Tale of Two Fishes : Hilsa and Sardine

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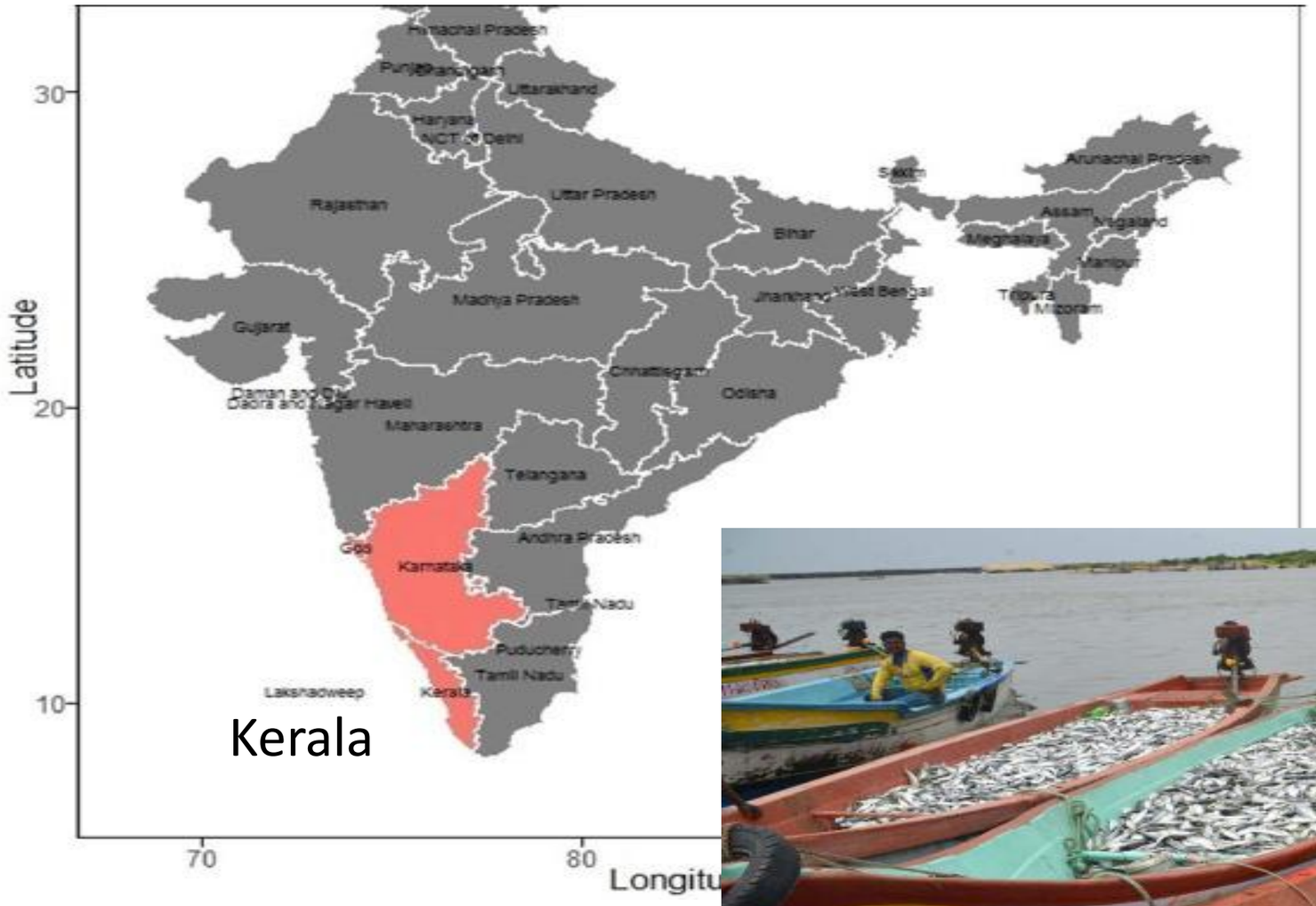
Indian Oil Sardine Fishery

Majority of the pelagic catch comes from the SW coast

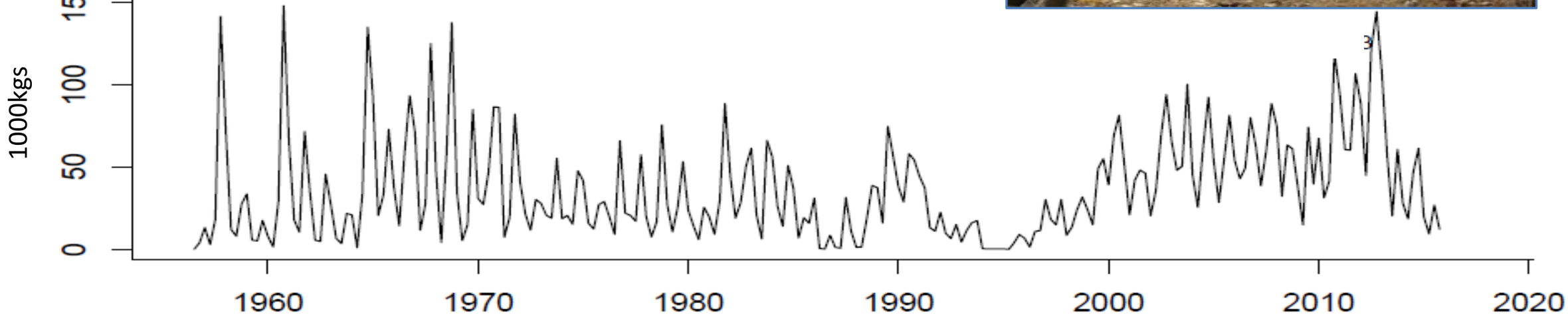


About the species:-

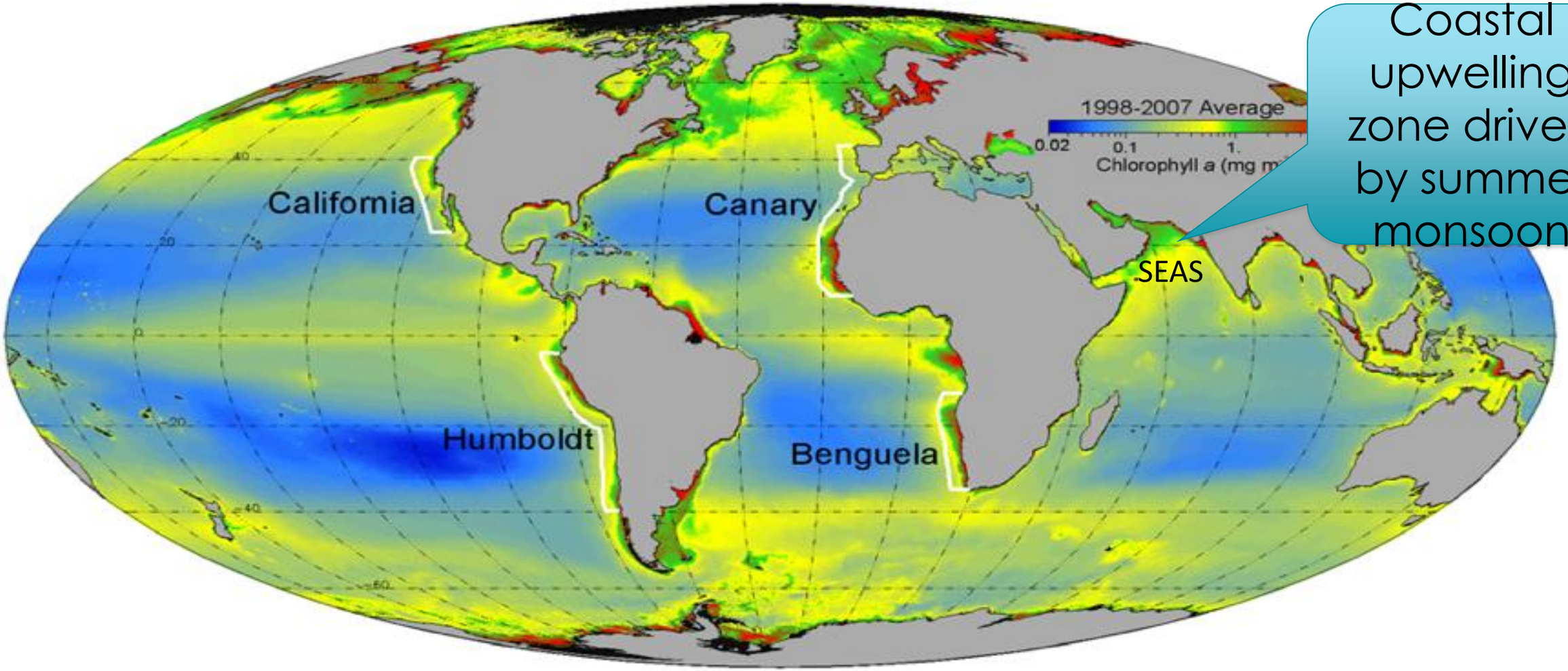
- The landings of Indian oil sardine (*Sardinella longiceps*, Clupeidae) along the southeastern Arabian Sea are about 43.8% of total Indian oil sardine production.
- The annual landings of this species exhibit large-scale variability with prolonged years of surplus or deficit landings without identified reason.

What drives variability in catches?

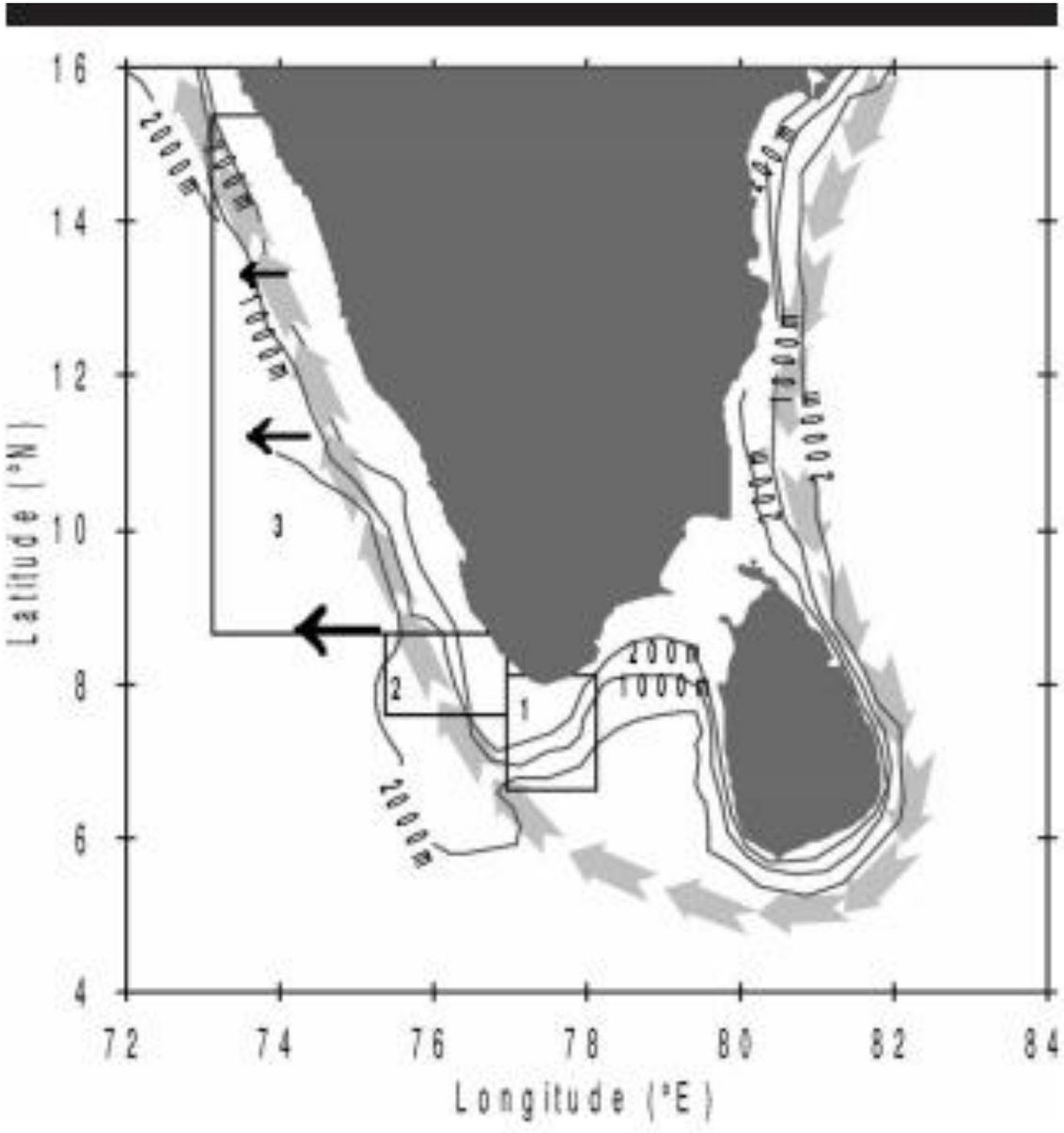
* seasonal
* yearly



The South East Arabian Sea is one of world's major upwelling zones and one of the most productive regions of the world's oceans

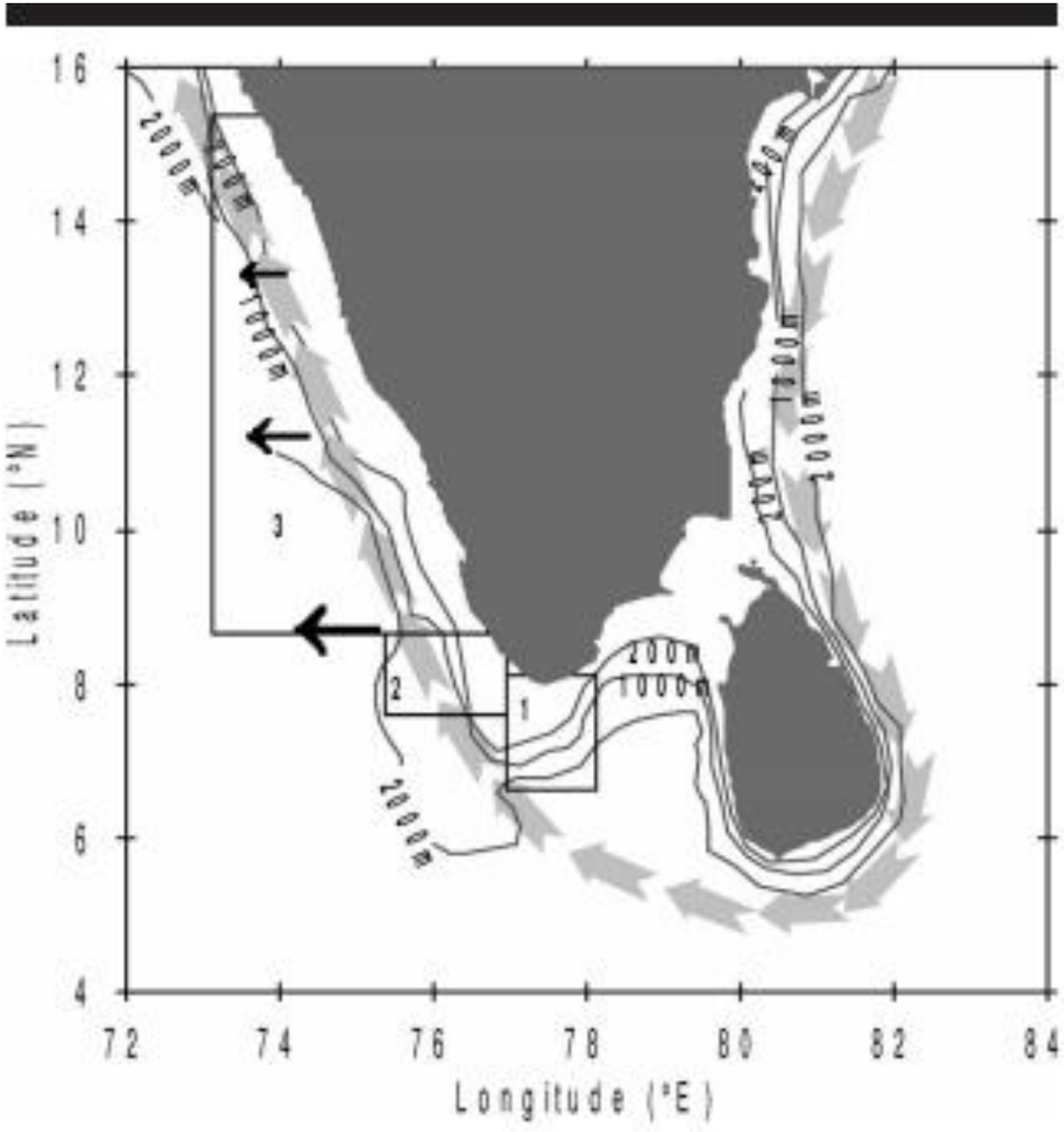


Surface Chl-a 1998-2007 Average



Smitha et al 2008

- Schematic representation of different upwelling zones classified according to the formation mechanism, as well as intensity.
- Arrows along the coast represent coastal Kelvin waves.
- Westwards-directed black arrows depict Rossby waves, the phase velocity of which decreases moving from the equator;
- Upwelling at area 1 is strongly wind driven
- Area 2 is a shadow zone with weak wind-driven upwelling
- Upwelling at area 3 is the result of remote forcing, as well as wind stress.



Smitha et al 2008

- 8 N and 9 N represents the shadow zone to the influence of the remote forcing on the upwelling
- Moderate to relatively intense upwelling occurs along the Kollam to Mangalore coast (9 N to 13 N) due to the combined action of the longshore wind stress, the coastally trapped Kelvin waves, and the offshore propagating Rossby waves.
- North of this area (13 N to 15 N), upwelling is weak due to weak wind stress and is closely confined to the coastal belt.

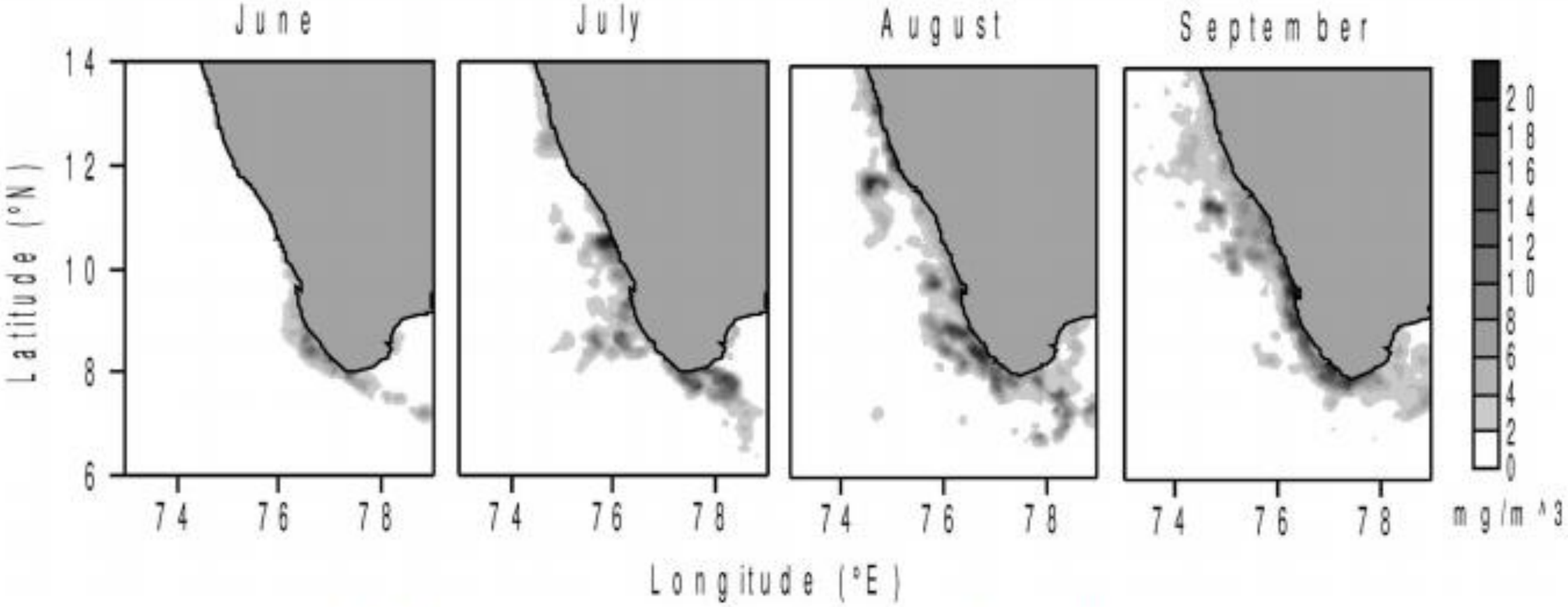


Figure 8. Four-year climatology (2003–2006) of monthly composite surface chlorophyll from MODIS AQUA for June–September.

Smitha et al 2008

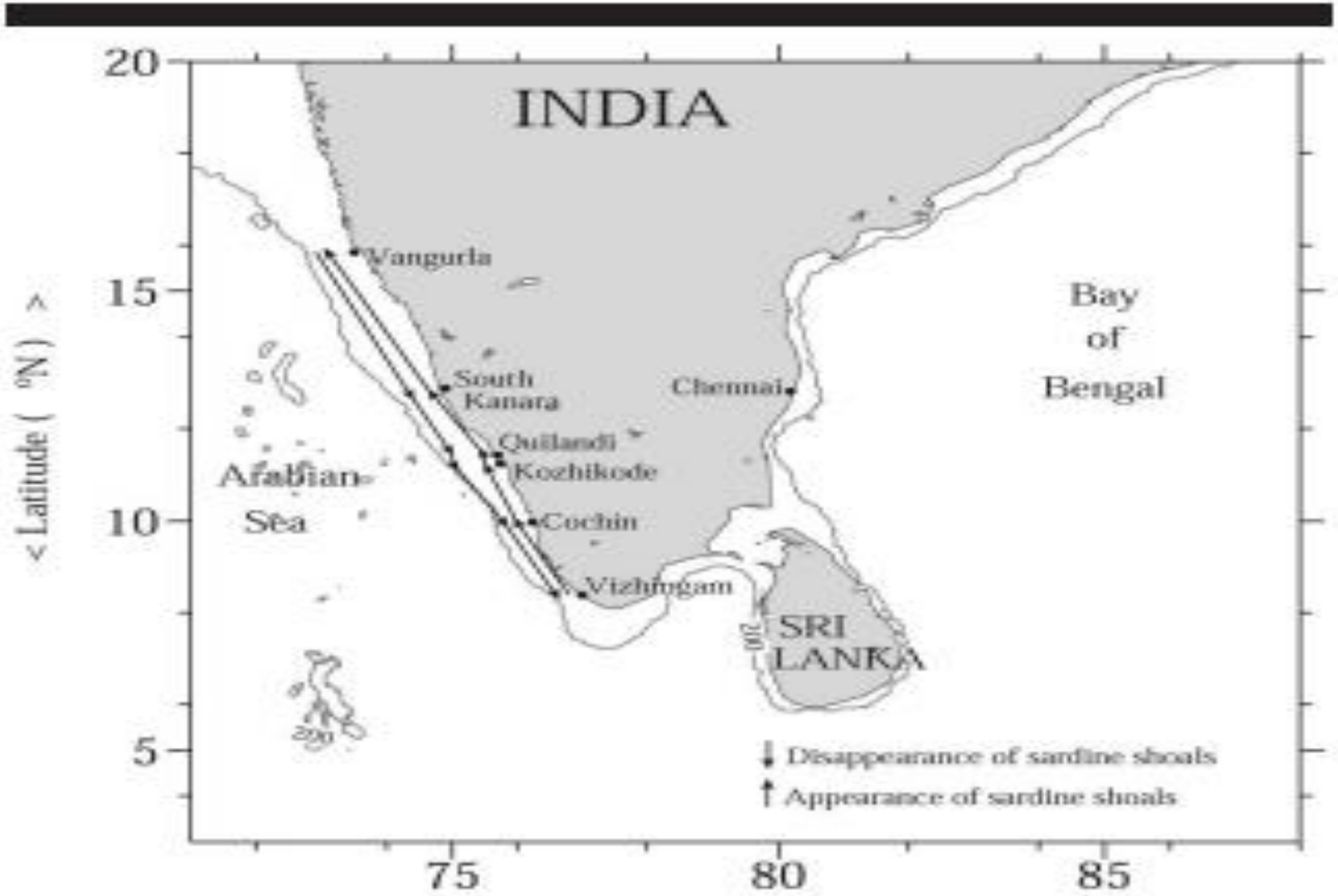


Figure 1. Schematic representation of progression of sardine shoals from Vizhingam to Vangurla (Chidambaram, 1950; Hornell, 1910b) and their departure in the reverse direction (Panikkar, 1952).

George et al 2012

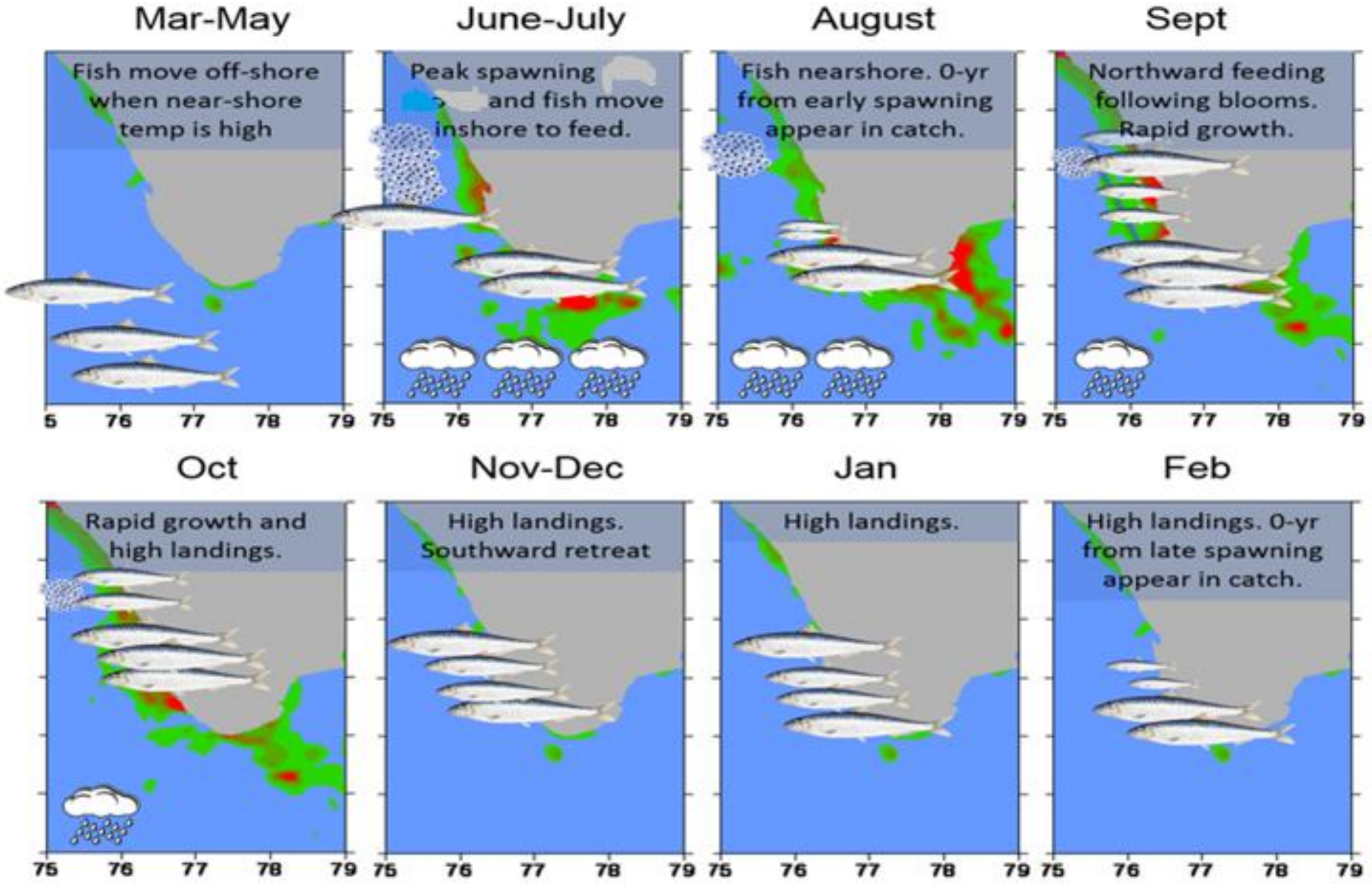
- From April to September, the shoals of spawners and juveniles migrate from offshore to inshore all along the west coast following the onset of bloom (Antony Raja, 1972).
- Northward migration of sardines happens steadily during southwest monsoon period and retrogression from north to south in the northeast monsoon phase

- Sardines perform a normal migration from offshore to coastal waters and vice versa coinciding with the customary wind conditions (Hornell, 1910b).
- A gradual increase in temperature within the range of 26 to 28 C is favourable for the inshore migration of the juveniles, and with increasing temperatures (above 29C) during March to May they disappear to deeper waters (Chidambaram, 1950).

Spawn in June-July

Mature at age 1 (12 months)

2 to 2.5 yr life span



- Salinity and temperature along with physical indices such as upwelling and mixed layer depth (MLD) of the ocean help to propose a mechanism to temporal variability in the landings of oil sardine.
- Colder temperature and timely intense upwelling lead to nutrient enrichment in the surface water, which promotes the growth of phytoplankton (chl-a) and thereby food availability to Indian oil sardine are found during years with surplus catch.

Hamza et al 2020

- Less saline surface waters and shoaling of MLD at these times could lead to the aggregation of fish at particular depths and thereby a good catches.
- The reverse mechanism, such as more surface saline water, warm temperature, downwelling or weak upwelling, and less nutrient enrichment, leads to deficit landings.
- Pacific decadal oscillation and Atlantic multidecadal oscillation have a more pronounced impact on Indian oil sardine landings over the coast of south-eastern Arabian Sea than ENSO associated impacts

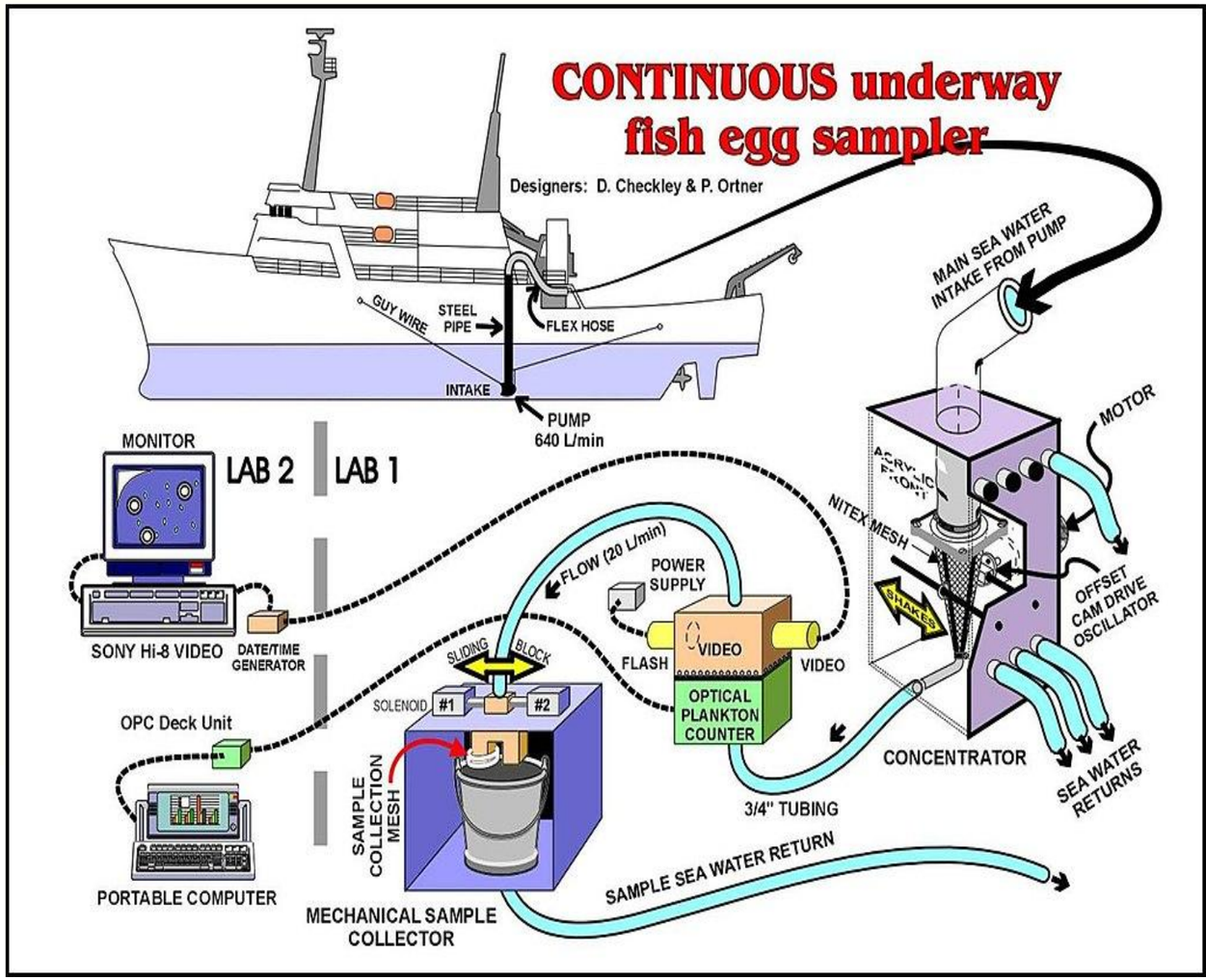
Hamza et al 2020

MoES-NOAA Collaboration: Development of Predictive Capabilities for Marine Fisheries and Harmful Algal Blooms in Indian Seas

MoES = Ministry of Earth Sciences (INCOIS & CMLRE)& NOAA working group

Inboard Fixed CUFES®

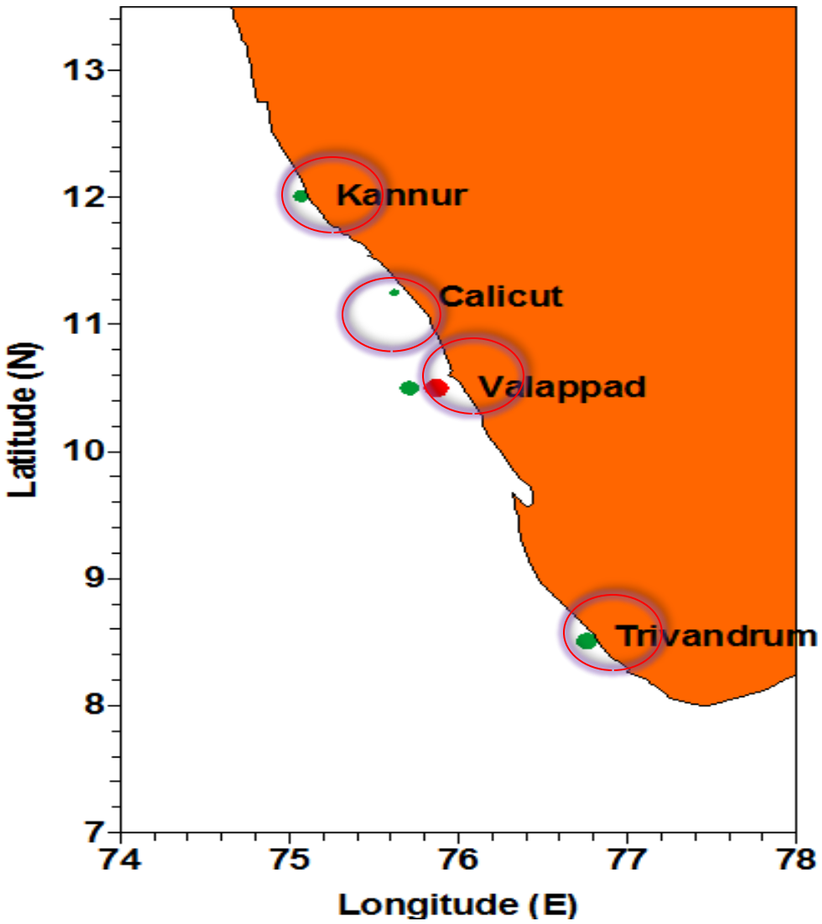
The Continuous Underway Fish Egg Sampler (CUFES®) is a new instrument used to study the distribution of fish eggs from a moving ship. It consists of a hull mount with submersible pump, concentrator and sample collector. Water is pumped continuously from a fixed depth (surface to 3 m) to the concentrator on board ship. Eggs and similarly-sized particles are retained in the sample collector. CUFES® operates continuously under all sea conditions.

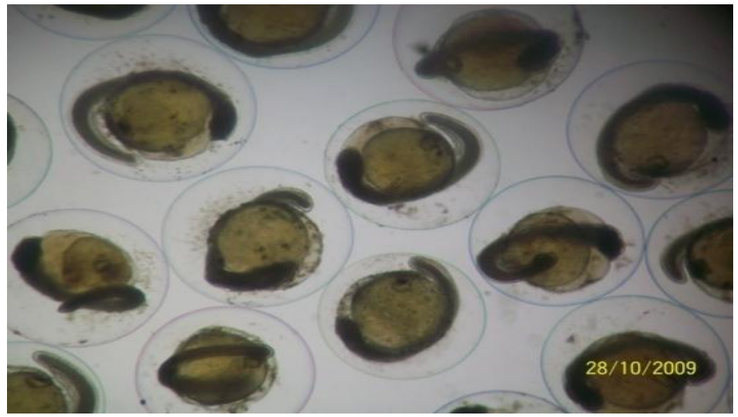


Presently installed in FORV SAGAR SAMPADA of CMLRE, MoES

Oil Sardine : Eggs & Larvae

Spawning Grounds of *Sardinella longiceps*

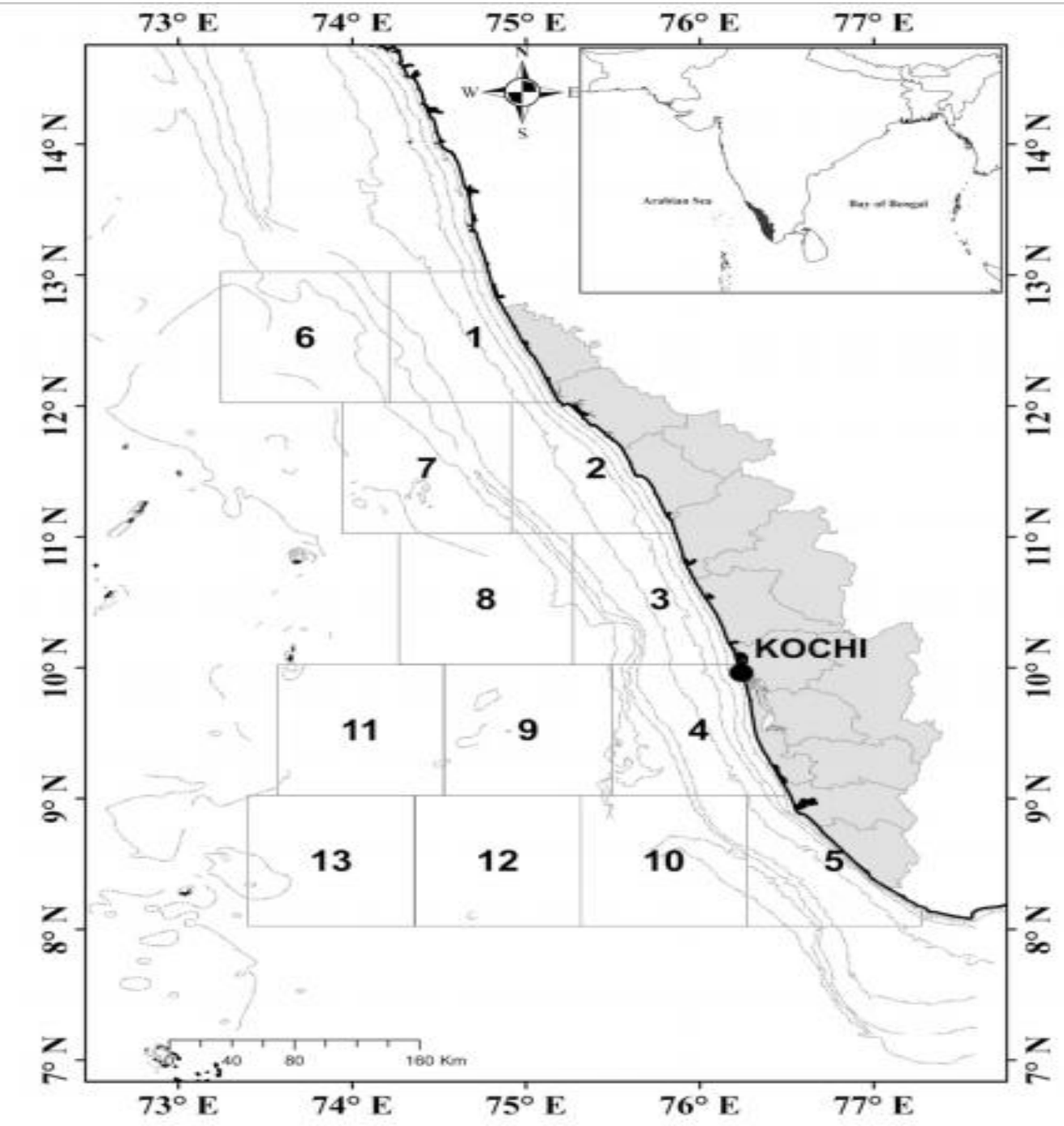




- Off Valappad
- Off Trivandrum
- Off Kannur
- North off Calicut

Summer Monsoon Season

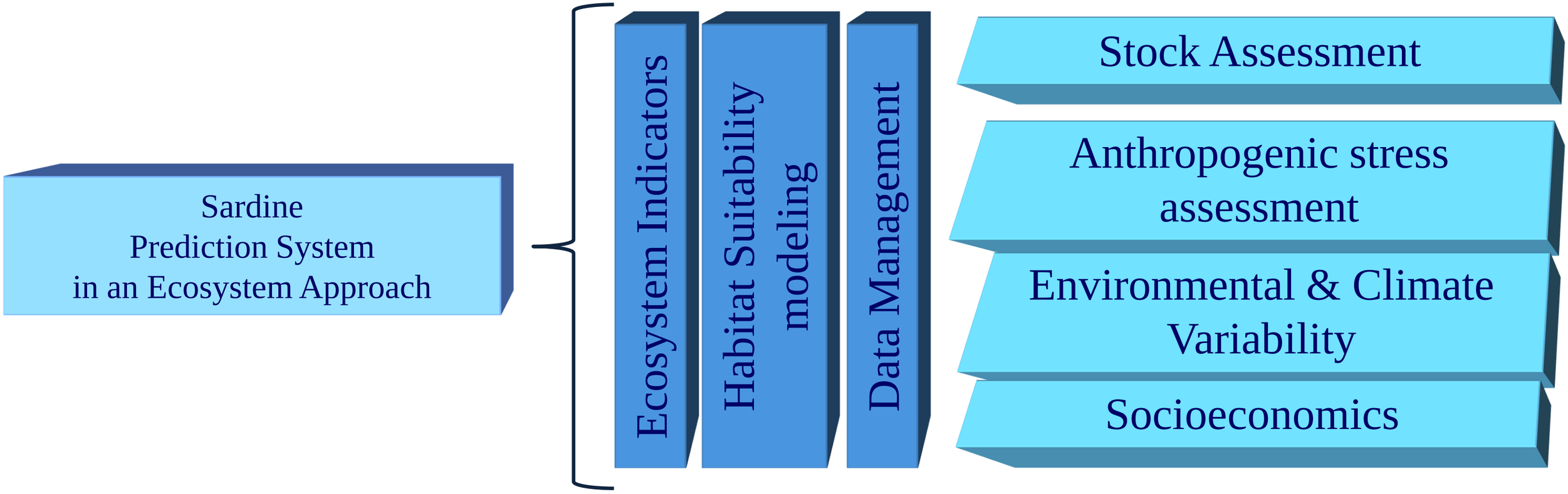
Source: CMLRE



- Strong temperature differential between the nearshore and offshore, and high primary productivity and surface chlorophyll in June–September
- Primary productivity subsides after September, whereas mesozooplankton abundances increase and remain high in the post monsoon period .

Predictive capabilities of Sardine in Indian Seas"

Approach:



Partners:

NMFS/NOAA (under NOAA-MoES SoI)

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)

Findings:

- Two covariates explained catch variation and improved prediction
- The 2.5-year average regional SST & precipitation over land during June-July.
- The most significant relationship was between the SST covariate and post monsoon landings
- Models with the second best covariate, precipitation over land during the monsoon with very minimum prediction error.

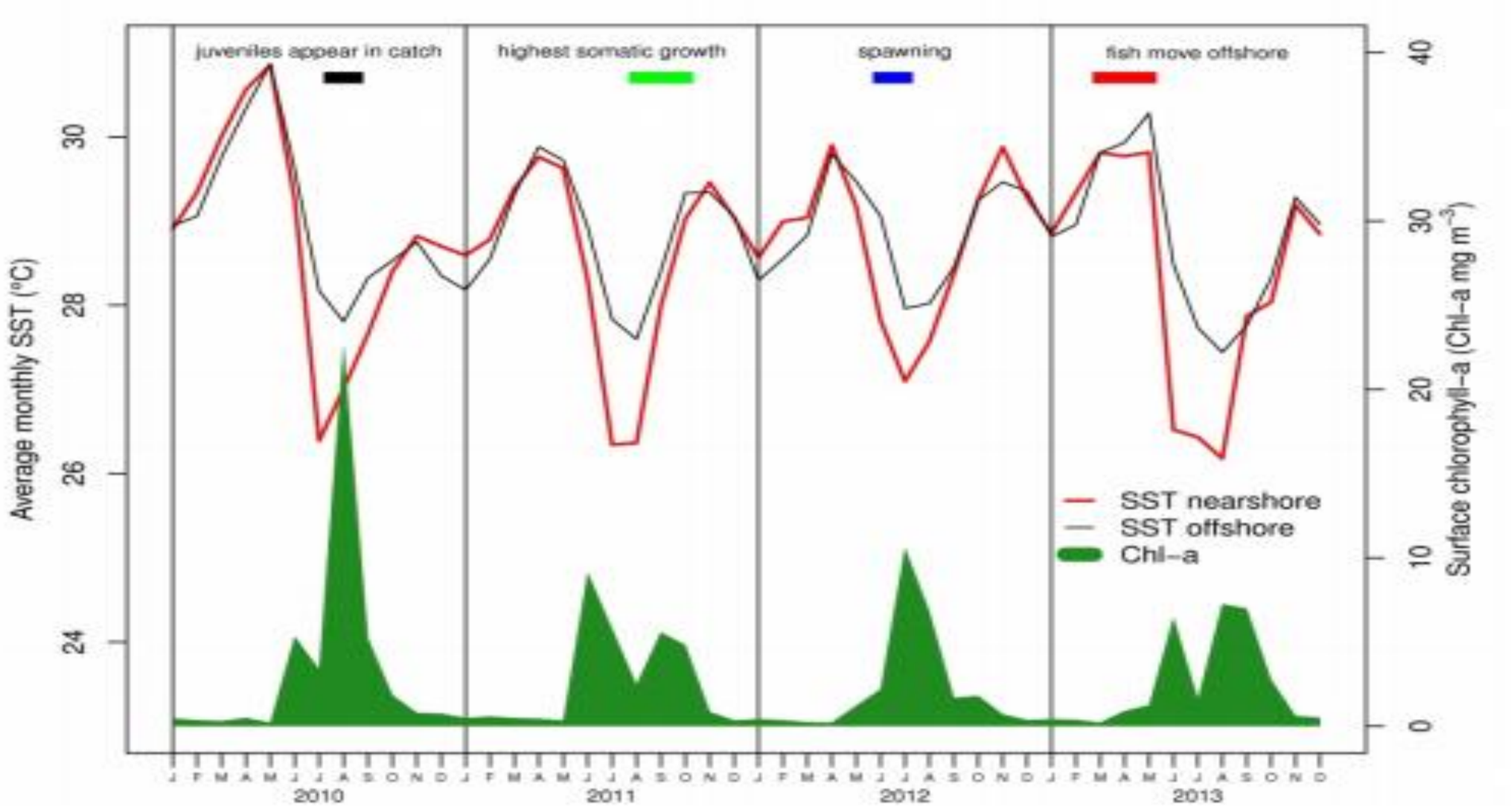


FIGURE 2 Key oil sardine life history events (top colored bars), overlaid on the monthly nearshore and offshore sea surface temperatures (SSTs; □C) and nearshore chlorophyll-a (Chl-a) concentrations (mg m-3).

Thanks for kind attention...

Acknowledgement.....

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Photo credit.....

Sachinandan Dutta