Activity 4: Distribution, migration and connectivity

Leaders: Naiara Rodriguez-Ezpeleta (Spain), Tatsuya Sakamoto (Japan)

Background

Understanding the distribution, migration, and connectivity of small pelagic fish is essential for improving stock assessments, fishery management, and studies of population dynamics. In recent years, significant range shifts of small pelagic species have been observed, likely driven by climate change. One of the most striking examples is the Japanese sardine, which has crossed the entire North Pacific to reach the U.S. west coast. However, the mechanisms driving such movements and whether common patterns exist across species and regions remain unclear, making future predictions highly uncertain. Additionally, these distribution shifts may have profound consequences for marine food webs, altering predator-prey relationships, ecosystem dynamics and biogeochemical cycles.

Recent advancements in techniques such as genomic sequencing and stable isotope analysis in archival structures (*e.g*., otoliths and eye lenses) are transforming our understanding of fish movements, population structures, and connectivity. As these tools continue to improve, they offer new opportunities for uncovering migration pathways and stock relationships. This activity aims to provide a platform for researchers to exchange knowledge, discuss emerging methodologies, and foster collaborations to enhance our understanding of small pelagic fish movements, their ecological impacts, and the implications for fishery management strategies (WG's *ToR 1*).

Objectives of the activity for 2024–2028 [with links to WG's ToR]

- **Review techniques for studying population structure and connectivity** – Examining current methods used to study population structure and connectivity, their global applications, and contributions to stock assessment (*ToR 2, 3 & 4*);
- **Perform comparative analysis of range shifts and colonization events** – Identifying common patterns in range shifts across regions (*e.g*., Arctic expansions, anchovy moving north) and assessing species-specific responses (*ToR 2, 3 & 4*).

Status of ongoing projects

- Collaboration between NOAA (USA) and AORI, The Tokyo University and Kyoto University (Japan): *Identifying Japanese sardine pathway across the Pacific onto the U.S. west coast*
  Status: Otolith and tissue isotope analyses started. The preliminary results will be presented at PICES 2025.
- Collaboration between AZTI (Spain), Institut National de Recherche Halieutique (Morocco) and University of Montpellier and IFREMER (France): *Studies on European sardine on recent colonization event associated to genome rearrangements*.
- Review work: Summarize status of population structure studies and techniques used in each SPF habitat and identify issues to improve stock assessment.
  Status: Yet to begin.
- Review work: Assess SPF range shifts and colonization events in each SPF habitat, discover driving mechanisms and compare across regions.
  Status: Yet to begin.

Deliverables and anticipated timeline

Deliverable/objective	Timeline
Convene a topic session at 2026 SPF Symposium	May 2026
Case study paper: Japanese sardine cross-Pacific migration written	December 2026
Review paper on SPF range shifts and colonization events written	2027
Review paper on the techniques for studying SPF population structure written	2027

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