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How do environmental factors affect the stock-recruitment relationship? The case of the Pacific sardine (*Sardinops sagax*) of the northeastern Pacific Ocean

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The Pacific sardine (*Sardinops sagax*) supports one of the most important fishing industries of the northeastern Pacific Ocean (NPO). The recruitment of juveniles in the NPO has shown fluctuations in recent decades; this has been attributed to variations in the spawning stock biomass (SSB) and to the oceanographic conditions within the California Current system (CCS). In this study, these hypotheses are tested by fitting three different stock-recruitment (SR) functions into different models using data of recruitment and SSB of Pacific sardine in three regions of the NPO: Magdalena Bay (MB), Ensenada (EN), and north Pacific (NP). To quantify the plausibility of each model, given the data and the set of three models, the Akaike weight of each model was calculated. The selection of the best model within each area was done by minimizing the small-sample, bias-corrected form of the Akaike information criterion. Through this approach, the MB and EN fisheries fitted both the asymptotic Beverton-Holt and dome-shaped Ricker models. These results agreed with prior evidence that recruitment of Pacific sardine has a density-dependent mortality term for eggs and juvenile stages, related to the total SSB and cohort size. To test environmental influence on sardine recruitment principal component analysis was undertaken. The first principal component group was determined by El Niño-La Niña episodes; the second, by the upwelling index. Upon incorporation of these principal components into the SR models, the recruitment of the sardine throughout the CCS was differentially affected, e.g., warm episodes in MB negatively affected recruitment, whereas in the EN and NP regions, the effect was positive.

Palabras clave: Models, Pacific sardine, California Current, variables, Oceanographic, Stock-recruitment

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