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SYMPOSIUM INTRODUCTION

Introduction to the Symposium: New Frontiers in Antarctic Marine Biology

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Synopsis Antarctica's erose coastline, where the ebullient cold sea blooms around the clock and, for a season, flourishes, taught me of life's voluptuous capacity to prosper just about anywhere.

The Crystal Desert
David G. Campbell
Houghton Mifflin 1992

It was a little <250 years ago that James Cook crossed the Antarctic Circle (1773) and established that if there was an Antarctic land mass at all, it was surrounded by a frozen sea. In 1820, members of British, Russian, and American expeditions all might have been among the first people to see the Antarctic shore. Since that time, this immense continent and its surrounding islands have captured the curiosity and imagination of laypersons and scientists alike. Expeditions during the 1820s led by the American and British sealers Nathaniel Palmer and James Weddell revealed a continent whose coasts teemed with marine life, including vast numbers of seals, penguins, and whales. Observations on the nature of Antarctic marine life continued during the expeditions of Durmont d'Urville (France, 1837–1840), Charles Wilkes (the United States, 1838–1841), and James Ross Clark (UK, 1839–1943). The Challenger Expedition (1872–1876), whose scientific staff was led by Sir Charles Wyville Thomson, contributed vast amounts of information on the morphology, taxonomy, and geographic distribution of Antarctic benthic and pelagic marine organisms, setting the stage for some of the paradigms that remain with us today.

The birth of Antarctic marine biology, however, probably should be placed with Robert Scott's British National Antarctic Expedition to McMurdo Sound in 1901–1904. During that expedition, a small group of workers, faced with horrendous conditions, managed to collect specimens year-round. A large proportion of what we know now about Antarctic marine biota is based on that material. In the early part of the 20th century, the land-based expeditions led by Shackleton, Borchgrevink, Bruce, Mawson, Charcot, de Gerlache, and Nordenskjöld made further observations on the coastal marine life (Walton 1987). The first long-term study of Antarctic pelagic ecosystems was conducted during the British Discovery expeditions that began in 1925. The resulting "Discovery Reports" (1929–1951 and up until 1980) contain extensive published information on fauna and flora of Antarctica. Modern marine biological studies in the Antarctic began in 1958–1959 during the International Geophysical Year. During the past 60 years, marine biological studies in Antarctica have increased enormously in importance and scope, and now they are major components of research efforts by many nations.

Past and contemporary studies of Antarctic marine biology reveal a rich and varied marine biota; in many respects without any temperate or tropical counterpart (see reviews by Arntz et al. 1994; Clarke and Johnson 2003; Knox 2007; Wiencke et al. 2014; Peck 2018). The Antarctic marine environment is characterized not only by low water temperatures, but also by marked seasonal patterns of pack-ice movement and photoperiod. Offshore, the biotic system is fueled by upwelled, nutrient-rich,

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circumpolar waters, which support rich primary production during the austral summer. Although Antarctic marine biology is a young science, research has gone far beyond just descriptions of plants and animals. More fundamental aspects of how these biotas live and interact have been studied. In particular, attention has been paid to processes that allow this environment to be part of our biosphere. These processes then can be compared in more general terms to living processes in other regions of the globe. Dynamics of production, reproduction, and ecological stability and interaction have been well developed in the past three decades. Indeed, in some ways, we know more about the remote Antarctic environment today that we do about more familiar environments closer to home. Importantly, the ecological impacts of the dramatic climate changes underway in western Antarctica and the Antarctic Peninsula have greatly elevated the significance of the interrelationships introduced above (Amsler et al. 2005; Aronson et al. 2007; Ducklow et al. 2007; McClintock et al. 2008; Steig et al. 2009; Ingels et al. 2012; Peck 2018).

The unique marine environment of Antarctica provides an exciting opportunity to highlight a suite of papers on aspects of Antarctic marine biology in this symposium volume of *Integrative and Comparative Biology* (*ICB*). Not only these papers are timely and authored by leaders in the field, they also describe innovative science, novel techniques, and future directions. Topical areas include, among others, the recent dramatic ecological impacts of climate changes across multiple trophic levels in Antarctic seas, linkages between larval krill supply and juvenile recruitment, the role of chemical ecology in how macroalgal–mesograzer interactions structure marine communities, marine invertebrate recruitment models, and implications for fjord benthic ecology, physiological mechanisms underlying the evolution in polar waters of gigantic marine invertebrates, and comparative physiology and genomics of hypoxia tolerance in pinnipeds. We believe these symposium papers will be pertinent to biologists (undergraduate and graduate students, postdocs, and research faculty) working in temperate and tropical marine environments, as well as polar marine environments.

The present symposium *New Frontiers in Antarctic Marine Biology* hosted by the Society of Integrative and Comparative Biology (SICB) follows in the footsteps of three highly successful society-wide SICB symposia on this topic that occurred ~10, 20, and 30 years ago, respectively. The first symposium on Antarctic Marine Biology was co-sponsored jointly by the American Society of Zoologists (now SICB) and the Western Society of Naturalists (WSN) at the 1988 meetings in San Francisco, CA. The second symposium took place at the SICB conference held in Atlanta, GA in 2000, and the third a decade later in Seattle, WA in 2010. All three past symposia resulted in publications in the society journal (formerly *American Zoologist*, now *Integrative and Comparative Biology* [*ICB*]). These past symposium papers continue to be widely cited. We are confident that the papers in this most recent symposium issue will similarly have a significant impact on Antarctic marine biology. We hope they convince readers that Antarctica truly remains a "frontier," both in its geographic isolation and its marine biology, and importantly, that the two are inherently integrated.

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