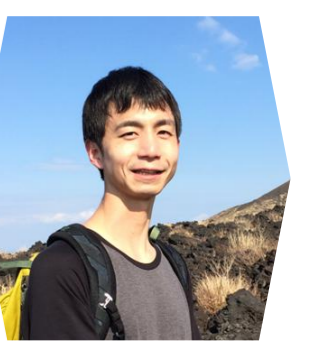


# Distribution of Spawning Grounds of Japanese Sardine During the Prolonged Kuroshio Large Meander Period



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## Key message :

During the prolonged Kuroshio Large Meander, Japanese sardine spawning became highly concentrated around the Izu Islands, followed by downstream dispersal along the Kuroshio.

## Introduction

Japanese sardine (*Sardinops melanosticta*) is a key fishery resource along the Pacific coast of Japan, and egg and larval surveys conducted since 1947 provide a unique long-term basis for evaluating its spawning ecology. This study examines how the prolonged Kuroshio Large Meander, which persisted from 2017 to 2025, has affected the distribution and spatial concentration of sardine spawning grounds.

## Objectives

To examine changes in the spatial distribution and concentration of Japanese sardine spawning grounds and to assess downstream dispersal based on multi-stage egg and larval distributions.

## Materials and Methods

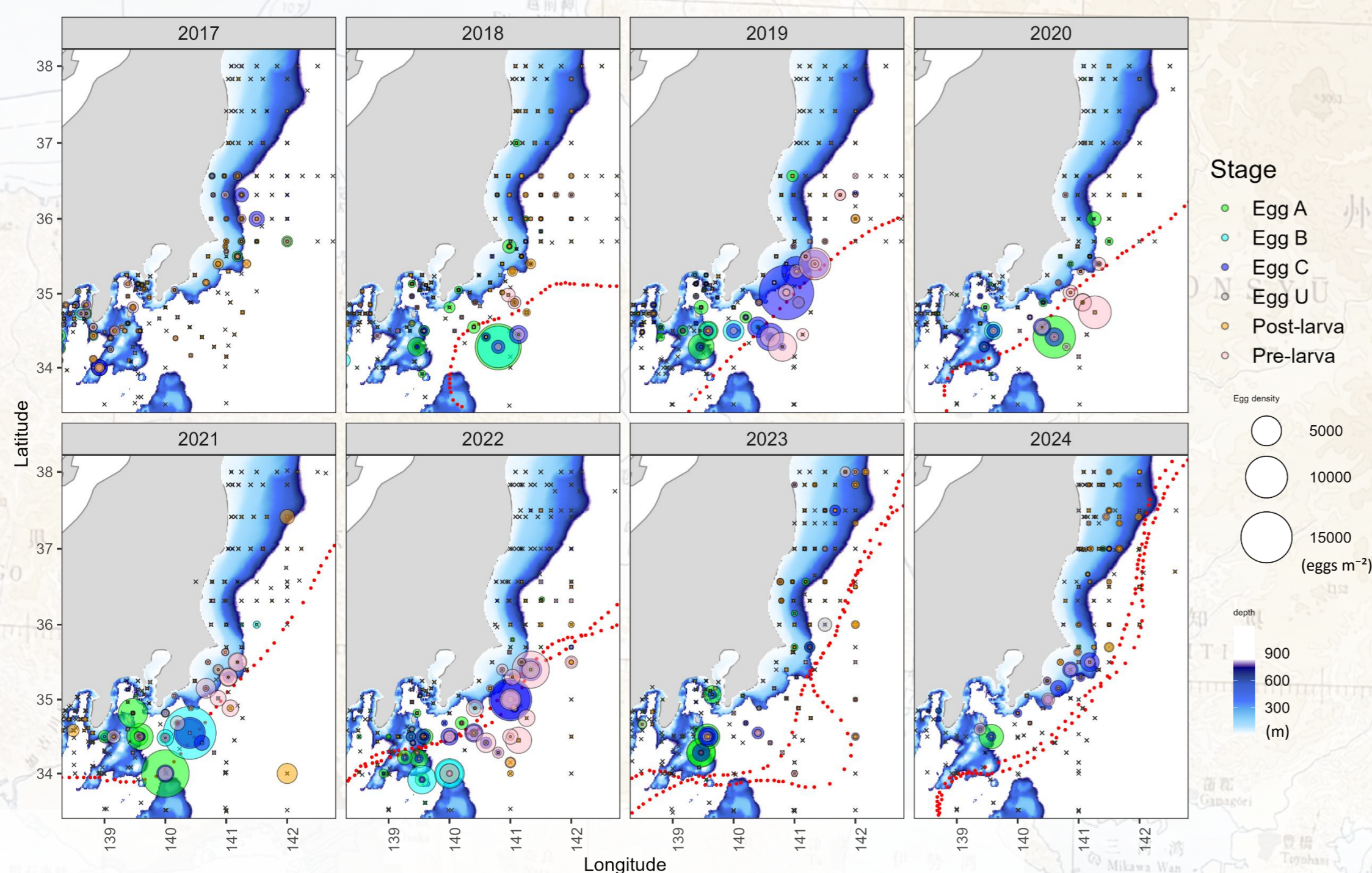
Monthly egg and larval surveys conducted along the Pacific coast of Japan were analyzed, focusing on early-stage eggs to characterize spawning grounds. Spatial patterns were evaluated using egg abundance, center of gravity (COG), and a spatial dispersion index based on distance from COG. Stage-specific distributions from early eggs to late larvae were examined to assess downstream transport along the Kuroshio.

## Annual egg production

Since 2018, egg production has increased mainly along the **Kuroshio axis** between  $140^{\circ}$  E and  $145^{\circ}$  E.

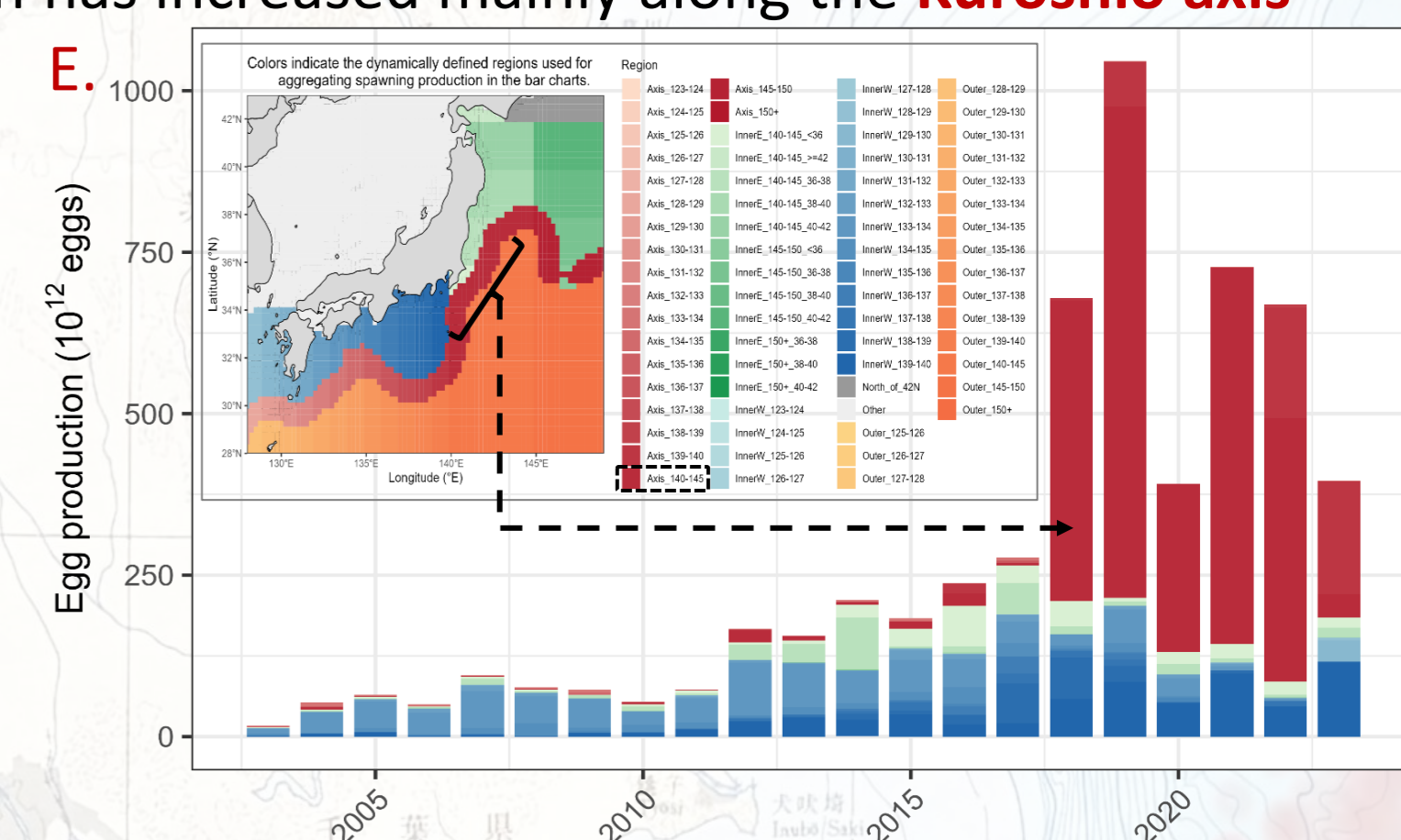
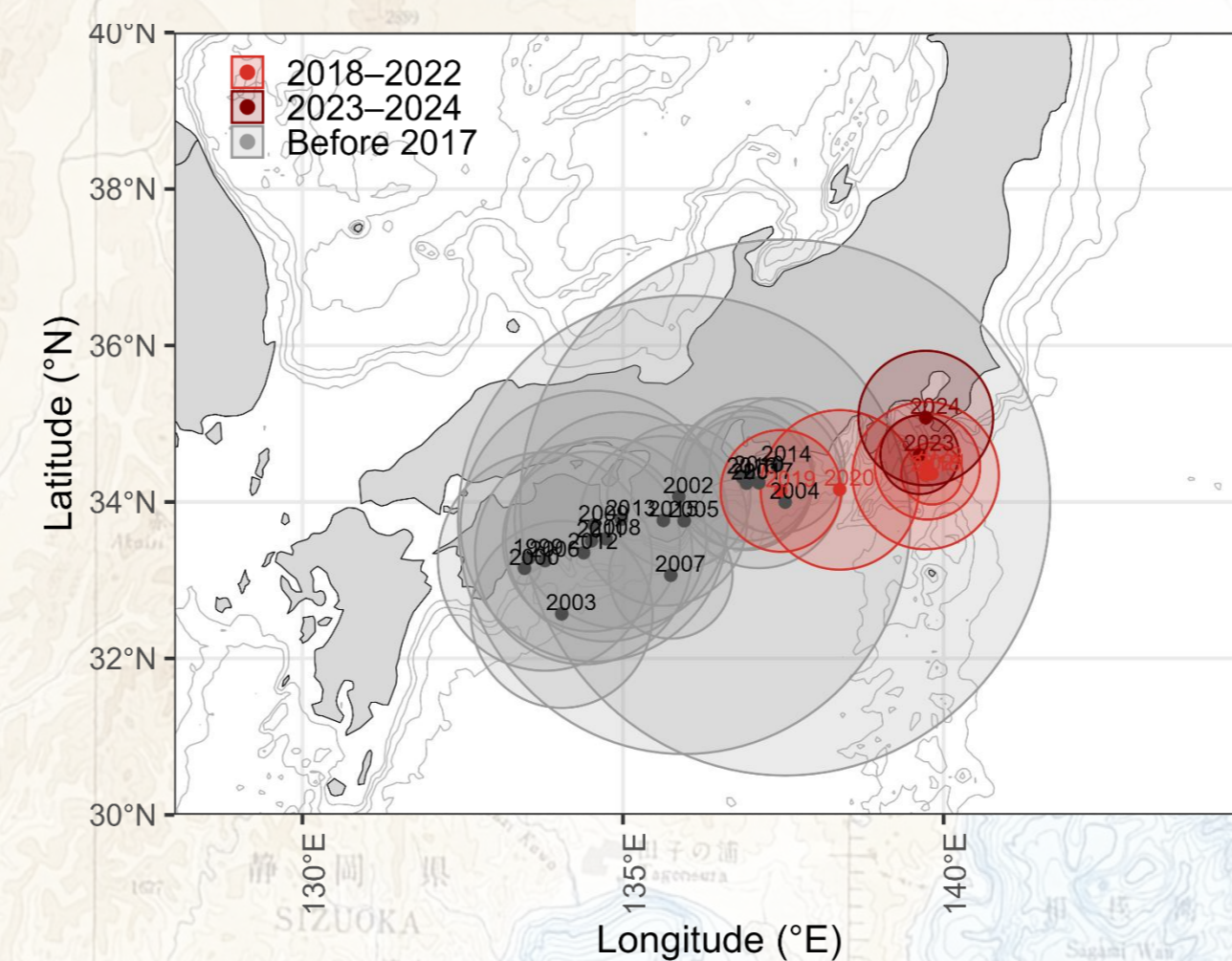
## Distribution from early eggs to late larvae

Eggs and larvae of all developmental stages frequently occurred between the Izu Islands and the Boso region, with developmental stages increasing downstream along the Kuroshio.



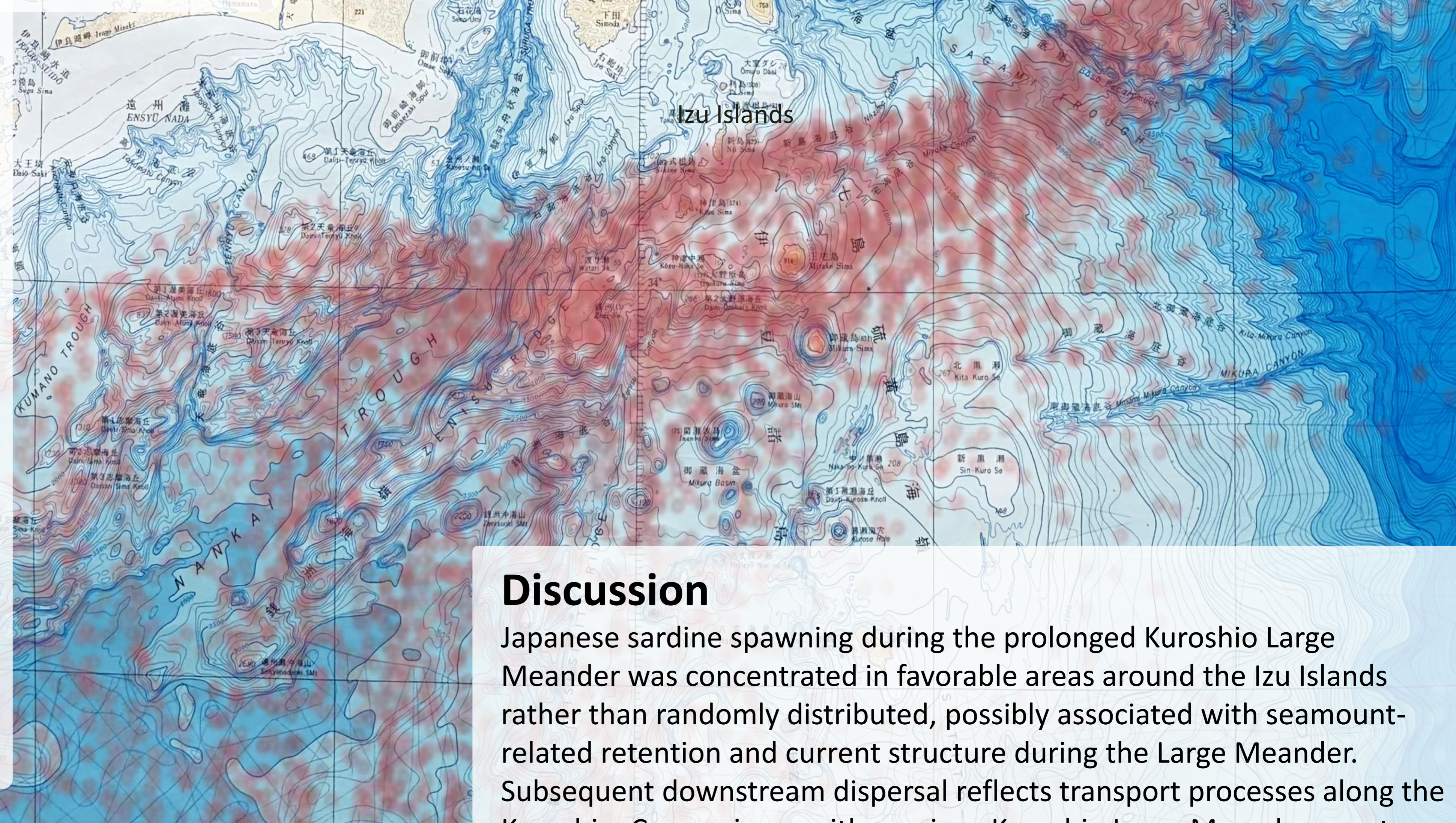
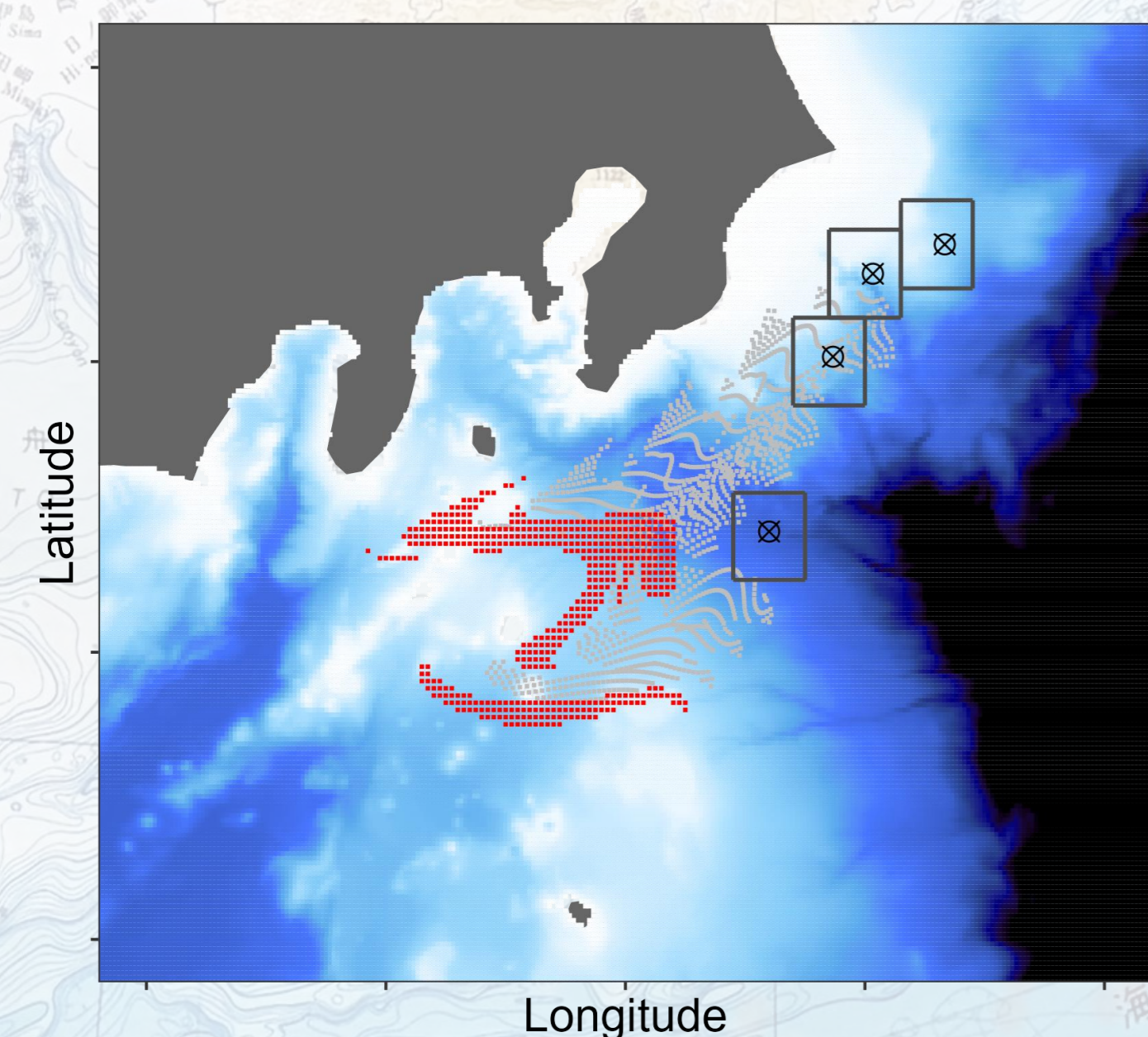
## Spatial Concentration of Spawning Grounds

High spatial concentration around the Izu Islands was observed from 2018 to 2024.



## Estimated spawning locations based on particle backtracking

A case-study backtracking analysis in 2019 indicates that eggs collected off the Boso region originated around seamounts near the Izu Islands and were transported downstream within approximately 48 hours.



## Discussion

Japanese sardine spawning during the prolonged Kuroshio Large Meander was concentrated in favorable areas around the Izu Islands rather than randomly distributed, possibly associated with seamount-related retention and current structure during the Large Meander. Subsequent downstream dispersal reflects transport processes along the Kuroshio. Comparisons with previous Kuroshio Large Meander events and analysis of the underlying mechanisms remain to be addressed.

## Conclusion

During the prolonged Kuroshio Large Meander, Japanese sardine spawning grounds became concentrated around the Izu Islands, followed by downstream dispersal along the Kuroshio. Long-term egg and larval surveys since 1947 provide critical insights into how large-scale oceanographic variability affects sardine spawning ecology.

Red dots indicate the Kuroshio axis (2018–2024), based on operational ocean current charts published by the Japan Coast Guard.