MEMBER OF
BASQUE RESEARCH
& TECHNOLOGY ALLIANCE

www.azti.es

DIRECTORATE-GENERAL FOR INTERNAL POLICIES
POLICY DEPARTMENT B
STRUCTURAL AND COHESION POLICIES

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 869342.

Artificial Intelligence for Fisheries Sustainability

Jose A. Fernandes-Salvador

jfernandes@azti.es

DIRECTORATE-GENERAL FOR INTERNAL POLICIES
POLICY DEPARTMENT B
STRUCTURAL AND COHESION POLICIES
European Parliament

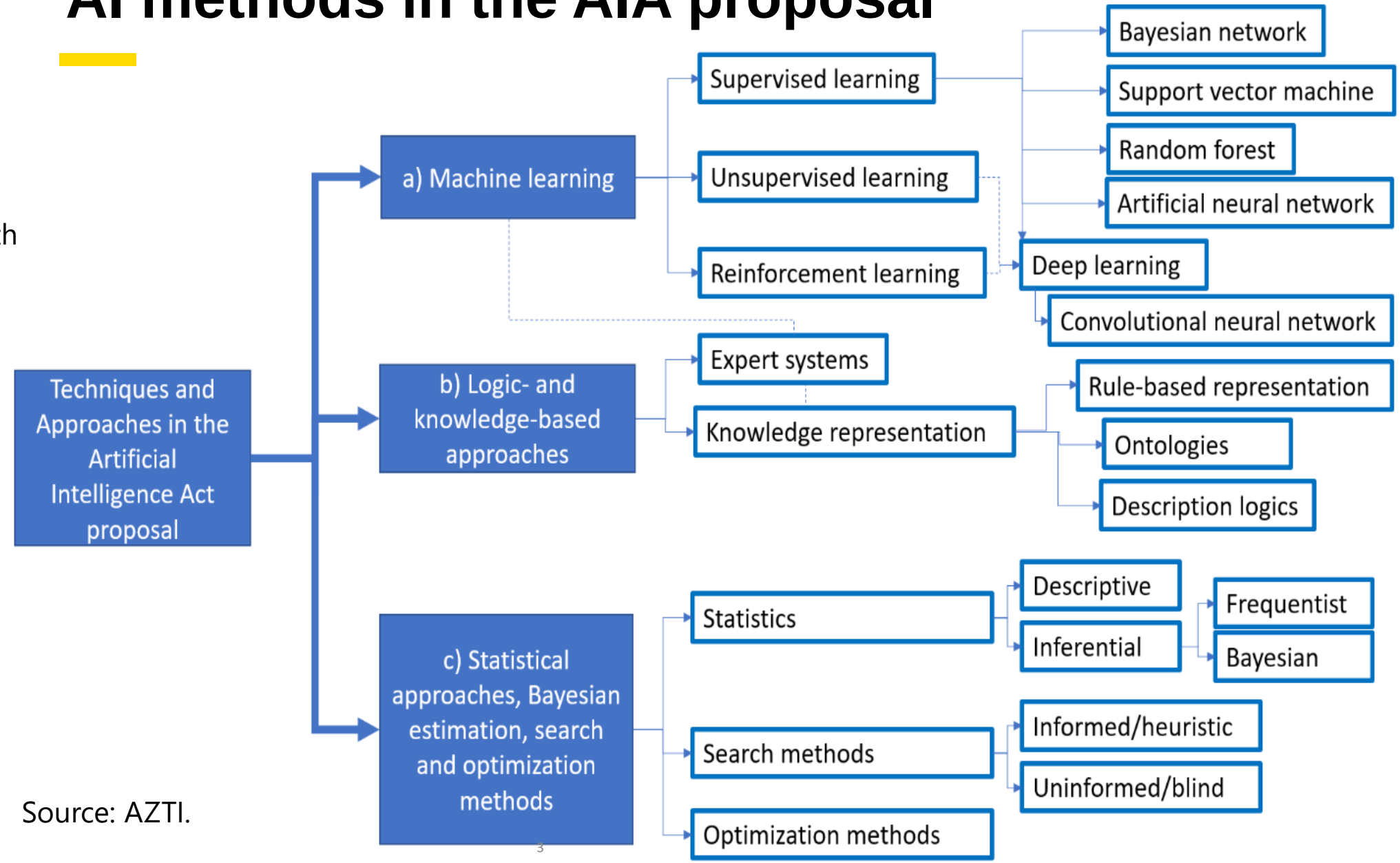
Artificial Inteligente and the Fisheries Sector

Fernandes-Salvador, J.A., Oanta, A., Olivert-Amado, A., Goienetxea, I., Ibaibarriaga, L., Aranda, M., Cuende, E., Foti, G., Olabarrieta, I., Murua, J., Prellezo, R., Iñarra, B., Quincoces, I., Caballero, A., Sobrino-Heredia, J. M, 2022, Research for PECH Committee – Artificial Intelligence and the fisheries sector, European Parliament, Policy Department for Structural and Cohesion Policies, Brussels

AZTI
MEMBER OF
BASQUE RESEARCH
& TECHNOLOGY ALLIANCE

AI methods in the AIA proposal

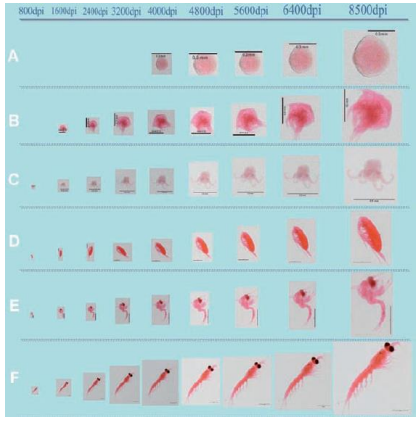
Classification of AI techniques and approaches in the AIA proposal expanded with further subcategories used in this study.



Source: AZTI.

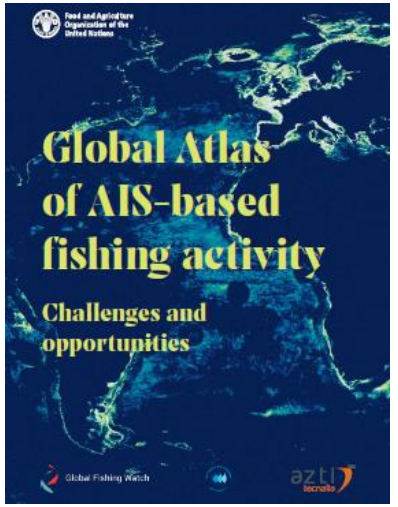
AZTI
MEMBER OF
BASQUE RESEARCH
& TECHNOLOGY ALLIANCE

Common and recent applications of AI in fisheries

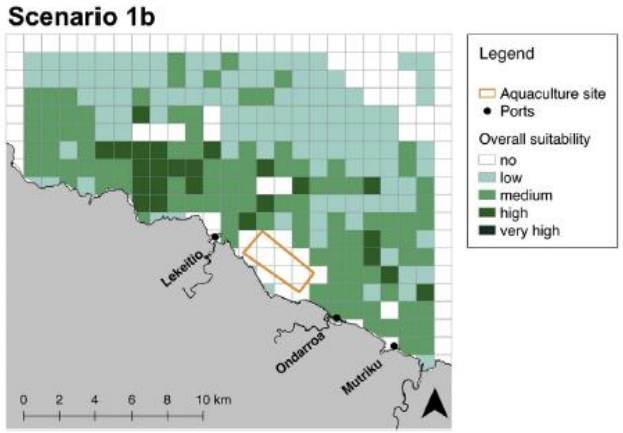


Sample processing
(e.g. Bachiller & Fernandes, 2011)

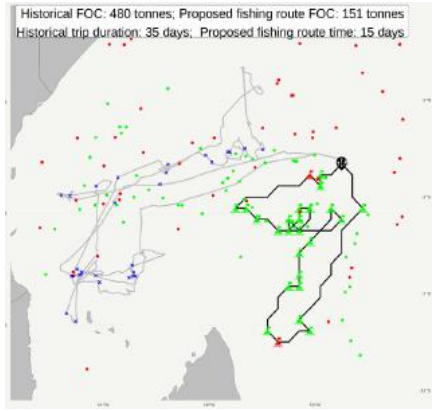
Fish counting and measurement
(e.g. Lekunberri et al., 2022)



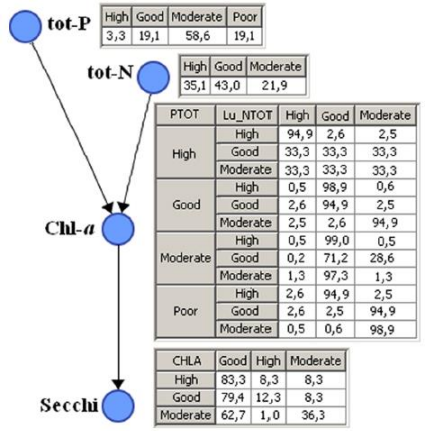
Fishers' activities
(e.g. Taconet et al., 2019)



Marine Spatial Planning
(e.g. Coccoli et al., 2018)



Route optimization
(e.g. Granado et al., 2021)



High	Good	Moderate	Poor
3,3	19,1	58,6	19,1

High	Good	Moderate
35,1	43,0	21,9

PTOT	Lu_NTOT	High	Good	Moderate
High	High	94,9	2,6	2,5
	Good	33,3	33,3	33,3
	Moderate	33,3	33,3	33,3
Good	High	0,5	98,9	0,6
	Good	2,6	94,9	2,5
	Moderate	2,5	2,6	94,9
Moderate	High	0,5	99,0	0,5
	Good	0,2	71,2	28,6
	Moderate	1,3	97,3	1,3
Poor	High	2,6	94,9	2,5
	Good	2,6	2,5	94,9
	Moderate	0,5	0,6	98,9

CHLA	Good	High	Moderate
High	83,3	8,3	8,3
Good	79,4	12,3	8,3
Moderate	62,7	1,0	36,3

Indicators evaluation
(e.g. Fernandes et al., 2013)

New AI jobs for young people and AI groups

- AI, similarly to digitalisation, is likely to **create new skilled jobs** while **decreasing** the need for **low skilled jobs** in the fisheries sector, as observed in other sectors.
- A more **digitalised and AI-based** fisheries sector might **attract new young talent**, but has to compete against **other industries with higher incentives**.
- There are **general AI groups** and networks at the European level but **lacking marine domain knowledge** to develop fisheries fit-for-purpose AI systems.
- There is at least **one European working group focused on AI for fisheries** and several fisheries groups where AI has been discussed, but there is a **shortage of sufficient resources**.

Opportunities and obstacles

Opportunities:

- Increased **transparency** of fishing activity and **reduced impact** on the environment, thereby improving the **public image of the sector**
- Early warning, forecasting and spatial planning systems can help in the **planning activities** considering **trade-offs** between them
- **Accelerated and increased data acquisition** and coverage for stock assessments, sustainability indicators evaluation and other management data needs
- **Increased economic sustainability** of the fishing industry, by **reducing operational costs**
- The **modernisation** of fisheries and its subsequent **attractiveness** to the younger population

Obstacles:

- Industry **trust** and **reluctance** to change
- Initial **costs**
- Lack of **expertise**
- Legal and bureaucratic **uncertainty**
- **Language barriers**

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 869342.

SusTunTech Project

MEMBER OF
BASQUE RESEARCH
& TECHNOLOGY ALLIANCE

IMAGE PREPROCESSING

Perspective correction:

- Arbitrarily placed cameras
- Same fish size throughout the image

Lens dirtiness estimation:

- Variance of the pixels across the set

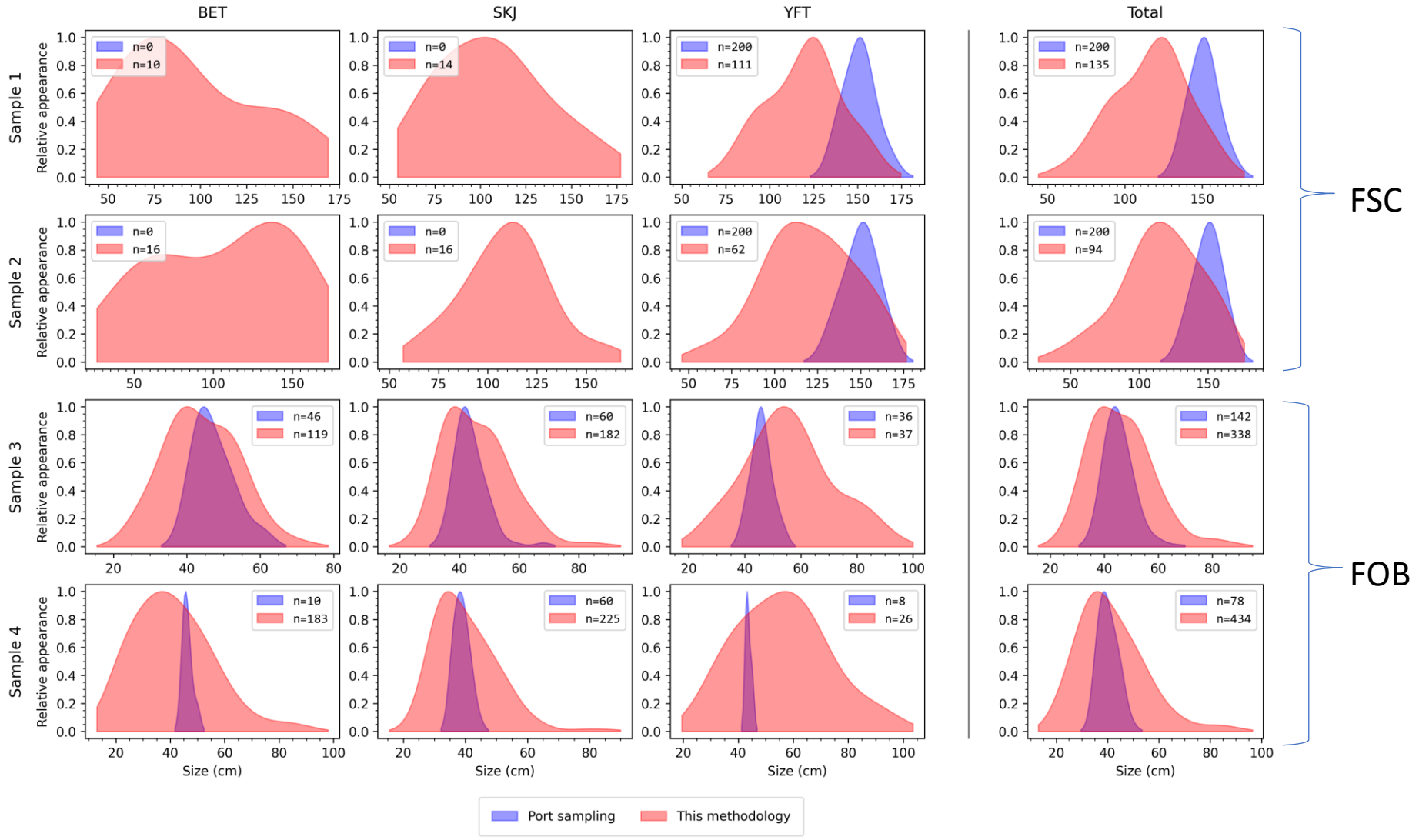
Contrast enhancement:

- CLAHE (Contrast Limited Adaptive Histogram Equalization)
- Locally instead of globally → Enhance edges

Lekunberri, X., Ruiz, J., Quincoces, I., Dornaika, F., Arganda-Carreras, I., & Fernandes, J. A. (2022). Identification and measurement of tropical tuna species in purse seiner catches using computer vision and deep learning. *Ecological Informatics*, *67*, 101495.

Comparison against port sampling

Lekunberri, X., Ruiz, J., Quincoces, I., Dornaika, F., Arganda-Carreras, I., & Fernandes, J. A. (2022). Identification and measurement of tropical tuna species in purse seiner catches using computer vision and deep learning. *Ecological Informatics*, *67*, 101495.

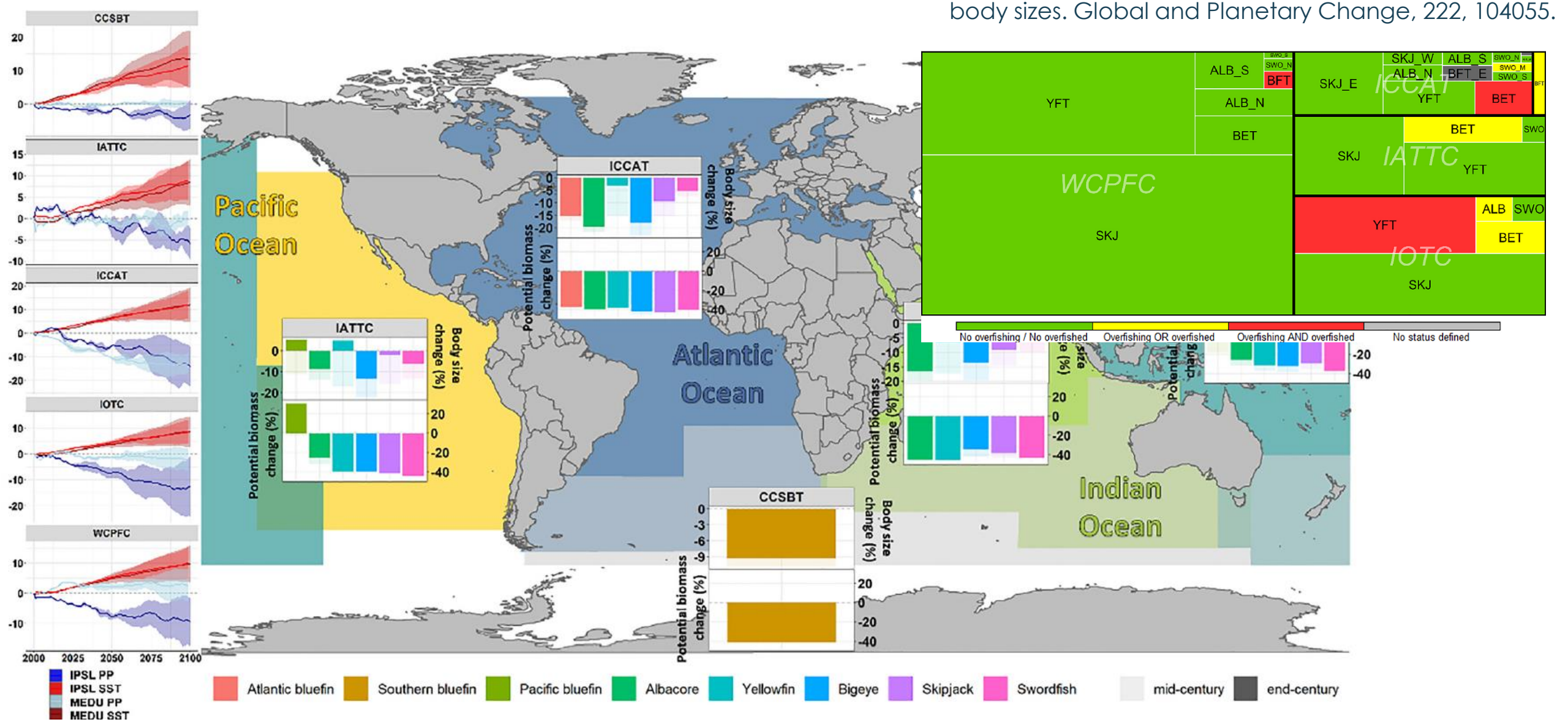


These images can be used for developing management and industry tools that increase the fleet sustainability, and its adaptation and mitigation capacity to climate change

Tuna species

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 869342.

Erauskin-Extramiana, M., Chust, G., Arrizabalaga, H., Cheung, W. W., Santiago, J., Merino, G., & Fernandes-Salvador, J. A. (2023). Implications for the global tuna fishing industry of climate change-driven alterations in productivity and body sizes. Global and Planetary Change, 222, 104055.



This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 869342.

High captures probability maps

Reduce bycatch risk

Goikoetxea, N,, Goienetxea, I., Goñi, N., Granado, I., Ibaibarriaga, L., Iñaki Quincoces, Ruiz, J., Fernandes-Salvador, J.A. (2022). SmartFishing: Climate change mitigation and adaptation using machine learning for sustainable tuna fishing. Ecological Informatics. Under major review.

Route optimization

Granado, I., Hernando, L., Galparsoro, I., Gabiña, G., Groba, C., Prellezo, R., & Fernandes, J. A. (2021). Towards a framework for fishing route optimization decision support systems: Review of the state-of-the-art and challenges. Journal of Cleaner Production, 320, 128661.

Granado, I, Hernando, L., Uriondo, U., Fernandes-Salvador, J.A. (2022). The tuna purse seiner Fishing Route Optimization Decision Support System (FROODS). European Journal of Operational Research. Under minor review.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 869342.

AZTI
MEMBER OF BASQUE RESEARCH & TECHNOLOGY ALLIANCE

SusTunTech

Route decision support systems

Small-scale coastal fleet

Large-scale pelagic fleet

ENVIRONMENTAL LAYER

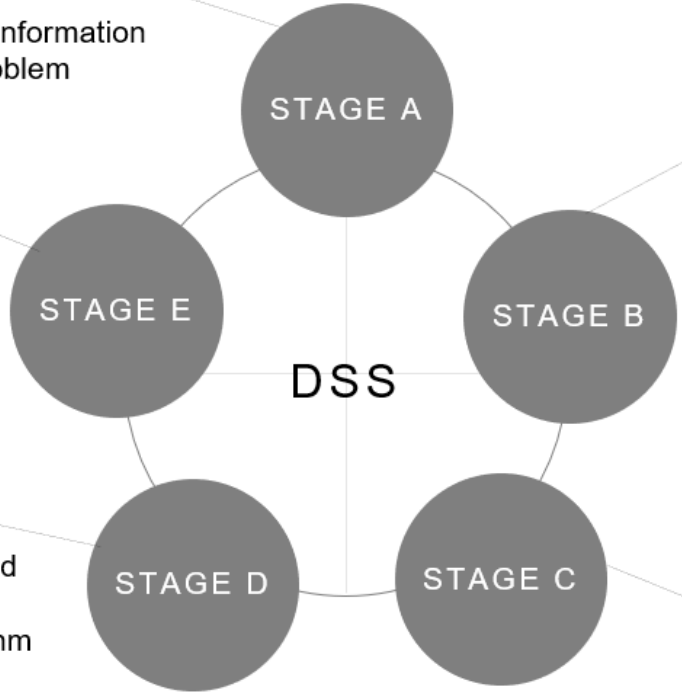
Provides the metocean information needed to model the problem

DECISION LAYER

It is the graphical component that interacts with the final user by selecting the final route.

ROUTING LAYER

This layer is the core of the DSS and according to the objectives, constraints and optimization algorithm the optimal route is computed



SHIP MODELLING LAYER

Predicts the ship performance under different weather conditions

FISHERIES LAYER

Provides the fisheries data, such as the target specie distribution, management regulations etc.

Large-scale demersal fleet

Distant-water fleet

Granado, I., Hernando, L., Galparsoro, I., Gabiña, G., Groba, C., Prellezo, R., & **Fernandes, J. A.** (2021). Towards a framework for fishing route optimization decision support systems: Review of the state-of-the-art and challenges. Journal of Cleaner Production, 320, 128661.

New chairs in WGMLEARN ICES working group

Meeting at ICES conference in Bilbao (11-14 September 2023)

To help accelerate the processing of the massive volumes of data collected in marine science and provide better decision support tools, we aim to:

- Organize and develop shared resources such as a shared bibliography database, training materials, and code examples.
- Increase knowledge and build competence through newsletters, seminars, training courses and networking with other ICES WGs and projects.
- Identify social and legal needs for trustworthiness development in AI for fisheries and marine sciences and propose development actions.

Jose A. Fernandes-Salvador (jfernandes@azti.es)