Fish life-cycle and Oceanographic Processes

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ESSO

INCOIS

Fishing Heritage - Fishermen

Bird Congregation

Colour

Bubbles breaking on Surface

Muddy and oily water and calm Sea

Reflection in the Night

Kaladu (a kind of smell)

Fish

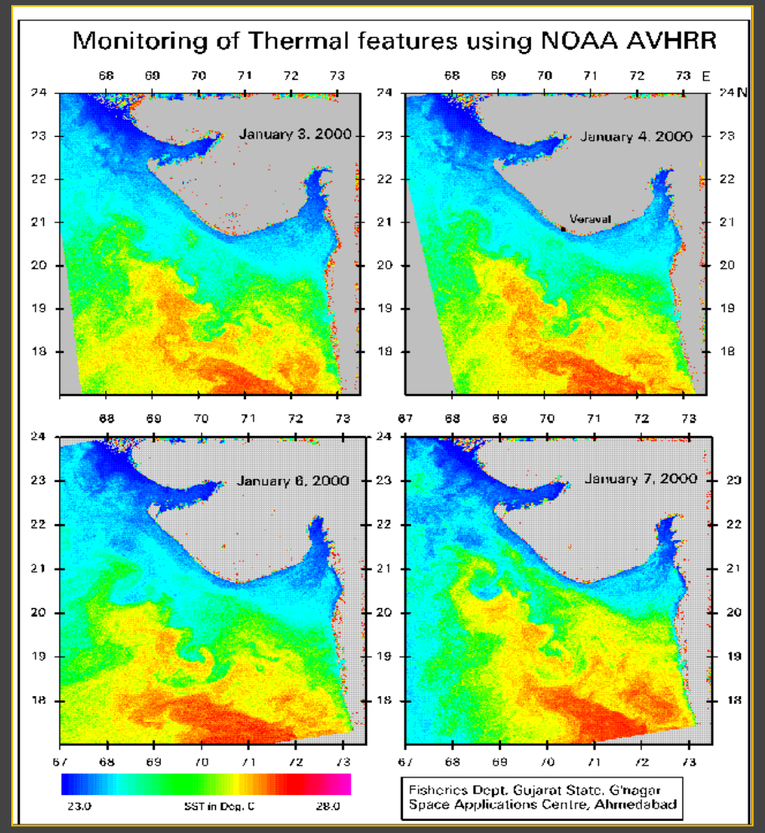
Availability

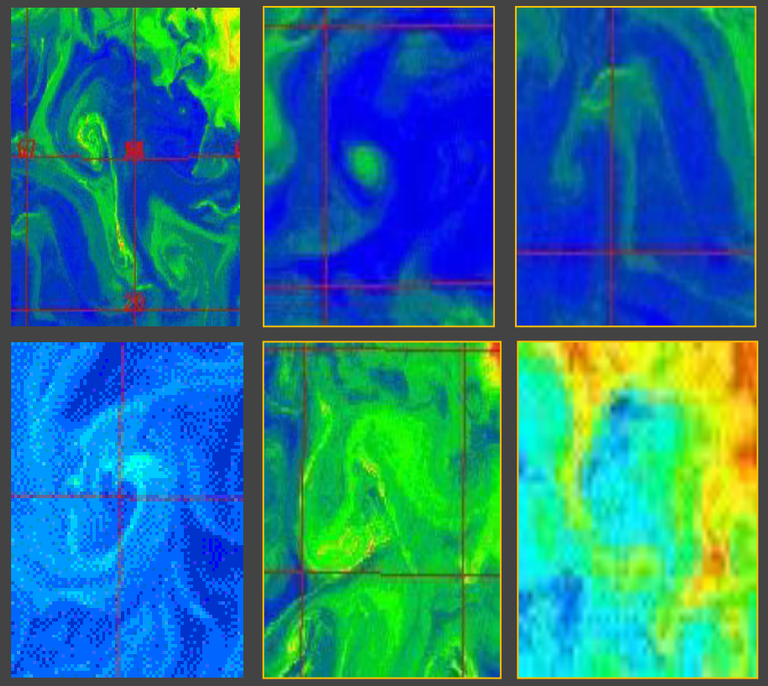
Type

Quantity

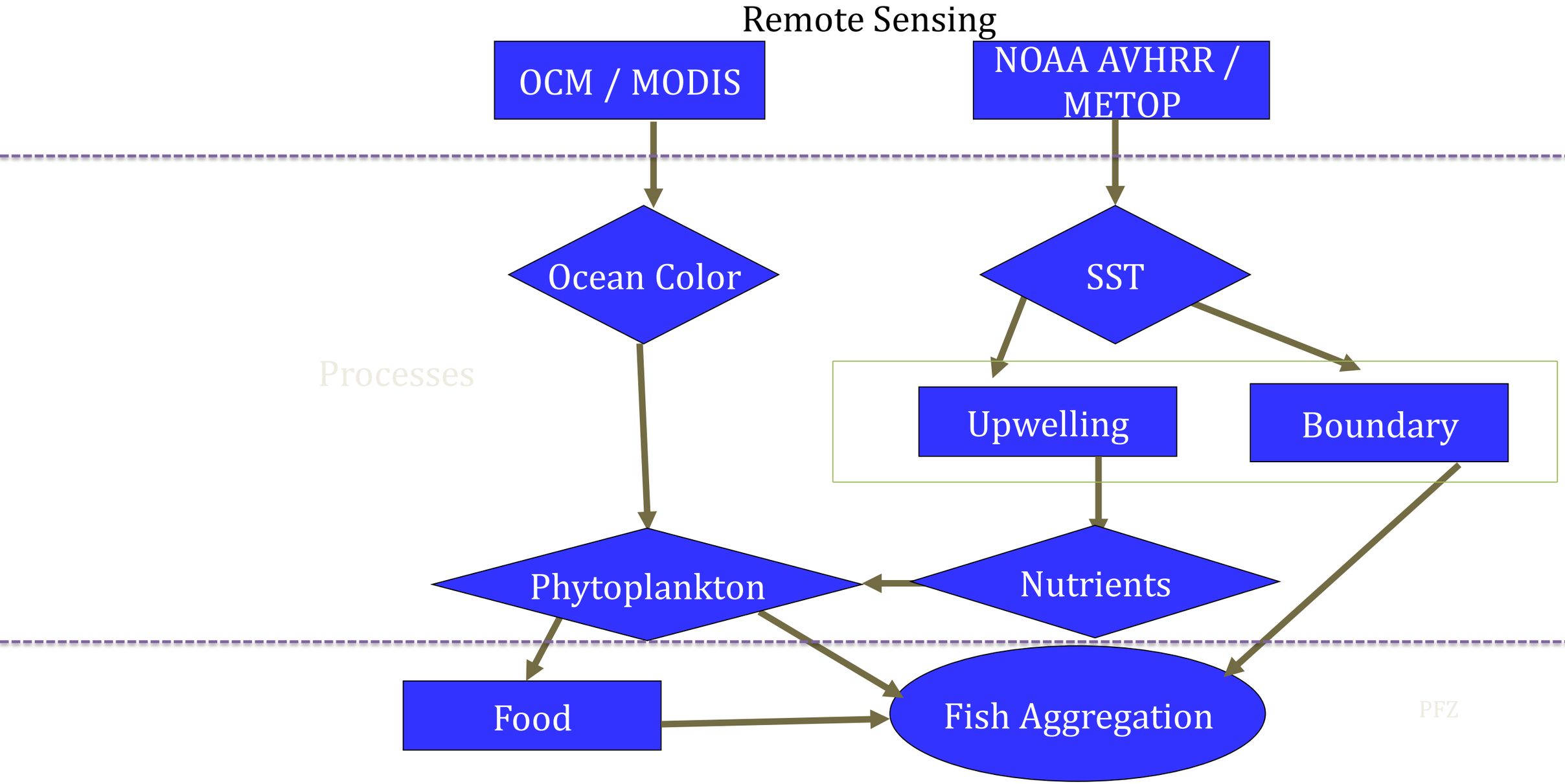
Identification Keys

- Oceanic Fronts
- Meandering Patterns
- Eddies
- Rings
- Mushroom shaped features
- Tongue shaped features
- Coastal Upwelling
- Shelf Break fronts
- Plume fronts
- Diverging fronts
- Converging fronts



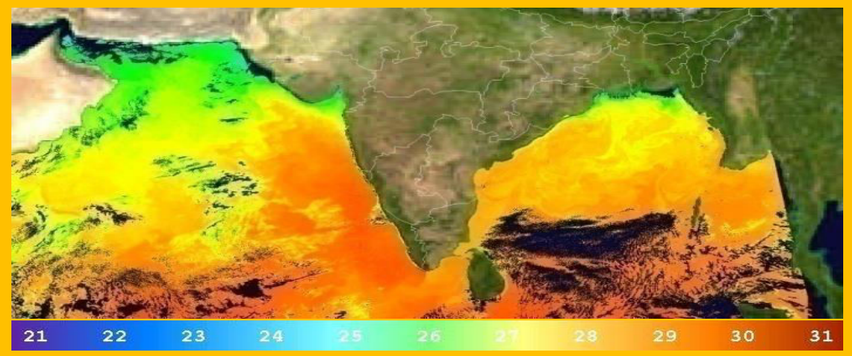


Fish Finding -The Remote Sensing Approach

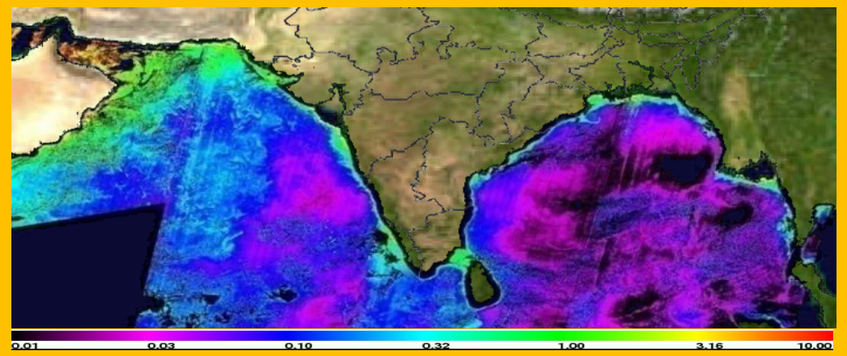


PFZ Advisory Services
(Lab – to – Land)

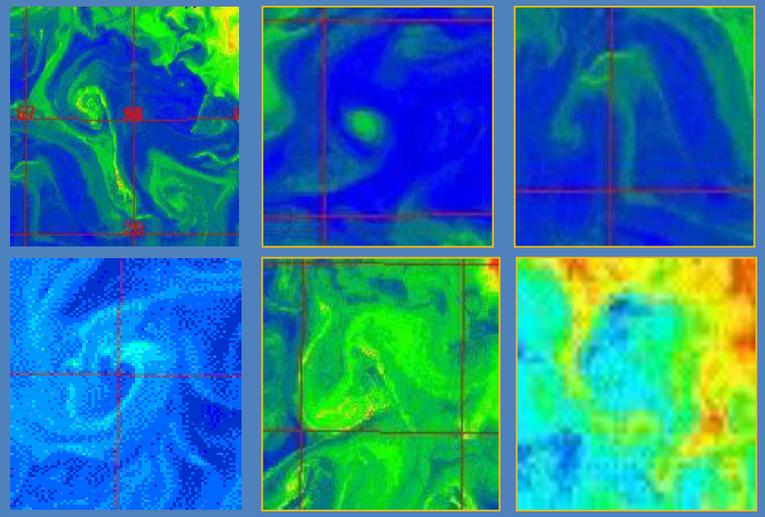
Sea Surface Temperature

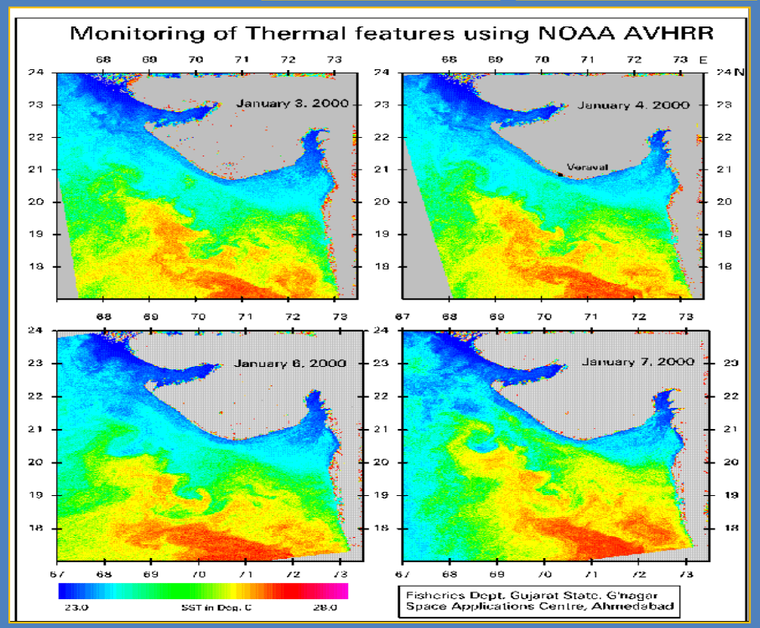


Chlorophyll

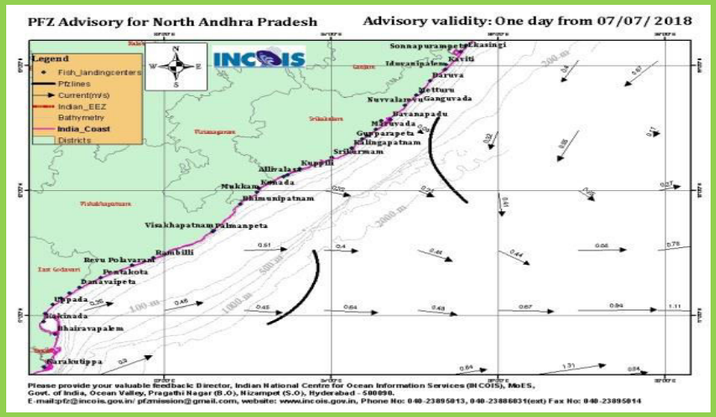


Satellite Data Products





Key Indicators



7/7/2018

Data updated on: 07-07-2018 15:53:33

Potential Fishing Zone
NORTH ANDHRA PRADESH
उत्तर आंध्र प्रदेश
ఉత్తర ఆంధ్ర

SATELLITE DATA SHOWS LIKELY AVAILABILITY OF FISH STOCK TILL 8 JUL 2018
उपग्रह से प्राप्त सूचना अनुसार 8 जुलाइ 2018 तक मत्स्य भंडार की उपलब्धता
ఉపగ్రహ సమాచారము ద్వార వేటలు 8 జులై 2018 వరకు లభించుటకు అవకాశము కలదు

తీరము నుంచి	దిశలో	కోణము (డిగ్రీలో)	దూరము (కిలోమీటర్) నుంచి-వరకు	లోతు (మీటరలో) నుంచి-వరకు	అక్షాంశము (డీయమ్మస్)	రేఖాంశము (డీయమ్మస్)
Rambilli రాంబిల్లి రాంబిల్లి	ఆగ్నేయం	104	104-109	2509-2514	17 14 13 ఉత్తరం	83 53 20 తూర్పు
Jagannadhapuram జగన్నాధపురం జగన్నాధపురం	ఆగ్నేయం	106	41-46	305-310	18 19 54 ఉత్తరం	84 35 32 తూర్పు
Pudimadaka పుడిమడక పుడిమడక	ఆగ్నేయం	100	98-103	2437-2442	17 19 39 ఉత్తరం	83 55 0 తూర్పు
Bavanapadu బవనాపాడు బావనపాడు	ఆగ్నేయం	103	26-31	126-131	18 31 59 ఉత్తరం	84 37 21 తూర్పు
Visakhapatnam విశాఖపట్నం విశాఖపట్నం	ఆగ్నేయం	110	68-73	2064-2069	17 26 59 ఉత్తరం	83 54 53 తూర్పు
Allivalasa అల్లివలస అల్లివలస	ఆగ్నేయం	98	107-112	2163-2168	17 59 58 ఉత్తరం	84 44 12 తూర్పు
Revu Polavaram రేవుపోలవరం రేవు పోలవరం	ఆగ్నేయం	105	113-118	2596-2601	17 7 38 ఉత్తరం	83 49 59 తూర్పు
Maruvada మరువాడ మరువాడ	ఆగ్నేయం	95	34-39	52-57	18 27 40 ఉత్తరం	84 36 9 తూర్పు
Kuppili కుప్పిలి కుప్పిలి	ఆగ్నేయం	98	92-97	2111-2116	18 3 32 ఉత్తరం	84 41 47 తూర్పు
Palmanpeta పల్మాన్‌పేట పల్మాంపేట	ఆగ్నేయం	105	123-128	2595-2600	16 58 9 ఉత్తరం	83 40 53 తూర్పు
Srikurmam శ్రీకూర్మం శ్రీకూర్మం	ఆగ్నేయం	101	69-74	1454-1459	18 8 21 ఉత్తరం	84 38 54 తూర్పు
Chintapalli చింతపల్లి చింతపల్లి	ఆగ్నేయం	97	120-125	2171-2176	17 56 43 ఉత్తరం	84 46 44 తూర్పు

1/2

PFZ Advisories

Real-time advisories to prediction

Observations

Independent observations

Knowledge & intuition

Fitting performance

Performance test (Validation & fine-tuning)

Conceptual model

Fitted model

Numerical & computational

Parameter(s) optimization

Numerical modeling

Prediction (Species level)

Distribution of Hilsa shad

Found in rivers and estuaries in India, Pakistan, Bangladesh, Burma and the Persian Gulf area where it can be found in the Tigris and Euphrates rivers in and around Iran and Iraq.

India: Hugli (tributary of Ganges), Mahanadi, Chilka, Godavari, Tapti and Narmada.

Total yearly production: 5 million tons.

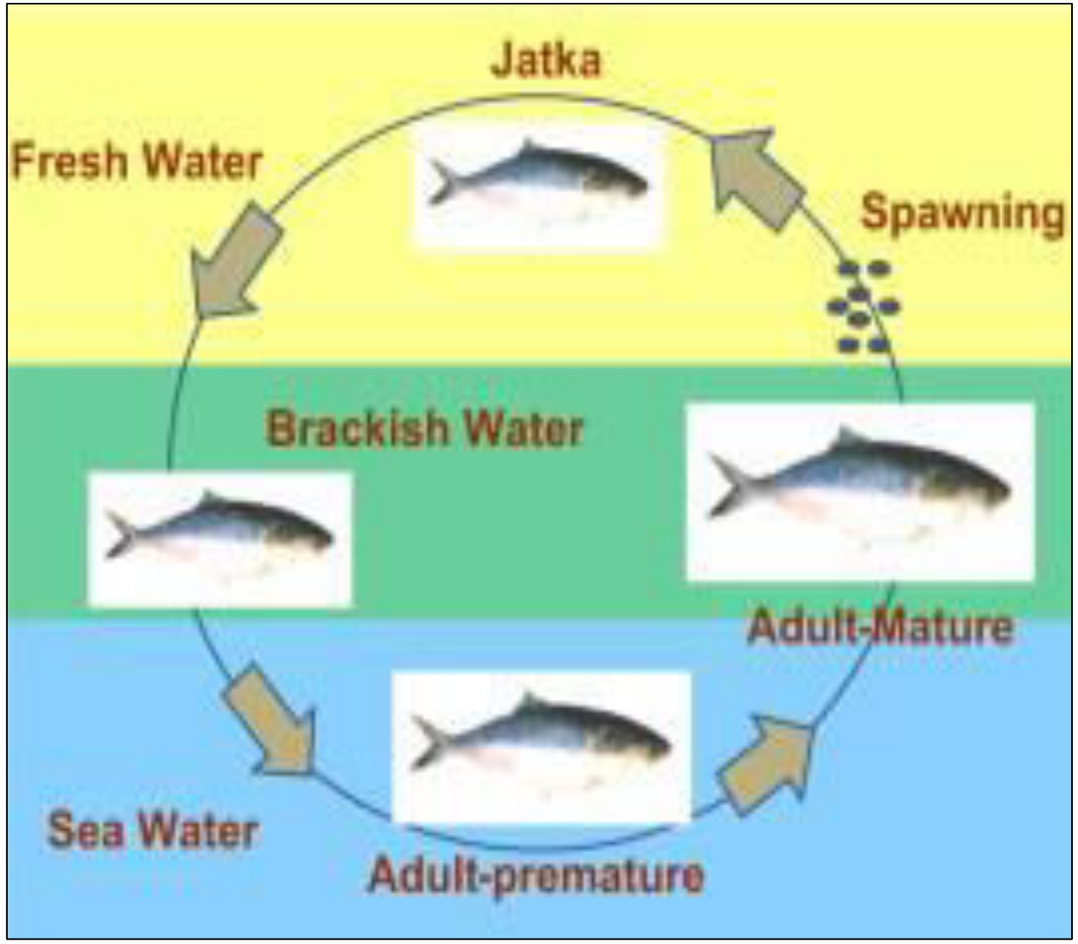
50%-60% are caught by Bangladesh, 15%-20% are caught by India, Pakistan and rest 5%-10% are caught by Malaysia, Thailand, China, Vietnam and Srilanka.

The fish contributes about 12% of the total fish production and about 1% of GDP in Bangladesh.

General Characteristics of Hilsa

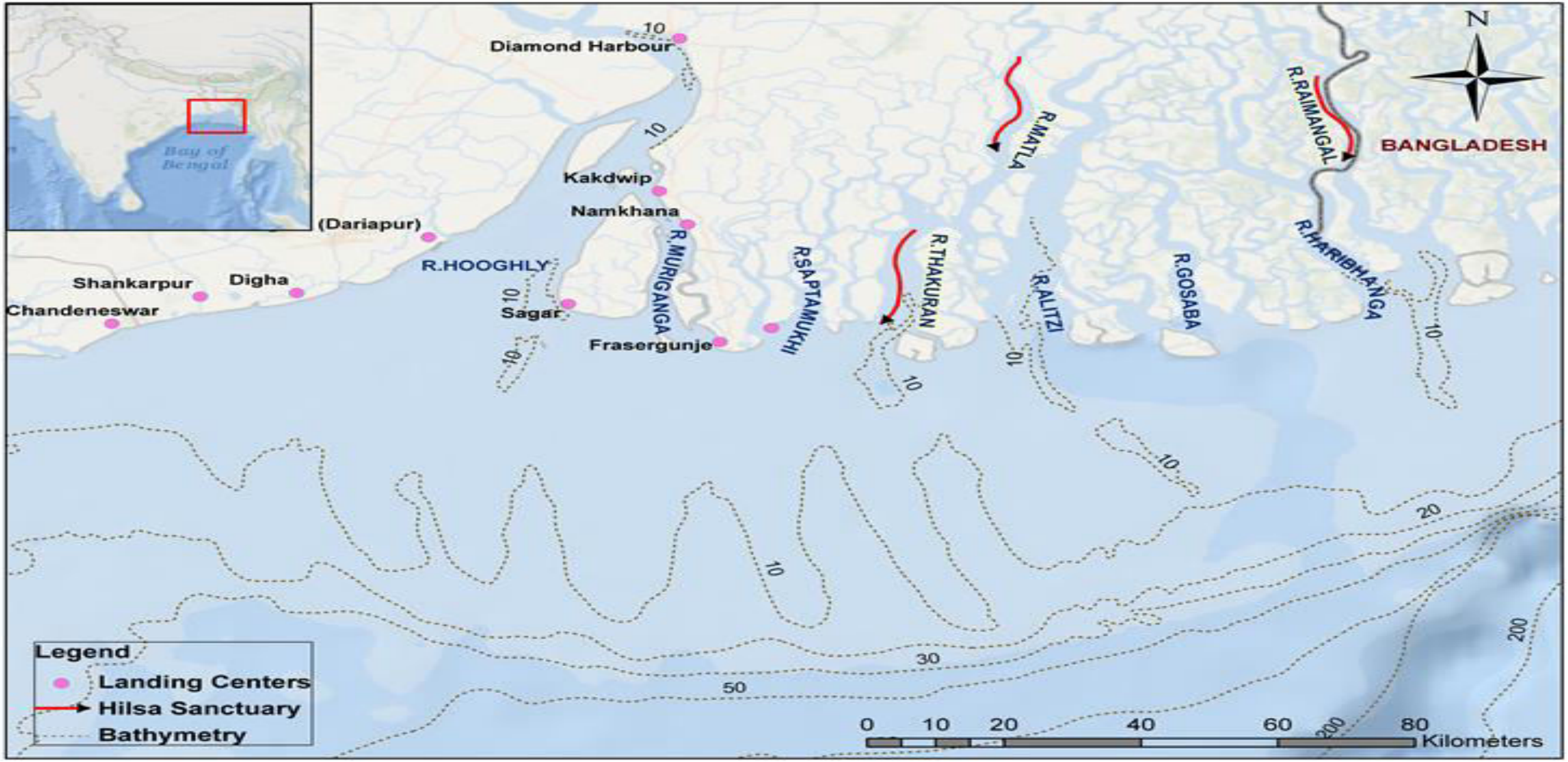
Tenualosa ilisha, popularly known as **Hilsa shad**, is a pelagic species in the Clupeidae family

Well distributed in the coastal shelf, estuaries, brackish water lakes and freshwater rivers in Indonesia, Java, Sumatra, Myanmar, Bangladesh, India, Pakistan, Kuwait, Iraq and Iran.
Breeding/Migration highly dependent on **fresh water discharge** and **phytoplankton** (Diatom) availability.
Ganges, Brahmaputra and Meghna reverine system is one of the largest drainage of Himalaya is used by the fish for breeding.

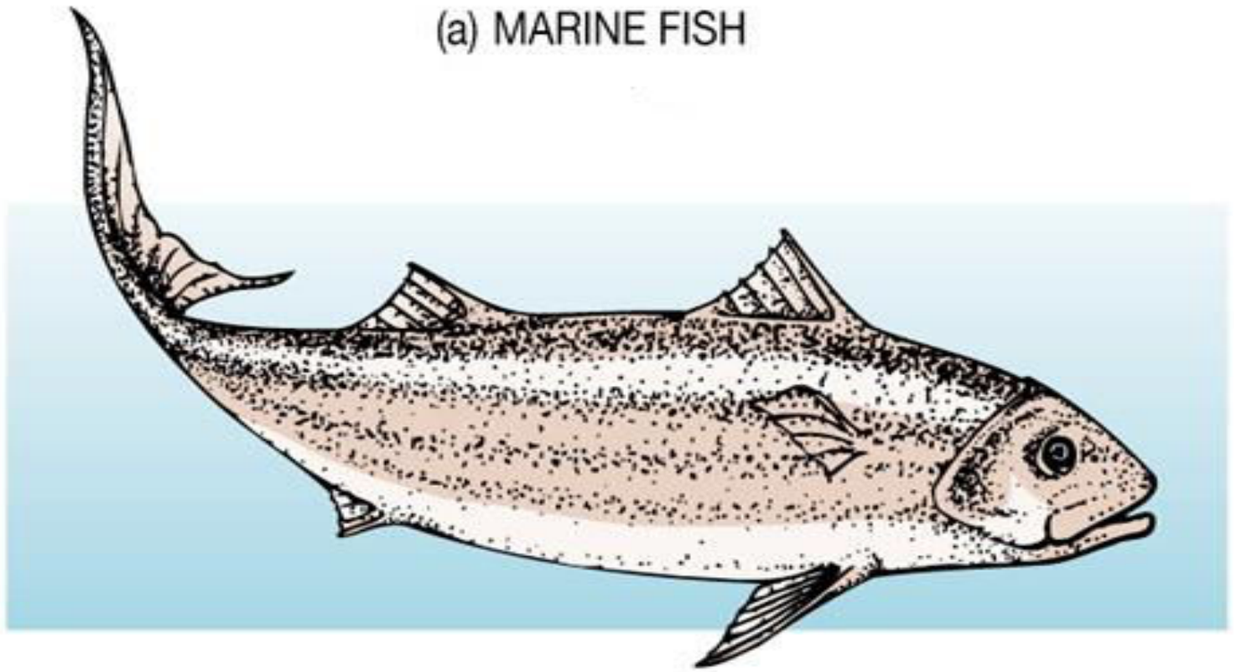


Anadromous in nature, Breeding highly dependent on **South-west monsoon** and Primary breeding period June – October

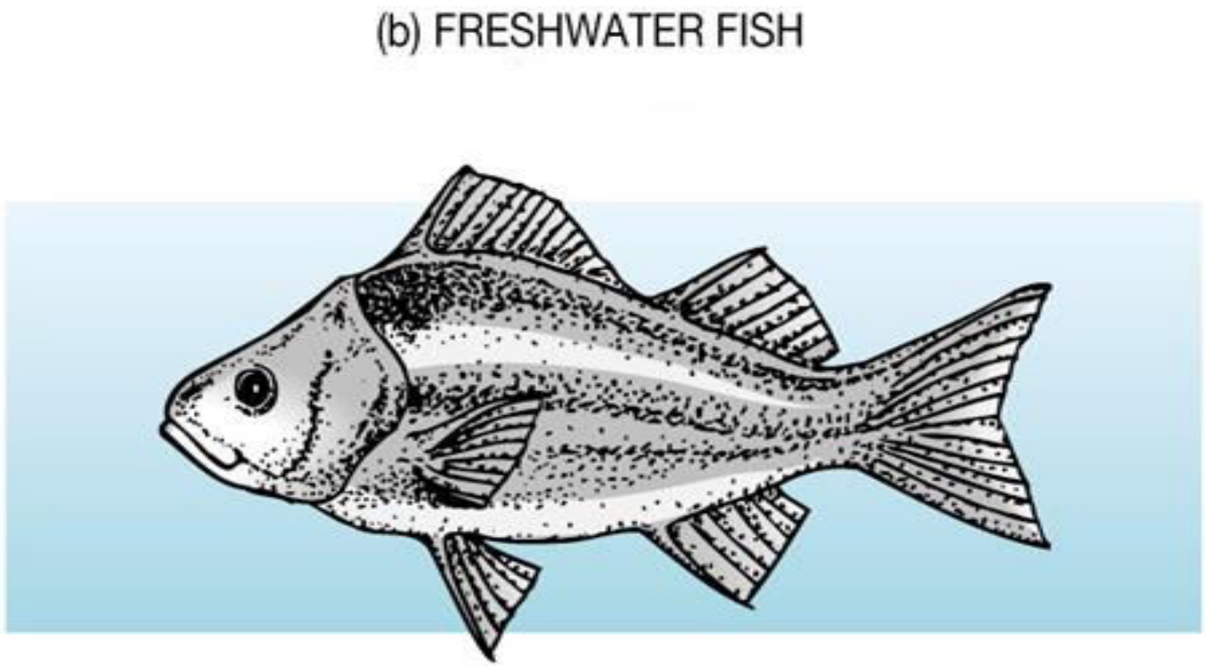
Hilsa sanctuaries in Indian Sndarbans
(demarcation may not be accurate)



Salinity adaptations



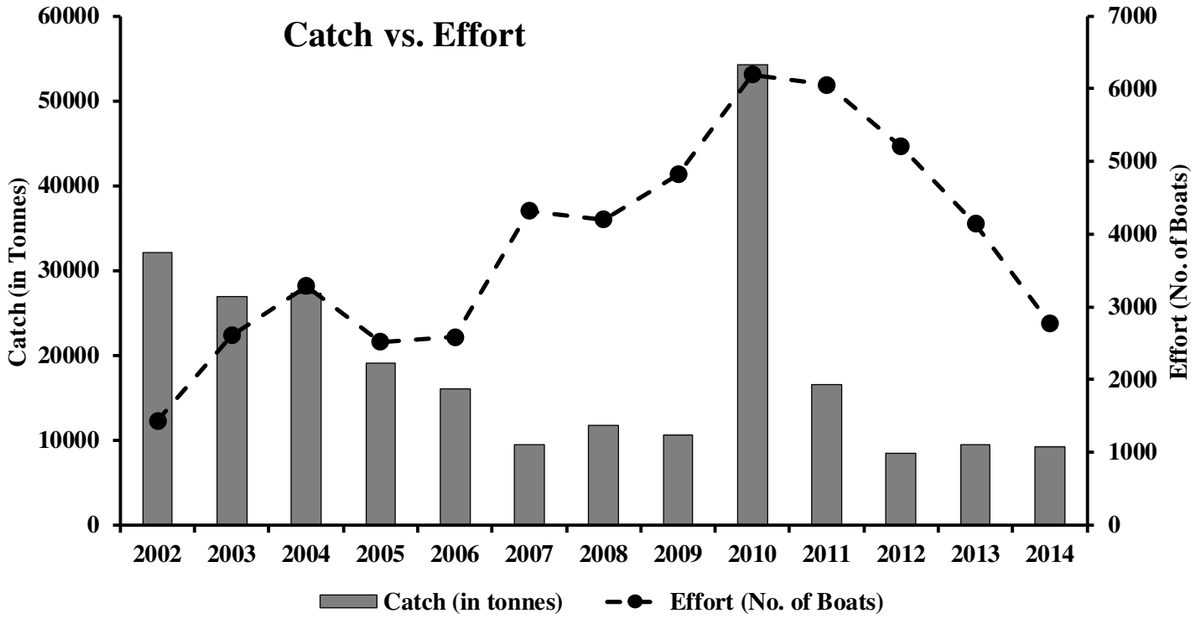
Drink large quantities of water
Secrete salt through special cells
Small volume of highly concentrated urine



Do not drink
Cells absorb salt
Large volume of dilute urine

Stenothermal, Eurythermal, Stenohaline, Euryhaline

HILSA FISHERY STATUS IN WEST BENGAL



(Data Source: West Bengal Fisheries Department, Govt. of W.B.)

- **Within the time span of eight years the condition factor has decreased ~45%, i.e. the health condition of the fish is deteriorating very fast in its natural habitat.**
- ***b* value represents the nature of growth of a fish. A value of 3.0 refers an allometric growth. *b* value of Hilsa reduced ~39% during this time span.**

Source: Das et al. 2018

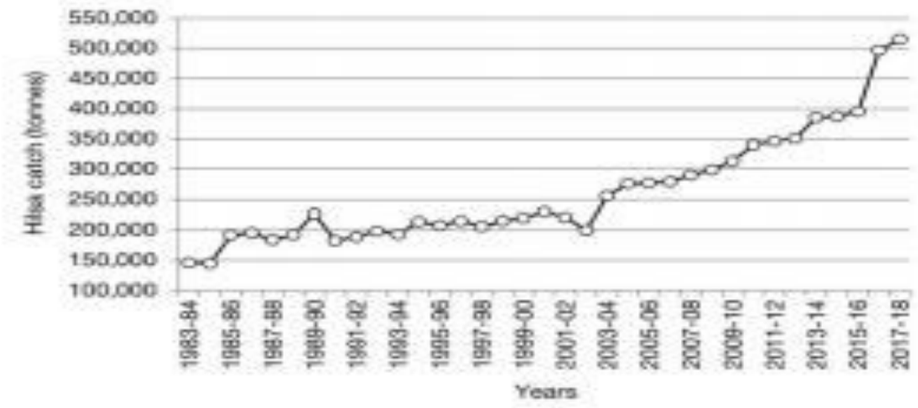


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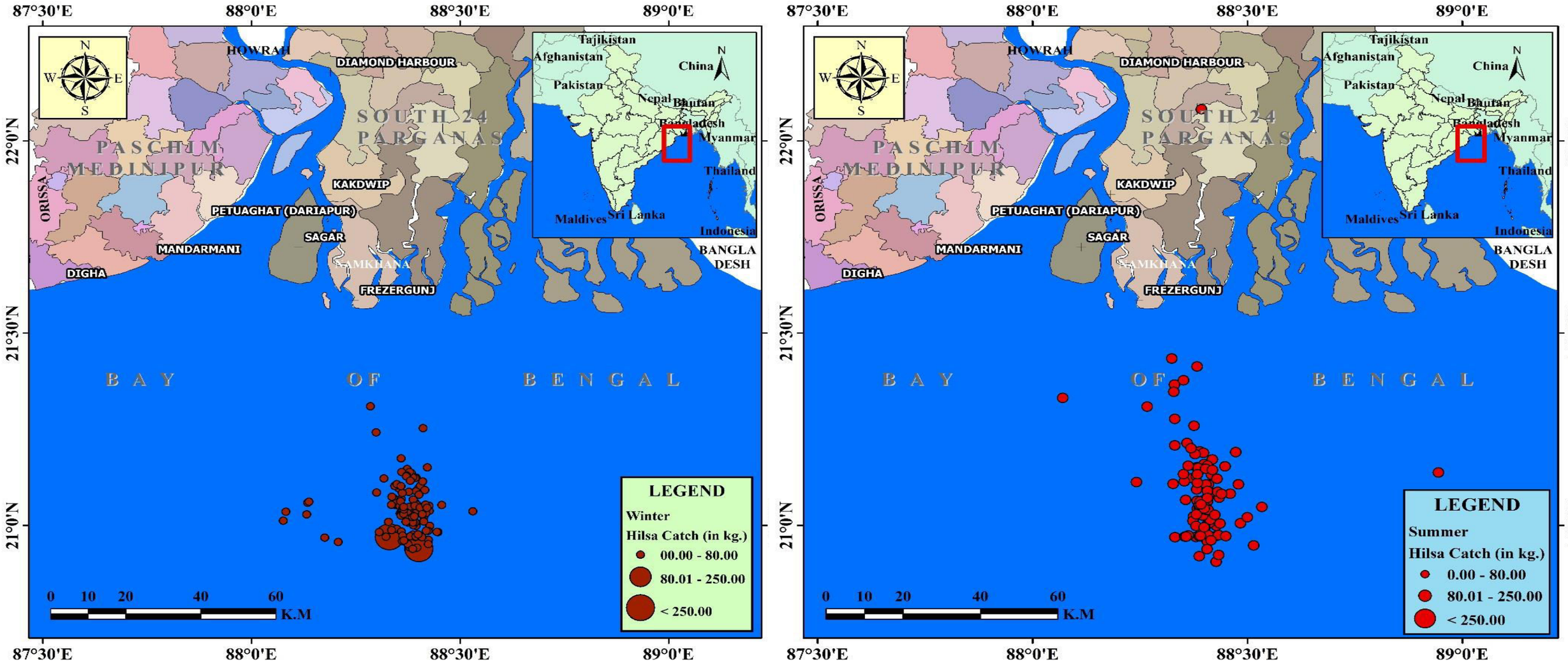
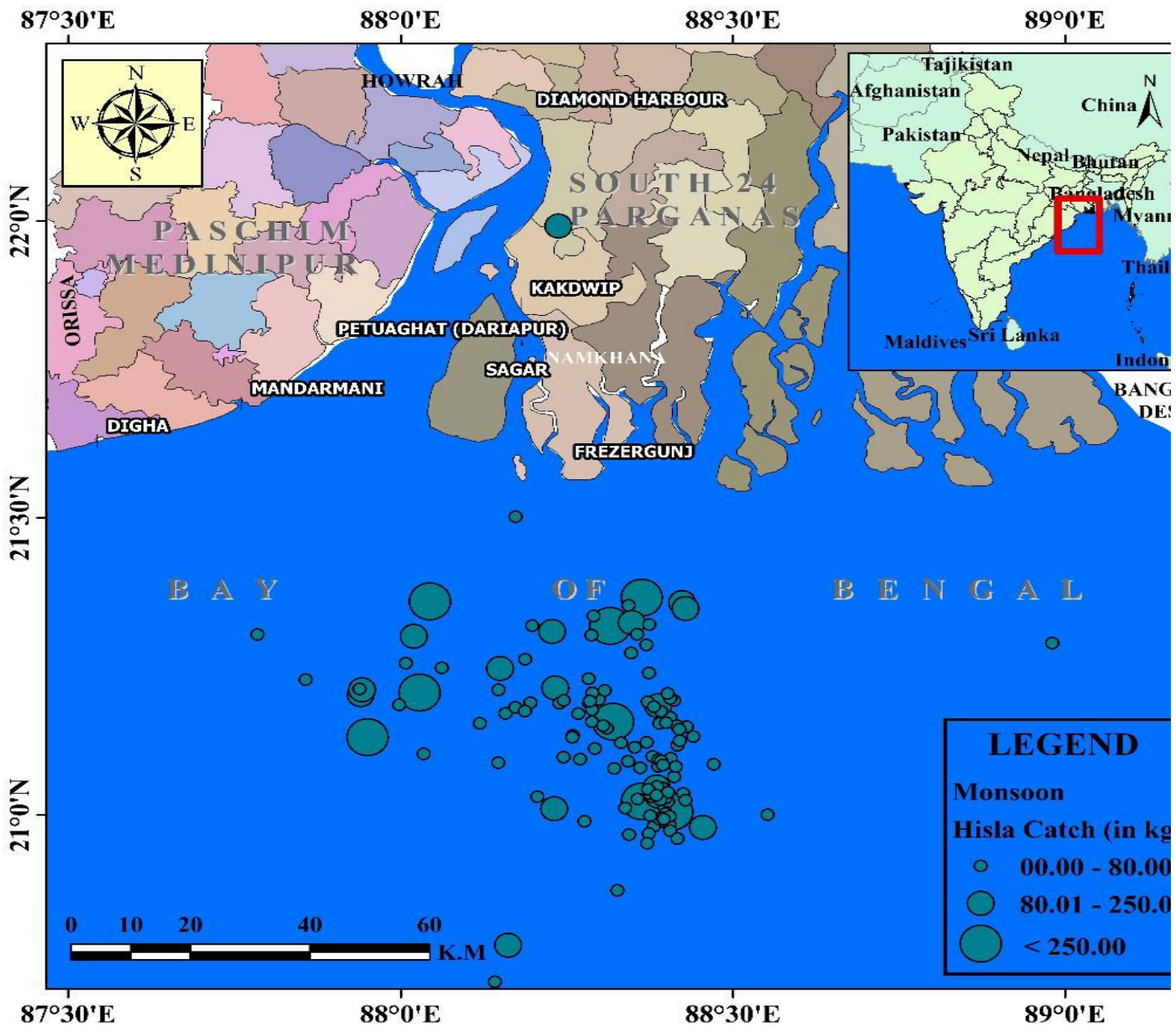
Figure 1. Annual hilsa catch in Bangladesh from 1983 to 2018 (*left*); and few hilsa fishes at a landing center

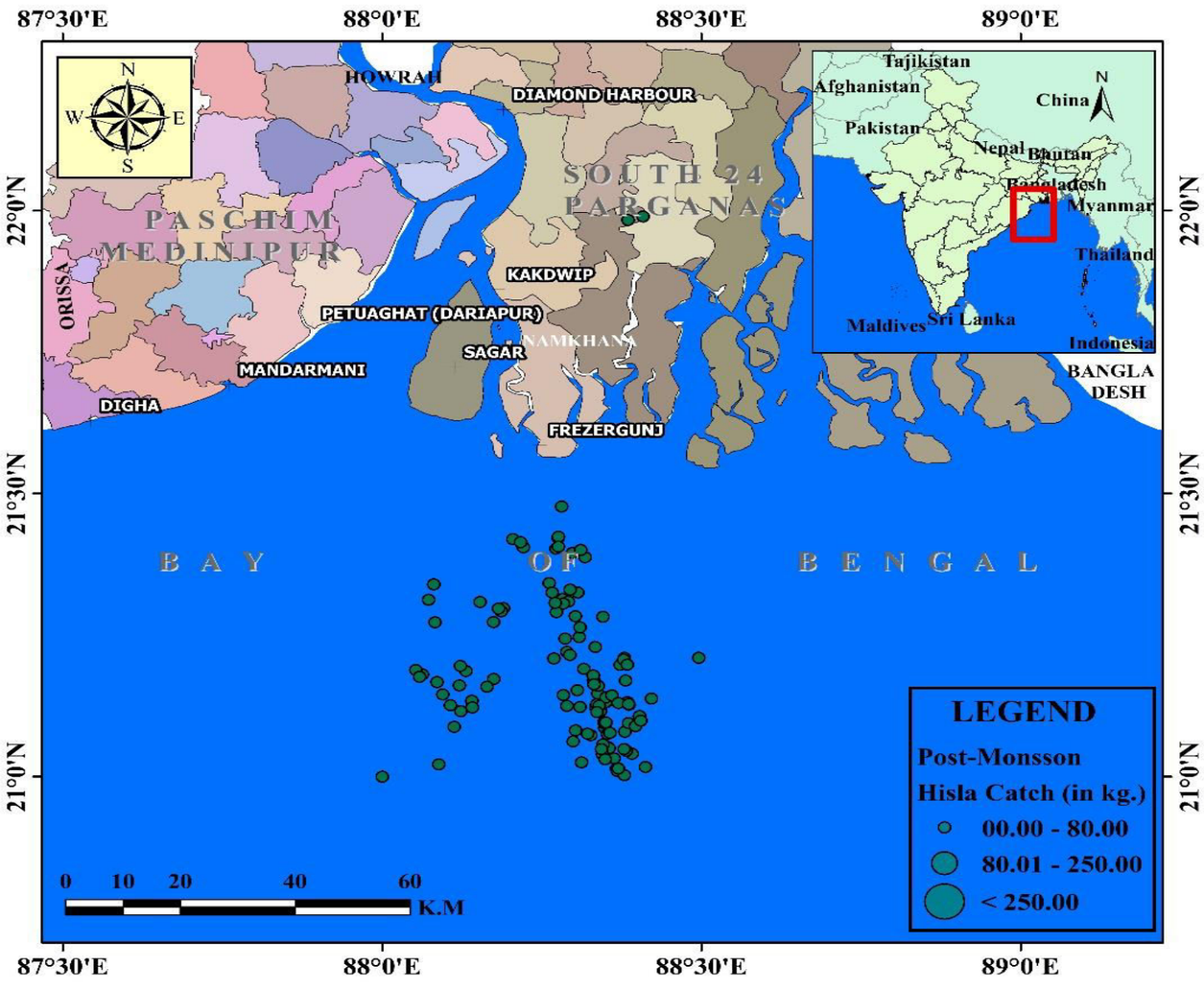
HILSA DISTRIBUTION



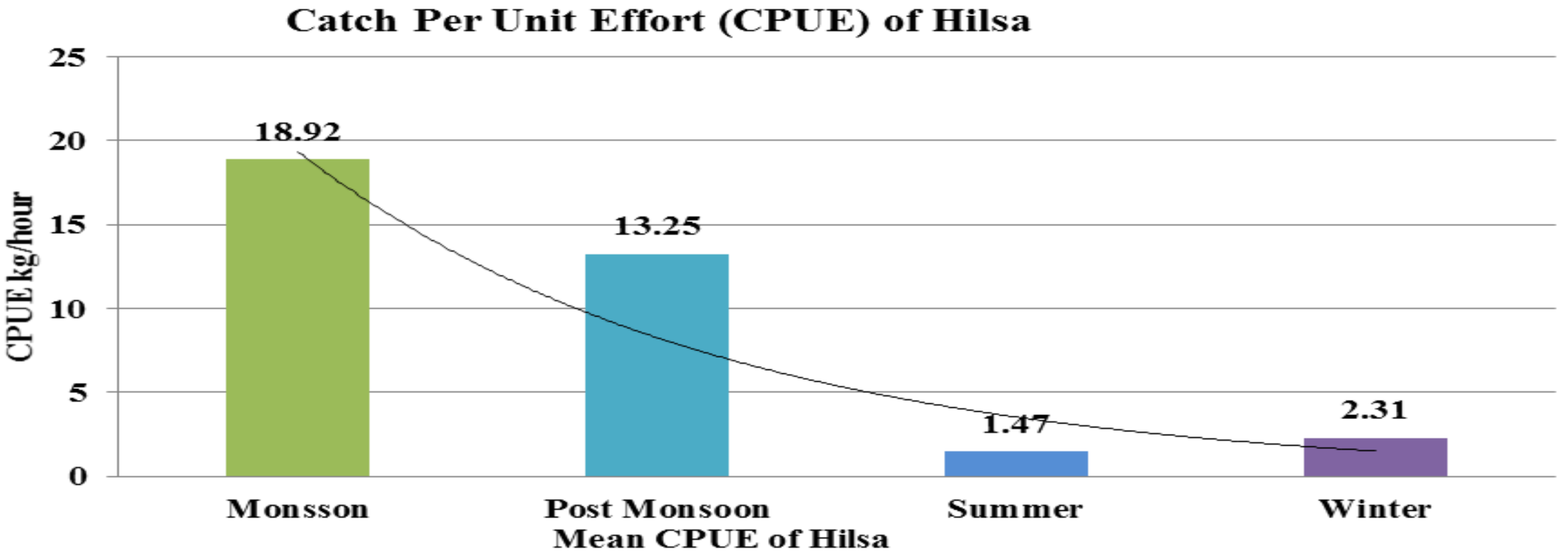
Catch Per Unit Effort (CPUE) Map of Winter and Summer Phase

HILSA DISTRIBUTION

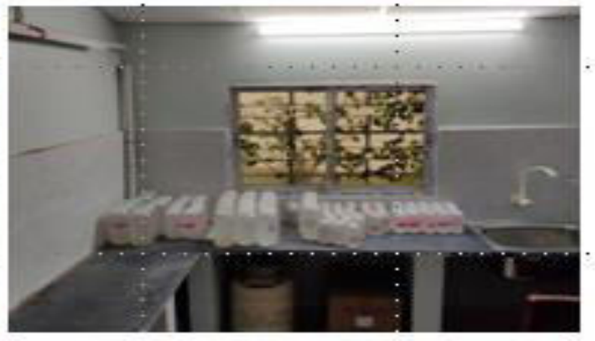




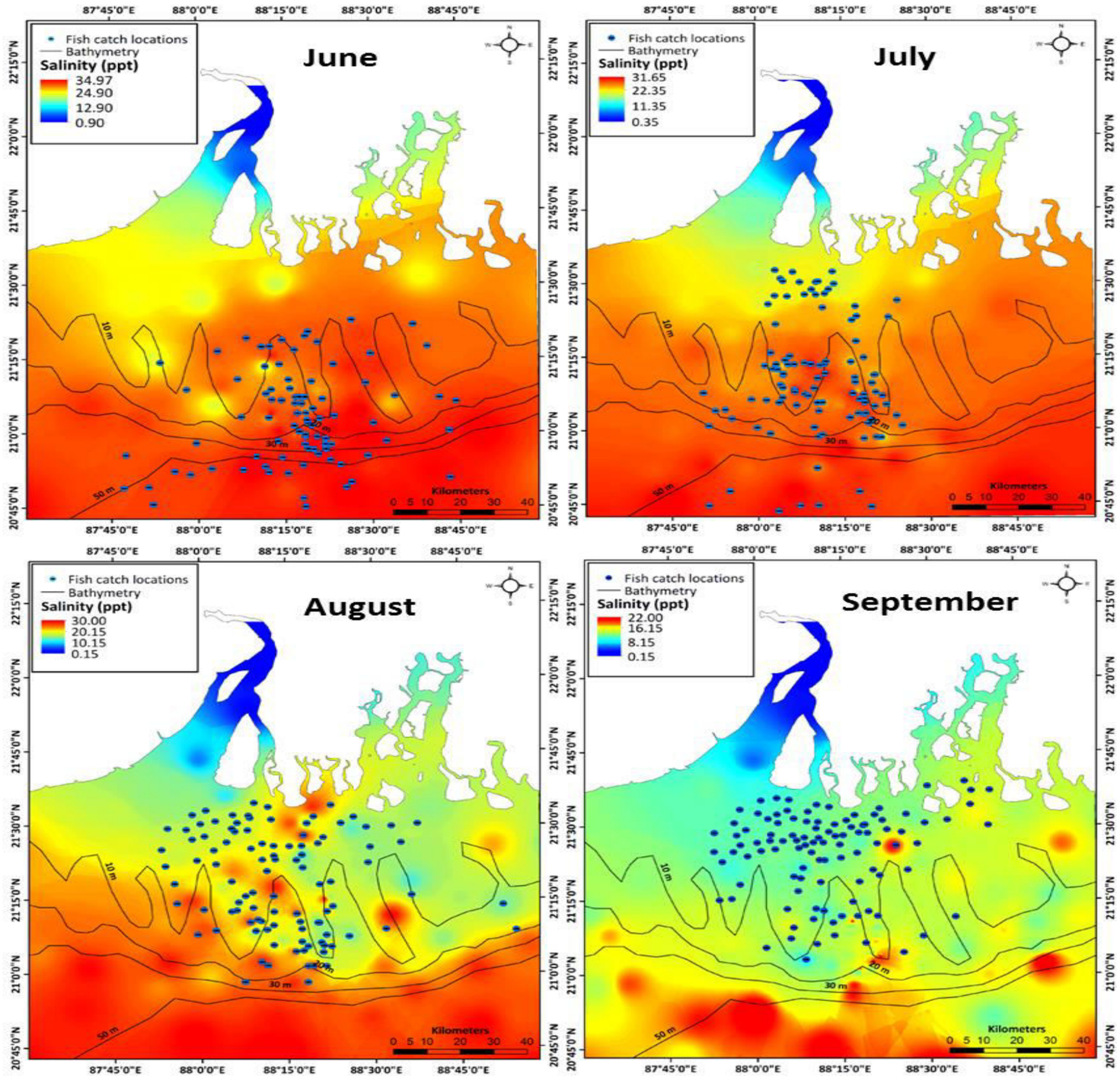
Catch Per Unit Effort (CPUE) map of Monsoon and Post Monsoon Phase


Catch Per Unit Effort (CPUE) of Hilsa
25
20
15
10
5
0
CPUE kg/hour
18.92
13.25
1.47
2.31
Monsson
Post Monsoon
Summer
Winter
Mean CPUE of Hilsa

Regular sampling and establishment of Digha Coastal laboratory



INCOIS has established a coastal laboratory at Digha to study the fish habitat of Hilsa in coordination with Govt. of West Bengal and local academia, to be inaugurated shortly

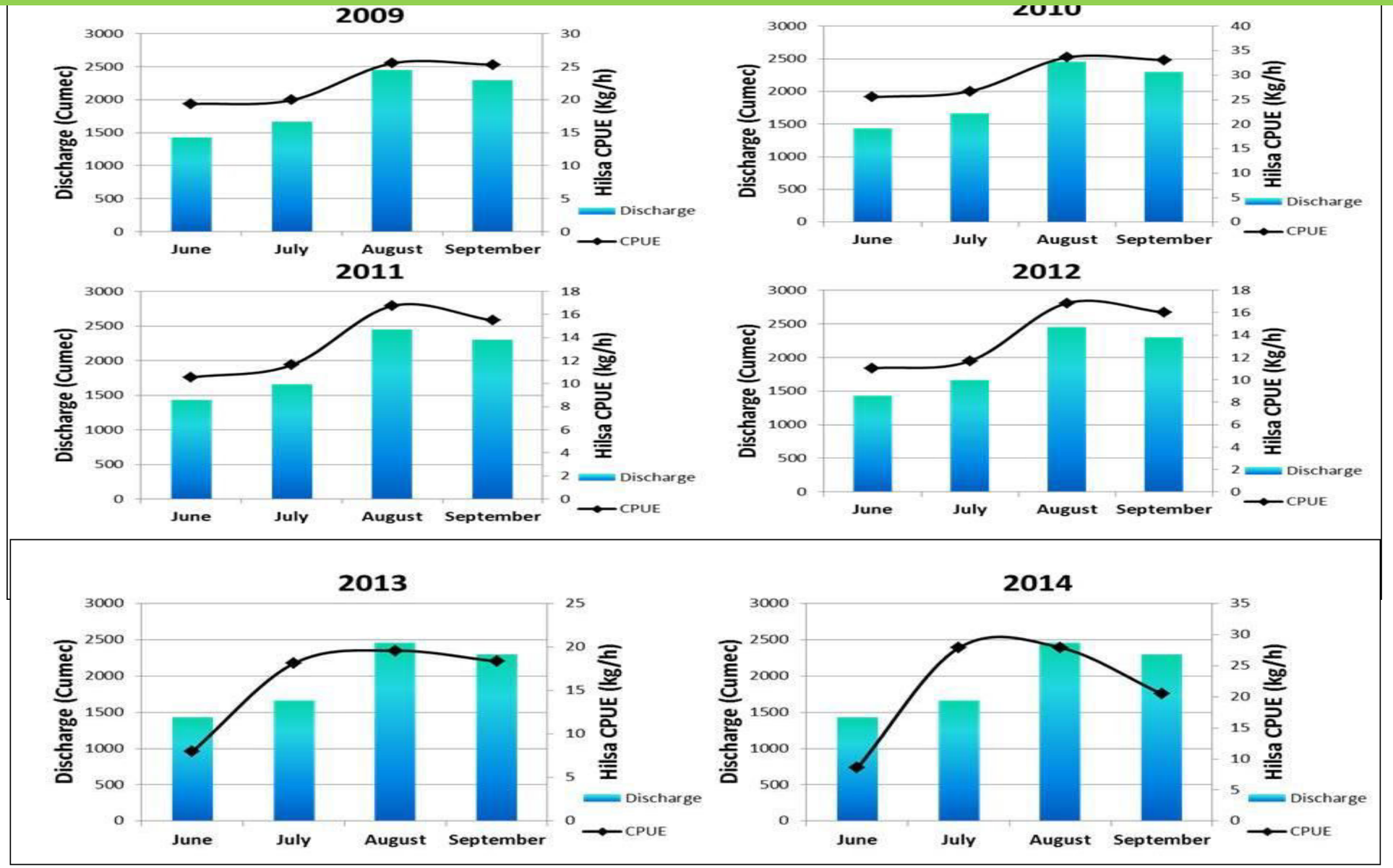


Salinity vs Hilsa catch

- As the monsoon intensifies from June-September, it leads to the salinity depletion leading Hilsa to migrate towards river.
- As the high resolution coastal salinity data from satellite as well as modeled salinity is unavailable, prediction of the monsoon is very much essential.

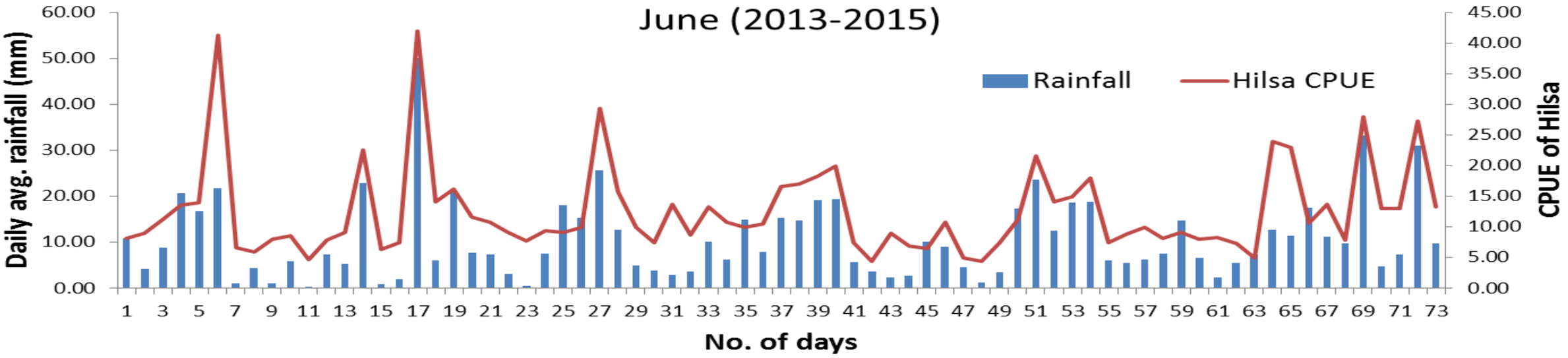
Collaborator: Jadavpur University

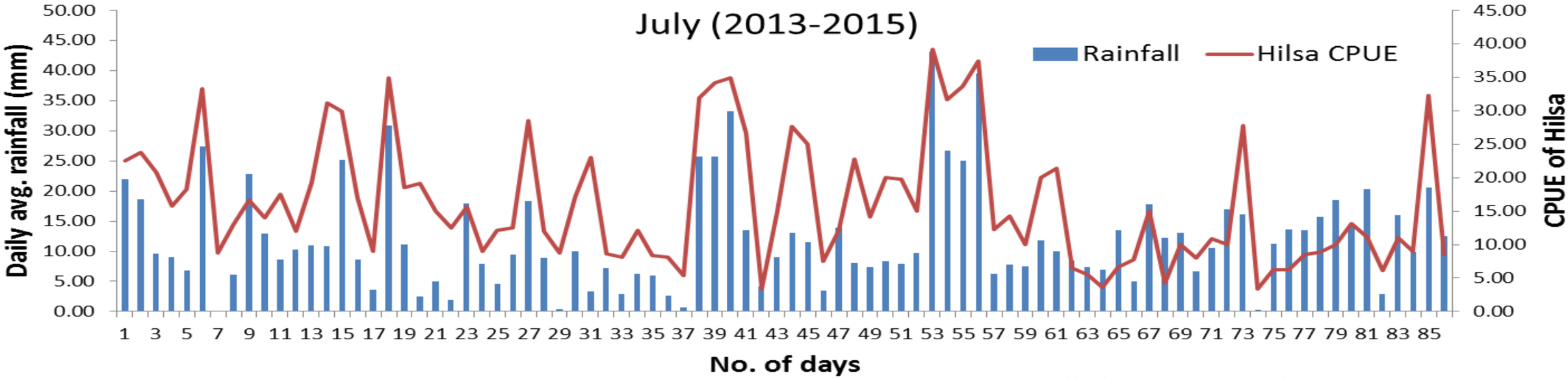
Effect of River Discharge on Hilsa Catch



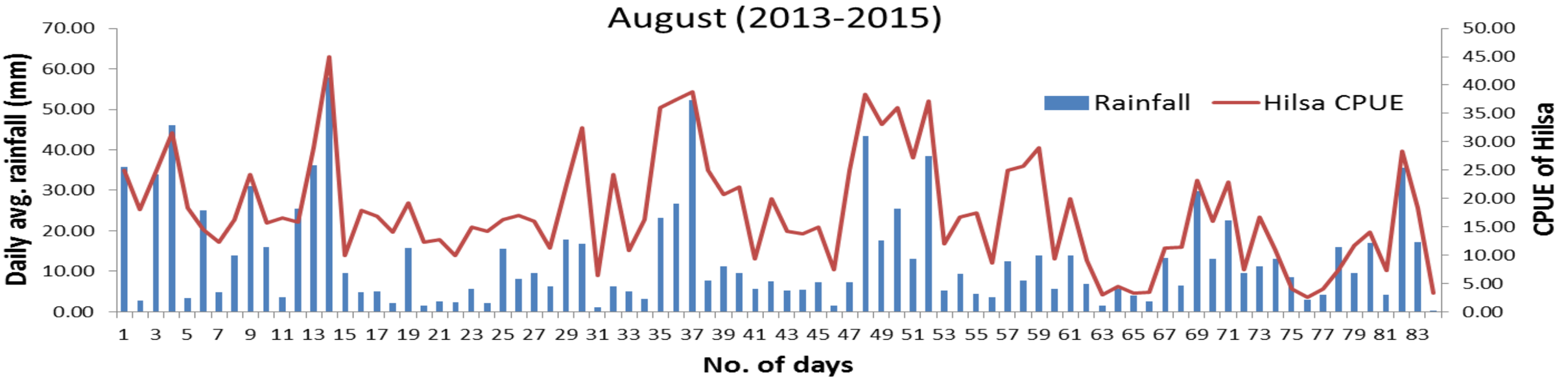
Collaborator: Jadavpur University

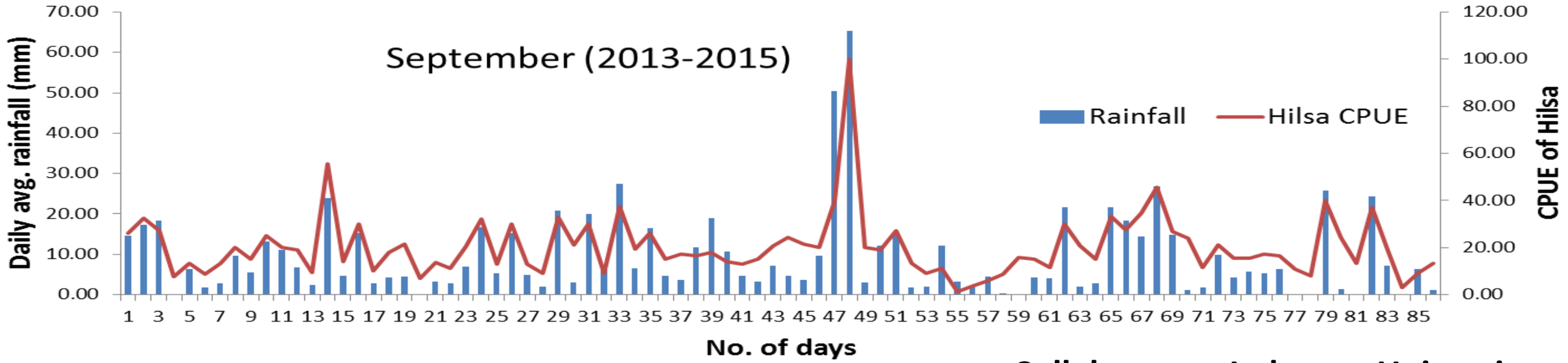
Daily rainfall vs Hilsa catch





Collaborator: Jadavpur University





Collaborator: Jadavpur University

Nutrients in BoB

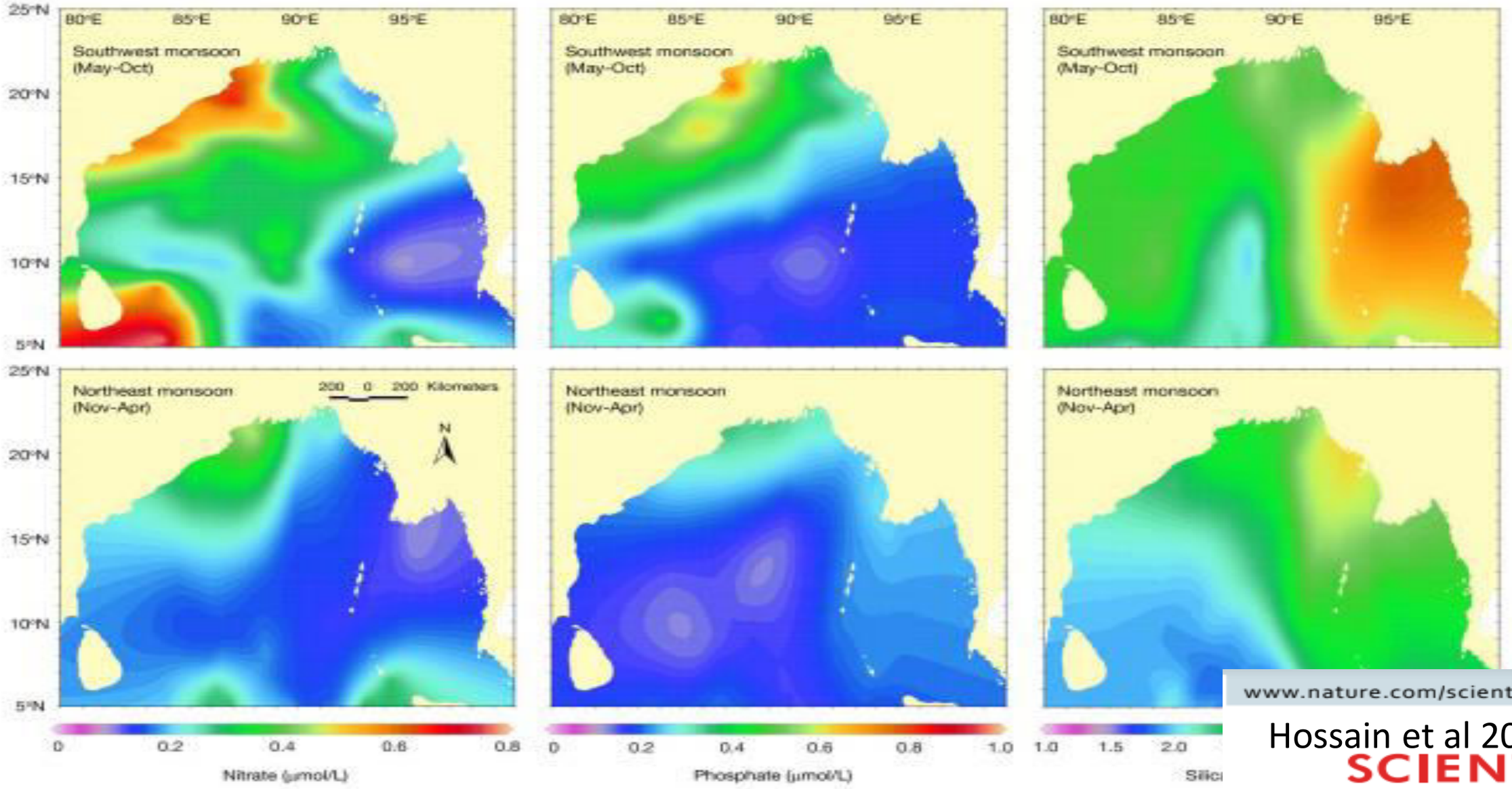


Figure 4. Spatial distribution of nutrient in the Bay of Bengal.

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Phytoplankton

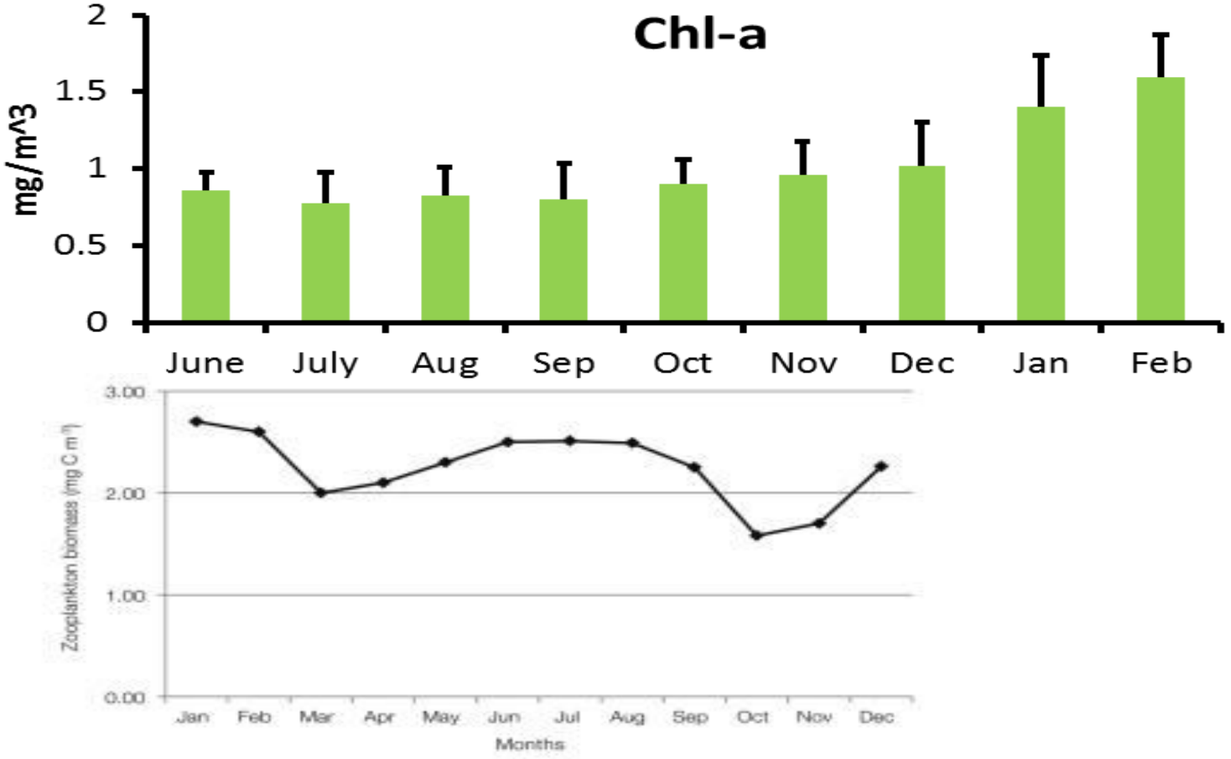

Figure 6. Temporal distribution of zooplankton biomass in the Bay of Bengal.

- During monsoon higher nutrients but lower phytoplankton biomass. Light limitation due to cloud cover
- High nutrient load during monsoon leads to the high phytoplankton biomass during post-monsoon.
- High silicate value during monsoon enhances the growth of diatoms as the diatoms are having siliceous structure.

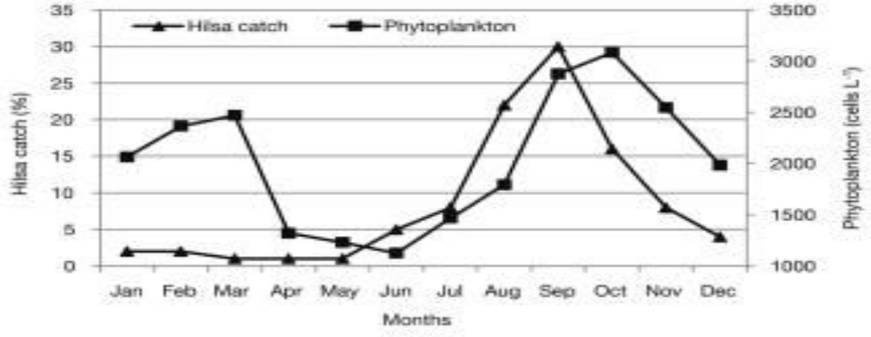

Figure 7. Phytoplankton abundance and hilsa yields (%) in the Ganges-Brahmaputra-Meghna (GBM) delta of the northern Bay of Bengal.

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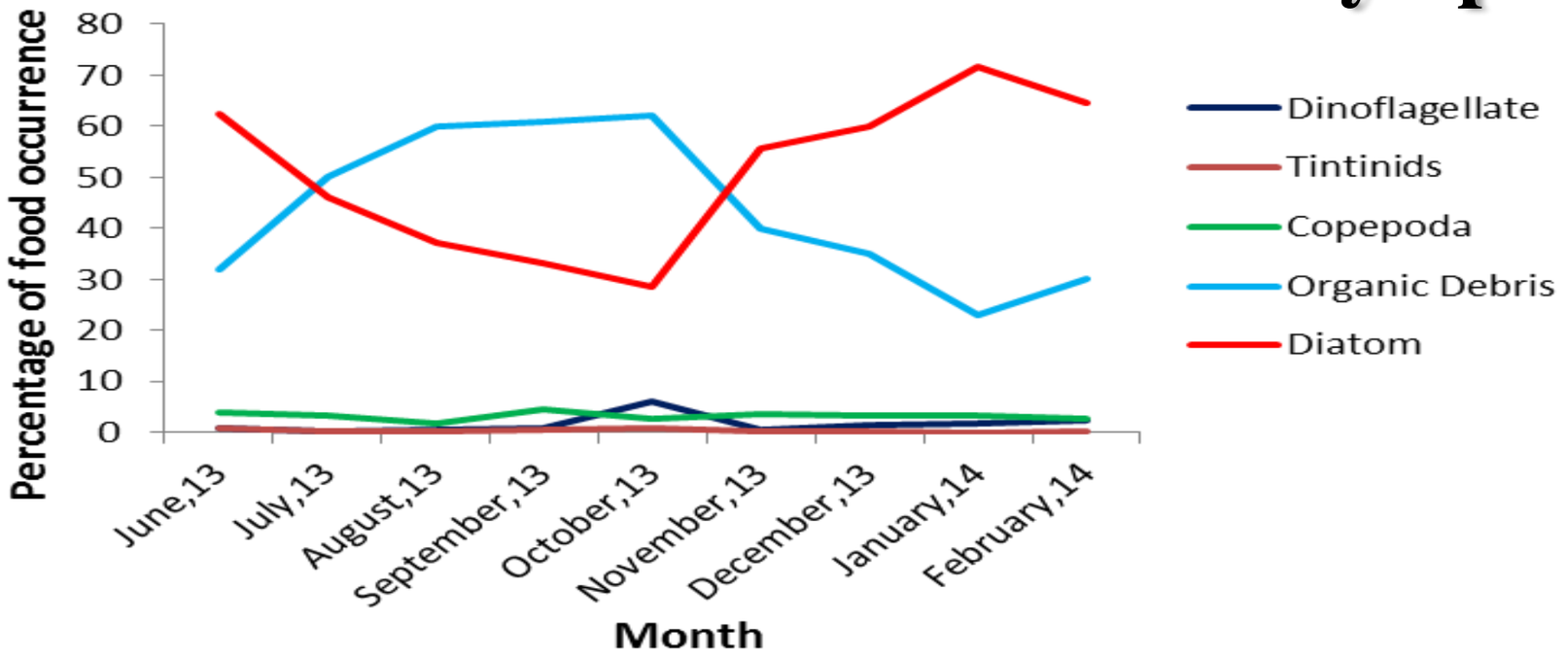
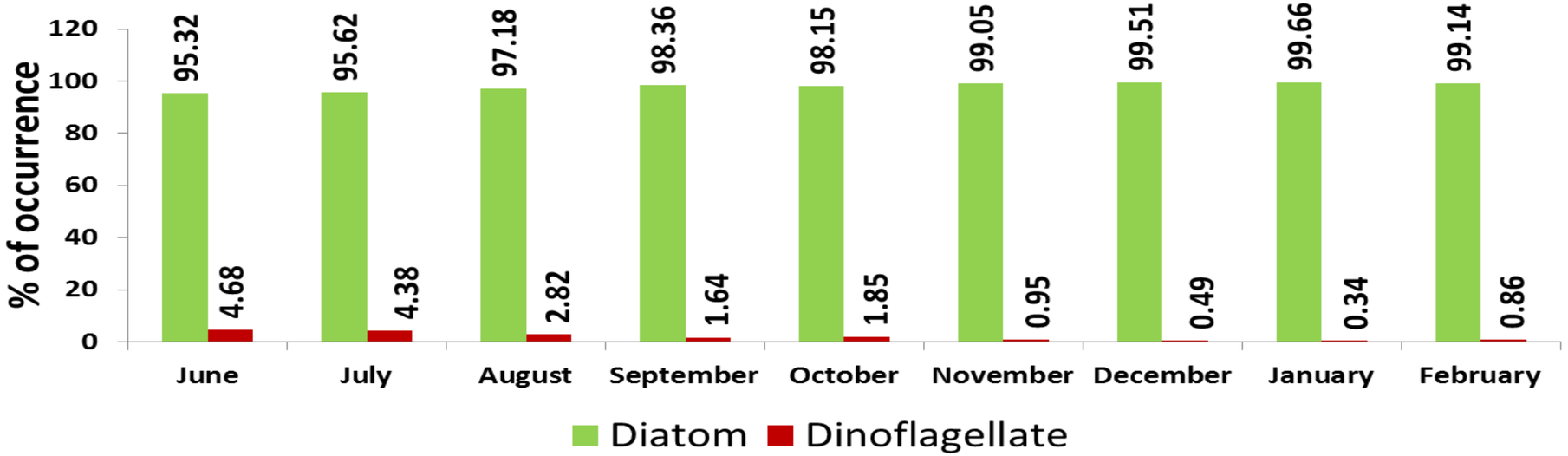
Gut content and Phytoplankton



•During monsoon brooder fishes are gradually decreasing Phytoplankton intake. However, sand/ organic debris intake increase.

•October onwards Diatom intake increases and sand/organic debris intake gets low.

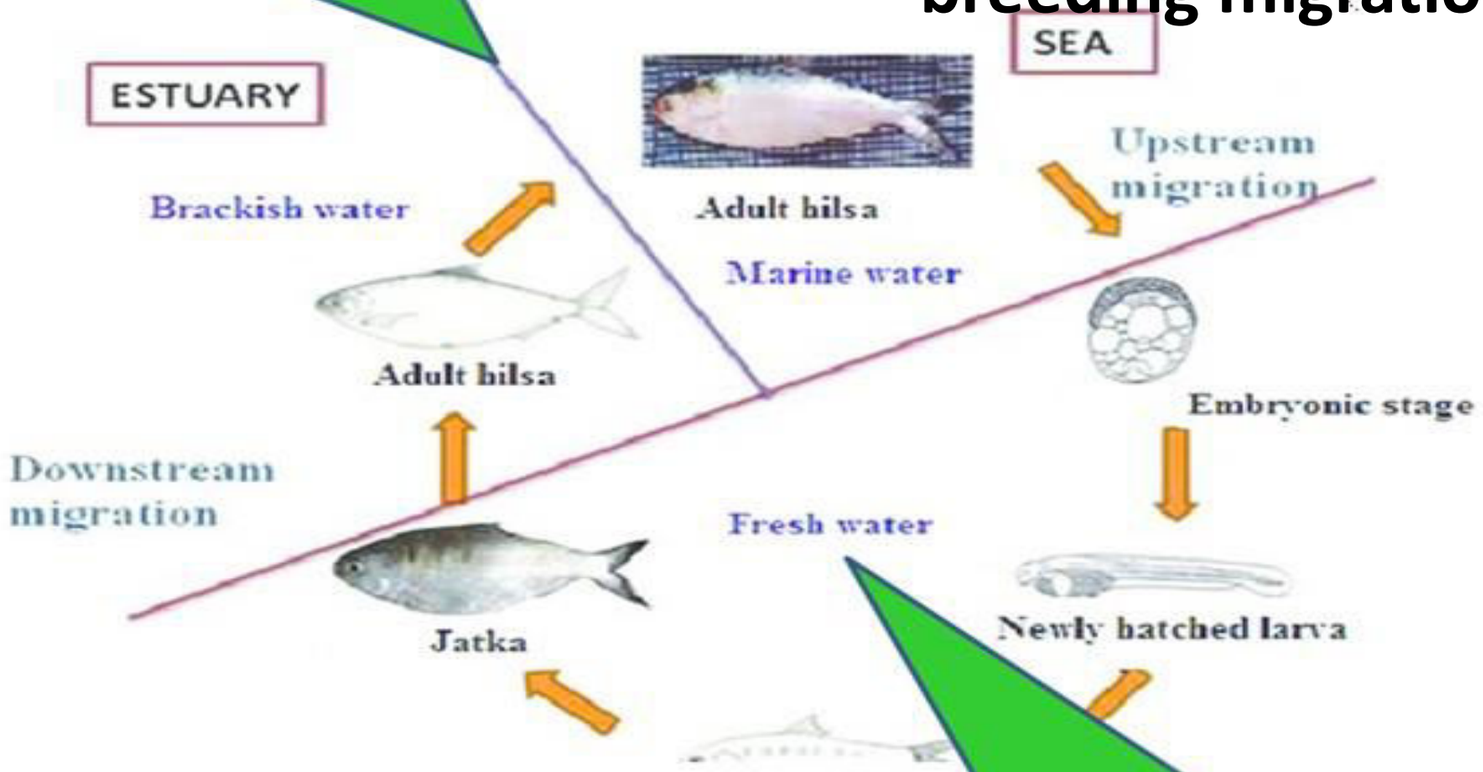


- Percentage of occurrence of Diatom increasing form monsoon to post-monsoon.
- Species diversity of Diatom also increasing during

Collaborator: Jadavpur University

Phytoplankton/ Chl. Is important for growth and nourishment

How much phytoplankton is important for adult during breeding migration ?



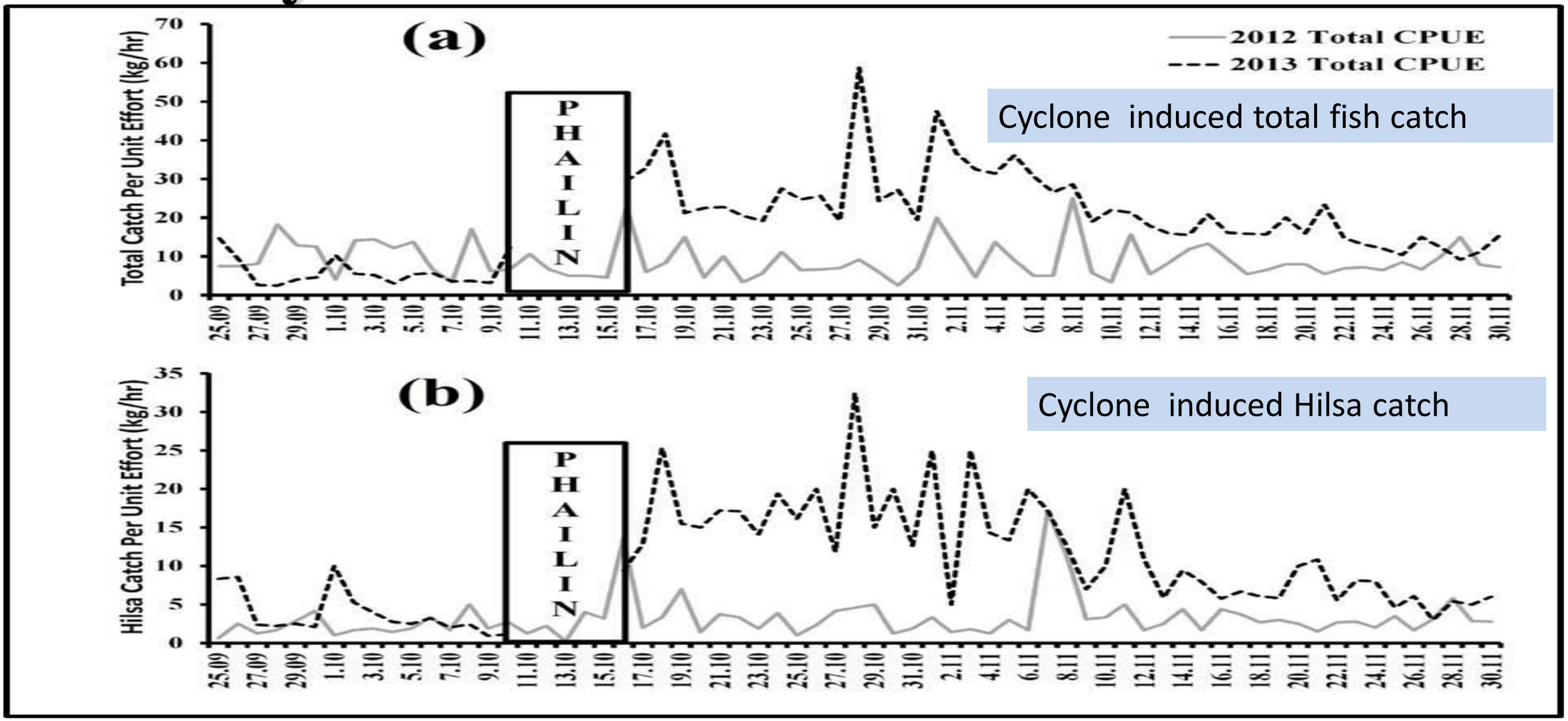
Phytoplankton/ Chl. Is very much important

For larval rearing & successful recruitment

Wind


Wind Speed (m/s) and Direction (°)
Average wind speed of 01–09–2013
84°
85°
86°
87°
88°
89°
90°
23°
22°
21°
20°
19°
18°
INCOIS/MoES
WEST BENGAL
ODISHA
Haldia
Diamond Harbour
Sundarbans
Digha
Chandipur
Gopalpur
Bhitarkanika
Paradip
Puri
Satapada (Chilika)
Barunei
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25

Cyclone induced increased fish catch



Cyclone induced total fish catch

Cyclone induced Hilsa catch

Collaborator: Jadavpur University

Phailin: October 2013

Primary productivity vs Hilsa

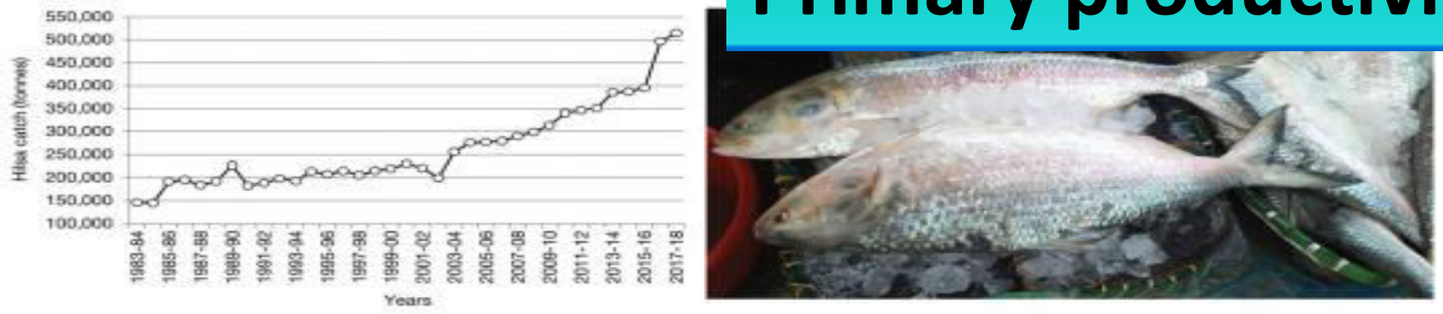


Figure 1. Annual hilsa catch in Bangladesh from 1983 to 2018 (*left*); and few hilsa fishes at a landing center

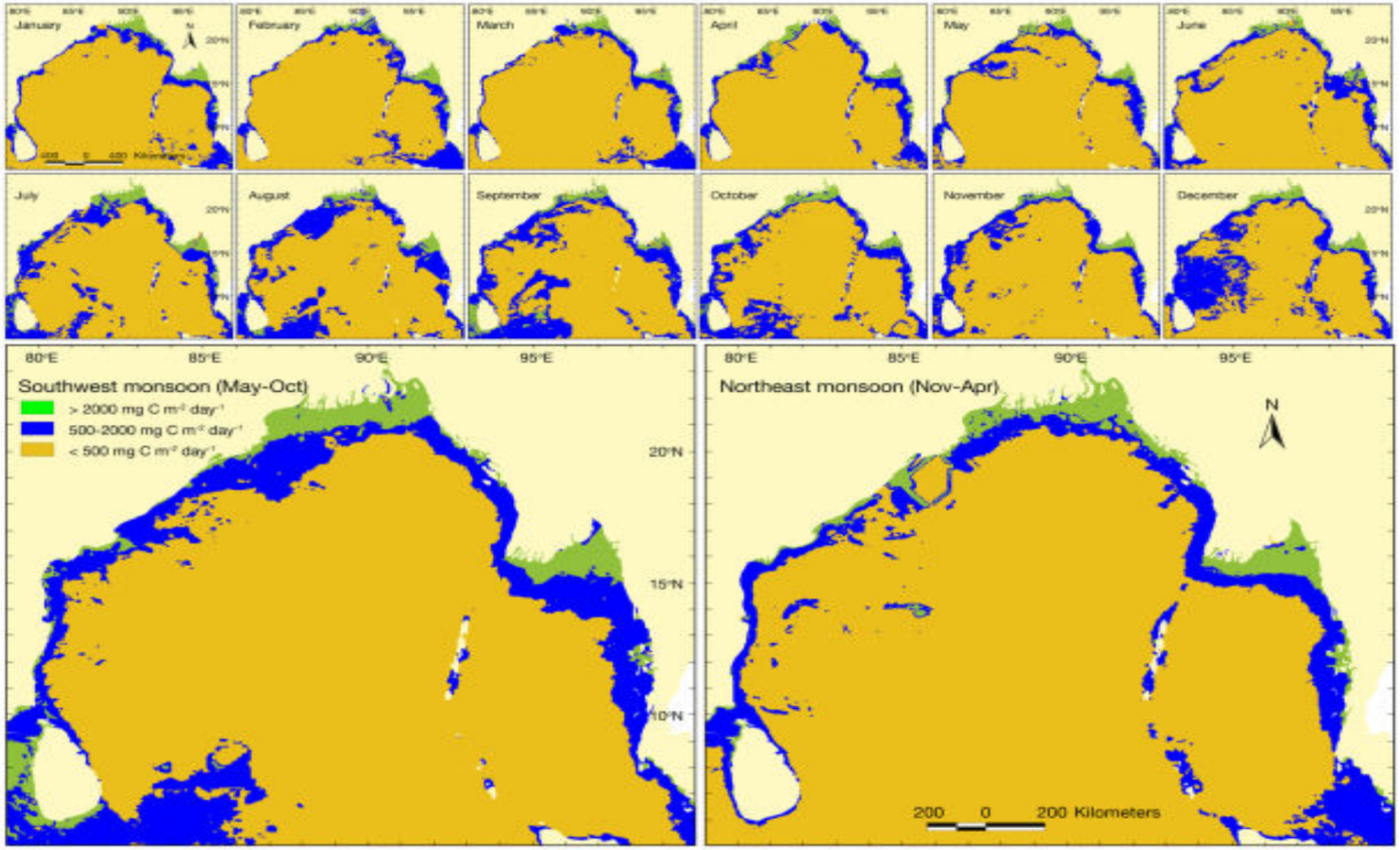


Figure 3. Monthly and seasonal variations of net primary productivity in the Bay of Bengal.

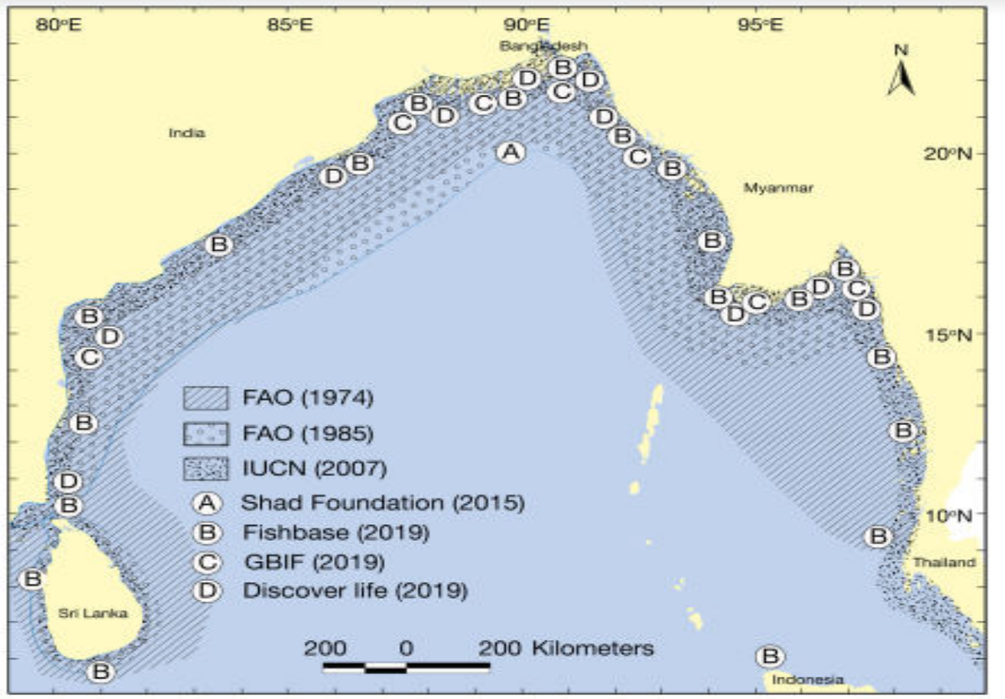


Figure 8. Spatial distribution of hilsa in the Bay of Bengal region since 1974.

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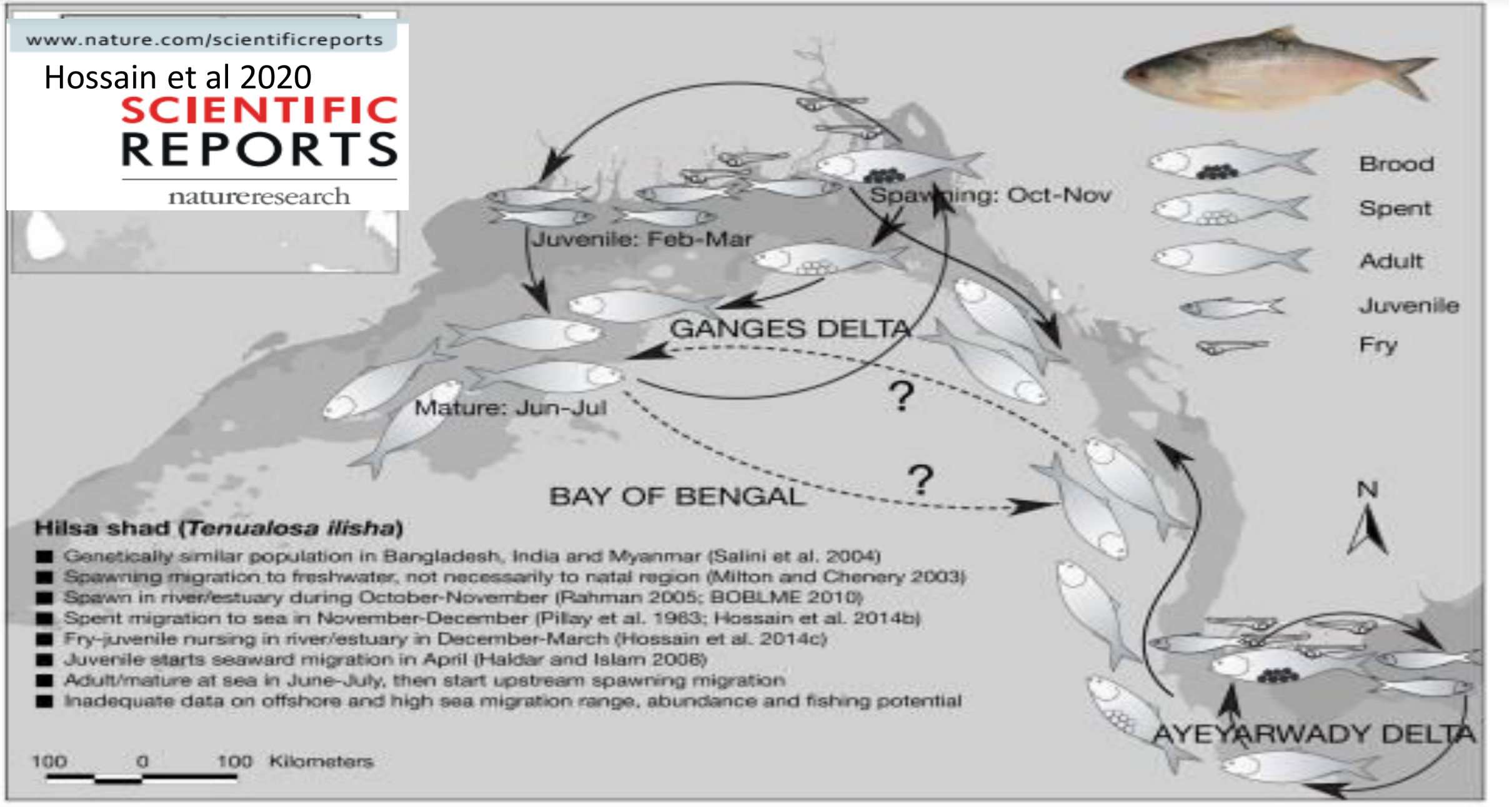
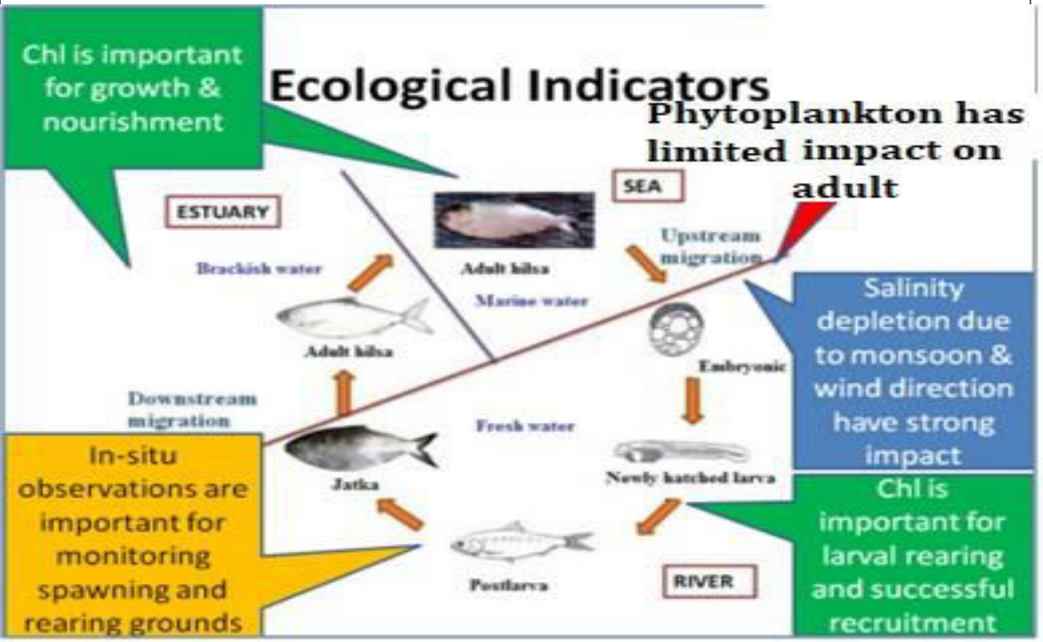


Figure 9. Conceptual map of hilsa habitats, their migration pattern and life cycle in the northern Bay of Bengal.

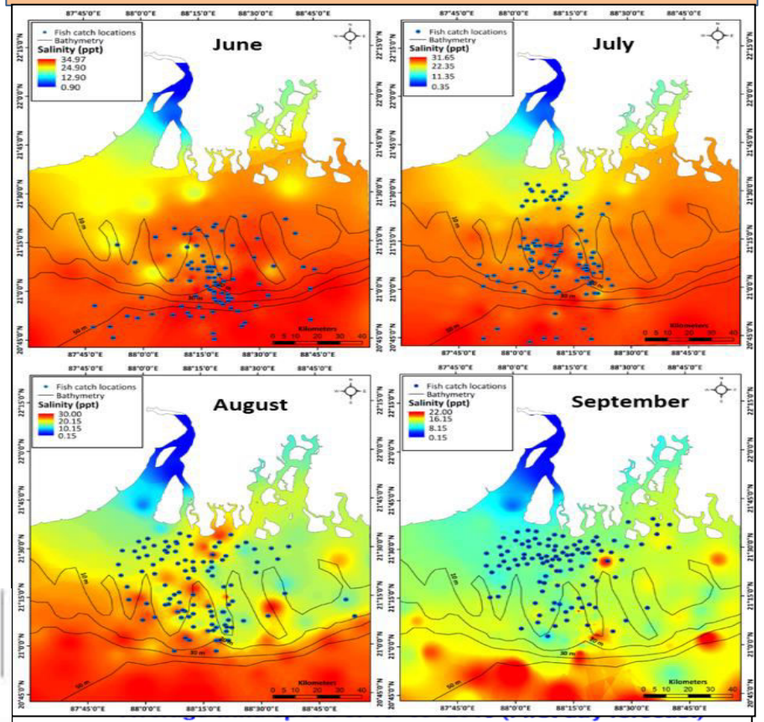
Hilsa shad predictive capabilities

Challenges

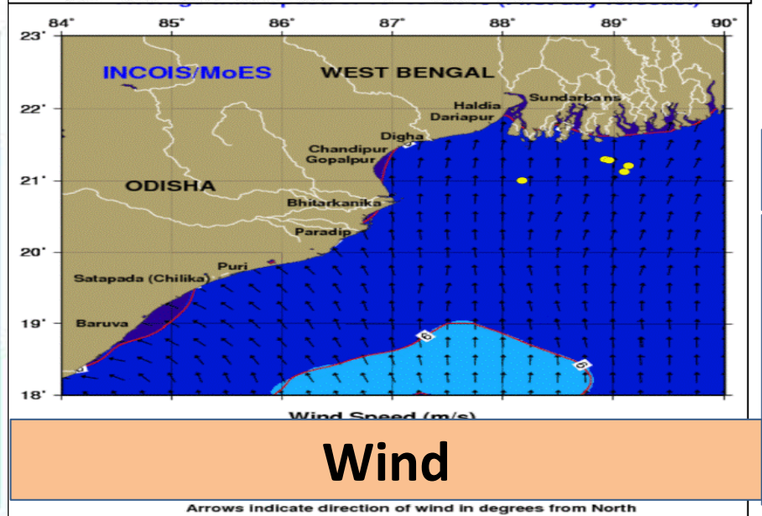
- High commercial value & over harvested
- Highly migratory & anadromous species
- Mostly targeted during monsoon, when the stock is near to coast/estuary for breeding
- High inter-annual variability
- Prediction need to be developed in quantitative approach and should be sustainable in nature
- Service on Maximum Sustainable Yield (MSY) & efforts are essential for policy makers



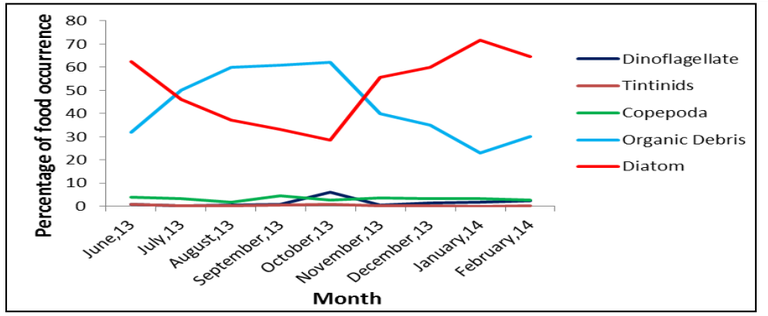
Salinity



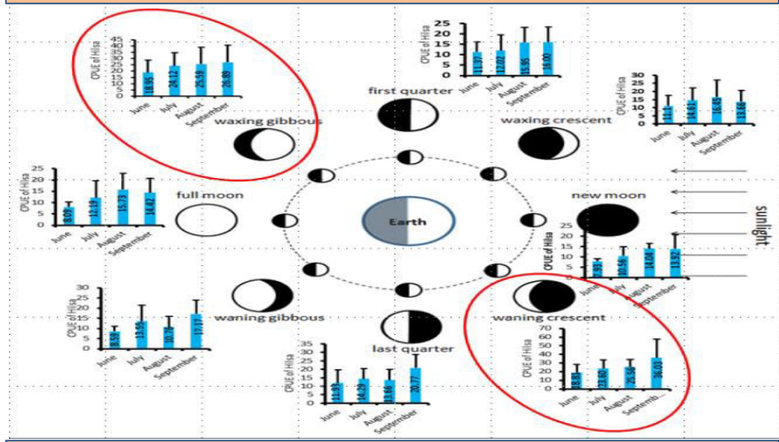
Wind



Phytoplankton



Lunar phase



Proposed Services

- **Short-term & long-term prediction**

Experimental Hilsa shad advisories

Approach

- Small-pelagic fish habitat-suitability modelling
- Model: Generalized Additive Model (GAM)
- Parameters Used:

(i) ROMS simulated sea surface temperature,

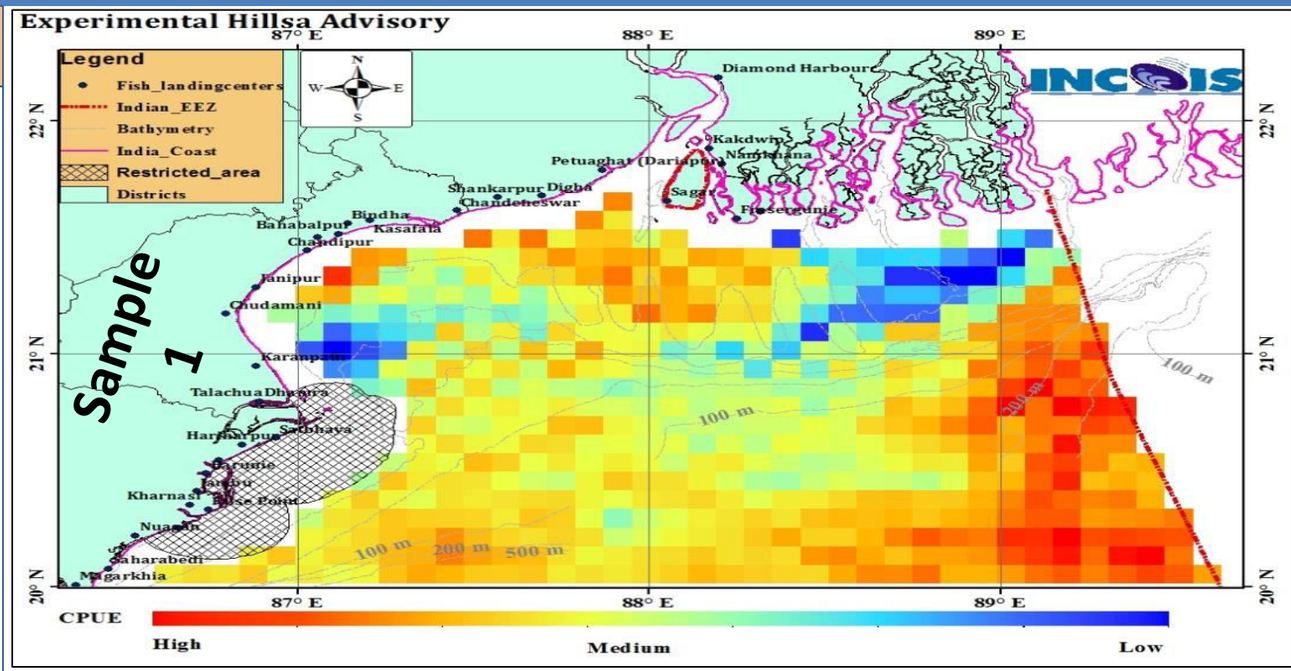
chlorophyll concentration, dissolved oxygen &

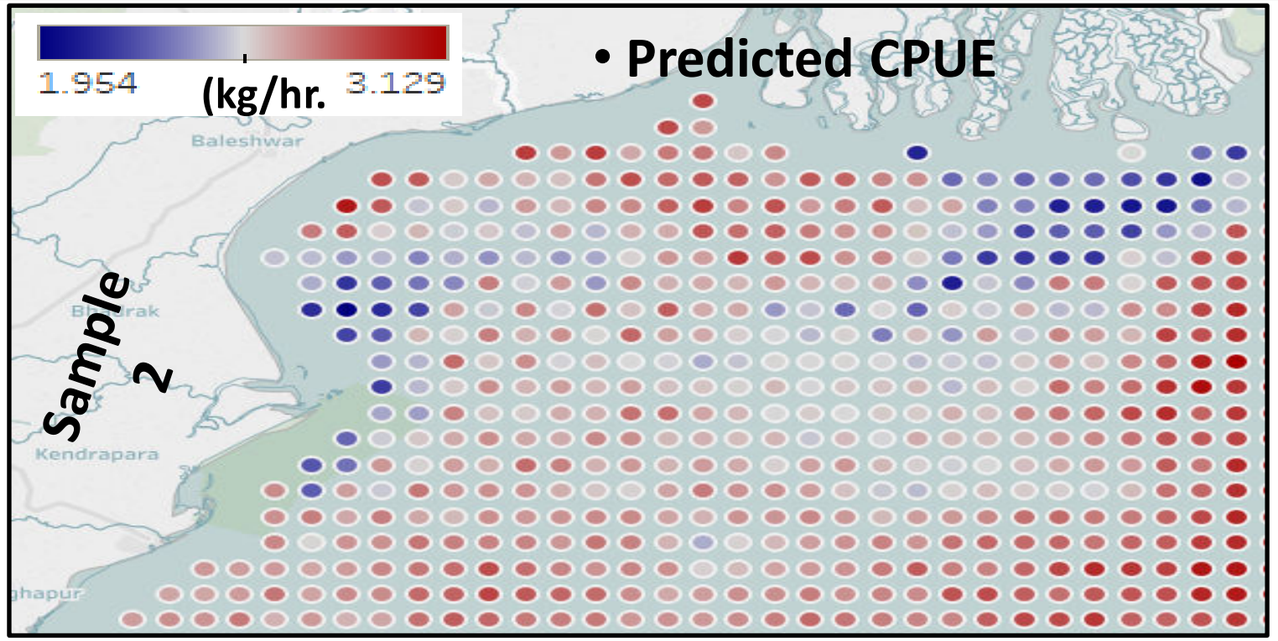
salinity (ii) Remotely sensed rainfall (iii) Fish catch as response variable

- Best fit model :

g(CPUE)=a+s(SST)+s(Rain)+s(Oxygen)+s(Chl)+s (salinity)

where g is the link function, a is a constant, s (.) is a spline smoothing function of the






Thanks for kind attention...
Acknowledgement....
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Sachinandan Dutta