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INTRODUCTION

This report summarizes the results of a workshop held from September 29 to October 2, 1995, at the Alyeska Resort, Girdwood, Alaska, to discuss the science of seabird restoration. The Pacific Seabird Group (PSG), an international scientific society, invited experts in seabird biology and management from Great Britain, Belgium, France, New Zealand, Japan, Canada, and the United States to devote their cumulative experience totaling half a millennium to develop practical advice and recommendations on how best to restore seabird populations injured by oil spills. The workshop and this report were funded by a grant from the *Exxon Valdez* Oil Spill Trustee Council (Trustee Council) through the U.S. Department of Interior, Fish and Wildlife Service.

We present here the first comprehensive review of seabird restoration. Although the workshop emphasized the seabird species considered to be "not recovering" from the *Exxon Valdez* oil spill (EVOS) at the time of the workshop, this report also provides generic guidance for developing seabird restoration plans anywhere. The workshop first addressed seabird restoration from a general perspective, and then applied the general discussions and conclusions to the specific problems of EVOS.

The Trustee Council, and other oil spill trustee councils, each independently have struggled in their attempts to derive the most efficacious means to restore seabird populations and to allocate seabird restoration funds. Seabird restoration, as a discipline, is in its infancy and represents a new approach to seabird management. Typically, past seabird management plans have focused on cataloguing and maintaining populations or removing perturbations (e.g., alien plants and mammals) from breeding colonies, and purchasing or protecting breeding habitat (e.g., USFWS 1995). Such plans were based on research that examined the natural and anthropogenic factors that affect fluctuations in population size or breeding productivity. Only recently have seabird biologists and managers had funds at their disposal designated for the restoration of seabird populations injured by oil spills or other anthropogenic events. Because many seabird populations often show large fluctuations in numbers and have demonstrated the ability to recover naturally from a wide range of perturbations, the design of restoration plans poses a number of special problems.

This report provides comprehensive background information and a series of recommendations for the Trustee Council. Topics include a synopsis of the type of pre- and postspill data needed to design an effective restoration plan; a description of the data needed to identify injured species or populations requiring restoration; a summary of the type of monitoring activities required to evaluate the success of a restoration activity; an evaluation of over 20 specific restoration techniques; and a summary of population-, community-, and ecosystem-level factors that may affect or be affected by restoration of seabird populations. The report also recommends specific restoration techniques for species that have not recovered from EVOS and describes untested

techniques having sufficient potential that, with additional research, they may merit inclusion in future management plans.

THE EXXON VALDEZ OIL SPILL AND THE TRUSTEE COUNCIL

In March 1989, the tanker *Exxon Valdez* grounded in Prince William Sound, Alaska, resulting in the spread of 11 million gallons of crude oil over a wide area. The spill was the largest in the history of the United States, and during the next several months it contaminated islands, beaches, and bays in Prince William Sound, the Kenai Peninsula, the Cook Inlet, the Kodiak Archipelago, and the Alaska Peninsula. The natural resource trustees have estimated that the oil or its effects killed between 260,000 and 580,000 seabirds totaling 90 species (Piatt *et al.* 1990, NOAA *et al.* 1991). Piatt and Ford (1996) estimated that about 250,000 seabirds died; however, the actual number of seabirds killed is disputed (e.g., Parrish and Boersma 1995a, 1995b; Piatt 1995). Most seabird species in the spill area escaped with only a few mortalities, while enough individuals of other species were killed that obvious declines to their populations occurred.

The Trustee Council was established in the aftermath of the spill, and is composed of representatives from six federal and state agencies. It administers a \$900 million trust fund that is to be used to restore, replace, enhance, rehabilitate, or acquire the equivalent of natural resources injured as a result of EVOS (Trustee Council 1994a, 1994b).

PACIFIC SEABIRD GROUP

PSG is an international scientific society founded in 1972 to promote the study and conservation of Pacific seabirds. PSG facilitates the exchange and distribution of information on seabirds through annual meetings, the biannual publication *Pacific Seabirds*, and periodic symposia. PSG has held symposia on the biology and management of virtually every seabird species affected by EVOS. In 1993, PSG hosted a symposium on seabird restoration following oil spills. This EVOS workshop is a microcosm of PSG's mission to advance marine ornithology by facilitating the exchange and distribution of information on seabird biology and conservation.

PSG, through its Conservation and Restoration Committees, frequently provides expert comments on seabird restoration plans throughout the Pacific coast of North America. PSG first commented on EVOS issues just weeks after the spill in 1989 when it corresponded with the Administrator of the Environmental Protection Agency. Until the trust fund was established in October 1991, the parties to the EVOS litigation released little information about the effects of the spill and there was little opportunity for public comment. Subsequently, PSG communicated frequently on the expenditure of EVOS Trust Funds. At PSG's 16th Annual Meeting in Victoria, British Columbia (February 1990), three EVOS-related papers were presented, and an EVOS-related public panel discussion was held. In 1992, PSG filed comments with the Trustee Council on the Restoration Framework, the 1992 Draft Work Plan, the Solicitation for Suggestions for the 1993 Work Plan, and the Draft 1993 Work Plan. In 1993, PSG provided written testimony to

the House Merchant Marine Committee regarding its oversight of EVOS restoration activities, and filed comments with the Trustee Council on its proposed Restoration Plan. Also in 1993, when government researchers were first able to publicly discuss their research, PSG held a symposium on EVOS and a separate session on seabird restoration. In 1994, PSG filed comments with the Trustee Council on the Draft 1994 Work Plan, the Draft Restoration Plan, the Draft Environmental Impact Statement, and the Draft 1995 Work Plan. In 1995, PSG filed comments with the Trustee Council on the Draft 1996 Work Plan. On the basis of all this effort related to EVOS, and given PSG's network with worldwide expertise in seabirds and its interest in solving practical problems related to seabird management, it follows that PSG was the ideal organization to host this workshop.

WORKSHOP BACKGROUND AND DEVELOPMENT

Soon after the Trustee Council notified PSG in November 1994 that it had received a grant, PSG's Executive Council appointed a five-person Steering Committee to direct the workshop. This committee was composed of Craig S. Harrison (PSG Vice Chair for Conservation) and Kenneth I. Warheit (Coordinator, PSG Restoration Committee), who were selected to be co-leaders; Mark Rauzon (PSG Chair); William Everett (Chair-elect); and John Piatt (past Chair). The Steering Committee hired George Divoky as the workshop's Executive Secretary.

The grant enabled PSG to provide travel funds to about 30-35 of the people attending the workshop (see pages iii-vi). The Steering Committee and PSG's Restoration Committee initially developed a list of about 100 researchers and resource managers who have worked with seabird damage assessment, monitoring, restoration, or breeding biology of seabirds. The Steering Committee issued invitations from this lengthy list with a view toward balancing the group as a whole to reflect the full spectrum of expertise, experience, and geographical dispersion. The Steering Committee believes that this process produced a workshop in which the whole was greater than the sum of its individual participants. Some invitees were unable to attend because of schedule conflicts, and many highly qualified or interested people could not be invited because the workshop was designed to facilitate discussions and debates that might have been difficult or impossible had the workshop been much larger. Each participant was invited because of his or her experience and expertise, and no one expressly represented any organization or government agency.

Initially the Steering Committee commissioned the preparation of four discussion papers that would address themes anticipated to recur in all workshop discussions. These papers were "The Role of Behavioral Ecology and Long-term Life History Studies in Seabird Restoration" (Sydeman and Nur); "The Population Ecology of Seabird Restoration: Population Dynamics and Metapopulation Models" (Nur and Sydeman); "The Role of Biotic and Abiotic Factors in Constraining or Enhancing Restoration of Seabird Populations" (Ainley and Nur); and "Seabird Restoration Techniques" (Divoky).

During late summer 1995, the Steering Committee sent these papers and other background materials to each participant. We asked participants to study pertinent literature and reports on

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seabird restoration techniques, general restoration issues, and the level of impact on nonrecovering seabirds in the EVOS area (harlequin duck, common murre, pigeon guillemot, marbled murrelet). The Steering Committee also asked participants to respond to several questions regarding seabird restoration.

The Steering Committee established four discussion groups, and recruited leaders for each group. These were (1) baseline data, resource damage assessment activities, and restoration goals (Ken Briggs and John Piatt); (2) restoration activities (Dan Roby and George Divoky); (3) restoration and recovery monitoring and modeling (Ed Murphy and Craig Harrison); and (4) factors limiting recovery (Tony Gaston and Bill Everett). We encouraged discussions and contact among participants well before the workshop. Stan Senner of the EVOS office assisted with the development of workshop objectives.

At the workshop, participants met both in plenary sessions and in small groups. Group leaders endeavored to guide the discussions toward conclusions or recommendations relating to specific questions. Some responses required scientists to bring their best judgment, intuition, and knowledge of scientific principles to bear on questions for which data are currently lacking. The Steering Committee urged participants to achieve consensus or, when this was not possible, to define areas of disagreement as explicitly as possible.

The workshop participants rose admirably to the task presented to them. On several occasions, some groups worked well past midnight to resolve the thornier restoration issues. We thank each participant for making the workshop a success, and for helping to make a "great leap forward" in the science of seabird restoration.

The content of this report is a group effort and is based entirely on the discussions among the workshop participants before, during, and after the workshop. Most workshop participants drafted at least a portion of this report, and we asked each participant to review the entire report. The results and recommendations reflect the consensus of the workshop, except where divergent views are expressed. The editors acknowledge that some sections of this report are redundant. This is intentional because many readers will not read this report in its entirety.

--PSG Steering Committee