

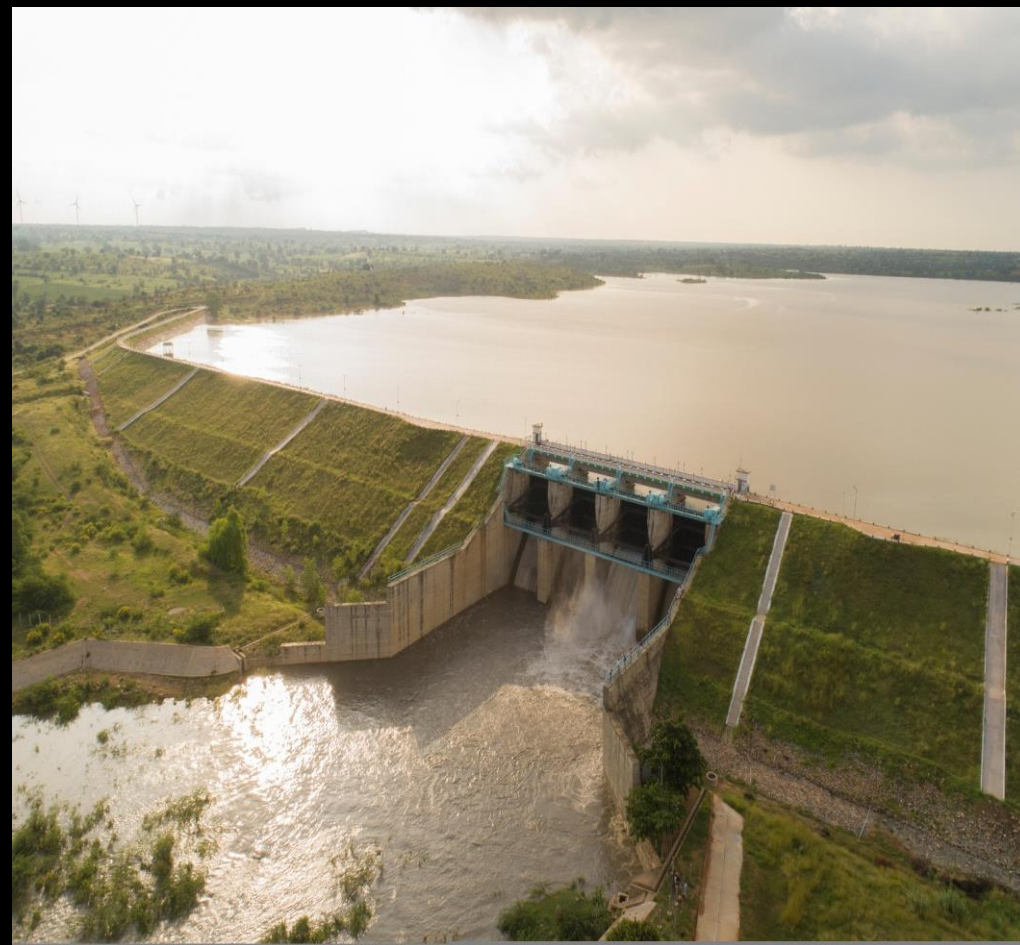
Reservoirs; An Introduction



Zahoor Mushtaq

RESERVIOR

- **Man-made lakes**
- **Created by impounding river water**
- **Purpose: irrigation, power generation, flood control, industries**
- **High biogenic production, potential**
- **Constitute one of the most important resources for inland fisheries development in the country**



- **Ecology of the reservoir differs from that of a river or lake, and the reservoirs form an important source of fisheries**
- **Reservoirs constitute the single largest inland fisheries resource in terms of resource size and production potential**
- **This potential has not been fully exploited in India**
- **They have to play major role in order to make significant improvement in inland fish production of the country**
- **Reservoirs are located in hilly regions as well as in plains**

CLASSIFICATION OF RESERVOIRS

- **Fish Seed Committee of the Government of India (1966) termed all water bodies of more than 200 ha in area as reservoirs**
- **In the former USSR, reservoirs up to 10,000 ha area are assigned the status of small reservoirs**
- **Whereas in USA they may range from 0.1 ha to several ha (Bennet, 1970)**
- **In China, where reservoirs are classified on the basis of storage capacity, those holding more than 100 million m³ of water are classified as large reservoirs, 10 to 100 million m³ as medium and 0.1 to 10 million m³ as small reservoirs**

Classification.....contd.

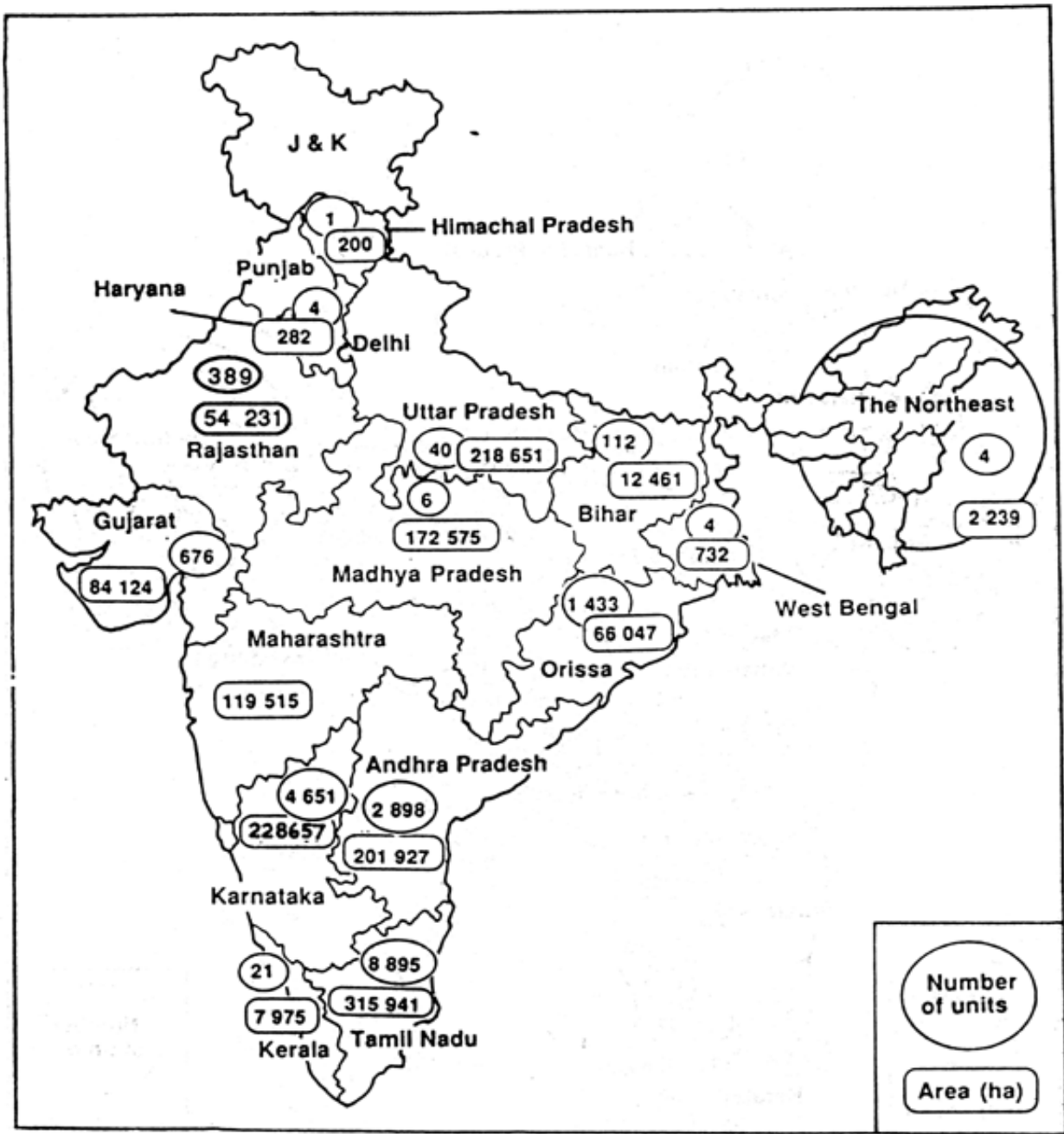
→ Reservoirs as per the records of the Government of India are classified generally as (Sarma, 1990):

- **Small**
- **Medium**
- **Large**

→ All man-made impoundments created by obstructing the surface flow, by erecting a dam of any description, on a river, stream or any water course, have been reckoned as reservoirs

Small reservoirs

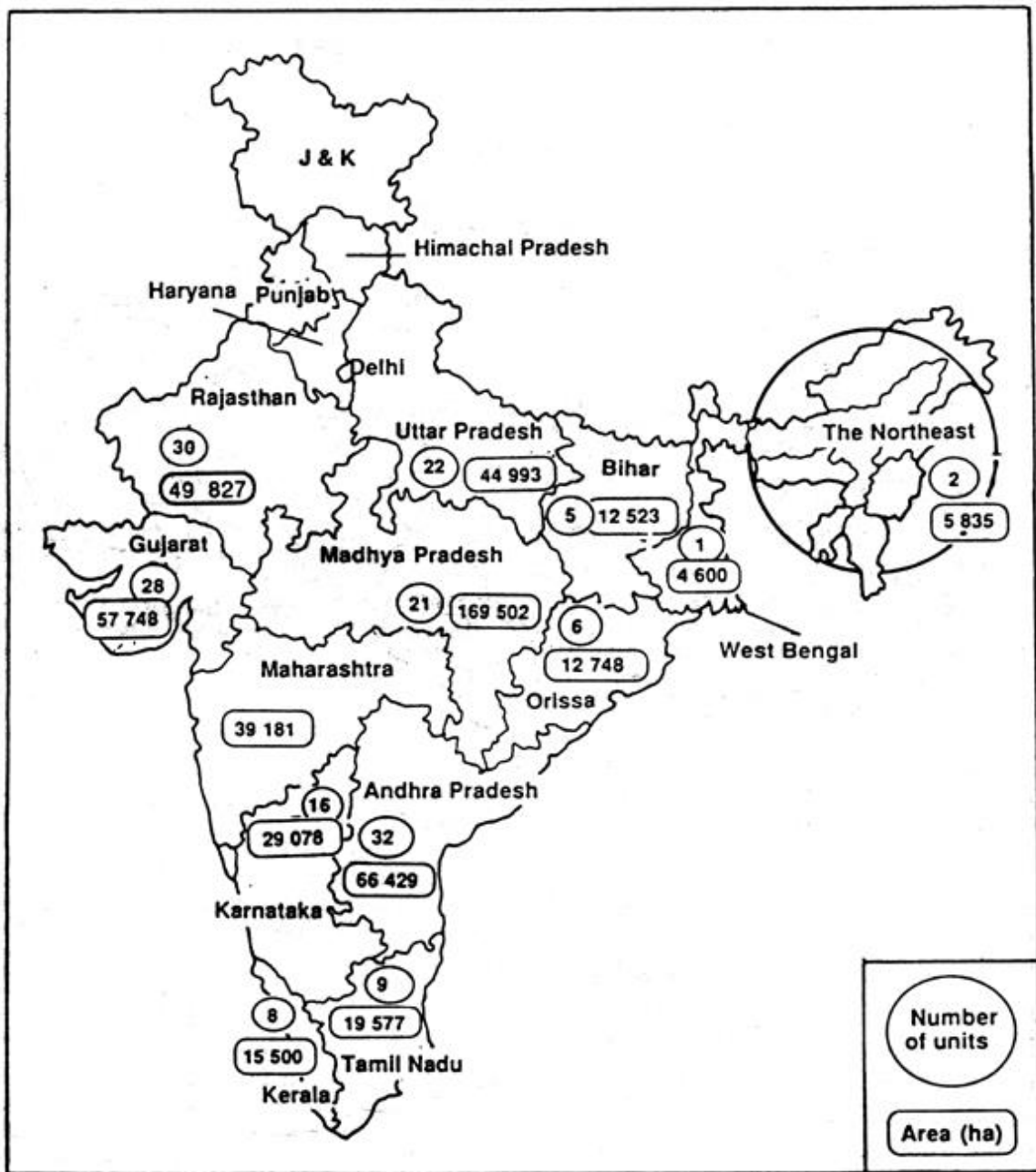
- ✓ Area; **less than 1000 ha**
- ✓ Number; **19134**
- ✓ Area; **1.48 million ha**
- ✓ Highest number of small reservoirs; **Tamil nadu: 8895 units**



Distribution of small reservoirs in India

Medium reservoirs

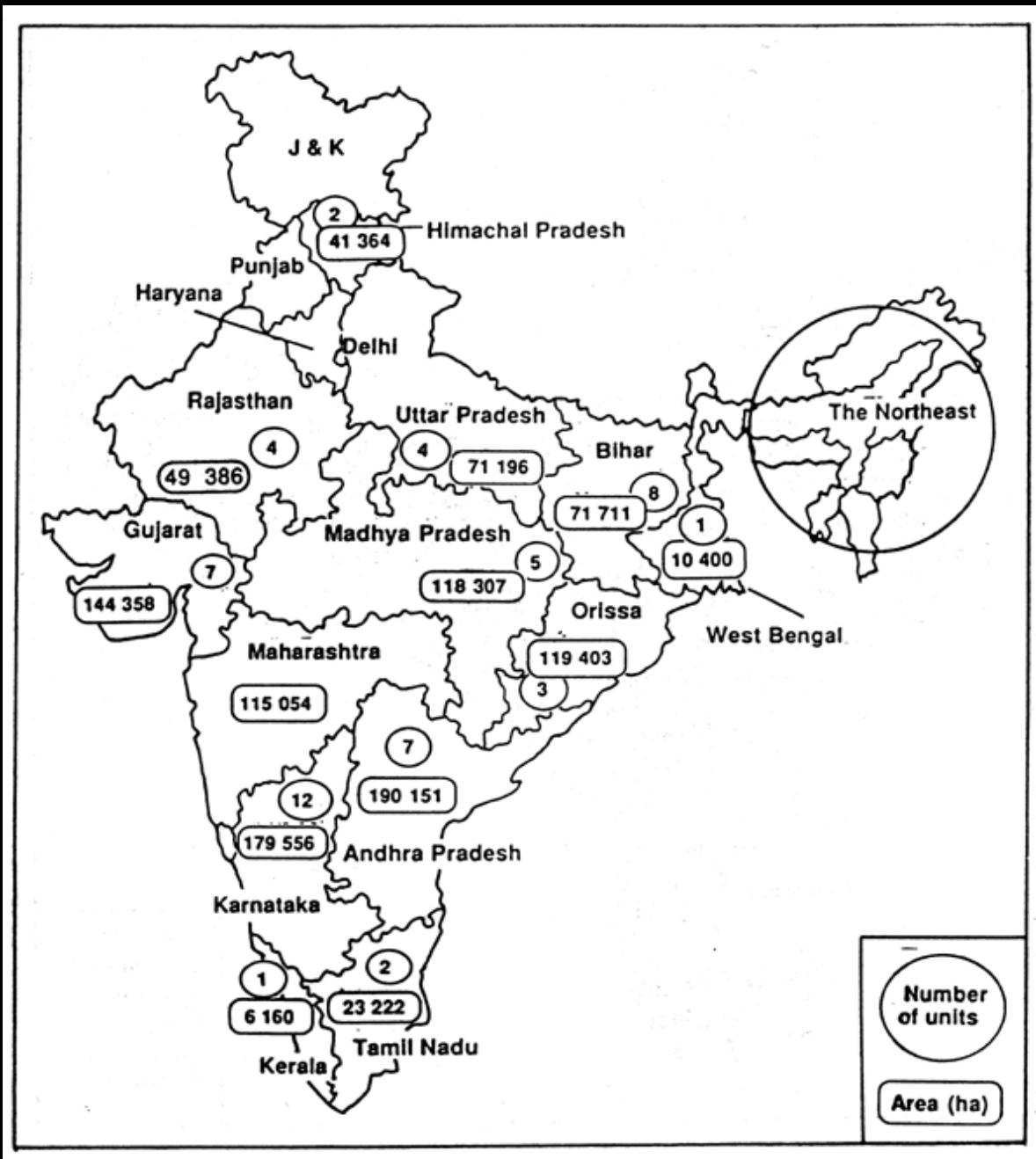
- ✓ Area; **1000-5000ha**
- ✓ Number; **180**
- ✓ Area; **0.507 million ha**
- ✓ **Highest number of medium reservoirs; Andhra Pradesh: 32 units but Madhya Pradesh has the highest area of these reservoirs**



Distribution of medium reservoirs in India

Large reservoirs

- ✓ Area; **>5000ha**
- ✓ Number; **56**
- ✓ Area; **1.60 million ha**
- ✓ **Highest number of medium reservoirs; Karnataka: 12 units but Andhra Pradesh has the highest area of these reservoirs**



Large reservoir in India

EXAMPLES OF SOME LARGE RESERVOIRS

- Nagarjuna Sagar.....**Andhra Pradesh**
- Srisaïlam.....**Andhra Pradesh**
- Somasila.....**Andhra Pradesh**
- Gobind Sagar.....**Himachal Pradesh**
- Maharana Pratap Sagar.....**Himachal Pradesh**
- Stanley reservoir.....**Tamil nadu**
- Shanti Sagar.....**Karnataka**
- Minimata Hasdeo Bongo.....**Chhattisgarh**

- Overall, India has **19 134 small reservoirs**
- **180 medium reservoirs**
- **56 large reservoirs of the country have an area**
- Thus, the country has **19 370 reservoirs covering 3 153 366 ha**

RESERVOIR ECOSYSTEM

- **Man-made ecosystem**
- **Combination of both lacustrine and fluvial systems**
- **The riverine and lacustrine characters coexist in reservoirs**
- **For example, the lotic sector of the reservoir sustains a fluvial **biocoenosis**, whereas the lentic zone and the bays harbor lentic communities**
- **In India, most of the precipitation takes place during the monsoon months which contribute substantially to the surface flow**

- **During this period, due to a heavy inflow of water into the system, all outlets of the dam are usually opened, resulting in total flushing**
- **This process dislodges a considerable part of the standing crop of biotic communities at the lower trophic level and disturbs the **natural primary community succession****
- **The sudden level fluctuations also affect benthos by exposing or submerging the substrata benthos by exposing or submerging the substrata**

- **The ecology of reservoirs is radically different from that of the parent rivers**
- **Dams alter river hydrology both up- and downstream of the river**
- **The obstruction of river flow and the consequent inundation trigger off sudden transformation of lotic environment into a lentic one**
- **During the months of heavy inflow and outflow, the whole reservoir mimics a lotic environment whereas in summer, when the inflow into and outflow from the reservoir dwindle, a more or less lentic condition prevails in most parts of it**

LIMNOLOGICAL PROFILE OF INDIAN RESERVOIRS

- **Nutrient rich**
- **Peninsular reservoirs have narrow range of air and water temperature fluctuations during different seasons. A phenomenon which prevents **thermal stratification****
- **Reservoirs in the North-East and western ghats are oligotrophic due to the poor nutrient status of the catchment soils**

WATER TEMPERATURE

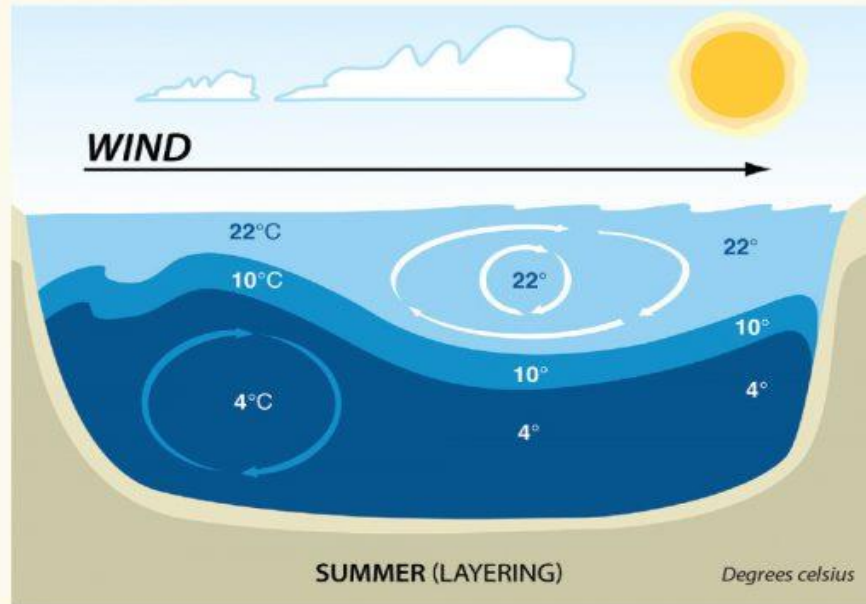


ILLUSTRATION: MICHIGAN SEA GRANT

EPIIMNION

The surface layer of water that is constantly mixed by wind and waves and is warmed by the sun, from late spring to late fall.

METALIMNION

The middle layer characterized by a steep gradient in temperature and demarcated by the regions above (epilimnion) and below (hypolimnion). The metalimnion is the barrier that prevents mixing and heat exchange between the epilimnion and hypolimnion.

HYPOLIMNION

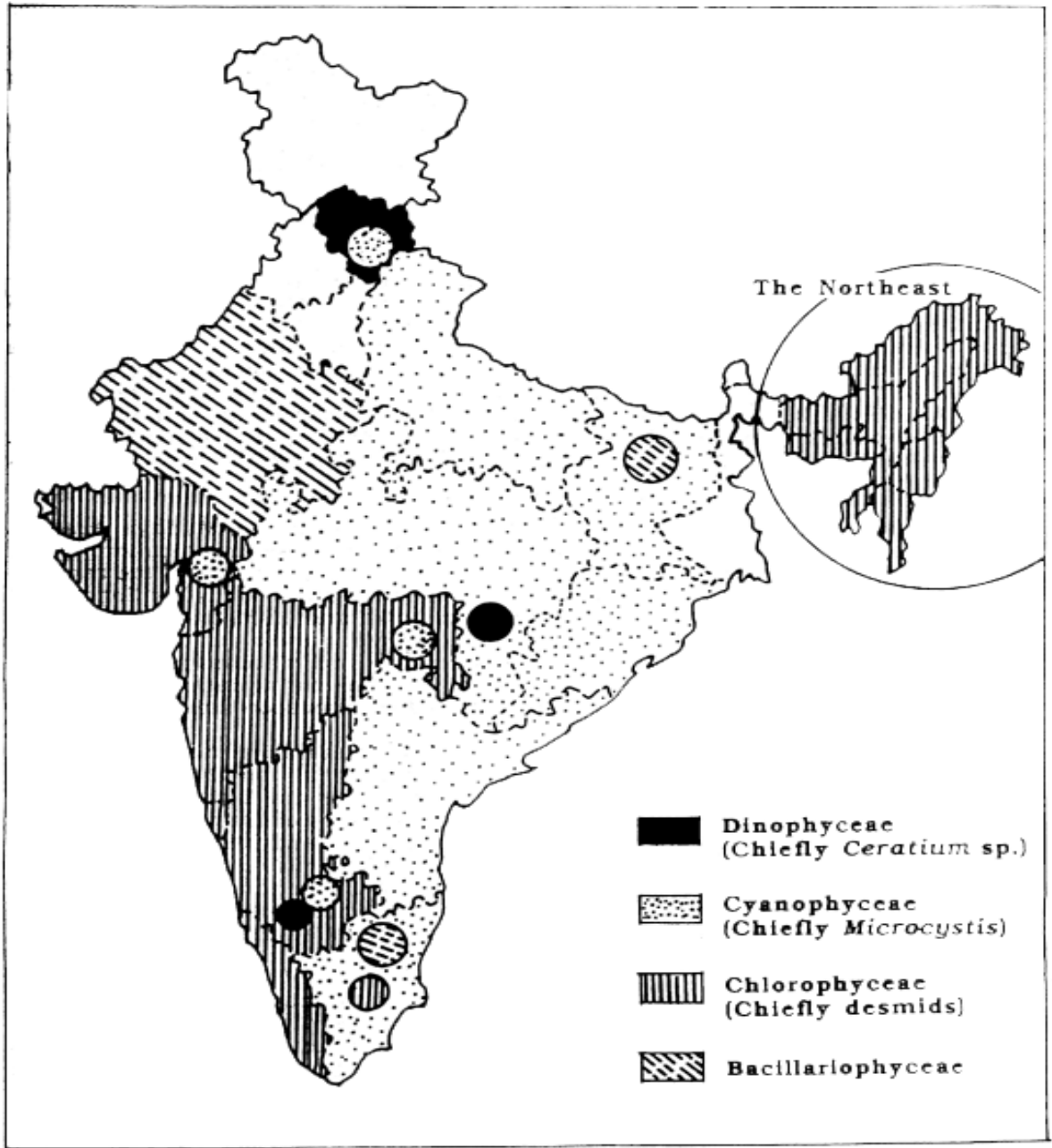
The deepest layer of uniformly cold water that does not mix with the upper layers and has low circulation. The colder water within the hypolimnion is at its maximum density at a temperature of 39.2° F (4° C).

THERMAL STRATIFICATION

Thermal stratification is a seasonal phenomenon that occurs from late spring to late fall in temperate regions. In the summer, the upper layer of water in the Great Lakes (epilimnion) is warmed significantly by the sun. Cooler water separates, forming two additional layers (metalimnion and hypolimnion) that are heavier or denser. During the winter, there is no stratification as the lake cools, and the overall temperature of the lake is more uniform.

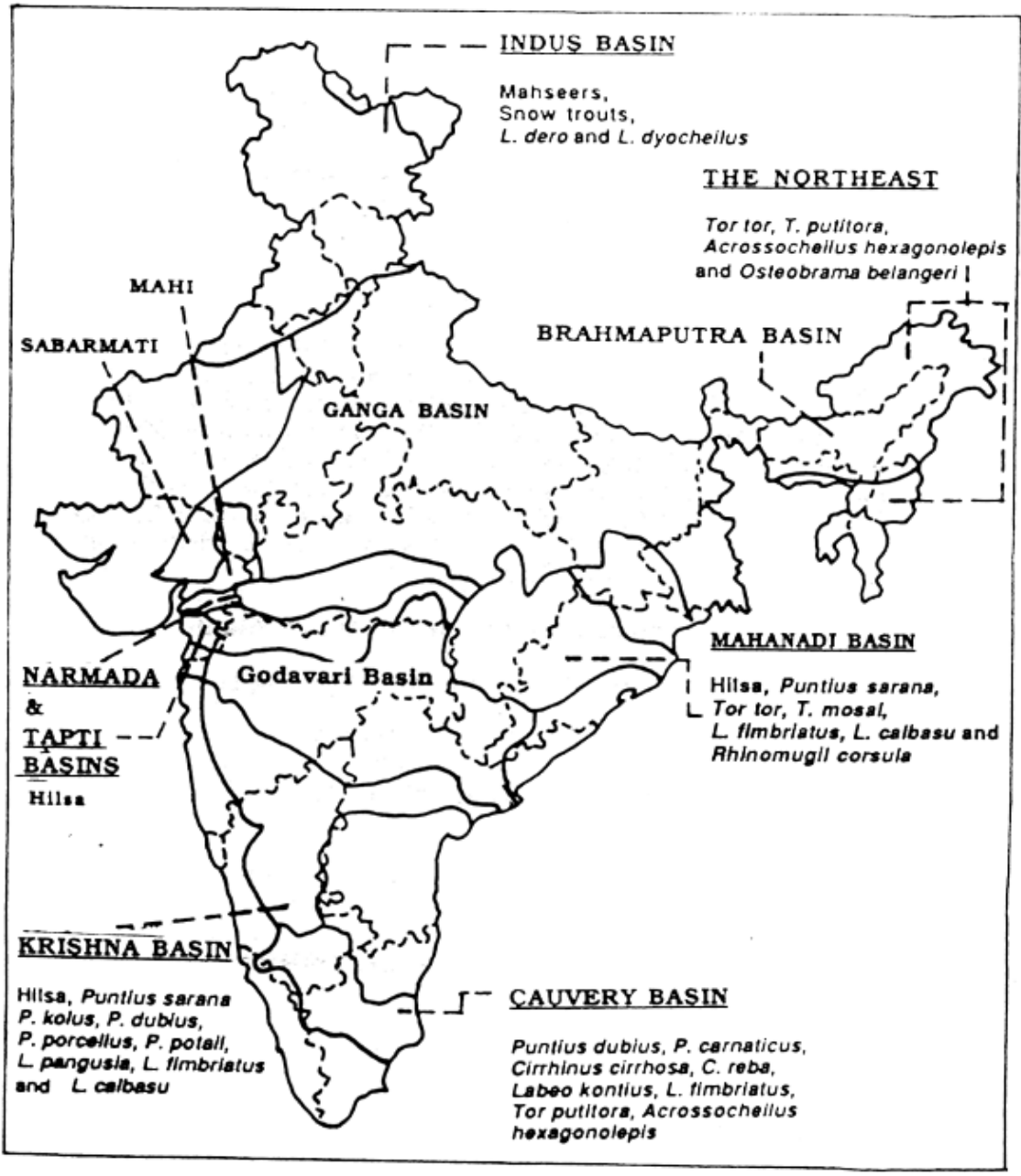
BIOTIC COMMUNITIES OF RESERVOIRS

- **Rich plankton community is the hallmark of Indian reservoirs**
- **Blue-green algae is form the main stage of planktonic community**
- **Overwhelming presence of cyanobacteria *Microcystis aeruginosa* in Indian reservoirs is remarkable**



Dominant phytoplankton in reservoirs (State-wise)

- **Rocky bottom and water level fluctuations adversely affect the benthic communities**
- **Ichthyofauna of the reservoir represent the fauna of the parent river system**
- **At the time of impoundment the fish diversity suffers setback as lotic habitat transfers into lentic habitat**
- **Many species perish and few only adapt to the changed situation**



Indigenous fish species affected by reservoir formation in India

ICHTHYOFAUNA

- **Despite the cataclysmic faunistic changes associated with the impoundment, Indian reservoirs preserve a rich variety of fish species**
- **On the basis of studies conducted so far, large reservoirs, on an average, harbour 60 species of fishes, of which at least 40 contribute to the commercial fisheries**
- **The fast growing Indo-Gangetic carps, popularly known as Indian major carps, occupy a prominent place among the commercially important fishes**
- **Number of exotic species have contributed substantially to commercial fisheries**

Broad categorisation of the species is as follows:

- The Indian major carps: *Labeo rohita*, *L. calbasu*, *L. fimbriatus*, *Cirrhinus mrigala*, *Catla catla*
- The mahseers : *Tor tor*, *T. putitora*, *T. khudree*, *Acrossocheilus hexagonolepis*
- The minor carps including snow trout and peninsular carps: *Cirrhinus cirrhosa*, *C. reba*, *Labeo kontius*, *L. bata*, *Puntius sarana*, *P. dubius*, *P. carnaticus*, *P. kolus*, *P. dobsoni*, *P. chagunio*, *Schizothorax plagiostomus*, *Thynnichthyes sandkhol*, *Osteobrama vigorsii*
- Large catfishes: *Aorichthys aor*, *A. seenghala*, *Wallago attu*, *Pangasius pangasius*, *Silonia silondia*, *S. childrenii*

- **Featherbacks** : *Notopterus notopterus*, *N. chitala*
- **Airbreathing catfishes**: *Heteropneustes fossilis*, *Clarias batrachus*
- **Murrels**: **Channa marulius**, *C. striatus*, *C. punctatus*, *C. gachua*
- **Weed fishes**: *Ambassis nama*, *Esomus danrica*, *Aspidoparia morar*,
Amblypharyngodon mala, *Puntius sophore*, *P. ticto*, *Oxygaster bacaUa*, *Laubuca laubuca*, *Barilius barila*, *B. bola*, *Osteobrama cotio*, *Gadusia chapra*
- **Exotic fishes** : *Oreochromis mossambicus*, *Hypophthalmichthys molitrix*, *Cyprinus carpio specularis*, *C. carpio commun*, *Gambusia affinis*, *Ctenopharyngodon idella*

Positive/augmentative factors
High shoreline development (coves, bays, bays etc.)
Low mean depth (less than 18 m)
Existence and extent of marginal vegetation
Optimum nutrient levels
Nutrient enrichment during floods
Moderate to long growing season
High frequency of phytoplankton blooms
Moderately developed macrophyte community
Periphyton abundant
Well established plankton and benthos
Tree and bush cleared
Conditions permitting passage of migratory fish
Introduction of fishes adapted to lentic conditions
Employment of modern fishing gear and optimization of fishing effort
Enforcement of fishery regulations

Negative/reductive factors
Low transparency in floods due to inorganic turbidity.
High mean depth
Erosion in the reservoir water shed area
Reduction of quantity of water flowing into reservoir
Large water level fluctuations creating large aridal (barren littoral)
Low level of dissolved oxygen in parts of hypolimnion
Pollution in the reservoir water- shed
Phytoplankton biomass mainly blue greens
Relative low fish species diversity indicating low stability and a potentially low resilience to stresses
Unbalanced fish populations favouring predatory and trash species
Low abundance and diversity of terrestrial vegetation hence early successional stage
Relatively low environmental heterogeneity
Low diversity of plankton and benthos
Low diversity of aquatic macro- phytes
Exposure of fish nests during drawdowns

Abiotic and biotic factors affecting productivity of reservoirs at various trophic levels



THANK YOU