

Foreword

You are holding a remarkable book in your hands. One reason is the particular organism it discusses, the Antarctic krill—*Euphausia superba*. It is named “superb” for good reasons, some of which I mention here and all of which are discussed in the book.

You will also learn the scientific history of Steve Nicol, one of the leading krill scientists of our time, and about the history of the Commission for the Conservation of Antarctic Marine Living Resources (CCAMLR), the first organization to adopt an explicitly ecosystem-based approach to fisheries management. Clearly this book is about a specific place (the Southern Ocean), but it is as much an adventure of ideas as it is bound to location. Here’s a little bit about krill, Steve Nicol, and CCAMLR.

Krill are crustaceans related to shrimp and prawns, but unlike their relatives krill live in the water column rather than on the ocean bottom. Antarctic krill are likely the most abundant (by biomass) animal on the planet; they inhabit entire oceans and use the whole ecosystem in the course of their lives. You’ll learn that Antarctic krill form some of the largest animal aggregations and have an amazing biology that includes long life and large size, as well as the ability to shrink when times are tough. They can eat up to twenty percent of their body

weight per day, and they are strong swimmers that can go wherever they want to go in the ocean. And, of course, krill are a terrific food source, powering the biggest animals (blue whales) on Earth. Indeed, most other organisms in the Southern Ocean either eat krill or eat something that eats krill.

Although we have studied krill for a long time, mysteries about them still abound. For example, why do we find them living and even mating at depths of six hundred meters (650 yards) below the surface? Did we only need to think earlier to search at deeper depths?

Your guide for this adventure, Steve Nicol, is a stellar scientist. Steve completed a PhD working on krill, and in 1987, after a couple of years of postdoctoral work, joined the Australian Antarctic Division. He has been deeply involved in krill research ever since. He also holds a master's degree in creative writing from the University of Tasmania, and the quality of writing shows on every page of the book.

Thus Steve has worked on krill for forty years and over that time has become one of the world's leading krill scientists. I have had the good fortune to know him for nearly thirty years. We first met during a working group concerning krill in 1989 (Steve describes that working group in the book).

Steve has been a leader in learning about live krill at sea and in the laboratory, where his team figured out how to grow krill successfully and get them to reproduce and swarm in the laboratory. These advances have allowed us to learn much about krill that we simply could not have determined from observations at sea. For example, after recognizing that about a quarter of the iron in the top twenty meters (twenty-two yards) of the ocean was bound up in krill, he pioneered iron fertilization experiments that broke new ground in our understanding of krill ecology.

Steve's personal story will also show you how science is done in practice (not in the idealized schoolbook manner that most people imagine), that obtaining more data often makes a problem more complex than simpler, and how industry and science can interact in positive and reinforcing ways.

You will learn in this book that krill have been the target of the largest fishery in the Southern Ocean for the past forty years. Because

of their enormous biomass, there is not much concern about harvesting krill unsustainably, but rather about local depletion of krill, especially around the breeding colonies of birds and seals. This concern has been highlighted because of new technologies for krill fishing that Steve describes.

Those concerns led to the establishment of the Convention for the Conservation of Antarctic Marine Living Resources (CCAMLR). The story of CCAMLR is the third thread in this book, and Steve is perfectly positioned to tell it since he has been on the Australian delegation to the CCAMLR Commission for thirty years.

The CCAMLR treaty is the first ecosystem-based approach to the management of fisheries, thinking not only about the target species but also about dependent predators and the consequences of fishing for them. You will learn about the “krill flux” and the “krill surplus,” associated, respectively, with movement of krill and the consequences of the near extinction of the great whales. And you will learn about the various krill products and their associated hype. Indeed, there were more than eight hundred krill-related patents filed between 1976 and 2000 for food, health products, and pharmaceuticals, such as enzymes for cleaning wounds.

Steve tells the story of the development of precautionary measures (starting in 1991), which were first applied in October 2010. We have gone from a situation in which there were no limits anywhere on krill fishing in 1991 to one in 2009 in which any krill fishery anywhere in the Antarctic was subject to strict limitations. Although the future of krill and krill harvesting is uncertain, Steve is optimistic about both.

Early in the book, Steve writes that virtually all science is interpretation: scientists share facts, and their challenge is to convert data into knowledge, which depends on how we understand and interpret the data. As scientists, we have the most impact when we embed our facts and data in a compelling story. And Steve Nicol has a very good one.

Bon voyage.

Marc Mangel
University of California, Santa Cruz, and University of Bergen