Networks of Drivers and Ecosystem Services Consequences of Marine Regime Shifts

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Abstract

[to be presented in session: Marine regime shifts around the globe: theory, drivers, and impacts] Marine regime shifts have typically been studied through statistical signature of jumps in state variables as response on changing drivers. They are caused by multiple drivers, making identification elusive and controversial. Instead of looking in retrospective whether they occurred or what caused them, we use a comparative analysis of marine regime shifts to identify patterns of driving processes. Tripartite networks are modelled to study which drivers are more likely to interact and which bundles of ecosystem services are more commonly affected. Our simulations show that driver interactions differ from random. The main drivers that produce marine regime shifts are climate forcing, nutrients inputs and fishing. Driver interactions often alter biophysical processes such as upwelling; while indirect drivers often connect land and ocean dynamics. Regime shifts might be masked by fast variables such as trade, high response diversity of functional groups, or fast dynamics of lower trophic levels. Masking variables can also mitigate the impact of regime shifts on ecosystem services such as fisheries and food security. Our analysis suggest that marine regime shift could be synchronized in time given the drivers they share, but also, that the occurrence of certain regime shifts could increase the likelihood of others. Integrated management of marine regime shifts is needed to avoid cascading regime shifts; by simultaneously addressing multiple drivers, several regime shifts can be avoided. However, managerial strategies are likely to fail if they are limited to direct drivers, and fail to consider indirect drivers, masking effects or stochastic events.

Keywords: regime shifts, global change, network, ecosystem services, marine

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