S. S. College, Jehanabad

Department: Zoology

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Subject: Zoology

Topic: Role of abiotic factors in fish production

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Q. 2. Role of abiotic factors in Fish production.

→ The principal abiotic (Physical) factors necessary for fish culture are given below :-

(a.) Depth :- Depth of a pond has determines the temperature circulation pattern of water and the extent of photosynthetic activity. In shallow ponds ; sunlight warm up the water and facilitates increase in productivity. Generally a depth of about 2 metre is considered congenial from the biological productivity of a pond view point.

(b.) Shore conditions → Longer shore line enhances productivity due to increase in the production of vegetation and phytoplanctons. But shady shore trees, surface and submerged plants and turbidity due to silt, lower the productivity due to light obstruction.

(c) Pressure and movement of water → Most of the fishes can survive in deep waters due to increased pressure and variations in the presentage of minerals. Movement of water due to waves, currents and renewal favours biological productivity of the fish ponds, provided motion not too rapid. Rapid movement of water leads to erosion of soil and increased turbidity effecting fish production.

(b) Temperature :- water temperature generally depends upon climate, sunlight and depth. The intensity and seasonal variations in temperature of a water body have a great bearing upon its productivity. All metabolic and physiological activities and life processes such as feeding, reproduction, growth, movement and distribution of fishes are greatly influenced by water temperature.

Warm water fishes grow best at temperature between 25°C to 32°C.

Therefore, requirements of fishes are more critical in warm water than in cooler water.

Fishes of temperate region can survive under ice in winter but those of tropics can not stand such low temperature. Indian major carps can thrive well in the temperature below 16.7°C and above 39.5°C prove fatal to them. The upper limit of temperature tolerance of air breathing fishes like Anabas, Channa, Heteropneustes, Clarias etc. lies between 39°C-41°C. Fishes have good tolerance to sudden changes in temperature or often a sudden change in temperature as little as 5°C may cause stress or even kill the fish. Fish readily tolerate gradual changes in temperature.

The reproduction in fishes is well associated with certain temperature changes.

The action of temperature on growth which is effective between variable limits from one species to major carps grow moderately between 18° to 30°C feeble between 5°C to 17°C and not at all below that.

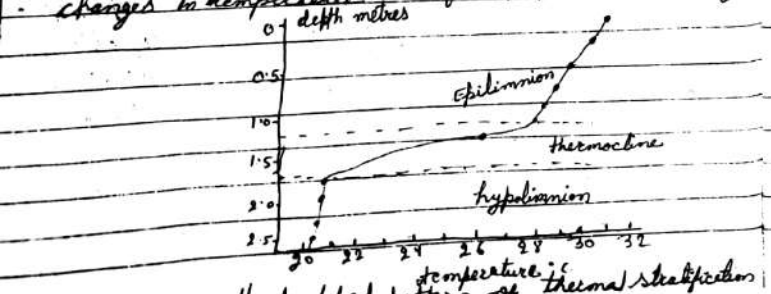

Fig. A well developed pattern of thermal stratification temperature in

(c) Light :- Light penetration in water depends upon the factors like the intensity of light, prevailing turbidity which is measured optically and presents the resultant effect of several factors such as suspended clay and silts and dispersion of planktonic masses, the depth of ponds, presence of shady plants along the bank of water and presence of bottom feeder fishes etc. in the pond.

Availability of light energy to a fish pond greatly influences its productivity.

The photoperiod control the gonadal maturity and this information is introduced into hormonal output via hypothalamic releasing factors and finally the hypophysis, which releases the gonadotropin hormones. The role of the different photoperiods on reproductive biology of certain tropical freshwater fishes have been made by one of the authors (K. Pandey et al. 1984, 85, 86).

Pandey and Agrawal (1988, 1990) observed the impact of various Pesticides on the testicular and amylase activity of a freshwater fresh calisa fasciatus.

(f) Turbidity and colour :-

Turbidity is the term for the suspended dirt and other particles in water. Turbidity in natural waters restricts the penetration of light thereby reducing the photosynthetic activity hence act as a limiting factor for productivity. Turbidity can be a problem particularly in shallow ponds. The agricultural gypsum is usually required to reduce turbidity in fish ponds.

Control of turbidity :- Turbidity caused by suspended silt and clay particles can controlled by application of hydrated lime according to Boyd (1990) among filter alum, hydrated lime, ferric sulphate, and agricultural gypsum. The most effective chemical to remove high turbidity is filter alum [$Al_2(SO_4)_3 \cdot 14H_2O$]

(g) Salinity :- The term Salinity to the total concentration of all the dissolved ions in a natural water expressed in mg/l or PPm Indicates that there is a part by weight of a substance in 1 million parts of the solvent. A water sample with 1 ppm salinity would contain 1 mg of ions and 999,999 ml of water. For all practical purposes 1 ppm equals 1 mg per litre.

The osmotic pressure of water increases with increasing salinity.

The degree of salinity in water reflects geological and hydrological conditions. Surface waters in areas of high rainfall where soils are continually leached usually have low salinity (10-250 mg/l). Salinities in excess of 45,000 mg/l are difficult for even marine species to tolerate.

CO_2 :- The presence of CO_2 in aquatic bodies can be attributed to -

(i) Atmosphere (ii) Respiration (iii) Bacterial decomposition (iv) Inflowing ground water (v) within the water itself in combination with calcium and magnesium. The free CO_2 which is necessary to retain calcium in solution in the form of $CaCH(CO_3)_2$ is called the equilibrium of free CO_2. This free CO_2 is contained in half bound state as H_2CO_3 and bound state as HCO_3 are bound state as CO_3. Both HCO_3 and CO_3 are together called combined CO_2.

CO_2 in natural water is reciprocally related to acid Base relationship in the medium. Rain water contains nearly 0.6 mg/l of dissolved CO_2 and only a small fraction of CO_2 form carbonic acid, which is a weak organic acid and soon dissociates into bicarbonates and carbonates ions with consequent release of hydrogen ions.

$CO_2 + H_2O \rightarrow H_2CO_3$ (carbonic acid)

$H_2CO_3 \rightarrow H^+ + HCO_3^-$

$HCO_3^- \rightarrow H^+ + CO_3^-$

High concentration of CO_2 can be tolerated by fishes, although fishes avoid levels as low as mg/l. Most species may survive in water containing upto 60 mg/l CO_2 provided dissolved O_2 concentration are high. Particularly high concentrations of CO_2 occur in ponds after phytoplanktons die-off after destruction of thermal stratification and during cloudy weather.