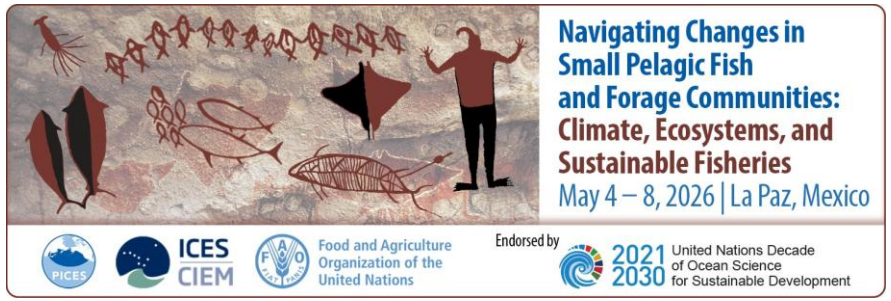

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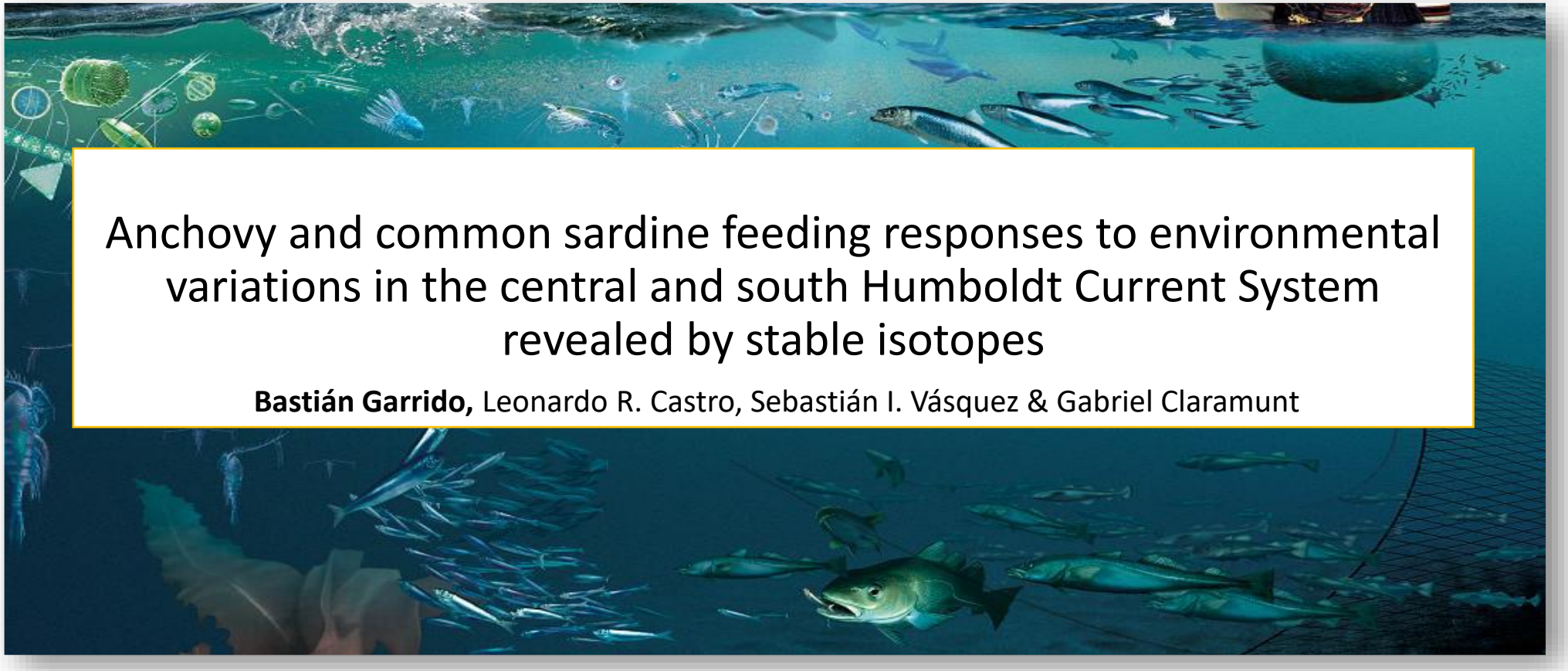

Anchovy and common sardine feeding responses to environmental variations in the central and south Humboldt Current System revealed by stable isotopes

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La Paz, BCS, México, May 8, 2026

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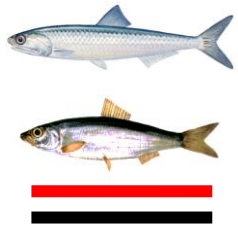
WWF Chile

Background: Small pelagic fish along HCS

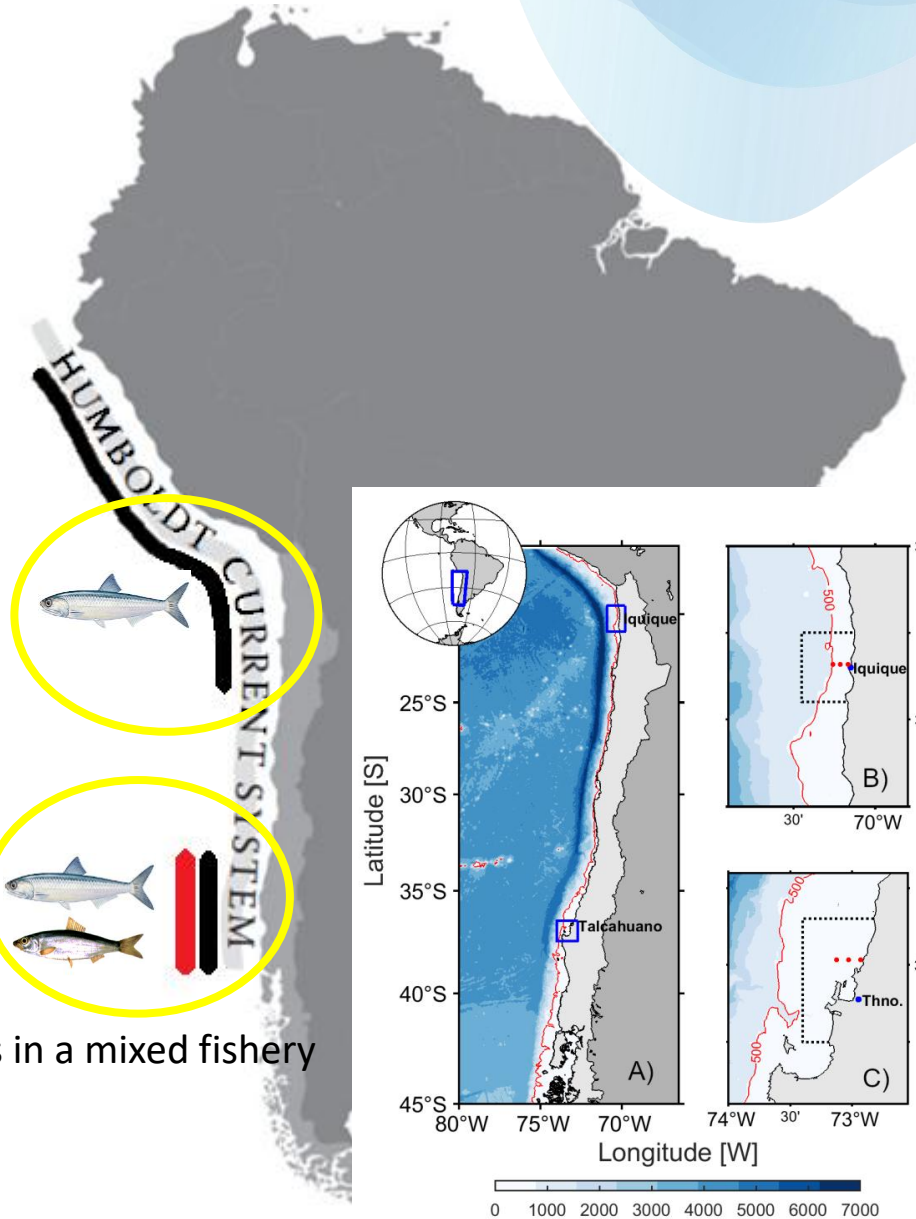
Central HCS (20° S)
Anchovy



South HCS (36° S)
Anchovy and Common sardine

Despite their importance, trophic ecology remains poorly understood. Most studies focus on diet, but we lack integration of:

- X **seasonal variability**
- X **environmental forcing**
- X **species interactions**



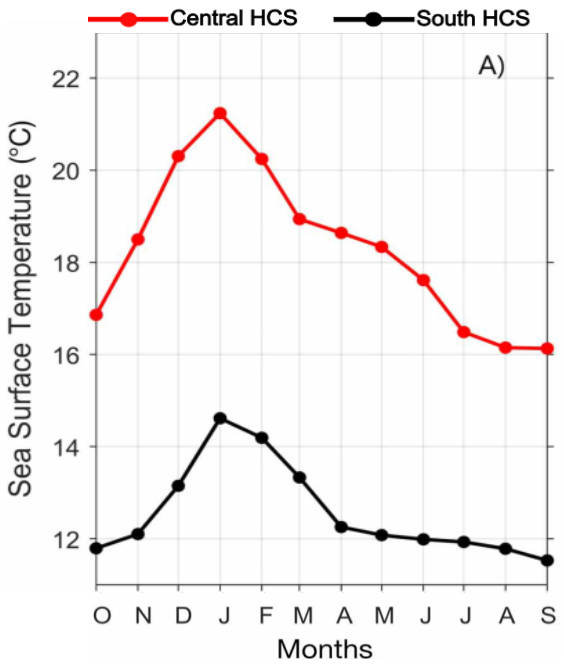
Both species in a mixed fishery

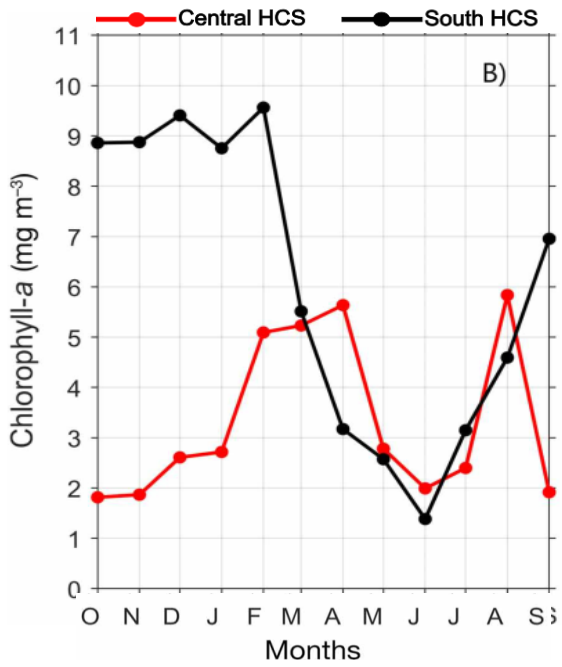
Objective

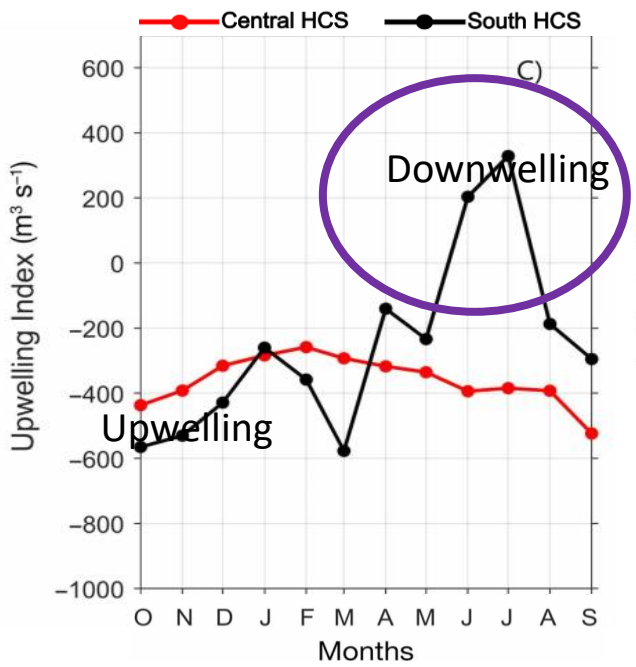
To assess seasonal trophic dynamics of anchovy and common sardine, their relationship with environmental variability, and species interactions in two contrasting zones of the HCS, using stable isotopes.

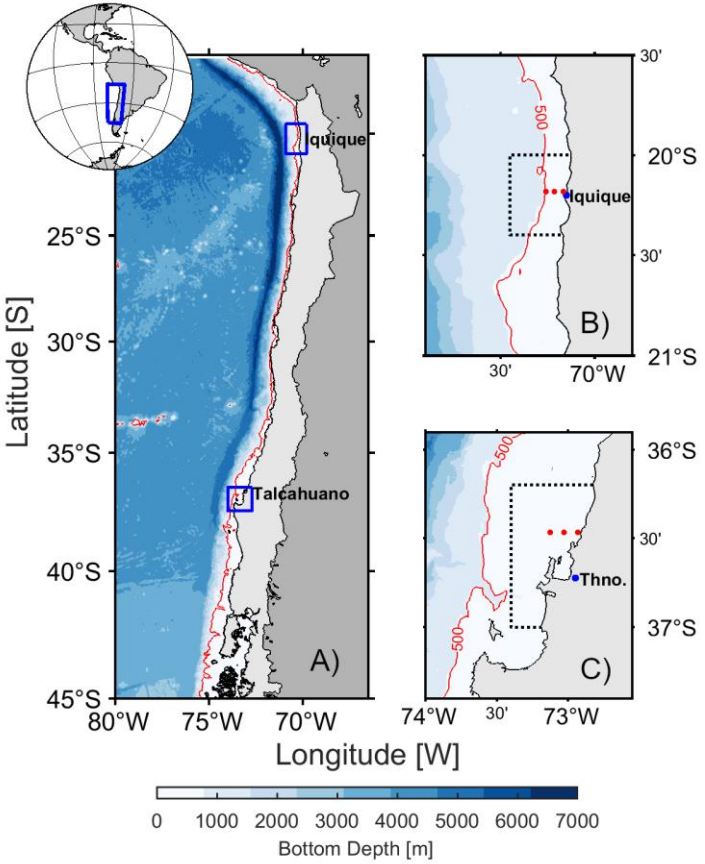
Hydrographic conditions

- ✓ **We studied two contrasting zones**
- ✓ **A Central HCS with relatively stable upwelling conditions**
- ✓ **A South HCS with strong seasonality (summer-upwelling) and freshwater inputs**
- ✓ **Areas with environmental and hydrographic differences**







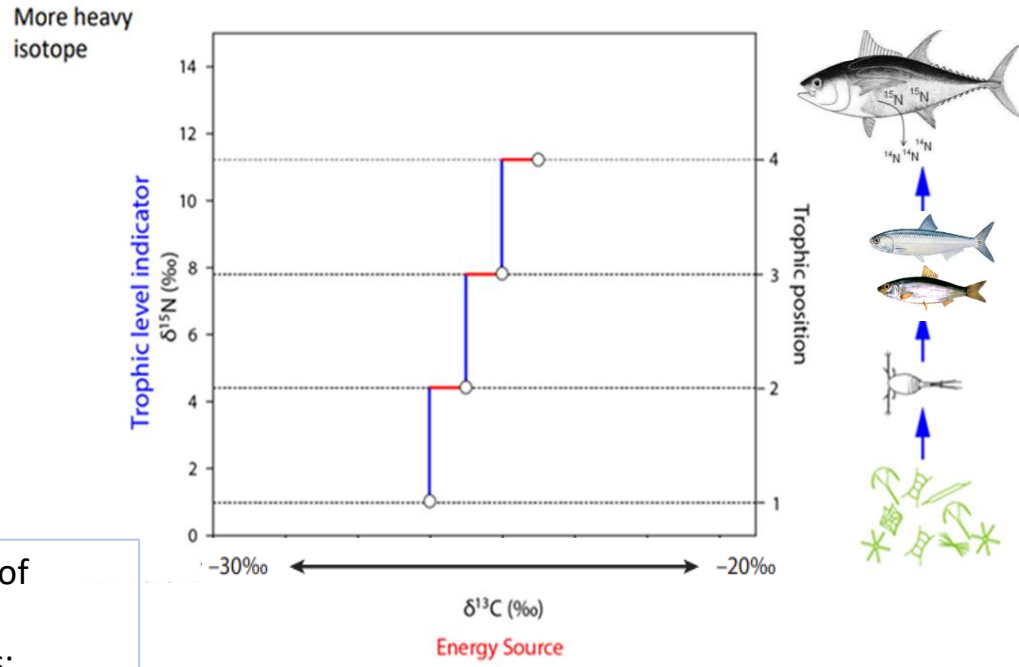


(A) Monthly average sea surface temperature, (B) chlorophyll-a concentration, and B) upwelling index

Seasonal sampling

	Central HCS	South HCS	
Spring 2021	(30)	(30)	(30)
Summer 2021	(30)	(30)	(30)
Autumn 2022	(30)	(30)	(30)
Winter 2022	(26)	(30)	(30)

We conducted seasonal sampling in both study areas. We collected 30 individuals per species in each area and season, along with plankton and POM samples.



- We used stable isotopes of carbon and nitrogen.

Across multiple trophic levels:

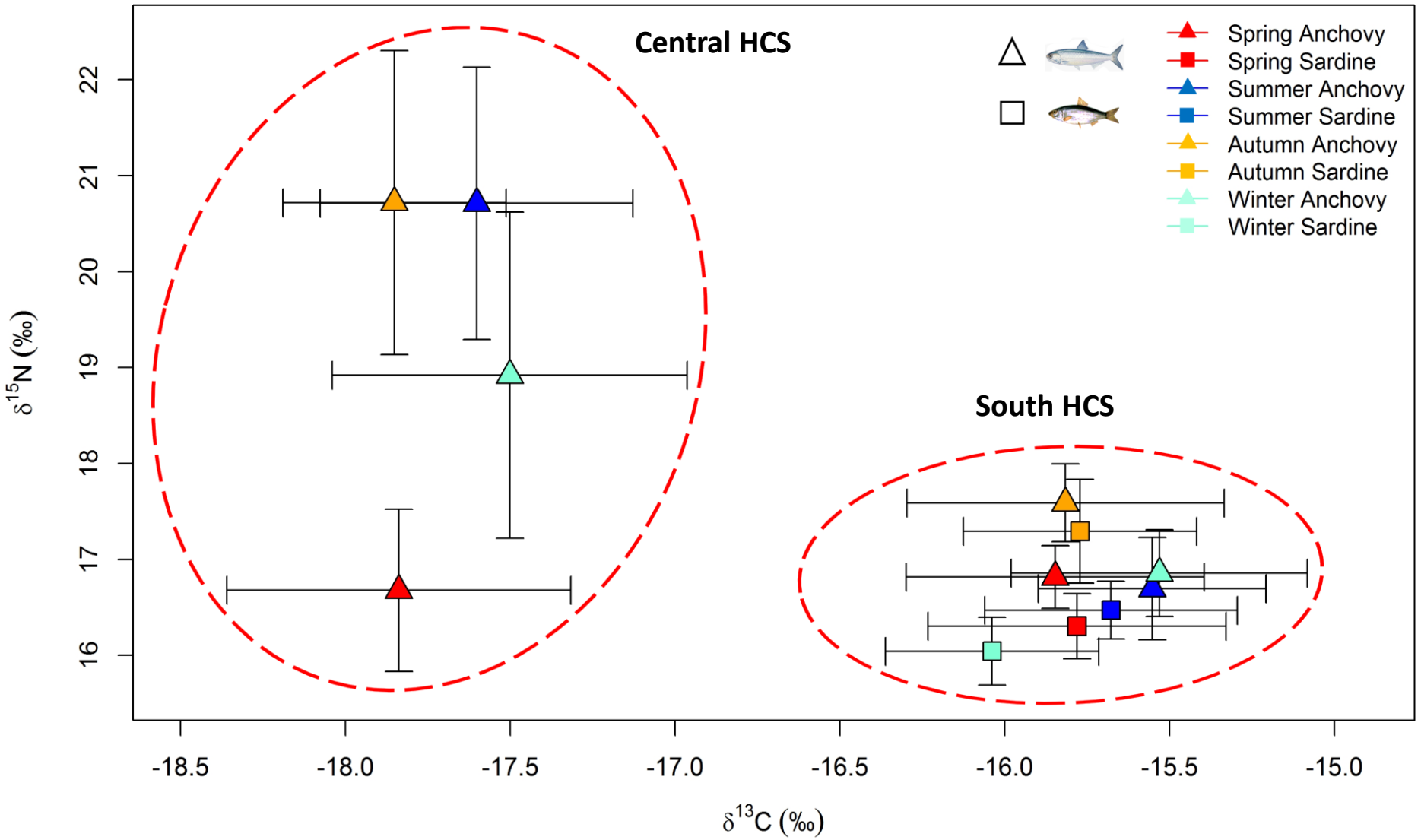
- particulate organic matter, zooplankton and fish.

"Both IE can provide key information on the ecosystem's trophic structure, interactions between species, and the assimilation of prey"

(Gutiérrez et al., 2012, 2017; Iriarte et al., 2012; Nakayama et al., 2017)

Results

Isotopic variability $\delta^{13}C$ and $\delta^{15}N$



Average (±SD) seasonal isotopic values of $\delta^{13}C$ and $\delta^{15}N$ in anchovy (triangles) and common sardine (squares), in the Central and South HCS, during 4 seasons: spring 2021 to winter 2022

$\delta^{13}C$ values showed significant spatial variations.

$\delta^{15}N$ values revealed marked seasonal variability, especially in the Central HCS

In the south HCS, there is less seasonal variability in $\delta^{15}N$

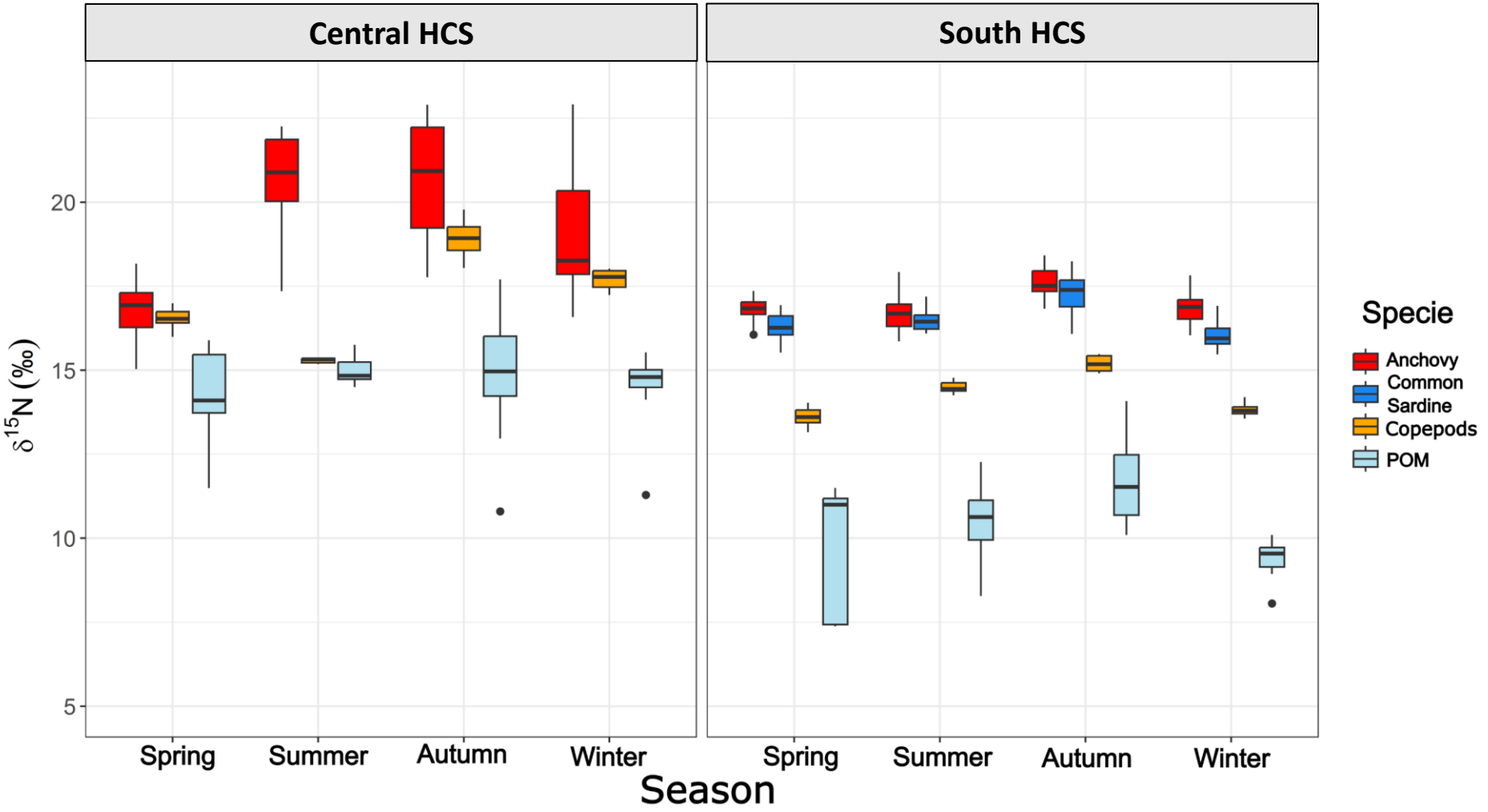
Results

Higher $\delta^{15}N$ values in all food web components analyzed in the Central HCS

Wider inter-seasonal variability in $\delta^{15}N$ in fish from the Central HCS compared to the South HCS

In the south HCS, $\delta^{15}N$ values were slightly higher in Anchovy than in Sardine

Seasonal variability of $\delta^{15}N$ in the food web



Seasonal $\delta^{15}N$ values for each functional group in the Central and South Humboldt Current System (HCS). (spring 2021 to winter 2022)

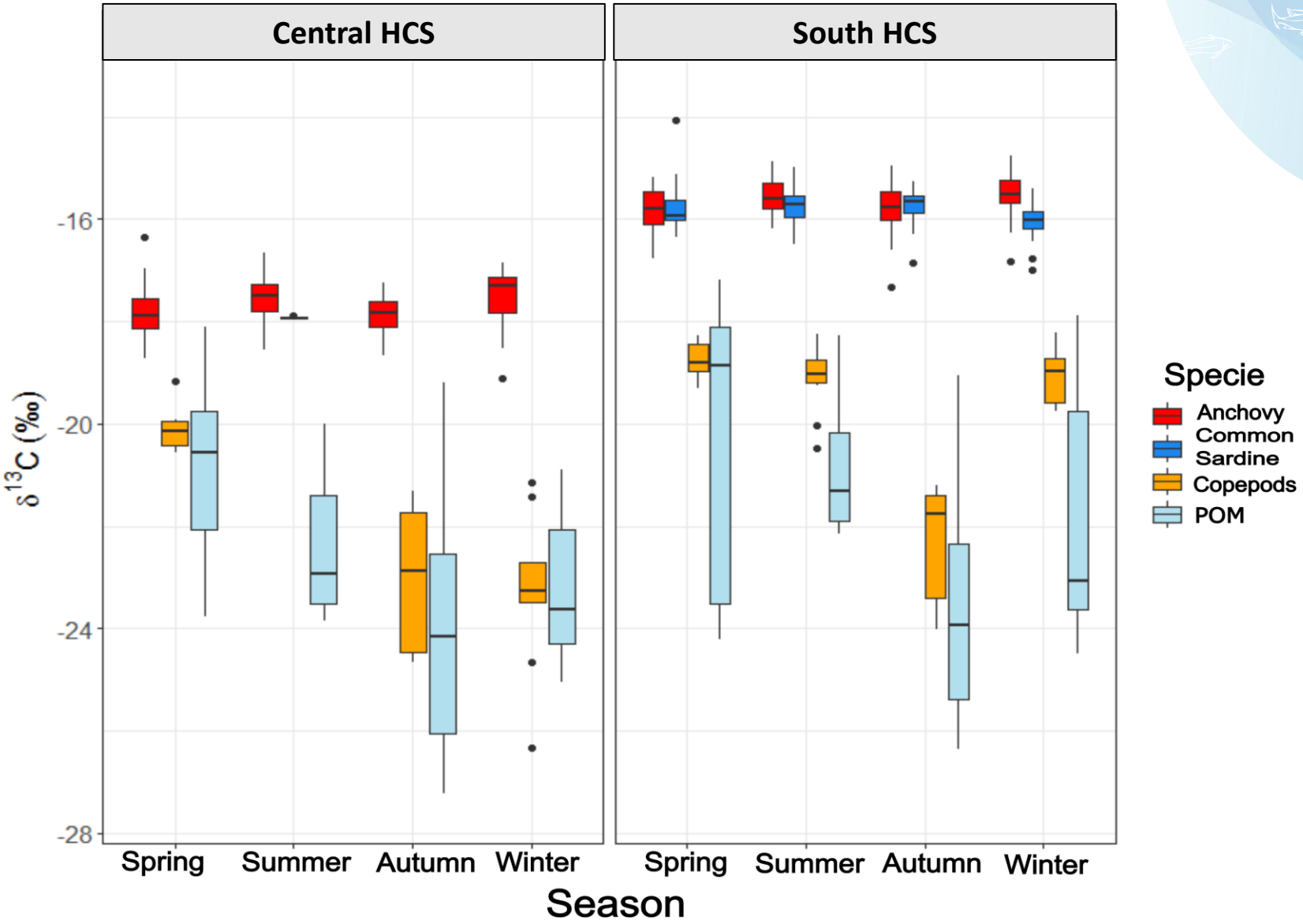
Results

Seasonal variability of $\delta^{13}C$ in the food web

Clear seasonal variability in $\delta^{13}C$ at lower trophic levels (POM and copepods), but not in fish

Higher $\delta^{13}C$ values in the South HCS exhibit spatial differences

This suggesting different dominant carbon sources between the two zones, likely associated with differences in upwelling and continental inputs.



Seasonal $\delta^{13}C$ values for each functional group in the Central and South Humboldt Current System (HCS). (spring 2021 to winter 2022)

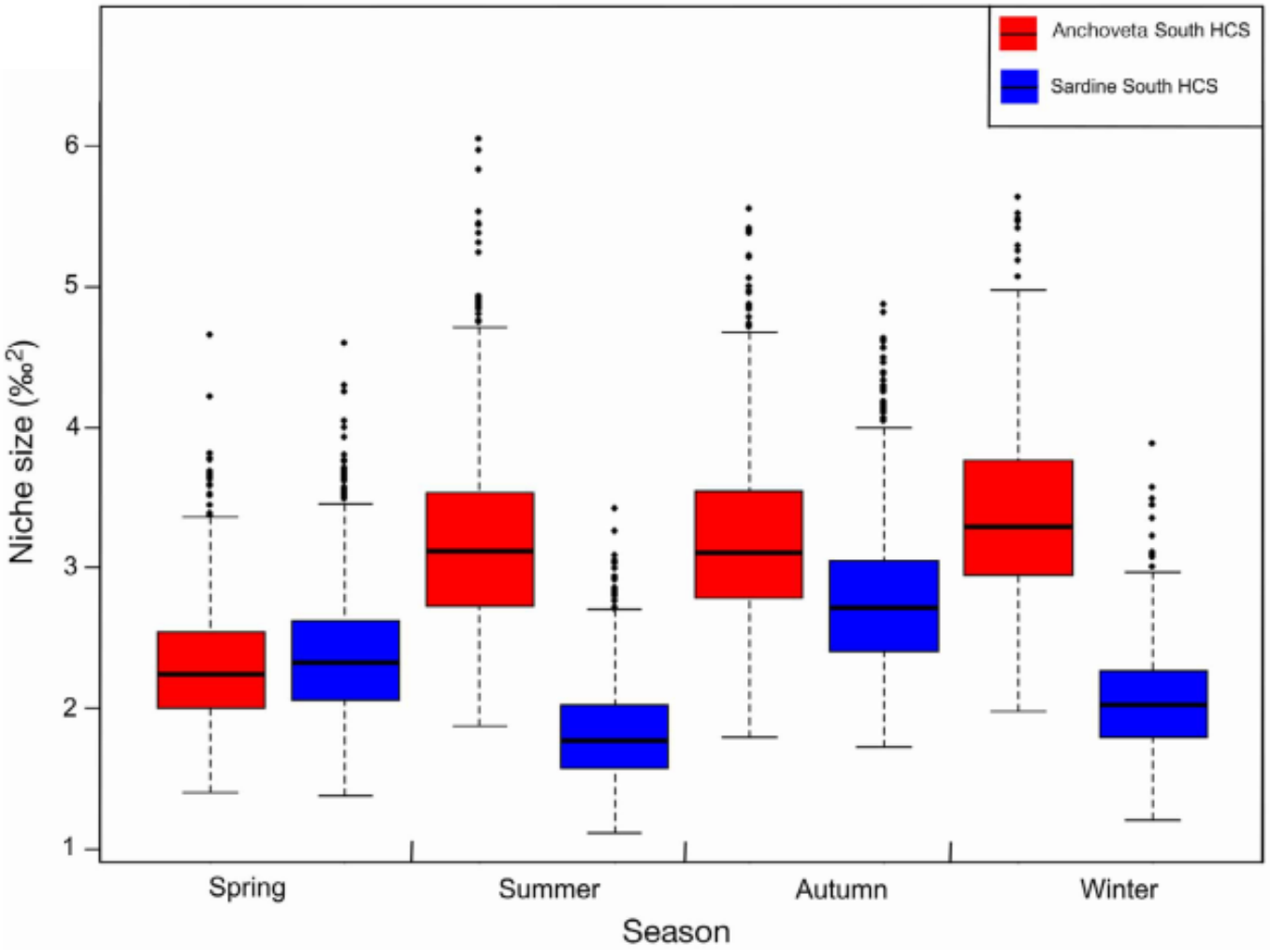
Species interactions: South HCS

The isotopic niche size varied seasonally, reflecting changes in food composition and availability

The isotopic niche size in anchovy was larger than that of Common sardine.

This is consistent with the high trophic plasticity described for anchovies in this area of the HCS

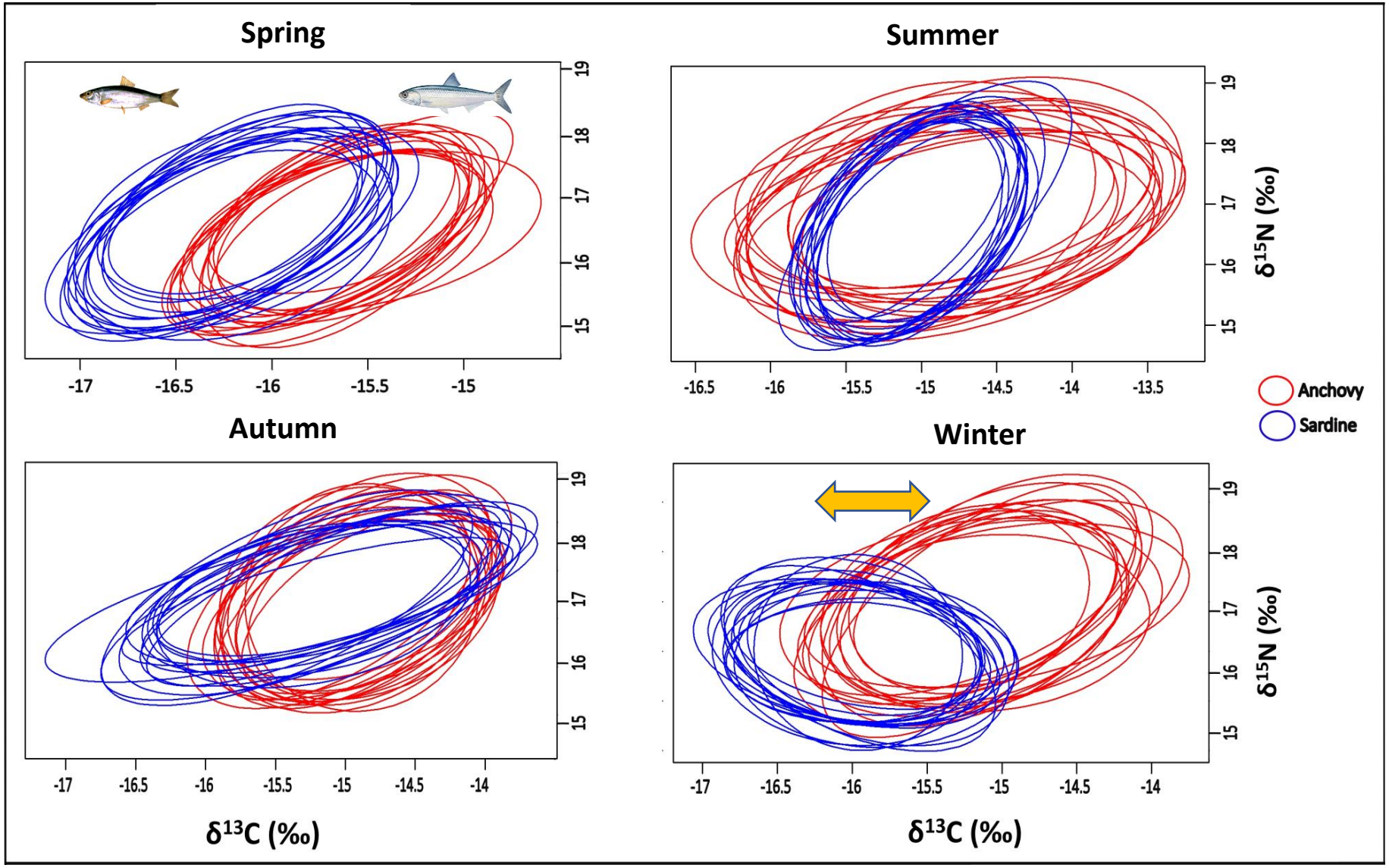
Isotopic Niche Size in South HCS



Estimated niche sizes of Anchovy and Common sardine in the South Humboldt Current System (HCS) zone during each season

Species interactions: South HCS

Isotopic Niche in South HCS



Isotopic niche overlap peaks in summer (high productivity) and decreases in winter

Overlap (%)

Common Sardine on anchovy

- Spring: 57,05
- **Summer: 97,69**
- Autumn: 83,36
- Winter: 85,67

Overlap (%)

Anchovy on common Sardine

- Spring: 59,13
- Summer: 68,87
- Autumn: 78,35
- **Winter: 30,62**

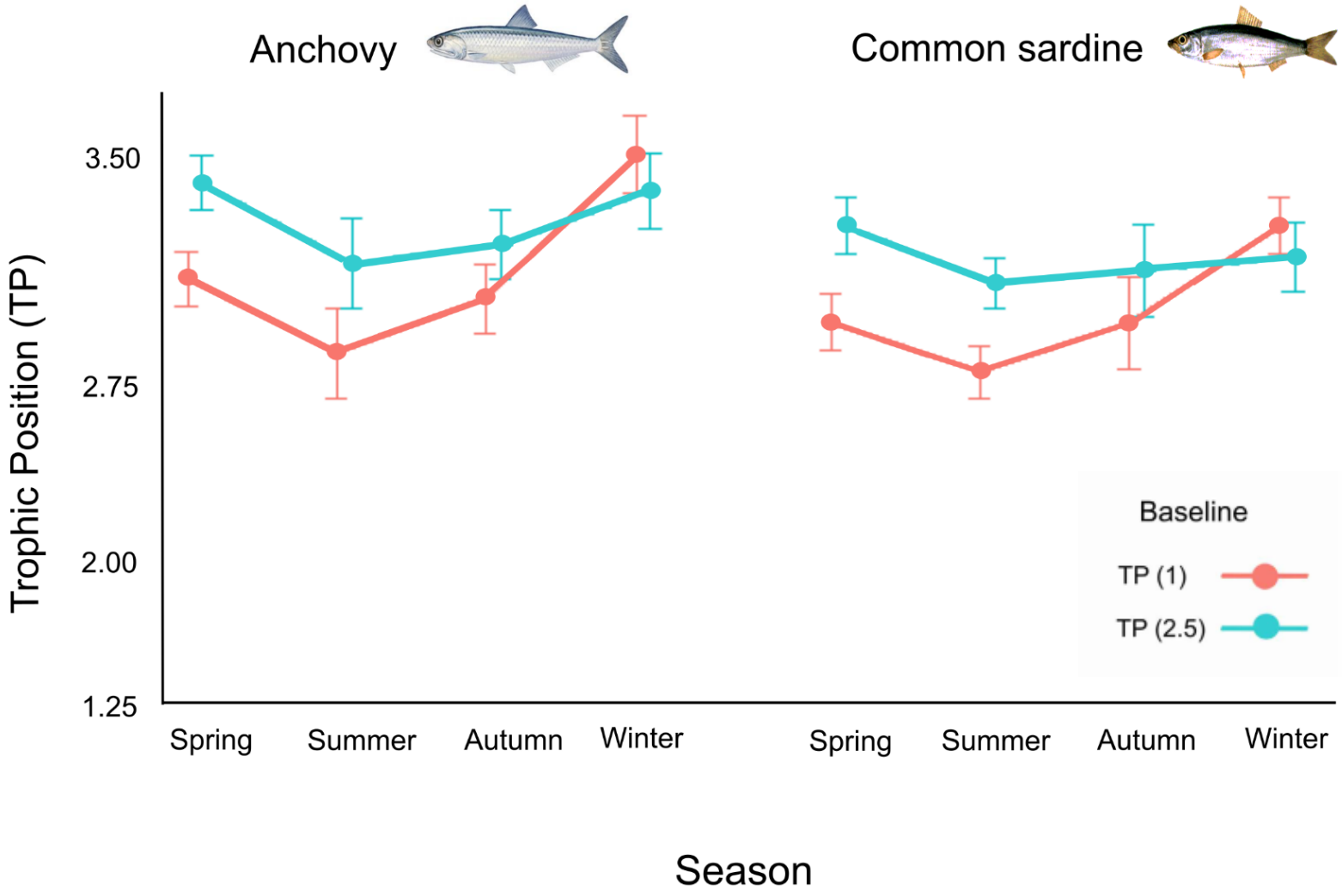
Seasonal random elliptical projections of the isotopic niche for Anchovy (red) and Common sardine (blue) in the south HCS zone, during 4 seasons: spring 2021 to winter 2022.

Species interactions: South HCS

The Trophic Position of anchovy was higher than that of common sardine.

The Trophic Position of anchovy had more pronounced seasonal variability than that of common sardine.

The lowest trophic positions occur in summer for both species



Mean (±SD) of the Trophic Position (TP) estimated using particulate organic matter (TP [1]) and copepods (TP [2.5]) as baselines

Some key findings

Regions – seasons

$\delta^{13}C$ values showed significant spatial variation, indicating diverse sources, with contributions from benthic sources in the south HCS

Higher $\delta^{13}C$ values in the South HCS, are associated with the presence of benthic sources in the area

$\delta^{15}N$ values revealed marked seasonal variability, especially in the Central HCS

In the South HCS, $\delta^{15}N$ values were higher in Anchoveta than in common Sardine

Species interactions

The isotopic niche size and trophic position of anchovy were greater than those of common sardine, consistent with the higher trophic plasticity of anchovy

Overlap peaks in summer, but decreases in winter, suggesting trophic partitioning under lower food availability.

Environmental variability strongly structures trophic dynamics across the Humboldt Current System

In the South HCS, slight differences in diet may be facilitating the coexistence of both species, a particularly important feature during periods of reduced food availability

Thank you

Acknowledgements