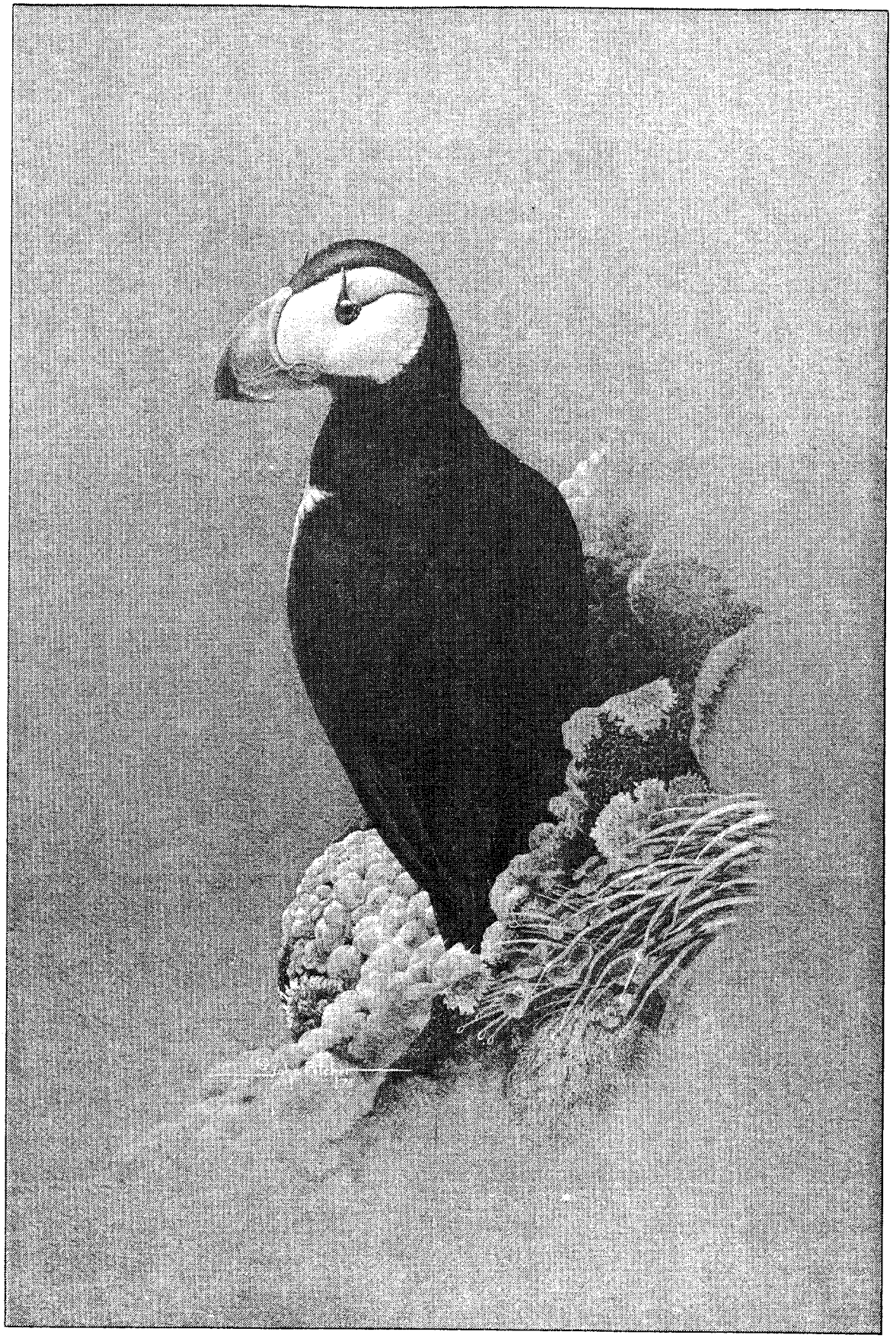
# PACIFIC SEABIRD GROUP

# BULLETIN

Vol. 5 Summer 1978 No. 1



PACIFIC SEABIRD GROUP

BULLETIN

VOLUME 5 SUMMER 1978 NUMBER 1

Pacific
Seabird
Group

DEDICATED TO THE STUDY AND CONSERVATION OF PACIFIC SEABIRDS AND THEIR ENVIRONMENT

## CHAIRMAN'S PAGE

Past chairmen have often emphasized that the Pacific Seabird Group owes in part its existence, establishment, and growth to the stimulus and increase of OCS oil interests. It has also been emphasized that PSG could play a major role in that effort--and our members have. This premise is certainly partly true. The OCS effort brought seabird enthusiasts in western North America together for the first time in a worthwhile, organized effort. And it created a new following. But the PSG is more than that and it always was!

Marine bird resources are much too important to believe that a waning of funds, interest, and effort of OCS-affinity will mean a concurrent waning of interest in the Pacific Seabird Group. Marine bird study and conservation are now blossoming fields in North America. Agencies now include marine bird resources in their programs. New issues (commercial fishing conflicts, island refuge establishment, offshore boundaries for coastal and island refuges, management strategies for marine birds, the roles of marine birds in offshore nutrient and energy cycling, new concepts in population dynamics, and other important applied and theoretical problems) are replacing the old (enumeration techniques, cataloguing and inventory of seabird colonies, seabird identification, etc.). The Pacific Seabird Group is now more relevant than ever.

PSG has always been a close and united group. The annual meetings have always been of a quality to compare with any professional ornithological group in North America. Old members should renew interests and newer members should become more involved. Our next annual meeting is scheduled for 13-16 December 1978 at Asilomar. How about a record turnout?

Daniel W. Anderson
Chairman

## FROM THE EDITOR

This Bulletin has two innovations. We now have an Art Editor, John Pitcher of Anchorage, and a Letters to the Editor section. John Pitcher is a free-lance wildlife artist dedicated to the avifauna of Alaska and "fascinated by the vast populations of seabirds here". His horned puffin frontice piece is from a Limited Edition Series available through Antique, Ltd., 314 G Street, Anchorage, Alaska 99501. Other pictures are from Okiotak, the newsletter of the Anchorage Audubon Society of which John was Editor.

We are indebted to Arthur Sowls for permission to use pictures drawn by himself, Margaret Peterson and Anthony R. DeGange for the catalogue of Alaskan seabird colonies they are doing.

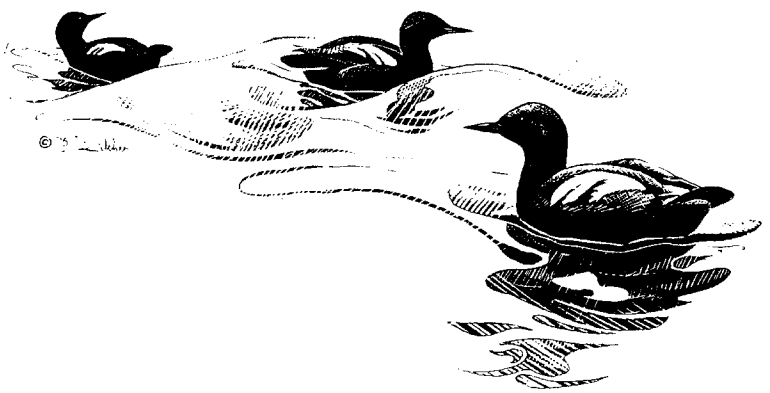
Mike Scott, former PSG Chairman, suggested the Letters Section. The PSG membership is the best "eyes and ears" the public has with regard to marine birds. Perhaps through the Letters Section, we can perform as an "early warning system" for problems and opportunities in the conservation of this avian resource. So if your pet bird area needs some attention, let us know. Please keep letters brief and suggest solutions to problems for consideration by the membership and Council. Ideas, proposals and informational letters are also welcome and copies of important letters to others.

We are indebted to Ann Schneider, U.S. Fish and Wildlife Service, Juneau, for help with layout and typing for this Bulletin.

The U.S. Fish and Wildlife Service provided printing of this issue because of the large number of Fish and Wildlife Service projects reported on at the Fourth Annual Meeting. Copies will be circulated to Fish and Wildlife Service offices.

Please renew your membership if you haven't already. If you are a new reader, we hope you will join us. We need your help, ideas and support.

James G. King



Pigeon Guillemot

## BUSINESS PROCEEDINGS OF THE FOURTH ANNUAL MEETING

The annual meeting of the PSG Executive Council was held at Victoria, British Columbia, 19-21 January, 1978. Members attending were David Ainley, Dan Anderson, Bill Drury, Jim King, David Manuwal, Palmer Sekora and Kees Vermeer. The elections of officers, working committees and publication were discussed.

The following members were nominated and elected as officers for 1978 by the general membership:

| | | |
|---|---|---|
| Dan Anderson | - | Chairman |
| Ralph Schreiber | - | Vice-Chairman |
| Stan Harris | - | Secretary |
| David Manuwal | - | Treasurer |

New regional representatives for 1978 by the membership were:

| | | |
|---|---|---|
| Lora Leschner | - | Washington |
| Palmer Sekora | - | Oregon |
| Ralph Schreiber | - | Southern California |
| Kees Vermeer | - | British Columbia (re-elected) |

Jim King was appointed as the new Editor of the PSG Bulletin. New offices up for election in the autumn of 1978 are:

Alaska - Northern California - Mexico - Washington - and the office for the representative at large.

PSG working committees will continue in 1978, with one dropped (colony censusing) and three added (seabird sanctuaries, seabird/fisheries interaction and human disturbance to seabirds). Committee chairmen are listed on Page 4.

The PSG Council discussed the possibility of publishing a seabird journal. It was felt that a journal could be published in conjunction with an organization having similar interests. The Council also decided to have regional reports in the autumn issue of the PSG Bulletin only. The general membership was encouraged to publish brief articles in the PSG Bulletin.

## COMMITTEE COORDINATORS

Pelagic observations:

Gerald A. Sanger
U.S. Fish and Wildlife Service
1011 E. Tudor Road
Anchorage, Alaska 99503

Beached bird surveys:

David G. Ainley
Pt. Reyes Bird Observatory
4990 State Route 1
Stinson Beach, Calif. 94970

Seabird sanctuaries:

Palmer Sekora
U.S. Fish and Wildlife Service
Finley National Wildlife Refuge
Route 2, Box 208
Corvallis, Oregon 97330

Human disturbances to seabirds:

Paul R. Kelly
California Department of Fish and Game
Wildlife Management Branch
350 Golden Shore
Long Beach, Calif. 90802

Coastal surveys:

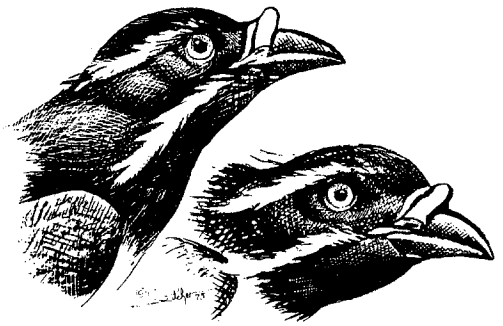
Robert Gill Jr.
U.S. Fish and Wildlife Service
1011 E. Tudor Road
Anchorage, Alaska 99503

Publications:

Daniel W. Anderson
Division Wildlife & Fisheries
University of California
Davis, California 95616

Seabird/fisheries interaction:

George L. Hunt, Jr.
School of Biological Sciences
University of California
Irvine, Calif. 92664



Rhinoceros Auklets

## RESOLUTION ON NEW ALASKAN BIRD REFUGES

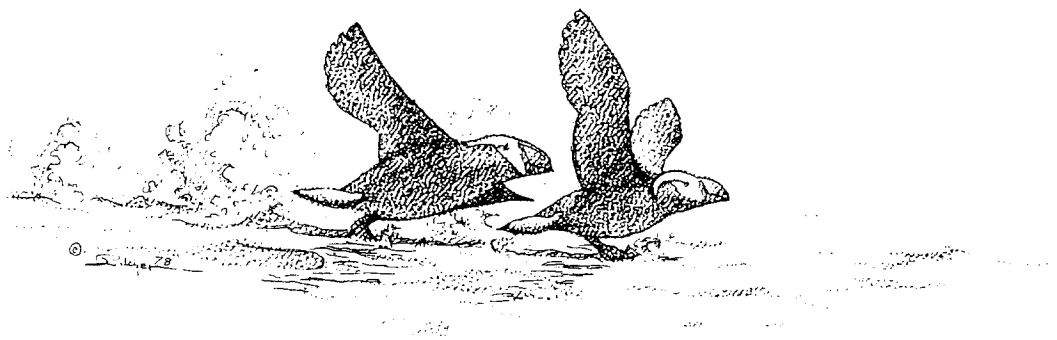
The Pacific Seabird Group, at its annual meeting in January, 1978, voted to advise the Congress of their support for establishment of National Wildlife Refuges in Alaska. We support the coastal seabird refuges as proposed by the Department of the Interior. Our concern and support is no less for the big Interior waterfowl refuges on the Yukon, Koyukuk, Innoko and Selawik Rivers, major sources of the loons, terns, grebes, shorebirds and songbirds as well as ducks that winter in the western states. Of particular concern is the maximum size refuge on the Yukon Flats where summer bird densities are greatest.

We urge the maximum size for proposed refuges in all these valleys. If economic conditions change or new discoveries of the future indicate Refuge Status for these lands is no longer warrented, some future Congress can make that decision.

The Pacific Seabird Group is largely composed of professional people in the western coastal states although there is membership in more than 18 countries.

This resolution has been sent to appropriate congressional leaders by the Chairman.

Tufted Puffins



## BULLETIN BOARD

Annual Meeting, Pacific Seabird Group, 13-16 December, 1978.

Call for Papers

Members and others are invited to submit abstracts of papers to be presented at the paper sessions on 14 and 15 December, 1978. To apply for a place on the program, potential contributors must submit an abstract as detailed below to Ralph W. Schreiber, Natural History Museum, 900 Exposition Blvd., Los Angeles, CA 90007. Applications will be reviewed by an ad hoc committee. Completed applications must be received by Schreiber by 10 November, 1978. Please indicate the amount of time you desire for your talk, not more than 30 minutes. Speakers requiring any audio visual aid other than a Kodak Carousel Projector should plan to supply it themselves.

Your abstract (including title, author, address and text) MUST be typed on an otherwise blank page of 8½ x 11 inch paper and MUST fit within a six-inch wide by four-inch high space. It must be error free, camera ready copy, in the following format, left-margin justified:

THE MARINE BIRDS OF THE CENTRAL PACIFIC

Cook, James. Natural History Museum, Los Angeles, CA 90007.

This paper deals with the super collection of magnificent feathered creatures that gave their all for our specimen storage cases...

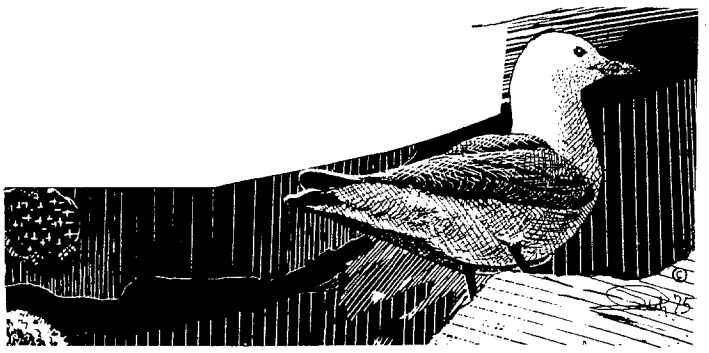
Remember that you are giving a verbal presentation of some of your research results and plan the visual presentation accordingly. We will enforce the time limits so as to have an efficient meeting.

Please inform non-PSG members that they are cordially invited to participate in the meeting and program.

A tentative schedule of events is attached; in a month or so you will receive pre-registration forms.

See you at Asilomar!

Ralph S. Schreiber
Program Chairman



Kittiwake

## Colonial Waterbird Group, Annual Meeting

The Linnaean Society of New York, as part of its centennial celebration, will host the Second Annual Meeting of the Colonial Waterbird Group at the American Museum of Natural History in New York City on October 20-23, 1978. The Linnaean Society will sponsor a symposium of invited papers on Factors Affecting Productivity in Colonial Species on October 21 and the morning of October 22. Submitted papers will be given on the afternoon of October 22 and on October 23. For information on contributing a paper, write to Dr. P. A. Buckley, North Atlantic Regional Office, National Park Service, 15 State Street, Boston, Mass. 02109.

The most convenient hotel is the Excelsior, 45 West 81 Street, New York, New York 10024 (212-362-9200), which advises immediate reservations. Single rooms there are $20 per day.

## Symposium on Birds of the Sea and Shore

## November 1979 University of Cape Town

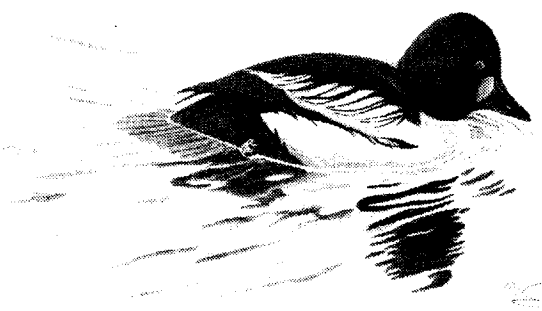
Organized by:

The Southern African Seabird Group
The Western Cape Wader Study Group and
The Cape Bird Club

A five-day symposium, consisting of three days of formal sessions and two days of excursions, will be held at the University of Cape Town, South Africa during 19-23 November 1979. The theme of the symposium will be "Birds of the Sea and Shore" and papers will be given on seabirds and waders, both inland and coastal. Excursions are planned for an offshore seabird breeding island, Langebaan Lagoon and a seawatching cruise.

Persons interested in attending the Symposium should write to the Organizing Secretary, Mr. G. D. Underhill, 12 Roseberry Road, Mowbray 7700, South Africa, for further information.

Those persons wishing to deliver a paper should also write to Mr. J. Cooper, Southern African Seabird Group, c/o FitzPatrick Institute, University of Cape Town, Rondebosch 7700, South Africa, giving details of their proposed paper. Abstracts will be requested at a later stage. It is intended to publish the formal proceedings as a special supplement to The Cormorant, Bulletin of the Southern African Seabird Group.





Common Goldeneye Male

Non-consumable Resources of the California Current.

A one-day symposium entitled "Non-consumable Living Resources of the California Current: Interactions with Consumable Resources and the Methods of Their Exploitation" will be held at the USC Conference Center in Idyllwild, California on October 31, 1978. The symposium is part of a three-day California Cooperative Oceanic Fisheries Investigations (CalCOFI) Conference. CalCOFI is a consortium of fishery managment and research institutions in California, and includes the California Department of Fish and Game, the National Marine Fisheries Service, and the Scripps Institution of Oceanography, among others. Mexico's Instituto Nacional de Pesca (INP) has recently become an informal member of CalCOFI, and Mexican fishery managers will therefore also be in attendance.

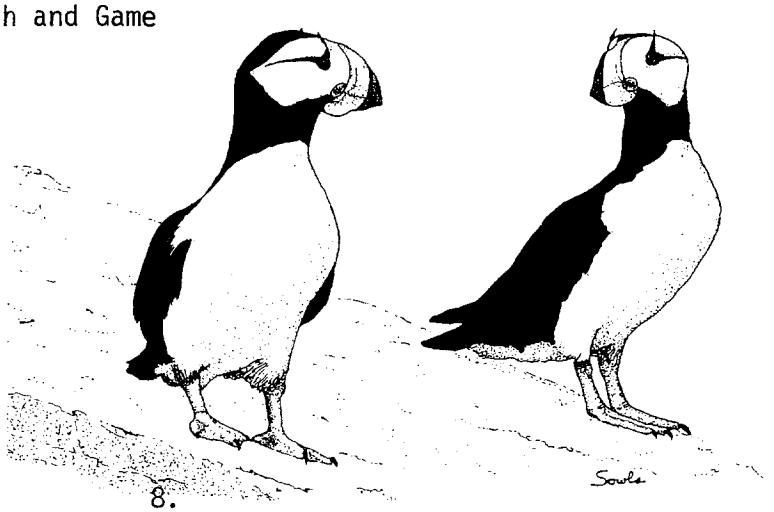
The purpose of the symposium is to engender greater awareness, appreciation and consideration by fishery management of those resources we cannot, or have chosen not to consume. These "non-consumable" resources often interact strongly with consumable resources, and in many cases, they may interact with harvesting operations.

A major portion of the symposium will be devoted to seabirds. The following speakers will be presenting papers: David Ainley, Pt. Reyes Bird Observatory, (trophic relationships and fishery interactions); George Hunt, Jr., UC Irvine (Santa Barbara Island avifauna); Daniel Anderson, UC Davis (brown pelican); and Paul Kelly, California Department of Fish and Game (alcids). Other portions of the symposium will include marine mammals, lower trophic levels and trophic structure of the ecosystem.

For further information, contact Alec MacCall, Convenor, CalCOFI Symposium, California Department of Fish and Game, c/o Southwest Fisheries Center, P.O. Box 271, La Jolla, California 92038.

Thank you,

Alec D. MacCall
California Department of Fish and Game




Horned Puffins

Current Literature

Harper, P. C. and F. C. Kinsky. 1978. Southern albatrosses and petrels. Victoria University Press, Box 2919, Wellington, New Zealand. NZ $4.95 by boat or NZ $5.95 by air. This is a new edition of the 1974 pocket guide with new identification plates, a simplified key and more photographs. Includes all species likely to be seen south of the Tropic of Capricorn.

Ogi, H. and T. Tsujita. 1977. Food and feeding habits of common murre and thick-billed murre in the Okhotsk Sea in summer, 1972 and 1973. Res. Inst. N. Pac. Fish., Hokkaido University. Spe. Vol., 459-517. This important paper is based on large sample sizes. Many of you may remember the preliminary report Dr. Ogi gave on this subject at the first PSG Annual Meeting in 1974 (see PSG Bulletin Vol. 2, No. 1 pp 29). The paper is in English. Possibly reprints would be available from Haruo Ogi, Research Institute of North Pacific Fisheries, Faculty of Fisheries, Hokkaido University, Hakodate, Hokkaido, 041, Japan.

Ohlendorf, H. M., R. W. Risebrough, K. Vermeer. 1978. Exposure of marine birds to environmental pollutants. U. S. Department of the Interior, Fish and Wildlife Service. Wildlife Research Report 9. 40 pp. This paper covers petroleum hydrocarbons, organochlorines, heavy metals and plastics. A summary of the paper was presented at the 13-15 May 1975 international symposium on "Conservation of Marine Birds of Northern North America" in Seattle, Washington. This is an overview based on over 300 cited references.

Pacific Seabird Group Bulletin. Clearance sale of back issues through Vol. 4, No. 2. One dollar each from Dr. David A. Manuwal, Treasurer, Pacific Seabird Group, Wildlife Science Group, College of Forest Resources AR-10, University of Washington, Seattle, Washington 98195.

Ed. Note. This is a real bargain. I recently spent a pleasant evening reading the whole set and found it a very rewarding review of recent seabird events.

Rickert, Jon E. 1978. A Guide to North American bird clubs. Avian Publications Inc., P.O. Box 310, Elizabethtown, Kentucky 42701. $10.75 U.S. and $12.45 Canadian includes postage. Reputed to be "the most complete bird finding sourcebook ever compiled". Includes "835 clubs from Alaska to Panama. Favorite birding areas of each club. Club locator maps for U.S. and Canada. Select list of local birding contacts with phone numbers. Membership and newsletter information. Rare bird alert numbers. Local bird finding guides and other publications. And more."

Dan Anderson says this is a worthwhile book and that PSG is included.

Letters to the Editor

March 24, 1978

Dear Editor:

I would like to see a "Letters to the Editor" column in the PSG Bulletin. I believe the column could provide a means of increasing communication among seabird researchers. As an example, Martin Cody's provocative article, "Coexistence, Coevolution and Convergent Evolution in Seabird Communities", appeared in Ecology in the winter of 1973 but it was the winter of 1976 before Jean Bedards' thoughtful review appeared in that same journal. The original article was the topic of heated debate among seabird researchers and an exchange of letters to the editor could have helped to place the paper in perspective and perhaps very quickly generated studies to test some of the hypotheses suggested by Cody.

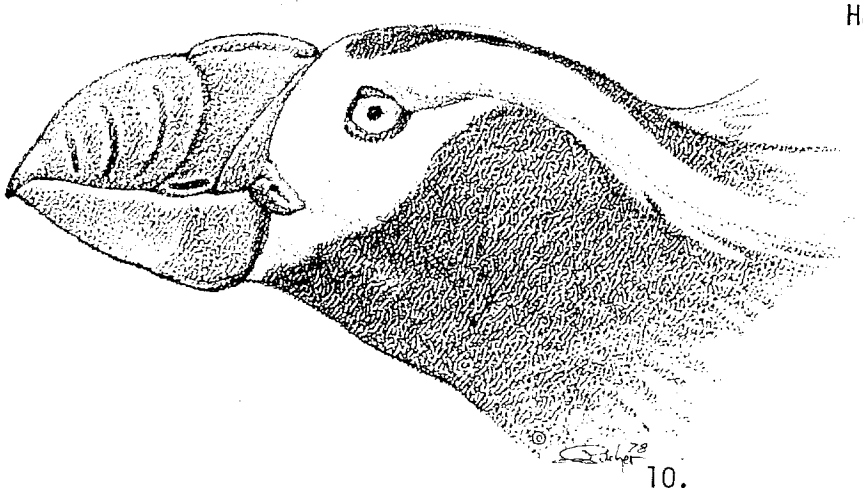
This column would be ideal for drawing attention to research problems. As an example of this, I am enclosing a letter on the need for research on the at-sea behavior of Alcids, especially of adult-chick groups for those having semiprecocial young.

Finally, the column could be used to identify threats to marine ecosystems and their biota and perhaps alert the membership to possible topics for policy statements and early action on matters of concern.

Thanks for your consideration of the above proposal.

Sincerely,

J. Michael Scott
Biologist-in-Charge
Mauna Loa Field Station
Post Office Box 44
Hawaii National Park
Hawaii 96718



Tufted
Puffin

March 24, 1978

Dear Editor:

The Alcids comprise one of the most abundant and diverse group of marine birds breeding in the north Pacific. They have been the subject of much research. One hundred one papers were presented at the first three PSG meetings; 27 of these dealt with Alcids. However, only one of these papers was on the at-sea behavior of adult-chick groups of the seven species of Alcids (razorbill, Alca torda, thickbilled murre, Uria lomvia, common murre, U. aalge, Xantus' murrelet, Endomychura hypoleuca, Craveri's murrelet, E. craveri, ancient murrelet, Synthliboramphus antiquus and Japanese murrelet, S. wumizusume) that have semiprecocious young. During the flightless period at sea they are particularly vulnerable to oiling and starvation as the result of local failures in the food supply.

Because of their extreme vulnerability we need to obtain as much information about their at-sea behavior as possible so that human manipulations of marine ecosystems will have minimal impact on their numbers.

Questions that should be asked are:

1) At what age do they leave the nesting colony?
2) How long do they remain flightless?
3) How long are they accompanied by an adult?
4) How many adults accompany each chick?
5) What is the sex and age of accompanying adult(s)?
6) What are the dispersal patterns of accompanied adults vs. unaccompanied adults?
7) What is the mortality of accompanied adults vs. that of unaccompanied adults?
8) How far from the nesting colony does the adult/chick group move? At what speed?
9) How does density of adult/chick groups at sea vary with distance from the colony?
10) What percent of any year's production can be found in any given area?
11) How are feeding activities shared between the chick and accompanying adults?
12) How does the nature of the pair bond vary with food availability?
13) How does dispersal from the colony vary with oceanographic conditions, i.e. upwelling, water depth, etc.?

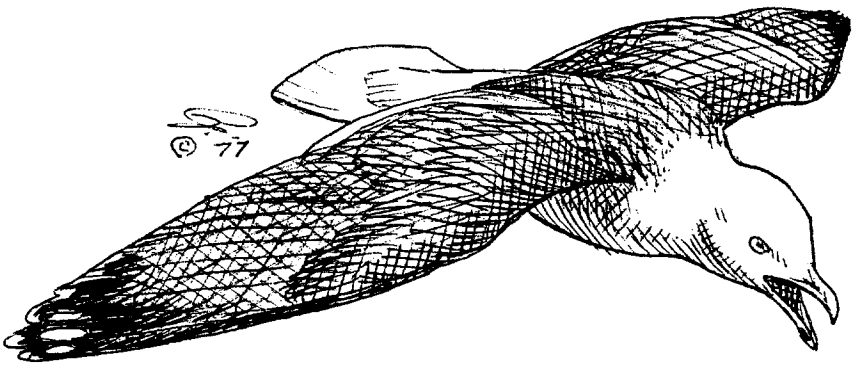
Individuals censusing marine birds at sea could add much to our knowledge by simply recording immature birds at sea, how many (if any) adults they were associated with, the plumage of all birds and the size of the immature relative to that of the adult. This information, when combined with data on oceanographic conditions, water depth and distance to nearest land and nesting colony, would provide much of the information needed to answer questions 3, 4, 6, 8, 9, and 10. The other questions are best answered by close observation of adult/chick groups at sea and through use of radio tags.

I am sure the members of PSG can think of additional questions that need to be asked. Answers to questions 6-10 are particularly important when one is attempting to assess the importance of an area to a species. We need to begin quantifying the importance of areas based on the percentage of a species population that occurs in an area.

Sincerely,

J. Michael Scott
Biologist-in-Charge
Mauna Loa Field Station
Hawaii National Park

Lesser Black-backed Gull




14 September 1978

John C. Ogden
National Audubon Society
115 Indian Mound Trail
Tavernier, Florida 33070

Dear John:

I am writing to firm up some of the items we discussed at the last AOU meeting.

(1) Proposed consolidation of Pacific Seabird Group and Colonial Waterbird Group is a subject that will need considerable discussion. Could you bring it up at your next council meeting this October? What you need to do now is feel out the council

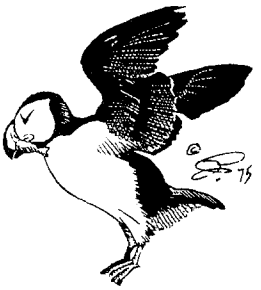
members and general membership. We can do the same at the PSG meeting later on. This leads to a joint meeting of the two groups sometime in the next year or two.

(2) A joint meeting of the PSG and CWG. This is a good idea even if both groups decide that a consolidation is not feasible. The wheres and whens need to be hashed about.

Best Regards,

Daniel W. Anderson
Chairman, PSG

May 26, 1978



Horned Puffin

Dr. W.R.P. Bourne
c/o Secretary General
Rolf Nohring
Hardenbergplatz 8.
Zoologischer Garten
D-1000, Berlin 30,
West Germany

Dear Bill:

Your request for comments for the International Ornithological Congress arrived late (May 26); therefore I had no time to consult with the Pacific Seabird Group members on the proposal I make below.

Proposal for International Marine Bird Congress

With increasing numbers of sea and shorebird studies and the growth of regional seabird groups in Europe, North Pacific, Australia and South Africa and one projected for eastern North America, there appears to be sufficient international interest for the possible establishment of an International Marine Bird Congress. Although there is an established International Ornithological Congress, that organization has become too general and extensive to be an effective international forum on marine bird matters. Many students on marine birds may go out of their way to attend an International Marine Bird Congress but not an International Ornithological one. A Seabird Group, on the other hand, represents our very specific interests, but is usually too local to serve as an international platform of exchange of information. The various Seabird Groups are ideally equipped to host an International Marine Bird Congress which could be held every four years. If Seabird Group members are in favour of establishing their own Congress, I would be willing to assist with organizing the first international meeting in Victoria, British Columbia by 1982.

Yours sincerely,

Keen Vermeer
Research Scientist

March 28, 1978

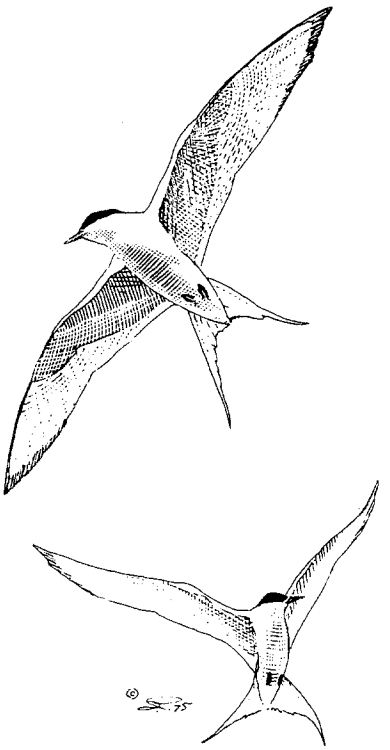
Honorable Robert Leggett, Chairman
Subcommittee on Fisheries, Wildlife Conservation
and the Environment
1339 Longworth House Office Building
Washington, D. C. 20515

Dear Mr. Leggett:

The Pacific Seabird Group (PSG) was formed in 1972 to foster better communication among Pacific seabird researchers. Among its members are professional scientists and amateur seabird enthusiasts from the United States, Canada and 18 other nations.

We have followed with great interest efforts to protect critical wildlife habitats in Alaska and are in support of the establishment of new National Wildlife Refuges and National Parks through the D-2 lands legislation.

An offshore boundary has been part of several proposals pertaining to Alaska lands. Former Interior Secretary Morton proposed a seaward boundary of three miles (from mean high tide, subject to valid, existing rights) in his original D-2 recommendations. Mr. Dingell's proposed National Wildlife Refuge System Organic Act of 1975 (94th Congress: H.R. 1522) included offshore boundaries of one to five miles for new coastal refuges in Alaska. More recently, the late Senator Metcalf proposed seaward boundaries of six miles for all new refuges and parks in his Alaska National Interest Lands Conservation Act, S. 1500.



Arctic Terns

Three existing National Wildlife Refuges (Nunivak, Semidi and Simeonof) and one National Monument (Glacier Bay) in Alaska presently have offshore boundaries. An additional 22 National Park System units outside Alaska have offshore boundaries. Thus, offshore boundaries would appear to be an established approach to protecting coastal resources.

Seabirds - murres, puffins, kittiwakes, cormorants and others - are dependent on nearshore waters as places for feeding, rearing their young, staging and resting during migration and, in some cases, wintering. Some waterfowl species (eiders, scoters, brant, etc.) also make extensive use of nearshore salt water.

Pollution of coastal waters threatens seabirds directly through contact with oil, but also indirectly through reductions in the populations of food organisms. Of as much concern as pollution are disturbances at colony sites.

Because of their low reproductive rates, losses due to disturbances or pollution could mean recovery rates of many years for some seabird populations.

It is impossible, of course, to include within a seaward boundary all the waters used by seabirds (even the 200 mile limit might be insufficient for these wide-ranging birds!). A boundary at the six mile line appears to be justified. Research at Buldir Island in the western Aleutians showed that 54 percent of all seabirds occured within six nautical miles of shore between May and September. Furthermore, a U.S. Fish and Wildlife Service "Progress Report on Seabird Surveys: Cape Lisburne to the Barren Islands (May 1975)" indicated that from 68 to 95 percent of the birds recorded on aerial surveys near colonies were within six miles of shore.

Marine mammals (e.g., Steller's sea lions, sea otters and harbor seals) also make extensive use of the coastal zone.

Offshore boundaries for new coastal refuges and parks in Alaska may be an appropriate mechanism for achieving sensitive management of nearshore waters.

Thank you for considering our views. We hope the information provided herein is of use in your consideration of any D-2 legislation. Please make the contents of this letter available to the members of your committee.

Sincerely,

Daniel W. Anderson
Chairman, PSG

## SHORT ARTICLES

# THE LAYSAN ALBATROSS BREEDING IN THE OGASAWARA ISLANDS

by

Hiroshi Hasegawa

Department of Biology, Faculty of Science,

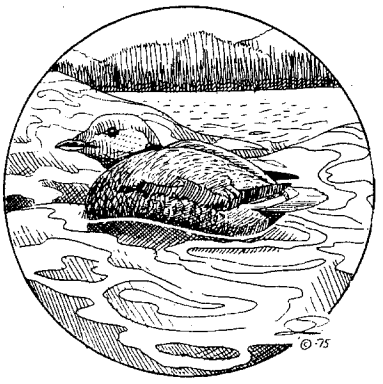
Toho University

Miyama, Funabashi, Chiba 274 Japan

The Laysan albatross Diomedea immutabilis is the most abundant among the three albatross species in the North Pacific Ocean and now breeds almost exclusively in the Hawaiian Islands. Formerly it bred on Torishima of the Izu Shotō, Minami-torishima (Marcus I.), Johnston Island and possibly Wake Island, but there have been no recent breeding records from these or adjacent islands in the western North Pacific Ocean (Rice & Kenyon, 1962. Auk, 79:365-386; Palmer, ed. 1962. Handbook of North American birds. Vol. 1; King, ed. 1974. Smiths. Contr. Zool. No. 158; Orn. Soc. Japan, ed. 1974. Checklist of Japanese birds).

A recent report by Y. Kurata (Misc. Rep. Yamashina Inst. Ornithol., 10:in press, 1978) of Diomedea immutabilis breeding in the Ogasawara (Bonin) Islands is therefore of great importance because it represents the only breeding of this species away from the Hawaiian Islands. Kurata's paper is in Japanese and what follows is a synopsis of his observations.

Three Laysan albatrosses were first observed on Torishima (27°40'30" N, 142°07'20"E), a small island a few hundred meters west of Mukojima (Keetaa I.) in the Mukojima Rettō, on 15 January 1976. Seven birds were seen there on 30 January 1976, but there were no indications of breeding in that season. During the next season, two Laysans were there on 7 January 1977, and a fledgling was found on 13 June 1977. In the current 1977/78 season, nine birds were observed on 14 January and 11 birds were seen on 26 January. Three of these were incubating eggs. At a visit on 6 February, two hatchlings, one egg and eight apparent-adults were present. On 16 February, three chicks and 21 apparent-adults were found. The



Kittlitz's Murrelet

Laysan albatrosses have thus bred on this island for at least two successive seasons. For further details and photographs see Kurata's original paper.

"White albatrosses" have often been sighted by fishermen at sea around the Mukojima Retto and, because there is no history of immutabilis breeding in the Ogasawara Islands, it has been supposed that the birds might possibly have been the short-tailed albatross, D. albatrus. This raised hopes of another breeding ground for a rare and endangered species which breeds only on Torishima of the Izu Shotō 450 km to the northwest (for recent status of albatrus see Hasegawa, 1977. PSG Bulletin 4(2). 1978. Misc. Rep. Yamashina Inst. Ornithol. 10:in press). Kurata's confirmation of the immutabilis colonization on the Mukojima Rettō clearly makes such speculation less plausible, although still a hoped-for possibility in the future.

Kurata observed that the black-footed albatross D. nigripes is also breeding on Mukojima-Torishima and some other islands. The two albatross species are nesting on small off-lying islands undisturbed by introduced goats. But he believes that for the successful colonization of the Laysan albatross and to promote the breeding of black-footed albatrosses on these islands, management of goat populations to an appropriate level is greatly needed now.

I would like to thank Mr. Yoji Kurata of the Ogasawara Fisheries Center at Chichijima, the Ogasawara Islands, Tokyo, for his kindness in allowing me to communicate the results of their observations in this bulletin, and I am very grateful to Dr. W. L. N. Tickell for his kind criticism on the earlier draft of this note.

Crested Auklet

# PSG MEETINGS AID FEDERAL MARINE BIRD PROGRAMS

by

Calvin J. Lensink

U.S. FWS Office of Biological Services, Anchorage, Alaska

Seabirds were identified as "Alaska's Most Neglected Resource" in a paper by Sowl and Bartonek (1974). This neglect was the focus of an international symposium on marine birds sponsored by the National Resources Council of America, the U.S. Fish and Wildlife Service, the Canadian Wildlife Service, the National Audubon Society and the National Wildlife Federation in Seattle during May, 1975. That this neglect did not relate solely to Alaska nor reflect lack of interest by ornithologists was indicated by the prior establishment of the Pacific Seabird Group in December, 1972, and its subsequent rapid growth. For example, the first Bulletin of the PSG published in January, 1974, listed a membership of 152 persons; the present membership is more than 250 representing 20 countries.

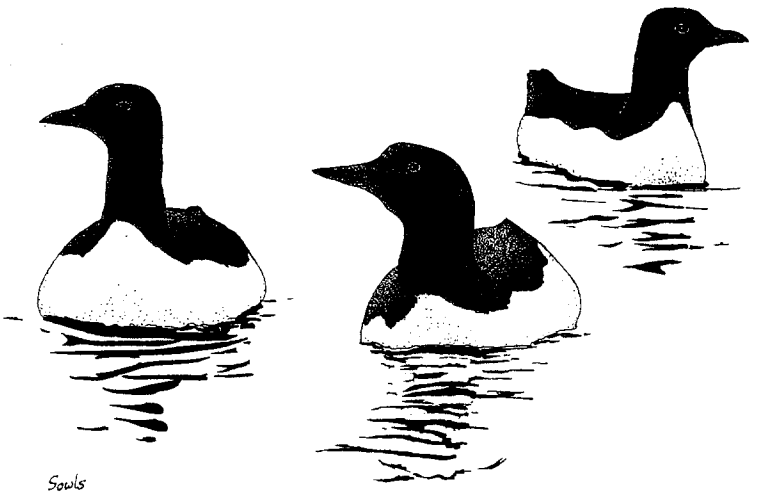
This Fourth Annual Meeting of the PSG rather dramatically indicates that seabirds are no longer neglected and that current interest in seabirds is much greater than that indicated in the first bulletin. The forty-three papers given at this conference touch on all subject areas that the 1974 membership considered to be of primary importance. These included in order of priority: census and cataloguing of breeding colonies, development of uniform and effective census techniques, studies of life history and biology, providing clearinghouse for informing members of research needs and opportunities, conservation of the marine environment, publication of a newsletter and providing an advisory service to government and industry, as well as several items of lesser priority.

The rapid growth of the Pacific Seabird Group and the broad interest in its annual meetings have been of key importance in promoting rapid flow of new information, sharing of new techniques, and the identification of work being performed by various scientists or institutions. These functions have been a major benefit to the U.S. Fish and Wildlife Service which has a primary responsibility for protection of marine birds but has not had substantial funding for that purpose. These functions of the PSG and the Service's urgent need for information on marine birds for evaluating the potential effects of coastal development programs justify the Fish and Wildlife Service assistance in publishing this issue of the PSG Bulletin.

Looking to the future, I am somewhat pessimistic regarding our ability to maintain the level of effort or progress we have made in research on seabirds over the past four years. A review of the papers presented at the Fourth Annual Meeting indicates that in 26 of 43 instances, the

research was funded all or partially by the Bureau of Land Management (BLM) or the National Oceanic and Atmospheric Administration (NOAA) as part of a program to provide information for evaluating the possible effects of petroleum development. Only six were funded all or in part by the U.S. Fish and Wildlife Service and 13 were funded from various other sources. The BLM and NOAA programs have already been significantly reduced and further reductions are anticipated.

Beginning in fiscal year 1980, there is some hope that U.S. Fish and Wildlife Service funding for research on marine birds may be increased. It is unlikely, however, that such funding will be adequate to meet the many urgent needs for information which arise from the rapid development of our coastal regions, and particularly the development of petroleum resources of the outer continental shelf. In view of this rather bleak analysis, it seems obvious that interest in seabirds generated by the PSG and the coordinating functions it performs will be of even more importance in the coming years. The PSG and its members will continue to play a crucial role in maintaining a viable National program of research on marine birds.



Murres

# COMMENTS ON THE FOURTH ANNUAL MEETING OF

# THE PACIFIC SEABIRD GROUP, VICTORIA, BRITISH COLUMBIA

19-21 January, 1978

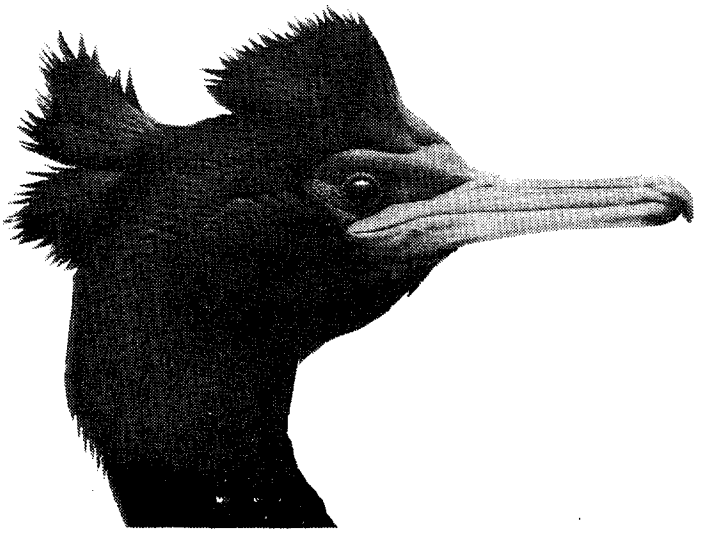
Kees Vermeer, Program Chairman

Preparations for the above meeting were hectic. David Manuwal, in the dual role of chairman and treasurer, and myself as secretary and program chairman worked industriously to bring all the pieces together for a smooth functioning of the proceedings. Wayne Campbell and assistants of the Provincial Museum and Gary Kaiser with personnel of the Canadian Wildlife Service looked after the arrangements. George Hunt and Duff Wehle organized the workshops on kittiwakes and puffins respectively, while Bill Drury and Spencer Sealy agreed to summarize/the workshop proceedings. Museum management provided free facilities and the British Columbia Government a free banquet for our members. The weather cooperated with sunshine.

Forty-three papers were presented at the meeting, ranging from topics on feeding and reproductive biology to surveys on birds at sea. Extensive information on tufted puffins and black-legged kittiwakes breeding in Alaska was presented for the first time. In addition there were many general papers to hold everybody's interest. The quality of the papers ranged from good to excellent. In no previous PSG meeting have I observed such a wealth of information on seabird ecology becoming available immediately after field observations. Many members who forwarded abstracts changed the original contents as last minute statistical analyses altered their interpretations drastically. Vast and new data on puffin and kittiwake ecology from Alaska was especially impressive. Members who did not attend, therefore, lost a first rate opportunity to acquaint themselves quickly and efficiently with information which will take much longer to obtain through present snailpace production of literature output in an insufficient number of journals on avian ecology. I am somewhat impatient in this connection with our seemingly lukewarm attitude towards a new journal on seabird and shorebird ecology which has been suggested for PSG several years ago. We should not wait any longer for another group with similar interests which may or may not join us to boost membership. Now is the time for action! With an efficient journal in place, membership will undoubtedly increase, which will further facilitate publication. Moreover, authors or their institutions can contribute financially to offset publication costs. The latter approach is now a common survival method adopted by many North American journals.

Among several topics suggested in Victoria for the next annual meeting of PSG was a proposal for a workshop on the feeding ecology of seabirds, particularly seaducks. Compared to other topics, PSG has somewhat ne-

glected the subject. Perhaps the time is ripe that we approach our seabird studies more from the point of ornithological oceanography. Oceanographers in the chemical, physical, meteorological and marine biology fields frequently study oceanic phenomena from the "bottom-up", i.e., they try to relate phenomena observed in the physical marine habitat to the lower trophic levels of the marine ecosystem. Our approach could be unique, compared to that of other oceanographers if we take the "top-down" approach. With the latter approach we can use data on distribution, occurrence, food and growth of seabirds to interpret the type and quantity of marine invertebrates, plants and fishes and sometimes substrate available to the birds in the marine habitat. The "top-down" approach may be a unique way to monitor oceanographic phenomena in the opposite direction which other oceanographers take. Perhaps we could discuss the possibilities of such an approach in our next workshop on feeding ecology of seabirds.



Red-faced Cormorant

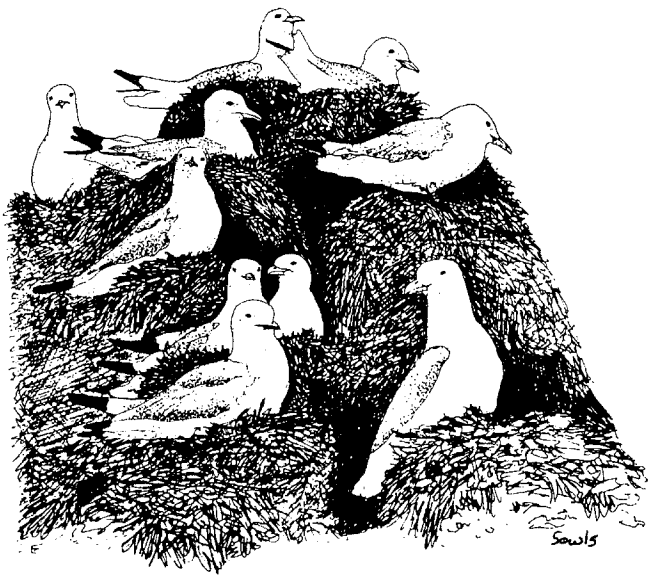
KITTIWAKE WORKSHOP SUMMARY

William H. Drury, Regional Representative "Inland"

On January 20, 1978, a workshop was held during the PSG meetings at the Provincial Museum, Victoria, British Columbia. The purpose was to allow the many biologists working on contracts with NOAA on the Alaskan outer continental shelf to compare results of their studies of black-legged kittiwakes (Rissa tridactyla).

George Hunt, in organizing the program of the workshop, emphasized the importance of concentrating on those data which would allow comparisons to be made among the regions studied: Cape Lisburne to Saint Lawrence Island or the Bering Strait; the Pribilof Islands and Cape Pierce in the southern Bering Sea; the southwest Gulf of Alaska including Kodiak Island; and the northeast Gulf of Alaska or Prince William Sound. Hunt posed the following questions:

Is the output of the colony or area consistent from year to year or highly variable?
Is there evidence of marked influence from weather, ice, food or predators?
Which influences hit hardest at which points of the reproductive cycle?
Are they different from one region to another?
Are they tied to specific food types?



Kittiwakes

Summary of the Workshop

There is a gradient in the date of the start of egg-laying from early in the Gulf of Alaska to late in the Bering Strait. There is apparently also an historical change in the schedule, at least at Cape Thompson, where, in the late 1950s and early 1960s, clutches were begun earlier than during the period of the present studies (1975-1977, Table 1).

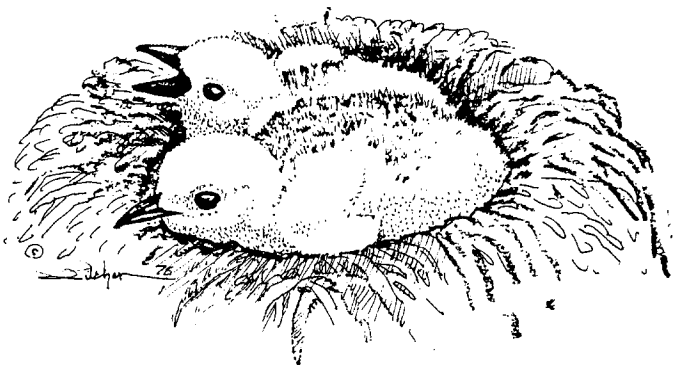
There are also regular variations in the percent of nests in which eggs are laid from a high percent receiving eggs in the Gulf of Alaska to a low percentage (less than 25 percent in some years) and smaller clutches in the Bering Strait region. Again, historical information suggests that in the late 1950s and early 1960s in the Pribilofs and Cape Thompson, clutch size may have been larger than at present (Table 1).

A correlation of clutch size with date, in which clutches are progressively smaller as the year advances has been observed among many species of birds including song birds and is well illustrated in the reports of breeding of black-legged kittiwakes in several parts of the species' range (Table 2). The reasons for this rather remarkable correlation are not clear but the correlation suggests that clutch size is not simply affected by the amount of food which the female can gather during the egg-laying period.

Important differences exist in the regularity of reproductive success in different geographic regions. These differences have, in the three years of these studies, usually been expressed in the number of eggs hatching per nest either because fewer eggs were laid or because eggs failed to hatch. Egg-loss, a major source of reproductive failure at least in the north, characteristically occurs in the first week after laying, as if the conditions depressing clutch size have a continuing influence on the intensity of the incubation drive. In some regions there have been years of failure and years of success (high productivity) in which some pairs raise two chicks. In other regions, reproductive performance is consistent and moderate and no parents have been able to raise twins (the Pribilofs).

The reasons for reproductive failure have differed in different regions. In the north, absence of food has been suggested to be the primary influence, while in the Gulf of Alaska predators are reported to be the proximate cause of failure. In Prince William Sound, predation by bald eagles and common ravens persisted into the early chick stages. Observations of birds on the nest suggest that lack of attentiveness and even absence from the nest during the early stages of incubation supply the opportunities for eggs to be taken. This lack of concentration and the absences may reflect difficulty in finding food. Observations that certain individuals are regularly present and do raise young during a general failure argue that individual differences and capabilities are important. The behavior of many birds during the period of failure resembles that of young birds nesting for the first time. This in turn supports Lack's suggestion that progressive improvements in feeding skills explain the increase in clutch size and breeding success with age and experience among seabirds.

The food used by kittiwakes varies in important ways among the regions. In the Gulf of Alaska, kittiwakes depend heavily on capelin (Mallotus villosus), which is evidently a reliable resource. The use of capelin



Young Kittiwakes

is augmented by sand lance (Ammodytes hexapterus) which appears about the time the young hatch. In the southern Bering Sea, kittiwakes use a diverse food supply without depending heavily on any single species. In the northern Bering Sea and Chukchi Sea, different colonies use different foods, but capelin is unimportant. Arctic cod (Boreogadus saida) is important in the Cape Thompson area. In the period of observation, 1975-1977, breeding success has depended on the appearance of sand lance in the feeding range of breeding birds and kittiwakes become conspicuous commuting to the schools of this fish as they move along shore.

Kittiwakes are evidently opportunists in their feeding. They will become specialists if suitable prey is available. Whether a colony has a consistent or a "boom/bust" economy seems to depend upon the kinds and numbers of small fish and crustacea as well as the phenology of those organisms in the surrounding seas.

Black-legged kittiwakes breeding in other parts of their circumpolar range, e.g., the northeast Atlantic where this species is reproducing well and the population is increasing, lay earlier and lay larger clutches than in Alaska. The observations reported in this workshop agree with those of other workers who have concluded that timing of laying, the percentage of nests receiving eggs and the size of clutches are all related to the abilities of the birds to get food. These results also suggest that the northern Bering Sea and Chukchi Sea populations may presently be subject to some stress due to food shortage. Nevertheless, this northern region supports some large colonies (20,000-35,000 birds).

Studies of kittiwakes offer opportunities to examine a number of basic biological questions. The first is what is the interaction between this predator and its prey? The actual densities of the prey species in the sea is not necessarily the density/availability as kittiwakes perceive the resource. How can this relation be clarified? We can approach this

question by relating the timing of reproductive efforts to the phenology of prey species, recognizing that a series of compromises must be in effect which maximize the probability of raising young.

Secondly, our observations that the majority of birds may not lay eggs in some years and that at some cliffs in some years fewer than 10 percent may do so raises the question of what benefits accrue to those individuals who persist in occupying and defending territories when they do not lay or after they have lost their eggs. What are the implications of this behavior both as to the functions (benefits) and as to the motivational and physiological mechanisms that produce the behavior? Why do the birds continue to display, court and build nests sporadically? One presumes (on the basis of current dogma) that the birds occupy territories and persist despite failure because those actions increase the probability that they will be able to reproduce successfully at some future time over the probability that would exist if they did not occupy the sites. Is it that the behavior is "programmed" to pass through these phases because the birds are at the cliffs and it is the proper time of year? Do they repeat the behavior patterns until stimulated to proceed by the appearance of eggs? Thus if the eggs disappear, they return to the earlier behavior. Natural selection would surely remove this expenditure of energy unless it produced young in the long run.

Thirdly, what are the implications of chronic reproductive failure on population structure and regulation? How are the colonies maintained which produce one young per 5-15 nests and for which one young in two nests is an unusually high success? Among herring gulls on the east coast of North America, we calculated that parents would have to produce one young in two nests to maintain a stable population. Are the colonies in the Bering Strait region a population sink and are they maintained by immigration from elsewhere? If so, where do the immigrants come from?

On the other hand, chronic reproductive failure may imply less competition for food and nesting resources among adults and thus longer individual lives. Hubert Kluyver, in his studies of a closed population of great tits (Parus major) on the island of Vlieland off the coast of the Netherlands, showed that he could reduce adult mortality significantly by removing half of the eggs in each clutch. The entire population nested in his artificial nesting boxes. He interpreted this as suggesting that competition with young birds for home ranges in the fall and for territories in the spring shortened adult bird's life spans and thus constituted a mechanism of population regulation. Can it be that by failing to reproduce in the course of several years, the kittiwakes of the northern Bering Sea are prolonging their own lives? Does this suggest that a population crash among the kittiwakes of the Bering Strait might have very serious, long-term effects because they are not replacing themselves?

Person contributing information to the workshop:

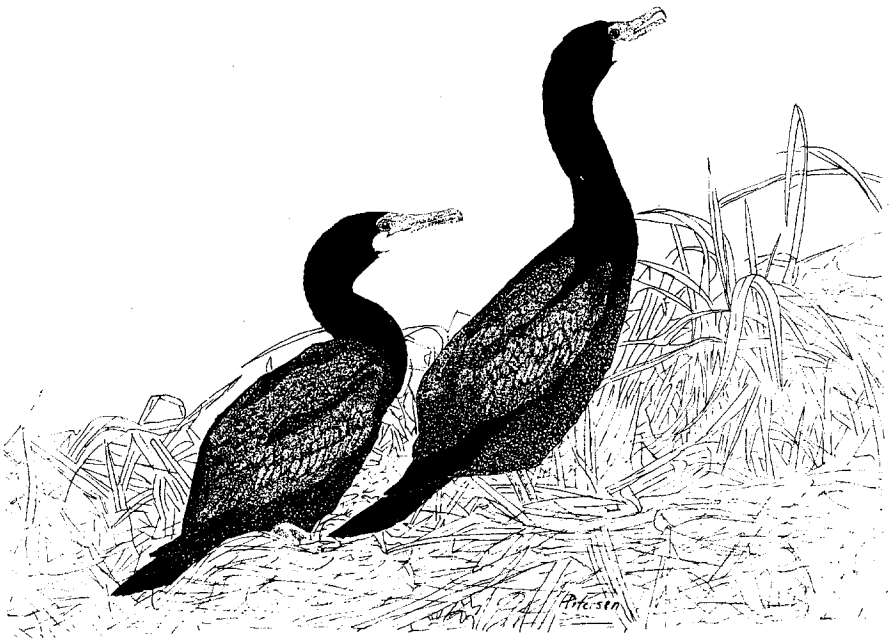
The Bering Strait, Chukchi Sea and northern Bering Sea: Alan Springer,

Dave Roseneau, William Drury, Benjamin Steele, John Eiderman, Gary Searing.

Southeastern Bering Sea, the Pribilof Islands and Cape Pierce: George Hunt, Molly Hunt, Dave Causey, Barbie Mayer, Ron Squibb, Margaret Peterson, Marilyn Sigman.

The southwestern Gulf of Alaska including Kodiak Island: Allen Moe, Henry Wehle, Martha Hatch, Lora Leschner, Brian Lawhead, Galen Burrell, Kevin Powers, George Divoky, Robert Day, Eric Hoberg, Matt Dick, Patricia Baird, David Nysewander, Gerald Sanger, Patrick Gould.

Northeastern Gulf of Alaska, Prince William Sound: Mary Sangster, David Nysewander, William Lehnhausen, Sue Quinlan, Carl Benz, David Kurhajec, Peter Knudtson.



Double-crested Cormorants

Table 1

CLUTCH SIZES OF BLACK-LEGGED KITTIWAKES IN ALASKA 1975-1977

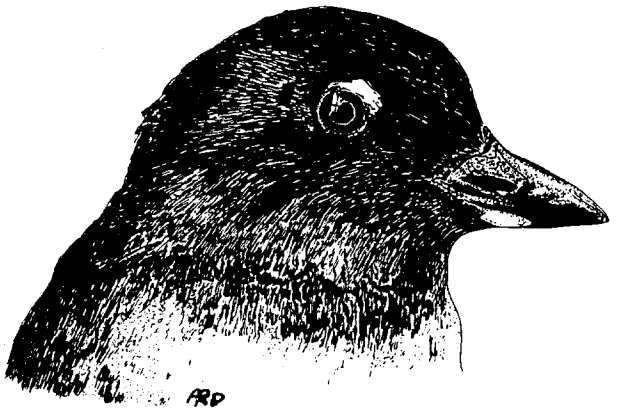
| Place | Date Clutches Begun | Date of Laying Peak | Clutch Size |
|---|---|---|---|
| Cape Lisburne | 7/1 | 7/10-16 | 1.02 |
| Cape Thompson | 7/2 | 7/5-13 | 1.1 |
| Cape Thompson (Schwartz '59-'61) | 6/21-25 | | (1.88-1.92) |
| Bluff Cliffs | 6/19-25 | 7/4-12 | 1.16-1.2 |
| Sledge Island | 6/20 | | 1.53 |
| Cape Pierce | 6/18 | 6/20 | |
| Saint Paul Is. | 6/29-7/5 | | 1.37-1.46 |
| Saint George Is. | 6/30-7/1 | | 1.36-1.46 |
| SW Gulf of Alaska | | | 1.38-1.87 |
| Kodiak Is. | 6/5-10 | 6/12-17 | 1.56-1.96 |
| NE Gulf of Alaska | 6/1-10 | 6/17-23 | 1.76 |

Table 2. Comparison of Kittiwake Clutch Sizes in England, Russia and Alaska.*

| | May | | | | June | | | | July | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1st wk | 2nd wk | 3rd wk | 4th wk | 1st wk | 2nd wk | 3rd wk | 4th wk | 1st wk | 2nd wk |
| England | 2.3-2.8 | 2.0-2.4 | 1.9-2.3 | 1.8-2.0 | 1.8-2.0 | | | | | |
| | (2.4)+ | (2.3)+ | (2.1)+ | (1.9)+ | (1.8)+ | (1.5)+ | | | | |
| Russia | 2.3 | | 2.0 | 1.5 | | | | | | |
| Alaska | | | | | 1.8 | 1.6-2.0 | 1.5-1.9 | 1.4-1.5 | 1.4-1.5 | 1.0 |

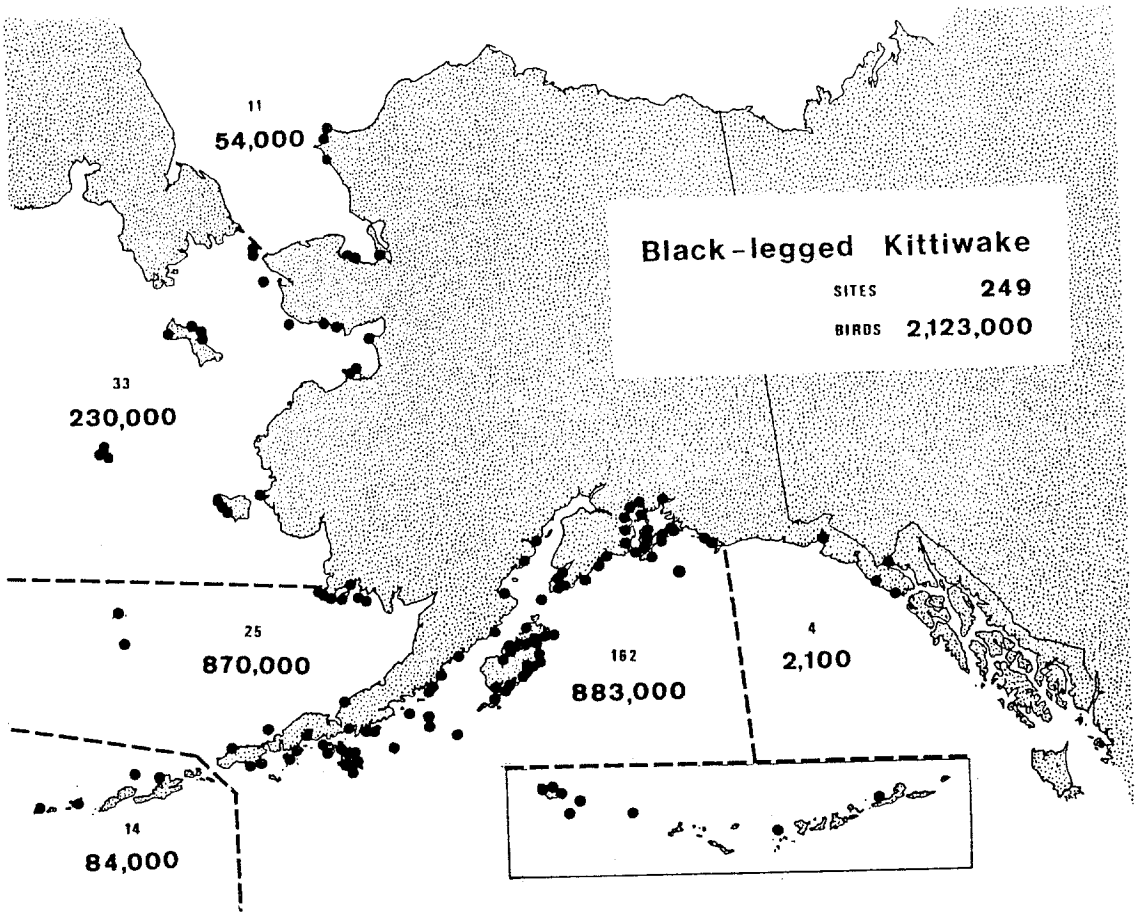
* Coulson and White (1961), Belopol'skii (1957) and Uspenski (1956).

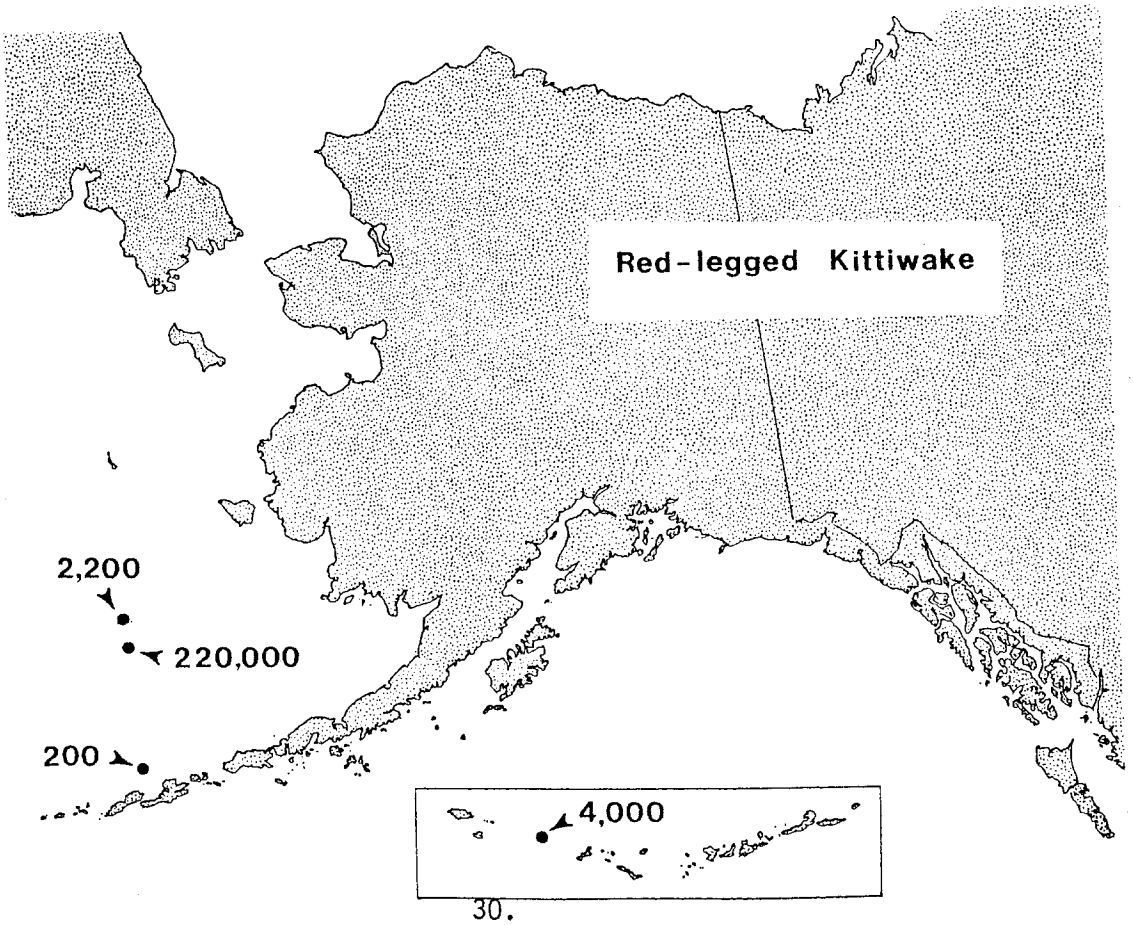
\+ Average clutch size.

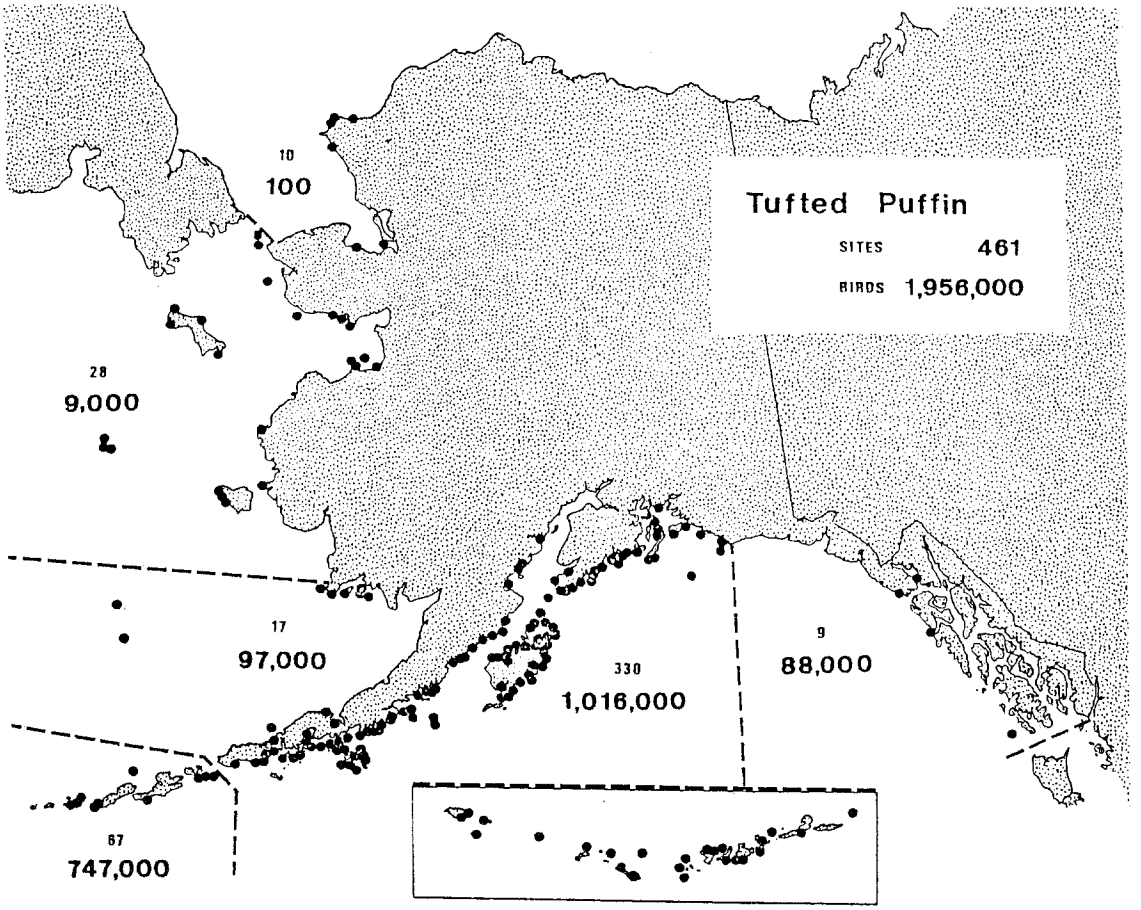


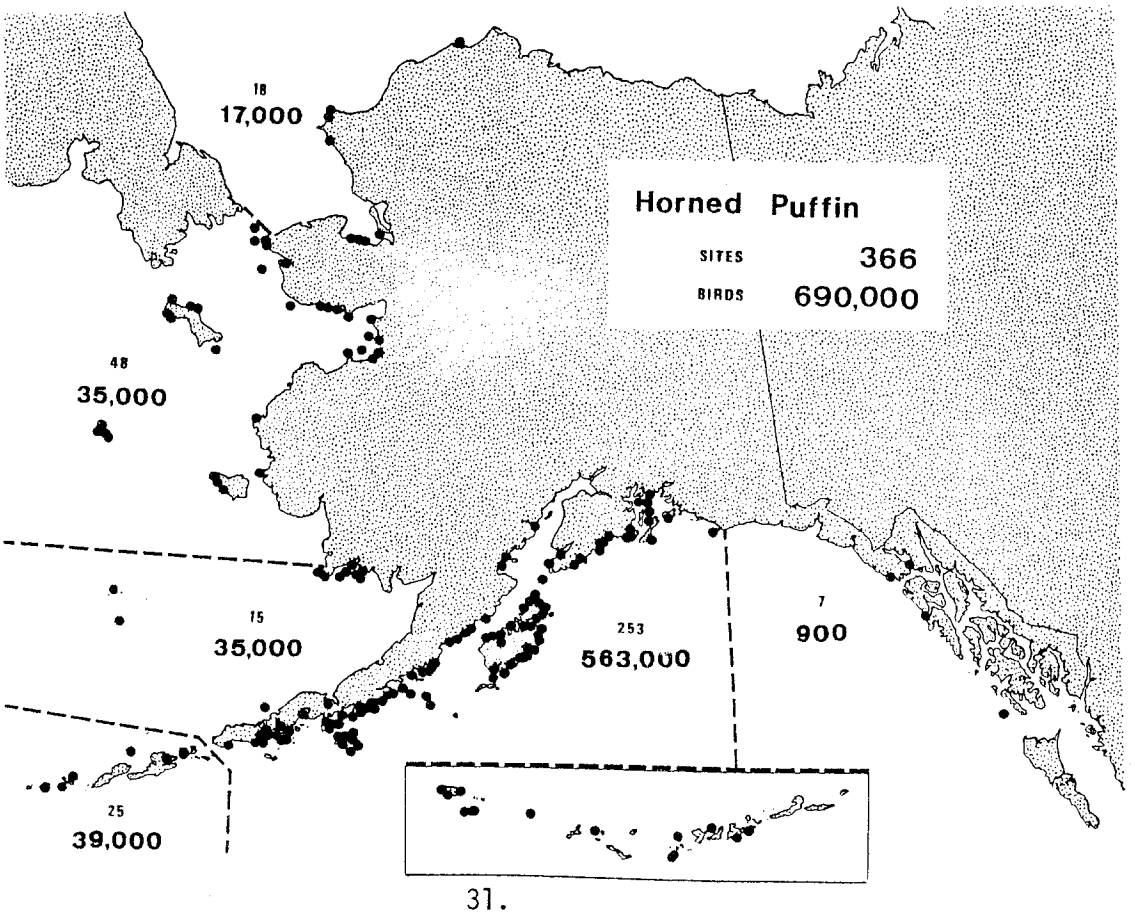
The maps on the next two pages relate to the Kittiwake and Puffin Workshops. They were graciously provided by Arthur Sowls of Anchorage. They, as the pictures here, are from the soon to be released Catalogue of Alaskan Seabird Colonies.

Rhinoceros Auklet


Black-legged Kittiwake
SITES 249
BIRDS 2,123,000
11
54,000
33
230,000
25
870,000
162
883,000
4
2,100
14
84,000


Red-legged Kittiwake
2,200
220,000
200
4,000


Tufted Puffin
SITES 461
BIRDS 1,956,000
10
100
28
9,000
17
97,000
330
1,016,000
9
88,000
67
747,000

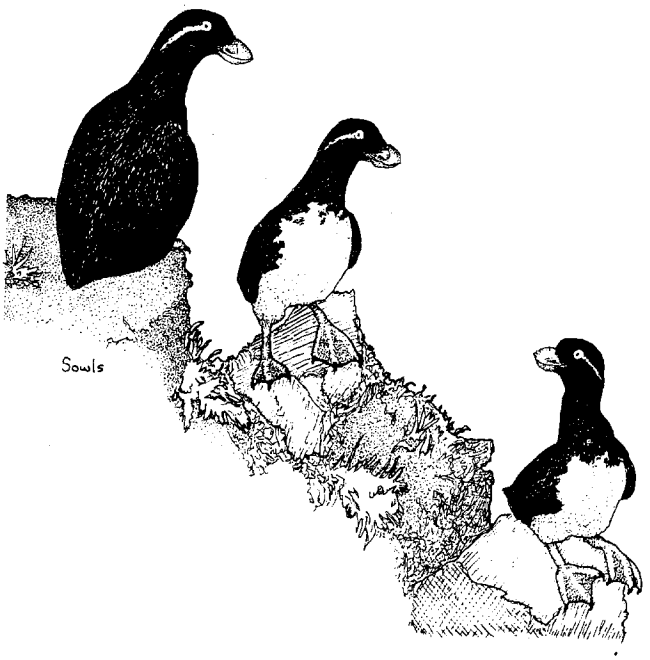

Horned Puffin
SITES 366
BIRDS 690,000
18
17,000
48
35,000
15
35,000
253
563,000
7
900
25
39,000

FOURTH ANNUAL MEETING

OF THE

PACIFIC SEABIRD GROUP

Abstracts




Parakeet Auklets

Victoria, British Columbia

19 - 21 January, 1978

1. THE FEEDING ECOLOGY OF STELLER'S EIDERS. Margaret R. Petersen, U.S. Fish and Wildlife Service, OBS-CE, 1011 E. Tudor Road, Anchorage, Alaska 99503.

The feeding ecology of Steller's eiders (Polysticta stelleri) was studied 18 April to 15 October 1977 at Nelson Lagoon, Alaska (56°00'N, 161°10'W). Eiders fed by head dipping and upending in water 10 to 20 cm deep and by diving in water to 6 m deep. Organisms were taken from 40 mm below the substrate surface to immediately above the substrate surface. Feeding was timed with daily tidal fluctuations, with maximum feeding occurring at low tide when food items were most available. The method of feeding was dependent on the depth of the water during feeding.

Eiders fed primarily on Mytilus edulis and Anisogammarus pugettensis, although birds took small amounts of polychaetes, the isopod Sadiroa entomon, the pelecypods Mya sp. and Macoma sp., shrimp and gastropods. The type of food taken varied throughout the season, with 85.7% of the food in May being Anisogammarus pugettensis, with increasing amounts of Mytilus edulis taken until the flightless period in August and September. Eiders fed exclusively on Mytilus edulis or Macome sp. during the flightless period. Possibly, Steller's eiders select pelecypods when flightless. After the flightless period, birds took all types of invertebrates available, reflecting the generally opportunistic nature of Steller's eiders.

2. FOOD HABITS OF THE WESTERN GULL (Larus occidentalis), BRANDT'S CORMORANT (Phalacrocorax penicillatus) AND CASSIN'S AUKLET (Ptychoramphus aleutica) IN SOUTHERN CALIFORNIA. Paul R. Kelly, Steven M. Speich, George L. Hunt Jr, 1250 W. Philadelphia Avenue, Ontario, California 91761.

The food habits of three species of marine birds were studied in 1976 through the analysis of regurgitated samples obtained on the California Channel Islands. Western gulls were opportunistic, taking a variety of invertebrates and fishes. The northern anchovy (Engraulis mordax) was the single most important food item taken by this species. However, marked variations were noted in the diets of western gulls breeding on different islands. Brandt's cormorants took a wide variety of benthic and nektonic fishes that inhabit littoral waters and particularly kelp beds. Cassin's auklets consumed larval flatfish and rockfish and lesser amounts of euphausids. The availability of food resources and the feeding strategies of these species are discussed.

3. FEEDING ENERGETICS OF THE SOOTY SHEARWATER, (Puffinus griseus) IN MONTERAY BAY. Lynne Krasnow, 1375 Orange Avenue, San Carlos, California 94070.

A study of the feeding energetics of the sooty shearwater (Puffinus griseus) is currently being undertaken to determine the extent of its demand on prey species shared by man. In 95 stomachs examined the most important of five identifiable prey species, as determined by index of relative importance calculations, were the market squid (Loligo opalescens) (IRI 2477) and the northern anchovy (Engraulis mordax) (IRI 673).

The existence energy requirement for an 800 g shearwater was calculated from the equations of Kendeigh and estimated to be 117 kcal/bird-day. Determinations of the average caloric values of gravid female, mature male and immature squid were made by oxygen bomb calorimetry. The caloric content of gravid female squid (5394 cal/g dry weight) was significantly greater than that of mature males (5282 cal/g dry weight) or immature squid of either sex (immature females 5156 cal/g dry weight, immature males 5182 cal/g dry weight). The mean caloric content of all sexes and reproductive groups combined was 5254 cal/g dry weight. The existence energy requirement of 117 kcal/bird-day could be supplied by 94 g of squid calculated on a mean caloric content basis.

The percent increase in metabolic requirement for freely foraging birds over existence energy will be estimated. From this estimate, the annual demand for squid by sooty shearwaters in Monterey Bay will be calculated and compared with landings by commercial fishermen in the same area.

4. SIZE DISTRIBUTION AND SHELL POLYMORPHISM OF LIMPETS IN RELATION TO PREDATION BY BLACK OYSTERCATCHERS. L. Tulloch and B. Hartwick, Department of Biological Sciences, Simon Fraser University, Burnaby, B. C. V5A 1S6.

Limpets inhabiting various levels of rocky shores on Cleland Island, B. C., were examined for size and shell pattern. Observations were made on oystercatchers foraging in the intertidal and limpets that were attacked were then collected and examined. Foraging times in various zones were monitored. Limpets of various sizes and shell patterns were presented in arrays to foraging birds and their responses were noted. Collisella digitalis were smaller in zones with high predation by oystercatchers and size selection by the birds was apparent. No preference for shell color or pattern type was exhibited by the birds. The results are discussed in relation to hypotheses explaining observed size distributions and shell polymorphisms.

5. A DETERMINATION OF TOTAL LENGTH OF FISH (CAPELIN AND SAND LANCE) BY FISH PARTS. Valerie F. Hironaka, Allan K. Fukuyama, Gerald A. Sanger, U. S. Fish and Wildlife Service, 1011 E. Tudor Road, Anchorage, Alaska 99503.

In feeding ecology studies, total length of prey is important in showing niche separation. Much of the time, food contents are found in a stage of digestion where only the hard parts remain. Therefore, methods for identifying prey and extrapolating total length should be developed. Parasphenoid bone (palate bone) lengths, vertebral column lengths and total lengths were measured in two species of fish, Pacific sand lance (Ammodytes hexapterus) and capelin (Mallotus villosus). Correlations between the parasphenoid bone and total length ($r^2 = 0.97$ in capelin, $r^2 = 0.87$ in sand lance) and between the parasphenoid bone and total length ($r^2 = 0.99$ in capelin; $r^2 = 0.87$ in sand lance) were found. Thus it appears that total lengths of fishes of certain species may be accurately determined if the parasphenoid bone or vertebral column can be measured.

6. THE FOOD HABITS AND FEEDING ECOLOGY OF BLACK-LEGGED KITTIWAKES IN THE KODIAK AREA. Gerald A. Sanger, Patrick J. Gould and R. Allen Moe, U. S. Fish and Wildlife Service, OBS-CE, 1101 E. Tudor Road, Anchorage, Alaska 99503.

As a part of the BLM/NOAA Outer Continental Shelf Energy Assessment Program in Alaska, the breeding ecology, population dynamics, pelagic distribution and abundance, and the feeding ecology of black-legged kittiwakes were studied in the Kodiak Island area from mid-May through mid-September 1977. Studies at breeding colonies were conducted in Chiniak Bay near the town of Kodiak and on Cathedral Island in the Sitkalidak Strait area of central Kodiak Island. Shipboard studies were conducted aboard a 58 foot charter vessel during five cruises of 10 to 24 days. Pelagic counts of birds were made along standard transects, specimens were collected and the location and behavior of feeding birds was noted.

Away from colonies, the kittiwakes tended to be dispersed. Flocks occurred in response to localized food sources or from social roosting. Seventy percent to 80% of all sightings of flying birds were of individuals. Kittiwakes occurred more frequently in bays and fjords (85-91% of transects there) than over the continental shelf (40% of transects). The highest densities were in the bays and fjords, except for early in the breeding season (late May to early June). Densities in the bays and fjords ranged from two to 17 birds/$km^2$, while those over the shelf were only four birds/$km^2$ or less. The high densities in the bays were during the chick stage. Feeding aggregations of kittiwakes ranged up to an estimated 1,400 birds (average-39) and occured up to 20 miles from land and 25 miles from the nearest colony, but during the chick stage, feeding flocks occurred only out to 10 miles from land and 17 miles from the nearest colony.

In 88 kittiwakes collected pelagically, capelin (Mallotus villosus) from 50 to 120 mm in length formed most of their food in terms of numbers and volume. Walleye pollock (Theragra chalcogramma) occurred sporadically in their stomachs and sand lance (Ammodytes hexapterus) were relatively important in September (33% average volume). On Cathedral Island, capelin was the most important prey species early in the chick state, but it decreased in importance by fledging. Correspondingly, sand lance increased in importance. This suggests that sand lance were more available to the foraging parents late in the chick stage and probably occurred very near the colony. It further suggests that different birds were sampled from the vessel than those from the Cathedral Colony; sand lance were absent from birds collected at sea until the September cruise. Prey species occurring in the food samples less frequently were Pacific sandfish (Trichodon trichodon), pandalid shrimp, the euphausiid Thysanoessa inermis, scavenged salmon eggs and testes, and trace amounts of pelagic amphipods, clams and polychaete worms.

Generally, the birds collected pelagically had little in their stomachs. Six (seven percent) were empty, and the stomach content weight of 14 more (16%) was less than 0.1% of the body weight; only 12 (eight percent) had a stomach content weight of five percent or more of their body weight (Max. of 8.4%). This suggests that either the kittiwakes subsist with several

small feedings per day rather than gorging like shearwaters or that the birds were collected at hours when there was little feeding. The kittiwakes were collected in approximately the middle third of the day and the early morning and late evening twilight hours were not sampled.

These same basic kinds of studies will be continued next year and will have the added advantage of being integrated with concurrent studies on fisheries and plankton.

7. KITTIWAKE COLONY DISTRIBUTION. Arthur Sowls, U. S. Fish and Wildlife Service, OBS-CE, 1011 E. Tudor Road, Anchorage, Alaska 99503.

Black-legged kittiwakes have a broad circumpolar breeding distribution. In Alaskan waters they breed from Cape Lisburne south, throughout the Aleutians to the west and to Glacier Bay in the east. The largest colonies are found in the Bering Sea (Cape Newenham, Cape Pierce, Nunivak Island and the Pribilof Islands) and the Gulf of Alaska (Middleton Island, Kodiak Island complex and the Semidi Islands).

Black-legged kittiwakes nest as single pairs or in colonies of over 100,000 pairs. Colony sites include offshore islands, rocks and mainland cliffs. Although most colonies are next to the open sea, some are in fjords, often near glaciers. One such colony in Glacier Bay is over 90 miles from the open sea. Sixteen hundred kittiwakes nest on a shipwreck on Middleton Island but this is the only "unnatural" site known in Alaska.

The Alaska colony catalog contains information on 249 black-legged kittiwake colonies with an estimated total of 2,123,000 birds. This population estimate should be considered minimum since: 1) there are probably undiscovered colonies, at least small ones, 2) non-breeding birds may not attend colonies, and 3) we suspect a general underestimation of colony sizes in the catalog data. An overall reasonable guess of the Alaskan black-legged kittiwake population would be two-and-a-half to three million birds. (See distribution Map pp. ).

8. STUDIES OF THE BREEDING BIOLOGY OF BLACK-LEGGED KITTIWAKES MADE BETWEEN CAPE LISBURNE AND SAINT LAWRENCE ISLAND. William H. Drury, College of the Atlantic, Bar Harbor, Maine. 04609.

This paper reports on the phenology, reproductive success, food and presumed causes of reproductive failure during the last few years. Studies have been made at Cape Lisburne, Cape Thompson, Little Diomede Island, King Island, Sledge Island, Bluff Cliffs, Cape Denbigh and the Southwest Cape on Saint Lawrence Island. The items of chief interest appear to be the small clutches and very low rate of production of young at these sites during recent years, as compared to Schwartz's finding at Cape Thompson in the early 1960's and especially as compared to Coulson's findings in England.

9. REPRODUCTIVE ECOLOGY OF BLACK-LEGGED KITTIWAKES, SOUTHEASTERN BERING SEA 1975-1977. George L. Hunt, Ron Squibb, Department of Ecology and Evolutionary Biology, University of California, Irvine, California 92717. Margaret Petersen, OBS, U. S. Fish and Wildlife Service, 1101 E. Tudor Road, Anchorage, Alaska 99503.

Black-legged kittiwake (Rissa tridactyla) reproductive ecology was studied by following individual nests on St. Paul Island (1975-1977) and St. George Island (1976-1977). At Cape Peirce studies were conducted throughout 1976 and during a one day visit, 21 August 1977. In the Pribilofs clutch size averaged between 1.36 and 1.46 eggs and never exceeded two eggs per nest. Mean laying dates varied from 5 July 1975 to 29 June 1976. Hatching success was between 55% and 80% as was fledging success. Productivity (chicks fledged per nest started) ranged from 0.42 to 0.75 chicks per nest, with no nests in our study areas producing more than one chick. Average growth rates varied between 11.5 g/day and 17.9 g/day, with growth rates on St. Paul Island slightly higher than on St. George Island.

At Cape Peirce in 1976, individual nests were not followed. However the modal date of egg laying in 48 nests was 20 June, at least two weeks earlier than on the Pribilofs. Productivity in a sample of 1986 nests was 0.25 young per nest, with eggs hatching in only 39% of the nests. In 1977, no young were produced. In 1976, avian predators were believed to have caused a significant portion of the mortalities. The extreme variation between years at Cape Peirce is in contrast to the remarkable constancy in spite of major variations in the weather over a three year period in the Pribilofs.

10. THE BREEDING SUCCESS OF THE BLACK-LEGGED KITTIWAKE (Rissa tridactyla) IN THE SOUTHWESTERN GULF OF ALASKA, 1974, 1976-1977. Allen Moe, Duff Wehle, Martha Hatch, Lora Leschner, Brian Lawhead, Galen Burrell, Kevin Powers, George Divoky, Robert Day and Eric Hoberg, U. S. Fish and Wildlife Service, OBS-CE, 1011 E. Tudor Road, Anchorage, Alaska 99503.

The breeding success of the black-legged kittiwake at three sites in the southwestern Gulf of Alaska was investigated as follows: Ugaiushak Island (56°47'N) in 1974, 1976-77; Chowiet Island (55°57'N) in 1976-77; and Big Koniuji Island (54°55'N) in 1976.

Both the initial breeding effort and fledging success were believed to be high at Ugaiushak in 1974, but in 1976 it was essentially a failure at both Ugaiushak and Chowiet Islands with all plots either undergoing total failure or producing less than .330 fledglings per nest with eggs. The point of this failure varied from the initial breeding input to the survival of nestlings. Such failure was not universal, however, for a colony on Big Koniuji Island, 130 miles south of Chowiet, produced .772 fledglings per nest started.

The data show that the main cause for the failure in 1976 was probably related to an inadequate food supply in the northern part of the study area. Predation and weather played secondary roles, their effects possibly inversely correlated with the overall reproductive effort.

In 1977 the reproductive success was high with .786 fledglings produced per nest started at Ugaiushak and .620 at Chowiet. Some pairs were able to fledge three young, so it is unlikely that the food supply was limiting in 1977.

11. REPRODUCTIVE SUCCESS OF THE BLACK-LEGGED KITTIWAKE ON KODIAK ISLAND IN 1977. David R. Nysewander, R. Allen Moe, Patricia A. Baird, Eric Hoberg, U. S. Fish and Wildlife Service, 1011 E. Tudor Road, Anchorage Alaska 99503.

Intensive breeding study in 1977 occurred at two Kodiak Island sites: Chiniak Bay and Sitkalidak Strait. The Sitkalidak Strait area supported 2060 breeding pairs of black-legged kittiwakes (Rissa tridactyla) while Chiniak Bay had 7115 breeding pairs. Most of these colonies were small and were dispersed over offshore rocks and insular ledges and cliffs.

One to three eggs were laid at both sites with a mean clutch size for completed clutches of 1.56 for Sitkalidak and 1.96 for Chiniak. One nest even fledged three chicks.

Phenology was essentially the same for the two sites. The first egg was laid on 5 June (Chiniak) and 10 June (Sitkalidak) while the peak of egg-laying was around 12 June (Chiniak) and 17 June (Sitkalidak).

The overall productivity for all four sample plots at Sitkalidak was 0.74 chicks per nest attempted (n = 136; range = 0.5-0.9). The two Chiniak Bay colonies studied varied more, ranging from 0.3 (n = 199) at an undisturbed site to 1.2 (n = 210) at an intensive study site, but the overall average (0.78) was quite similar to that at Sitkalidak.

Reproductive success appeared to be influenced most by the presence or lack of avian predation and quality of nest sites.

12. REPRODUCTIVE SUCCESS OF THE BLACK-LEGGED KITTIWAKE IN PRINCE WILLIAM SOUND AND THE NORTHEASTERN GULF OF ALASKA, 1976-1977. Mary Sangster, U. S. Fish and Wildlife Service, 1011 E. Tudor Road, Anchorage, Alaska 99503. David Nysewander, William Lehnhausen, Sue Quinlan, Carl Benz, David Kurhajec and Peter Knudtson.

The breeding biology of black-legged kittiwakes (Rissa tridactyla) was studied at colonies in Prince William Sound and the northeastern Gulf of Alaska during 1976 and 1977. The Porpoise Rocks colony, situated in the Hichinbrook Entrance to Prince William Sound, supported 1300 breeding pairs in 1977. The Wooded Island colony, situated 50 km southwest of Hichinbrook Entrance in the Gulf of Alaska, supported 1200 breeding pairs in 1977.

Egg laying on Porpoise Rocks began the first week of June in 1976 and a week earlier in 1977. Peak of laying occurred during the third week of June, 1976, but in 1977, approximately 72 percent of all nests were initiated between 30 May and 10 June. Laying on Wooded Islands began 4-10 June, 1976, and 1-6 June, 1977.

The mean size of 429 clutches at all colonies was 1.76 eggs. Hatching success on Porpoise Rocks in 1976 was one to two percent and in 1977 it was 41% with 0.82 chicks hatched per nest. Productivity at Porpoise Rocks was

0.03 fledglings per nest in 1976 and 0.51 fledglings per nest with a reproductive success between egg-laying and fledging of 25.8%. Wooded Island colonies produced 0.62 fledglings per nest for both years.

Avian predation, especially to eggs, was a major factor in reducing production at colonies. Adverse weather conditions appeared to contribute to chick mortality.

13. PUFFIN COLONY DISTRIBUTION. Arthur L. Sowls, U. S. Fish and Wildlife Service, OBS-CE, 1011 E. Tudor Road, Anchorage, Alaska 99503.

The world breeding distribution of horned puffins is restricted to the North Pacific from Cape Lisburne in the north, to the Sea of Okhotsk in the west and Forrester Island in the east. The largest concentration of individuals is in the north-central Gulf of Alaska.

Horned puffins not only nest in colonies but are scattered as singles or small groups along suitable coastlines. Most pairs are crevice nesters but some will nest in burrows. The largest known aggregation of birds on any one island is 108,000 for Chowiet Island.

The Alaska colony catalog contains information on 66 colony sites with an estimated 690,000 birds. This figure is probably quite low because of the difficulty in censusing scattered pairs and very large colonies. Several hundred thousand additional birds, for example, are likely to exist in the Semidi Islands for which we have an estimate only for Chowiet Island. (See distribution map pp. )

Tufted puffins breed in the North Pacific from Cape Lisburne in the north to Hokkaido in the west and southern California in the east. The major part of the Alaskan population is found in the north-central Gulf of Alaska, Aleutian Islands and Bristol Bay.

Tufted puffin colonies vary from a few pairs to over 250,000 on Kaligagan Island. Burrows are the preferred type of nesting location.

The Alaska colony catalog has information on 461 tufted puffin colonies with an estimated total of 1,956,000 birds. This figure, however, is probably quite low for the same reasons as listed for kittiwakes and horned puffins and the actual Alaskan population is probably on the order of four million. (See distribution map pp. .)

14. HABITAT UTILIZATION BY TUFTED PUFFINS ON FISH ISLAND, ALASKA. William Lehnhausen, U. S. Fish and Wildlife Service, 1011 E. Tudor Road, Anchorage, Alaska 99503.

During the summers of 1976 and 1977, utilization of habitats, emphasizing nest sites, by tufted puffins was studied on Fish Island, Prince William Sound, Alaska. Four general types of habitats were used for nesting; cliff edge, cliff face, grassy slope, and rocky slope. Greatest concentrations of burrows were along the cliff edge where 91% were within 2 m of the edge.

Rocky slopes rated second in concentration of burrows where 87% were above 20 m from the highest water line. Available grassy slope habitat was limited to a few small areas and suitable crevices in cliff faces were scattered. Unvegetated slopes of mixed large and small boulders were more heavily utilized than other rocky slope areas. In 1977, 56% of the cliff edge burrows contained eggs. At the cliff edge the mean length of burrows containing eggs ($\bar{x}$ = 98.1cm) was significantly greater (P 0.05) than those which did not have eggs ($\bar{x}$ = 79.0cm). Heavy predation by river otters and ravens reduced successful production to a few nests on the cliff face in 1977. The puffin's limited ability to take off from land is thought to influence the location of nest sites, especially in rocky slopes.

Nest site utilization by pigeon guillemots, parakeet auklets, and horned puffins was also investigated. Overlap of habitats occurred on rocky slopes and cliff faces. Some nest site separation occurred as a result of body size limiting each species to a minimum size of nest entrance.

15. UNUSUAL NESTING HABITAT OF TUFTED PUFFINS. Robert Gill, Jr., U. S. Fish and Wildlife Service, OBS, 1011 E. Tudor Road, Anchorage, Alaska 99503.

During 1976 and 1977, a small population (14-18 Pairs) of tufted puffins successfully nested in an Alaska Peninsula lagoon on several small sand islands subject to tidal inundation. The timing of nesting, burrow placement, nest attendance and success, and burrow placement in relation to normal and storm generated tides are discussed.

16. A COMPARATIVE BREEDING BIOLOGY OF THE TUFTED AND HORNED PUFFIN IN THE BARREN ISLANDS, ALASKA. Michael J. Amaral and David A. Manuwal, Wildlife Science Group, College of Forest Resources, University of Washington, Seattle, Washington 98195.

The breeding biology of the tufted and horned puffin was studied from May to September, 1976, and from June to August in 1977. There are approximately 95,300 and 6,510 pairs of tufted and horned puffins in the Barren Islands during the breeding season.

Both sexes share the incubation and chick feeding duties. The mean incubation period for 11 tufted and 13 horned puffin eggs was 45 and 41 days, respectively.

In both years capelin (Mallotus villosus) and sand lance (Ammodytes hexapterus) were the two most important food items in the nestling diet of the two puffin species. Using Morisita's (1959) index of overlap in comparative studies of diet, it was determined that there is a 90% overlap in the nestling diet of the two puffins. For tufted puffins, the weight of a feeding, the number of fish per load and the number of feedings per day increase as the nestling grows and requires more energy. Although a similar increase in the number and weight of fish per load was not observed for horned puffins, an increase in the number of daily feedings over time was evident. On the average, tufted puffins carried more fish per load, had heavier loads and more loads per day than horned puffins.

Descriptive development on 23 horned and 56 tufted puffin nestlings was recorded at five day intervals. In both years horned puffin nestlings exhibited a slightly faster growth rate (K. Ricklefs, 1967, 1968) than tufted puffin nestlings. The mean nestling period was 47 days for tufted puffins and 39 days for horned puffins. Nestlings of both species fledged at about 70% adult body weight.

The overall breeding success for tufted and horned puffins was 34% and 46% respectively. Although predators such as bald eagles, peregrine falcons and river otters do occasionally take adults and young, the two most important factors influencing breeding success in the study colonies were egg desertion and nestling mortality due to storms.

17. ASPECTS OF A COMPARATIVE BREEDING BIOLOGY OF THE TUFTED AND HORNED PUFFIN ON BULDIR ISLAND, ALASKA, 1975, AND UGAIUSHAK ISLAND, ALASKA, 1976 and 1977.
Duff H. S. Wehle, 202 Bunnell, University of Alaska, Fairbanks, Alaska 99701.

The breeding biology and feeding ecology of the tufted and horned puffin was studied on Buldir Island, Alaska, from 17 May to 5 September, 1975, and on Ugaiushak Island, Alaska, from 24 May to 2 September, 1976, and from 23 April to 28 August, 1977. This paper reports some of the data obtained on the breeding biology of these two species.

The breeding phenology (including dates of first arrival, permanent occupancy of colony, egg-laying, hatching and fledging) is given for both species for all three years. The length of incubation period for tufted puffins was 46.8 days (N=16) in 1976, and 46.2 days (N=19) in 1977. The length of the nestling period for tufted puffins was 45.9 days (N=7) in 1976 and 41.9 days (N=4) in 1977. Mean hatching weight in 1977 was 61.9 grams for tufted puffins and 47.5 grams for horned puffins. Mean fledging weight of tufted puffins was 566 grams (N=17) in 1976 and 556 grams (N=6) in 1977.

Egg relaying experiments were conducted in 1977 on both tufted and horned puffins. Seven of the 10 tufted puffin and three of the 10 horned puffin nests which had eggs removed from them had eggs relaid in them between 10 and 21 and between 17 and 20 days, respectively, after the eggs were removed. None of the seven tufted puffin, and possibly one of the three horned puffin nests had a third egg laid in them.

Experiments in egg recognition were also conducted with both species. Eggs of glaucous-winged gulls, eggs of the other puffin species and color-marked eggs of the original species were substituted for the natural eggs of both tufted and horned puffins. Tufted puffins continued to incubate in 11 out of 14 nests and horned puffins in 10 out of 12 nests containing experimental eggs.

Nest site tenacity of tufted puffins was studied by banding 18 adult birds in their burrows on Ugaiushak Island in 1976. In 1977, these burrows were checked for banded birds. Only seven had eggs laid in them and at least two of these contained banded birds.

The percent of actively breeding birds on the colony was determined by constantly monitoring a study plot of 35 burrows throughout the breeding

season. Results indicate that although 89% of these burrows had birds associated with them during the breeding season, approximately only one-half of these came to have eggs laid in them.

Tufted puffin chicks exhibited one of two color phases on their bellies at both the downy stage and in juvenile plumage once the contour feathers were in. Percent frequency of occurrence of each color phase was approximately the same for samples taken at Ugaiushak Island and Barren Island (Amaral pers. com.) in 1977. In the downy stage, seven percent and 2.5% were white and 93% and 97.5% were black and in juvenile plumage, 24% and 25% were white and 76% and 75% were dark on Ugaiushak Island and Barren Islands, respectively.

Production statistics for tufted puffins for all three years, and for horned puffins in 1977, are discussed.

Finally, initial results of growth rate experiments for tufted and horned puffin chicks under the following conditions are discussed: naturally fed singles, food supplemented singles, naturally fed twins, food supplemented twins, captive singles, captive twins, and tufted puffin chicks raised by horned puffins and horned puffin chicks raised by tufted puffins.

19. SOME NOTES ON THE FEEDING ECOLOGY OF THE TUFTED PUFFIN (Lunda cirrhata) IN THE SITKALIDAK STRAIT REGION OF KODIAK ISLAND, ALASKA, DURING THE 1977 BREEDING SEASON. R. Allen Moe and Patricia A. Baird, U. S. Fish and Wildlife Service, 1011 E. Tudor Road, Anchorage, Alaska 99503.

Data on adult food selection were obtained from 43 stomachs of birds collected at intervals throughout the breeding season while data on food brought back for the chicks consist of 56 samples of bill loads and food items accumulated in the burrows while the bills of the chicks were taped.

Capelin (Mallotus villosus) was the most important prey species taken, occurring in 82.4% of the stomachs and 79.2% of the samples of chick food. It accounted for 64.9% of the total numbers of food items (n=322) and 58.5% of the total weight consumed by the chicks during the later part of the nestling period. Sand lance (Ammodytes hexapterus) was next in importance, accounting for 25.8% of the total numbers of food items brought back to the chicks, but it had little importance as adult food. Also taken were sockeye salmon smolt (Oncorhynchus nerka), Pacific sandfish (Trichodon trichodon) and walleye pollack (Theragra chalcogrammus), but in lower numbers.

There was considerable variation in the amount of food brought daily to the chicks. During the latter part of the nestling period food brought to burrows over a 24-hour period ranged from 0-113.5 g (n=28) and food brought over a 48-hour period ranged from 0-180.5 g (n=12). Chicks 19-30 days old received more food daily than those 30-40 days old (P .05).

20. RAISING TUFTED PUFFIN CHICKS IN CAPTIVITY. Frank S. Todd, Zoe Eppley, John Colby, Sea World, Inc., 1700 S. Shores Road, San Diego, California 92109.

On August 3, 1977, we collected 25 tufted puffin (Lunda cirrhata) chicks from an island off La Push, Washington. They varied in age from two to six weeks. Twenty-three successfully fledged. After fledging there were five deaths. The major causes of death were: aspergillosis infection and enteritis. We used three diets; smelt, herring and anchovy. Best results were obtained with a diet of smelt, 90-150g/day. Vitamins were administered to compensate for using fish that had been frozen.

The puffins were kept in individual "burrows" until fledging. They then were introduced in groups and monitored until aggressive interactions subsided, usually three to five days. We exposed the fledglings to water for short periods of time until their plumage became water resistant. After that time they were left in the water. Within a few days, their plumage became completely waterproof.

Our controlled growth rates followed trends similar to those seen in native birds. There is a stabilization and then decrease in weight associated with fledging. Also indicative of fledging were: loss of down from the middle of the back; a new vocalization; and a decrease in aggressiveness.

21. THE AT-SEA DISTRIBUTION OF XANTUS' MURRELET (Endomychura hypoleuca) AROUND SANTA BARBARA ISLAND DURING THE BREEDING SEASON. Robert L. Pitman, Audrey L. Martin, Barbara J. Burgeson, George L. Hunt, Jr., Department of Ecology and Evolutionary Biology, University of California, Irvine, California 92717.

Santa Barbara Island, California, has one of the largest Xantus' murrelet colonies known. The at-sea distribution of murrelets around this colony was studied during the 1976 breeding season (January - July). Censuses were conducted using regularly spaced 18.5 km (10 mo) radial transects directed out from the island. Seasonal occurrence of murrelets in the waters around the island was closely coincident with breeding activity on the island. Murrelets were consistently concentrated north and west of the island with maximum densities occurring between 0.5 and 14.5 km offshore. The vast majority of the foraging murrelets encountered throughout the season were paired (83% of the total individuals sighted). The total Xantus' murrelet population associated with Santa Barbara Island was estimated at 10,000 to 20,000 birds during the peak in late May. Additional information collected during the 1977 season will also be presented.

22. A METHOD OF DENSITY ESTIMATION OF BIRDS AT SEA. Dennis Heinemann, Zoology Department, Oregon State University, Corvallis, Oregon 97331.

A line transect method for the estimation of bird densities at sea from ships is presented. The method has been constructed from the results of computor simulations of pelagic transect conditions, from a review of the literature on line transect theory, from considerations of the behavior and distribution patterns of Northeast Pacific seabirds, and from field experience with those birds and with line transect censusing at sea. The utility of the proposed method and its applicability to aerial censusing will be discussed.

23. THE CO-OCCURENCE AND ATTRACTION OF SEABIRDS TO FISHING VESSELS OFF THE COAST OF WASHINGTON. Terry Wahl, 3041 Eldridge, Bellingham, Washington 98225, and Dennis Heinemann, Department of Zoology, Oregon State University, Corvallis, Oregon 97331.

Data on the relative abundances of seabirds in relation to the distributions of foreign and domestic fishing vessels were taken off the coast of Washington from 1971 to 1977. The behavioral observations of many observers at fishing vessels over continental shelves have suggested that many seabirds are attracted to fishing vessels. Analysis of our data has shown that those species occur in greater numbers near fishing vessels than away from fishing vessels. The form, extent in space and time, and significance of this co-occurrence will be discussed.

24. LOW SEABIRD DENSITIES IN THE PELAGIC ENVIRONMENT OF THE STRAIT OF GEORGIA BRITISH COLUMBIA. Ian Robertson, 6267 Thorne Road, Burnaby, British Columbia, Canada V3N 2V2.

Seabird surveys in the pelagic environment of the Strait of Georgia indicated an exceptionally low annual average density of 3.16 seabirds per $km^2$ when compared to similar estimates of seabird densities in other south coastal British Columbia waters. In spite of a wide (20 km) pelagic zone, the avifauna lacked most of the open ocean species and, in fact, was typical of the inshore protected waters of B. C. Two possible explanations were considered. First, though the biological productivity of the study area is not low, the apparent absence of suitable foods, particularly adult Paciric herring (Clupea harengus pallasii) (Valenciennes) may explain the low seabird numbers. Second, the discharge of the Fraser River which creates a highly turbid layer of surface water may seriously limit the effectiveness of visual predators like birds.

25. REPRODUCTIVE SUCCESS OF THE BLACK OYSTERCATCHER IN WASHINGTON STATE. David R. Nysewander, Wildlife Science Group, College of Forest Resources, University of Washington, Seattle, Washington 98195.

State-wide census during 1973-75 indicated that the present population of black oystercatchers (Haematopus bachmani) in Washington (260-286) has not significantly changed overall since 1900. Six winter flock concentrations (ca. 40 individuals per site) were located in the state in 1973. One of these, Destruction Island in Jefferson County, was intensively studied during the breeding seasons of 1974 and 1975.

In the seven years since lighthouse automation, breeding pairs have increased from four to 10-11 in 1974 and 12 in 1975. Hatching success was 61.5% (1974) and 76.7% (1975). Fledging success was 25% (1974) and 73.9% (1975). Lack of summer storms in 1975 was responsible for this greater fledging success. Productivity varied from 0.4 to 1.4 chicks fledged per nest attempt. The island production recorded in 1975 was the highest noted for this species in published accounts.

Oystercatchers nesting on gravel had larger clutches, laid these clutches earlier, and were more successful than those nesting elsewhere. Deeper nest cups and larger pebbles associated with the nest also made for more successful reproduction. High quality nest sites appeared to influence reproductive success of the black oystercatcher more clearly than did food resources.

Gull and crow predation were dominant mortality factors during incubation whereas storms were major sources of mortality for nestlings. Effects of human disturbance on incubation and reproductive success are also discussed.

26. SOME ASPECTS OF THE BREEDING BIOLOGY AND BEHAVIOR OF Larus marinus. Nico A. M. Verbeek, Department of Biology, Simon Fraser University, Burnaby, British Columbia, Canada V5A 1S6.

In 1973 and 1974 I studied the nestling success of 28 pairs of great black-backed gulls in Walney Island, Cumbria, England. This represented the entire breeding population of this species on the island. Most of the nests were placed on slightly elevated positions, close to the water edge. Much of the nest material was robbed from the nests of herring and lesser black-backed gulls. Several nests were found containing eggs of herring gulls as well as those of great black-backed gulls. Nesting success was low in 1974, mainly because of the death of adults. Much of the food is obtained intertidally and much of it is stolen mainly from herring gulls. Fishes form the main diet of the young. Behavioral observations pertaining to the habit of great black-backed gulls to interfere in fights among herring gulls, and apparent interspecific courtship between great black-backed gulls and herring gulls are described.

27. COMPARATIVE ECOLOGY OF ARCTIC AND ALEUTIAN TERNS. Pat Baird, U. S. Fish and Wildlife Service, 1011 E. Tudor Road, Anchorage, Alaska 99503.

Arctic and Aleutian terns (Sterna paradisea and S. aleutica) are sympatric on Kodiak Island in the northeastern Gulf of Alaska. In the Sitkalidak Strait area of Kodiak, there were two mixed species tern colonies and one monospecific Arctic tern colony. The two species segregated the nesting habitat by vegetation volume at laying, with Arctic terns choosing areas with greater vegetation volume. However, in the monospecific Arctic tern colony, the vegetation volume chosen was the least of all the colonies.

Hatching success of Arctic terns on the monospecific colony was positively correlated with vegetation volume at laying and hatching, whereas in the mixed colonies it was positively correlated to slope and week laid. Earlier clutches in nests with less slope were most successful. The hatching success of Aleutian terns was positively correlated with total vegetation volume at hatching and to a lesser extent with week laid. Earlier clutches in nests with more cover were most successful.

The fledging success of the two species is directly related to their ability to feed the chicks. Arctic terns had little difficulty in feeding their chicks. They would make a mean of 3.5 trips per day to the chicks and were not often attacked by other terns in their attempts, while Aleutian

terns fed their chicks a mean of 2.3 times per day and they were constantly attacked by the Arctic terns on their trips to the nest. They would circle the colony for 20-30 minutes before landing and would often be forced to drop their bill load of fish. These differences in feeding behavior are reflected by differences in growth rates of the chicks and in fledging success of the chicks of the two species. Fledging success for Aleutian terns is inversely correlated with nearest neighbor distance and vegetation height, reflecting that successful Aleutian terns are those whose nests are clumped with lower vegetation, perhaps making it easier for them to find their nests. Fledging success of Arctic terns was correlated with no habitat parameters in the mixed or in the monospecific colonies.

28. REPRODUCTIVE SUCCESS IN A DISTURBED COMMUNITY. Mark J. Rauzon, U. S. Fish and Wildlife Service, 1011 E. Tudor Road, Anchorage, Alaska 99503.

Reproductive success of a disturbed seabird community was monitored at Tern Island, U. S. Coast Guard LORAN Station, French Frigate Shoals, Hawaiian Islands National Wildlife Refuge, for the period 26 February to 24 May, 1977. This twenty acre island supported minimum breeding populations of red-footed boobies, red-tailed tropicbirds, brown and black noddies, white, sooty and gray-backed terns, Laysan albatross and black-footed albatross. Booby, tropicbird and albatross success remained relatively unaffected by human occupation. Terns, primarily sooty, were a 'target species' for control by Coast Guard personnel. Bird-aircraft collision problems arose due to the communal nature of the breeding population. Gray-backed terns and brown noddies, species which associate with sooty terns, suffered egg loss and colony desertion due to human disturbance. White tern mortality was linked to weather conditions.

29. EGG-NEGLECT IN THE FORK-TAILED STORM-PETREL (Oceanodroma furcata). Dee Boersma, Institute for Environmental Studies and Nathaniel T. Wheelwright, Department of Zoology, University of Washington, Seattle, Washington 98195.

Egg-neglect occurs regularly in many Procellariiform birds. The embryo of the fork-tailed storm-petrel, in particular, can tolerate frequent periods of abandonment during incubation. Of 34 nests in which chicks hatched, the mean number of days of egg-neglect was 11.5. Embryos survived intervals of up to seven days of continuous desertion during which burrow temperatures average 10° C. Depending upon the incidence of egg-neglect, incubation periods extended from 39-68 days ($\bar{x}$ = 50.5 days). The number of days of actual incubation, rather than the length of the entire incubation period including egg-neglect, determines hatching. Increased egg-neglect was associated with higher chick mortality.

When unattended during their first week, chicks can fall into extreme torpor. This ability, in addition to resistence of the embryo to temporary abandonment and low metabolic rates (reflected in low body temperatures), appears highly adaptive in an environment where storms are severe and unpredictable and food resources are temporarily and spacially patchy.

30. THE EFFECTS OF PREDATION ON STORM PETREL NESTING SUCCESS AT FISH ISLAND, ALASKA. Susan E. Quinlan, Alaska Cooperative Wildlife Research Unit, University of Alaska, Fairbanks, Alaska 99701.

The breeding biology of fork-tailed and Leach's storm petrels at their northernmost known breeding site was studied during the summers of 1976 and 1977. Potential predators on storm petrels included glaucous-winged gulls, peregrine falcons, bald eagles, common ravens and river otters. While avian predators took some birds, river otters were the most important predators in both years. In 1977, a river otter exclosure was set up to learn the effects of predation on nesting success. Nesting success outside the exclosure was significantly less than within. Fork-tails nesting in rocky areas were inaccessible to river otters and nesting success there was similar to that within the exclosure. Also, as a result of otter predation, nesting success was inversely related to colony density. River otter predation may be affecting storm petrel nesting behavior.

31. ATTENDANCE AND FEEDING PATTERNS OF THE FORK-TAILED STORM PETREL. Theodore Simons, Wildlife Science Group, College of Forest Resources, University of Washington, Seattle, Washington 98195.

Specially designed event recorders and direct observation were used to monitor the incubation behavior and post hatching attendance patterns of fork-tailed storm petrels on their breeding grounds in the Barren Islands, Alaska. Observation of marked individuals allowed collection of information on the incubation rhythm of the adults. Incubation shifts varied between one and five days with a mean of 2.54. A reduction of shift length prior to hatching may represent an adaption to insure attendance by adults during hatching and for several days following. Adults assisted the chick in hatching. Feeding of the chick began several hours after hatching and continued on a regular basis during the period the chick was brooded. Adults shared equally in feeding. Food loads delivered by adults varied from two to 17 grams, the latter representing approximately 30% of mean adult weight during this period. Chicks were observed to consume up to 31 grams in a single night which resulted in weight gains of over 75%. Feeding patterns suggest an adaptation to a variable food resource.

32. NESTING HABITAT DIFFERENCES BETWEEN THE RED-LEGGED AND BLACK-LEGGED KITTIWAKE. Ron Squibb, Department of Ecology and Evolutionary Biology, University of California, Irvine, California 92717.

Analysis of nesting species on 124 cliff section shows red-legged kittiwake nests to occur in proportionately greater numbers on the higher cliffs than do nests of major nest-site competitors, the black-legged kittiwake and the thick-billed murre. Detailed descriptions of 245 nest-sites demonstrate that nesting ledges occupied by red-legged kittiwakes tend to be smaller and more covered by rock overhangs than those occupied by black-legged kittiwakes, and that the former species builds smaller nests and tolerates closer nest spacing than does the latter. The copulatory posture of the red-legged kittiwake is particularly suited to its compact nesting

platform. Pre-nesting behavioral observations shed some light on the nest site selection process. We collected these data in the Pribilof Islands during the 1976 and 1977 breeding seasons.

33. REPRODUCTIVE RESPONSES OF CASSIN'S AUKLETS TO ORALLY ADMINISTERED BUNKER C OIL AND ELIMINATIVE RESPONSES IN SEABIRDS. David Ainley and Steve Morrell, Point Reyes Bird Observatory, Box 8, Alder Road, Bolinas, California 94924. Joan Dobbs, C. R. Grau and Tom Roudybush, Department of Avian Sciences, University of California, Davis, California 95616.

During the 1977 breeding season on southeast Farallon Island, 251 female Cassin's auklets (Ptychoramphus aleuticus) were force-fed gelatin capsules containing either 300 or 600 mg bunker C oil. These birds and an undosed control group of 79 females along with their eggs and chicks were observed throughout the breeding season. No significant differences in laying, hatching or in fledging success were observed among the four groups. No differences were observed in yolk structure in eggs from either oil-dosed or empty capsule-dosed auklets.

In an attempt to understand the lack of effect of bunker C oil on reproductive success in auklets and to determine the eventual fate of ingested oil, birds of several species were dosed with oil. The fate of the oil is shown in the following table:

| | | Time between dosing and | | | |
|---|---|---|---|---|---|
| | | Regurgitation | | Fecal Elimination | |
| Species | | Mean | Range | Mean | Range |
| 1) Cassin's Auklet (Ptychoramphus aleutica) | 10 | -- | -- | 36 min | 12-82 min |
| 1) Western Gull (Larus occidentalis) | 15 | * | 0-35 min | -- | -- |
| 2) Common Murre (Uria aalge) | 3 | 10 min | 7-13 min | 18 min | 7-33 min |
| 2) Black-footed Albatross (Diomedea nigripes) | 3 | -- | | 10 hrs | 6-20 hrs |
| 3) Japanese Quail (Coturnix coturnis japonica) | 6 fed | -- | | 177 min | 143-226 min |
| | 5 unfed | -- | | 29 min | 11-67 min |
| 3) Mallard (Anas platyrhynchos) | 6 fed | | | 52 min | 20-145 min |
| | 6 unfed | -- | | 46 min | 31-79 min |

* Upon contact with oil. Some oil was hidden in bait.
1) Dosed on southeast Farallon Island.

2) Dosed at International Bird Rescue Research Center, Berkeley, California.
3) Dosed at University of California, Davis, California.

We observed by aspiration that no food was present in auklet stomachs at night. This information, together with data on passage time of oil in fed and unfed quail and mallards indicates that if auklets are similar to quail, then oil may have passed through the auklets too quickly to affect their eggs.

The cooperation of Alice Berkner of the International Bird Rescue Research Center is gratefully acknowledged.

34. NOTES ON SUMMERING AND WINTERING BLACK-LEGGED KITTIWAKES IN WASHINGTON. Bill Harrington-Tweit, Route 3, Box 944, Olympia, Washington 98506.

Black-legged kittiwakes are present every summer along the coast of Washington, in varying numbers. During this season, they are strictly coastal in distribution; they do not utilize pelagic waters. Two differing hypotheses accounting for this type of distribution are:

1) Summering kittiwakes, mostly immature birds, are outcompeted in and excluded from the pelagic zone by the tremendous numbers of marine birds utilizing this zone in summer.

2) Summering kittiwakes remain in the coastal zone, attracted by more productive feeding conditions there than in the pelagic zone.

The relative proportions of different age classes in the summering population and their molt schedules will be discussed.

Even less is known about wintering populations when the species is largely pelagic in distribution. The species is subject to infrequent periods of high mortality, the causes of which can usually be traced to oceanographic and/or atmospheric conditions and an individual's energy reserves and budget, even though the actual circumstances can vary tremendously. Some of these periods will be reviewed and discussed, in conjunction with the minute amount of data we have on the distribution, abundance and age structure of wintering populations of kittiwakes off the coast of Washington.

35. FEEDING HABITS AND POPULATION STRUCTURE OF KITTIWAKES ON WINTERING GROUNDS OF MONTEREY BAY, CALIFORNIA. G. Victor Morejohn, James Harvey, Lynne Krasnow and Janice L. Cross, Moss Landing Marine Laboratories of the State Colleges and University, Moss Landing, California 95039.

Feeding habits of nonbreeding populations of seabirds on wintering grounds are largely undocumented. The extent to which food resources are available affect seabird species diversity or the number of seabird individuals on wintering grounds. This has not been adequately assessed. The degree to which disease or unavailable food resources at the breeding grounds affects reproductive success may be measured in part by numbers of post-reproductive dispersants to wintering grounds. Some species are known to have "good years" or "poor years". Along with Pacific fulmars, kittiwakes suffered a die-off as well during the winter and spring of 1976 off coastal California.

In an effort to substantiate food resource exploitation by kittiwakes on wintering grounds south of their breeding distribution, we provide information of their feeding habits and population structure in Monterey Bay, California, for a period prior to the die-off (1974-1975) and during the die-off.

Seventy specimens were studied. Twenty-one specimens collected by shotgun provided information on feeding habits. During the four to five month period of overwintering, only three major food items were eaten: commercial squid (Loligo opalescens), anchovies (Engraulis mordax) and euphausids (Thysanoessa spinifera). The volume of squid eaten was 10 times greater than anchovy; the volume of anchovies eaten was 30 times greater than euphausids. Of the 53 die-off specimens picked up on beaches (February through May, 1976), 19 were fresh enough to confirm that stomachs were empty; four other carcasses had stomachs with fragments of algae, wood, fish bones and crushed squid beaks. Thirty carcasses were too decomposed or partly eaten to assess stomach contents. During the die-off, kittiwakes were also collected by Dr. Alvin Smith of the Naval Biomedical Lab in Richmond, California, in an attempt to isolate pathogenic bacteria or viruses. No pathogens were found.

Plumage type and sex distribution of all specimens showed that 84% were in adult plumage and sexes were equally distributed. Wintering kittiwakes on Monterey Bay are greatly dependent upon squid and anchovy. We conclude that kittiwake mortality of 1976 was due to starvation based on: 1) carcasses were emaciated, 2) no pathogens were isolated, 3) most stomachs were empty, 4) peak die-off occurred when fulmars also had peak die-off, and 5) aberrant temperatures in Monterey Bay depressed availability of squid to surface-feeding birds during late winter and spring of 1976. Seabird observations during winter and spring of 1977 showed marked decreases in numbers of kittiwakes and fulmars in Monterey Bay and vicinity.

36. MORTALITY PATTERNS OF BLACK-LEGGED KITTIWAKES ALONG THE CALIFORNIA COAST, 1971-1977. David G. Ainley and Stephen H. Morrell, Pt. Reyes Bird Observatory, Box 8, Alder Road, Bolinas, California 94924.

Volunteers and staff of Point Reyes Bird Observatory censused beached bird carcasses monthly on selected beaches along the California coast from May 1971 through June 1977. The density of black-legged kittiwake carcasses found varied among the six years of study. We compare the densities between different areas along the coast, between different seasons of the year, and between different years. Differences in kittiwake mortality patterns are related to spatial and temporal variability in oceanic conditions along the coast.

37. BREEDING SEABIRD DISTRIBUTION AND ABUNDANCE IN THE SHUMAGIN ISLANDS, ALASKA. Edgar P. Bailey, U. S. Fish and Wildlife Service, 1011 E. Tudor Road, Anchorage, Alaska 99803.

Data on breeding seabird distribution and abundance have been obtained on five Shumagin expeditions since 1970. Excluding nocturnal nesters,

roughly a million seabirds, representing at least 18 species, breed on the some 30 Shumagin Islands, a proposed National Wildlife Refuge.

Horned and tufted puffins are the most numerous and widely distributed species, each totalling nearly 200,000 birds.

Murres totalled about 270,000. A huge mixed murre colonly exists on Karpa Island, where the largest glaucous-winged gull colony also is situated.

Black-legged kittiwakes nest on 10 islands. Red-faced and pelagic cormorants were common, but double-crested cormorants were found only on one island.

Most of the area's estimated 43,000 crested auklets nest on Big Koniuji Island. Parakeet auklets inhabit 12 islands with over half the birds occurring on Castle Rock, which also has the largest population of Cassin's auklets. Rhinoceros auklets were noted on Near Island only.

Ancient murrelets are the most widely distributed nocturnal nesters, occurring on seven islands. Both Leach's and fork-tailed storm-petrels breed on some of the smaller islands.

Red foxes appear indigenous to the larger islands and Arctic foxes have been introduced to others. Foxes have limited seabirds to cliffs and colluvium; no nocturnal species were located on islands with foxes.

38. THE BREEDING DISTRIBUTION AND STATUS OF CASSIN'S AUKLET IN THE SOUTHERN CALIFORNIA CHANNEL ISLANDS. Steven M. Speich, 1250 W. Philadelphia Avenue, Ontario, California 91761. George L. Hunt, Jr., Department of Ecol & Evol Biology, University of California, Irvine, California.

This paper examines the breeding distribution of Cassin's auklet (Ptychoramphus aleuticus) as known over the past 100 years at the various colony sites in the southern California offshore islands. An attempt is made to construct the bird's status at each colony site in the past and at the present time, and to discuss factors affecting that status. A summary of present colony site types is presented. Finally, a prognosis of survival at each colony is considered in light of such factors as colony size, the island substrate, human disturbance, ground predators and the potential for pollution.

39. BEHAVIOR, HABITAT USE, AND TIME BUDGET OF THE PARAKEET AUKLET IN THE BARREN ISLANDS, ALASKA. David A. Manuwal and Naomi J. Manuwal, Wildlife Science Group, College of Forest Resources, University of Washington, Seattle, Washington 98195.

We classified the nesting environment of parakeet auklets into habitat components that we believe the auklets recognize. These habitats are nesting cliffs and rocks, middle rocks loafing area, intertidal loafing area, inshore flocking area, offshore flocking area, and staging area. During 230 hours of observation, we were able to recognize specific displays (in

parentheses) for each of the four major behavioral patterns: maintenance behavior (3), displacement and alarm behavior (4), courtship behavior (3), and agonistic behavior (4).

During the breeding season the time and energy budgets of parakeet auklets are divided into both oceanic and terrestrial components. We determined the following habitat-specific time budget for auklets on East Amatuli Island: Feeding Area (59.7%), Inshore Flocking Area (21.3%), Offshore Flocking Area (7.2%), Nesting Cliffs Middle Rocks Loafing Area (1.4%). When parakeet auklets are in the late stages of incubation or early nestling period, adults spend about 60% of their time at sea feeding. About 40% is spent at or near the colony site. While there they spend roughly 20% of their time engaged in social behavior in the water immediately adjacent to the nest sites.

40. THE ROLE OF SEA-ICE FOR ARCTIC TERNS BREEDING ON AN ARCTIC ALASKA BARRIER ISLAND. Robert J. Boekelheide, Division of Wildlife and Fisheries Biology, University of California, Davis, California 95616, and George J. Divoky, Point Reyes Bird Observatory, 4990 State Route 1, Sinson Beach, California 94970.

A breeding population of Arctic terns (Sterna paradisaea) was studied on Cooper Island, a barrier island 35 km east of Barrow, Alaska. Aspects of phenology, success and feeding ecology were monitored in relation to several factors including sea-ice conditions.

Four distinct ice periods were recognized during the breeding season: 1) shorefast ice, 2) shorefast ice breakup, 3) drifting pack-ice, and 4) open water. Egg laying occurs prior to breakup in late June and early July, during which food sources are limited to lacusterine waters on the mainland and shallow moats encircling the island. Shorefast ice lingers onshore into July, making island colonies accessible to Arctic foxes (Alopex lagopus) throughout the laying period. Hatching occurs in the last half of July, a transitional ice period leading to drifting pack-ice in inshore waters. Marine prey associated with the drifting pack, particularly Arctic cod (Boreogadus saida) and an under-ice amphipod (Apheruse flacialis), become major prey items for birds at this time. Other prey sources during pack-ice and open water periods include plankton assemblages not intimately associated with the ice. These assemblages appear sporadically in inshore waters as current waifs in single and mixed species patches. The transition from drifting pack to open water varies temporally from year to year depending upon the magnitude and direction of wind systems. Thus, fledging, which takes place during mid-August, may occur in either pack-ice or open water periods. We suggest that the annual period of drifting pack-ice and its associated fauna in inshore waters of the Plover Islands is an ultimate factor in the breeding phenology of Cooper Island terns and the timing of migration for most terns from the Beaufort Sea.

41. DISPERSAL OF AUTUMNAL MIGRANT DUNLIN AND WESTERN SANDPIPERS FROM THE ALASKA PENINSULA. Robert Gill, Jr., U. S. Fish and Wildlife Service, 1011 E. Tudor Road, Anchorage, Alaska 99503.

Nelson Lagoon, along the north central Alaska Peninsula, is an important

molting and staging area for autumnal migrant shorebirds (see 1976 PSG Shorebird Symposium). During 1977, approximately 1,000 each dunlin and western sandpipers were color banded and dyed using rocket-netting at high tide roosts as a capture technique. From these preliminary data collected at time of capture and from subsequent resightings, we have developed 1) age and sex composition of birds using Nelson Lagoon, 2) turnover times of birds within the Lagoon, 3) patterns of intra-lagoon movements between roosting and foraging areas, and 4) dispersal and migration strategies of dunlin and western sandpipers from the area.

Western sandpipers use the Lagoon for approximately 30 days, build moderate fat reserves and depart in early August, following the Alaska and British Columbia coastline. Dunlin, however, use the Lagoon for approximately 110 days, go through a complete molt, build heavy fat reserves and depart in early October on, we believe, a trans-Pacific migration to Oregon and California; this being induced and aided by large cyclonic low pressure systems originating in the Bering Sea each year at this time.

42. SPATIAL STRUCTURE OF AIRBORNE DUNLIN FLOCKS. Peter F. Major, Lawrence M. Dill, Department of Biological Sciences, Simon Fraser University, Burnaby, British Columbia, Canada V5A 1S6.

The three dimensional structure of flocks of dunlin (Calidrus alpina) was studied while the birds were in transit between feeding or loafing sites. A technique was developed that combines stereoscopic photography and photogrammetric analysis to determine the three coordinate position of individuals in flocks. The mean interbird distance of first nearest neighbors was 0.69 m; second and third nearest neighbor distances were 0.86 m and 1.05 m respectively. The mean density of birds in such flocks was about four birds/$m^3$. Analysis of interbird angles in both the vertical and horizontal planes indicates that dunlin nearest neighbors are concentrated to the right, behind and below. Such a spatial alignment results in areas in which few nearest neighbors occur (e.g. in front and below).

43. THE COLONIAL BIRD REGISTER: AN ACTIVE AND OPERATIONAL NATIONAL DATA BANK. Donald A. McCrimmon, Jr., Cornell Laboratory of Ornithology, 159 Sapsucker Woods Road, Ithaca, New York 14853.

Since 1975, a variety of private, state, regional and Federal projects have surveyed nesting colonies of seabirds throughout North America. The Colonial Bird Register is a unique computerized National data bank for the efficient dissemination of much of this information. This paper reviews the data collection, management and retrieval methodology of the Register, summarizes the diversity of current holdings of colony information and focuses attention on present and future needs for additional data.

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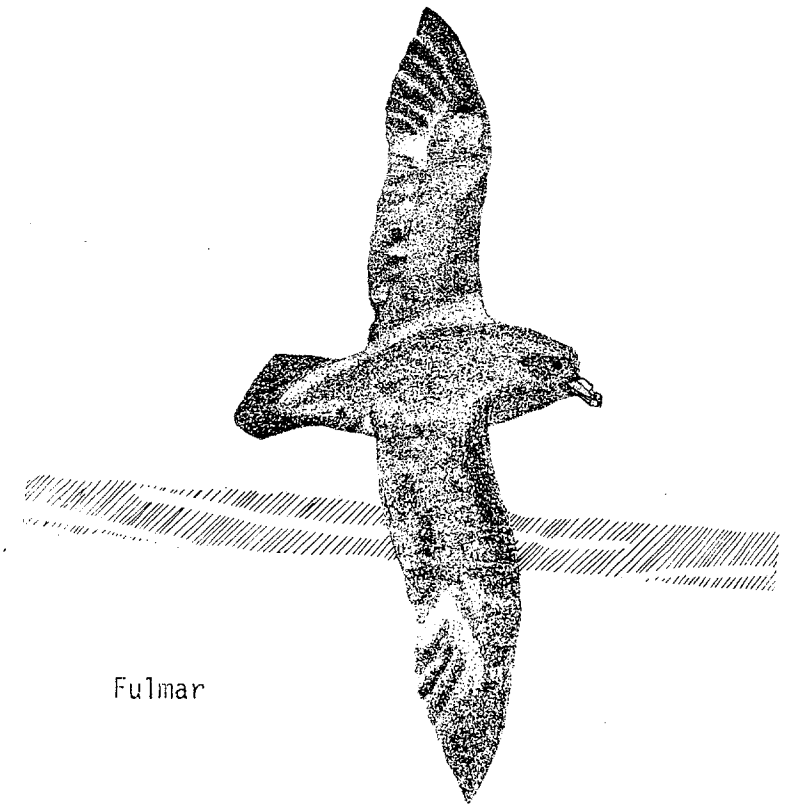

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