



**Tuna in Warming
Oceans:
*Changing Behaviour
& Management
Options***

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World Tuna Day 2023

Tuna Fisheries in BOB Region:

Emerging Challenges under changing Climate and BBNJ Region

2 May 2023

Importance of tunas

- Global tuna and tuna-like fish catch (2020): 7.8 million tons
- Dock value: \$12 billion; End value: \$41 billion
- 20% of value of all marine capture fisheries
- > 8% of all globally traded seafood
- Critical role in sustainable development, food security, economic opportunity, livelihoods of people around the world.



Issues in sustaining tuna fisheries

Unsustainable fishing

- Overwhelming demand leads to overfishing: ***Globally one-third of 7 principal species of tunas fished at biologically unsustainable levels***

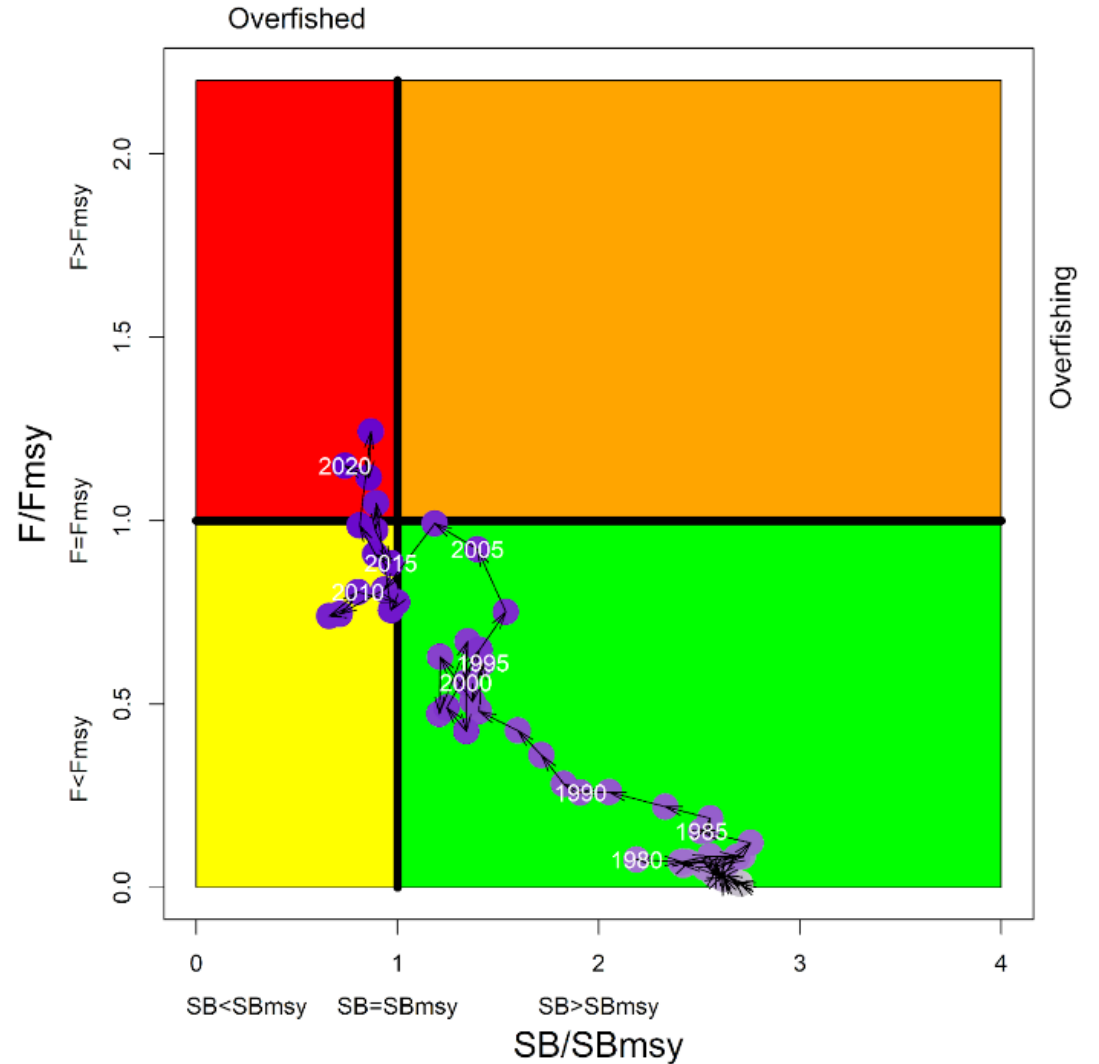
Bycatch

- Bycatch of Sharks, Marine Mammals, Sea Birds in tuna fishing

Climate change

- Shift in geographical distribution of tunas

Status of yellowfin tuna in Indian Ocean (Source: IOTC)



World Tuna Day 2023: Theme **YES WE CAN**

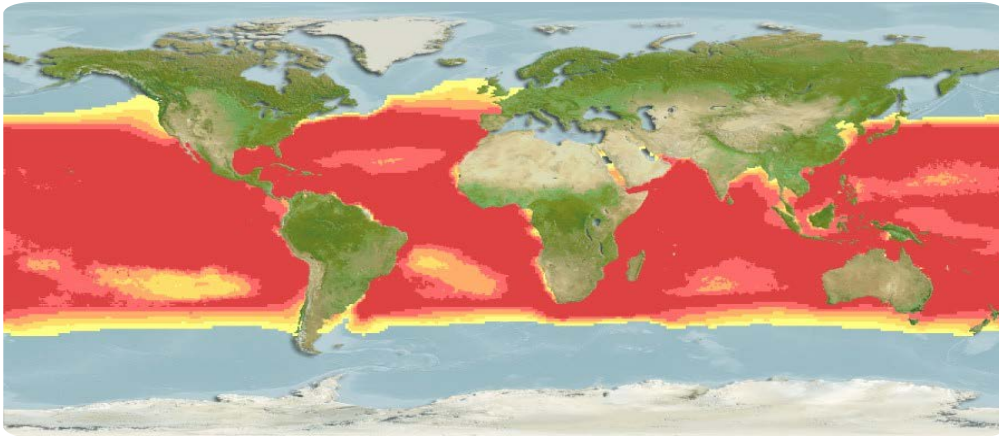
Raising awareness to end overfishing
and ensuring supplies for the future

Reducing bycatch of Sharks, Marine
Mammals, Sea Birds in tuna fishing

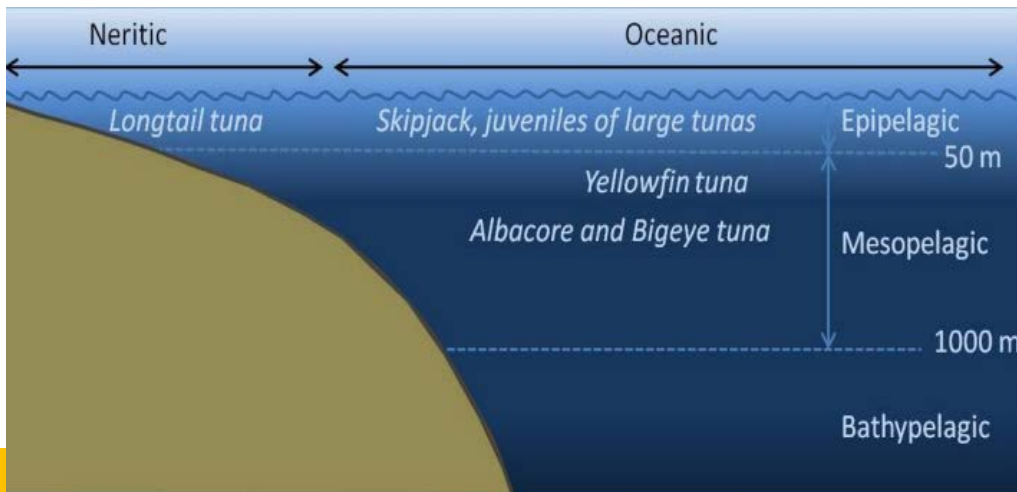
Understanding and reducing the
impact of climate change

- *Tuna fisheries need robust management and effective enforcement*

Key facts for understanding climate change impact on tunas



Yellowfin tuna distribution (www.fishbase.org)



Source: www.fao.org/fishery/topic/16082/en#Distribution

Distribution & movement

Wide distribution in *tropical* (Skipjack & yellowfin in global catch: 85%); *subtropical* (bigeye: 8%); *temperate* waters (albacore & bluefin: 7%)

Horizontal and vertical migration driven by optimal temperature window

Sensitive to low concentrations of oxygen

Key facts for understanding climate change impact on tunas (*contd..*)

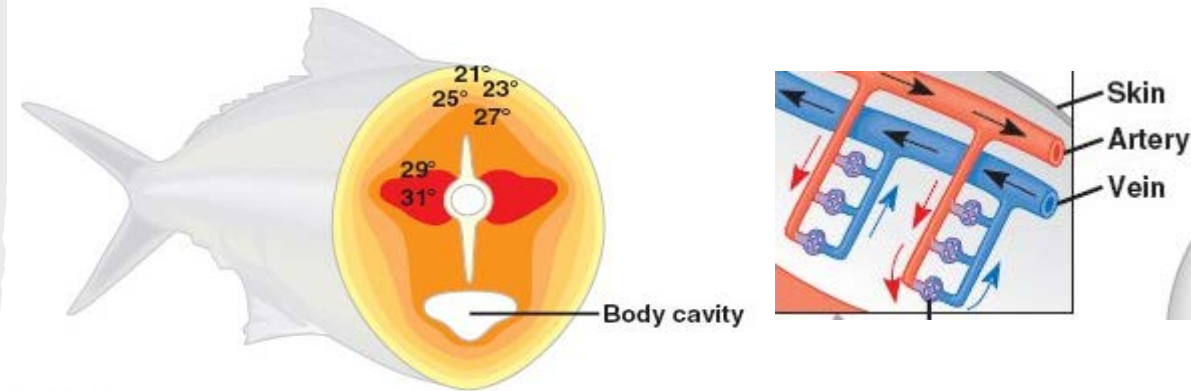
Physiology

Endothermy (unlike other teleosts, regulate body temperature above ambient water temperature by using internal counter-current heat exchange system)

Thermoregulation, circulation, energy metabolism, swimming speed, muscle architecture different from other teleosts – require large amounts of food

Air bladder develops later in life (> 60 cm), limiting vertical movement of young tunas

Thermoregulation

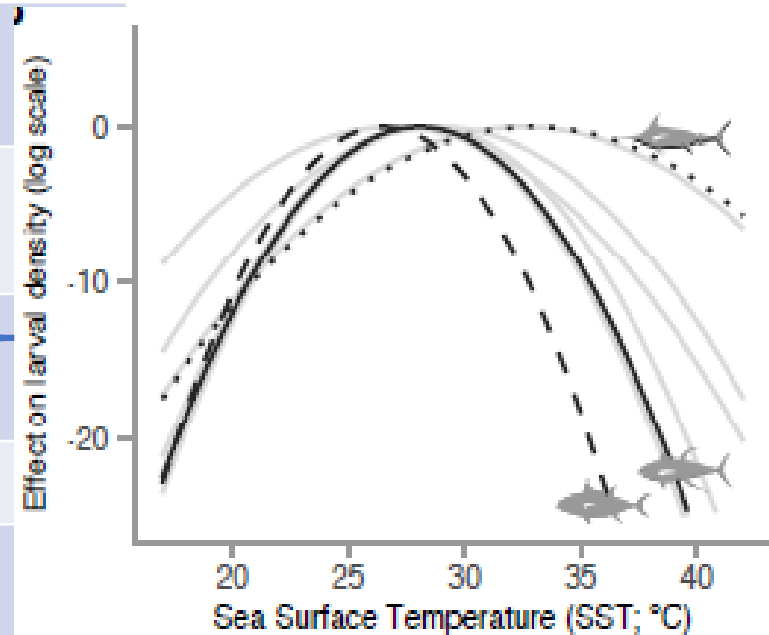


Air bladder



Tolerance and optimum level*

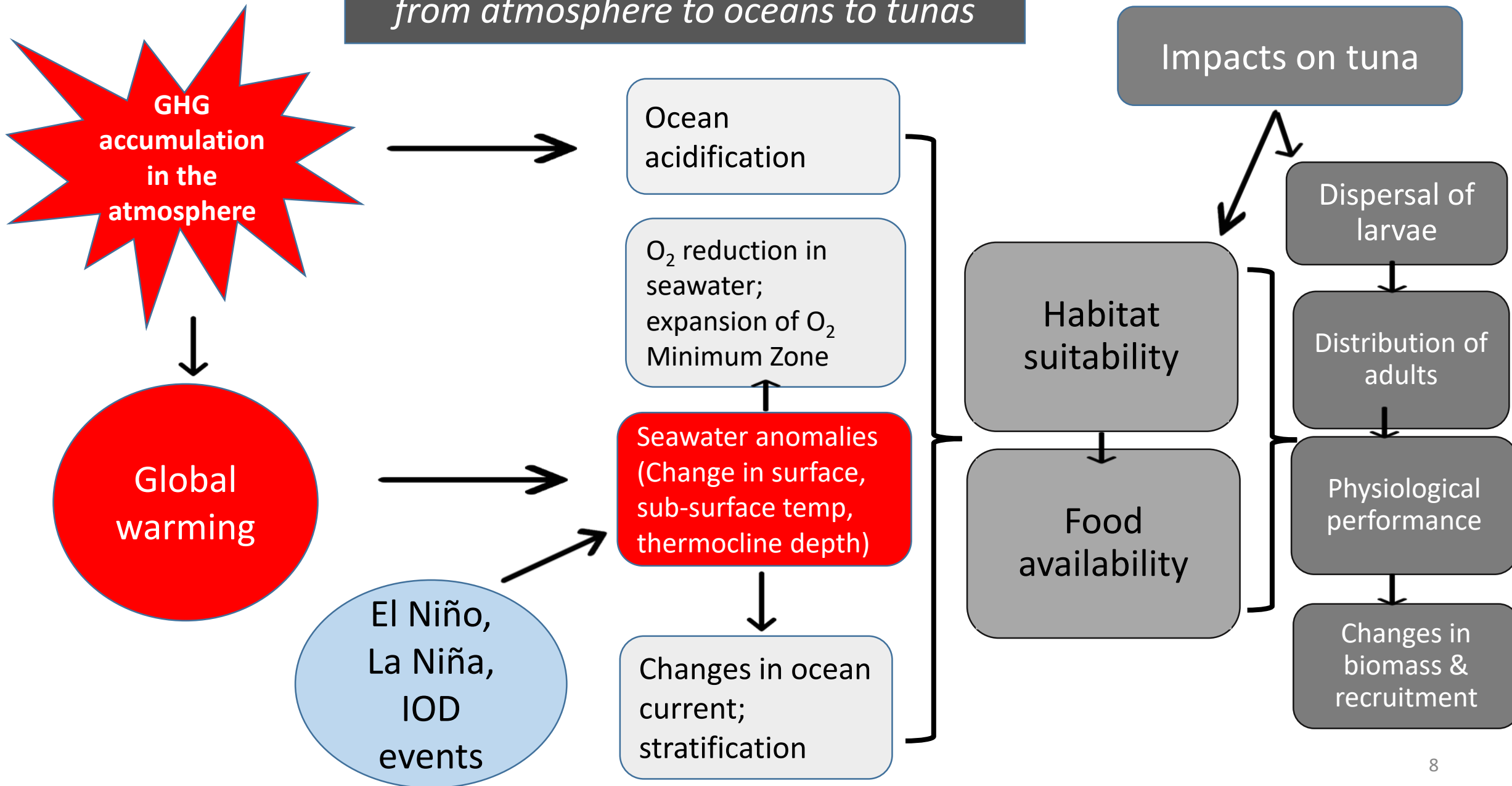
Species	Temperature range (°C)	Optimum SST (°C)**	Loss of larvae (%) at SST ± 1°C from optimum**
Skipjack tuna	14.7 – 33.0	28.4	14.8
Yellowfin tuna	7 - 31	28.1	16.8
Bigeye tuna	3 - 29	27.9	17.0
Albacore	7 - 25	28.1	17.1
Longtail tuna	16 - 30	28.0	17.0



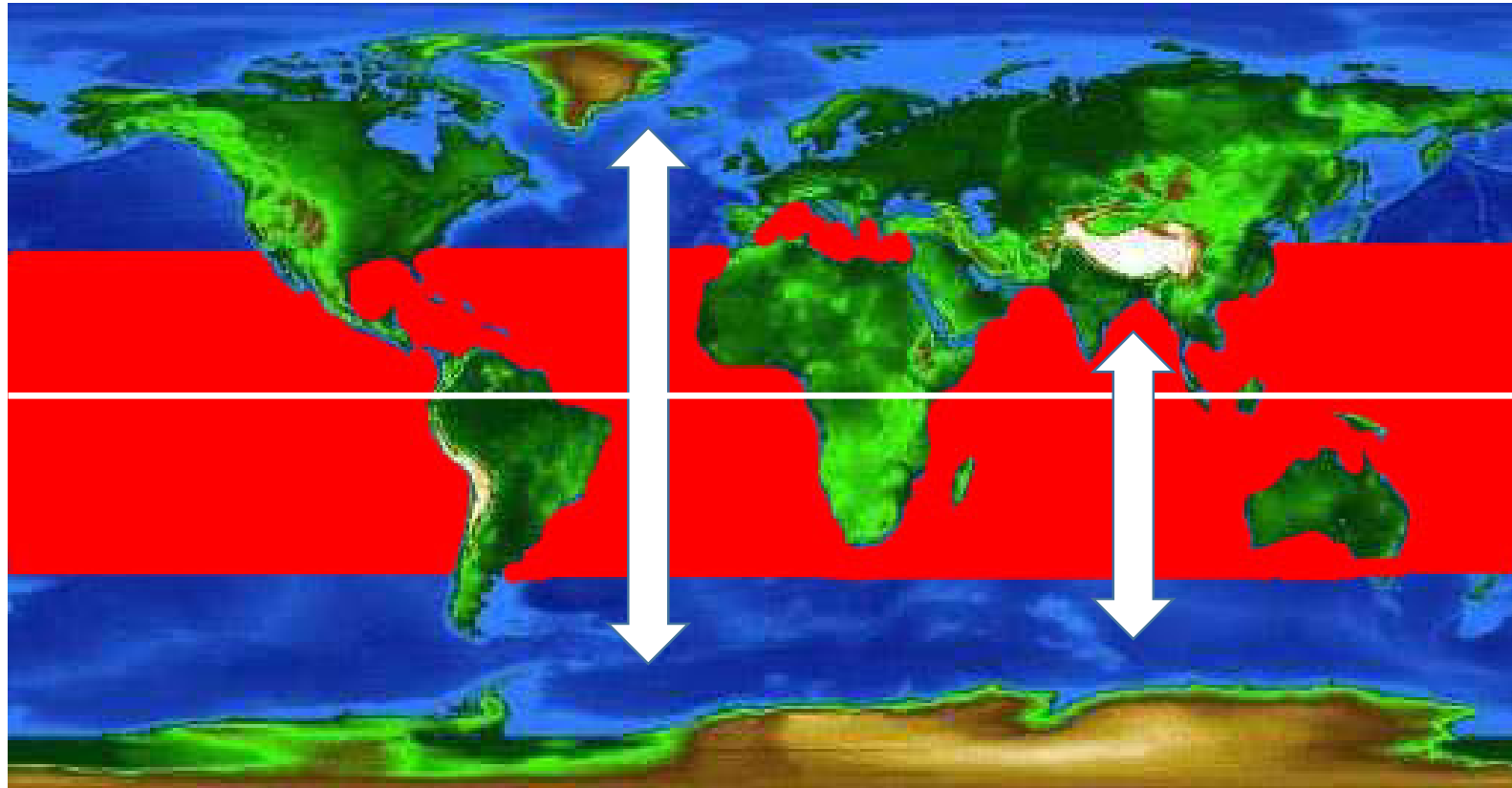
Minimum dissolved O ₂ conc (ml/l)
3.5
3.5
2.0
3.7
?

*From many sources and different locations; **Ijima and Jusup, 2023

Climate Change Pathway: *from atmosphere to oceans to tunas*



Tunas move towards higher latitudes



6.5 km/decade in
northern hemisphere

5.5 km/decade in
southern hemisphere

Projected habitat and biomass changes in Indian Ocean for RCP 4.5*

*Source: Dueri 2017

Species	Habitat change		Biomass change	
	2050	2095	2050	2095
Skipjack tuna	Decrease in habitat suitability in equatorial waters; Increase in suitability at latitude >10°N, >10°S	Strong decrease near equator; decrease in northern Indian Ocean	Increase; displacement to higher latitudes	Strong decrease
Yellowfin tuna	Spawning temp range exceed; Decrease in food availability		Biomass decrease	
Bigeye tuna	Habitat shift to deeper waters or higher latitudes; Decrease in food availability			
Albacore	DO decrease will have impact; habitat will be affected			

IPCC Report 2022

Climate change is causing **redistribution** of marine fish stocks (high confidence)

Increasing risk of **conflicts** among fisheries users

Negatively affecting **equitable distribution** of food provisioning services as fish stocks shift from lower to higher latitude regions

Increasing the need for climate-informed **transboundary management and cooperation**

IOTC 23rd Session of Working Party on Tropical Tuna

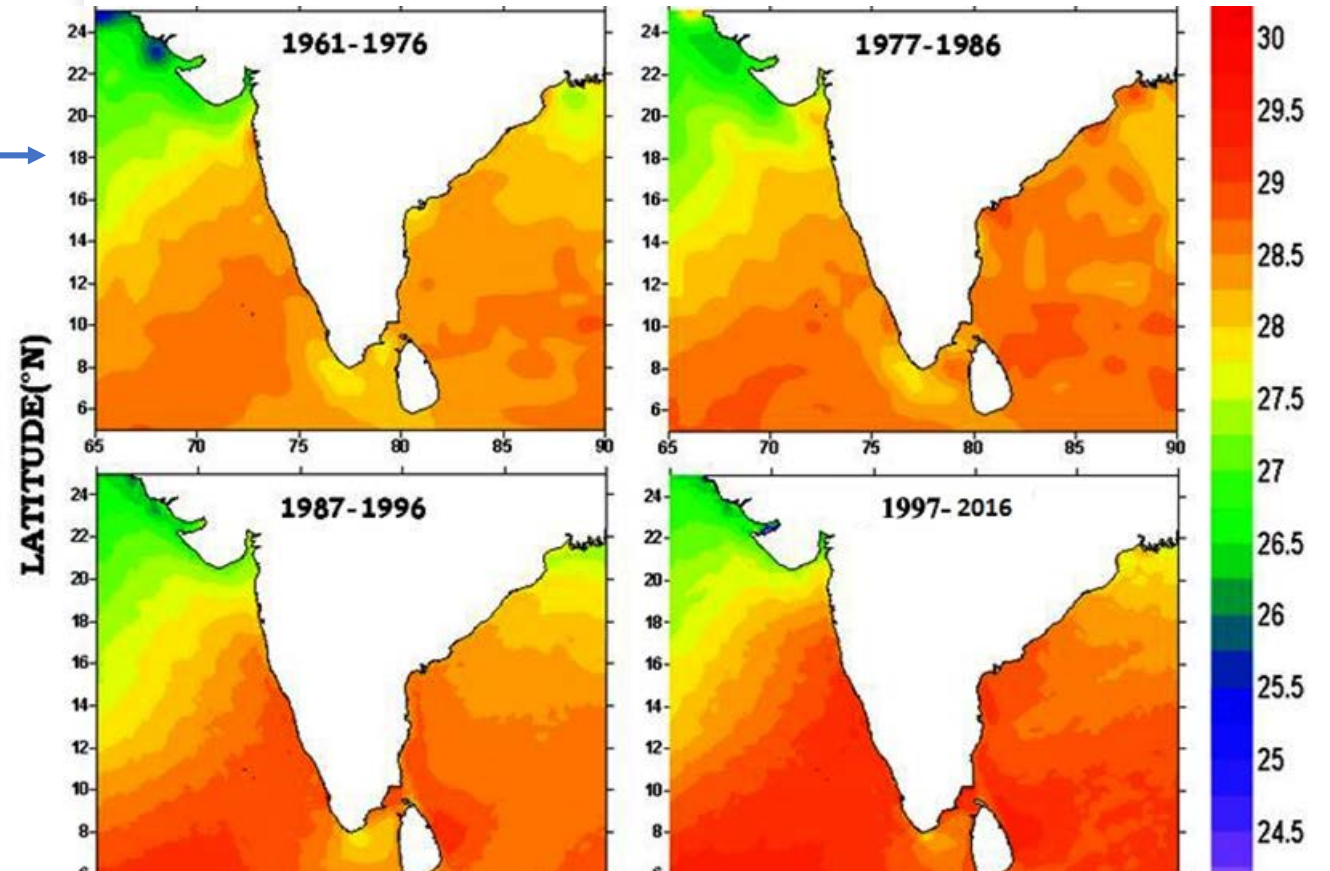
“Changes in ocean temperatures could have direct impacts on tuna spatial distributions and stock dynamics”

1. Take into account scientific information available on impacts of climate change on tuna stocks, bycatch and ecosystems
2. Support further scientific research on the impact and measures to mitigate and/or adapt
3. Consider advise on impacts on tuna stocks, and related impacts on the economies, food security and livelihood
4. Consider how climate change and fishing activities are related
5. Undertake capacity-building programs
6. Seek funding for implementation of climate change related scientific works and capacity building programs

Changing climate in Bay of Bengal

- Annual **SST** increase 0.3°C in 50 y; projected increase: $2.0 - 3.5^{\circ}\text{C}$ by end of century
- **DO** reduction 2% per decade for last 30 years
- **pH** reduction 0.01 unit per decade
- **Sea level** rise 5 to 14 cm in last 30 years; may increase by 0.5 m by 2050;
- 13 **cyclonic storms** in last 5 years (incl 5 very severe & 2 extremely severe)

SST increase over 50 years

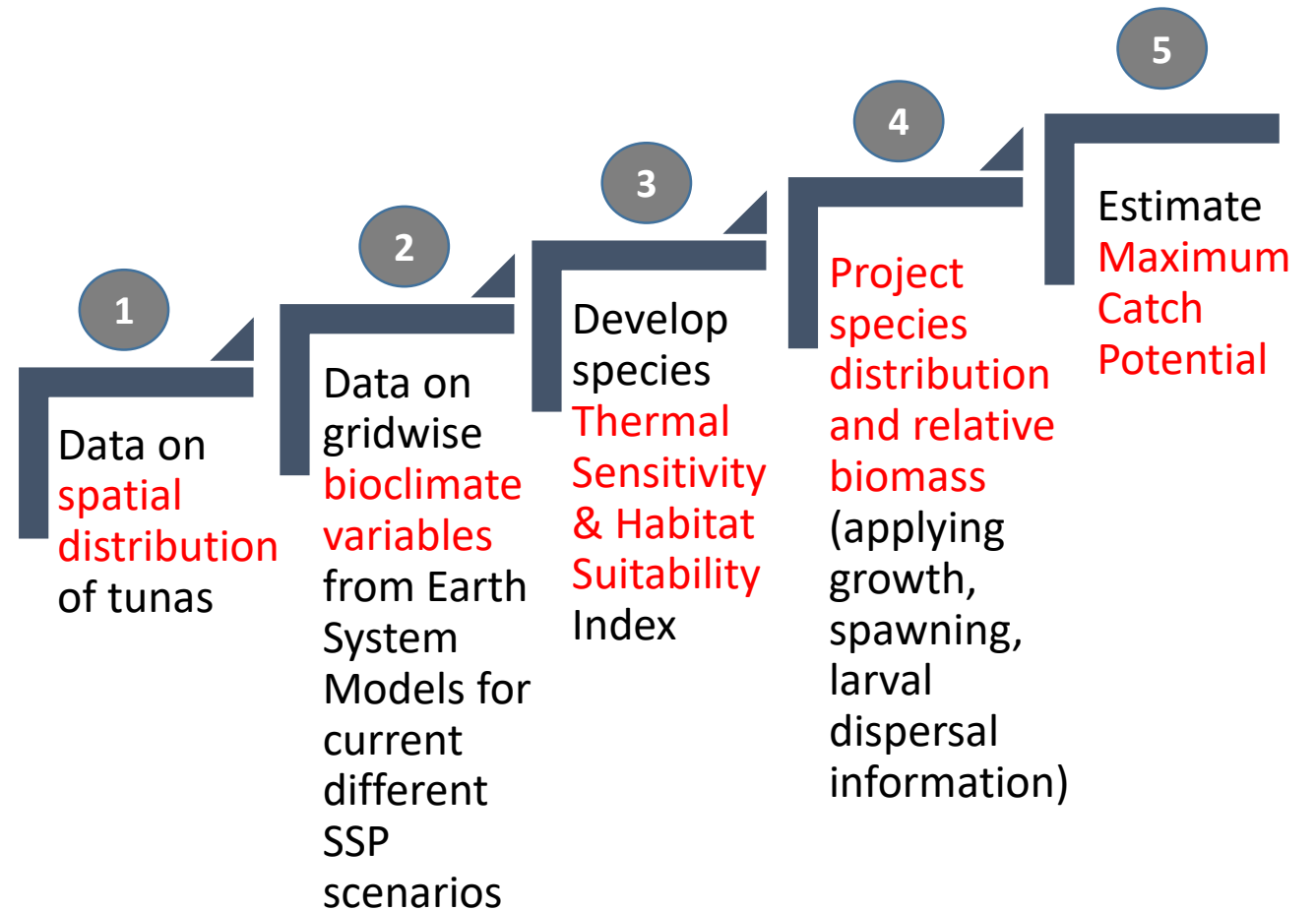


Tuna in Bay of Bengal: More questions than answers

- What is spatial, seasonal **catch and fishing effort** at species & gear level?
- What is the **status of stocks**?
- **Migration** routes of tunas?
- What is the relationship of tunas with the **tropical environment**?
- What and how much **bycatch**?
- What is the **potential biomass**?
- Are the BoB and Indian Ocean **stocks** the same?
(Is there a subpopulation of YFT in the BoB?
Tagging studies by CMFRI show that the YFT along east coast of India remains within the coastal waters)
- What is the potential impact of climate change on tuna **value chain**?

Developing projection model for BoB tunas

What will be distribution and biomass changes in BoB under SSP scenarios?



Let's be
optimistic of
the tuna of
tomorrow

