzalves & Joshi 1946; Singh V. P 1960; Munawar 1970b,; Kumar 1995A) most of them emphasized on the importance of light temperature, pH CO_2 , Alkalinity nitrates & phosphate in blue-greens algae. This was true in present observation at all stations of present study area. This was due to the eutrophic status of Tapti.

The physical factors were very likely also important the periodicity of phytoplankton & seasonal distributions of various species.

The member of euglenoids were recorded very few at all stations as confirming the earlier finding of Chakrabarty et.al (1959); Venkateswarlu(1969c) & Patil (1995).

IV) Eutrophication, Pollutions & Saprotophication:

Due to increase in the industries and populations may undesirable modification are responsible for eutrophication, pollution & Saprotophication in the aquatic environment.

a) Eutrophication: Eutrophication means the increase of growth of algae & other aquatic plants as a consequence of increase inputs of minerals nutrients which are responsible for water pollution. The concept of eutrophication was introduced by earlier workers

Similarly, Nygaard (1949) introduced five indices in the study of eutrophication. According to him, certain algal groups were indicative of levels of nutrients enrichment. He studied the compound index with production levels of same Danish lakes for the purpose of determining their tropic levels.

In the present investigation the dominance of blue-greens throughout the investigation, at T - D stations of Tapti indicating highly eutrophic nature of water then those of the other sites (Table-15) as agreed with the views of Hasler (1947). He observed eutrophic lakes, many of them having nuisance blooms of *Microcystis.* Similarly in present investigation in the late summer and early monsoon the algal blooms of *Microcystis* were observed.

The effect of dissolved oxygen concentrated on eutrophication of lakes, during the summer seasons was observed by Anderson (1961). Total alkalinity was used to determine the trophic status of several European lakes (Vollenwinder 1968). The value of total alkalinity above 60 ppm is indicative of nutrient rich conditions. When total alkalinity goes above 40 ppm, the water quality considered as hard water (Sing & Swaroop, Gupta & Sharma 1994; Tiwari 1999). They found maximum alkalinity in the summer months and declined subsequently in monsoon months as agreed with the present study.

The concentrations of phosphates were more in summer during the formation of the blooms of *Microcystis.* The concentrations of phosphates & Phytoplankton density were directly correlated in the present investigation

indicating the eutrophic status of rivers. Increase in concentrations of phosphate, nitrate & chloride were observed due to addition of wastes of waters materials in the from of domestic sewage which can be used as an index of eutrophication.

Nygaard's indices- the Myxophyceae, Chlorophyceae diatoms, euglenoids & compound were used for evaluation of eutrophication. In present investigation all the stations showed eutrophic except index of diatoms for all the stations of Tapti (Table-15). This result is agreed with the earlier workers, Gunale & Balakrishna 1981; Nandan & Patel 1985b; & Wani 1998).

Certain eutrophication taxa like the blue-green algae *Oscillatoria rubenscene* was observed in present study. Similarly green algae *Coelastrum spharericum, Scenedemus armatus, Scenedesmus bijugatus* was observed as reported by Wani(1998).

According to Hutchinson (1967) the nutrient increase in the river due to human activities in the catchments lead to change of river flora from diatoms assemblage to those of green and blue greens. This suggests that river is under heavy stress of nutrient loading. In eutrophic river changed algal flora includes species of Bacillariophyceae (*Cyclotella, Cymbella, Fragilaria, Navicula, Nitzschia*) Chlorophyceae (*Ankistrodesmus, Chlorella, Cosmarium, Coelastrum, Scendesmus*) Cyanophyceae (*Merismopedia, Oscillatoria, Anabaena*) & Euglenineae (*Euglena, Phacus*). In present investigation these species were recorded. This is agreed with observation made by Wani (1998). Hence recent approach for assessment of eutrophication is based on an algal communication rather than single algae. The same approach is applied in present study.

b) Pollution :

In the aquatic systems, due to the growth of biotic communities, biological pollution is observed & it increased total solids, pH, alkalinities, total hardness, Calcium, $Co_{2,}$ Chlorides, Phosphates & nitrates.

Palmer (1969) has shown that the genera like *Scendesmus, Oscillatoria, Microcystis, Navicula, Nitzschia* & *Euglena* are the species found in organically polluted waters supported by Goel et.al (1986) & More (1997). Similar genera were recorded in the present investigation.

In the present study, the dominance of *Oscillatoria* was indicating pollutants of biological origin which agreed with the observations of Rai & Kumar (1976), and Singh Y (1979), Joy et.al (1990) classified diatoms according to their tolerance of oxygen levels, pH & salinity. Cholnoky (1968) gave detailed account of dominate species of diatoms being used as indicators of water quality. This view was supported by Prasad and Singh (1982).

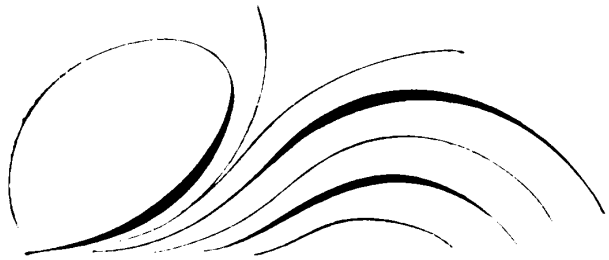
c) Saprotophication :

Kolkwitz & Marsson (1908) investigated a system of indicator organism for the assessment of surface water quality. The saprobic system which is the basic of biological water analysis and still continuous to provide the starting point for all other Saprobiological works. Saprotophication in an extreme stage of organic pollution which shows quick results in smaller bodies of stagnant water.

The eutrophication is special initial process reaching generally b-mesosaprobity as the climax stage and is clearly connected with pollution of aquatic systems.

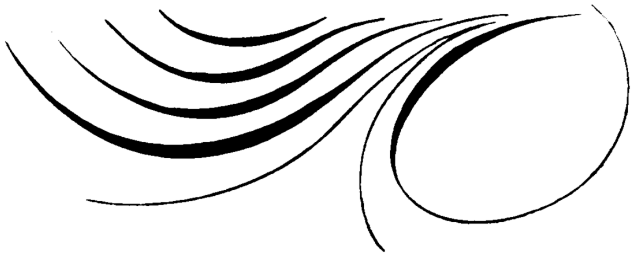
Casper and Karbe (1967) stated a metabolic dynamic aspect of Saprobity & differentiate 3 saprobic zones viz, oligotrophic, mesotrophic & eutrophic. Thomas (1994) recorded presence of *Spirogyra, Clostrium & Cosmarium* in b-mesosaprobic zone as it is true in present observation.

According to Kolkwitz & Marsson (1908) the most of the forms in the present study were categorized into b-mesosaprobic zone. It must be born in mind that while evaluating water quality on the basis of biological indicators that the prominent difficulties comes across in deciding what indicators type to a particular species is to be grouped.



CHAPTER-6

SUMMARY & CONCLUSIONS



SUMMARY AND CONCLUSION

Very little attention appears to have been paid ecological studies of algae from rivers of India. In Maharashtra late Prof. M. S. Balakrishana and his students initiated the ecological studies of algae in and around Poona. To fulfill the lacuna in the study of ecology of algae in Maharashtra the present investigation was carried out on ecology of algae from river Tapti of Jalgaon district of North Maharashtra. In present investigation the study was made on 3 stations of Tapti. Regular sampling of water samples and algal samples at monthly intervals was made for Physico-chemical and algal analysis over a period of two years. i.e from April 2008 to March 2010.

Meteorological data and seasonal fluctuations of 17 parameters for 3 stations of Tapti were observed from April 2008 to March 2010.

The correlation between Physico-chemical parameter and algae was made for all stations. Water temperature played important role in periodicity of blue-green in present data.

Throughout the period of investigation the biotopes was supported a rich and varied biocenose. In total composition of 4 groups of algae 270 algal taxa were recorded at 3 stations of Tapti river. Blue-greens were greater in species composition to other groups of algae at all sites of study areas.

The population density of 4 groups of algae was recorded at each month for all stations during period of two years. The algal periodicity was affected by water temperature and other parameter during the summer seasons. In general the populations of Cyanophyceae was dominant as compared to other group of algae. The seasonal percentages of 4 groups of algae was more in monsoon seasons at all stations for both years. While seasonal percentage of blue-greens and diatoms were

more in summer seasons at majority of the sites for both the years. The total population of euglenoids was less as compared to other groups of algae in present study.

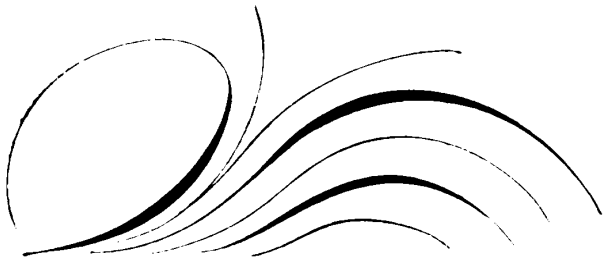
The pollution tolerant genera & species of 4 groups of algae from 3 stations of Tapti were recorded according to Palmer (1969). The most pollution tolerant species of *Navicula, Oscillatoria, & Euglena,* were recorded in present study. By using Palmer's index of pollution for rating of water samples as high or low organically polluted at 3 stations of Tapti were studied. The highest degree of pollution was observed at T - D of Tapti.

By using Palmer's pollution index number the total score of all stations of Tapti was greater than 20 indicating the confirmed high organic pollution. Thus the pollution tolerant algal communities can be used as 'Bioindicators, of organic pollution.

Nygaard's indices of different groups of algae viz. Myxophycean, Chlorophyceae, Diatoms, Euglenophytes and compounds were used to get meaningful evolution of the extent of pollution of sites Trophic state indices were calculated for all stations. All the indices were showing eutrophic nature of all sites except diatoms indices. The compound index which had the widest range and was very sensitive holds good index for assessing the eutrophication of all stations.

Kolkwits system was used for classifying the 4 saprobic levels of all sites. Saprobic index of 3 stations of Tapti showed b-mesosaprobic nature of water. No polysapribian alga was recorded in present study. The water qualities of 3 stations were assessed by Physico-chemical analysis and also by algal communicates with relation of pollution index, trophic indices and saprobity index.

The number of algal taxa observed in of Tapti was 270, of these, 83 belonging to Chlorophyceae, 89 belonging to Cyanophyceae, 74 belonging to Bacillariophyceae and 24 belonging to Euglenineae. Among 4 groups algae, Cyanophyceae was dominated in present study. In Cyanophyceae dominated genus was *Oscillatoria,* represented by 11 species.



CHAPTER-7

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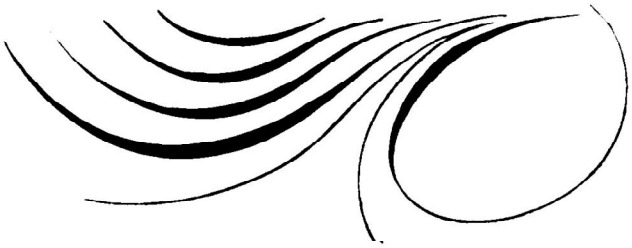

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Abbreviations

T – C	River Tapti at Changdev
T – D	River Tapti at Deepnagar
T – B	River Tapti at Bhusawal
WT	Water Temperature.
CO2	Free carbon dioxide
DO	Dissolved oxygen
HCO3	Bicarbonate
TA	Total alkalinity
Ca	Calcium
CH	Calcium hardness
Mg	Magnesium
MH	Magnesium hardness
TH	Total hardness
Chl	Chloride
PO4	Phosphate
NO3	Nitrate
TS	Total solids
TDS TSS	Total dissolved solids
PI	Total suspended solids
SI	Pollution index
B	Saprobity index
D	Blue-greens
E	Diatoms
F	Euglenoids
G	Flagellates
	Greens