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Research for marine sustainability:
multiple stressors, drivers, challenges
and solutions

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Case studies of palaeoenvironmental perturbations' effect on fish distributions

Agiadi K. and [Karakitsios V.](#)

Environmental variability determines fish distribution, migration and abundance both in the present as well as the past. The close link between climate and fish populations has been observed in modern times, from seasonal to centennial time scales. However, the effect of long-term environmental changes and variability is little known. New data on fish eastern Mediterranean palaeobiogeography shows that naturally-occurring changes in the past have repeatedly modified the fish distribution in this area. Two study cases are exemplified. The distribution of small pelagic fish, such as *Engraulis encrasicolus* and *Sardinella maderensis*, in the northeastern coast of Rhodes Island between 2-0.5 million years before present, is correlated to the palaeoenvironmental conditions. Anchovies became very abundant in this area during warm periods, and departed with climatic deterioration. The concurrent presence of *Aphia minuta* with *E. encrasicolus* would indicate SST between 13-16°C. On the other hand, sardines are favored recurring upwelling conditions. A more complex scenario may be postulated for the varying distribution of Gadidae in the Ionian Sea and the south Aegean Sea, over approximately the last 5 million years. *Gadiculus argenteus*, *G. labiatus*, *G. thori* and *Micromesistius poutassou* inhabit eastern Mediterranean waters from the Miocene onwards, each associate with a distinct palaeoenvironmental setting. The blue whiting is part of the deep-water assemblages. *G. labiatus* is an extinct species found regularly in the Miocene to Middle Pleistocene associations, occasionally coexisting with *G. argenteus*. Its distribution is considered subtropical at that time. The three cod species' basin-wide distributions, at the stratigraphic stage level of resolution, generally overlap. However the more detailed study reveals that, at the regional scale, their occurrence is linked to significant climatic shifts. Indeed, *G. labiatus* gradually relinquishes its niche to *G. argenteus*, clearly a response to the general climatic deterioration from the late Pliocene to the Middle Pleistocene. Meanwhile, during the colder Pleistocene intervals *G. thori* invades the Mediterranean Sea, from the northeastern Atlantic, displacing *G. argenteus*.

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Poster presentation