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LIMNOLOGICAL STUDIES OF THE WATER AT SANJAY GANDHI THERMAL POWER PLANT SITE MANGTHAR BIRSINGHPUR PALI (M.P.)

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ABSTRACT: - In the present study of limnological parameters, the water was collected from the water bodies located in Sanjay Gandhi thermal power plant Mangthar (Birsinghpur Pali) were determined during September 2019 to August 2020. Sanjay Gandhi thermal power plant is located at Birsinghpur Pali in Umaria district of Madhya Pradesh. Sanjay Gandhi thermal power plant is situated longitude 23°18′21″N and latitude 81°03′54″E on the right pool of the Johilla river. The Power plant is one of the coal based power plant of Madhya Pradesh power generating company limited (MPPGCL).This power plant was established in 1993. Physico-chemical parameters showed the following ranges on the surface water of Johila river : temperature range (17.4 0C to 25.6 0C), D.O. (2.20-6.11 mg/l), pH (6.70-8.60), NH4 (0.25-3.50 mg/l), Nitrate (22.6-63.1 mg/l), H2S (0.001-.008 mg/l), CO2 (0.11-3.60 mg/l), Chlorine (0.005-0.020 mg/l) and Cyanides (0.001-0.020 mg/l). It is concluded from the present investigation that the quality of the water system is continuously degrading. The source of water pollution in this water body, thermal power plant, municipal, domestic and agricultural wastes. Various physical and chemical parameters have been observed to either approach or to have exceeded the permissible limits set for drinking water or for human use.

KEYWORDS:- Power plant; Water quality; Physico-chemical parameters.

INTRODUCTION:-

Aquatic ecosystem is the most diverse ecosystem in the world. The first life originated in the water and first organisms were also aquatic where water was the principal external as well as internal medium for organism. Surface water acts as a receptor of pollutants, which are washed out and carried by surface runoff from Urbanized catchments or watersheds. Rapid urbanization leads to degradations upon water quality via eutrophication and pollution. Polluted surface water includes river and lakes as well as agricultural drains. Nearly all water bodies, including ground water, are affected by pollution. Polluted water loses its economic and aesthetic value. Resultantly, in many developed countries, water pollution is a major problem and many river basins have been found to show high organic matter concentration.

Water pollution from domestic, agricultural or industrial wastes sources affect living organisms and make water unfit for uses (Andrew & Jakson, 1996; Cong, 1999). Coal operated thermal power plant can be a source of pollution, because ash derived from burning of coal containing heavy metals such as arsenic (As), cadmium (Cd), lead (Pb), mercury (Hg) and zinc (Zn), can contaminate water in the drainage system, presenting a potential hazard to the environment (Kanungo & Mohapatra, 2000). In addition, sediment or other matter containing insoluble particles (in soil & other solids) can also suspend in water that can ultimately reduce photosynthetic activity in the water and disrupt aquatic food webs (Miller, 1995). In addition, inorganic nutrients, such as water soluble nitrogen and phosphorus, can cause excessive growth of algae, forming algal blooms and eventually cause the serious problem of eutrophication in lakes and reservoirs (Waite, 1984; Miller, 1995; Andrew & Jakson, 1996).

Most of the fresh water resources in recent years are rapidly degrading due to intense of human activities and loading of pollutants. The rapid expansions of human population and increasing rate of industrialization create unfavourable hydro biological conditions of the water due to pollution which may cause mysterious mass killing of the fishes and aquatic organisms.

Previous scientific studies demonstrate that a significant proportion of the elements detected in the fly ash samples can be readily leached from them, posing a threat to the receiving environment Treatment processes to reduce the quantities of these elements in the fly ashes would simply result in the production of additional contaminated waste streams. In addition to their toxic element content, fly ashes produced by these facilities pose a threat due to their very fine particle fraction. These particles are small enough to be inhaled into the extremities of the lung airways, and to various body systems of aquatic organisms resulting into adverse impact over the concerned organism. Pollution control devices are significantly less efficient at capturing such 'respirable' as well as easily dissolvable particles, which can contain higher concentration of toxic elements that the fly ash as a whole.

On-going use of coal combustion for power production will result in future releases of toxic and potentially toxic elements to the environment. This can only be avoided through the cessation of coal combustion and the implementation of sustainable technologies such as solar- and wind power generation.

Study Area:-

In the present study is going to centralize on Sanjay Gandhi thermal power plant is located at Birsinghpur Pali in Umaria district of Madhya Pradesh. Sanjay Gandhi thermal power plant is situated longitude 23°18′21″N and latitude 81°03′54″E on the right pool of the Johilla river. The Power plant is one of the coal based power plant of Madhya Pradesh power generating company limited (MPPGCL).This power plant was established in 1993.

An attempt has been made to study the limnological parameters at the site of thermal power plant responsible for fly ash production and its contamination into surrounding water bodies. An attempt has also been made to establish the impact of fly ash pollution on the reproductive mechanism of experimental fish. For the study of limnological parameters, the water was collected from the water bodies located in Sanjay Gandhi thermal power plant Mangthar (Birsinghpur Pali).

OBJECTIVES:-

The objectives of the present study are following:

- To check the physico chemical characteristic of water of Johilla river.
- To find out some hidden fact of the impact of coal fly ash water body.
- To observe the productivity of Johilla river.

MATERIAL AND METHODS:-

The quality of Johila river water is deteriorated because of in-stream uses of water in the following ways. During survey it was observed that limnological parameters at the site of thermal power plant responsible for fly ash production and its contamination into surrounding water bodies. This ultimately deteriorates the quality of the river water to a considerable extent. The present study conducted from September 2019 to August 2020.

Water samples were collected monthly in the morning at 8 am to 10 am from surface layer of the dam. Physico-chemical analysis of water samples were made following standard methods suggested by APHA, AWWA, WPCI (2005).

RESULT AND DISCUSSION:-

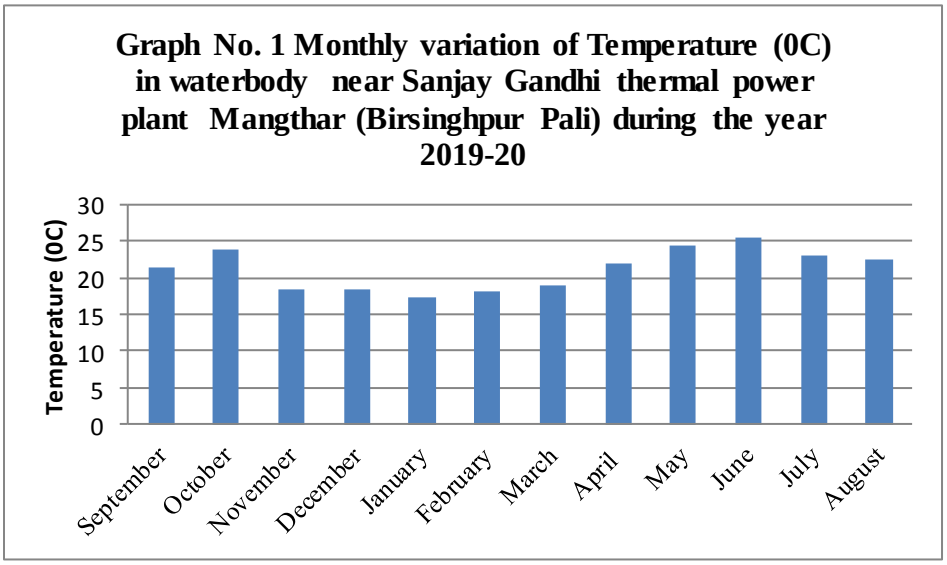
For the study of limnological parameters, the water was collected from the water bodies located in Sanjay Gandhi thermal power plant Mangthar (Birsinghpur Pali) have been given in table no. 1

Table No. 1 Monthly variation of water quality parameters of water bodies located in Sanjay Gandhi thermal power plant Mangthar (Birsinghpur Pali) during the year 2019-20.

Months 2019-2020	Temp. (In ^{0} C)	pH	Dissolve Oxygen (mg/l)	NH_4 (mg/l)	Nitrates (mg/l)	H_2S (mg/l)	CO_2 (mg/l)	Chlorine (mg/l)	Cyanides (mg/l)
September	21.4	7.0	5.40	1.02	60.1	0.005	3.11	0.006	0.001
October	23.8	7.3	5.50	0.41	63.1	0.006	2.60	0.007	0.002
November	18.4	7.1	5.70	0.32	58.5	0.007	1.11	0.006	0.001
December	18.3	6.7	6.11	0.30	38.5	0.008	0.11	0.006	0.001
January	17.4	6.7	5.31	0.25	30.5	0.007	1.69	0.007	0.001
February	18.01	7.1	4.40	0.60	31.6	0.005	0.80	0.005	0.002
March	19.01	8.3	4.20	0.84	31.7	0.006	1.09	0.006	0.007
April	21.9	8.6	4.10	1.34	22.6	0.005	1.30	0.007	0.008
May	24.4	7.7	3.51	2.11	29.9	0.006	1.31	0.008	0.010
June	25.6	8.5	2.20	2.67	28.7	0.003	0.50	0.011	0.014
July	23.0	8.0	4.40	3.50	23.2	0.001	1.11	0.020	0.020
August	22.4	7.9	5.11	2.40	26.4	0.002	3.60	0.006	0.001

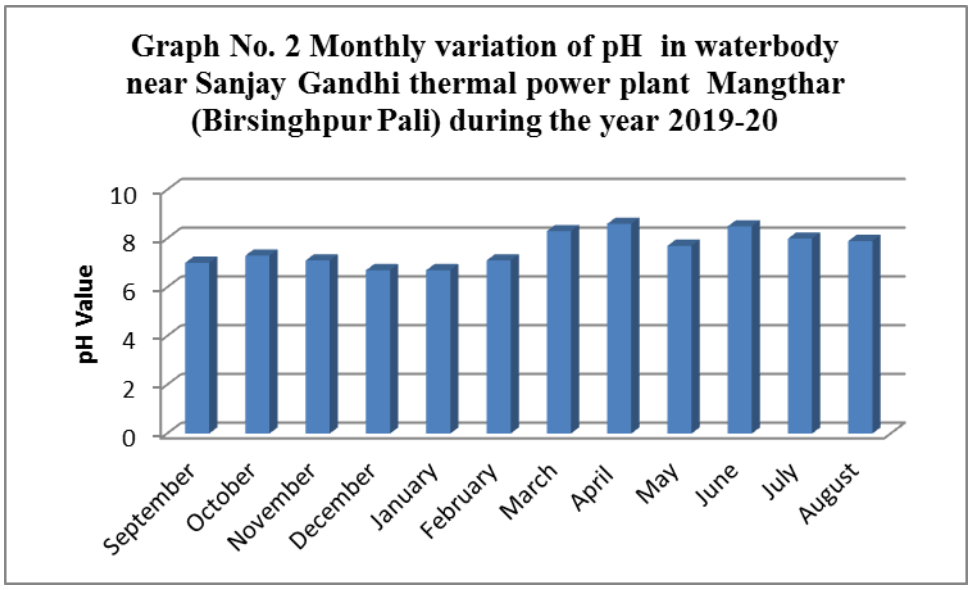
Water temperature (^{0}C):-

Metabolic activities of fishes are closely associated with the temperature fluctuations as they are poikilothermic animals. Previous studies indicate strongly that process of reproductive mechanism has very close association with rise and fall of water temperature. The larger water bodies one arose to change the atmospheric condition around then self. During the presents study period water temperature ranged from 17.4 ^{0}C to 25.6 ^{0}C. Similar results were found by Singhai et al. (1990) Jayabhaye et. al; (2006), Salve and Hiware (2006) and Baghel R.K.(2017), observed that during summer, water temperature was high due to low water level and clear atmosphere. In their original habitat, usually fish tolerate the seasonal fluctuations in water temperature Keeping in mind with above-mentioned facts, study of water temperature is very significant for the proper management of modern pisciculture.



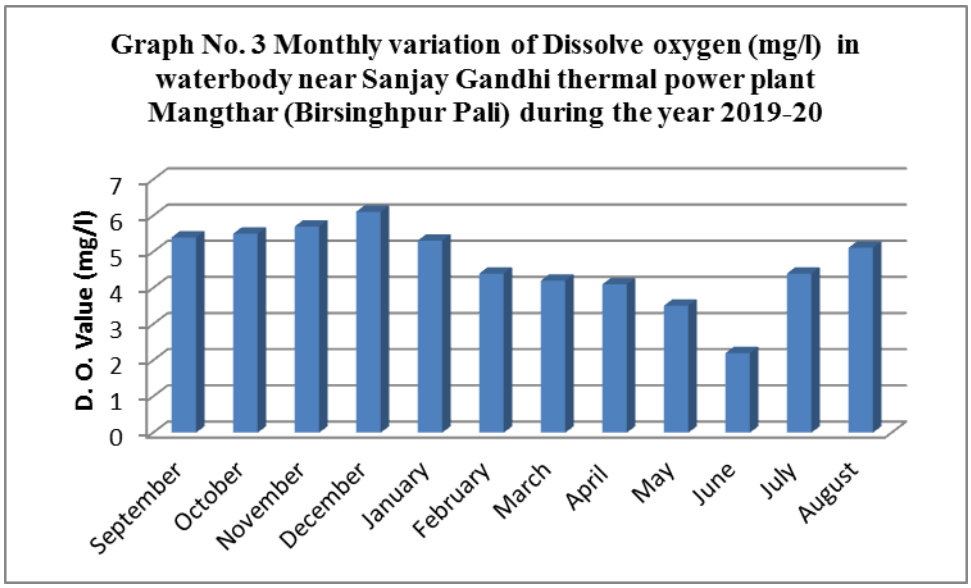
pH:-

pH of the water plays significant role in the regulation of metabolic activities of fish. 6.5-8.5 are the optimum values tolerable to fish species. The pH values ranges from 6.7 to 8.6 . The maximum value was recorded from Summer months and Minimum in the winter season. pH was alkaline throughout study period. Similar results were found Radhika et. al. (2004) and Baghel R. K. (2017). During spring and summer high value of pH has been recorded whereas during rainy seasons and winter value of pH found to be almost normal. Probably factors behind this fact are less quantity and greater release of fly ash during summer and winter and higher quantity of water during rainy season.



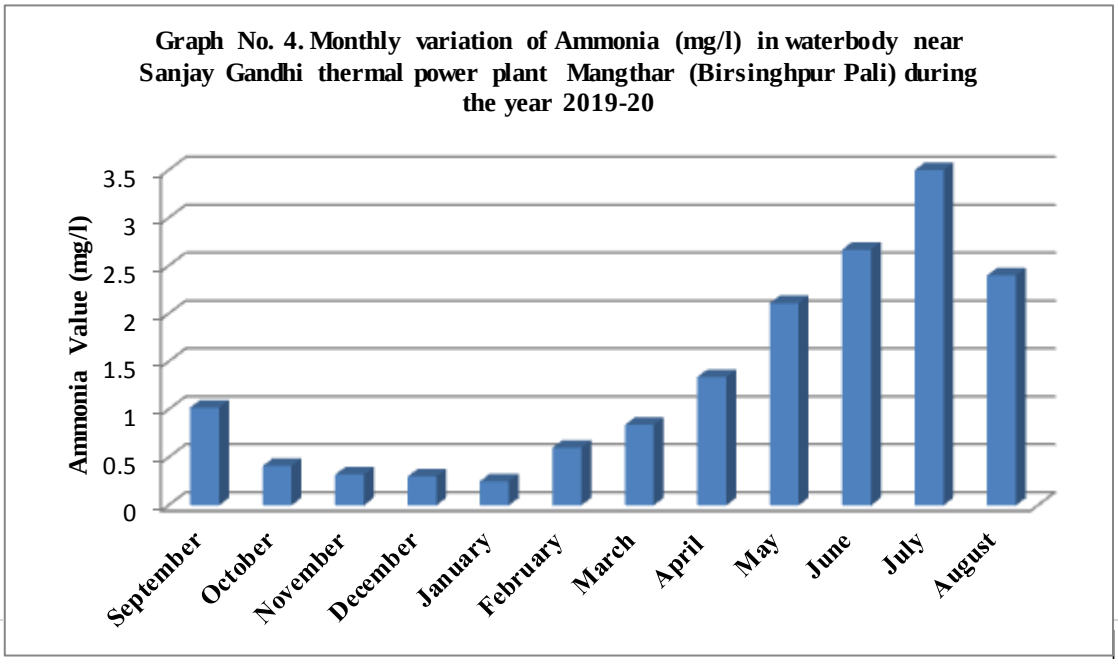
Dissolve Oxygen (mg/l):-

Oxygen enters the water in diffused form from the air and through photosynthetic assimilation of aquatic plants. On the other hand, oxygen is removed by anaerobic decomposition of organic substances, by the oxidation of some organic compounds and through respiration of aquatic organisms. The value of DO fluctuate from 2.2 to 6.11 mg/l. The maximum values were recorded in the month of winter and minimum value in the summer month summer season. Similar trend of dissolved oxygen in fresh water lakes also observed by Bhatt *et al.* (1998), Pandey (1993). The high DO in winter season is attributed to increase in temperature and duration of bright sunlight. The long days and intense sunlight during summer seems to accelerate photosynthesis by phytoplankton's, utilizing CO_2 and giving off oxygen. This accounts for the greater quality of O_2 recorded during summer. The quantity is slightly less during winter as reported by Masood Ahmed and Krishnamurthy (1990).

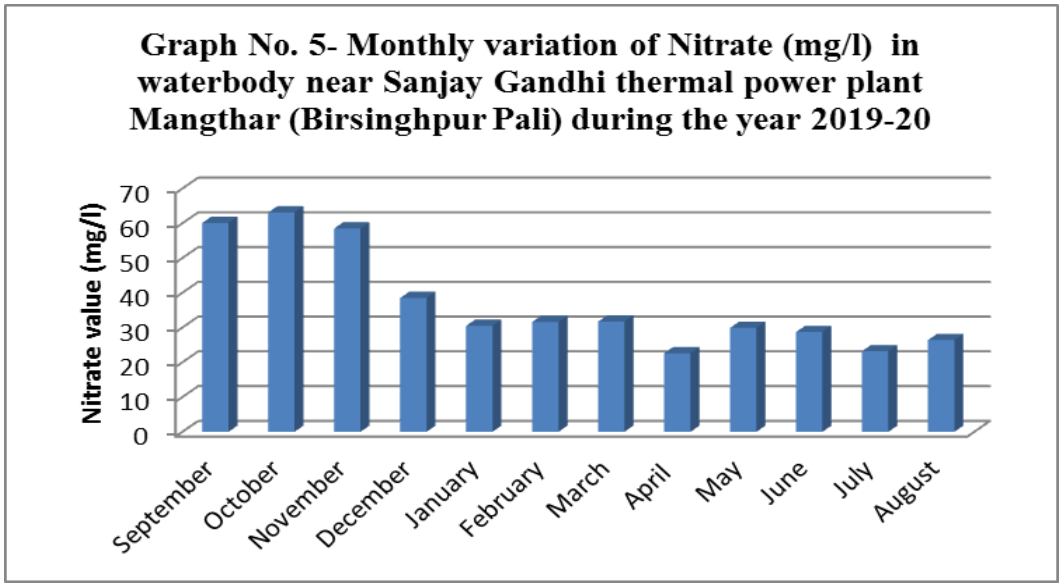


Ammonia (mg/l):-

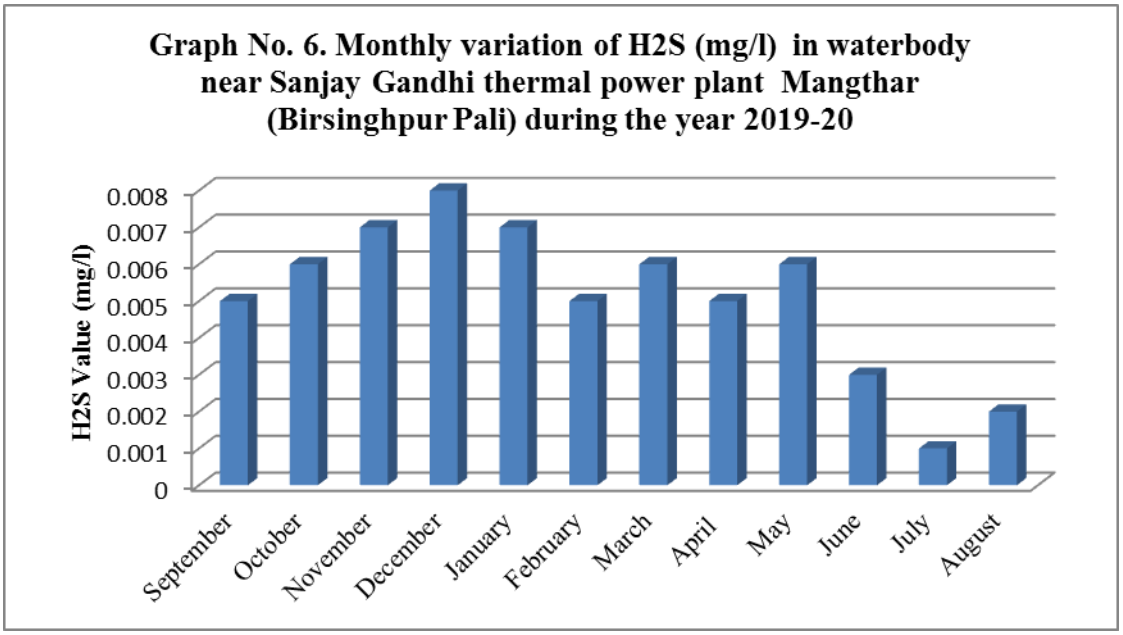
Substance of organic origin, industrial pollution and agricultural pollution are the responsible factor for ammonia pollution in aquatic environment. The experimental site of observation, receives both types of substance le agricultural pollution as well as industrial pollution in the form of fly ash. But the fly ash does not contain the elements responsible for ammonia pollution in large quantity. The Ammonia values ranges from 0.25 to 3.25 mg/l. In water ammonia is present either in dissociated form or non-dissociated form. So far its dissociated form I. e. (NH_4) is concerned; toxicity of non-dissociated form i.e. (NH_3) is greater as it penetrates in to cell wall. It is absorbed by the gills of fish, reaches to blood and finally damages to the cells of brain. Direct impact of ammonia over regulation of reproductive physiology has yet to be investigated. However probably it alters the secretions of biologically active substances from NPO and NLT of the hypothalamus of fish brain responsible for the release of gonadotropin hormone from pituitary. This justifies the poor spawning rate in the fishes collected from experimental site.



Nitrates:-
Nitrogenous chemical fertilizers are the main sources of nitrate pollution in water. Nitrates exhibit variable toxicity to fishes under influence of factors. As a result of nitrate intoxication the oxygen carrying capacity of haemoglobin lowered resulting in low rate of metabolic activities and suffocation leading into death of fish. In present observation values if nitrates were maximum during the month of October-December probably the maximum consumption of fertilizers these days.

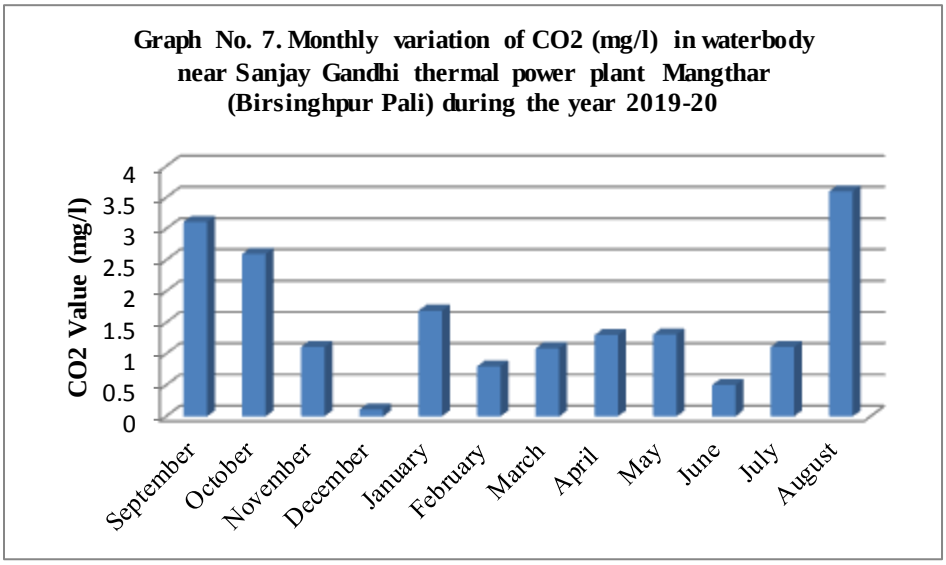


Hydrogen Sulphide:- Hydrogen Sulphide is the main feature of water that receives effluents from industries like metallurgical, chemical works, paper and pulp and tanneries. Hydrogen Sulphide is very toxic to fish. The toxicity of hydrogen Sulphide decreases with increasing water pH as in high pH, the non-dissociated hydrogen Sulphide that is highly toxic converts into less toxic hydrogen Sulphide ions. In present observation the quantity of hydrogen Sulphide recorded is negligible.



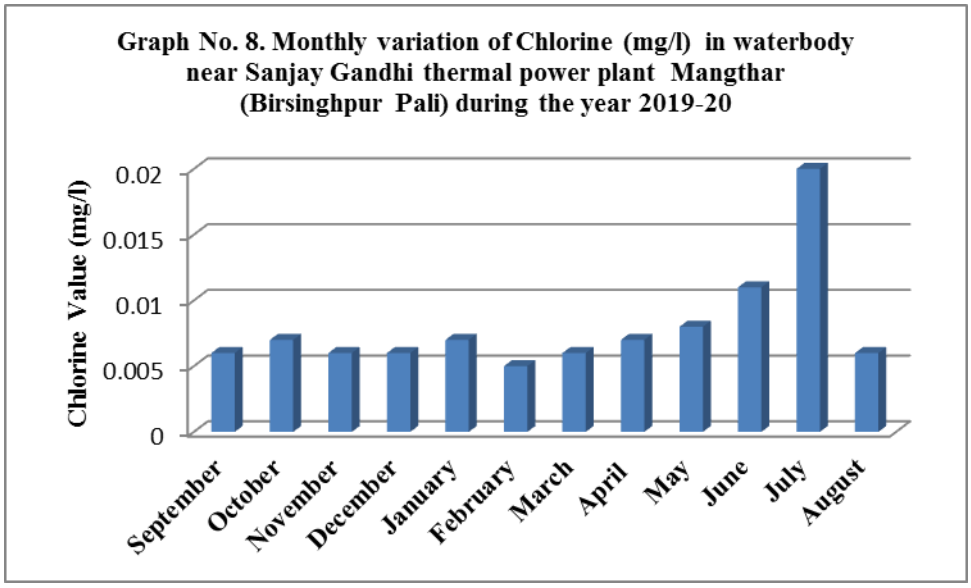
Carbon Dioxide:-

The carbon Dioxide remains in water in molecular state. 10 percent of carbon dioxide forms carbonic acid whereas 90/ remain in the form of fixed carbon dioxide. Both of its form collectively constitutes free carbon dioxide. Action of carbon dioxide on the metabolism of fish is either direct or indirect. The indirect action of carbon dioxide is exerted on the fish through its influence on water pH. High concentration of pH is fatal to the survival of fish. 20 gm per litre free carbon dioxide has been considered maximum permissible free carbon dioxide for trout, 25 mg per litre for carps. The sensitivity of fish to free carbon dioxide declines with increasing acid capacity of water, in present observations the concentration recorded during 2005 at experimental site for carbon dioxide was in between 12,5 to 22.7 mg per litre.



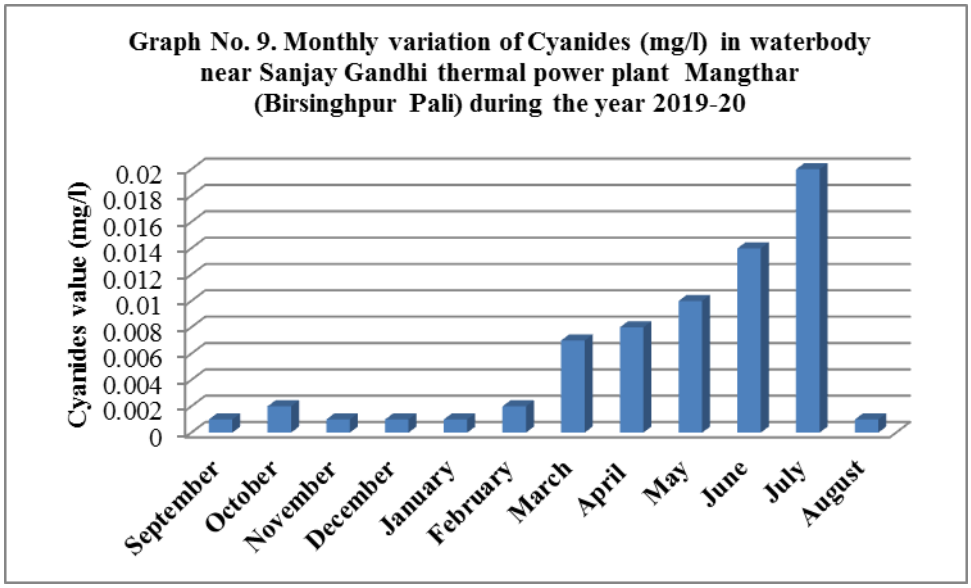
Chlorine: -

Chlorine has the fatal effect over the fish, It damages the gills as well as nervous system of fish. Histopathologically, there is marked dystrophy, nacrobiosis to nacrosis with desquamation of the respiratory epithelium of gills and epidermis of skin has been reported. In present observations the concentration recorded for chlorine at experimental site ranges from 0.004 to 0.02 very close to toxic level of chlorine intoxication.



Cyanides:-

In natural water intoxication of cyanide has never been recorded but in the water where pollution persists with either industrial origin in thermal power origin remarkable quantity of cyanide has been observed. At experimental site during the course of observation large quantity of cyanide has been recorded.



CONCLUSION -:

The assessment of water quality from the three Johila river around the Sanjay Gandhi thermal power plant Mangthar (Birsinghpur Pali) has classified into the water of class 2 - 3 (clean to medium clean fresh surface water resources) according to the value of Surface water quality standards recommended by Pollution Control Department of India (2001). However, all investigated water quality parameters from this study did not exceed both in the Surface Water Quality Standards and the Industrial Effluent Standards of BSI, thereby showing no significant effect on water pollution on the aquatic ecosystem.

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