

## Review



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# The revolution of crossdating in marine palaeoecology and palaeoclimatology

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Over the past century, the dendrochronology technique of crossdating has been widely used to generate a global network of tree-ring chronologies that serves as a leading indicator of environmental variability and change. Only recently, however, has this same approach been applied to growth increments in calcified structures of bivalves, fish and corals in the world's oceans. As in trees, these crossdated marine chronologies are well replicated, annually resolved and absolutely dated, providing uninterrupted multi-decadal to millennial histories of ocean palaeoclimatic and palaeoecological processes. Moreover, they span an extensive geographical range, multiple trophic levels, habitats and functional types, and can be readily integrated with observational physical or biological records. Increment width is the most commonly measured parameter and reflects growth or productivity, though isotopic and elemental composition capture complementary aspects of environmental variability. As such, crossdated marine chronologies constitute powerful observational templates to establish climate–biology relationships, test hypotheses of ecosystem functioning, conduct multi-proxy reconstructions, provide constraints for numerical climate models, and evaluate the precise timing and nature of ocean–atmosphere interactions. These ‘present–past–future’ perspectives provide new insights into the mechanisms and feedbacks between the atmosphere and marine systems while providing indicators relevant to ecosystem-based approaches of fisheries management.

## 1. Background

In terrestrial systems, tree-ring data are well replicated from multiple individuals, absolutely dated, and thus constitute the ‘gold standard’ of high-resolution environmental archives. This level of accuracy is possible through crossdating,