

FROZEN OCEANS: THE FLOATING WORLD OF PACK ICE. By DAVID N. THOMAS. Richmond Hill, Ontario: Firefly Books Ltd., 2004. ISBN 1-55407-000-7. 224 p., maps, colour and b&w illus., glossary, bib., index. Hardbound. Cdn\$45.00; US\$45.00.

Thirteen years have elapsed since the publication of *Glaciers* (Hambrey and Alean, 1992), a lavishly illustrated book that reflects the authors' considerable experience investigating alpine and polar glaciers and their wish to share their knowledge and enthusiasm with a broad audience. At the time *Glaciers* appeared, I had seen enough sea ice to convince me that it offered ample scope for a similar book. Thanks to David Thomas, that book is now available.

In the preface, *Frozen Oceans* is described as "...an introduction to the large-scale distribution of pack ice around the world." This hardly begins to describe the content and purpose of *Frozen Oceans*. As a marine biogeochemist who has worked in both polar regions, the author views the pack ice as a habitat for diverse organisms: a major global habitat that at the time of its maximum extent (between June and November) covers 13% of the Earth's surface, an area similar to that covered by deserts and tundra (p. 4).

The publication of *Frozen Oceans* in early October 2004 could not have been more timely. It coincided with an announcement that the Arctic Ocean pack ice had reached a near-record minimum extent for the third consecutive year (NSIDC, 2004). There is some debate as to whether the continuing large changes in Arctic sea-ice extent are due to natural climate change, or polar amplification of the greenhouse effect on global climate, or a combination of the two. Whatever the cause of these changes, the NSIDC article was soon followed by widely reported concern about unprecedented increases (more than 2 ppm) in annual atmospheric carbon dioxide concentration in both 2002 and 2003 (Brown, 2004). Then, as much of this review was being written, the International Symposium on Climate Change in the Arctic convened in Reykjavik, Iceland, on 9–11 November 2004, and the Arctic Climate Impact Assessment (ACIA, 2004) was published online.

Physical changes in the Arctic tend to grab the headlines, and the ACIA report ought to lead to a wider appreciation for the fact that polar climate change also has biological and human dimensions and consequences. *Frozen Oceans* is primarily a book about the pack-ice ecosystem and its inhabitants, with a focus on a broad range of biota, from the micro-organisms that inhabit the smallest spaces within the ice to the largest organisms that live above, on, between, and under the ice floes. People, too, have long had an association with the pack ice, particularly the indigenous peoples of the Arctic, but sealers, whalers, explorers, the oil industry, tourists, and scientists and their methods are also discussed briefly.

Written "in a lively style" (according to the publisher's blurb on the dust jacket), *Frozen Oceans* conveys in "non-technical terms and...through colour photography" the physical conditions and processes of the ice cover itself and the

biological dimensions of the complex and sensitive pack-ice habitat. There are five chapters on the biology of the pack ice, organized in a sequence from the smallest to the largest organisms. They are preceded, logically, by three chapters that describe the physical environment. The two final chapters provide a history of pack-ice exploration and how the pack ice has been studied and a discussion of threats to and the potential of the pack ice.

It's a little odd that fast ice is excluded from the book. There is no question that the total global area of fast ice is much smaller than the area of pack ice, and some might consider the fast ice to be much less spectacular than the pack ice. For example, fast ice doesn't move across the ocean surface, often at speeds of many kilometres per day, opening up leads in some places, and elsewhere closing them and deforming ice into sometimes spectacular pressure ridges. On the other hand, fast ice is important to people—the Inuvialuit and Inuit of the Canadian Arctic, for example—and the current knowledge of pack-ice microbiology is built on the firm foundation of earlier studies of fast-ice microbiology.

The geographer in me would prefer to see Chapter 3, Pack-ice Regions of the World, presented as the first chapter, with a more detailed description of the spatial distribution of pack ice, particularly in the Northern Hemisphere. The chapter concludes with descriptions of three unusual pack ice regions: the White, Baltic, and Caspian seas. Since the Caspian Sea is an inland sea not connected to the global ocean, that sea ice occurs at its northern end is curious and perhaps not widely known (I had no idea). On the other hand, that there is sea ice in the White Sea, located on the Arctic Circle and directly connected to the Arctic Ocean, is unremarkable. And if Baltic Sea ice is worthy of mention, why not also mention the Gulf of St. Lawrence, the Sea of Okhotsk, and the Bo Hai? Each is far from the Arctic Ocean; the Gulf of St. Lawrence is roughly 10° farther south than the Baltic Sea and the Sea of Okhotsk; and the Bo Hai, at the same latitude as San Francisco, New York, and Lisbon, has the southernmost sea ice in the Northern Hemisphere.

Frozen Oceans is neither reference book nor textbook, and the knowledgeable reader will wince at some of the numerous and avoidable errors. Here are just two examples. First, on page 38 it is incorrectly stated that, in Antarctica, it is only in the Weddell and Amundsen seas that significant amounts of pack ice last for more than one year (i.e., become multiyear ice). The error is partially corrected on page 55, where it is noted that the circulation patterns of the Weddell and Ross gyres create conditions that favour the establishment of significant volumes of multiyear ice. So now we have multiyear ice in the western Weddell, Amundsen, and eastern Ross seas, but that still omits the Bellinghousen Sea. Second, on page 45 it is claimed that the over 7 km spatial resolution of the Advanced Very High Resolution Radiometer (AVHRR) is better than that which can be achieved by active microwave remote sensing. Putting aside the fact that the spatial

resolution of AVHRR is actually 1.1 km, the claim would be correct if the comparison is made with scatterometer-derived maps of sea-ice extent (50 km spatial resolution), but quite wrong if the comparison is made with synthetic aperture radar data, which have spatial resolution two to three orders of magnitude better than AVHRR. I leave it to a biologist to document any problems with the chapters on the bugs and critters.

I counted 150 colour photographs, 17 black-and-white photographs, 15 colour illustrations and 22 diagrams/graphs/maps, all reproduced very well on high-quality paper. The book has a glossary (with two different definitions for ice concentration, but never mind), an index, and three pages of further information that list some relevant books, specialized journals, and websites. As a book that seeks to spread knowledge and appreciation of the pack ice beyond the small number of us who have had the privilege of working there, *Frozen Oceans* will appeal to the scientifically literate layman who is interested in the polar regions. But we specialists, too, ought to have the book on our shelves; no personal or institutional polar/marine science library will be complete without it. It would also serve as a useful introduction to sea-ice biology for undergraduate and graduate students in the polar marine physical sciences.

Notwithstanding the errors, I strongly recommend *Frozen Oceans* for experts and non-experts alike. The first of its kind, *Frozen Oceans* is exceptionally good value. David Thomas is to be congratulated for reducing a complex subject, more or less successfully, to a readable and informative description of the pack ice, and for sharing his knowledge and enthusiasm with a wider audience.

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Martin O. Jeffries
Geophysical Institute, University of Alaska Fairbanks
903 Koyukuk Drive
P.O. Box 757320
Fairbanks, Alaska, U.S.A.
99775-7320
martin.jeffries@gi.alaska.edu

THE WHALES THEY GIVE THEMSELVES: CONVERSATIONS WITH HARRY BROWER, SR. Edited by KAREN BREWSTER. Fairbanks: University of Alaska Press, 2004. ISBN 1-889963-66-6. xvii + 232 p., map, b&w illus., bib., index. Softbound. US\$22.95.

The Brower family has a long and very public history on the North Slope of Alaska. Charles D. Brower, self-styled king of the Arctic, dominated much (although by no means all) of Barrow social life through most of the first quarter of the 20th century. His many-volume, unpublished journal, archived at the University of Alaska, was published in a much shorter version entitled *Fifty Years Below Zero* (1942). His daughter Sadie Neakok is probably best known as Barrow's serving magistrate over many years, a position in which she was determined that local residents would not suffer unjustly from unfamiliar law ways. Sadie was also active in many arenas of public life during the second half of the 20th century and was universally held in high regard by Iñupiat and non-Iñupiat alike. Her remarkable life history was recorded with the help of Margaret Blackman in 1989.

As Brewster says, Harry Brower was perhaps less visibly in the public eye, but his influence was nevertheless profound, not least in helping to foster an unusually collaborative and mutually respectful relationship between scientists and many Iñupiat with specialized knowledge of their environment. For this alone, the present volume makes an important contribution to the social studies of science, posing an important alternative to the all too common assumption of inevitable tensions between expert and lay knowledge, between traditional and modern knowledge, and between indigenous and scientific knowledge.

Through her conversations with Harry Brower, Brewster brings to light a detailed history of this important relationship, beginning with Charles D. Brower's interactions with visiting scientists in the late 19th century, a role that incorporated his children as collectors of scientific specimens. She continues by recounting further interactions with scientists connected to NARL (the Naval Arctic Research Laboratory, established a few miles north of Barrow), who recruited local children to bring them desired specimens. Up to this point, the story is well known, although Harry Brower's account provides nice details that I have not seen elsewhere. What is less well known, but of central importance to an understanding of contemporary political life in Barrow, is Harry Brower's influence in incorporating scientists in the activities of the Alaska Eskimo Whaling Commission (AEWC). When the International Whaling Commission (IWC) proposed to ban Iñupiaq bowhead whaling in 1977, local whalers insisted that the bowhead population was stronger than the IWC believed. The IWC rejected the claim, insisting that Iñupiat whalers did not have the scientific knowledge to back up their assertions. The subsequent organization of the AEWC included the incorporation of scientific research, largely at the encouragement of Harry Brower and