

ESTUARINE FISHERIES

Dr. D. K. Paul

Associate Professor & Course Coordinator
M. Sc. Environmental Science & Management
Department of Zoology, Patna University
Member, SEAC (for EIA), Bihar, Constituted by
MoEF & CC, Govt. of India
dkpaul.pat31@gmail.com

Definition

- It has been described as ‘an arm of the see’ , ‘a frith or firth’ , “ a narrow passage, or the mouth of a river or lake’, where the tide meets the current” [Webster’s New 20th century Dictionary].
- Every and Stevenson [1957] consider an estuary as the wide mouth of a river, or arm of the sea, where the tide meets the river currents.
- An estuary is a semi-enclosed coastal body of water which has a free connection with the open sea and within which sea water is measurably diluted with freshwater derived from land drainage (D W Pritchard , 1967)

Definition

- According to [Ketchum \(1951\)](#) “An estuary may be defined as a body of water on which the river water mixes with and measurable dilutes sea water”.
- In brief , an estuary is the ‘ecotone’ or ‘buffer zone’ between freshwater of the stream and salt water of the sea.

Classification and Types of Estuaries

Estuaries are classified variously on the basis of

- geomorphology ([Pritchard, 1967](#));
- on the patterns of their water circulation ([Bowden, 1967](#)) and
- on the basis of ecology ([Carriker, 1967](#)).

Generally, the estuaries may be divided into two main types:- **1. Open Estuary**

2. Embanked Estuary

1. Open Estuary

- An open estuary is found at the mouth of river and remains connected with the sea. It is in the form of a lake, containing brackish water.
- An open estuary may be perennial because of being filled with the river water all the year round (e.g. those found on Gangetic delta) or it may be a seasonal type when like the river mouth it dries up during the summer and a land bar isolates the estuary from the back water of the sea.
- Ex. **Chilka Lake**

2. Embanked Estuary

- The embanked estuary is a confined one of brackish water, being exposed to sea only at low tides or else it may remain surrounded by a continuous chain of barrier islands.
- These are formed by embanking the land formed by continuous silting from rivers and used for agricultural purposes.
- Ex Sundarbans and other parts of West Bengal where embanked brackish water fisheries exist .

Ecological Characteristics of Estuary

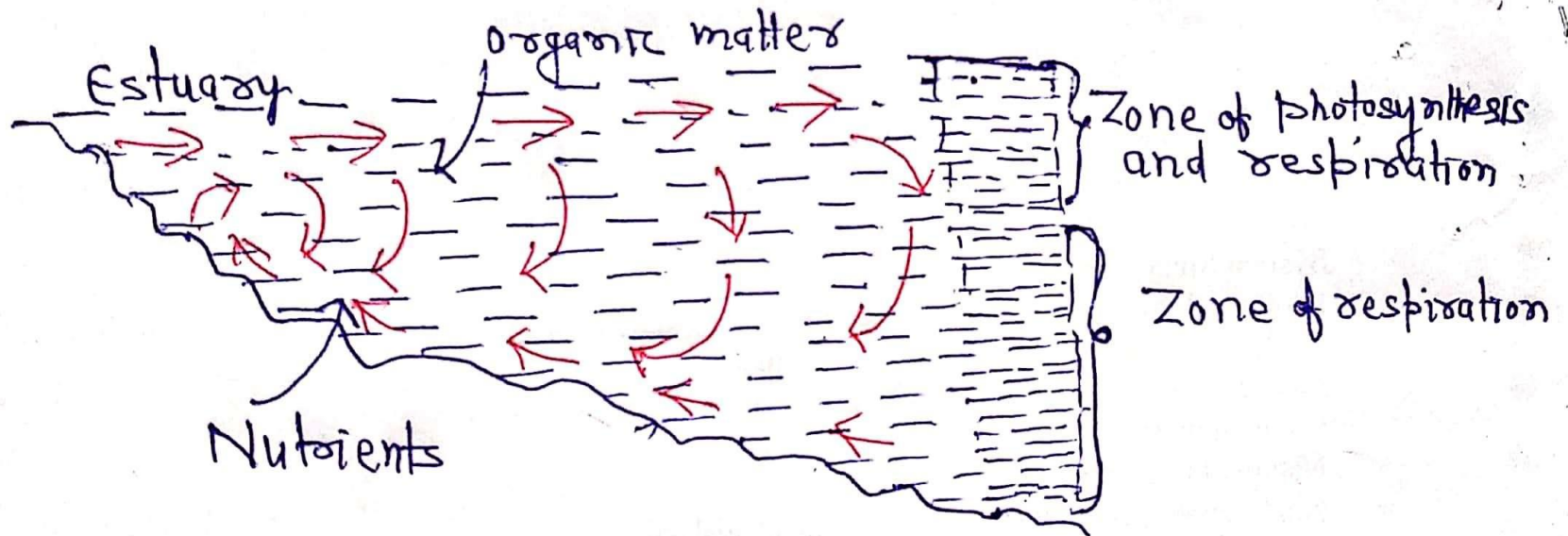
The salinity of estuarine water is subject to reasonable fluctuations and the gradient may be distributed either vertically or horizontally. Some of the **important characteristics** determining the productivity of brackish water are as follows:-

1. The water is a mixture of fresh and marine water, hence **saline**. The salinity though fluctuate seasonally, it remains always high in comparison to fresh water.
2. The pH value ranges from **7.5 to 8.3** .

Ecological Characteristics of Estuary

3. The fresh water being lighter than saline water, tends to mix with latter. As such the currents in water are produced and nutrients of the estuary are repeatedly mixed in a vertical movement of water, depending upon the flood-tide volume of water entering the estuary. The zone bounding the fresh and marine water causes horizontal turbulence resulting in **eddy formation**. These eddies contain most of the nutrients of the estuary.

Fig: Showing current pattern and nutrient circulation in estuary



Ecological Characteristics of Estuary

4. The source of the nutrients are the inorganic and organic matters brought in by the river and tidal waters of the ocean. Besides, depending upon the shallowness and penetration of light, the estuary has its own photosynthetic zone comprising producers.
5. The flora consists of phytoplankton (of Myxophyceae and Chlorophyceae), macrophytes, sea weeds, marsh grasses etc.
6. The fauna is mostly of marine origin consisting of zooplankton, various migrant species such as shrimps eels, mullets and salmon etc.
7. Circulating water brings the organic matters down to the bottom and plant nutrients from bottom to surface to enhance the productivity.

Ecological Characteristics of Estuary

6. Shallow estuaries have well oxygenated water while the deeper ones have only the surface layer well oxygenated.
7. **Salinity of the estuary determines its fish fauna.** The percentage of salinity, however depends upon influx of tidal water and evaporation, both increasing the soil contents and so the salinity.
8. Fishes inhabit estuary according to their tolerance range of salinity. **On the basis of tolerance of salinity, fishes are of 3 types:**

Ecological Characteristics of Estuary

- **Oligohaline fishes** – are the fresh water fishes, which can tolerate salinity upto 1% and therefore inhabit the river head.
- **Euryhaline fishes** – can tolerate salinity from 5 to 30 % and are regarded as truly estuarine fishes.
- **Marine fishes** – include those forms which migrate from the sea and are able to tolerate lower salinity for a brief time during their life.

Principal Estuaries

Important Estuaries of East coast River system

- i. Hooghly- Matlah estuary
- ii. Mahanandi estuary
- iii. Godavari east coast estuary
- iv. Krishna estuary
- v. Pulicat lake
- vi. Cauvery embanked estuary
- vii. Adyar estuary
- viii. Vellar estuary
- ix. Valgai and other estuary
- x. Chilka estuary

Principal Estuaries

IMPORTANT ESTUARIES OF WEST COAST RIVER SYSTEM

- i. Narmada estuary
- ii. Tapti estuary
- iii. Nethravathi Gurupur estuary (South Karnataka)
- iv. Choodapur estuary (S.K)
- v. Kalihandi estuary

Principal Fisheries

(A) Migratory Fishes

- Estuarine fishery principally comprises various marine fish species, which can tolerate variations in salinity (euryhaline).
- It also includes many catadromous and anadromous species of eastern coast, which migrate for spawning to the sea or to upstream in fresh water respectively.
- The chief anadromous fishes include the *Hilsa ilisha*, *Polynemus paradiseus*, *Sillaginopsis panijus* and *Pama pama* and the catadromous fishes, the *Tachysurus jella*, *Osteogeneiosus militaris*, *Polynemus indicus* and *P. tetradactylus* migrating to spawn in the brackish waters of estuaries.
- Some catadromous species spawning in saline areas of estuaries include the fish *Pangasius pangasius* and the prawns *Macrobrachium rosenbergii*.

Principal Fisheries

(B) General Fishes

- Principal groups of resident estuarine species include generally the clupeids, herrings, anchovies, sprats, mullets, catfishes, thread fins, perches and prawns.
- The half beaks, gar fishes, eels, sharks, rays, flat fishes, oysters and lime shells also contribute to lesser extent to the fisheries of estuaries.
- The coastal waters of Narmada, Tapti, Cauveri, Pennar, Godavari, Krishna and Mahanadi afford large quantities of *Hilsa ilisha*.

(C) Clupeids

- These include *H. ilisha*, *Nematolosa masus*, *Pellona sp.*, *Setipinna sp.*, *Elops*, *Megalops* and cyprinoids etc. Of these ,the fish *H. ilisha* contributes a regular fishery .
- The main fishing season is after the monsoon rains but the fishes are also caught in winter months. Fishes are caught by Sangha jal , gill nets, seine nets and the bag nets.
- They are salted and dried under the sun for consumption in the interior parts of the country.

(D) Cat fishes

- These include *Arius sp.*, *Osteogenosus militaris*, *Pangasius pangasius* and various species of genera *Mystus*.
- Their breeding season varies from November to March, during which they migrate to estuarine water to spawn.
- All this time the fishes become very sluggish and are easily caught in large numbers. Being cheaper, these fishes are consumed in large amounts by the weaker sections of the society.

(E) Mulletts

- Above 26 species including following important species are known.
- These are generally caught by the gill nets and by the cast nets in shallow area.
- Fish species include *Mugil cephalus*, *M. cunnesius*, *M. dussumieri*, *M. speigleri*, *M. parsia*, *Rhinomugil corsula* and *Liza troschellii*.
- *Mugil cephalus* constitute an important estuarine fisheries of tropical and sub tropical waters of the coasts, particularly the Bhasabada fisheries of Bengal and at Narakkal farm at Cochin.

(F) Perches

- Important perches of brackish water are the *Lates calcarifer*, *Etroplus suratensis*, *E. maculatus*, *Epinephius* sp., *Lutjanus* sp., *Ambassis* sp. and *Therapan* sp.
- Of these the betki (*Lates calcarifer*) constitute important fisheries of Ganga, Godavari and Mahanadi estuaries on the east and Kalinadi, Aghanashini and Sharavati estuaries on the west.

(G) Thread Fins

- The thread fins (*Eleutheronema tetradactylum*) also called Indian salmon is widely distributed in the estuaries. It is caught along with mullets, clupeids and other fishes by seine and drag nets in the lower reaches of estuaries. Other important thread fins are *Polynemus indicus*, and occasional visitor from the sea and the *P. paradiscus* restricted mostly to estuaries of Bengal.

(H) Prawns

- Prawns contributing to the estuarine fisheries mainly include the *Metapenaeus monoceros*, *M. dobsoni*, *M. affinis*, *M. brevicornus*, *Penaeus indicus* and *P. monodon*.
- Of these, *M. monoceros* is the most abundant species.
- They are caught by dragnets and skate nets throughout the year.

Chilka Lake – Example of Open Estuary

Topography

- **Chilka lake is an example of open estuary.** It is a pear shaped and one of the largest brackish water lagoon with a water spread of about 906 sq. km. in summers and 1,165 sq. km. during the monsoon season.
- It is situated between latitudes $19^{\circ} 54'$ N and longitudes $85^{\circ} 67'$ and $85^{\circ} 35'$ E on the east coast of India in Puri and Gangam districts of Orissa.
- The total length of this lake is about 65 km and a width of 16 km along the coast.
- The depth of the lake varies from 2.5 meter in the summer to 3.6 meter in the flood season. Loose mud chiefly characterizes the bottom of the main lake. The outer channel is essentially sandy.

- The main body of the lake receives freshwater from several branches of the river Mahanadi and opens into the Bay of Bengal by a long outer channel opening through a single mouth, of a width of about 135 m.
- The inner side of channel is separated from the outer side by a series of peninsular islands.

Physicochemical features

Salinity	- 0.13 (in November and December- - 36.02% (in April-June)
Water temperature	- 17.5° - 32°C
DO ₂	- 2.6- 15.6 ppm
pH	- 6.8 – 9.7
Total alkalinity	- 25.8 – 157 ppm
Phosphate	- 0.18 ppm
Nitrate	- 0.19 ppm

Sectors of the Chilka lake

- For the purpose of fisheries survey and the estimation of fish yield, Chilka lake has been divided into three sectors, viz., northern, central and southern sectors. Rambha, Sabulia, and Khalikota form the fresh fish landing centers for the southern sector, Balugaon and Gangadharpur for the central sector and Kuhuri and Kaluparaghat for the northern sector.

Fisheries of the Chilka lake

- The fishery of Chilka lake is very rich, consisting of about 150 species of fishes and 20 species of prawns.
 - A rich biomass of Phyto and zoo planktons sustain the fisheries throughout the year.
 - Two peaks of net plankton production occurs, the first around April to August and second during October to November.
- (Contd..)

Fisheries of the Chilka lake

- The April- August peak is chiefly contributed by phytoplankton and that of October- November by zooplankton.
- Certain parts of the lake also abound in crabs (*Scylla serrata* and *Neptunus pelagicus*), which constitute a minor fishery.
- Important species from fisheries view point include *Mugil cephalus*, *M. macrolepis*, *Polynemus tetradactylus*, *Nematolosa nasus*, *Mystus gullio*, *Hilsa ilisha*, *Lates calcarifer* and *Pseudoscianeno coiter* etc. among the fishes and *Penaeus* sps. and *Metapenaeus* sps. among the prawns.
- Besides several other fish species of minor importance are: *Ambassis*, *Hemiramphus*, *Gerres* and *Glossogobius*.
- A small quantity of fresh water fishes that enter the lake during monsoons are also caught. These constitute less than 1% and are composed of carps and murrels.

Annual Production

- The annual production of Chilka lake is around 3,000 metric tonnes, of which 90% are exported in fresh condition and the remainders are consumed locally or salt dried.
- The overall estimated average annual yield (both prawns and fishes) of the lake may reach upto about 4000 tonnes.

Nets Used in Chilka lake

- Net fishing operations are locally known as 'bahani'. Drag nets such as 'Patna Jal' and 'Khadi Jal' and Gill nets such as Menjia Jal, Bhida Jal and Borago Jal are used for fishing in Chilka lake.
- Flat-bottomed and plank-built boats, the 'Nava' are the commonly used crafts for operating nets.

Suggested Readings

1. Jhingran VG (1982). Fish and Fisheries of India . Hindustan Publishing Corp. Delhi.
2. Khanna SS (1970) . An Introduction to Fishes. Central Book Depot. Allahabad, India
3. Pandey K and Shukla JP (2012). Fish and Fisheries. Rastogi Publications, Meerut.
4. Gupta SK and Gupta PC (2010). General and Applied Ichthyology. S Chand & Company Ltd. New Delhi

Thanks

Thanks

**NURTURE THE NATURE
FOR OUR FUTURE**