Activity 3: Drivers of growth, reproduction and survival

Leaders: Florian Berg (Norway), Martin Huret (France), Martin Lindegren (Denmark), Motomitsu Takahashi (Japan)

Background

Growth, reproduction and survival, the vital rates of organisms, have always exhibited strong spatial and temporal variability within marine fish populations. This variability is even more pronounced in small pelagic fish (SPF), which are highly dependent on environmental conditions. With climate change pushing populations beyond their historical environment references, trends in the rates, beyond just variability, are more and more frequently detected as available time-series are extending . These individual rates are influenced by external factors, *i.e*. environmental conditions such as temperature and food, but also by internal factors such as the genome on the individual scale, or density-dependent processes at the population scale. Disentangling the impacts of these factors is essential for accurately predicting the effects of climate change and assessing the ability of populations to adapt. At the population scale, these individual vital rates eventually drive the population dynamics, through reproductive investment of the spawning biomass, recruitment, and characteristics such as length or age structure of the populations. Thus, enhancing our understanding of the factors driving the observed temporal and spatial variability of these traits is crucial for stock management. This knowledge allows for the integration of environment variability or density-dependent processes into stock assessment. The WG framework enables comparative analyses across species, stocks, as well as regions, helping to better disentangle the effects of various factors on growth, reproduction, survival, and on the population dynamics of SPF.

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

- Describe the variability in the life history traits of SPF across regions and species, as well as their population dynamics (*ToR 1*);
- Analyze the internal and external drivers of this variability, through various complementary approaches: experimental, statistical and mechanistic modelling (*ToR 2 & 5*);
- Examine responses of the spawning biomass, recruitment abundance, and characteristics such as length or age structure of the populations between the conventional (before 2000) and the recent (after 2000) climate phases using the data sets established in the former project (*ToR 2*);
- Assess which processes, among bottom-up and top-down, affect the population dynamics of forage species in the recent climate phases (*ToR 2*).

Description of tasks

- Dataset on traits have been compiled and will be updated for the most recent years and enriched with potential new contributions from new members of the group based on templates proposed in the previous (2020–2024) term. First dataset is made of experimental data on traits (size, weight, *etc*.) and covariables (temperature, food, numbers of individual in experiments, *etc*.). Second dataset is made of survey data on population characteristics (mean size-at-age, mean weight-at-age, numbers-at-age, recruitment, SSB) from field surveys, and sometimes from stock assessment, as well as covariables (temperature, zooplankton, fishing pressure, *etc*.).
- Experimental review: review available data on traits from experiments and their associated conditions, and perform statistical 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).

Status of ongoing projects

Preliminary results are available from the 3 approaches analyzing the two compiled datasets (experimental and field data). A statistical meta-analysis was conducted on both datasets using different statistical methods, and a bioenergetics model (DEB) was run for European sardine and anchovy and compared to the field dataset. The objective is to finalize these analysis and work on papers.

Deliverables and anticipated timeline

Analysis set in the first term of the WG will be finalized towards the 2026 Symposium (SPF-2026).

Membership

Name	Institution	Email address
Marta Albo-Puigserver	IEO-CSIC, Spain	marta.albo@ieo.csic.es marta.albo.puigserver@gmail.com
Rebecca Asch	East-Carolina University, USA	aschr16@ecu.edu
Matthew Baker	North Pacific Research Board, USA	Matthew.Baker@nprb.org
Florian Berg	IMR, Norway	florian.berg@hi.no
Benoit Berges	Wageningen Univ. and Res., The Netherlands	benoit.berges@wur.nl
Jennifer Boldt	Department of Fisheries and Oceans, Canada	Jennifer.Boldt@dfo-mpo.gc.ca
Jacob Burbank	Department of Fisheries and Oceans, Canada	jacob.burbank@dfo-mpo.gc.ca
Ignacio Catalan	IEO-CSIC, Spain	ignacio@imedea.uib-csic.es
Ali Cemal Gucu	METU, Turkey	gucu@ims.metu.edu.tr
Jaclyn Cleary	Department of Fisheries and Oceans, Canada	Jaclyn.Cleary@dfo-mpo.gc.ca
Brad Erisman	NOAA-SWFSC, USA	brad.erisman@noaa.gov
Susana Garrido	IPMA, Portugal	susana.garrido@ipma.pt
Cecilie Hansen	IMR, Norway	cecilie.hansen@imr.no
Tarek Hattab	IFREMER, France	Tarek.hattab@ifremer.fr
Brian Hunt	University of British Columbia, Canada	b.hunt@oceans.ubc.ca
Martin Huret	IFREMER, France	martin.huret@ifremer.fr
Nis S. Jacobsen	DTU, Denmark	nsja@aqua.dtu.dk
Isaac Kaplan	NOAA-NWFSC, USA	isaac.kaplan@noaa.gov
Stefan Koenigstein	Leibniz ZMT, Germany	stefan.koenigstein@leibniz-zmt.de
Kui Zhang	South China Sea Fisheries Res. Inst., P.R. China	zhangkui@scsfri.ac.cn
Raul Laiz-Carrion	IEO-CSIC, Spain	raul.laiz@ieo.csic.es
Martin Lindegren	DTU, Denmark	mli@aqua.dtu.dk
Salvador Lluch-Cota	CIBNOR, Mexico	slluch@cibnor.mx
Marta Moyano	NIWA, Norway	marta.moyano@uia.no
Shin-ichiro Nakayama	FRA, Japan	shinichironak@affrc.go.jp
Richard Nash	CEFAS, UK	richard.nash@cefas.co.uk
Haruka Nishikawa	JAMSTEC, Japan	harukan@jamstec.go.jp
Cristina Nunes	IPMA, Portugal	cnunes@ipma.pt
Laure Pecquerie	IRD, France	laure.pecquerie@ird.fr
Vladimir Radchenko	VNIRO (TINRO), Russia	vladimir.radchenko@tinro.vniro.ru

Fernando Ramos	IEO-CSIC, Spain	fernando.ramos@ieo.csic.es
Margarita Rincon	IEO-CSIC, Spain	margarita.rincon@ieo.es
Isabel Riveiro	IEO-CSIC, Spain	isabel.riveiro@ieo.csic.es
Alba Serrat Llinas		alba.serrat@udg.edu
Dongwha Sohn	Pusan National University, Korea	dongwhasohn@gmail.com sohndongwha@pusan.ac.kr
Stelios Somarakis	HCMR, Greece	somarak@hcmr.gr
Peng Sun	Ocean University of China, P.R. China	sunpeng@ouc.edu.cn
Motomitsu Takahashi	FRA, Japan	takahamt@fra.affrc.go.jp
Akinori Takasuka	University of Tokyo, Japan	atakasuka@mail.ecc.u-tokyo.ac.jp
Jeroen van der Kooij	CEFAS, UK	jeroen.vanderkooij@cefas.co.uk
Carl Van der Lingen	UCT, South Africa	carl.vanderlingen@gmail.com
Sebastian Vásquez	INPESCA, Chile	svasquez@inpesca.cl