Larval fish mortality and vertical chlorophyll structures: A reexamination of the stable ocean hypothesis in the Southern California Current Ecosystem

The natural mortality of fishes is an important component for understanding population dynamics. The larval stage of pelagic fishes—those that live in the open ocean—are particularly vulnerable to high rates of mortality, and fluctuations in these rates are thought to exert a large influence on the number of fish maturing into the spawning population. Early stage larval fishes are thought to undergo a critical period after hatching when they must find food or succumb to starvation. While the availability of suitable food for larval fishes is, on average, too low in the open ocean to support survival, patchy distributions of planktonic food can be vital habitat. The stable ocean hypothesis describes how wind mixing can influence this habitat through dilution of plankton patches and increase the mortality of larval fishes.

In this dissertation, I reexamined the stable ocean hypothesis from three perspectives to understand how it might influence several key components of the California Current Ecosystem. First, I calculated larval mortality rates for five fishes—northern anchovy, Pacific sardine, Pacific hake, Pacific mackerel and jack mackerel—from 1979 to 2015. Then I compared the mortality rates to indices of wind events and calm periods as a proxy for water column mixing and planktonic patchiness. Contrary to expectations, the survival of no species was negatively influenced by wind events. In fact, mortality for Pacific hake decreased with an increased number of wind events. Next, I examined the effect that wind events had on the vertical distribution of chlorophyll layers. I found that wind events tended to decrease the occurrence of high-concentration chlorophyll layers in the water column. Finally, changes to the planktonic community composition within the chlorophyll layers were assessed. Significant variability associated with years and regions were found among sampled community compositions. Furthermore, a proxy for larval fish food did not vary much among the years examined, which suggests that the plankton structures examined are stable environments for larval fish foraging.

Overall, evidence was found to support the notion that winds may influence the plankton communities larval fish rely upon; however, little support was found for a direct link to larval mortality. The stable ocean hypothesis may be important for fish recruitment in the California Current Ecosystem but its influence was variable on interannual and regional scales.