Title

Retrospective analysis of the pelagic ecosystem of the Western Mediterranean Sea: Drivers, changes and effects

Abstract

In the Western Mediterranean Sea, forage fishes have changed in abundance, body condition, growth, reproduction, and distribution in the last decades. Different hypotheses have been proposed to explain these changes, including increase in fishing mortality; changes in environmental conditions affecting species fitness, and planktonic productivity and quality; recovery of top predators; and increase in competitors. We investigated the main drivers and changes of the pelagic ecosystem and their effects using an ecosystem-based modelling approach. Specifically, we (1) quantified the potential historical contribution of various drivers of change, (2) investigated changes in temporal trends and spatial distributions of main ecosystem components, and (3) identified ecological consequences of these changes in top predator and competitors, their fisheries and ecosystem traits during 2000–2020. We updated an established Ecopath food-web model representing the Spanish and French Mediterranean sub-areas (GSA06 and GSA07) in 2000 with recent available data. We applied the temporal dynamic Ecosim module, and tested historical time series of fishing effort, fishing mortality and environmental factors as potential drivers. Observed biomass and landings of key species were used to validate model projections. A spatial-temporal Ecospace model was developed to project species distribution changes. Results showed historical biomass and catch changes driven by a combination of high fishing pressure and environmental change (i.e. increase in temperature and salinity, and decline in primary productivity). Small pelagic fish showed significant temporal changes and predicted shifts in their distributions, following a latitudinal gradient. Predators and competitors showed changes as well, displaying heterogeneous spatial patterns, while fisheries landings

declined. Overall, results matched observations (e.g., decline of sardine, fluctuations of anchovy and increases in bluefin tuna) and illustrated the need to complement traditional assessments with integrative frameworks to move towards an ecosystem-based approach in the Mediterranean. They also highlighted important knowledge gaps to guide future research in the region. © 2023

Authors

Coll M.; Bellido J.M.; Pennino M.G.; Albo-Puigserver M.; Báez J.C.; Christensen V.; Corrales X.; Fernández-Corredor E.; Giménez J.; Julià L.; Lloret-Lloret E.; Macias D.; Ouled-Cheikh J.; Ramírez F.; Sbragaglia V.; Steenbeek J.

Author full names

Coll, Marta (57200581637); Bellido, José María (7003268719); Pennino, Maria Grazia (40762087900); Albo-Puigserver, Marta (55607790600); Báez, José Carlos (8373427200); Christensen, Villy (7102413844); Corrales, Xavier (56582368900); Fernández-Corredor, Elena (57218453255); Giménez, Joan (37032586500); Julià, Laura (57969532300); Lloret-Lloret, Elena (57217195252); Macias, Diego (15827627900); Ouled-Cheikh, Jazel (57218193570); Ramírez, Francisco (55612439700); Sbragaglia, Valerio (53880213900); Steenbeek, Jeroen (26668052900)

Author(s) ID

57200581637; 7003268719; 40762087900; 55607790600; 8373427200; 7102413844; 56582368900; 57218453255; 37032586500; 57969532300; 57217195252; 15827627900; 57218193570; 55612439700; 53880213900;

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Affiliations

Institute of Marine Sciences (ICM-CSIC), Barcelona, Spain; Ecopath International Initiative (EII), Barcelona, Spain; Spanish Institute of Oceanography (IEO-CSIC, CO Baleares, CO Málaga, CO Murcia y CO Vigo), Spain; Institute for the Oceans and Fisheries, The University of British Columbia, Vancouver, Canada; AZTI, Marine Research Division, Basque Research and Technology Alliance (BRTA), Sukarrieta, Spain; European Commission, Joint Research Centre (JRC), Directorate D – Sustainable Resources, Ispra, Italy; Instituto Iberoamericano de Desarrollo Sostenible (IIDS), Universidad Autónoma de Chile, Av. Alemania 1090, Región de la Araucanía, Temuco, Chile

Authors with affiliations

Coll M., Institute of Marine Sciences (ICM-CSIC), Barcelona, Spain, Ecopath International Initiative (EII), Barcelona, Spain; Bellido J.M., Spanish Institute of Oceanography (IEO-CSIC, CO Baleares, CO Málaga, CO Murcia y CO Vigo), Spain; Pennino M.G., Spanish Institute of Oceanography (IEO-CSIC, CO Baleares, CO Málaga, CO Murcia y CO Vigo), Spain; Albo-Puigserver M., Spanish Institute of Oceanography (IEO-CSIC, CO Baleares, CO Málaga, CO Murcia y CO Vigo), Spain; Báez J.C., Spanish Institute of Oceanography (IEO-CSIC, CO Baleares, CO Málaga, CO Murcia y CO Vigo), Spain, Instituto Iberoamericano de Desarrollo Sostenible (IIDS),

Universidad Autónoma de Chile, Av. Alemania 1090, Región de la Araucanía, Temuco, Chile; Christensen V., Ecopath International Initiative (EII), Barcelona, Spain, Institute for the Oceans and Fisheries, The University of British Columbia, Vancouver, Canada; Corrales X., AZTI, Marine Research Division, Basque Research and Technology Alliance (BRTA), Sukarrieta, Spain; Fernández-Corredor E., Institute of Marine Sciences (ICM-CSIC), Barcelona, Spain; Giménez J., Institute of Marine Sciences (ICM-CSIC), Barcelona, Spain; Julià L., Institute of Marine Sciences (ICM-CSIC), Barcelona, Spain; Lloret-Lloret E., Institute of Marine Sciences (ICM-CSIC), Barcelona, Spain; Macias D., European Commission, Joint Research Centre (JRC), Directorate D – Sustainable Resources, Ispra, Italy; Ouled-Cheikh J., Institute of Marine Sciences (ICM-CSIC), Barcelona, Spain; Ramírez F., Institute of Marine Sciences (ICM-CSIC), Barcelona, Spain; Sbragaglia V., Institute of Marine Sciences (ICM-CSIC), Barcelona, Spain; Steenbeek J., Ecopath International Initiative (EII), Barcelona, Spain

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Correspondence Address

M. Coll; Institute of Marine Sciences (ICM-CSIC), Barcelona, Spain; email: mcoll@icm.csic.es

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