

Introduction to the special marine issue

Eastern Boundary Upwelling Systems (EBUS), such as the California Current, the Peru-Humboldt, the Canary, and the Benguela Systems, are among the most productive marine ecosystems of the world's oceans. Of these, the best studied is the California Current Ecosystem (CCE) resulting from the vision, collaboration and sustained support from the State of California's Department of Fish and Wildlife, NOAA's National Marine Fisheries Service, University of California San Diego's Scripps Institution of Oceanography and a broad host of academic, agency and non-governmental partners. While EBUS are productive they are also characterized by boom-bust cycles of some of their commercial fisheries that, in turn, affect the health of California's coastal communities, such as that of Monterey's Cannery Row immortalized in John Steinbeck's 1945 novel.

For the better part of the last century, scientific efforts in the CCE, such as the California Cooperative Oceanic Fisheries Investigations (CalCOFI) and others, have provided the conceptual foundation as well as the datasets against which all other major upwelling systems in the world have been compared. The studies in the CCE have provided a baseline for understanding marine ecosystems and their fluctuations ranging from the underlying physical and biogeochemical signals to the propagation of nutrients and energy through food webs resulting ultimately in the health and abundance of higher trophic levels. In turn, the mechanistic understanding we have developed has enabled better management of our fisheries. Fluctuations in fish populations are not only important for recreational and commercial fisheries, but we also have learned that we need to manage certain fisheries as forage for populations of pinnipeds, cetaceans, and birds, as well as the juvenile salmon that leave the watershed as they begin their oceanic migration.

The efforts to understand the broader picture CCE mechanisms have played an instrumental role to improve the science supporting the sustainable management of California's nearshore resources. California's science-based network of Marine Protected Areas is an example of where a broad array of science (both on oceanographic and biological levels) was used to guide a process that balanced conservation goals with the needs and interests of diverse user groups. This network has historical roots in the very journal you are reading today. One hundred years ago, in Volume 1, Number 1 of *California Fish and Game*, the editors published a 1912 letter from the great conservationist Gifford Pinchot to the Game Commission of the State of California expressing his support for establishing a refuge for fish near San Clemente and Santa Catalina islands; that idea that can be seen as a precursor to the network of Marine Protected Areas off California's coastline today.

From its humble beginnings in 1914 as a two-person Department of Commercial Fisheries, the Department of Fish and Wildlife's Marine Region has grown in size and scientific capacity as the scope of responsibilities has increased. No longer focused solely on mainstream commercial fisheries, the Marine Region and its partners employ scientific investigations to understand the ecological underpinnings of natural processes and anthropogenic impacts at the species, community and ecosystem scales.

While we have learned a great deal about the CCE and we have very good reason to celebrate our achievements, we also know that we are in the midst of one the most significant changes in our Earth's climate system. The simultaneous rate of change and the magnitude of the changes in atmospheric greenhouse gases, pollution, land-use practices, and human population increases, etc., are unprecedented in history. We are already witnessing changes in global temperatures, ocean stratification, biogeographic shifts of species, severity of storms, as well as changes in oxygen levels and ocean acidification in our coastal regions. Concurrently, global human population continues to rise adding growing pressure on marine resources to meet nutritional demands and resulting in impacts from increased ocean industry, continued coastal development and growing demands for consumptive and non-consumptive recreational uses. The century-long studies of the CCE will again prove to be fundamental to our ability to determine the nature of the changes we will observe in our waters. The data we collected will give us a critical reference frame relative to which we will be able to assess the nature and the severity of the impending changes, as well as the effect of our mitigation measures. In some ways, we need even more than ever to continue our century-long studies, enhance our collection of new data, and our surveys of the CCE and nearshore habitats.

The landmark California statutes of the Marine Life Protection Act and the Marine Life Management Act introduced the important concepts of adaptive fishery management and ecosystem based management to the lexicon of state marine natural resource management policy. These important management concepts are key to addressing the growing challenges of a changing global climate. The research papers in this issue are examples of some of the important work that the California Department of Fish and Wildlife Marine Region is conducting to fulfill the guiding tenets of these two important statutes. The information presented here will add to the expanding knowledge base for improving and implementing adaptive fishery and ecosystem based management in California.

We close with heartfelt congratulatory remarks to our scientists for what they have accomplished and contributed over the past decades and to the authors of this Marine Issue of the centennial volume of the California Fish and Game Journal. But at the same time we issue a call to action for what is going to be one of the most urgent challenges in the decades to come as we enter the Anthropocene, and into an unknown, no-analogue state. Based on what we achieved in the previous 100 years, there is every reason to believe, that working together as we have in the past, we will continue to provide the necessary science, which will result in the best management advice and ultimately in a healthy California Current Ecosystem supporting our human coastal communities.

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