Biological Effects of Climate Change on Marine fish

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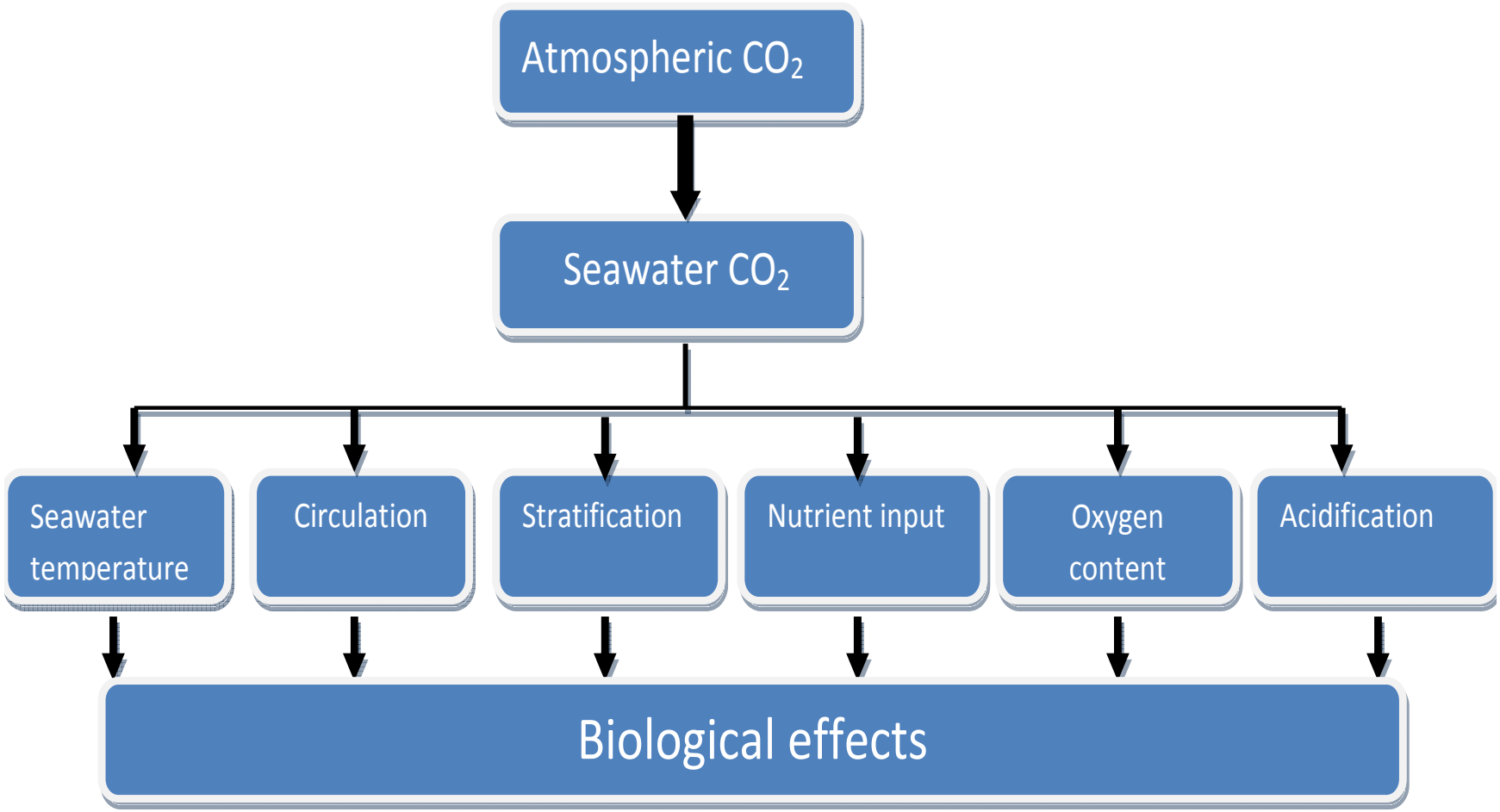
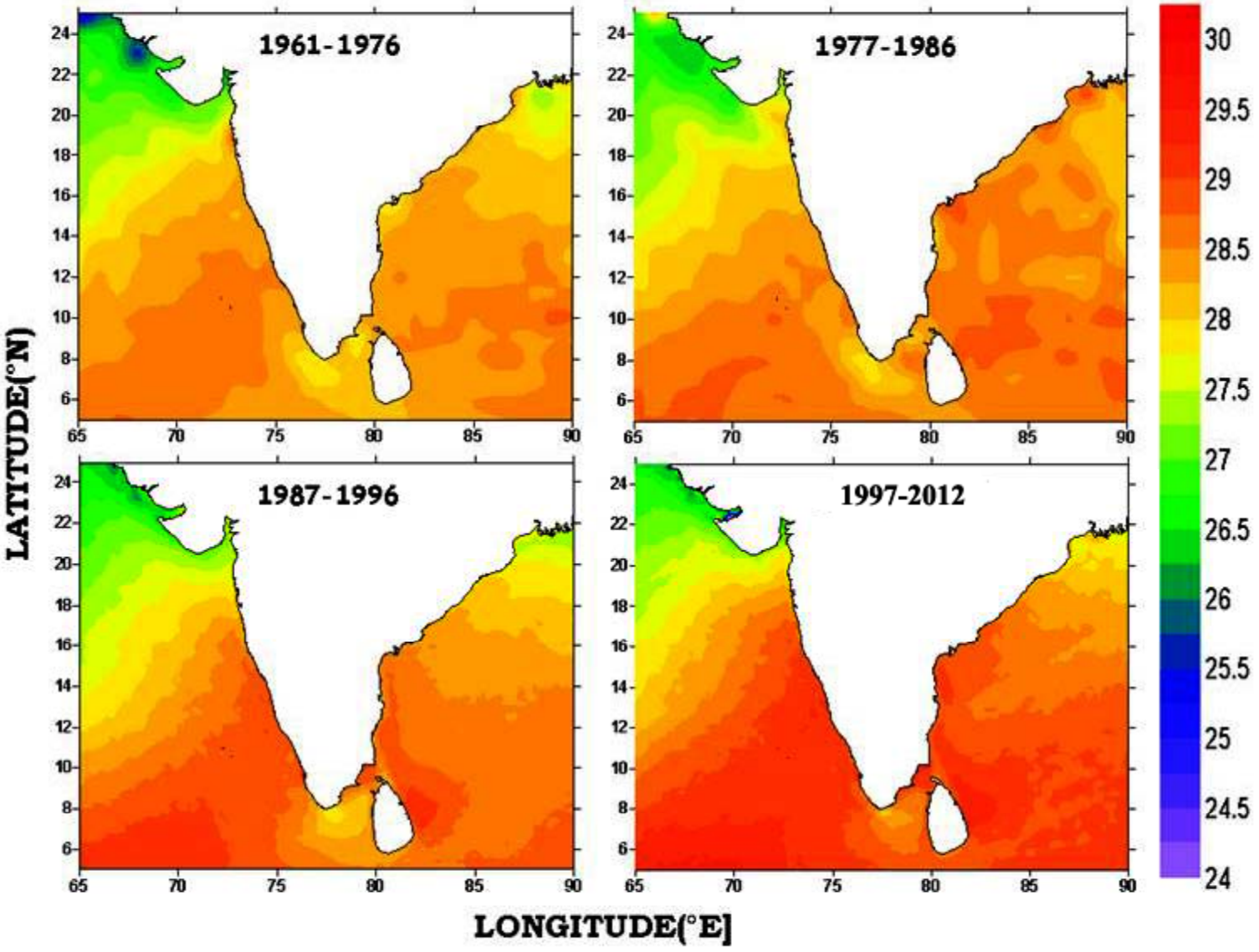
Climate Change on Biological Effects



Climate Change in the Oceans: *Rise in Sea Temperature*

- The global average air temperature rose 0.74°C during the 100 year period ending in 2005.
- If the trend continues, the atmospheric temperature will increase by 2.2 to 4.8^{o} C by 2100.
- Seawater mean temperature increased 0.06^{o} C in the last 50 years.
- Increase is not even: upper 300 m of the oceans increased by 0.31^{o} C.
- The mean sea surface temperature in the Indian Seas warmed by 0.2^{o} C in the last 45 years.

Rise in Sea Surface Temperature in the Indian Seas



Climate Change in the Oceans: *Rise in Acidity*

- When CO_2 enters the oceans, it reacts with seawater to form carbonic acid, producing hydrogen ions, which cause the acidity of seawater to increase.
- In the last 250 years, the concentration of H+ ions in seawater has increased by 30%, equating to a fall in pH by 0.1 unit.
- Continued rises in the concentration of atmospheric CO2 will lead to a global surface water pH reduction of up to 0.4 units by 2100.

Fish are poikilotherms (cold-blooded).

Rise in water temperature by even 1^{o}C will induce distributional, physiological and phenological changes

Biological Effects

(i) Changes in distributional ranges

- *Extension towards northern latitudes*
- *Extension towards deeper waters*

(ii) Changes in physiological parameters

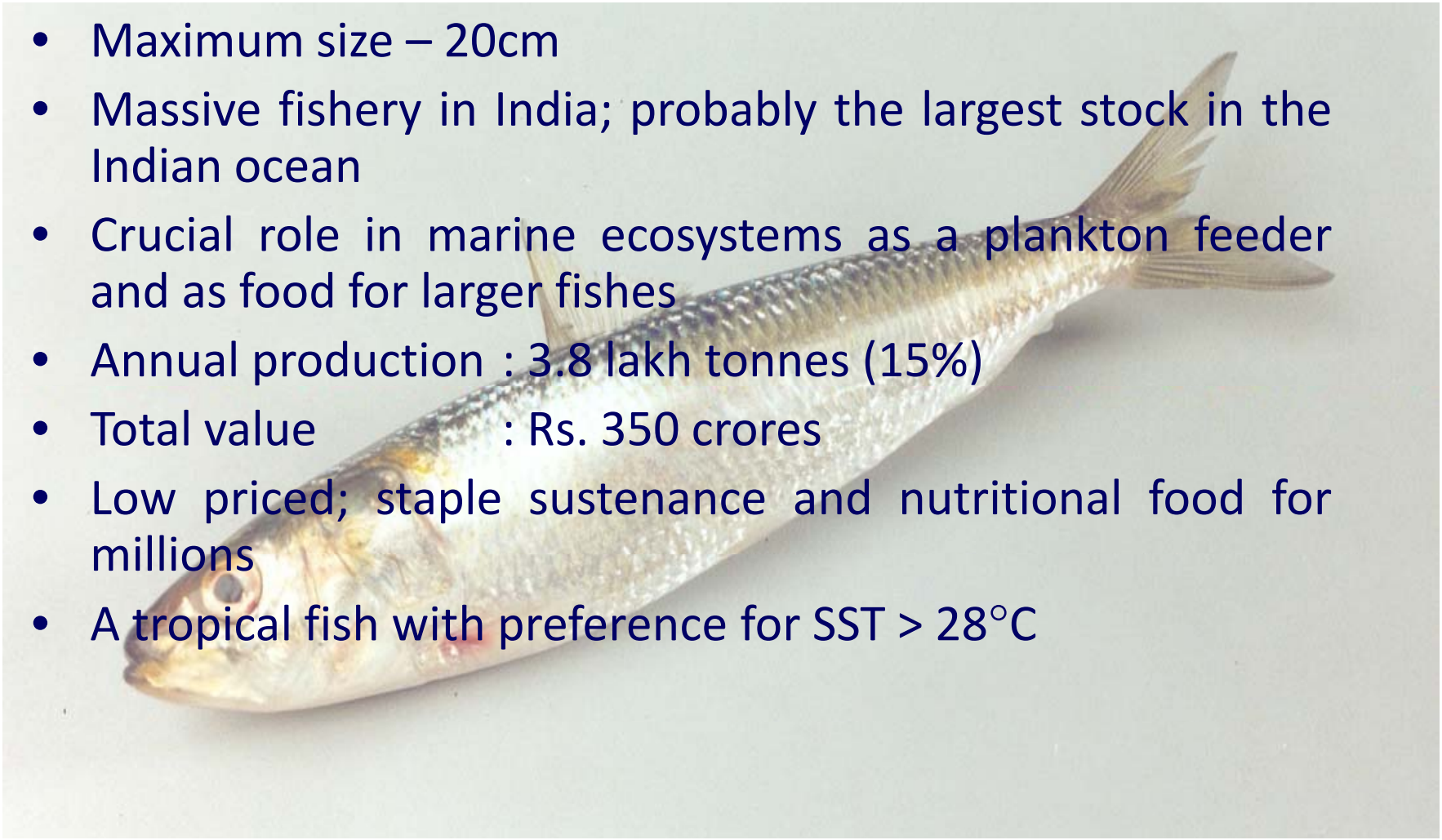
- *Food consumption*
- *Growth*
- *Early maturity*

(iii) Phenological changes

- *Shift in spawning season*

1. Distribution

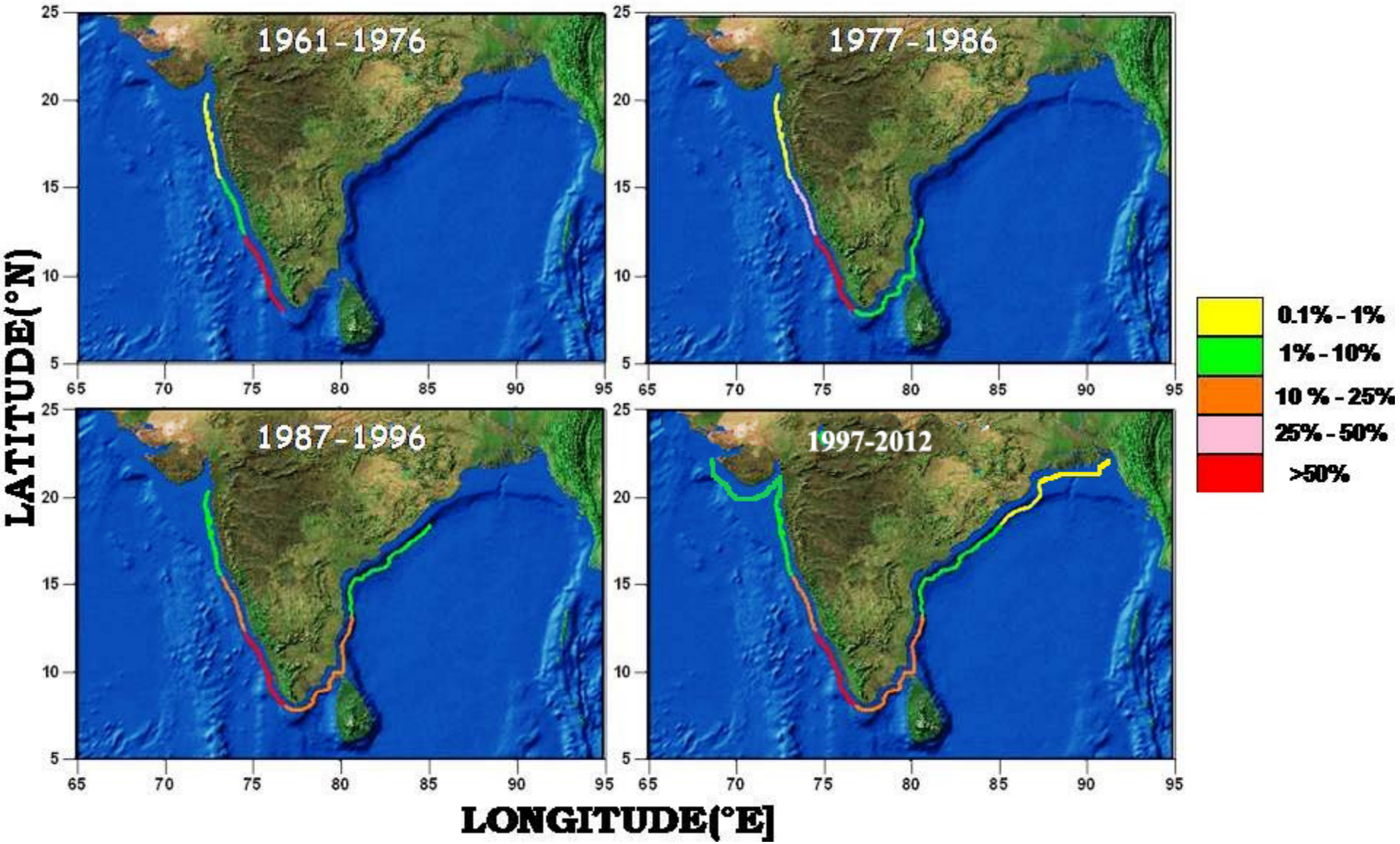
Oil Sardine *Sardinella longiceps*



- Coastal, pelagic, schooling fish
- Maximum size – 20cm
- Massive fishery in India; probably the largest stock in the Indian ocean
- Crucial role in marine ecosystems as a plankton feeder and as food for larger fishes
- Annual production : 3.8 lakh tonnes (15%)
- Total value : Rs. 350 crores
- Low priced; staple sustenance and nutritional food for millions
- A tropical fish with preference for SST > 28°C

Extension of northern boundary of oil sardine

(the colored lines indicate percentage of All India oil sardine production)



Indian mackerel descends to depths

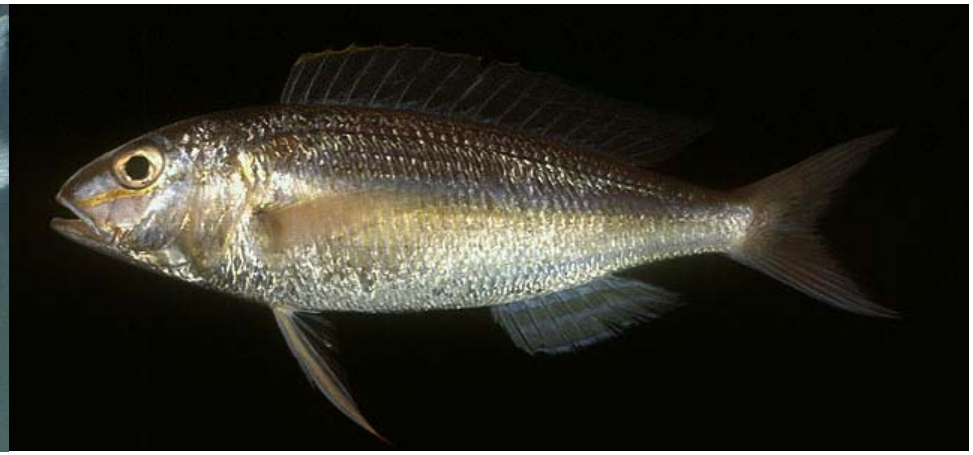
- Indian mackerel generally occupies surface and subsurface waters.
- In recent years, the occurrence is extending upto about 50 m depth.
- This shows that the fish descends down to overcome warmer surface waters.

2. Physiology

- Faster growth (at age 1 year: 16 cm in 1980s ; Now: 18 cm)
- Increased food ingestion; higher metabolic rate
- Attains early maturity (at age: 1 year in 1980s; Now: at 8 months)
- Smaller egg size and larvae
- Larval survival?

3. Phenological changes

- Spawning season is changing towards cooler months
- More spawning activity during October - March



Phenological Changes …

- Larval release - food supply
- Recruitment into fisheries
- Fisheries management options

Mobile species may adapt

Sedentary species are more vulnerable

For example, sedentary species

Corals are very sensitive to temperature and acidity

Bivalve larvae are sensitive to acidity and ocean current

Adaptable Marine Organisms

(species with wider ecological niches, greater mobility, fast growth, quick turnover of generations)

Small pelagics (clupeids, mackerel etc)

Threadfin breams

Cobia

Tunas

Squids

Pufferfish

Jellyfish

Vulnerable Marine Organisms

(species with narrow ecological niches, sedentary/sessile with calcareous exoskeleton, slow growth)

Corals

Sponges

Bivalves

Gastropods

Echinoderms

Bombayduck, catfish, Hilsa

Large predatory fish (sharks, rays, seerfish)

Sea turtles

In conclusion ….

- These changes, and difference in adaptive capacity marine organisms are expected to result in novel species mix and drastic changes ecosystem structure and function.
- Some marine regions may gain, but others may lose.
- As the threshold is exceeded over time, the proportion of losers would increase.
- This will, in turn, impact the economic returns to the fishermen.

Human Interventions on Marine Ecosystems & Biodiversity

- Overfishing
- Habitat Degradation
- Pollution
- Climate Change


THANK YOU