{rokbox title=|High-resolution spatial and temporal analysis of hake length distribution in relation to environmental drivers :: Image: Authors| thumb=|images/stories/ieo/imagenespublicaciones/centro-oceanografico-baleares-ieo-csic-high-resolution-spatial-hidalgo-thumb-2025.jpg|}images/stories/ieo/imagenespublicaciones/centro-oceanografico-baleares-ieo-csic-high-resolution-spatial-hidalgo-2025.jpg{/rokbox}

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High-resolution spatial and temporal analysis of hake length distribution in relation to environmental drivers.
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Abstract: Mediterranean fisheries face critical challenges, with European hake (*Merluccius merluccius*) exemplifying both high ecological and commercial value and severe overexploitation. Sustainable management is further complicated by the species' complex spatial population structure, necessitating high-resolution data such as on length distributions. In this study, we applied artificial intelligence to produce continuous spatial and temporal data on hake length distributions at the boat-day level in Mallorca Island, representative of one of the Mediterranean geographical statistical subareas within FAO major fishing area 37. Analyzing over 18,000 images of landed hake boxes from 2021 to 2023, our method captured approximately 77 % of the landed biomass, ensuring representative coverage of diverse fishing grounds. By integrating Self-Organizing Maps, Random Forest, and Generalized Linear Mixed Models, we identified depth and geographical areas as a key drivers of hake size: smaller individuals predominated in shallow NE and SW zones, corresponding with known juvenile habitats. Seasonal patterns further revealed an increased prevalence of small-length classes during spring and autumn-winter. Although variations in catch length were largely boat-specific-reflecting métier-based strategies-this approach enabled the detection of subpopulation dynamics. This approach offers a cost-effective, fisheries-dependent tool that complements existing data sources. The high-resolution, spatially explicit insights gained here provide a valuable foundation for adaptive, regionally tailored management strategies aimed at ensuring sustainable Mediterranean fisheries.

Keywords: Merluccius merluccius,Length,Deep learning,Distribution,Mediterranean,Environmental effects