

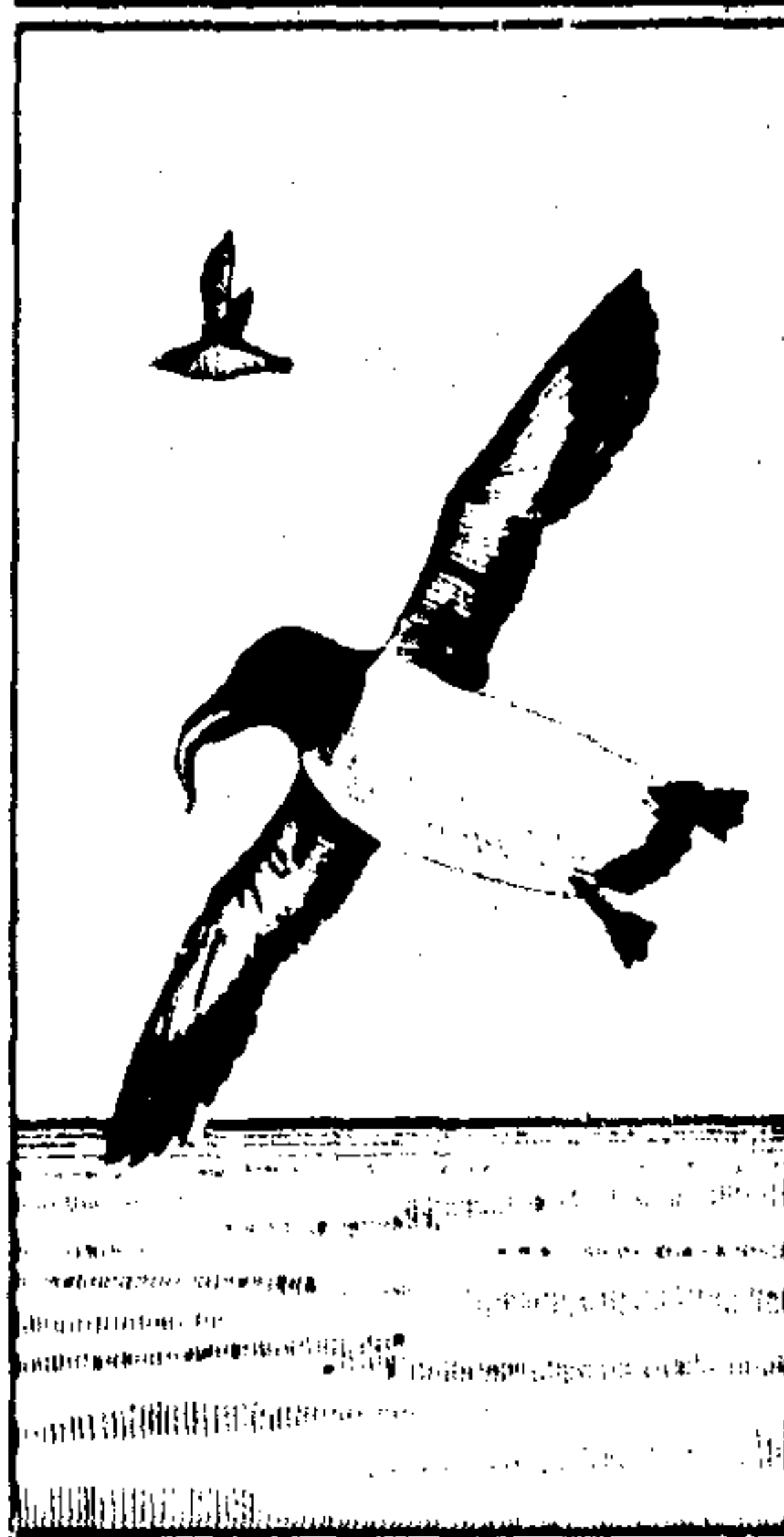
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**Edited by**  
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# **Marine birds: their feeding ecology and commercial fisheries relationships**

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**This volume is  
dedicated to the  
memory of**

**Gordon A. Calderwood**, research technician of the Seabird Research Unit, Canadian Wildlife Service, who drowned in Witless Bay, Newfoundland, on 6 July 1980 while conducting censuses of breeding seabirds,

**Anne J. Vallée**, wildlife biologist with the Canadian Wildlife Service and Ph.D. student in zoology at the University of British Columbia, who died on Triangle Island, British Columbia, on 31 July 1982 while performing studies on Tufted Puffins.

**Gunnar Lid**, research scientist with the Zoological Museum, Oslo, who drowned in seas off Røst, Norway, on 1 August 1983 while making observations on Atlantic Puffins at sea.

## Preface

The papers in this volume were presented as a special symposium at the eighth annual meeting of the Pacific Seabird Group (PSG) held in Seattle, Washington, on 6-8 January 1982. The meeting and special symposium were co-sponsored by the Seattle Aquarium and Washington Department of Game. The program chairman for the meeting was Harry M. Ohlendorf. The hosts, the Washington Department of Game and the Seattle Aquarium, and the local committee chairmen, Lora L. Leschner and Gary Ballew, co-ordinated local arrangements.

The idea to hold a special symposium on the feeding ecology of seabirds originated at the executive council meeting in Tucson, Arizona, in November 1980. The council identified a series of integrated themes which together encompass a wide range of species groups and biological interests. First, they decided not to restrict the symposium to primary seabird species, rather to include marine waterfowl and their nearshore habitats. They wished to accomplish two goals: (1) to focus attention on the immense, undescribed flocks of waterfowl that play an important role in coastal marine ecosystems, particularly in the northeast Pacific where they are highly vulnerable to oil developments; and (2) to bring waterfowl and seabird investigators together to exchange technical information and conservation strategies. Once the executive council agreed to devote a full session to marine waterfowl and another to pelagic seabirds, discussion focused quickly on the need for a third session to review the effects of commercial fisheries on marine-associated birds. At that stage the special symposium was born, with session chairmen selected by the program chairman and endorsed by the executive council. The final task was for chairmen to identify and secure those individuals whose contributions might best meet the aims of the symposium and represent current thinking on their respective topics. Contributors were required to submit a draft of their paper to the editors prior to the symposium; after the meeting they could submit a revised draft before the official review was initiated. All papers were reviewed by at least two external referees (see "Reviewers of the special symposium") and the editors before they were accepted for the published proceedings. Papers listed under symposium sessions of the Pacific Seabirds Group eighth annual meeting *Program and Abstracts* guide which do not appear in this publication were withdrawn or rejected.

The symposium consisted of three parts: I. The feeding ecology of marine waterfowl (chairmen: P.F. Springer and J. King), II. The feeding ecology of pelagic marine birds (chairmen: G.A. Sanger and D.G. Ainley), and

III. Seabird and commercial fisheries interactions (chairmen: D.N. Nettleship, G.L. Hunt, Jr., and A.D. MacCall). Session I comprises six papers which discuss aspects of the winter or summer feeding ecology of six waterfowl species inhabiting coastal waters of Alaska and British Columbia. The papers compare the usage of habitat types and food items, with some consideration of prey availability, trophic relationships, and resource partitioning. Session II contains seven papers, four of which present observations collected exclusively in the pelagic environment and three which deal with bird distribution and food data gathered at colonies during the breeding season or close to land. Three papers discuss various characteristics of the feeding ecology of the Sooty Shearwater at certain locations in the North Pacific. These reports, and other papers on chick diet and on oceanographic factors influencing the distribution and abundance of food in marine waters, illustrate the complexity of the feeding dynamics of seabird populations. Session III consists of 10 papers which attempt to show the interrelationships among species and the serious effects that commercial fisheries can have on seabird populations and communities by competing directly for food and by accidental drowning of birds in fish nets. Examples are drawn from regions throughout the world's oceans, wherever the appropriate studies have been conducted. Characteristics common to instances of competition between fisheries and seabird communities are highlighted. Also, the contributors underline differences in vulnerability between those systems where the target fish species forms the basis of the food web and those having a more diversified prey structure. They look at drowning of seabirds in fish gill nets in three different regions (from high arctic to boreal waters); and they show the wide variation in form that this source of mortality can take and how easily it can lead to a serious decline in a seabird population.

We hope that the 23 papers included in these proceedings will provide answers to some of the questions being posed by seabird and waterfowl workers concerning the feeding ecology of avian species inhabiting coastal and offshore marine habitats. They do at least bring together the findings of a number of individual investigations in their respective subject areas. We hope this volume will also provide the stimulus for much more research. For example, sessions I and II reveal the need for more detailed study of the diet of seabirds when they are away from land, particularly outside the breeding season, and for researchers to determine prey preference and consumption rates by comparing the use the birds make of habitats and food items to their availability. They also point to the need to study a



prey's availability relative to other potential prey. For understanding relationships between seabirds and other components of marine ecosystems, including fisheries, we must develop techniques that enable us to measure directly or estimate with known precision how much of a given prey seabirds eat per unit time. Only then will we be able to relate seabird diets to fisheries quantitatively and accurately. Information on these and other aspects of the feeding ecology of marine birds is required, not only to better understand the structure and function of avian components of marine ecosystems, but also to provide a bank of knowledge for evaluating the effects of both natural and man-induced environmental perturbations.

The symposium and these proceedings are the result of a tremendous amount of hard work on the parts of many people. The Washington Department of Game and the Seattle Aquarium, the co-sponsors of the meeting, together with Lora Leschner and Gary Ballew did an excellent job with the local arrangements. The Seattle Aquarium provided outstanding logistical support before and during the meeting, and free access to their fine marine exhibits. We owe special thanks to Harry Ohlendorf for the successful development and co-ordination of the scientific program including both the symposium and "contributed-paper" sessions, to Kees Vermeer for his support as chairman of the PSG executive council, and to David G. Ainley for his considerable contribution to the editing of symposium papers in session II. Joyce Dagnall has been of invaluable assistance, not only in dealing with the voluminous correspondence and retyping of manuscripts that took place through all phases of the symposium's development and completion, but also in organizing and maintaining the manuscript files for all sessions as revised drafts were received from authors and editors. Susan Johnson and Angela Nettleship have been extremely helpful with proof-reading certain parts of the galley. We also are extremely grateful to Patricia Loshak, chief of Canadian Wildlife Service Scientific and Technical Publications Division, in guiding this volume through its various stages of development to publication, and to Susan Burns who performed the final edit and proof-reading of the entire manuscript. We are also grateful to the U.S. Fish and Wildlife Service for their support in permitting two of us (G.A.S. and P.F.S.) to participate and use office time to edit and prepare manuscripts, which in the end made possible the collaboration necessary to produce these proceedings.

Finally, we sincerely thank the authors for their contributions and the co-operative manner in which they collectively responded to suggestions for revision and editorial comments from external referees and the editors. We also extend our special thanks to those many individuals who served as reviewers of manuscripts (see section entitled "Reviewers of the special symposium"), whose combined efforts ensured that contributions accepted for publication attained a satisfactory scientific standard. In closing, we wish to express our gratitude to the Canadian Wildlife Service, Environment Canada, for providing the financial support and technical staff to publish these papers as a proceedings volume, and for allowing us to undertake the editing and preparation of the book at the Bedford Institute of Oceanography.

David N. Nettleship  
Gerald A. Sanger  
Paul F. Springer

February 1984

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## Reviewers of the special symposium

The editors and authors thank the following individuals who served as referees of manuscripts submitted for publication in the symposium proceedings; it is only through their considerable efforts and care that we have succeeded in achieving a high scientific standard for papers presented in this volume (individuals who reviewed two or more manuscripts are indicated by an asterisk):

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