Workshop: 6
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Inter-annual variability in *Sardinella longiceps* in response to ENSO event in the coastal waters of India

Grinson George, Muhammad Shafeeque, Nandini Menon, Shubha Sathyendranath and Trevor Platt

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CMFRI

Presented by,
Dr. Shubha Sathyendranath
Plymouth Marine Laboratory, UK

About Oil Sardine:

Distribution - Kerala, Karnataka, Goa and southern parts of Maharashtra on the west coast and Tamil Nadu and Andhra Pradesh on the east coast.

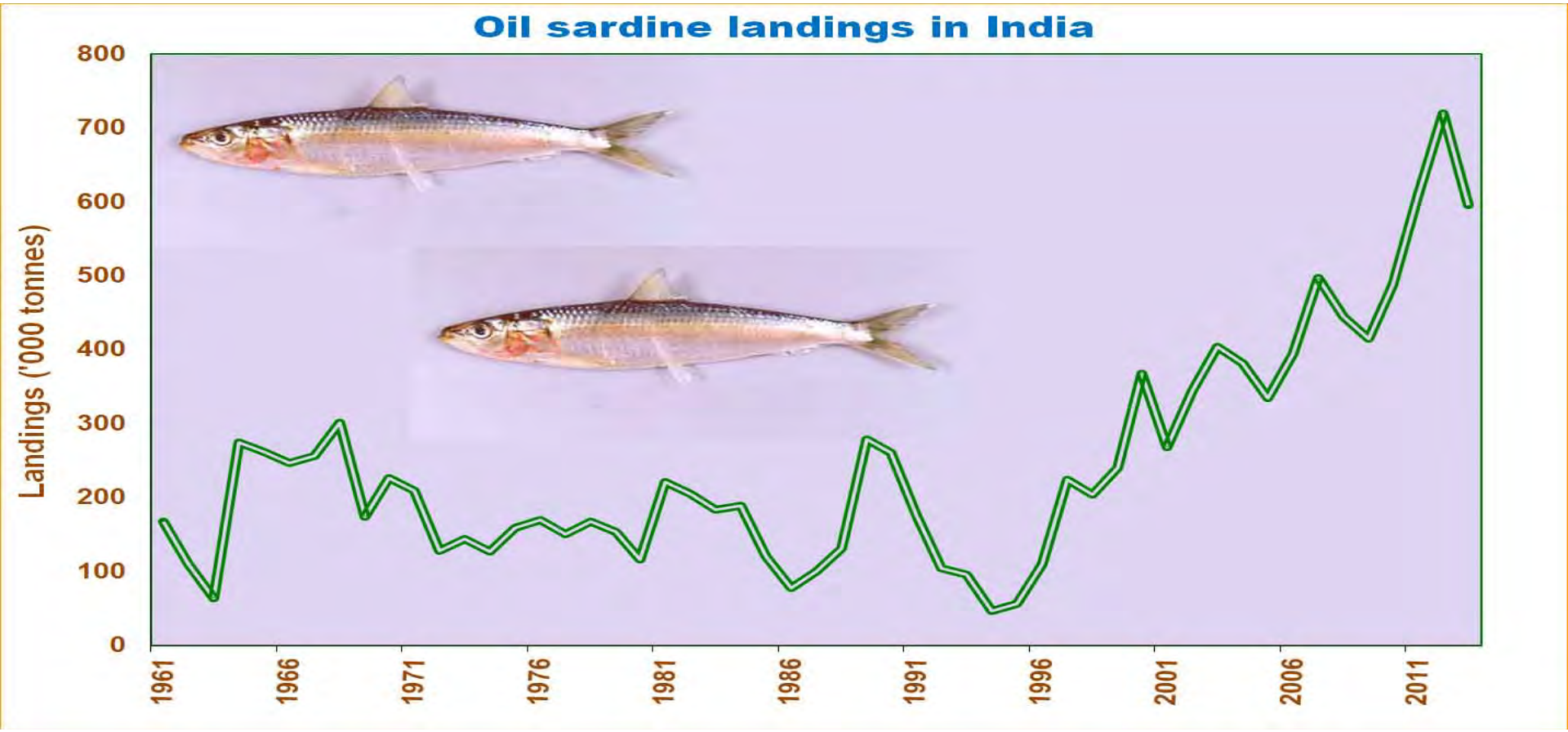
Feeding habits - Oil Sardine is a plankton feeder and is known to feed mainly on diatoms (*Fragillaria oceanica, Coscinodiscus, Biddulphia*) and dinoflagellates (*Ceratium, Prorocentrum*).

Growth - Grow rapidly, mature early and a few survive through the second year of life. The fish is known to attain sexual maturity within one year (0-year class) at a length of 150 mm.

Spawning - Takes place at the end of first and second year. The spawning season shows certain amount of inter annual variation in its duration. It extends from May to October with intense spawning during June to August.

Recruitment - The fishery is usually dominated by 0-year class with a length range of 125 – 175 mm in the inshore waters.

Gear used - Ring seines, purse seines, shore seines and pair trawls

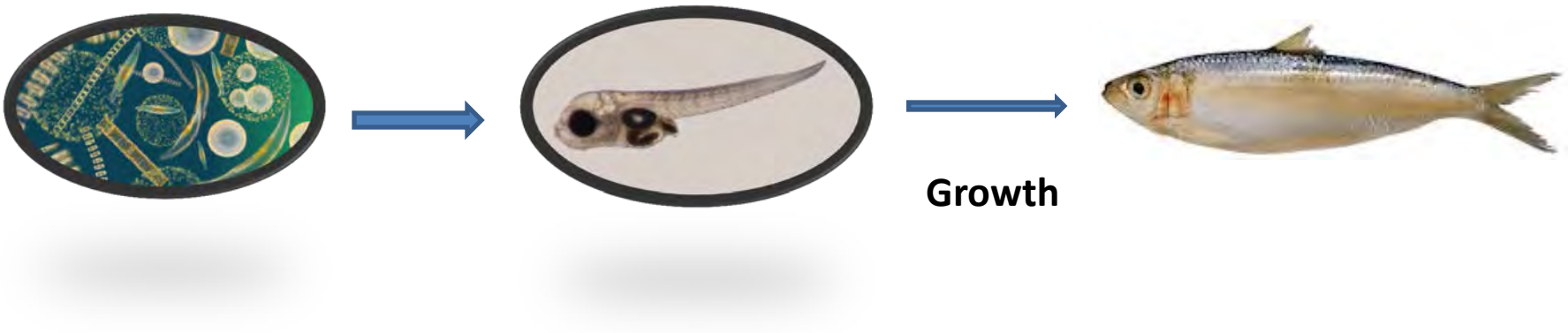


Source: CMFRI database

Large inter-annual variability in sardine catch has been noticed irrespective of an increased and sustained fishing efforts (Longhurst and Wooster, 1990; Srinath, 1998; Jayaprakash, 2002).

How are algae related to ecosystem health?

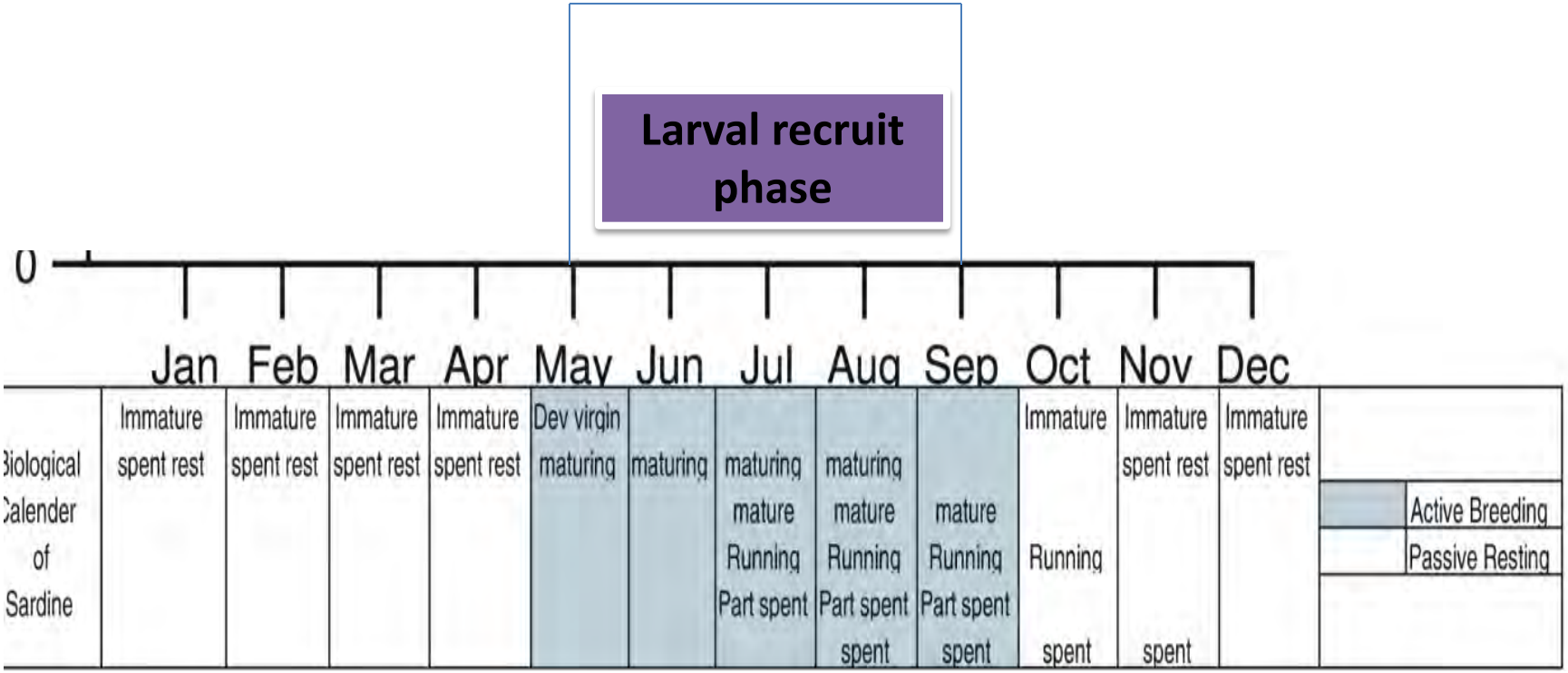
Algae serves as food to commercially important fish, especially the pelagic herbivores.

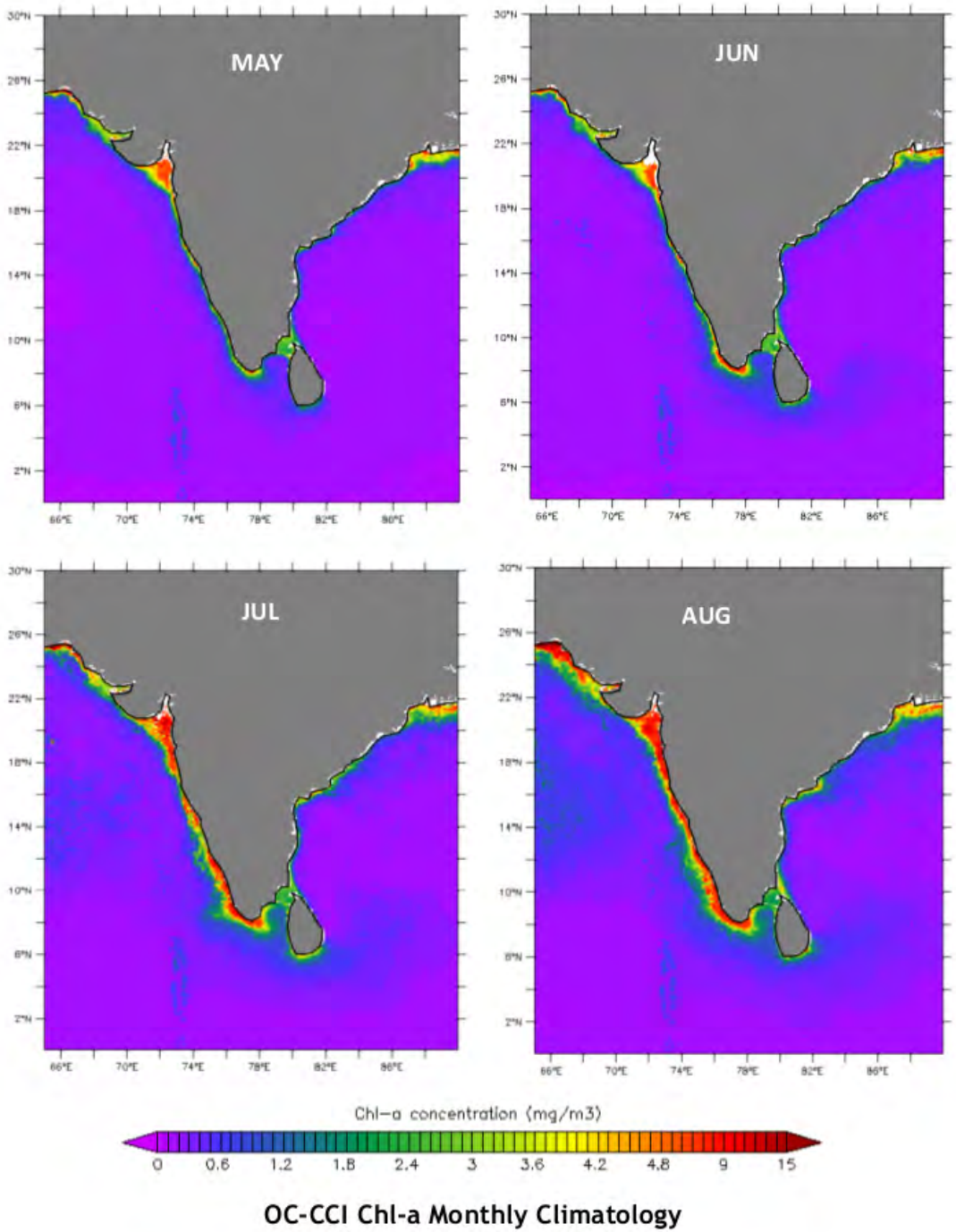


Several studies have indicated that the abundance of oil sardine in the south west coast of India is highly variable and environmental factors such as temperature, salinity, rainfall and availability of food seems to be the factors controlling its availability.

Sardine larvae are predominantly surface and column feeders, preferring phytoplankton dominated by diatoms such as *Fragillaria oceanica*, *Pleurosigma sp.*, *Coscinodiscus* sp. (Kuthalingam, 1960; Nair, 1959

The earliest spawned surviving individuals will be recruited to the fishery by the end of the spawning period, which in turn determines the yearly landings. Thus, larval ecology decides the later abundance of recruits to the fishery





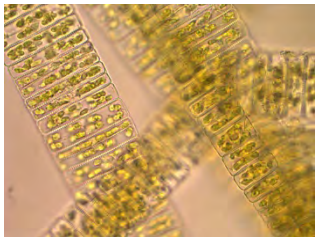
Monthly Chl-a (OC-CCI) Climatology for May- August

Sampling site – off Cochin

Bloom events

1)Trichodesmium sp. **bloom – 29- Apr -2014**

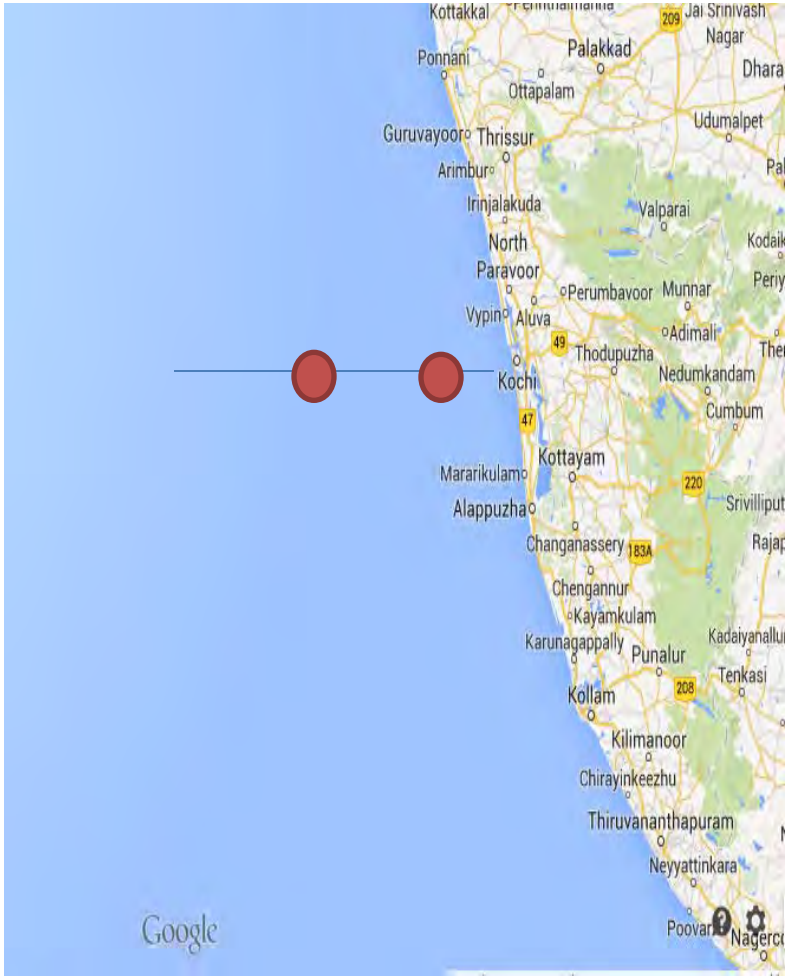
2)Fragillariopsis **spp. Bloom- 08 – Jun - 2014**



Non bloom events

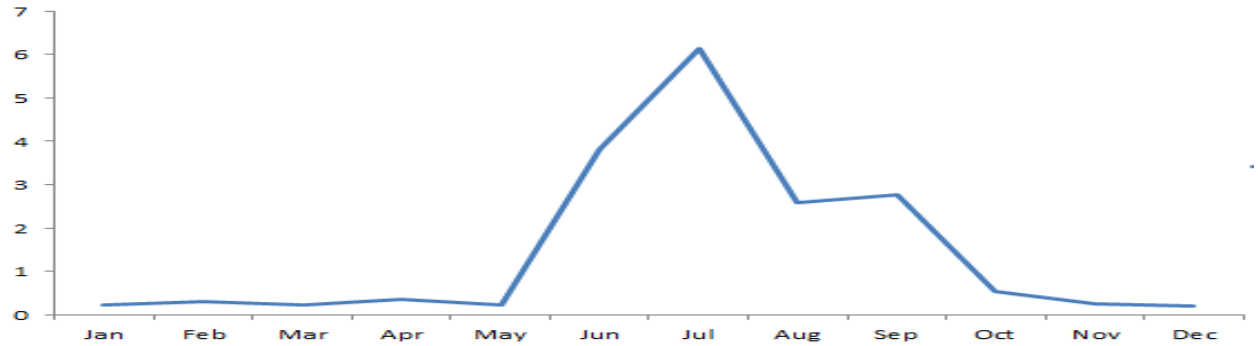
1) 12- Feb -2014
2) 05 - May -2014
3) 13- Oct - 2014

How the occurrences of bloom affect sardine population?

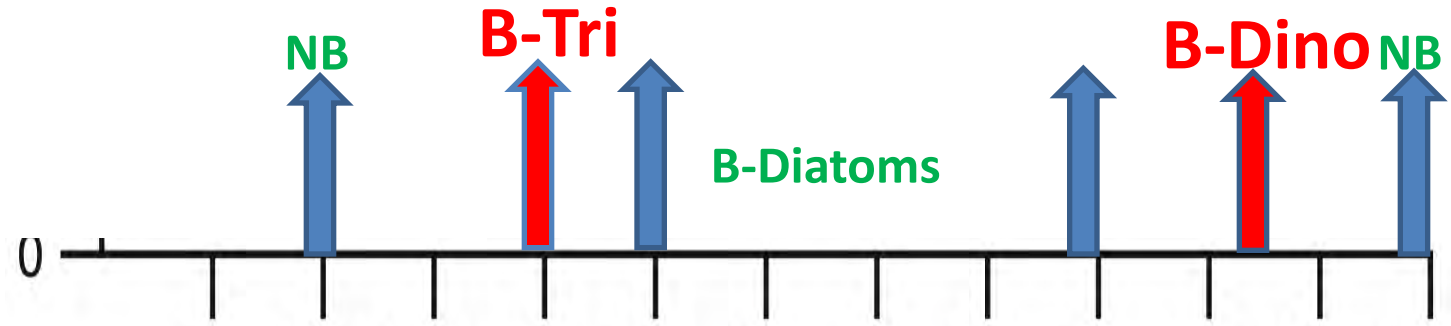


Sampling date	29-April-2014	05-May-2014	08-Jun-2014
No of species	12	35	19
Total cell density (No of cells/l)	$2.8*10^5$	1235	$2.7*10^6$
Dominant genera	***Cyanobacteria***	***Diatoms***	***Diatoms***
	Trichodesmium erythraeum	***Asterionella glacialis***	*Fragillariopsis sp.*
	Coscinodiscus sp.	***Coscinodiscus centralis***	*Chaetoceros sp.*
	Chaetoceros sp.	***Ditylum brightwelli***	*Asterionellopsis sp.*
	Ceratium furca	***Skeletonema sp.***	*Thalassiosira sp..*
	Asterionella sp.	***Ceratium sp.***	*Asterionella sp.*

Area Averaged monthly Time series Chl a concentration (mg/m^3)



B – Tri: Trichodesmium bloom **NB – Non bloom** **B – Dino: Dinoflagellate bloom**



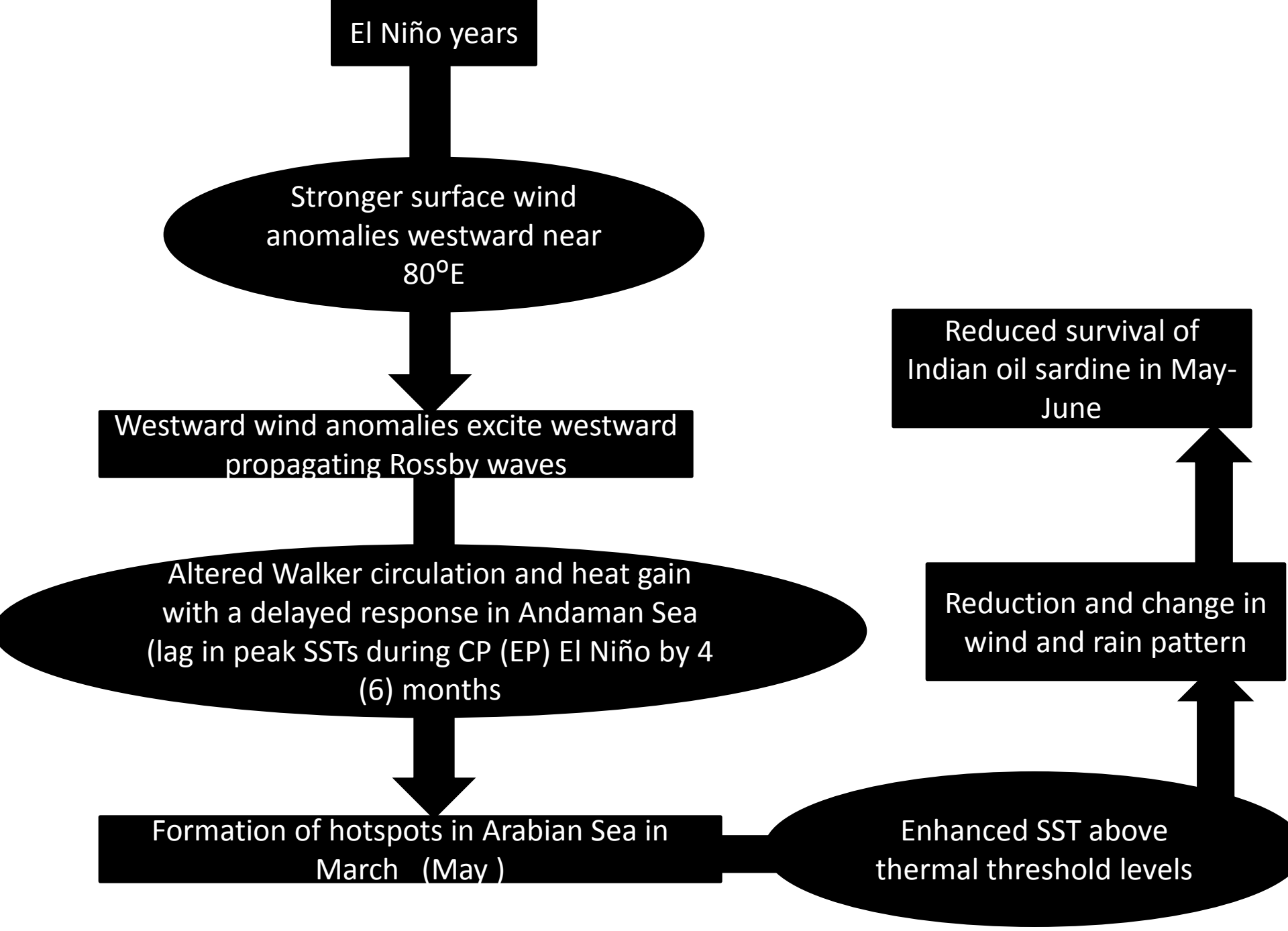
Biological Calender of Sardine	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
	Immature spent rest	Immature spent rest	Immature spent rest	Immature spent rest	Dev virgin maturing	maturing	maturing mature Running Part spent	maturing mature Running Part spent spent	mature Running Part spent spent	Immature Running spent	Immature spent rest spent	Immature spent rest

Active Breeding

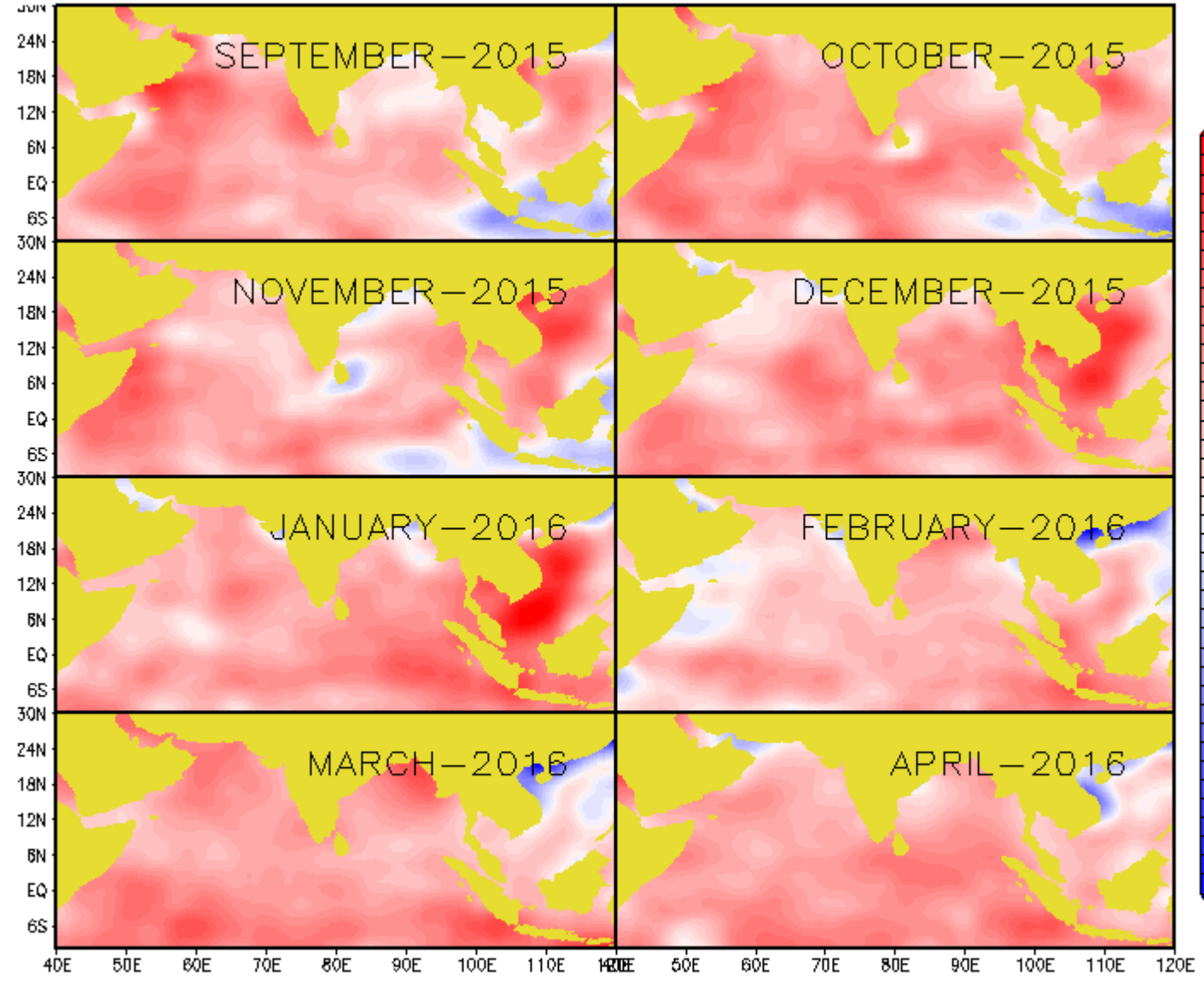
Passive Resting

Sardine inter-annual variability

Ocean temperature – Whether extreme events such as El Niño-Southern Oscillation (ENSO) are an indication?


El Niño years
Stronger surface wind anomalies westward near 80°E
Westward wind anomalies excite westward propagating Rossby waves
Altered Walker circulation and heat gain with a delayed response in Andaman Sea (lag in peak SSTs during CP (EP) El Niño by 4 (6) months
Formation of hotspots in Arabian Sea in March (May)
Enhanced SST above thermal threshold levels
Reduction and change in wind and rain pattern
Reduced survival of Indian oil sardine in May-June

SST anomalies in Indo-Pacific during El Niño (Sep-15 to April-16)



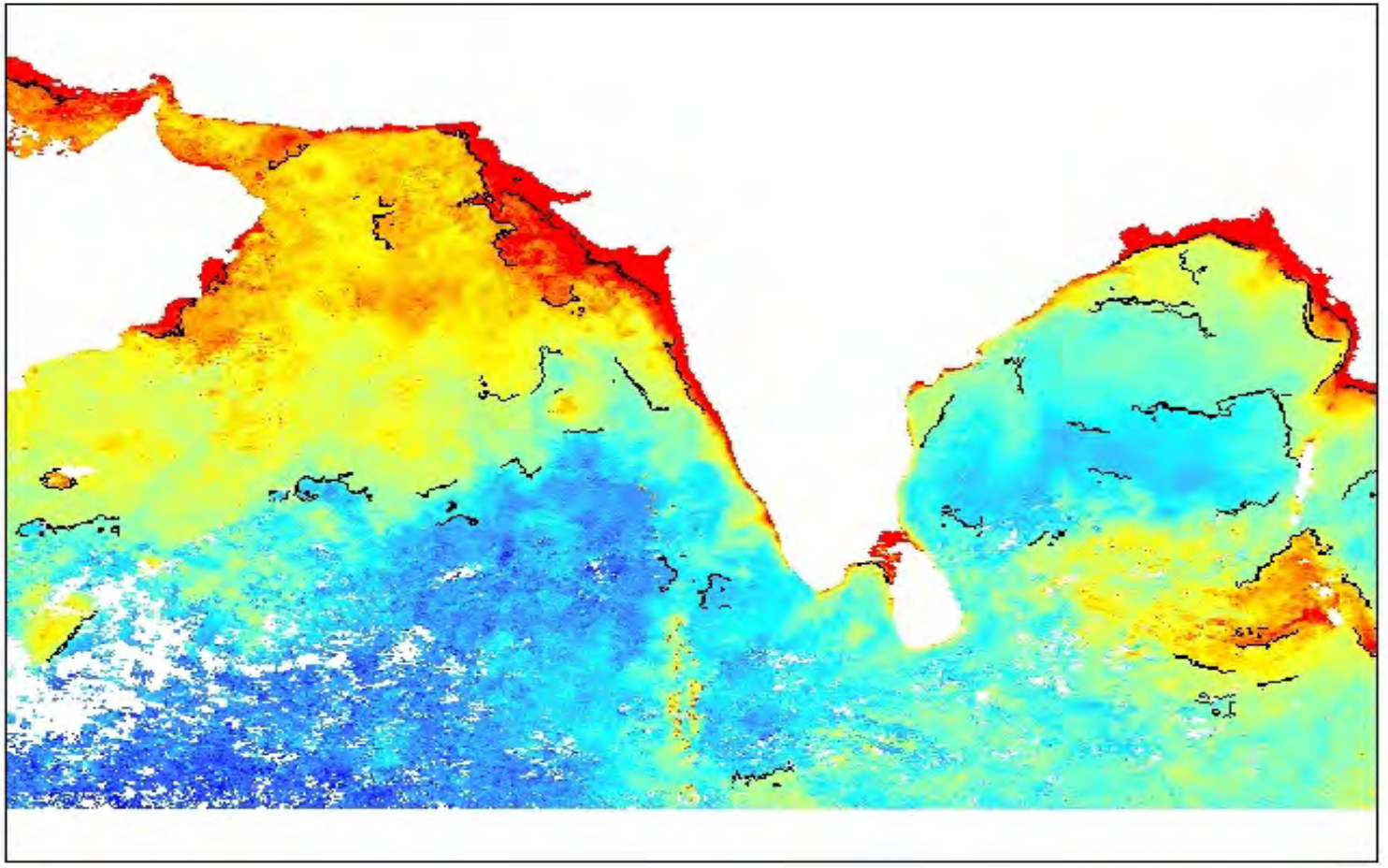
Red color +ve anomalies

Blue color -ve anomalies.

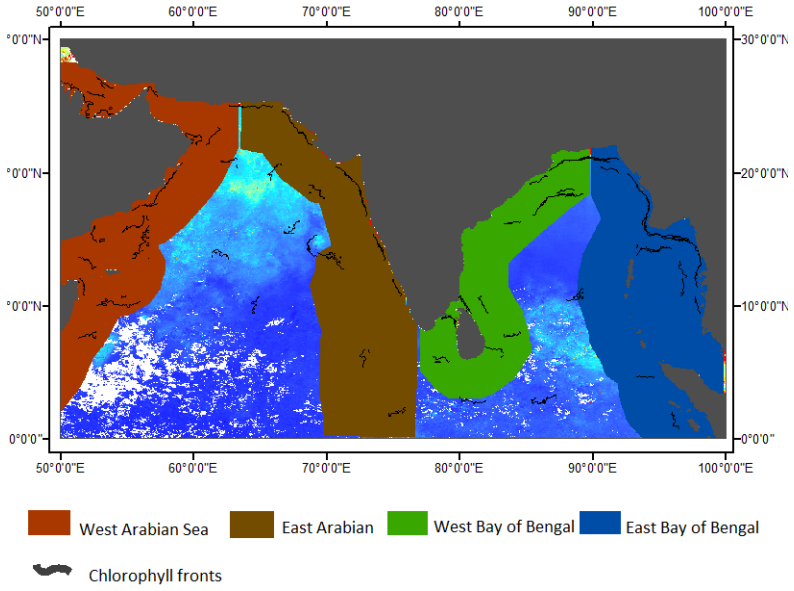
[NOAA SST (1x1 degree) monthly average

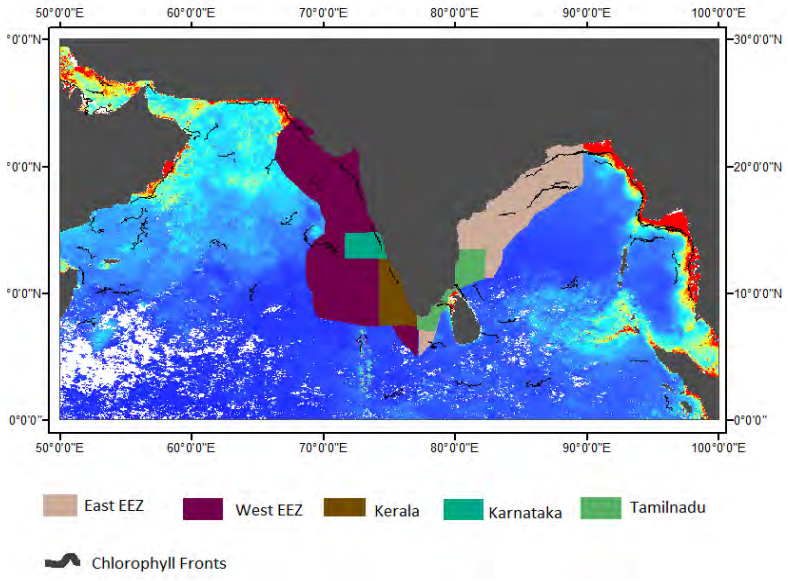
1985 to 2016

Can the distribution of oceanic fronts have any impact on fisheries in the northern Indian ocean

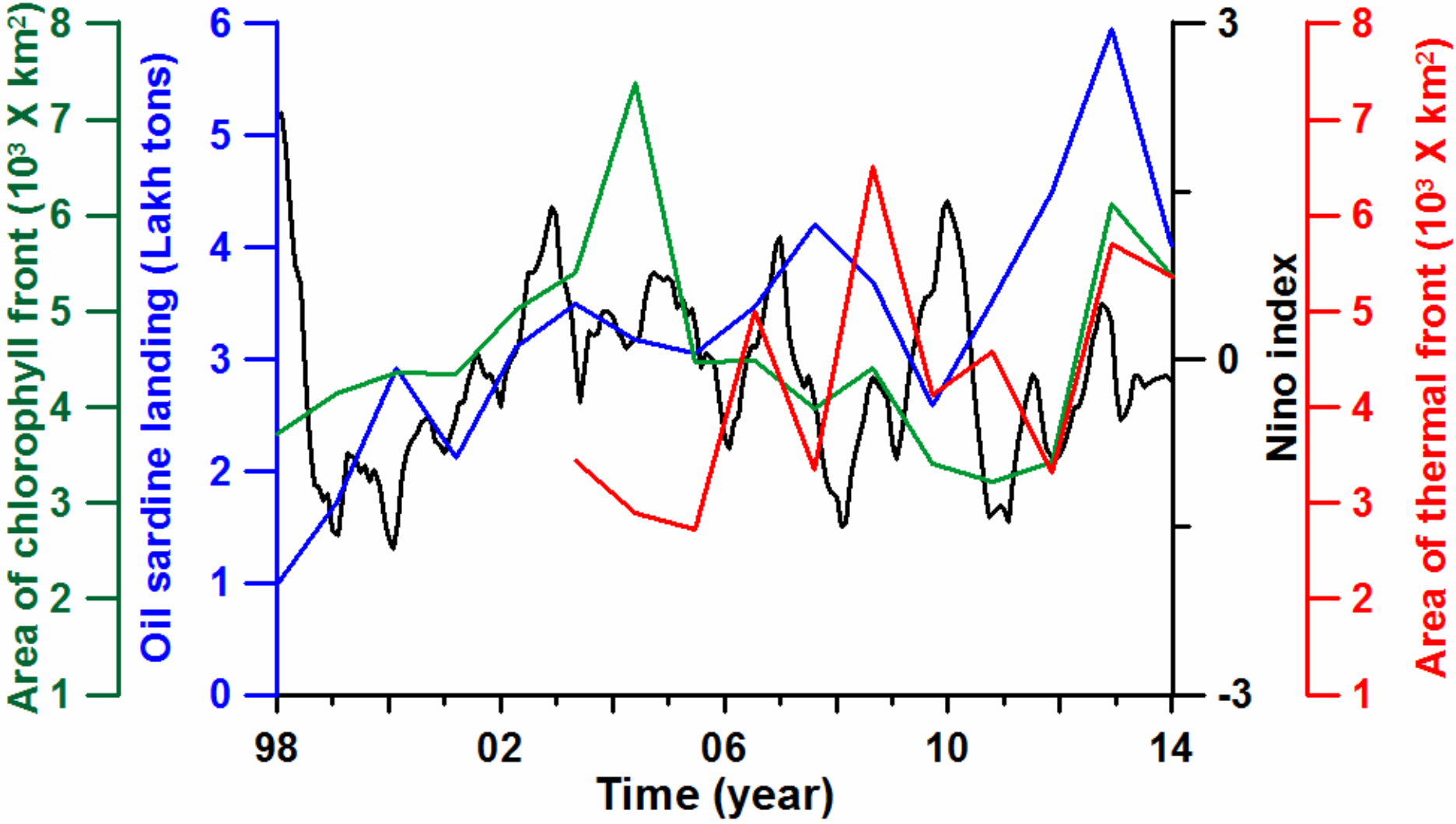


Preliminary study is conducted by classifying coastal region into Western Arabian Sea, Eastern Arabian Sea, Western Bay of Bengal, Eastern Bay of Bengal, East coast of India, West coast of India, Kerala, Tamilnadu, and Karnataka with oil sardine catches from the year 1998-2013 to Oceanic fronts

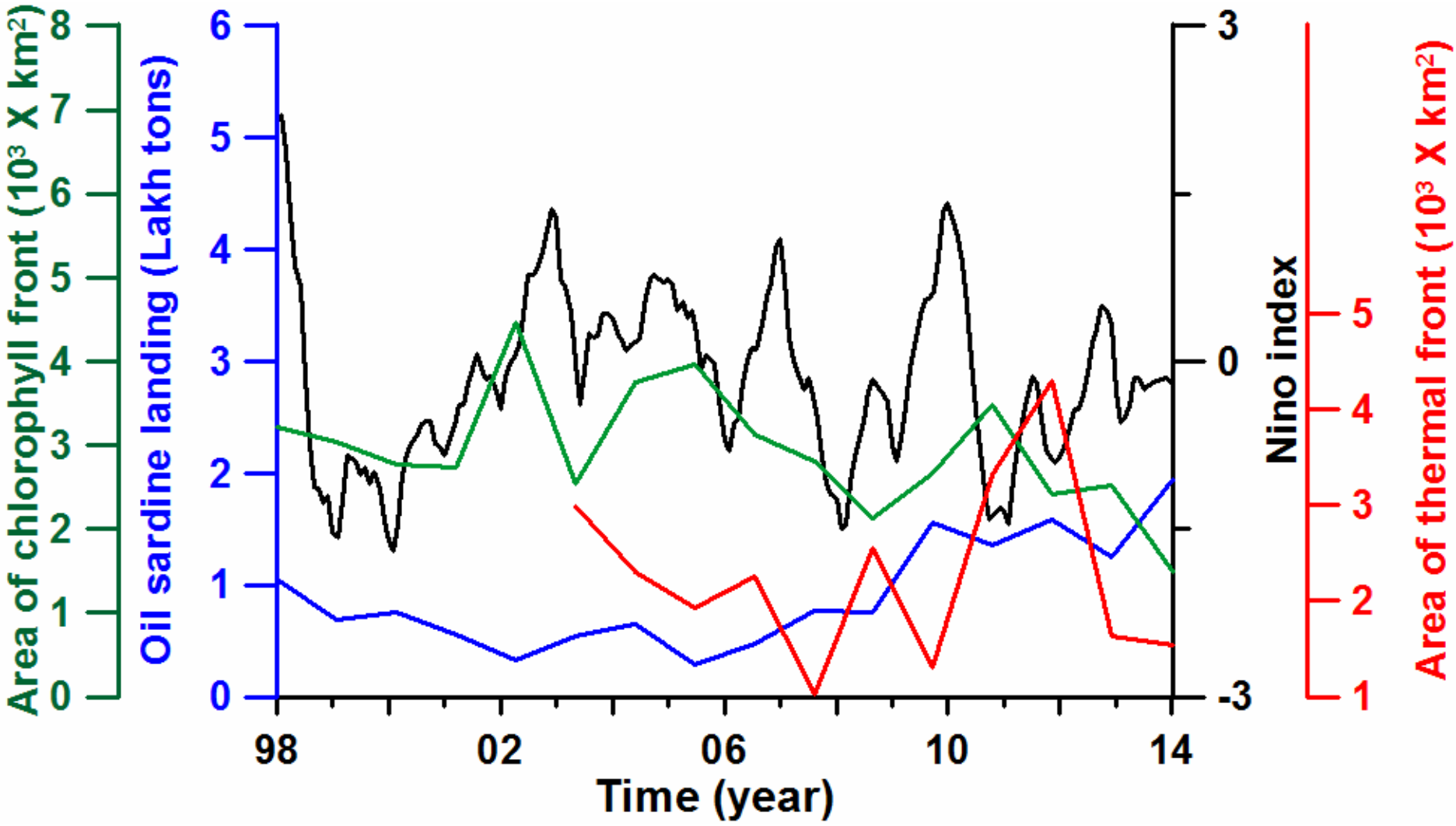




West EEZ of India



East EEZ of India



Summary:

- An attempt to look to the inter-annual variability of Indian Oil Sardine using satellite derived Chlorophyll and SST.

- Recruitment to Sardine fishery towards the end of summer monsoon and success is dependent on the type, initiation and termination of algal bloom prevailing during pre- monsoon (Trichodesmium), monsoon (Diatoms) and post- monsoon (Dinoflagellates).

- El-Nino Southern Oscillation also affect the SST in the Northern Indian Ocean region. These changes coincides with low Sardine production

- A comprehensive study is required to establish the resilience of the Sardine stocks and how its distribution will vary from year to year.

Thank You

Acknowledgement