Edited by Kees Vermeer, Kenneth T. Briggs. Ken H. Morgan, and Douglas Siegel-Causey

The status, ecology, and conservation of marine birds of the North Pacific

Special Publication Canadian Wildlife Service



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Proceedings of a symposium sponsored by the Pacific Seabird Group, the Canadian Wildlife Service, and the British Columbia Ministry of Environment, Lands and Parks, held at the Royal British Columbia Museum in Victoria, B.C., on 22 and 23 February 1990.

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Introduction

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This book presents the proceedings of a symposium on the status, ecology, and conservation of marine birds of the North Pacific. The symposium was held on 22 and 23 February 1990 in the Newcombe Auditorium of the Royal British Columbia Museum, Victoria, British Columbia. The objective of the symposium was to provide a review of what is currently known about the status, ecology, and conservation of marine birds of the North Pacific. The proceedings are partly an update of those of a symposium entitled: "Conservation of marine birds of northern North America," held on 13–15 May 1975 at Seattle, Washington (Bartonek and Nettleship 1979).

These proceedings consist of three sections: (1) Bird distribution at sea as determined by physical and biological processes, (2) Status, ecology, and conservation of nesting and visiting seabirds, and (3) Environmental hazards to seabirds. The first section describes the distribution of birds at sea in relation to physical and biological processes in the Bering Sea, in the central North Pacific, off the coasts of British Columbia and Washington, and in the California Current, and explores the effects of climatic changes, such as the El Niño/Southern Oscillation and potential global warming, on seabirds and their prey.

The second section includes chapters on both nesting and visiting seabirds in the North Pacific, from the Tropic of Cancer in the south to the Bering Sea in the north. Bird groups covered are albatrosses, fulmars, gadfly petrels and stormpetrels, shearwaters, gulls, kittiwakes, terns, guillemots, murrelets, murres, puffins, and auklets. The third section includes chapters on the effects of environmental hazards such as gillnetting, introduced predators, human disturbance, plastic ingestion, contamination by trace metals and chlorinated hydrocarbons, and oil spillage on marine birds.

Individual chapters include recommendations on necessary future studies and actions to protect seabirds. Although the chapters and sections vary in scope and depth, this book provides the most recent overview of what is known of the status, ecology, and distribution of marine birds of the temperate North Pacific. We hope that these proceedings will become an important reference for ornithologists and managers, and that decision makers will act on the recommendations so that North Pacific marine birds and their biological environment may be preserved.

Literature cited

Bartonek, J.C.; Nettleship, D.W. (eds.). 1979. Conservation of marine birds of northern North America. U.S. Fish Wildl. Serv. Wildl. Res. Rep. 11. Washington, DC.