

# Press Democrat

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## Salmon, seabirds and the state of the ocean

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Chinook salmon returns are low. Coho salmon returns are low. The breeding success of seabirds is low, too. Together, this suggests that this year's sharp drop in the salmon population is the result of recent, dramatic changes in ocean conditions.

We recently completed analyses that demonstrate the connections between seabirds and chinook salmon. Our work shows that seabird breeding success and salmon abundance tend to be high (or low) in the same years and supports the idea that seabirds and salmon are affected by the ocean environment in similar ways.

This means that we may be able to use seabirds to help guide fisheries management. Specifically, we may be able to use seabirds as indicators of the ocean conditions that are affecting salmon, which could help us predict future salmon returns.

The ocean along the central California coast is one of the most productive -- and most variable -- in the world.

In most years, spring winds force surface waters offshore and cause the upwelling of nutrient-rich waters that are well below the surface at other times of the year. Those waters then support the growth of phytoplankton (small marine plants) that feed krill and small fish that both salmon and seabirds rely on for food. In 2005 and 2006, delays in spring upwelling had negative impacts at all levels of the marine food web.

As researchers at the nonprofit PRBO Conservation Science, we saw the impacts of delays in upwelling on the Farallon Islands, where many of the nesting seabirds experienced poor breeding success or complete breeding failure.

Cassin's auklets (small, diving seabirds) feed almost exclusively on krill and apparently could not find enough food to successfully raise chicks. Research cruises in the waters surrounding the Farallones confirmed that krill were scarce in those years.

Other seabirds that feed primarily on fish showed changes in their diets. Fewer juvenile rockfish -- normally found near the Farallones -- were seen in chick diets.

Some seabird species turned to other prey, including anchovy, that occur farther away from the breeding colony and require adult seabirds to fly farther to find food.

The increased time and energy that this requires may have made it more difficult for the

adults to feed and care for their chicks.

We may now be seeing similar impacts on chinook and coho salmon. Low salmon returns in 2007 (and projected for 2008) may indicate that salmon survival at sea has been low for the last several years. Salmon leave the freshwater environment as juveniles and spend several years at sea before returning to their natal rivers and streams to spawn.

Salmon are most sensitive to ocean conditions as they leave the freshwater environment to spend their first year at sea. The salmon that should be returning to Central California rivers this year entered the ocean at the same time that we were seeing drastic reductions in seabird breeding success on the Farallones. Salmon rely on some of the krill and small fish that support seabird populations and may not have been able to find the food that they needed to survive.

There has been some debate about whether the current reductions in local salmon returns are due to problems in the freshwater or marine environments.

Salmon are certainly threatened by a myriad of forces, including freshwater habitat degradation and low river flows. However, low returns are being seen in rivers and streams all along the coast.

The widespread nature of the phenomenon and the other evidence of problems in the marine system suggest that the declines seen this year are largely due to altered ocean conditions.

Understanding the changes we are seeing in the marine environment, and the connections between different species, may ultimately help to protect vulnerable salmon stocks and the commercial fisheries dependent on them.

The ability to scientifically predict wildlife abundance is crucial for keeping fish stocks viable. Fisheries managers currently use jack (2-year-old male) returns to predict salmon abundance in the next year. Our analyses to date indicate that data on seabird breeding success can also be used to predict salmon abundance.

Finding ways to use seabird data in predictive fisheries models may allow us to incorporate information on ocean conditions into the models, thereby providing us with new tools for predicting salmon abundance that will contribute to the sustainable management of the salmon fishery.

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