Environmental DNA method in open ocean revealed environment dependent distribution patterns of small pelagic fish

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2025-11-12

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【1. Introduction】

The small pelagic fish and Kuroshio (survey area)

Fishery (high catch)

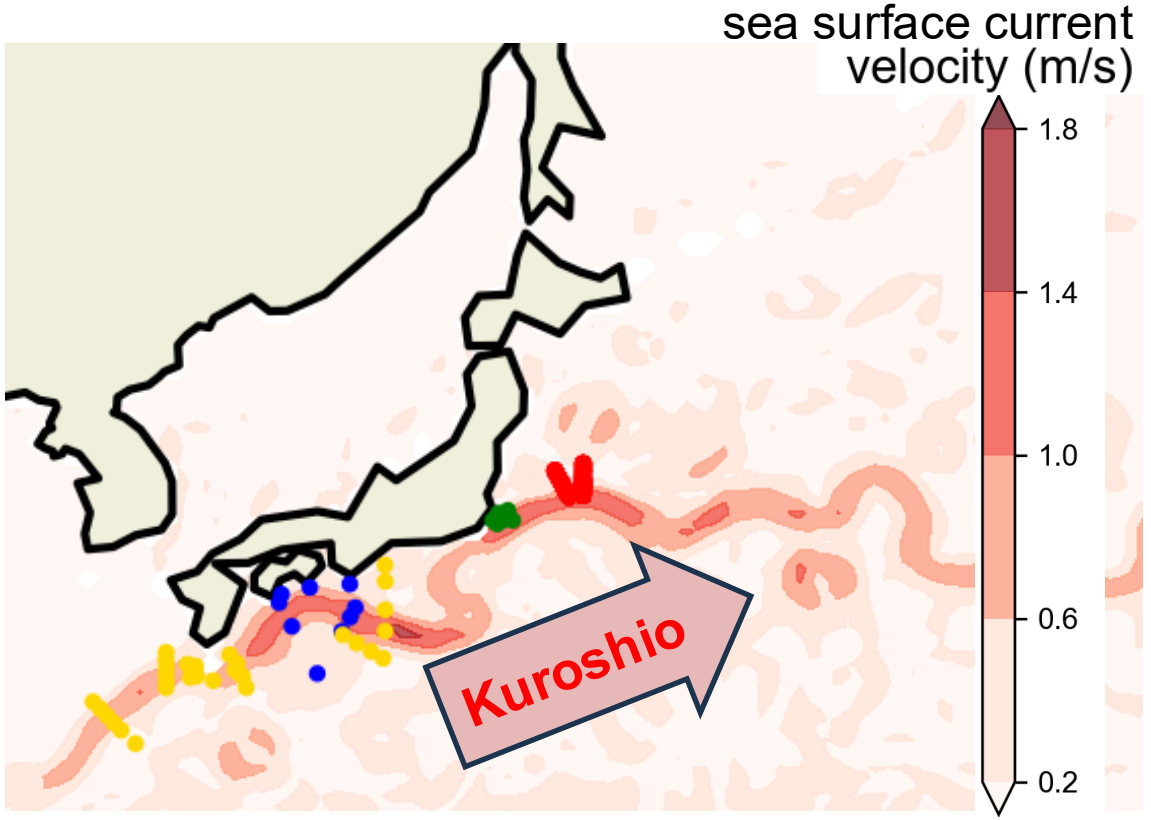
(Figs from wikipedia)

Capture ranking of 2020 (FAO, 2022).

Ecosystem (low-high level connector)

Small pelagic fish

The Kuroshio current area: includes spawning & nursery grounds (Nishikawa et al., 2011; …)



Why Environmental DNA (eDNA) ?

There is a wealth of environmental observation data.

Fish?

Fish catch
(environment, cost, …)

Environmental DNA (eDNA)

harmless for fish; relatively simple and low-cost
(Jerde, 2019; Sahu et al., 2022)

Widely used, from inland to open ocean recently (Yu et al., 2022)

Research Topic:
The Distribution Characteristics of Small Pelagic Fishes in Kuroshio Current Region Using eDNA

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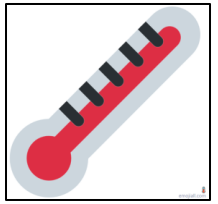

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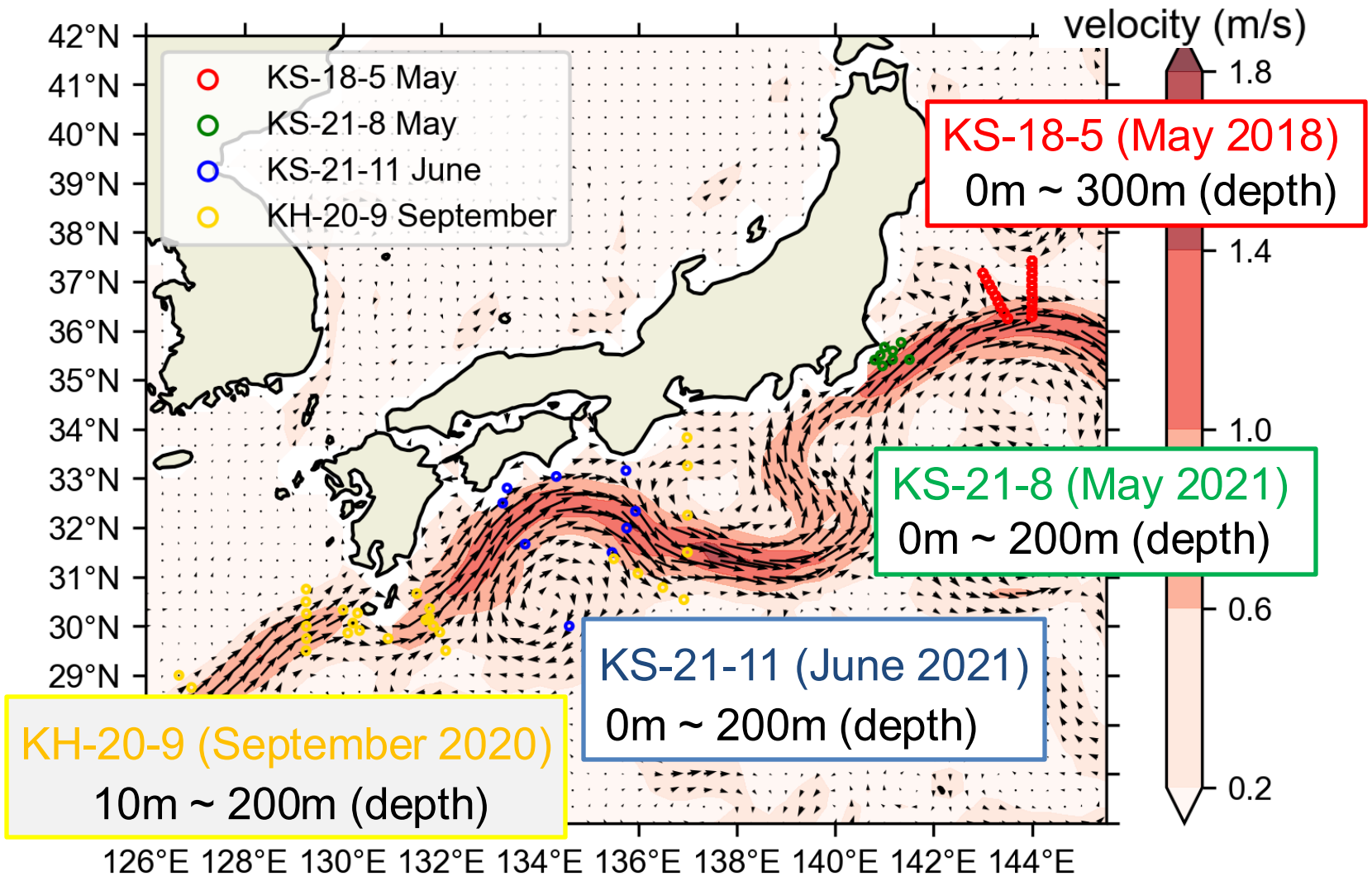
【2. Research method】

1. sampling (Kuroshio~Kuroshio extension)



Water sampling

environment data also

↓

Water Filtering
0.45μm size
10L water

↓

Extraction

↓

DNA analysis
(qPCR)

From Yu et al. (2023)

2. Target fish

Sardinops melanostictus
sardine

Engraulis japonicus
anchovy

Scomber japonicus
chub mackerel

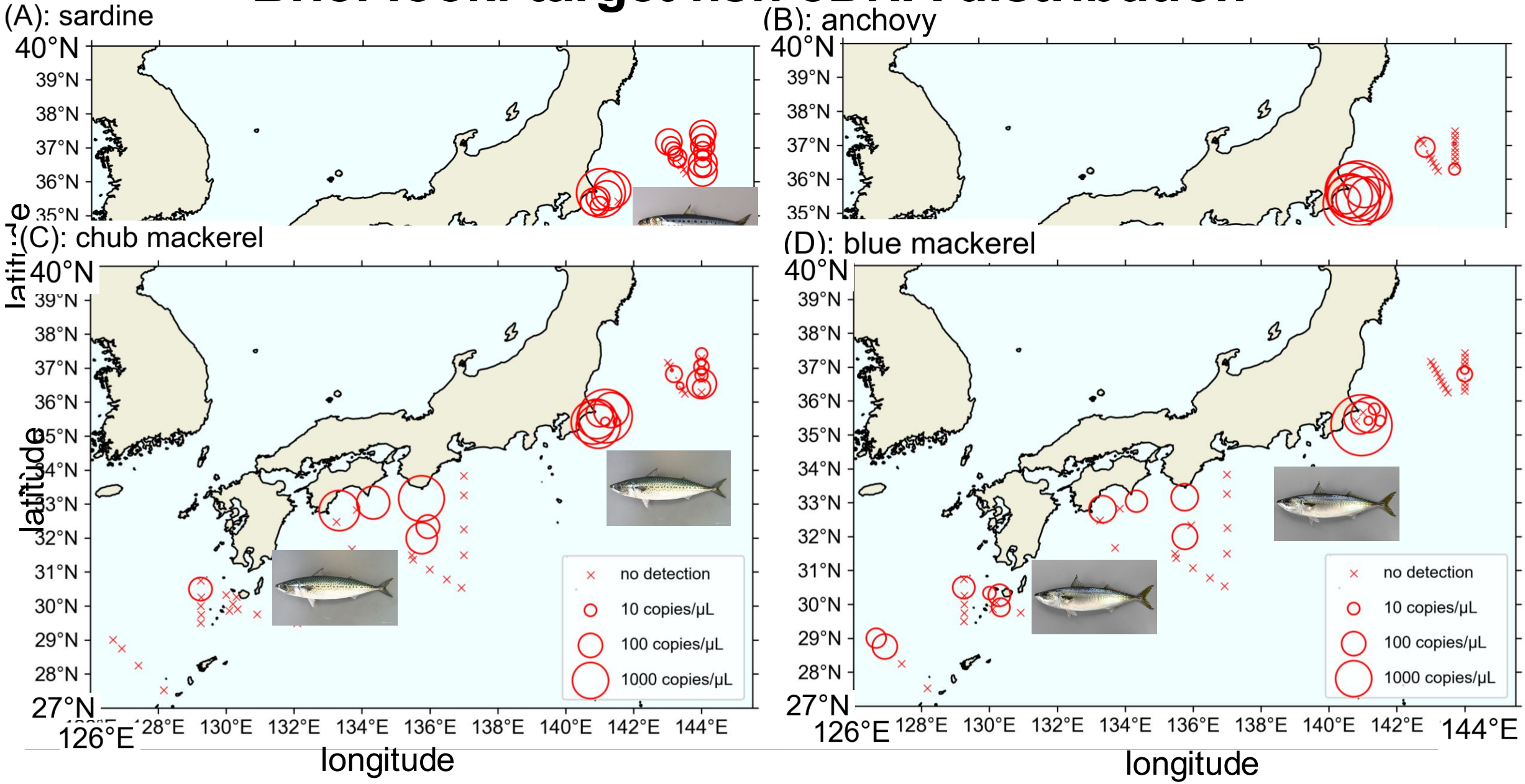
Scomber australasicus
blue mackerel

four small pelagic fish

1) representative fish in the multi-species regime shifts (Takasuka et al., 2008; etc.)

2) influenced by Kuroshio (Nishikawa et al., 2011 etc.)

Brief look: target fish eDNA distribution

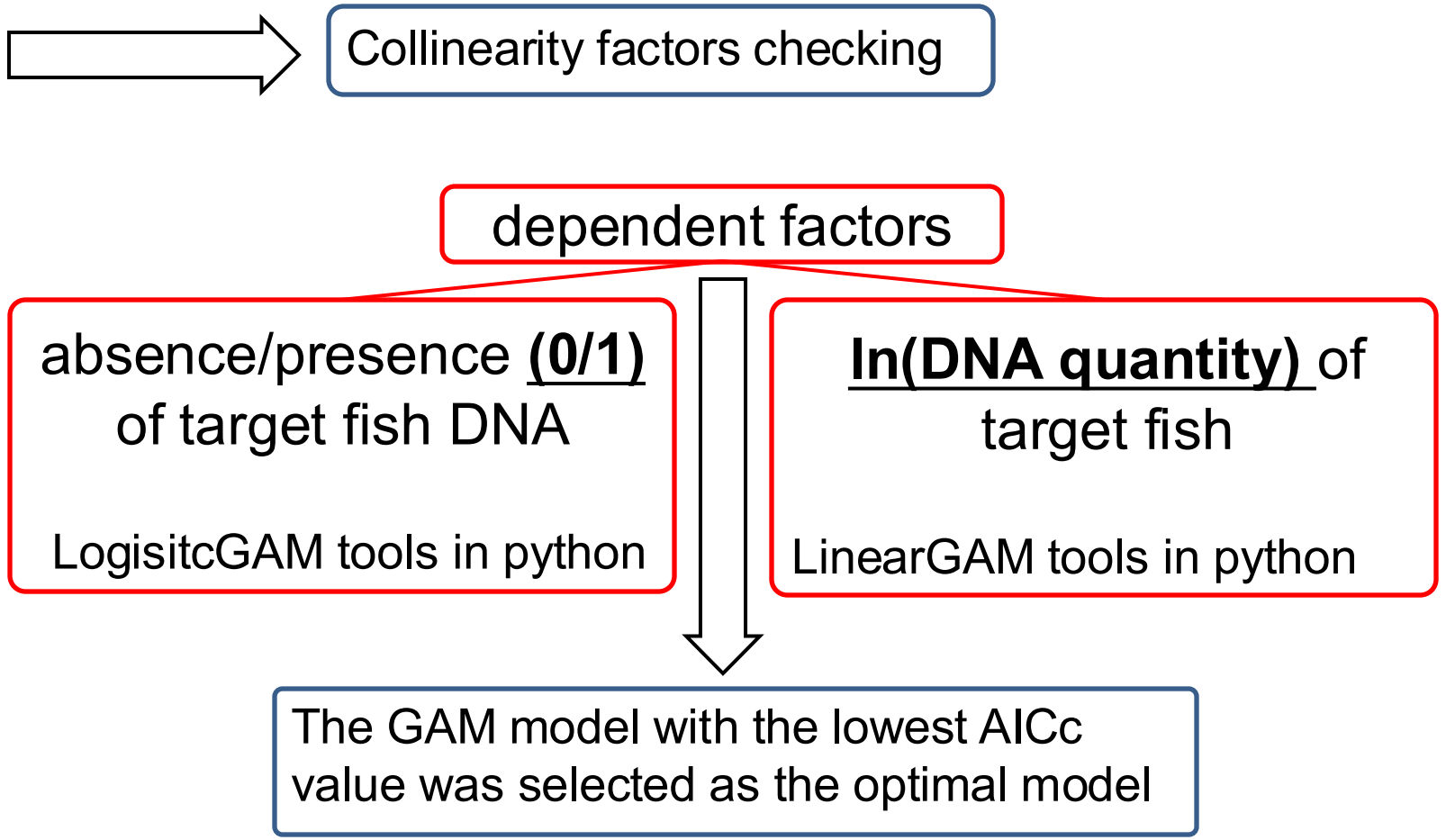


Horizontal distribution of target fish eDNA above 60 m depth. From Yu et al. (2023)

Generalized additive models (GAMs)

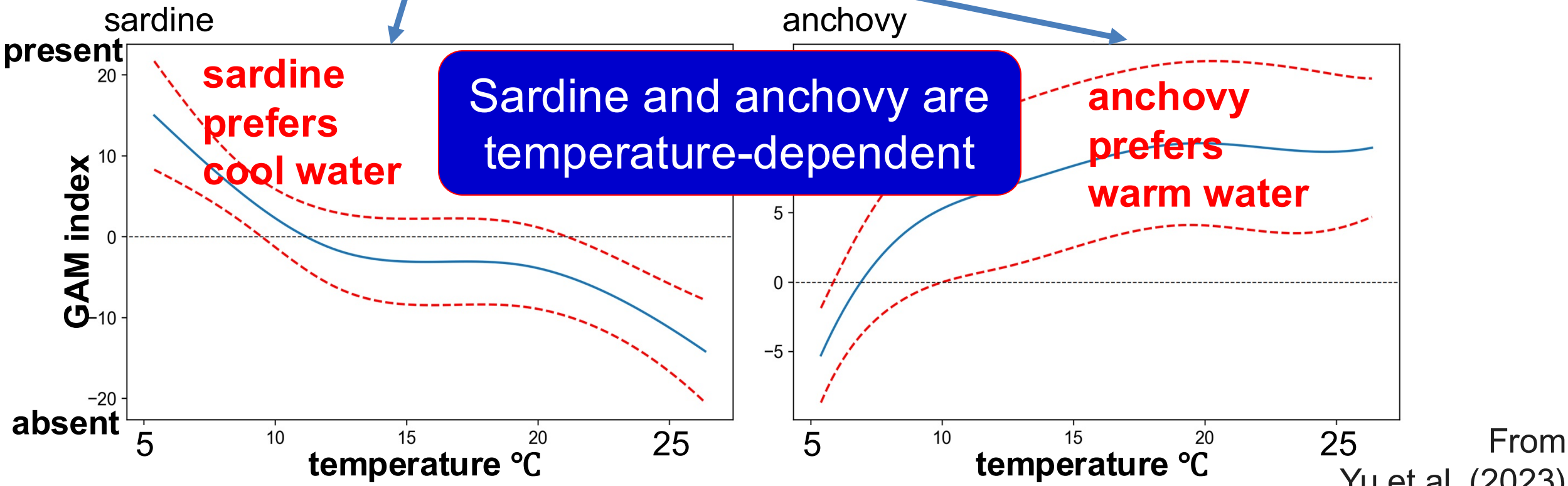
Environment factors:

- ✓ temperature
- ✓ temperature gradient
- ✓ salinity
- ✓ salinity gradient
- ✓ oxygen concentration
- ✓ ln (chl-a concentration)



Result-2: GAMs for eDNA distribution (sardine/anchovy)

	temperature	temperature gradient	salinity	salinity gradient	oxygen	ln(chl)
sardine-0/1	***	-	**	○	***	-
ln(sardine)DNA quantity	*	-	**	-	*	**
anchovy-0/1	***	-	**	-	-	○
ln(anchovy)DNA quantity	*	○	-	-	○	-



From Yu et al. (2023)

Result-3: GAMs for eDNA distribution (mackerels)

Chl-a→phytoplankton

But mackerels also eat small fish

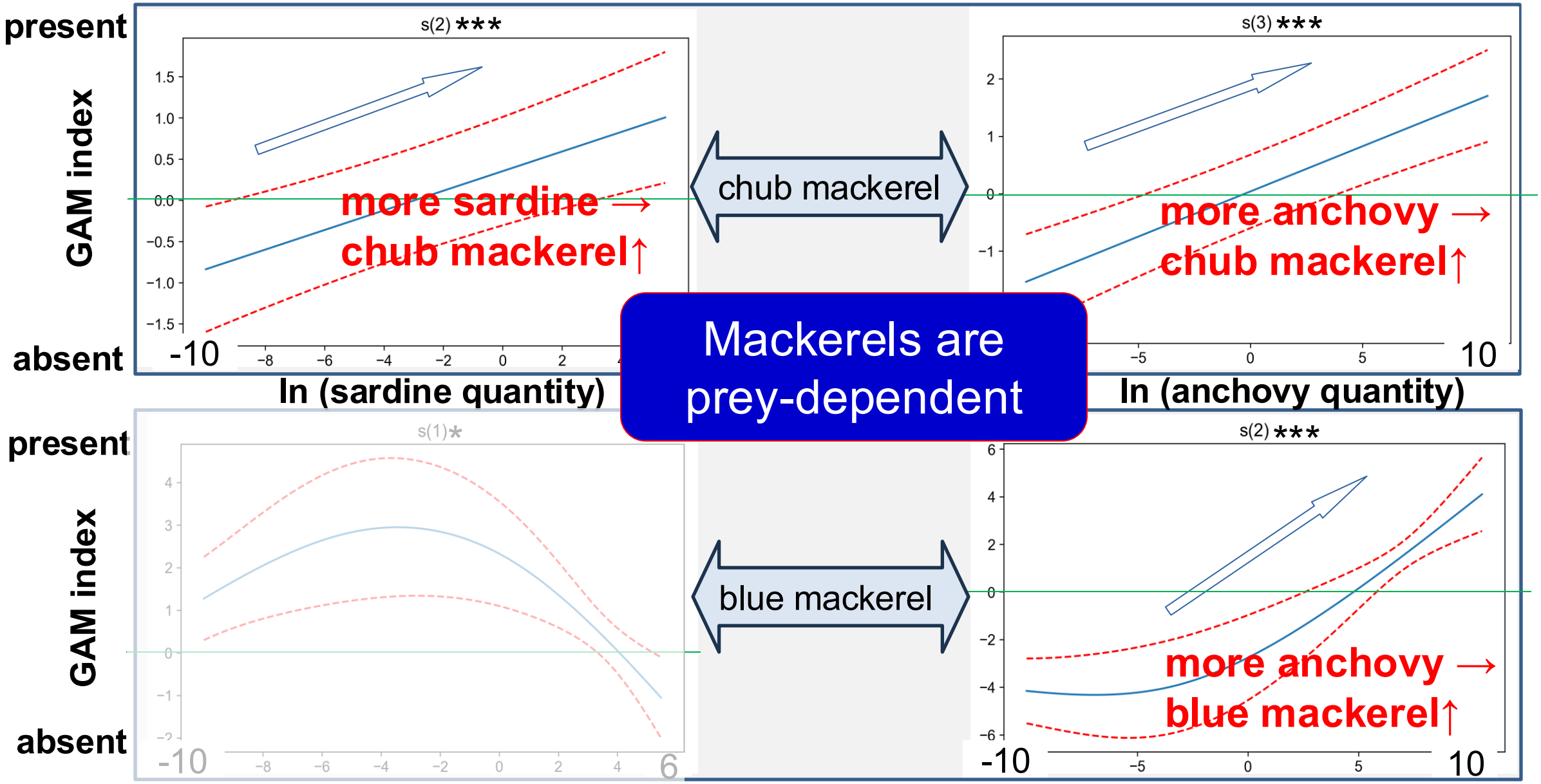
GAM including prey fish

	temp	temp gradient	salinity	salinity gradient	oxygen	eDNA data: ln sardine	eDNA data: ln anchovy
chub mackerel-0/1				○	○	***	***
chub mackerel-ln(quantity)	*	○	○		○	○	***
blue mackerel-0/1					○	*	***
blue mackerel-ln(quantity)	○			***			**

Mackerels' distribution influenced by sardine/anchovy

From Yu et al. (2023)

Result-3: GAMs for eDNA distribution (mackerels)



From Yu et al. (2023)

【4. Summary】
Environment and small pelagic fish distribution

eDNA
+
environmental
factors

T °C

Consistent with prior knowledge.

(Takasuka et al., 2007; Ma et al. 2019)

Sardine and anchovy are temperature-dependent

Mackerels are prey-dependent

New discovery

Thank you very much for your attention.