

# **Scales of Benthic-Pelagic Coupling and the Intensity of Species Interactions: From Recruitment Limitation to Top-Down Control**

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## **Abstract**

Large and usually unpredictable variation in species interaction strength has been a major roadblock to applying local experimental results to large-scale management and conservation issues. Recent studies explicitly considering benthic-pelagic coupling are starting to shed light on, and find regularities in, the causes of such large-scale variation in coastal ecosystems. Here, we evaluate the effects of variation in wind-driven upwelling on community regulation along 900 km of coastline of the southeastern Pacific, between 29°S and 35°S during 72 months. Variability in the intensity of upwelling occurring over tens of km produced predictable variation in recruitment of intertidal mussels, but not barnacles, and did not affect patterns of community structure. In contrast, sharp discontinuities in upwelling regimes produced abrupt and persistent breaks in the dynamics of benthic and pelagic communities over hundreds of km (regional) scales. Rates of mussel and barnacle recruitment changed sharply at 32°-33°S, determining a geographic break in adult abundance of these competitively dominant species. Analysis of satellite images demonstrates that regional-scale discontinuities in oceanographic regimes can couple benthic and pelagic systems, as evidenced by coincident breaks in dynamics and concentration of offshore surface chlorophyll-a. Field experiments showed that the paradigm of top-down control of intertidal benthic communities holds only south of the discontinuity. To the north, populations seem recruitment-limited, and predators have negligible effects, despite attaining similarly high abundances and potential predation effects across the region. Thus, geographically discontinuous oceanographic regimes set bounds to the strength of species interactions and define distinct regions for the design and implementation of sustainable management and conservation policies.