Joint ICES/ PICES Working Group on Small Pelagic Fish (WGSPF)

2019/FT/EPDSG05 A Joint **ICES/ PICES Working Group on Small Pelagic Fish** (WGSPF), chaired by Myron Peck*, Germany (ICES), Ignacio Catalan*, Spain (ICES), Ryan Rykaczewski*, USA (PICES), and Akinori Takasuka*, Japan (PICES) will work on ToRs and generate deliverables as listed in the Table below.

	Meeting dates	Venue	Reporting details	Comments (change in Chair, etc.)
Year 2020	9-12 March	Copenhagen, Denmark	Final report by January 2023	Inter-sessional meeting, funding mechanisms being explored. Location dependent on success of funding raising efforts.
Year 2020	September	Copenhagen, Denmark		(ICES ASC)
Year 2020	October	Qingdao, China		(PICES AM)
Year 2021	September	TBA		(ICES ASC)
Year 2021	October	TBA		(PICES AM)
Year 2021	Late November / Early December	Barcelona, Spain (proposed)		SPF Symposium (resolution to be submitted to ICES & PICES)
Year 2022	Spring	TBA		Synthesis writing workshop planned (depending on successful funding applications)
Year 2022	September	TBA		(ICES ASC)
Year 2022	October	TBA		(PICES AM)

ToR descriptors

ToR	Description	Background	Science plan codes	Duration	Expected Deliverables
a	To review recent progress on understanding how various drivers (environmental and/or anthropogenic) impact the population dynamics of SPF in different ecosystems and whether and how potential drivers shift with changes in ecosystem state.	a) Science Requirements	1.2, 1.3, 2.2	3 years	Review paper(s) within peer-reviewed journal
b	Create a networking environment for international and multidisciplinary collaboration to foster the establishment of similar study frameworks and comparative analyses of SPF across different social–ecological systems, based on updated time series data sets of climate indices, environmental factors and	a) Science Requirements	1.9, 5.2	3 years	Meeting reports submitted to ICES and PICES, Perspective Paper(s) submitted to peer-reviewed journal(s)

	fisheries biology as well as ecophysiological information (feeding, growth and survival).				
c	Identify, prioritize and conduct research most needed to advance our knowledge and capacity to predict the population dynamics of SPF at both short (seasonal to inter-annual) and long (decadal to centennial) time scales.	a) Science Requirements	1.3, 7.6	3 years	Meeting reports submitted to ICES and PICES, Perspective Paper(s) submitted to peer-reviewed journal(s)
d	Recommend strategies of marine ecosystem monitoring and fisheries management of SPF which will contribute to sustainable ecosystem-based fisheries management, through biophysical, ecosystem and/or socio–economical models.	a) Science Requirements	2.5, 3.1, 4.1	3 years	Meeting reports submitted to ICES and PICES, Perspective Paper(s) submitted to peer-reviewed journal(s)
d	Propose topic sessions at PICES Annual Meetings and ICES Annual Science Conferences focused on advances in SPF science and to organize a joint ICES/PICES symposium on SPF at regular intervals (e.g., once every 4 years) leading to the publication of findings in special issues of primary journals.	a) Science Requirements	NA	3 years	Joint ICES-PICES theme sessions. An International ICES-PICES SPF symposium (follow-up to March 2017 Victoria meeting) Special issue(s) in peer-reviewed journal(s)

Summary of the Work Plan

Year 1	Initial meeting will take place in Spring 2020 of members from both ICES and PICES communities including a broader array of scientists from non-ICES and PICES regions (e.g. Humboldt EBUS, Mediterranean Sea). The ToRs will be discussed. Emphasis will be on summarizing ongoing work in various regions and scoping of joint research activities such as comparative analyses to be conducted by participants. A resolution for an international symposium on small pelagic fish will be submitted to ICES prior to the kick-off meeting. Two additional meetings will take place at the ICES ASC and PICES AM.
Year 2	An international Symposium will be convened (tentatively in late November / early December in Barcelona, Spain) immediately followed by a writing workshop to start producing synthesis articles stemming from activities in Year 1 and outcomes of the SPF symposium. The group will also meet at the ICES ASC and PICES AM.
Year 3	Meetings will take place at the ICES ASC and PICES AM. Final reporting of this first, 3-year phase of this group will be prepared. It is anticipated that a resolution will be submitted to extend the life-time of this joint group beyond this first, three-year phase.

Supporting information

Priority	Small pelagic fish (SPF) account for more than 30% by weight of the total landings of marine capture fisheries around the world. They also play an important role in the

transfer of energy through mid-trophic levels in marine ecosystems and are key resources for the world's growing aquaculture industry. The oscillations in the populations of SPF are dramatic and cyclical in response to climate variability on multi-decadal time scales. However, mechanisms linking climate variability to population dynamics are still unresolved. Hence, there are many challenges to sustainable use of SPF production. As the population dynamics of SPF display basin-scale teleconnections, synthetic and multidisciplinary studies are required to understand the processes and mechanisms to build predictive capacity.

International collaboration on SPF research was spearheaded by the GLOBEC Regional Program on Small Pelagic Fish and Climate Change (SPACC), launched in 1994 with a workshop in La Paz, Mexico. The SPACC program aimed to understand and predict climate-induced population dynamics of SPF in relation to physical and biological processes and included several major themes: long-term changes in ecosystems, retrospective analyses, comparative population dynamics, reproductive habitat dynamics, and economic implications of climate variability. The SPACC program culminated in 2010 with the publication of its review book. Since then, no international program specific to SPF has been launched, even though SPACC-II visions have been discussed (e.g., Alheit (2010) and van der Lingen et al. (2010)). In the following decade, there has been substantial scientific progress made in several ecosystems: different hypotheses of mechanisms of population dynamics of SPF have been proposed, data from long-term monitoring and stock-assessment efforts have accumulated, numerical modelling approaches have progressed, and technologies such as genome analysis have rapidly developed. ICES and PICES co-sponsored a symposium on "Forage fish interactions: Creating the tools for ecosystem-based management of marine resources" (Nantes, France, November 12–14, 2012) leading to publication of 12 articles in the ICES Journal of Marine Science (Peck et al., 2014). The need for a platform to organize intensive international collaboration was re-confirmed during the PICES/ICES Symposium on "Drivers of dynamics of small pelagic fish resources" (Victoria, BC, Canada, March 6–11, 2017). This symposium led to special issues in Deep-Sea Research Part II (Alheit et al., 2019; 15 articles) and Marine Ecology Progress Series (Alheit and Peck, 2019; 22 articles). The platform for international collaboration will allow the marine science community to more rapidly address challenging goals such as to:

1. Perform a synthesis of mechanisms linking climate variability to population dynamics of SPF among different ecosystems to reconcile various recruitment hypotheses;
2. Gain an holistic, ecosystem-level view of the causes and consequences of fluctuations in SPF populations such as how different factors (physical forcing, trophodynamics, and fishing pressure) interact to control the dynamics of populations;
3. Unite various fields (climate science, oceanography, plankton and fish ecology, quantitative fisheries stock assessment, sociology and economics) to build interdisciplinary approaches to examine SPF in social–ecological systems;
4. Incorporate new monitoring (e.g., environmental DNA) and modelling (e.g., end-to-end) technologies to better understand and manage pelagic ecosystems;
5. Provide projections of the effects of climate change on the distribution and productivity of SPF;
6. Propose strategies to safeguard marine ecosystem services stemming from SPF including conservation concerns related to SPF and their predators.

Because small pelagic fish (SPF) are highly valued by society and exhibit variability associated with changes in climate forcing, ecosystem structure, and fishing pressure, efforts to understand their dynamics require an integration of knowledge across oceanographic disciplines. Human society cannot expect to prepare a plan for sustainable development of the oceans unless we can improve our understanding of the largest component of ocean fisheries—the small pelagic fish. Consideration of the dynamics of these species, their sensitivity to exploitation and climate change, and the implications of such changes for the human populations that they support is essential to promote ocean

	sustainability and guide adaptation. The activities of the proposed joint working group will contribute primarily to the first three of the six goals identified in the PICES Strategic Plan (https://meetings.pices.int/About/PICES-Strategic-Plan-Oct-2016.pdf): (1) Foster collaboration among scientists within PICES and with other multinational organizations; (2) Understand the status and trends, vulnerability, and resilience of marine ecosystems; and (3) Understand and quantify how marine ecosystems respond to natural forcing and human activities (Goals 2 and 3 are similar to the two research themes in the PICES integrative scientific program on Forecasting and Understanding, Trends, Uncertainty and Responses of North Pacific Marine Ecosystems (FUTURE)). The activities of the joint working group also align with at least five of the seven ICES science priorities set in the ICES Strategic Plan (https://issuu.com/icesdk/docs/ices_stategic_plan_2019_web), including: (1) Ecosystem science, (2) Impacts of human activities, (3) Observation and exploration, (4) Seafood production and (5) Conservation and management science. The activitiesof this joint WG are considered to have a very high priority for both ICES and PICES. References: Alheit, J. (2010) SPACC continues under ICES wings. GLOBEC International Newsletter, 16(1): 24. van der Lingen, C.D., Lluch-Cota, S., Checkley, D., Bernal, M., Herzka, S., and Takasuka, A. (2010) SPACC II Planning Meeting 24-26 February 2010, La Paz, Mexico. GLOBEC International Newsletter, 16(1): 25–26. Alheit, J., Rykaczewski, R.R., Sundby, S., and Di Lorenzo, E. (2019) Drivers of dynamics of small pelagic fish resources: environmental control of long-term changes. Deep Sea Research II (special issue), 159: 1–3 Alheit, J. and Peck M.A. (2019) Drivers of dynamics of small pelagic fish resources: biology, management and human factors. Marine Ecology Progress Series (special issue), 617/618: 1–6. Peck, M.A., Neuenfeldt, S., Essington, T.E., Trenkel, V.M., Takasuka, A., Gislason, H., Dickey-Collas, M., Andersen, K.H., Ravn-Jonsen, L., Vestergaard, N., Kvamsdal, S.F., Gårdmark, A., Link, J., and Rice, J.C. (2014) Forage Fish Interactions: A symposium on "Creating the tools for ecosystem-based management of marine resources". ICES Journal of Marine Science (special issue), 71: 1–4.
Resource requirements	Some resources to support travel of key group members to PICES Annual Science Conferences will be requested (see below).
Participants	The group is expected to attract between 25 to 35 members and guests with broad coverage of ecosystems within and outside ICES and PICES regions.
Secretariat facilities	The group will request meeting rooms / times associated with the ICES ASC. This will require some assistance from members of the secretariat organizing those events. Similar requests will be made of the PICES secretariat.
Financial	Funds will be requested to support travel of key participants to the PICES ASC.
Linkages to ACOM and groups under ACOM	The group will identify how environmental drivers influence the productivity of SPF within ICES areas. This information will be useful to ACOM.
Linkages to other committees or groups	It is anticipated that very close working relationships will be created with other groups within the Ecosystems, Processes and Dynamics Steering Group such as those working on predators (e.g. JWGBIRD) and prey (WGZE) of SPF. Similarly, the work conducted will be useful to food web modelling (e.g. WKEWIEA) and to state-of-the-art biophysical modelling (e.g. WGIPEM) within SG Integrated Ecosystem Assessments.
Linkages to other organizations	Joint partnership between ICES and PICES: the proposal is simultaneously submitted to PICES; FAO General Fisheries Commission for the Mediterranean (GFCM; http://www.fao.org/gfcm): Working Group on Stock Assessment of Small Pelagic Species;

	North Pacific Fisheries Commission (NPFC; https://www.npfc.int/): Technical Working Group on Pacific Saury Stock Assessment (TWG PSSA) and Technical Working Group on Chub Mackerel Stock Assessment (TWG CMSA); UN Decade of the Oceans: The mandate of this joint ICES/PICES activity is relevant to the objectives of the UN Decade of Ocean Science for Sustainable Development and UN Strategic Development Goals (*e.g.*, SDG 14, Life Below Water).