

THE OFFICIAL MAGAZINE OF THE OCEANOGRAPHY SOCIETY

# Oceanography

#### CITATION

King, J.R. 2014. Review of *Regional Fisheries of the California Current System: The CalCOFI Program*, by S. McClatchie. *Oceanography* 27(4):177–178, <http://dx.doi.org/10.5670/oceanog.2014.102>.

#### DOI

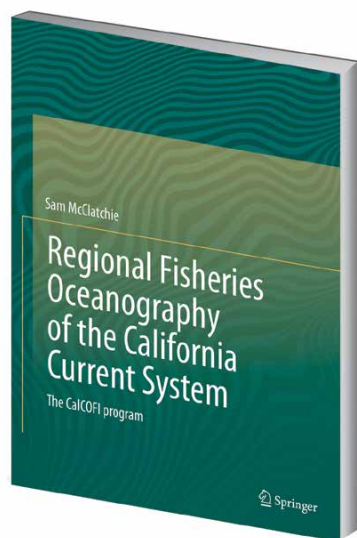
<http://dx.doi.org/10.5670/oceanog.2014.102>

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## REGIONAL FISHERIES OF THE CALIFORNIA CURRENT SYSTEM: THE CALCOFI PROGRAM

By Sam McClatchie, 2014, Springer, 235 pages, ISBN 978-94-007-7223-6, e-book: \$149 US, Hardcover: \$189 US

Reviewed by Jacquelynne R. King

The California Cooperative Oceanic Fisheries Investigations (CalCOFI) program has been operating for over 60 years and is one of the longest running fisheries oceanography survey programs in the world. CalCOFI has made significant contributions to the knowledge of oceanographic processes in the California Current System and made this ocean region one of the best studied systems in the world. How odd then that a contemporary, comprehensive synthesis of fisheries oceanography in this region has been lacking until now. The book *Regional Fisheries Oceanography of the California Current System* by Sam McClatchie completes the difficult task of providing an integrative review and brings the reader up to date on relevant literature, from peer-reviewed journal papers, to technical reports, to “gray literature,” that might not otherwise be readily available to readers.

This book is not for the casual reader: it is technical, and while the author attempts to balance explanatory with expert text, it is not a book for a quick overview. But it is engaging—the writing style and integration of disciplines makes it a pleasure to read. There are number of elements that make it accessible. Each chapter begins with a suite of historical quotes from people involved with CalCOFI or from California Current studies; they are a nice way to set the stage for the chapter theme

and provide a window into past thinking on scientific issues. Though review books often present only a limited number of figures, here there are numerous figures to support the text. And while this book does provide a thorough synthesis of CalCOFI research, the author periodically balances it with his own personal views on alternate hypotheses or suggests avenues for future analyses without being overly intrusive or biased to the synthesis.

The CalCOFI program was initiated in 1950 to investigate the decline of the Pacific sardine fishery. Chapter 1 provides a brief background on that fishery and a perspective on oppositional hypotheses with regard to its collapse. This chapter contains a section on Commercial Fisheries of California over the past 90 years, providing the reader with useful historical landings of several pelagic species of commercial importance in waters off California. The final two sections of this chapter are a nice amalgamation of the CalCOFI sampling design and its unique numbering system for its transects and stations. Here, the reader will also find an explanation of the temporal and spatial changes to survey coverage.

Chapter 2 concatenates historical CalCOFI survey data (such as from CTDs) with modern technology, including Argo float and glider data, to provide a physical oceanographic description of the California Current along with its origin waters. Taken together, these data help to paint a more complex and varying picture of the California Current than a “broad, weak, equatorward flow,” as it is typically characterized. A particular highlight of Chapter 2 is the section that links the physical oceanography to

the biological oceanography, specifically, advection versus upwelling currents as they relate to zooplankton. This section provides a useful overview of the relevant literature, with the right amount of explanation of their methods and results. The later sections of this chapter provide considerable detail on the regional processes affecting production; they are specific to central and southern California and likely of interest to researchers working within those regions, but perhaps of limited interest to others.

Chapter 3 may be the shortest chapter of the book, but perhaps it is the most important. Over the course of the CalCOFI program, the survey gear and methodology for biological sampling have changed. An integral part of CalCOFI has been documenting those changes and conducting the required comparisons of gear and methods in order to develop correction factors. This chapter places all of the information on gear types and sampling methods contained in numerous reports into one place. If you are a researcher that uses CalCOFI time series, this chapter will be important for ensuring that you are aware of the changes across the years. It is also useful background for students or researchers who are designing a sampling program: it offers information on the specifications of the current gear employed by CalCOFI. One of the program’s legacies is the CalCOFI Atlases: 35 volumes published between 1963 and 2002 on ichthyoplankton and zooplankton. This section serves as an introduction to the atlases, with brief descriptions of krill, chaetognaths, copepods, and ichthyoplankton. A nice concluding section deals with how the ichthyoplankton time

series generated by CalCOFI have been used to identify recurrent groups related to regional and ENSO-driven differences in oceanography.

Chapter 4 presents the multitude of temporal-scale forcing concepts that have been developed to explain trends in physical and biological time series. It is the only chapter where the author's bias is intrusive. The overview of regime shifts and climate indices is rather subjective, which is perhaps fair to expect in a book of this type, but it would have been more refreshing to have a balanced account. These issues notwithstanding, the literature provided is a good start toward networking in order to build an understanding of the climate indices and scales of variability important to the California Current System. This chapter is one from which readers will need to build upon information provided in order to develop their own opinions regarding conflicting hypotheses. The detailed account of major El Niño and La Niña impacts on regional oceanography and biota of the California Current system is thorough. A focus of the CalCOFI program is the environmental drivers of sardine and anchovy recruitment, and this chapter provides the details of both. Missing is any research on Pacific hake, which is surprising given its changes in seasonal migratory behavior and its importance as a commercially exploited species.

It might be easy to forget that CalCOFI initially included laboratory-based experimental studies on the early life-history stages of small pelagic fish. Chapter 5 revisits this important component and provides a reminder that some truly innovative research was conducted specifically on identifying anchovy larvae predation by krill in the ocean. The coupling of these laboratory experiments to field observations resulted in advancements toward understanding the predation, bioenergetics, growth, behavior, and cannibalism of the larval stages of small pelagic fish, particularly anchovy. It's unfortunate that this component of CalCOFI has now taken a less prominent role.

There are very few global examples of the operationalization of environmental factors into the provision of tactical advice for fisheries management. Chapter 6 provides an outline of how CalCOFI oceanographic and ichthyoplankton time series have been incorporated into stock assessments for a number of species, including sardine, anchovy, cowcod, bocaccio, and Pacific mackerel. These examples are valuable to have, and one in particular, the case for sardine, provides an example of how the relationship of an environmental variable (here, sea surface temperature) to recruitment can break down over time, and reliance on these relationships without continuous revalidation can have major impacts on the stock assessment process.

Chapter 7 may be the weakest chapter simply because it relies on a single reference that places fisheries oceanography in California as the strong influence on the global development of the concept of ecosystem-based management (EBM). Though I can see the reasoning for incorporation of such an argument within this book, it overstates the case and fails to provide a balanced and informative review of the global development of EBM. That notwithstanding, CalCOFI is unequivocally a stellar example of expansion from a single-species focus (initially sardine) into a holistic approach to fisheries oceanography. Today, fisheries science is struggling to implement EBM, and CalCOFI, with its long-term data sets, is well placed to begin EBM in the California Current region. This chapter outlines avenues for that implementation, particularly in integrated ecosystem assessments (IEAs). It is a bit disheartening that, despite CalCOFI being a world renowned, long-term, integrated ecosystem sampling program, it has yet to be used for IEAs and in full EBM. This perhaps provides the scientific and management communities with food for thought.

Chapter 8 is a collection of personal perspectives from previous and current researchers and students of CalCOFI on why it was/is such an important scientific

program. This chapter is the jewel of the book, and reading it was an absolute pleasure. It brought the scientists to the forefront, and reminds the reader that a world-class program such as CalCOFI is only successful because of its engaged, passionate, and determined scientists. The legacy of CalCOFI is not limited to its long-term data sets but must include the countless researchers who have contributed to the program over the years. Technology makes data collection such a different creature than it was when CalCOFI first started, and students should understand and appreciate the efforts of those who came before them. I find it remarkable how many eventual CalCOFI researchers began as summer and graduate students within the program's projects and labs. This speaks to the long-standing role that CalCOFI has played in providing mentorship to young students and its provision of a vibrant academic environment. This is not to say that the researchers were infallible; there are, of course, personal accounts that tell us about some of the mistakes made or even how successes came about from trial and error. These just make the program all the more inspiring.

This book will appeal to researchers and graduate students who study the California Current System. It is truly regional, focusing only on the central and southern portion because the current CalCOFI program operates in this region only. However, my own research focuses on the coastal migrants in the northern portion of the California Current System, and I will be routinely consulting this reference text to understand the dynamics in the southern range. McClatchie has provided a well-written, accessible, and integrated review of the CalCOFI program. I would highly recommend reading this book. 📖

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