PICES-ICES WG53/WGSPF

Joint PICES/ICES Working Group on Sustainable Pelagic Forage Communities

Co-chairs: Rebecca Asch, Susana Garrido, Motomitsu Takahashi, Chris Rooper

https://meetings.pices.int/members/working-groups/wg53

Activities

Activity 1: Spatiotemporal processes affecting life history	R. Asch, D. Silva, B. Erisman
Activity 2: Food-web Dynamics	S. Garrido, B. Hunt
Activity 3: Drivers of growth, reproduction, and survival	M. Huret, M. Lindegren, F. Berg, M. Takahashi
Activity 4: Distribution, migration and connectivity	N. Rodriguez-Ezpeleta, T. Sakamoto
Activity 5: Non-climatic and non-fisheries anthropogenic impacts	P. Polte, H. Ojaveer, F. Juanes
Activity 6: Forage beyond boundary currents	R. Rykaczewski, C. Rooper
Activity 7: Advanced technologies and methodologies	M.M. Angélico, C. Rooper, D. McGowan
Activity 8: Short-term forecasts and long-term projections	S. Koenigstein, R. Wildermuth
Activity 9: Improving management with actionable science	K. Jacobson, P. Sun, R. Wildermuth
Activity 10: Social-ecological analysis	M. Gasalla, N. Heck, I. Kaplan, P. Sun
Activity 11: Future in 2050	M. Peck, S.-I. Ito

Activity 1 - Spatiotemporal processes affecting life history

Leads: **R. Asch, D. Silva,** B. Erisman

- Identify trends, interannual variability, and environmental drivers of reproductive phenology
- Evaluate environmental sensitivity in pelagic forage fish spatial distributions through the analysis of interspecific and intraspecific responses of SPF distributions to environmental variables
- Determine best practices for applying life history traits to define and characterize SPF populations
  - growth patterns,
  - spatiotemporal dynamics of spawning,
  - larval dispersal and recruitment,
  - seasonal migrations,
  - ontogenetic shifts in habitat
- Joint modelling fishery-dependent and fishery-independent data sources
- Establish standardized methodologies, best practices for analyzing maturity status and GSI data

- <u>Specific sub activities</u>
- Using maturity status and GSI data to look at phenology
- Joint modeling using fisheries-dependent and independent datasets
- Stock characterization related to life history traits
- Environmental sensitivity in spatial distribution
- Trends and thermal sensitivity of reproductive phenology

Activity 2: Food-web Dynamics

Leads: **S. Garrido, B. Hunt**

- Address all aspects of SPF food web dynamics, benefiting from the global community of experts involved in this WG
  - Focus on interactions with higher trophic levels.

- <u>Specific sub activities</u>
- Compile metadata on top predator diet databases from different regions
- Review paper on SPF nutrition (e.g., energy density, fatty acids, lipid content, essential vitamins) as it related to top predator health
- Review of predator-prey allometric relationships of SPF—top predators using already available data on 29 species and data on tuna (albacore, bluefin) and billfish (swordfish) diet from the California Current System •
- Modification of ecosystem models to divide species into stanzas (life history stages of larger fish species that overlap with SPF during early life history) and compare outputs
- Application of semi-quantitative stomach fullness categories (from empty to full; categories 1–4) to examine, e.g., seasonal and diel variations in feeding, as well as spatial variation, using data available for multiple species
- Review and recommendations for best practice in evaluating larval fish diets using molecular methods
- Further development of a paper on a global stable isotope-based trophic level comparison of SPF
- Assessment and characterization of SPF functional traits across freshwater, coast to offshore habitats

Activity 3: Drivers of growth, reproduction, and survival

Leads: M. Huret, M. Lindegren, F. Berg, **M. Takahashi**

- Describe the variability in the life history and population dynamics of SPF across regions and species
- Analyze the internal and external drivers of this variability
  - experimental, statistical and mechanistic modelling approaches
- Examine responses of the spawning biomass, recruitment abundance, etc. with climate phases
- Assess which processes, (bottom-up and top-down) affect the population dynamics of forage species

Specific tasks
- Dataset on traits have been compiled and will be updated
  - experimental data on traits and covariables
  - survey data on population characteristics and covariables▪
  - Experimental review: review available data on traits from experiments and their associated conditions, and perform analysis of the experimental database to understand the relationships between traits and covariables.
  - Meta-analysis of field data: statistical modelling of the variability of the traits across species and stocks and analysis of the link with the internal (density-dependent) and external (temperature, zooplankton) drivers.
- Mechanistic modelling: bioenergetics modelling to explore the variability in traits across species and stocks and responses to external factors (temperature, zooplankton

Activity 4: Distribution, migration and connectivity

Leads: N. Rodriguez-Ezpeleta, **T. Sakamoto**

- 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

    - genomics, archival structures, stable isotopes, tagging, etc.

Specific tasks
- 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
- 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.
- Review work: Assess SPF range shifts and colonization events in each SPF habitat, discover driving mechanisms and compare across regions.
- 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
- 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

Activity 5: Non-climatic and non-fisheries anthropogenic impacts

Leads: P. Polte, H. Ojaveer, F. Juanes

- Synthesize information across species and oceans on cases of seascape modification effects;

- Develop a conceptual framework for assessing the vulnerability of SPF communities to non-climate and fishery-related stressors across regions and species;

   - Wind farms, oil spill risk, etc.

Specific tasks
- Workshop for expert scoring assessing the sensitivity and exposure of selected SPF to environmental modifications
- Species traits and respective stressor lists will be collected and backed with literature
- Develop vulnerability analysis framework with the following key elements:
   - **Exposure**: degree to which SPF communities are exposed to anthropogenic stressors like underwater noise (from construction and operational activities of wind farms, shipping lanes, and LNG terminals), sediment suspension (turbidity from dredging and other activities), and changes in hydrodynamic conditions
   - **Sensitivity**: The intrinsic biological traits that make SPF communities vulnerable to these stressors, such as their reliance on specific habitat types (e.g., estuaries, shallow coastal waters), sensitive life stages (e.g., larvae or juvenile stages), and migration patterns that may be disrupted by noise and hydrodynamic changes.
   - **Adaptive capacity**: This measures the ability of SPF species and ecosystems to adapt to or recover (mobility, behavioral plasticity (e.g., shifting to alternative habitats), ecosystem resilience (e.g., recovery of habitats affected by sedimentation or noise), genetic diversity, and life history traits)

Activity 6: Forage beyond boundary currents

Leads: R. Rykaczewski, **C. Rooper**

- Conduct comparative analyses of forage communities in open ocean systems

  - spatial and temporal variability and underlying drivers

- Synthesize insights from established mesopelagic research communities to understand current knowledge of sensitivity to oceanographic conditions

- Improve understanding of interannual to multi-decadal scale variability in forage communities

- Assess current understanding of climate change impacts on open ocean forage communities, particularly in subtropical gyres

Activity 7: Advanced technologies and methodologies

Leads: M.M. Angélico, **C. Rooper,** D. McGowan

1) Review of survey methods currently used to assess small pelagics

2) Review methods for improving, measuring or correcting existing sampling methods for potential gear selectivity and sampling bias

3) Review applications of new technologies and data analysis methods to complement traditional/existing surveys to provide better abundance indices

4) Research new technologies that can be used to develop new surveys or augment existing monitoring efforts, and examine new tools that can provide data to support small pelagic assessments
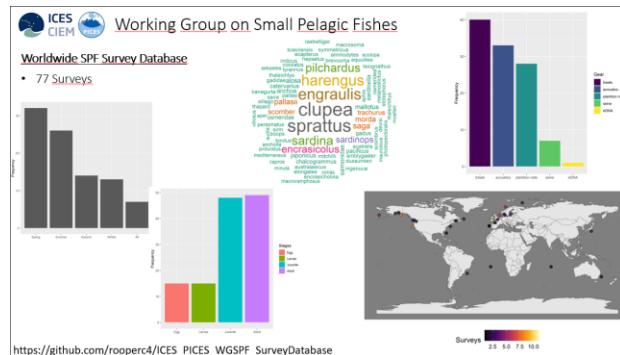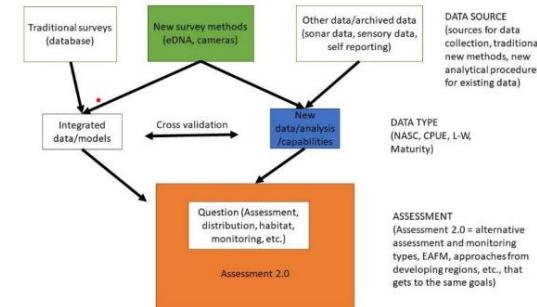
Activity 8: Short-term forecasts and long-term projections

Leads: S. Koenigstein, R. Wildermuth

- Understand fluctuations and ecosystem linkages of forage fish
- Conduct comparative analyses of forage fish
- Identify research gaps and advance forecasting capacities
- Project climate change impacts

- <u>Specific tasks</u>
- Advance incorporation of environmental and ecological drivers into forage fish population dynamic models.
- Conduct intercomparison of similar models across regions and species,
    - commonly applied models (larval dispersal models, bioenergetic models, population models, IBMs, food-webs
    - Technical interchange on software packages and analyses used
- Advance ensemble comparisons of hindcasts and projections of different model types,
    - advancing analyses of driving mechanisms behind model dynamics,
    - Interchange with FishMIP regarding comparison of future fisheries projections.
- Explore good practice in coupling of models
- Identify key areas of uncertainty and knowledge gaps, guiding observations and experiments aimed at improving future modeling efforts
- Novel applications of models in adaptive management (short-term forecasts) and supporting fisheries adaptation (long-term projections).
    - Identify advances needed in forage fish models, and suggest novel management applications for advances

Activity 9: Improving management with actionable science

Leads: K. Jacobson, **P. Sun**, R. Wildermuth

- Develop management tools adapted to the challenges presented by for SPF

  – advancing management strategy evaluations,

  – metrics for better understanding of stock and ecosystem status through models or simulations

  – incorporating ecosystem models in forage fish management

Specific tasks
- Survey of fishing industry and management community to determine priority areas and research needs for SPF to address regulatory issues across national and regional jurisdictions (lead: Matt Baker);
- Comparative study on SPF-adapted management procedures, including novel assessment and monitoring strategies, ecosystem-informed advice pathways, and data deficient or qualitative approaches (lead: Dorota Szalaj);
- Management strategy evaluation of alternative assessment approaches for SPF (e.g., dynamic reference points, ecosystem-informed assessments, management across jurisdictions, etc.);
- Coordinate assessment approaches with developments from Activity 8: Short-term forecasts and long-term projections

Activity 10: Social-ecological analysis

Leads: M. Gasalla, N. Heck, I. Kaplan, **P. Sun**

- Cross-cutting group considering social-ecological analyses of small pelagic species (SPF) and fisheries.

  - quantitative bioeconomic modeling in various forms,

  - end-to-end modeling and vulnerability and risk assessments utilizing stakeholder generated data.

  - Traditional Ecological Knowledge and Objectives from indigenous communities or stakeholders.

  - fleet behavior for transboundary stocks and options for international management

Specific objectives
- Advance research connecting SPF to human dimensions, communities, and wellbeing (ToR 4 & 5);
- Conduct a review paper on modeling methods that can be used to "stress test" international management of shifting transboundary SPF stocks (ToR 4 & 5);

Activity 11: Future in 2050

Leads: M. Peck, **S.-I. Ito, C. Rooper**

- Integrate the outputs from each WG activity into a picture of what small pelagic forage communities might look like in 2050,

  - biology,

  - distribution,

  - fisheries

  - management perspectives

  - socio-economics

Upcoming Activities

PICES Annual Meeting (Yokohama Nov. 8 - 14, 2025)

4 SPF Related Sessions

- S4: Responses of Small Pelagic Fish Communities to Recent Climate Regime Shifts and Climate Extremes
- S12: Understanding the Linkages Between Forage Species and Top Predators and How They May Affect Resilience in North Pacific Ecosystems
- S2: Changing Ecosystem Structure Under Global Climate Change: Monitoring, Detecting, Modelling, and Socio-Ecological Impacts
- S11: ELH and SPF

2 Hybrid Business Meetings (Yokohama, Nov 11 & 13, 2025, 1800-2030 JST)

Individual activity meetings (~quarterly)

PICES-ICES-FAO Symposium (La Paz, May 4-8, 2026)

Navigating Changes in Small Pelagic Fish and Forage Communities: Climate, Ecosystems, and Sustainable Fisheries
May 4 – 8, 2026 | La Paz, Mexico

Endorsed by
2021 2030 United Nations Decade of Ocean Science for Sustainable Development

Food and Agriculture Organization of the United Nations

Draft Agenda

1. Introductions
2. Review ToR (attached below)
3. Reports from activities
   a. Activity 1 - Spatiotemporal processes (??)
   b. Activity 2 - Food Web Dynamics (Susana?)
   c. Activity 3 - Growth, reproduction and survival (?)
   d. Activity 4 - Distribution, migration and connectivity (?)
   e. Activity 5 - Non-climatic and non-fishery impacts (Rebecca/Francis?)
   f. Activity 6 - Forage beyond boundary currents (Ryan/Chris?)
   g. Activity 7 - Advanced tech (Chris)
   h. Activity 8 - Short-term forecasts and long term predictions (?)
   i. Activity 9 - Improving management with actionable science (?)
   j. Activity 10 - Social-ecological analysis (Isaac?)
4. Breakout Groups (maybe a chance for the individual activity groups to meet for an hour in person?)
5. Activity 11 - Small Pelagics in 2050 (Shin-ichi, Myron, Chris?)
   a. Description of activity
   b. Discussion of contributions from other activities
   c. Action items
6. SPF Symposium 2026
7. Future plans/action items (e.g. session submissions to PICES or ICES, etc.)