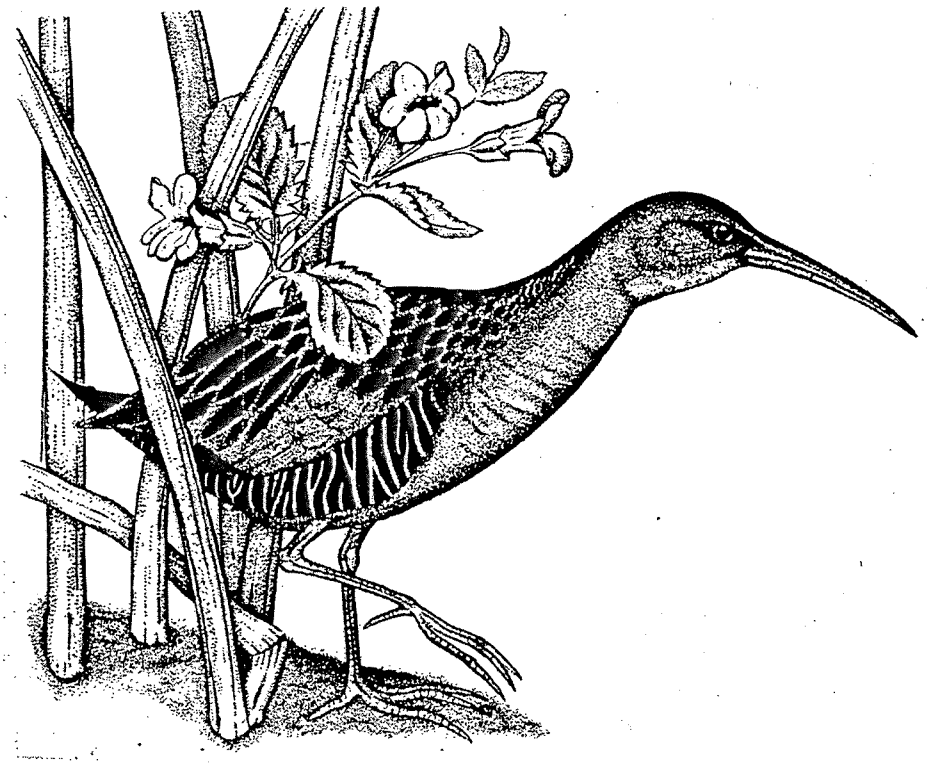
Book Reviews



Wetlands in Danger. Patrick Dugan (ed.). Oxford University Press, New York. 192 pp., numerous color photographs and maps. ISBN 0-19-520942-7, cloth $35.00.

Wetlands include some of most important and neglected habitats. This volume highlights the importance and conservation needs of wetlands. Patrick Dugan, the editor, is one of the most qualified to edit this volume. He has been the coordinator of the Wetland Program of the International Union for the Conservation of Nature (IUCN) since 1984. He has been heavily involved in the conservation of wetlands throughout the world, and primarily in Europe and West Africa.

This is the third volume in a series on conservation of ecosystems by Oxford University Press. The two preceding volumes are The Last Rain Forests, and Deserts: The Encroaching Wilderness.

The book begins with a series of introductory chapters on "What are Wetlands," "Why we need Wetlands," "Adapting to Life in Wetlands," and "Wetland Loss." These are followed by the bulk of the book: an "Atlas of the world's wetlands." The land masses of the world excluding the Antarctic are divided into 19 areas which are covered individually. Each section of 4 to 12 pages (median 6) has been written by a group of authors. The book concludes with a chapter on "The Challenge of Conservation."

The Section on "The United States - The Lower 'Forty-eight'" includes sections on the national wetlands inventory and the concept of no net loss as well as sections on major wetlands: floodplains, the loss in California's Central Valley, the Chesapeake Bay, the Mississippi delta, and the Everglades. One to two paragraphs are devoted to each topic.

The book is a well-researched coffee-table book. It is lavishly illustrated, often with three photographs per page. The information is up to date, but each geographic area or topic is only briefly summarized. The result is a nice, but limited overview. The text may offer a short introduction to wetlands in geographic regions with which the reader may be unfamiliar, but for those areas that the reader knows, the text will be of little help.

I can only recommend this as a coffee-table introduction for wetlands conservation. Those who need details and more specifics should seek more detailed references.

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Andell, P., J., Durinck, and H. Skov, 1994. Baltic marine areas of outstanding importance for wintering seabirds. World Wildlife Fund Baltic Bulletin March 1994: 2–8. (P. Andell, Dept. of Ecology, University of Lund, S–223 62 Lund, Sweden.)

Though the Baltic Sea is far away from our Pacific seabirding areas, this paper, indeed the whole bulletin of the World Wildlife Fund, is worthy of our attention. The first complete survey of the offshore wintering seabirds of the Baltic Sea was carried out in January and March 1992 and 1993 by ship–based transects, complemented during the second year by aerial census, total count, of all waterbirds along all coastal areas. While the survey was coordinated by Danish scientists, all nine Baltic countries (Denmark Estonia, Finland, Germany, Latvia, Lithuania, Poland, Sweden, and Russia) contributed to its success. We find here for the first time the total numbers of wintering seabirds of the Baltic, and the classification and tabulation of the 39 most important wintering areas (offshore as well as inshore) of the 30 seabird species present. Among the seabirds are the Fulmar, five species of loons and grebes, a cormorant, a coot, a swan, 13 kinds of sea ducks and mergansers, five species of gulls, and three alcids. Almost all of the northwest European population of the Old Squaw and Velvet Scoter winter in the Baltic, together with one–third of the three million Common Eiders. A total of over nine million seabirds were found in the censused, southern portion of the Baltic, more than twice as many as previously estimated. The northern Baltic arm, the Bay of Bothnia was not included, apparently it often freezes in winter and thus offers no good offshore wintering areas. The authors summarize the necessity, indeed urgency of increased protection of areas of wintering concentrations and we learn that a special international commission is working on management plans. This report is accompanied by excellent color photos of Baltic seabirds. This issues of the W.W.F. Baltic Bulletin has other seabird–related articles as well

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Abstracts from the Twenty-Second Annual Meeting of the Pacific Seabird Group

ABUNDANCE OF MARBLED AND KITTLITZ'S MURRELETS (*BRACHYRAMPHUS MARMORATUS* AND *BREVIROSTRIS*) IN SOUTHCENTRAL AND SOUTHEAST ALASKA. *Beverly A. Agler, Steven J. Kendall, Pamela E. Seiser,* and *David B. Irons,* U. S. Fish and Wildlife Service, Anchorage, Alaska 99503.

We used small boats to conduct surveys of Lower Cook Inlet (June 1993, February-March 1994), Prince William Sound (July 1993, March 1994), and Southeast Alaska (June-July 1994). In all areas, we surveyed randomly-selected, short transects. Although transect length and definition of strata varied among surveys, survey methodology was identical. We used a ratio estimator to estimate population sizes and variances. Marbled and Kittlitz's murrelets were combined as *Brachyramphus* murrelets, because of the difficulty in separating these species in breeding plumage. We estimated (+95% CI) that there were 58,227 + 16,058 *Brachyramphus* murrelets in Lower Cook Inlet during June 1993, and 11,627 + 7,410 murrelets in the eastern half during February-March 1994. For Prince William Sound, we estimated 159,433 + 42,059 *Brachyramphus* murrelets during July 1993, and 36,318 + 17,705 murrelets during March 1994. We estimated that 687,061 + 201,162 *Brachyramphus* murrelets were in Southeast Alaska during June-July 1994. Estimated densities by area were: Lower Cook Inlet, summer 4.2 birds/km2, winter 3.1 birds/km2; Prince William Sound, summer 17.8 birds/km2, winter 4.0 birds/km2; and Southeast Alaska, summer 19.4 birds/km2. We discuss the distribution of *Brachyramphus* murrelets in these three areas and the validity of these estimates.

WILL THE THREATENED NEWELL'S SHEARWATER SOON BE ENDANGERED? *D.G Ainley, L. DeForest, N. Nur, R. Podolsky, G. Spencer,* PRBO, Stinson Beach CA 94970; and *T.C. Telfer,* Dept. Land & Natural Resources, Lihue HI 96766.

We investigated the status of Newell's Shearwater on Kauai in three ways: (1) analysis of data gathered annually, 1978–1994, on 1000–2000 fledglings by the Save Our Shearwaters (SOS) program provided an index to population trends; (2) field work in a breeding colony and in the urban corridor encircling the breeding areas, 1993–94, helped to calibrate and interpret SOS data; and (3) population modeling projected the consequences from various factors. Estimated size of the breeding population is 12,600 pairs. We found (1) a high incidence of non–breeding among burrow occupants (0.46%); (2) a high incidence of predation on subadults and adults by introduced house cats and Barn Owls (2.5% of burrow occupants per year); (3) respectable success among breeding pairs (0.66 chicks per year); (4) about 15% of all fledglings produced each year are processed by SOS; (5) mortality of fledglings due to fallout (coming to ground after attraction to lights) is high (ca. 10%); and (6) mortality to adults and especially subadults from collisions with powerlines is lower (0.6–2.1% per year). Driving population (negative) growth is, foremost, mortality of adults/subadults by introduced predators and, secondarily, mortality of fledglings and adults/subadults due to collisions with human–made structures. The SOS program is critical to reducing the rate of population decline.

INTRODUCTION OF FOXES TO ALASKAN ISLANDS–HISTORY, EFFECTS ON AVIFAUNA, AND ERADICATION. *Edgar P. Bailey,* Alaska Maritime National Wildlife Refuge, 2355 Kachemak Bay Drive, Homer, Alaska 99603.

Foxes originally were absent from most Alaskan islands in the North Pacific. Red foxes (*Vulpes vulpes*) were indigenous to the Fox Islands in the eastern Aleutians and to some islands off the Alaska Peninsula and in the Gulf of Alaska. The first recorded introduction of foxes was in 1750 when Russians released arctic foxes (*Alopex lagopus*) from the Commander Islands on Attu, the westernmost island in the Aleutians. Russians released red and arctic foxes on other islands mainly in the early 1800s. By the 1930s, over 450 islands had been stocked mainly with arctic foxes for fur farming. During this period the first government surveys and concerns about the effects of alien foxes on insular avifauna arose, although Aleuts had indicated that seabirds were disappearing on some islands with introduced foxes as early as 1811. Besides foxes, Norway rats (*Rattus norvegicus*), ground squirrels (*Spermophilus undulatus*), and other mammals were introduced. Foxes eliminated populations of Aleutian Canada Geese (*Branta canadensis leucopareia*) on all except three small islands. Populations of seabirds, particularly burrow–nesters, were also drastically reduced by foxes. Refuge personnel began eliminating foxes in 1949, and spectacular recoveries of bird populations are occurring. Introduced foxes remain on 40 islands, mostly in the Aleutians and south of the Alaska Peninsula.

FLIGHT ENERGETICS OF FREE–RANGING WEDGE–TAILED SHEARWATERS. *Lisa T. Ballance,* SW Fisheries Science Center, 8604 La Jolla Shores Drive, La Jolla, CA 92037.

Flight energetics of free–ranging Wedge–tailed Shearwaters (*Puffinus pacificus*) were quantified on Johnston Atoll using doubly labeled water to measure field metabolic rate (FMR), an open–flow system to measure oxygen consumption rate, and activity recorders to monitor foraging behavior at sea. Birds spent an average of 9% of the time brooding, 25% sitting on the water, and 65% in flight. Mean FMR was 7.9 W; mean resting metabolic rate was 3.0 W; and the power required for flight averaged 9.9 W. The latter value was only 37% of that predicted (26.8 W) from equations based on aerodynamic theory. Aerodynamic theory predicts that birds in this study would require a mean of 0.5 m s^{-1} of lift to be able to soar. Wind velocity during the period of FMR measurement averaged more than ten times this, 5.5 m s^{-1}. Thus, this striking difference between measured and predicted costs of flight is likely due to the ability of birds to soar, and in fact, observations of Wedge–tailed Shearwaters at sea confirm that their flight includes a complex set of behaviors which probably serve to take advantage of wind energy and substantially

lower their energetic cost of flight.

RESTORATION OF SEABIRD ISLANDS. *Brian Bell*, Wildlife Management Inc., Wellington, NZ

Seabirds are most vulnerable at their breeding sites, the oceanic and continental shelf islands. Most of these have been affected by the introduction of exotic animals, particularly but not exclusively mammals. There have been many reasons for these introductions which historically interesting but more important are the affects that have had on the ecology, especially seabird habitat and numbers. Today we have the ability to remove most of these animals through improved technology and poisons and better transportation. This does not mean there are no problems and challenges to be met, but with commitment and resources these can be overcome.

The variety of animals which have been introduced is large, but some stand out as the more significant. Goats and rabbits have proved most destructive to seabird habitat causing gross devegetation and loss of soil, while cats and rats species, and man himself have caused mass depletion of seabird numbers. The eradication of problem animals can result in a rapid restoration of habitats and numbers, and often no further action is required (rehabilitation). On other islands, the degradation may be so great and recovery so slow that some interventionist management may be required to assist or speed up the recovery (restoration). This may involve regeneration projects or the translocation of species. There are excellent examples available which illustrate these approaches.

International recognition that action can be taken to restore islands in growing. Several countries have undertaken projects and some international agencies are prepared to fund such programmes.
There us a need for this message to be spread and applied throughout the world. The PSG conference is a step in that direction.

What remains to be accepted is the conviction that even large islands with multiple problems ca be restored, the only restriction being resources. New Zealand is moving into this phase over the next year or two.

CHRONIC OIL POLLUTION IS A LARGE SOURCE OF MORTALITY FOR MAGELLANIC PENGUINS (*SPHENISCUS MAGELLANICUS*). *P. Dee Boersma*, Dept. of Zoology, Univ. of Washington, Seattle, WA 98195.

Chronic pollution appears to be a global problem and may be a more important source of seabird mortality than currently recognized. Chronic oil pollution kills more than 22,000 juveniles and 20,000 adults Magellanic Penguins each year along the coast of the Province of Chubut, Argentina. Mortality of this magnitude from chronic pollution exceeds mortality from many major oil spills. At Punta Tombo, Argentina the penguin population has declined each year since 1987. The largest decline occurred in 1991, a year when a large amount of oil was released as penguins returned to breed. Oil pollution appears to be a factor in the decline of the population, however, other factors such as variation in food appear to also be important. When seabird populations are already in decline, chronic oil pollution may accelerate the process.

ALCID REPRODUCTIVE BIOLOGY AT THE OREGON COAST AQUARIUM. *Lauric L. Brogan*, Oregon Coast Aquarium, 2820 S.E. Ferry Slip Road, Newport, OR 97365.

The seabird breeding program at the Oregon Coast Aquarium has been involved in ongoing research projects dealing with the reproduction of captive seabirds. The research program has been initially aimed at our breeding population of tufted puffins (*Lunda cirrhata*). The project started in 1993, replacing four Tufted Puffin eggs with a dummy egg containing radio telemetry equipment to measure incubation temperatures. This data was transmitted to a base computer for storage and later retrieval and analysis. Utilizing this data, the staff set the incubator to reflect a more accurate parent incubation temperature for the pulled eggs. The result of this effort was the first Tufted Puffin to be hatched by artificial incubation. The chick was hand raised, but was later euthanized due to possible congenital problem. In the 1994 breeding season, we placed six dummy eggs with an upgraded computerized egg containing orientation sensors and microchip thermocouples to gain more accurate data on egg incubation temperature and rotation. Concurrently, we again artificially incubated, hatched, hand raised, and this time, successfully fledged a Tufted Puffin.

We intend to adapt this technology to further our captive breeding program of Rhinoceros Auklets (*Cerorhinca monocerata*) and Pigeon Guillemots (*Cepphus columba*).

THE COMPOSITION, DENSITY AND DISTRIBUTION OF THE SEABIRD FAUNA OFF SOUTHWESTERN VANCOUVER ISLAND IN 1993-1994. *Alan E. Burger*, Dept. of Biology, Univ. of Victoria, Victoria, B.C., Canada V8W 2Y2; and *Andrea D. Lawrence*, 5012 Old West Saanich Road, Victoria, B.C., Canada V8X 3X1.

Vessel surveys were made once a month along a 145 km transect loop, over the broad continental shelf off southwestern Vancouver Island. This is a productive and physically dynamic area which supports high densities of seabirds, particularly non-breeding migrants. There is also a high risk of oil spills here, from large volumes of shipping and the Alaska-Puget Sound tankers. Seabird densities were compared with sea surface temperatures, salinity, relative prey abundance (measured with a 200 kHz echosounder) and bottom topography at both coarse (>10 km; monthly means) and fine (250 m; 1 min) scales. The presence of hake factory ships in summer and fall strongly affected the distribution of surface-feeding species (shearwaters, fulmars and gulls) but had negligible effect on divers (cormorants and alcids). Concentrations of both guilds were sometimes, but not invariably, associated with fine-scaled thermosalinity fronts. The highest concentrations of several species were found in shallow shelf areas (50-80 m deep) adjacent to the Juan de Fuca Canyon.

INTERANNUAL VARIATIONS IN THE DENSITIES AND BEHAVIOUR OF MARBLED MURRELETS ON LAND AND AT SEA, VANCOUVER ISLAND. *Alan E. Burger*, Dept. of Biology, Univ. of Victoria, Victoria, B.C. Canada V8W 2Y2.

Standardized dawn surveys of Marbled Murrelets (*Brachyramphus marmoratus*) were made in old-growth forest in the Carmanah-Walbran watersheds, SW Vancouver Island from 1990 through 1994. Within each season, data were selected from a 9-week core period to make interannual comparisons. Marine censuses were made in three nearshore areas (Trevor Channel and the Broken Group Islands in

Barkley Sound, and off the West Coast Trail) in most of these years. High nearshore sea temperatures were associated with decreased abundance of prey (euphausiids and schooling fish) in 1992 and 1993. In these years there were lower densities and premature departures of murrelets at sea, and lower detection frequencies and smaller proportions of occupied (subcanopy) behaviours at several inland sites. The timing of inland activity peaks also varied among years, but usually by less than 10 days. These interannual variations make it difficult to confirm and interpret apparent declines in the densities of local populations of Marbled Murrelets over the past 15 years. They also show the risks associated with assessing inland habitat suitability and occupancy from single-season studies.

DISTRIBUTION AND HABITAT RELATIONSHIPS OF THE MARBLED MURRELET IN CALIFORNIA. *Esther E. Burkett, Heather L. Johnson, Thomas Lupo*, Calif. Dept. of Fish and Game, 1416 Ninth Street, Sacramento, CA. 95814; and *Peter Morrison*, Sierra Biodiversity Institute, P.O. Box 298, Winthrop, WA. 98862.

Distribution information on the Marbled Murrelet has increased since the species was state-listed as endangered and federally-listed as threatened in 1992. The State has been compiling inland and at sea distribution information into a data base to aid in recovery planning. Information comes from public and private sources and includes historical, anecdotal, and systematically-collected data. Geographic Information System technology allowed historic and current extent of old-growth redwood forests to be combined with murrelet distribution for mapping purposes. Records most indicative of murrelet nesting behavior were used to help refine the current extent of murrelet nesting habitat through satellite imagery interpretation. An analysis for Del Norte and Humboldt counties found ninety-six percent of murrelet nesting-associated records within 400 meters of old-growth redwood forests. The maps demonstrate that nesting-associated records rarely extend beyond thirty miles, and the eastern distribution boundary closely matches the historical extent of old-growth redwood forests. At sea records demonstrate clumped breeding season distribution, and limited non-breeding season movement from nesting areas. Additional surveys inland and at sea are needed to help recovery planning efforts.

MONITORING SEABIRDS ON THE ALASKA MARITIME NATIONAL WILDLIFE REFUGE: A PROPOSED LONG-TERM APPROACH. *G. Vernon Byrd*, Alaska Maritime NWR, 2355 Kachemak Bay Dr., Suite 101, Homer, AK 99603.

As part of its ecosystem management initiative, the U.S. Fish and Wildlife Service is emphasizing long-term wildlife status and trends monitoring programs on National Wildlife Refuges in Alaska. The Alaska Maritime NWR contains 80% of Alaska's estimated 50 million seabirds of some 35 species breeding at several thousand sites. The proposed strategy for long-term monitoring on this refuge is to select indicator species of seabirds based on trophic guilds for which annual productivity, major prey, and environmental correlates would be measured annually at 9 sites scattered geographically over the refuge. Population trends would be tracked from index plots surveyed at the 9 sites at least every 3 years. Information from these annual sites would be used as a basis for identifying resource problems and for interdisciplinary studies of ecosystem processes. Geographic gaps would be filled by less frequent observations at other sites. Input is being sought from seabird experts on whether this plan is biologically sound and whether it is a reasonable approach even if it is only partially funded.

FACTORS AFFECTING THE COST-EFFECTIVENESS OF OILED WILDLIFE RESPONSE. *Curtiss J. Clumpner*. International Bird Rescue Research Center, Berkeley, CA.

After the *Exxon Valdez* oil spill much discussion among environmentalists, trustee agency personnel and oil industry representatives centered on the cost of the oiled wildlife response. Many questioned the expenditure of millions of dollars to attempt to save less than 2,000 wild animals. This paper will compare costs among several spills that have occurred since 1988, including the *Exxon Valdez, American Trader, Shell Martinez, Nestucca*, and Texaco Fidalgo Bay. It will compare the total cost, cost per animal treated, and ratio between costs of wildlife response and overall response costs of a spill and attempt to identify factors that can affect them.

PENGUIN FORAGING BEHAVIOR IN RELATION TO THE DISTRIBUTION OF PREY. *Donald A. Croll*, Institute of Marine Sciences, University of California, Santa Cruz, Ca. 95064; *Roger P. Hewitt*, Southwest Fisheries Science Center, La Jolla, Ca. 92038; *David A. Demer*, Scripps Institution of Oceanography, La Jolla, Ca. 92093; *John K. Jansen*, Oregon Institute of Marine Biology, University of Oregon, Charleston, Or. 92074.

The diving behavior of 7 breeding Chinstrap Penguins (*Pygoscelis antarctica*) (N=12,171 dives) was measured concurrently with a hydroacoustic assessment of the vertical distribution and abundance of their primary prey, krill (*Euphausia superba*) in the vicinity of Seal Island, Antarctica between January 19 and March 10 1992. Penguin foraging was concentrated around noon and midnight, with a reduction in effort around dawn and dusk, perhaps a result of diel changes in the methods used by penguins to locate prey. The depth of Chinstrap Penguin dives followed the migration pattern of krill which dispersed in the upper portion of the water column at night and was concentrated and deeper during the day. On average, chinstrap penguins dove to the shallow limit of the distribution of krill. The maximum depth of penguin dives did not exceed the maximum depth distribution of krill. Our results suggest that penguins do not require dense aggregations of prey in order to capture sufficient krill to meet their energetic needs. We hypothesize the diel migration pattern of krill, found to be variable in different study locations at different times, may in part be determined by the intensity of predation pressure in the upper portion of the water column.

FLIGHT SPEEDS AND COSTS DURING REPRODUCTION IN HEERMANN'S GULLS. *Horacio de la Cueva*, CICESE, Ensendada, Baja California, México, 22800.

Estimations of reproductive expenses and daily energy balance of any bird with parental responsibilities should include the costs of chick rearing, adult maintenance, and foraging. I consider chick growth (estimated with a Gumperts curve), adult maintenance and flight costs, and morphology to determine parent's optimal flight speed and

energy expenditure when feeding young. Predicted (testable) flight speeds and costs, respectively, for *Larus heermanni* (Heermann's Gull) are: minimum power (9.2 ms–1, 5.3 W), maximum range (12.6 ms–1, 6.1 W, and optimal speeds for feeding 1–3 young (13.6 ms–1, 8.6 W; 14.6 ms–1, 11.3 W; and 14.2 ms–1, 14.2 W, respectively). When food load and predominant winds are taken into account optimal speeds, flight costs, and foraging ranges change. The model can be tested measuring: chick growth rate, load size, flight speeds, and maximum flight range of adults rearing chicks.

IMPACTS OF AIRCRAFT DISTURBANCE ON REPRODUCTIVE SUCCESS OF THICK–BILLED MURRES: MAJOR THREAT OR MINOR STRESSOR. *Tarra Curry* and *Edward Murphy*, Institute of Arctic Biology and Dept. of Biology and Wildlife, Univ. of Alaska Fairbanks, Fairbanks, AK 99775.

During the years 1992–93, we monitored Thick–billed Murres on St. George Island for reproductive success both on plots which were heavily disturbed by aircraft overflights and on plots farther from the airport. These plots were monitored every 1–3 days from the first egg–laying until the last chick–fledging to determine hatching success, duration of incubation, fledging success, and duration of the chick period. In addition, several plots were selected for videotaping with cameras set up to record behavior of the murres prior to, during, and after aircraft overflights. Videos were analyzed and scored for birds leaving the plot, incubators standing off of their eggs, brooders standing off of their chicks completely and brooders tending (standing off of their chicks but with wings in a protective positions). Our analyses failed to detect a significant decrease in reproductive success due to aircraft disturbance; plots in the vicinity of and distant from the airport showed similar success rates and breeders seldom abandoned eggs or chicks, even temporarily, during overflights. There was a strong correlation between the noise level of a light and the number of non–breeders flushing in response.

MOVEMENT PATTERNS OF DARK–RUMPED PETRELS AND NEWELL'S SHEARWATERS AT KAUAI ISLAND, HAWAII. *Robert H. Day* and *Brian A. Cooper*, ABR, Inc., P.O. Box 81934, Fairbanks, AK 99708.

We studied movement patterns of these two endangered, nocturnal tubenoses at Kauai in 1992–1994 with ornithological radar and night–vision scopes. Movement rates for both species peaked for 2 h around sunset and sunrise but were low in the middle of the night. Dark–rumped Petrels generally moved when there was more ambient light than did Newell's Shearwaters, which were strongly nocturnal. Movement rates were much higher in fall 1993 than in fall 1992 (probably because of Hurricane Iniki in 1992) and were higher in summer than in fall. Movement rates increased through time in summer, probably because of increasing numbers of subadults at that time but declined through time in fall because of fledging. Lunar effects on movement rates appeared to be small. Movement rates varied geographically, being much higher on eastern and northern Kauai than on southern Kauai. Movements were predominantly inland in evening, seaward in the morning, and both directions in the middle of the night. Most birds flew 25–275 m above ground level, with no relationship between elevation of a site and flight altitude of birds at that site. Flight altitudes at a site were similar seasonally and were highest in early evening in summer but not different in fall. Dark–rumped Petrels flew at significantly higher altitudes than did Newell's Shearwaters in fall 1993 and summer 1994 but not in summer 1993.

VOCALISATIONS OF THE XANTUS' MURRELET: REPERTOIRE, INDIVIDUALITY, AND MANAGEMENT IMPLICATIONS. *Sharon B.C. Dechesne*, Dept. of Biology, Univ. of Victoria, Victoria B.C. V8W 2Y2.

Accurate population sampling of Xantus' Murrelet (*Synthliboramphus hypoleucus*) is complicated by many factors. First, traditional techniques are logistically difficult and costly. Second, the murrelets' nocturnal activity pattern at their colony and cave or crevice nesting further hinders observations. Third, census efforts on the colony provide information on the population of breeders, but not non–breeders. Finally, none of these techniques capitalise on the birds' only conspicuous colony acitivity, the nightly chorus, occurring on the waters surrounding the colony. Individually distinct vocalisations are predicted for this species to facilitate mate, parent, and/or offspring recognition (as necessitated by their life histories); they have also been found in closely related species. If individual differences in the vocalisations could be detected, inexpensive tape– recordings could complement other census techniques. Relative to other techniques, recording is also not invasive: an important factor to this candidate for threatened or endangered species status (C2: USFWS). In this preliminary study I determined the murrelets' call repertoire, measured the call–type variation, and, where possible, measured the individual variation of the vocalisations. Some aspects of the adult and chick calls appear to show sufficient stereotypy to be useful for individual discrimination and may prove useful in population censusing.

WINTER DISTRIBUTION OF THICK-BILLED MURRES FROM THE NORTHWEST ATLANTIC IN RELATION TO COLONY OF ORIGIN. *G.M. Donaldson*, Dept. of Biology, University of Ottawa, Ottawa, Ontario, K1N 6N5; *A.J. Gaston*, Canadian Wildlife Service, 100 Gamelin Blvd., Hull, Québec K1A 0H3; *J. Chardine*, Canadian Wildlife Service, St John's Newfoundland; *K. Kampp*, Zoological Museum, Universitetsparken 15, DK-2100 Copenhagen 0, Denmark; *R.D. Elliot*, Canadian Wildlife Service, Sackville, New Brunswick.

Distributions of recoveries of birds banded at colonies on Coats, Digges, and Coburg Islands, at Cape Hay and in Greenland, showed some similarities which were characteristic of colonies from similar geographic areas. Murres from Hudson Strait colonies were recovered later in the winter than birds from all other locations. Significant differences in distribution were detected between colonies located relatively closely to one another. Recovery rates of first winter and second winter birds from Digges Island were significantly lower than those for birds of the same age from the adjacent colony on Coats Island suggesting different spatial distributions of the young birds from the two colonies. Differences in the overwintering areas for adults from Coburg Island and Cape Hay, again located closely together, differed significantly with Coburg adults recovered in greater numbers in Newfoundland while Cape Hay adults were recovered most often in West-

ern Greenland. A small number of recoveries from adult birds banded on Prince Leopold Island were all recovered inGreenland.

THE PROPOSAL TO LIST THE ALASKA BREEDING POPULATION OF STELLER'S EIDERS AS THREATENED UNDER THE ENDANGERED SPECIES ACT: AN OVERVIEW. *Janey B. Fadely* and *Lori Quakenbush*, U.S. Fish and Wildlife Service, 1412 Airport Way, Fairbanks, AK, 99701, and *Karen Laing*, U.S. Fish and Wildlife Service, 1011 E. Tudor Road, Anchorage, AK, 99503.

In July, 1994, the U.S. Fish and Wildlife Service published a proposal to list the Alaska breeding population of the Steller's Eider as threatened under the Endangered Species Act. A final rule on the listing is expected in 1995. Rough estimates of the world population in the 1960s ranged from 400,000 to 500,000, but the current estimate, based on aerial surveys, is between 150,000 and 200,000. Most Steller's Eiders nest in Russia and winter in the Aleutian Islands of Alaska. As many as 3,500 pairs were estimated to nest on the Yukon–Kuskokwim Delta in the 1960s; however, only one nest has been found on the Delta since 1975. Currently the only documented breeding population in Alaska is in the vicinity of Barrow on the arctic coastal plain. The size of that population is uncertain. Causes of the decline of Steller's Eiders are unknown.

USE OF PESTICIDES FOR MANAGING PREDATORS TO ENHANCE SEABIRD POPULATIONS. *Kathleen A. Fagerstone*, Denver Wildlife Research Center, P.O. Box 25266, Denver Federal Center, Denver, CO 80225–*0266*.

In recent years, the Animal Damage Control (ADC) program and its research facility, the Denver Wildlife Research Center (DWRC), have become increasingly involved in protection of seabirds and of threatened and endangered species. This talk will describe some of those efforts. The DWRC developed required data and coordinated efforts to register diphacinone in Hawaii to control mongooses, which prey on endangered bird species. The DWRC is also working with a variety of groups to register diphacinone to control rat depredation on Hawaiian threatened and endangered plants and animals. A program has been established to control brown tree snake populations, which have caused the extinction of most bird species in Guam, and prevent their introduction into Hawaii. The ADC program conducted the following work in the Pribilof Islands to protect populations of ground–nesting seabirds: 1) eradicated arctic foxes from Kiska Island using Compound 1080 baits; 2) registered the M–44 for controlling arctic foxes; 3) assessed the potential impact of rodents on island environments; and 4) assisted in establishing a surveillance system to prevent rat infestations. An emergency use registration for brodifacoum was obtained by ADC for use against rats in American Samoa on Rose Atoll. DRC–1339 labels were expanded to include protection of threatened and endangered, including the California least tern, from predators. Additional examples will be provided.

BREEDING BIOLOGY OF THE MAGNIFICENT FRIGATEBIRD (FREGATA MAGNIFICENS) ON THE ISLAND OF BARBUDA, WEST INDIES. *Jack P. Feldman*, Point Reyes Bird Observatory, 4990 Shoreline Hwy., Stinson Beach, CA 94970; and *Wayne Z. Trivelpiece*, Dept. of Biology, Montana State University, Bozeman, MT, 59717.

The Magnificent Frigatebird has a unique breeding strategy among seabirds, where males can attempt breeding every year, while successful females can only breed every other year. Due to the long chick–rearing period (13 months+), at least one of the parents must take care of the single chick, thus negating the possibility of breeding the following year. In this species, the male departs when the chick is approximately 3 months old, leaving the female to provision the chick for the remaining 10 months of post–fledging care. About 120 pairs were followed in each of two consecutive years between Nov. 1988 and June 1990 in a large colony on the island of Barbuda in the NE corner of the Caribbean, to determine basic breeding biology, including reproductive success, breeding chronology and parental investment. Also included were diet samples, and chick monitoring to determine growth rates as well as sex ratio.

MARBLED MURRELET PRODUCTIVITY IN 1994: AGE DETERMINATION AT SEA AND AGE RATIOS AS A MEASURE OF PRODUCTIVITY. *David Fix, Jeff Jacobsen, Craig S. Strong, Ron LeValley*, and *Brian Smith*, Crescent Coastal Research/Mad River Biologists, 1696 Ocean Dr., McKinleyville CA 95521.

Assessment of Marbled Murrelet productivity using hatch–year/after hatch–year (HY/AHY) ratios at sea is confounded by difficulty in distinguishing HY birds from AHY birds in advanced prebasic molt. During marine surveys in northern California from June to September, 1994, we examined body and wing molt characteristics to evaluate which were most useful for accurate age determination in the field. As the season progressed, the most effective criterion changed from upper body molt to abdominal body molt to primary wing molt and behavior. Accurate age determination was possible until mid–September. Daily HY/AHY ratios averaged 5.4% during August and September (range 0 to 21.8%). The proportion of HY birds increased from June to late July, but did not show an increasing trend after late July. The significance of this apparently low reproductive rate is discussed.

UPDATE ON THE STATUS OF SEABIRDS BREEDING IN THE TROPICAL ISLAND PACIFIC. *Elizabeth N. Flint*, U.S. Fish and Wildlife Service, Pacific Remote Islands National Wildlife Refuge Complex, P.O. Box 50167, Honolulu, Hi 96850, U.S.A..

I reviewed seabird distribution and conservation status on all islands and archipelagos of the tropical Pacific administered by 26 different governments. Information levels from each island nation vary, but a common theme of widespread loss of breeding populations of all but the most predator–resistant species was evident. Threats to seabirds in the region include predation by introduced mammals including man, habitat destruction by introduced mammals including man, various fishery interactions, contaminants including oil, volcanic eruption, and sea level rise. Introduced mammals are almost ubiquitous. I assigned breeding seabirds to four classes of predator vulnerability based on their ability to coexist with various combinations of introduced mammals. Class A birds include storm–petrels, *Pterodroma* petrels, small shearwaters, and Blue–gray Noddies. All species in this group have undergone dramatic range and population declines since human

colonization of the Pacific. Entire archipelagos and island nations have apparently lost all breeding Procellariforms. Of the 26 countries surveyed, perhaps only eight still have healthy colonies of class A species, and only six of these have legal protection for sites and management plans. Just a subset of these countries are actually implementing management of their seabird colonies.

INVOLVEMENT OF THE COMMUNITY OF BAHIA ASUNCION IN THE RESTORATION OF SEABIRD COLONIES IN THE ISLANDS OF ASUNCION AND SAN ROQUE, BAJA CALIFORNIA SUR, MÉXICO. *Lourdes Flores*, School of Marine Affairs, University of Washington, HF–05, Seattle, WA 98195; *Raven Skydancer*, The Evergreen State College, 2417 Island Dr, Olympia, WA 98502; *Bernie Tershy*, *Don Croll* and *Dawn Breese*, Island Conservation and Ecology Group, Long Marine Lab., University of California, Santa Cruz, CA 95060.

To obtain better results in the eradication of non–native cats and rats and the restoration of migratory seabird colonies in the islands of Asuncion and San Roque, BCS, Mexico, we developed a program for community involvement in the adjacent town of Bahia Asuncion. The program consisted of several visits to Bahia Asuncion. During the first visit we 1. identified key members in the community and introduced ourselves and the restoration project, and 2. explored feasible ways to introduce the information about the project to the community and to promote individual participation. Three months later we made a second visit in which we 1. did surveys in the schools, fishing cooperatives and general public to asses knowledge and use of the islands before the eradication and restoration project started; 2. organized a workshop with the elementary school teachers to provide information on basic ecology of islands and environmental education, as well as to explore their ideas on the subject; 3. obtained information from the school teachers on how to elaborate an adequate product to inform the kids at school and the general public about the restoration project; and 4. interviewed several of the first settlers of the community to obtain information on the early history of Bahia Asuncion and the natural history and usage of the islands to asses the date of introduction of non–native rats and cats and which bird species used to nest there. We concluded that local community involvement plays a critical part in seabird restoration projects.

SEABIRDS OF HOWLAND AND BAKER ISLAND – SEVENTY YEARS OF ADAPTING TO DISTURBANCE, INTRODUCED PLANTS, RATS, AND CATS. *Douglas J. Forsell*, U.S. Fish and Wildlife Service, 177 Admiral Cochrane Dr., Annapolis, MD 21401.

Howland and Baker islands are located near the equator at approximately 176 degrees west longitude. In the past 130 years the islands have been subjected to guano mining, colonists, and military occupation. These occupations have brought several severe disturbances by man and each has left rats, cats, or introduced plants. Although the islands are separated by 40 miles, several hundred thousand seabirds of 12 species have moved between the islands responding to each disturbance. The entire colony moved from Baker Island to Howland Island with the occupation by the military in 1942. The military left cats and a vigorous growth of Digitaria on Baker Island. Cats and Digitaria were eliminated from Baker in the late 1960's. By the early 1970s most of the birds had moved to Baker from Howland which still had cats and had developed a vigorous growth of Digitaria. Only Red–tailed Tropicbirds, Masked Boobies, and a few Brown Boobies remained on Howland. Cats were eliminated from Howland Island in 1986. Red–footed Boobies have started nesting and several other species have been seen on Howland. Nesting chronology indicates the cats preyed on young chicks of Masked Boobies.

ECOTOURISM, FIELD STUDIES AND STRESS: BEHAVIORAL AND HORMONAL RESPONSES OF MAGELLANIC PENGUINS TO NEST SITE DISTURBANCE. *Gene S. Fowler*, Dept. of Biology, Pomona College, *609 N. College* Ave., Claremont CA 91711.

Seabird colonies can be tourist attractions, and often receive many visitors, but human visitation at nest sites poses many potential problems for breeding birds. I studies behavioral and hormonal responses to nest visits at a Magellanic Penguin colony, in 3 areas with very different histories and rates of human visitation. One area (TOURIST) received many visits daily, and had for many years. The other 2 (STUDY and CONTROL) received a single daily visit for 2 years, or none at all, respectively, prior to this study. I visited nests for 5 minutes and collected behavioral data, and then collected a blood sample to assess levels of corticosterone as an indicator of stress. STUDY and CONTROL area birds did not differ in either behavioral or hormonal responses, but both differed strongly from TOURIST area birds, which exhibited fewer alarm behaviors and had lower corticosterone titers. Penguins appear to habituate to constant high levels of visitation, but not to less constant (even though regular) visitation. These results suggest that tourism should be concentrated in as small an area as possible, allowing the visited birds to habituate to humans, while leaving the majority of the colony undisturbed.

CONSERVATION GENETICS OF MARBLED MURRELETS. *V.L. Friesen*, Dept. Biology, Queen's University, Kingston, Ont. K7L 3N6, Canada; *A.J. Baker*, Dept. Ornithology, Royal Ontario Museum, Toronto, Ont. M5S 2C6, Canada; and *J.F. Piatt*, NBS, 1011 E. Tudor Rd., Anchorage, AK 99503.

Genetic information is important for the design of a successful conservation policy for Marbled Murrelets (*Brachyramphus marmoratus*). Most importantly, as a population declines, its genetic resources become depleted; this depletion can decrease the animals' ability to cope with environmental perturbations, such as climatic change or disease epidemics. If local populations of murrelets are genetically different, then populations must be managed as independent units to prevent loss of genetic variation; if the species is essentially panmictic, protection of individual subpopulations will be less critical. Genetic data can also provide insight into the extent of gene flow among local populations, and thus the potential for natural recolonization of depopulated areas. Furthermore, genetic information is essential for restocking or captive breeding. We are currently conducting genetic analyses of murrelets from throughout the North Pacific. Preliminary results of protein electrophoresis and sequence analysis of the cytochrome b indicate that Long-billed Murrelets (*B. m. perdix*) are genetically isolated from North American Marbled Murrelets (*B. m. marmoratus*) and repre-

sent a distinct species. Genetic differences also exist among North American Marbled Murrelets, with murrelets from Attu Island being most distinct.

MASS AND DATE AT DEPARTURE AFFECT THE SURVIVAL OF ANCIENT MURRELET *SYNTHLIBORAMPHUS ANTIQUUS* CHICKS AFTER LEAVING THE COLONY. *Anthony J. Gaston*, Canadian Wildlife Service, National Wildlife Research Centre, 100 Gamelin Blvd., Hill, Quebec K1A 0H3, Canada.

I compared the timing of colony departure and mass of 53 Ancient Murrelet *Synthliboramphus antiquus* chicks that were retrapped as adults in Haida Gwaii, British Columbia, with those of 3992 chicks not retrapped. Assuming that the probability of recapture is a measure of survival, I found that survival was related to both mass and date. The chances of survival increased with mass at departure for chicks from the Reef Island colony, while at East Limestone Island, those that left after the median date of departure survived better than those that left earlier. The effect of date was not related to a seasonal change in departure mass, because chick mass declined with departure date. I suggest that, because of heavy adult mortality during breeding, the timing of breeding in the Ancient Murrelet is based on a compromise between the optimum dates for chick and adult survival. This is in contrast to evidence from other, non–precocial, seabirds.

SUCCESSIVE CLUTCHES IN THE BLACK NODDY, *ANOUS MINUTUS* . *Vanessa Gauger*, Zoology Dept., Univ. of Hawaii, Honolulu, HI 96822.

Most tropical seabirds have been reported to raise a single brood per year; however, the reproductive strategy of nesting more than once a year has seldom been looked for. I studied Black Noddies nesting on Tern and Laysan Islands in the Northwestern Hawaiian Islands, and on Heron Island in eastern Australia, to determine whether pairs attempt successive clutches within an annual nesting season. I also studied factors which may affect a pair's reproductive success, including mate and nest fidelity, timing of nesting, and the fledgling's behavior in prolonging the period of post–fledging feeding. I monitored the reproductive success of color–banded pairs on Tern Island from 1987 to 1989. During the nesting season from November 1987 to October 1988, 36% of 56 pairs fledged two successive chicks (about five months apart). During the 1988-1989 year-long nesting season, 37% of 75 pairs fledged two successive chicks, and 4% fledged three successive chicks. These results indicate that successive clutches may regularly contribute to reproductive success in this population. However, I observed no attempts at successive clutches by pairs nesting on Heron Island during the 1992–1993 nesting season, nor on Laysan Island during the 1993–1994 nesting season. I compared chick growth rates, and incubation shift lengths between the three populations, as indirect indicators of the availability of food resources.

AGE AND BREEDING SITE SELECTION IN THICK–BILLED MURRES: EFFECTS ON VULNERABILITY TO PREDATION BY GLAUCOUS GULLS. *H. Grant Gilchrist, Leah N. deForest*, and *Anthony J. Gaston*. (H.G.G) Dept. of Zoology, University of British Columbia, 6270 University Blvd., Vancouver, BC, Can. (L.N.d. & A.J.G.) Canadian Wildlife Service, 100 Gamelin Blvd., Hull, Que., Canada.

Thick–billed murres (*Uria lomvia*) breeding for the first time (inexperienced) typically have lower reproductive success than experienced breeders. Vulnerability to egg and chick predation by glaucous gulls (*Larus hyperboreus*) may provide a proximate mechanism for this observation. We compared gull predation and reproductive success of murres in relation to age and type of breeding site (e.g. number of neighbours, ledge width, proximity to rock walls, etc.) During calm wind conditions, gulls foraged on foot and successfully attacked edge nest sites on broad ledges. During windy conditions, gulls attacked narrow ledges by using updrafts that increased their maneuverability in flight. Based on these observations murre breeding sites were ranked from most to least vulnerable: 1) broad ledge, low breeding density, 2) narrow ledge, low density, 3) narrow ledge, high density, 4) broad ledge, high density. Murres breeding for the first time nested on sites that were associated with high rates of gull predation and low reproductive success. However, young breeders had a lower reproductive success than older breeders, even when both occupied the same type of site. We concluded that an increased probability of gull predation due to occupation of sub–optimal breeding sites accounted for part, but not all of the differences in breeding success between young and older breeders.

COMMUNITY–BASED SEABIRD MANAGEMENT IN NORTH–WEST GREENLAND. *H. Grant Gilchrist*, Dept. of Zoology, University of British Columbia, 6270 University Blvd., Vancouver, B.C. Canada.

The Thick–billed Murre (*Uria lomvia*) has declined dramatically at many breeding colonies in West Greenland due primarily to the substantial by–catch of the salmon gill–net fishery during the 1970s, and to persistent hunting and egging at colonies. In response to these declines, the Greenland Home Rule Government introduced legislation in 1988 which prohibited human access to colonies and hunting during the breeding season. However, the effectiveness of these restrictions in restoring murre numbers is largely unknown. Indeed, recent censuses in the Upernavik region indicate that colonies continue to decline there. I integrated data concerning murre reproductive ecology, gull predation, sources of colony disturbance, and hunting dynamics in the Upernavik region in a simulation model to assess the effectiveness of current legislation. The model indicated that hunters could meet their annual demand despite current seasonal constraints by concentrating their effort just prior to egg–laying. The model predicted the extirpation of several murre colonies in the region within 20 years. Smaller daily bag limits and a shorter hunting season could reverse this trend assuming high levels of hunter compliance, something that is unlikely given present levels of enforcement. I recommend: 1) further research on murre reproduction in the area, 2) that a detailed hunter survey is conducted, and 3) that community–based education programs are established to increase the level of voluntary compliance with current and future hunting legislation.

MONITORING ACTIVITY OF A MARKED MARBLED MURRELET POPULATION IN BRITISH COLUMBIA. *Michael J. Gill* and *Irene A. Manley*, c/o Chair of Wildlife Ecology, Biological Sciences, Simon Fraser University, Burnaby, B.C., V5A 1S6; *Andrew E. Derocher*, B.C. Ministry of Forests, 2100 Labieux Road,

Nanaimo, B.C., V9T 6E9; and *Gary W. Kaiser*, Canadian Wildlife Service, P.O. Box 340, Delta, B.C., V4K 3Y3.

During the 1994 breeding season, we attempted to study the local stability and movements of a population of Marbled Murrelets in an area near Powell River, British Columbia. Between June and July, we captured and color-marked 174 individuals and attached 43 telemetry transmitters. Color-marks were dyed feathers attached to the back of the head. This proved to be a poor marker as the feathers would remain attached for only a short period. Marbled Murrelets were captured at dawn and dusk in a narrow inlet using an array of three mist nets floating on light rafts. The mean capture times were 5 min before sunrise and 22 min after sunset. The mean capture rate was 2.5 birds/h (SE=0.2) with a high of 8.8 birds/h on the evening of 25 Jun. 1994. Fifty-eight resightings of 32 individuals (including a recapture of a bird banded in 1993 at the same site) were made. Forty-two of these resightings were made through radio-tracking, 13 through direct sightings of color marks, and three through recapture.

IMPROVING SAMPLING DESIGNS AND ANALYTICAL TREATMENT OF MARINE BIRD SURVEYS. *J. Christopher Haney*, The Pennsylvania State University, DuBois, PA 15801.

Since the early 1970s, exploration for energy reserves on continental shelves of North America (e.g., the OCSEAP studies) prompted numerous ship-board and aerial surveys of marine birds. These data are routinely used to estimate density and population size, detect habitat use and foraging patterns, and model trophic relationships. Here, I provide examples for improving analytical quality of these studies. (1) For exploratory surveys that seek primarily to document taxonomic composition and seasonal occurrence, asymptotes of cumulative species curves plotted against effort can reveal marginal costs (in ship time or travel distance) arising from added effort; (2) rarefaction from such curves allows valid comparisons of species richness across regions or seasons. (3) When available and bias-free, species proportions at colonies provide null models against which to test composition of species detected at sea (e.g., via log-linear analysis). Lower- or higher-then-expected proportions may indicate that some species are under-represented by marine sampling, that some species have more non-breeders foraging near the colony, or both. (4) Because they provide unbiased estimates of density and population size, adaptive cluster sampling is appropriate when locations and shapes of clusters (foraging patches) cannot be predicted a priori, a common problem in at-sea surveys of marine birds.

COMPARATIVE DEMOGRAPHY OF BLACK-LEGGED KITTIWAKES (*RISSA TRIDACTYLA*) IN THE GULF OF ALASKA AND SEA OF OKHOTSK. *S.A. Hatch*, Alaska Science Center, National Biological Survey, 1011 E. Tudor, Anchorage, AK 99503, *A. Ya. Kondratyev* and *L.F. Kondratyeva*, Institute of Biological Problems of the North, Russian Academy of Sciences, 24 Karl Marx St., Magadan 685000 Russia.

By Atlantic standards, the productivity of kittiwakes in Alaska is low and declining. Compensating for their low productivity, Pacific kittiwakes are relatively long-lived. We posed the question, "What mechanisms produce the observed trade-off of productivity and survival in different populations of Black-legged Kittiwakes?" We're testing two hypotheses by comparing productivity and survival rates at kittiwake colonies in the Gulf of Alaska and Sea of Okhotsk. H1: The inverse relation between productivity and survival is a direct result of the cost of reproduction. (Prediction: productive colonies in the Sea of Okhotsk will have lower rates of adult survival, consistent with the contrast between Pacific and Atlantic populations.) H2: The inverse relation between productivity and survival reflects the relative amounts of seasonality in different systems. (Prediction: Pacific colonies should have relatively similar rates of over-winter survival because birds from different colonies experience much the same environment in winter.) Our preliminary findings support hypothesis 2. In spite of differences in productivity between the Gulf of Alaska and Sea of Okhotsk, kittiwakes in these two regions have similar mean survival rates. We suggest the following conclusions based on hypothesis 2: (1) over-winter survival is determined primarily by the interaction of population density and food supply in winter, (2) kittiwakes from widely separated Pacific colonies experience relatively similar feeding conditions in winter, and (3) Pacific kittiwakes experience less seasonal variation (summer versus winter) in food resources than Atlantic kittiwakes.

RECOVERY MONITORING OF PIGEON GUILLEMOT POPULATIONS IN PRINCE WILLIAM SOUND, ALASKA. *D. Lindsey Hayes*, U.S. Fish and Wildlife Service, Anchorage, AK 99503.

The population of Pigeon Guillemots in Prince William Sound decreased from about 15,000 in the 1970s to about 3,000 in 1993. Some local populations were affected by the *Exxon Valdez* oil spill in 1989, but there is evidence suggesting the overall population was already declining. In 1994, we monitored 20 guillemot nests on Naked Island (NI) and 24 on Jackpot Island (JI) from the egg stage through fledging. Hatching success was 0.89 (n=37, NI) and 0.80 (n=46, JI); fledging success was 0.55 (n=33, NI) and 0.76 (n=37, JI). On NI, predation was the cause of several nesting failures and suspected of being the cause of numerous others. The most likely mammalian predators were river otters. Predation on eggs by jays, crows, or especially magpies was also suspected. Although predation was infrequent or nonexistent on JI, abandonment of eggs was high. Sandlance accounted for about 1% and 8% of prey items delivered to guillemot chicks at JI and NI in 1994; by contrast, the sandlance component of the chick diet at NI was about 55% in 1979. Gadids were much more prevalent in the diet of guillemot chicks at NI in 1994 (about 30%) than in 1979-1981 (<7%). Changes in the relative proportions of benthic and schooling fish in the diet of guillemot chicks might represent a key change in the ecosystem that is affecting several species of marine birds and mammals in the Sound.

WING MORPHOLOGY AND FLIGHT BEHAVIOR OF PELAGIC SEABIRDS ON JOHNSTON ATOLL. *Fritz Hertel*, Dept. of Biology, UCLA, Los Angeles, CA 90024; and *Lisa T. Ballance*, SW Fisheries Science Center, 8604 La Jolla Shores Drive, La Jolla, CA 92037.

Johnston Atoll in the central Pacific provides a breeding site for twelve species of pelagic seabirds that exhibit a variety of feeding behaviors including plunge diving, pursuit plunging and aerial feeding. Data were collected from eight of these species,

which represent a taxonomic diversity of three orders and four families. Wing loadings (body weight/wing area) and aspect ratios (wing span2/wing area) were calculated for each species and analyzed using a principal components analysis and a discriminant function analysis. Results indicate that wing loadings and aspect ratios are reasonable predictors of flight behavior in these species even when considering historical factors by adjusting for differences in phylogeny.

EGG SIZE AND THE GROWTH OF NESTLING THICK–BILLED MURRES: AN EGG SWITCH EXPERIMENT AT TWO COLONIES IN HUDSON STRAIT, N.W.T., CANADA. *Mark Hipfner*, Dept of Biology, Univ. of Ottawa, Ottawa, Ontario, K1N 6N5: and *Garry Donaldson*, Canadian Wildlife Service, Hull, Quebec, K1A 0H3.

We examined the contributions of egg size and parent quality to the growth of nestling Thick–billed Murres *Uria lomvia* by switching eggs at random among breeding pairs at two Low Arctic colonies, Coats and Digges Islands, N.W.T., Canada. Egg sizes were similar at the two colonies. Feeding rates were ca. 3 times higher at Coats than at Digges, so that by 14 days of age chicks at Coats averaged 70% heavier than those at Digges. At Coats, the size of foster eggs and the mass of foster chicks were positively and significantly correlated at 2 days of age, but the correlation weakened considerably as chicks grew older. At Digges, the correlation was still significant when chicks were 14 days old. At neither colony was the size of egg laid by a breeding pair a good predictor of the growth of the chick they fostered. The importance of egg size may vary depending on the potential growth of the chick.

FACTORS AFFECTING THE LENGTHS OF INCUBATION PERIODS OF THICK–BILLED MURRE EGGS AT COATS ISLAND, N.W.T., CANADA. *Mark Hipfner*, Dept of Biology, Univ. of Ottawa, Ottawa, Ontario, K1N 6N5; and *Anthony J. Gaston*, Canadian Wildlife Service, Hull, Quebec, K1A 0H3.

We examined the effects of lay date, mean daily air temperature, and egg size on the lengths of incubation periods of eggs of Thick–billed Murres *Uria lomvia* at Coats Island, N.W.T., Canada. There was a significant negative correlation between incubation period and lay date. This seasonal decline in incubation periods was not caused by the seasonal warming trend. Nor could it have been caused by obvious seasonal changes in the incubation behaviour of adult birds, because murres lay a single egg and incubation is continuous from the time of laying. There was no relationship between egg size and incubation period. In fact, the seasonal decline in incubation periods occurred in the absence within our sample of a seasonal decline in egg sizes. A seasonal decline in incubation periods could be adaptive for murres in that it may increase hatching synchrony among breeding pairs. It may also contract the length of the breeding season for late–laying pairs. The proximate cause of the decline is unknown.

CENSUS TECHNIQUES AND POPULATION TRENDS OF BLACK–LEGGED KITTIWAKES IN GLACIER BAY, ALASKA. *Elizabeth R. Hooge*, NBS, Alaska Science Center, Glacier Bay Field Station, Gustavus, AK, 99826; and Museum of Vertebrate Zoology, Dept. of Integrative Biology, Univ. of California, Berkeley, CA, 94720.

Glacier Bay National Park hosts several Black–legged Kittiwake (*Rissa tridactyla*) colonies. I will report on techniques being developed to measure fine–scale population trends. In 1993 we tested the multiple–count method with a bootstrapping technique, and demonstrated that five counts are sufficient to encompass the observed variation in colony attendance and to detect changes as small as five percent. In addition, a new photographic census technique was tested; it greatly reduced the time required for censusing while producing counts that were not significantly different. The number of breeding pairs at Margerie Glacier declined significantly from 1991 through 1993, and fewer than ten percent of nests produced a chick in 1991 and 1992. However, in 1993, a record–breakingly warm year, chick production was very high, with 47% of all nests producing at least one chick. In the subsequent year (1994) adult colony attendance increased significantly to the highest value observed to date, yet virtually no chicks were produced. I will present a hypothesis to explain the large variance in colony attendance and reproduction, which will be tested in subsequent years.

PROGRESS IN RAT EXTERMINATION ON LANGARA ISLAND, BRITISH COLUMBIA. *G. R. Howald*, Dept. Animal Science, University of British Columbia, Vancouver, B.C.; *G. W. Kaiser*, Canadian Wildlife Service, P.O. Box 340, Delta, B.C., V4k 3Y3; *P. F. Buck*, Huksta Forestry Services, P.O. Box 258, Massett, Haida Gwaii, B.C., V0T 1M0.

In 1995, the Canadian Wildlife Service plans to recover a seabird colony habitat by eradicating rats on Langara Island (3,200 ha) and adjacent Lucy Island (40 ha). During 1994, we used remote sensing cameras to record scavengers at carcasses of trapped rats and tested baiting methods on Lucy Island. After a 7-day delay, rats took all of the baits offered until a sudden cessation of activity 8 to 10 days later. Most of the baits and carcasses remained underground, offering limited exposure to non-target animals. We terminated the test baiting as soon as activity ceased, but a rat was trapped 3 weeks later. The actual baiting period will need to be extended in 1995 to ensure success. The local population of dusky shrews (*Sorex obscurus*) was hit very hard (perhaps 85% loss), but a mitigation plan has been developed. The remote sensing cameras recorded many crows and ravens scavenging carcasses of snap-trapped rats. We made a great effort to make such rats available to eagles, but they showed no interest. Beetles (*Nicrophorus* sp.) buried many rat carcasses within 2 to 14 days.

CALIFORNIA'S OFFICE OF OIL SPILL PREVENTION AND RESPONSE (OSPR) OILED WILDLIFE CARE NETWORK. *David A. Jessup*, Veterinary Services Unit, CDFG–OSPR, 1701 Nimbus Rd. "D", Rancho Cordova, CA, 95670.

Catastrophic oil spills can cause considerable environmental damage and immediate loss of wildlife. In 1990 California Legislature passed SB 2040 which states "The administrator shall establish rescue and rehabilitation stations for sea birds, sea otters, and other marine mammals." To meet this mandate OSPR is building a facility in Santa Cruz for rehabilitation, veterinary care, and research on oiled marine wildlife. When completed in the summer of 1996 at a cost of approximately $5 million dollars this facility will be capable of caring for at least 125 sea otters, be flexible enough to care for other marine animals, and house ongoing research projects. In 1993 a sec-

ond piece of legislation, SB 775 (Watson) allowed OSPR to use the interest from the $50 million dollar Emergency Response Fund to establish an Oiled Wildlife Care Network for the entire California coast in conjunction with existing scientific, educational institutions and wildlife rehabilitation facilities. The Network will share pertinent information, improve and standardize treatment and cooperate in research. OSPR's goals are to improve our ability to care for oiled marine wildlife, and to improve our ability to determine both the immediate and sublethal effects of oil pollution on marine animal populations.

DAILY VARIABILITY IN ACTIVITY PATTERNS OF MARBLED MURRELETS AT INLAND FOREST SITES IN THE OREGON COAST RANGE. *Patrick G.R. Jodice* and *Michael W. Collopy*, National Biological Survey Forest & Rangeland Ecosystem Science Center, Corvallis, OR, 97331.

Surveys for Marbled Murrelets were conducted at 4 inland forest sites in the Oregon Coast Range from 1 May–4 August, 1994. Surveys generally followed the Marbled Murrelet Survey Protocol, with the exception that each station was surveyed 55–66 times. Numbers of detection/day ranged from 0–198 across the 4 sites, with a maximum two day range of +100 detections. Daily detection maximums occurred from early July through early August. Mean number of detections/day ranged from 16–36 across the 4 sites, and most detections were auditory only. Variability in numbers of daily detections was high, with coefficients of variation (CV) ranging from 0.49–1.34. Mean duration of daily activity was also quite variable, with means ranging from 44–68 minutes, and CV's of 0.41–0.94. Mean time of first detection was 24 minutes prior to sunrise, and mean time of last detection was 28 minutes after sunrise. Measures of variation in daily Marbled Murrelet activity (e.g., detections, duration) will be useful in determining the feasibility of using these metrics for long–term monitoring at inland forest sites.

DID *AETHIA* AUKLET ORNAMENTS EVOLVE THROUGH SEXUAL SELECTION FOR SENSORY EXPLOITATION? *Ian L. Jones*, Department of Biological Sciences, Simon Fraser University, Burnaby, British Columbia, V5A 1S6, CANADA.

Male and female auklets (*Aethia* spp., Alcidae) display conspicuous facial ornaments including white plumes, crests and colorful bill plates during the breeding season. Previous experimental work has shown that Least and Crested auklets *Aethia pusilla* and *A. cristatella*, express mating preferences for elaborate natural ornaments, suggesting that the ornaments are favoured by mutual inter–sexual selection. I experimentally measured the sexual response of naturally crest–less Least Auklets to crests of different sizes on seven realistic least auklet models made from skins, at a large mixed species auklet colony at Buldir Island, Alaska. Least Auklets not only expressed a heterospecific mating preference for artificial crests similar to the crest ornament of Crested and Whiskered auklets *A. pygmaea*, but they also preferred larger crests over smaller ones. This is the first example from any bird of a sexual preference for the ornament of a different species. Because Least Auklets are ancestral to the two naturally crested auklet species, it is possible that crests evolved due to a mating preference that existed before the evolution of the ornament itself. These results are consistent with the sensory exploitation hypothesis, but do not preclude a role for other sexual selection mechanisms.

WHERE DO ADELIE CHICKS GO? *Nina J. Karnovsky, Bill Fraser, Donna Patterson, Wayne Trivelpiece, Doug Wallace*. Montana State University, Dept. of Biology, Lewis Hall, Bozeman, MT. 59717.

Adelie Penguins are highly philopatric to their natal colony but seldom return before the age of two. Several large colonies of Adelie Penguins breed on the Antarctic peninsula. Although it is well known that adults winter on the edge of the pack ice, it has not been known where the juveniles go during the winter period. We conducted seabird censuses during daylight hours in the Bellinghausen sea from 26 August, to 23 September 1993, on board the RVDuke. The transects covered the area between 64 - 68°S Lat. and 96 - 88° W Long. We encountered 123 Adelie Penguins and made the first observations on the pelagic distribution of juveniles. Like adults, juveniles were associated predominately with permanent ice. Although juveniles tended to make up a greater proportion of the Adelies found in the northern part of the study area, the high proportion of adults in the southern region was possibly a result of the close proximity to the Adelaide Island breeding colonies and the return migration of adults to colonies in the Anvers Island region. However, the tendency for a difference in distributions between the age classes could also have been related to difference in habitat preference or dispersal tendency.

FORAGING BEHAVIOR OF JAPANESE CORMORANTS IN RELATION TO ANNUAL CHANGE IN PREY TYPE. *Akiko Kato*, National Institute of Polar Research, Itabashi, Tokyo 173, Japan; *Yutaka Watanuki*, Lab. Appl. Zool., Hokkaido Univ., Sapporo 060; Yasuhiko Naito, Natl. Inst. Polar Res.

Annual difference in foraging behavior of Japanese Cormorants in relation to change in food availability was studied at Teuri I., Hokkaido in 1992–94 breeding seasons. Diving patterns were recorded with micro data loggers for 11 birds. Mean depth and duration of dives were 5–20m and 22–45 sec, respectively. Dive duration was dependent on dive depth. Distribution of dive depth were bimodal and varied between years. There were significant differences in food availability between years. In the years that pelagic fish (Japanese sand lance in 1992 or Japanese anchovy in 1994) dominated, the cormorants fed on pelagic fish utilizing shallower dives. In 1993 that pelagic fish was not abundant, they fed on benthic fish (greenling) utilizing deeper dives. Mean growth rate of chicks did not differ between years. They made shorter foraging trips more frequently in 1992 than later two years. Although they spent more time for foraging in 1993, fledging success was lower in that year. Japanese Cormorants appear to be opportunistic feeders, and that they can change their foraging patterns in response to prey availability.

DISPERSAL OF YOUNG WHITE PELICANS FROM WESTERN BREEDING COLONIES. *James O. Keith*, 159 Highland Dr., Bailey, CO 80421 and *Edward J. O'Neill*, Box 69, Merrill, OR 97633.

Young White Pelicans in three breeding colonies were either sprayed with dyes or fitted with patagial tags during six years to monitor their movements after fledging. This was part of an effort to determine where White Pelicans were contacting insecticides responsible for an unusual and continuous mortality. Young at Anaho Is-

land NWR were color-marked green, while those at Lower Klamath NWR were marked with yellow and those at Clear Lake NWR with red. Dyed birds provided greatest sightings (76%), but colors disappeared in 4 months. Fewer birds with tags were seen (24%), but reports continued for up to 34 months. Of 838 reports received from the public and biologists, 36% were from California, 18% from the western Great Basin, 27% from the northern Great Basin, 17% from the Snake River plain and Great Salt Lake, and 2% from elsewhere. Young from Anaho Island NWR were primarily seen in California (45%) and the western Great Basin (38%). Those from Lower Klamath NWR and Clear Lake NWR had similar dispersal patterns and were reported from the northern Great Basin (40%), California (29%), and the Snake River plain and Great Salt Lake (23%).

ESTIMATES OF MARINE BIRD ABUNDANCE IN SOUTHEAST ALASKA, DURING SUMMER 1994. *Steven J. Kendall, Beverly A. Agler, Pamela E. Seiser, David B. Irons*, U.S. Fish and Wildlife Service, Migratory Bird Management, Anchorage, Alaska 99503; and *John Lindell*, U.S. Fish and Wildlife Service, Ecological Services, Juneau, Alaska 99801.

During June and July, 1994, we conducted a small boat survey of Southeast Alaska. This was a preliminary survey done to estimate the abundance and distribution of marine birds. No such study had ever been done in this region. We used two 25-foot boats to survey short (approximately 1 mile long) transects distributed randomly throughout the entire southeastern Alaska panhandle. There were 650 transects selected from two strata, pelagic (> 200m from shore) and shoreline (<200m of shore). Survey methods were similar to those used previously in Prince William Sound and Lower Cook Inlet. Population estimates and variances were calculated using a ratio estimator. We estimated the total marine bird population (+95% CI) as, 1,924,662 + 568,894 birds. The most abundant species or species groups were *Brachyramphus* murrelets (687,061 + 201,162); waterfowl (Family Anatidae; 309,444 + 414,485), mostly scoters (*Melanitta* spp.; 252,213 + 413,588); gulls (*Larus* and *Rissa* spp.; 221,888 + 60,247), Rhinoceros Auklets (*Cerorhina monocerata*; 199,373 + 120,961) and murres (*Uria* spp.; 137,777 + 77,7333). To examine bird distribution we generated maps for important species and species groups using observation data from the transects. We also examined ways to improve the precision of the estimate for future surveys.

CHANGES IN MASS AND THE ADULT WITHIN-SEASON SURVIVAL RATE OF CASSIN'S AUKLETS ON TRIANGLE ISLAND, B.C. *Hugh Knechtel*, Department of Biological Sciences, Simon Fraser University, Burnaby, B.C. Canada V4A 1S6.

I describe changes in mass and the adult within-season survival rate of Triangle Island Cassin's Auklets during the 1994 breeding season. Triangle Island supports over a million Cassin's Auklets making it the largest colony of this species in the world. Birds were captured as they departed the colony to minimize disturbance, between April 6 and August 6, 1994. The total number of individuals trapped was 1001, while the total captures were 1609. Comparisons were made between two capture sites of different nesting density (West Bay nesting site is all Cassin's Auklets, while Calamity Cove is a mix of Rhinoceros Auklets and Cassin's Auklets), between sexes and between adults (white eyes) and sub-adults (brown eyes). Changes in mass are evaluated in the light of two hypotheses that concern mass loss by birds during breeding: that mass loss is a symptom of stress or that it is an adaptive response to optimize mass in relation to the increasing demands of breeding activities. Significant differences were found among groups of different age and breeding status. I propose to continue this study for an additional two years to examine the relationship of body mass and adult survival with environmental variability.

THE GROWTH OF CAPTIVE ANCIENT MURRELETS. *Alexander Ya. Kondratyev* and *Luba F. Kondratyeva*, Institute of Biological Problems of the North, Russian Academy of Sciences, Magadan 685000, Russia.

Ancient Murrelet chicks (*Synthliboramphus antiquum*) leave their nesting burrows at 2-3 days of age, so growth patterns cannot be studied under natural conditions. We collected two Ancient Murrelet chicks from different nests just before they left their burrows on Talan Island, Sea of Okhotsk, and raised them in captivity at our field station on the island. The chicks preferred to eat small fish such as capelin (*Mallotus villosus*), sand lance (*Ammodytes hexapterus*), and Arctic smelt (*Osmerus mordax*). During the first week of the chicks' life we fed them small amounts every 30-45 minutes day and night. During this week the chicks consumed about 100% of their body mass each day and doubled their body mass. At 8-9 days contour feathers appeared on the breast, belly, flank, and shoulder, and scapulars, but the growth rate did not decrease. Secondaries and tertials appeared at two weeks. Plumage growth was complete at one month except for the primaries and rectrices. Body mass increased rapidly for 30-35 days, at which time 80% of adult mass was attained; slow growth continued thereafter. At 45 days down was still visible on the nape and rump, and primaries and rectrices were still growing rapidly.

A SURVEY OF SEABIRD COLONIES IN THE NORTHERN SEA OF OKHOTSK. *Alexander Ya. Kondratyev*, Institute of Biological Problems of the North, Russian Academy of Sciences, Magadan 685000, Russia, and *Vivian M. Mendenhall*, U.S. Fish and Wildlife Service, Anchorage, Alaska 99503, U.S.A.

We surveyed 650 km of coastline in the Gulf of Shelikov, at the northern end of the Sea of Okhotsk (Russian Far East), for seabird colonies during 10-19 July 1994. This area had not been surveyed for bird populations previously. We recorded a total of 320,000 seabirds in 31 colonies. Most colonies consisted of a few hundred Pelagic Cormorants (*Phalacrocorax pelagicus*), Slaty-backed Gulls (*Larus schistisagus*), Spectacled Guillemots (*Cepphus carbo*), and Tufted and Horned puffins (*Fratercula cirrhata* and *F. corniculata*). We found two major colony complexes of approximately 85,000 and 200,000 birds. The primary species in these colonies were Common and Thick-billed Murres (*Uria aalge* and *U. lomvia*), and smaller numbers of Black-legged Kittiwakes (*Rissa tridactyla*). We hope that future work in this region can elucidate the prey resources that support these colonies and can survey portions of the coast that we were unable to.

USE OF AN ABANDONED DREDGING RIG AS AN ARTIFICIAL NESTING

PLATFORM BY DOUBLE-CRESTED CORMORANTS IN SAN DIEGO COUNTY. *John K. Konecny, Susan E. Wynn*, and *Doreen Stadtlander*, U.S. Fish and Wildlife Service, Coastal Ecosystem Program, 2730 Loker Avenue West, Carlsbad, California, 92008.

The Double-crested Cormorant (*Phalacrocorax auritus)* is a common permanent resident in California along the coast, and locally common on inland lakes in the coastal slope region. During spring and summer, numbers usually decrease and nesting occurs on coastal islands and inland near large rivers and lakes. Coastal Double-crested Cormorant nesting colonies are located in the Channel Islands, Farallon Islands, and Los Coronados Islands, and on nearshore rocks and islands north of San Francisco. The total breeding population on the coast of California is estimated to be approximately 2000 individuals. Breeding has not been documented in San Diego County until recently. For the last eight years the Double-crested Cormorant has opportunistically nested on an abandoned dredging barge anchored within Western Salt, Inc., in south San Diego Bay. Thirty-four nests were documented on the barge during the 1993 nesting season, and 44 nests were initiated during the 1994 season. The success of this barge as a nesting platform illustrates the high feasibility and likely success of creating artificial nesting structures at other locations in southern California.

CONTROL OF GULLS AND INTRODUCED PASTURE GRASSES FOR RESTORING TERN NESTING HABITAT ON MAINE COAST ISLANDS. *Stephen W. Kress*, Seabird Restoration Program, National Audubon Society, 159 Sapsucker Woods Road, Ithaca, New York 14850.

To restore a historic tern colony of Common Terns (*Sterna hirundo*) and Roseate Terns (*S. dougallii*) at Eastern Egg Rock in Muscongus Bay, Maine, 82 Great Black-backed Gulls (*Larus marinus*) and Herring Gulls (*L. argentatus*) were killed using the avicide DRC 1339 in 1973 and 1974. Subsequent control using shooting, nest destruction and human presence has kept nesting attempts to less than 25 pairs. To create nesting habitat for Common Terns, we found that application of rock salt (halite) at the rate of 0.73 kg/m limits plant growth during the season of application, but not in subsequent years and a controlled burn in spring had no apparent effect. Of the techniques tested to date, placement of landscape fabric to create patches of open space has proved most successful with 65 pairs of terns using these plots 4 years after placement. Grazing by goats and sheep within fenced enclosures at Seal Island NWR also offers promise of creating open patches for tern nesting. These techniques have resulted in restoration of the Egg Rock tern colony and its growth to 1198 pairs of Common Terns, 63 pairs of Roseate Terns and 48 pairs of Arctic Terns (*S. paradisaea*) in 1994.

FORAGING OF RADIO-TAGGED MARBLED MURRELETS IN PRINCE WILLIAM SOUND, ALASKA. *Katherine J. Kuletz, Dennis K. Marks, Debbie Flint*, U.S. Fish and Wildlife Service, Anchorage, AK 99503, and *Rick Burns* and *Lynn Prestash*, 726 E 4th st., N. Vancouver, BC, Canada V7L1K2.

We radio-tagged 46 Marbled Murrelets in Prince William Sound, Alaska, to study foraging patterns. We hypothesized that birds in Port Nellie Juan (PNJ), a deep water fjord, traveled farther than birds at Naked Island (NI), which is surrounded by relatively shallow water. We caught birds at sea in June 1994 and attached a 2 g transmitter to the back. In June and July we tracked by air (N=231 locations; 24 days), and boat (N=177; 42 d). Six inland sites (= 1.6 km inland) were assumed to be nests. We found no significant differences between birds at PNJ (N=33) and NI (N=13). Average straight-line distances for birds at PNJ were 17 km from capture site, 11 km between consecutive sites, 23 km maximum distance, and 129 km2 (minimum area polygon). Birds at NI averaged 15 km, 7 km, 20 km and 54 km2, respectively. From nests, average distance around land was 21 km, and 40 km for 1 bird. After chick hatching began, distance from capture site increased, but minimum area polygons decreased. Birds at NI used shallow areas (<80 m) more than expected based on availability. Birds at PNJ used depth classes in proportion to availability, and frequently used sites of upwelling. Thus, between areas, birds modified their habitat use, but not the distances traveled. These distances may represent a limitation for murrelets during the breeding season.

ADAPTIVE SIGNIFICANCE OF LAMPFISH DIETS FOR REPRODUCTION IN RED-LEGGED KITTIWAKES. *Brian K. Lance* and *Daniel D. Roby*, Alaska Coop. Fish and Wildlife Res. Unit, Univ. of Alaska, Fairbanks, AK 99775-0990.

Red-legged Kittiwakes (*Rissa brevirostris*) breeding on the Pribilof Islands, Alaska feed their young primarily lampfish (Myctophidae), while Black-legged Kittiwakes (*R. tridactyla*) are generalists that feed on a more diverse array of prey. Lampfish are extremely high in lipids and have over twice the energy density of gadids. We interspecifically cross-fostered chicks of the two kittiwake species to test the hypothesis that the more specialized diet of Red-legged Kittiwakes confers some adaptive advantage to chick of that species. Survival rates and peak body mass of cross-fostered chicks were not different from those of conspecific control chicks. Black-legged Kittiwake chicks had higher growth rates and greater lean mass at fledging that Red-legged Kittiwake chicks, regardless of whether they were raised by foster parents. But chicks of either species raised in Red-legged Kittiwake nests were on average 50% fatter at fledging than those raised in Black-legged Kittiwake nests. Consequently, growth rate of lean tissue was genetically/physiologically constrained, while fat deposition rate was constrained by diet. We hypothesize that the adaptive advantage of lampfish diets for Red-legged Kittiwake chicks is manifest in higher post-fledging survival.

RELATIONSHIPS BETWEEN PREY ABUNDANCE AND THE SPATIAL CORRELATIONS OF SEABIRDS AND PREY. *Elizabeth Logerwell*, Ecology and Evolutionary Biology, University of California, Irvine, CA 92717.

I studied the at-sea distribution and abundance of Common Murres (Uria aalge) and their prey, juvenile Pacific Herring (*Clupea harengus pallasi*), off the west coast of Vancouver Island in July 1993. I found that murres were successfully locating large-scale regions of high herring abundance but that within those regions murre and fish numbers were not correlated. To investigate whether the weak small-scale correlation between murres and herring was related to high prey abundance, relative to seabird food requirements, I estimated regional seabird consumption rates. In 1993

the seabird community consumed 22% of the biomass of juvenile herring off the west coast of Vancouver Island. These consumption rates may have been sufficiently low that it was not necessary for the murres to forage at the largest prey aggregations in order to meet their daily energetic needs—a foraging strategy that would result in poor small-scale correlations between the abundance of murres and herring. If correct, this hypothesis could explain the lack of small-scale correlation between the abundance of seabirds and their prey that has been observed by a number of authors in a variety of pelagic systems.

SPATIAL FORAGING MODEL OF CONTAMINANT UPTAKE BY DIVING DUCKS. *James R. Lovvorn*, Department of Zoology & Physiology, University of Wyoming, Laramie, WY 82071; and *Michael P. Gillingham*, Faculty of Natural Resources & Environmental Studies, University of Northern British Columbia, Prince George, BC V2N 4Z9.

Contaminant studies of migratory birds include two main approaches: (1) collecting wild birds and analyzing their tissues, and (2) toxicity assays with captive birds. In the first approach, one seldom knows how long individual birds have been in the area (perhaps they acquired contaminants elsewhere), and sites are often in urban environments where shooting is problematic. The second approach with captive birds ignores changes in food and contaminant intake with varying activity and weather experienced by wild birds. Neither of these approaches alone can predict maximum allowable contaminant levels in foods that avoid toxic effects under different field conditions, or what body burdens accumulate during varying lengths of stay and affect the birds' biology at other places and times. To allow such predictions, we developed an individual-based model of food intake by diving ducks for varying weather, water depth, food dispersion, and nutrient content of food. Food-intake estimates are combined with laboratory data on contaminant uptake as a function of food consumption and contaminant content. As an example, we estimate cadmium uptake by Canvasback ducks foraging on belowground tubers of the submerged plant *Vallisneria americana*.

USE OF FRESHWATER LAKES AND THE NEW AIRSTRIP BY KITTIWAKES ON ST. GEORGE ISLAND, ALASKA. *Sharon D. Loy* and *Edward C. Murphy*, Department of Biology and Wildlife, University of Alaska Fairbanks, Fairbanks, AK, 99775.

Red Legged Kittiwakes (*Rissa brevirostris*) and Black Legged Kittiwakes (*R. tridactyla*) aggregated in large numbers on the new airstrip on St. George Island, Alaska in 1993. Atka Lake, a freshwater lake near the airstrip, is a strong attraction for kittiwakes (for bathing, preening, and drinking), and about half the kittiwakes leaving Atka Lake flew to the airstrip to roost. Habitat manipulations in 1994 (hazing on the airstrip and a wire array covering Atka Lake) precluded use of Atka Lake and reduced numbers of kittiwakes roosting on the airstrip. In 1994, counts at Govorushka Lake were significantly higher than in 1993, but counts at Umanangula Lake were significantly lower. Telemetry data from 1993 showed that kittiwakes used freshwater lakes an average of 0.44 times/day. Kittiwakes nesting on the northwest and west cliffs (the areas of highest nesting densities) used the airstrip and the lakes near the airstrip most often. Birds nesting on the south side of the island typically used Umanangula Lake. Kittiwakes visit lakes most often after nest duty, before going out to feed. Birds may stay at nests for periods exceeding 48 hours.

ORGANOCHLORINE CONTAMINANTS IN NORTH PACIFIC ALBATROSSES: LONG-TERM IMPLICATIONS FOR REPRODUCTION AND POPULATIONS. *James P. Ludwig*, *Heidi J. Auman*, and *Cheryl L. Summer*, The SERE Group, Ltd., Box 556, Eureka, MI 48833 USA.

Laysan and Black-footed albatross tissues from Midway Atoll in the North-central Pacific were sampled for contaminants in 1992–1994. Blood and eggs have been tested for total and coplanar PCBs, dioxins, furans, other organochlorines and dioxin equivalents (TCDD-EQs). Black-foots were 2–4 times more contaminated than Laysans by PCBs and DDT-group compounds. Neither species was highly contaminated, but the patterns were unique; TCDD-EQs were elevated enough to cause reproductive problems. Black-foots had lower rates of egg viability, more egg cracking and higher embryo death rates than Laysans in 1993–94. Hazard indices for both species suggest that Laysans are near the NOAEL value for TCDD-EQs, but that black-foots are well into the LOAEL range where reproductive effects are expected. DDT-group levels are below levels expected to initiate eggshell thinning, but a third of the DDT compounds recovered were parent DDT isomers and not DDE, which indicates widespread active sources to this pelagic environment. Partially burned plastics from landfills are suspected as a source of the unique dioxin-furan contamination in these birds. Further increases in TCDD-EQs is predicted to cause greater transgenerational reproductive damage.

PIGEON GUILLEMOT NEST BOX PROJECT. *Mary S. Mahaffy*, U.S. Fish and Wildlife Service, Olympia, Washington 98501.

Wooden nest boxes for Pigeon Guillemots were placed at five locations in Washington between 1992 and 1994. Chicks and adults were color banded for individual recognition. These nest boxes are part of the bird monitoring program in Puget Sound under the Puget Sound Ambient Monitoring Program (PSAMP). PSAMP is an interagency, long-term monitoring program for measuring ambient, or background conditions in Puget Sound. The health of the Sound's fish and wildlife and their habitats are monitored to assess cumulative effects of contamination and habitat degradation. Depending on the success of the nesting box project, Pigeon Guillemots may be used as a contaminants monitoring species. Nest boxes were placed under piers at three locations in Puget Sound, on Protection Island National Wildlife Refuge, and on a coastal breakwater. Boxes were used by pigeon guillemots at all locations except one of the piers. Two boxes were used all three years at one location and a banded adult returned to the same box at a different location. Chicks were weighed and wing measurements taken. Rock doves used the boxes at all the pier sites. After the nesting season at one site, a mist net was attached to the outside edge of the pier and eight adult guillemots were captured and banded.

SEABIRD DENSITY AND SPECIES COMPOSITION ON MONTEREY BAY DURING EL NIÑO AND NON-EL NIÑO PERIODS. *John W. Mason*, Moss Landing Marine Laboratories, Moss Landing, CA

PO Box 401; and *James T. Harvey*, Moss Landing Marine Laboratories, PO Box 450, Moss Landing,, CA .

Long term monitoring of seabird populations is necessary to determine effects of large scale oceanographic events such as El Niños. Seabirds have been censused intermittently in Monterey Bay since the early 1980's. Density and species composition were determined from strip transects conducted on Monterey Bay from 1984-1987 (n=30) and 1992-1993 (n=16). For this study, seabird data collected from 1992-1993 represented El Niño effects, whereas 1984-1987 was considered non-El Niño data. Mean seabird densities were consistently greater in 1992-1993 than 1984-1987. For both El Niño and non-El Niño years, Procellariidae, Laridae, and Alcidae, respectively, were the most abundant families. For all years, Sooty Shearwaters were the most abundant species. Shearwaters occurred from May to October and accounted for 40 to 95% of total seabirds. Fifty-four seabird species were observed during El Niño years and only 44 species during non-El Niño years. Differences in species diversity may be El Niño related or an artifact of sample timing. Densities did not differ markedly between El Niño and non-El Niño years, however, species composition was affected by changes in oceanographic conditions.

CONTROL OF THE ALIEN PLANT *CENCHRUS ECHINATUS* ON LAYSAN ISLAND, NORTHWESTERN HAWAIIAN ISLANDS. *Duane K. McDermond, Elizabeth N. Flint, Marc A. Webber*, and *Cynthia A. Newton*, U.S. Fish and Wildlife Service, Honolulu, Hawaii, 96850.

In June 1991 Hawaiian Islands National Wildlife Refuge staff initiated a control and monitoring program for the introduced plant sandbur (*Cenchrus echinatus*). The sandbur infestation covers approximately 28% of the 212ha vegetated portion of the island. Monitoring data shows that sandbur displaces native vegetation and degrades habitat for fossorial seabirds and two endangered endemic landbirds. We evaluated several techniques to control sandbur, including manual removal, burning, and application of herbicides. The preferred method of control evolved into a combination of herbicide treatment and pulling of sprouts. Our long range objective is eradication of sandbur on Laysan Island. We will accomplish this by eliminating scattered outlying infestations while containing the main infestation within marked boundaries. After controlling outlying areas, our efforts will turn to elimination of the main infestation. As of October 1994, we are actively controlling 33ha of sandbur. Given the magnitude of Laysan's sanbur infestation, elimination of parent plants and an extensive seed bank will require years of vigilant effort.

CONTAMINANT LEVELS AND TROPHIC POSITIONING OF MARINE BIRDS AND MAMMALS IN THE GULF OF THE FARALLONES. *Elizabeth B. McLaren, William J. Sydeman, Peter Pyle*, PRBO, 4990 Shoreline Hwy., Stinson Beach, CA 94970, *Walter M. Jarman, Corrine E. Bacon, Janet A. Bott*, Univ. of California, Santa Cruz, Santa Cruz, CA 95064, and *Keith Hobson*, Canadian Wildlife Service, Saskatoon, SK, Canada S7N 0X4.

We conducted an integrative study of contaminant levels, trophic structure and trophic interactions in the food web of the Gulf of the Farallones with an emphasis on marine birds and mammals. We utilized stable isotope analysis to quantify trophic positioning, conventional diet studies to determine trophic interactions and assessed levels of organochlorine compounds and heavy metals in zooplankton, fish, seabird eggs and marine mammal tissue. Results indicate elevated levels of certain organochlorines (DDE and PCBs) and metals (mercury) in Common Murres and Steller's sea lions. Stable isotope analysis proved useful in quantifying trophic structure and bioaccumulation of organochlorines in the marine food web. Overall results indicate that most Farallon seabirds and their prey are relatively free of environmental contaminants.

MONITORING OF SEABIRD POPULATIONS AND PRODUCTIVITY IN WESTERN ALASKA, 1989-1991. *Vivian M. Mendenhall*, U.S. Fish and Wildlife Service, Anchorage, AK 99503; *Donald E. Dragoo* and *Arthur L. Sowls*, U.S. Fish and Wildlife Service, Homer, AK 99603; *Ada C. Fowler*, National Biological Survey, Anchorage, AK 99503; *Lisa Haggblom*, U.S. Fish and Wildlife Service, Dillingham, AK 99576; *Edward C. Murphy*, University of Alaska, Fairbanks, AK 99775; *Mike Nishimoto*, U.S. Fish and Wildlife Service, Honolulu, HI 96850, and *Brian E. Sharp*, 2234 NE 9th, Portland, OR 97212.

The U.S. Fish and Wildlife Service and Minerals Management Service jointly monitored populations and productivity of kittiwakes (*Rissa* spp.) and murres (*Uria* spp.) at six colonies in the Bering and Chukchi Seas: St. George Island, Cape Peirce, St. Matthew Island, Bluff, Little Diomede Island, and Cape Thompson. Diets were also monitored at several sites. Methods were standardized to facilitate comparisons among colonies and years. Most populations have been stable since 1984 or earlier at colonies where we could analyze trends by comparison with earlier data. Exceptions were a long-term decline in Red-legged Kittiwakes at St. George and recent moderate declines in two species at St. Matthew. Productivity (particularly of kittiwakes) fluctuated during the study, probably in association with diet. Mean productivity differs greatly among colonies in western Alaska; causes appear to include food resources and possibly predation. In order to detect and interpret population trends, we need statistically sound monitoring studies, careful selection of representative sites, observations at frequent intervals, and supporting data on life history and environmental factors.

VARIANCE–SENSITIVE PROVISIONING IN COMMON TERNS. *Dave Moore*, Dept. of Biol. Sciences, Simon Fraser University, Burnaby, B.C. V5A 1S6.

Until recently, Central Place Foraging theory has not considered how the effects of parent or offspring state may effect provisioning behaviour. In response to variation in brood demand, parents can adjust (a) the amount of time spent foraging, (b) their provisioning rate, or (c) their foraging decisions (e.g., prey selection criteria). An important factor in the latter case is that food items of different value also differ in variability about the mean encounter rate. Theory predicts that when the mean energy gains of two foraging options are similar, parents with a low probability of satisfying brood demand should choose the foraging option associated with high variability in expected energy gain and 'gamble' on an above-average encounter rate. Individuals able to meet brood demands should avoid such variability (i.e. foraging decisions are "variance– sensitive"). To test the predic-

tion that provisioning decisions of Common Terns are variance–sensitive, I manipulated brood size to simulate variation in energy demand on parents. I assessed parental responses to changes in demand by observing the types of prey they delivered to chicks, employing radio–telemetry to determine foraging locations and flight speeds, and measuring chick growth.

FACTORS AFFECTING THE FLEDGING DECISION OF CASSIN'S AUKLETS (*Ptychoramphus aleuticus*). *Yolanda E. Morbey*. Dept. of Biological Sciences, Simon Fraser Univ., Burnaby, B.C., V5A 1S6.

A seasonal decline in fledging mass is widely reported for alcids with semi–precocial or intermediate fledging strategies. This phenomenon is usually explained by seasonal deterioration of food availability or parental quality. An alternative explanation considers the differential growth and mortality faced by chicks in the nest and at sea. The est is characterized by low predation but low growth; the sea offers high growth but high predation. A chick should fledge when the benefits of higher growth at sea outweigh the costs of higher predation risk. When the fledging decision is modelled given these conditions, a seasonal decline in fledging mass is predicted (Ydenberg 1989). This general model also predicts that chicks hatched later in the season should fledge lighter and younger. I empirically tested the model using Cassin's Auklets by manipulating hatch date and measuring fledging mass and age. I conducted this research from Apr–Jul 1994 on Triangle Is., as part of the Triangle Is. Research Project. I will briefly describe the experimental protocol, describe the patterns of fledging behaviour, and compare the observed patterns to those predicted by the model.

WHITE BLOOD CELL REFERENCE RANGES OF ALASKAN SEABIRD SPECIES AND THE POTENTIAL EFFECTS OF OIL AND REHABILITATION ON THE AVIAN IMMUNE SYSTEM. *Dr. Scott Newman* , Wildlife Health Center, University of California, Davis, CA, 95616.

White blood cell counts and differential cell counts are among several routine blood tests performed to assess the health of a particular patient upon presentation to a rehabilitation facility following an oil spill. Alterations in these test values may be due to the effects of oil, the effects of stress, or a combination of the two. In the past few years, research has been undertaken to establish normal values for avian species commonly affected by oil spills.

During the summer of 1989, blood samples were collected from 13 species of sea birds which inhabit the Shumigan Islands, Alaska. Blood smears from these birds were used to estimate the white blood cell count and to perform a differential cell count of heterophils, lymphocytes, monocytes and eosinophils. During the summer of 1994, more baseline sea bird blood studies were conducted in California and Alaska. This work is currently being supported by The Department of Fish and Game, Office of Oil Spill Prevention and Response. In this paper I will discuss the avian immune system, how white blood cell counts and differential counts are performed, and the application of this information to veterinarians attempting to treat oiled wildlife.

THE SIGNIFICANCE OF CHRONIC OILING FOR SEABIRD POPULATIONS IN CENTRAL CALIFORNIA. *Nadav Nur, Peter Pyle, Lynne Stenzel, David G. Ainley, William J. Sydeman*, and *Elizabeth McLaren*. Point Reyes Bird Observatory, 4990 Shoreline Highway, Stinson Beach, CA 94970.

We evaluate the utility of two long-term data sets, collected by PRBO, for studying impacts of chronic and acute oiling incidents on seabird populations in Central California. The first data set consists of beached bird surveys conducted along California beaches, 1971-1984. Of 39,444 dead or dying marine birds censused, cause of death was ascribed for 4713 (11.9%), mostly attributed to oiling (83%). The second data set consisted of oiled birds (live or dead) observed at Southeast Farallon Island, 1977-1994. During this time, 2385 oiled birds or marine mammals were observed, mainly Common Murres (62%), but also Western Gulls and Cassin's Auklets. During this time period, four major oiling episodes were recorded (defined as >100 oiled birds observed in a restricted time period), only two of which were associated with a known oil spill; nine minor episodes of oiling were identified. 692 oiled individuals were observed outside major or minor oiling episodes. We compare temporal and taxonomic patterns of oiling for the two data sets, to provide insight into the spatial extent of oiling (local vs. regional), and compare known population trends with indices of oiling mortality (number and proportion of oiled birds). We discuss difficulties with determining population impacts from beached bird data. We conclude that chronic oiling presents an important source of mortality for many seabird species.

STATUS OF JAPANESE MURRELET COLONIES IN THE IZU ISLANDS, JAPAN, IN 1994. *Leigh K. Ochikubo*, Natl. Biol. Survey, 6924 Tremont Road, Dixon, CA 95620; *Harry R. Carter*, Natl. Biol. Survey, 6924 Tremont Road, Dixon, CA 95620; *John N. Fries*, Inst. of Ecology, Univ. of California, Davis, CA 95616.

The status of the three largest colonies of the Japanese Murrelet (*Synthliboramphus wumizusume*) in the Izu Islands, Japan, was investigated in April 1994 by a joint expedition between the pacific Seabird Group and Japanese biologists, including H. Higuchi and M. Ueta (Wild Bird Soc. Japan, Tokyo Res. Ctr.), M. Hasegawa (Chiba Nat. Hist. Mus. and Inst.) and J. Moyer (Wild Bird Soc. Japan, Miyakejima Nat. Ctr). Between 100–400 nests were estimated for each colony at Onbase Reef, Tadanae Island and Sanbondake Reef, based on nests discovered and amount of available nesting habitat surveyed on these small islands. At all islands, we found many broken eggshells and carcasses of dead adults, apparently due to predation by Jungle Crows and Peregrine Falcons, respectively. Populations on Onbase Reef and Sanbondake Reef apparently have declined since the late 1950s. At Sanbondake Reef, numbers had declined earlier due to bombing by the U.S. military in the early 1950s. At Tadanae Island, murrelets are further predated by Striped Snakes which also may be contributing to decline there.

CROW PREDATION ON JAPANESE MURRELETS ON BIRO ISLAND, JAPAN. *Koji Ono*, Dept. of Biol., Toho Univ., 2–1, Miyama 2, Funabashi, Chiba, 274 Japan; *John Fries*, Division of Environmental Studies, Univ. of Calif., Davis, CA 95616; *Yutaka Nakamura*, Miyazaki Medical College, 5200 Kiwara, Kiyotake, Miyazaki, 889–16 Japan.

The Japanese Murrelet (*Synthliboramphus wumisuzume*) nests on islands off the

coast of Japan and South Korea. Biro Island (400m x 400m, 75m a.s.l.), Miyazaki Prefecture, Japan, is the largest known colony, with an estimated 3000 birds. We conducted a preliminary study of predation at this colony from March–May 1994. Large numbers of people fish off the rocks around the base of the island, broadcasting ground–up seafood over the surface of the water to attract fish. Unused bait and other refuse is often left on the rocks, attracting crows from the mainland (2 km distant). Several crows (*Corvus corone, C. macrorhynchos*) breed on the island; however, we've observed more than thirty at a time fly in from the mainland. Our study site represents 17% of the island's surface. Evidence of predation was most often found in an open, rocky area at the foot of a cliff with a high density of murrelet nests. In 1994, we collected shell fragments from nearly 100 separate eggs and several adult kills. In order to reduce crow numbers, the local government plans to begin a program of education aimed at recreational fishermen.

EVALUATION OF MARINE CONCERNS RELATED TO THE MARBLED MURRELET. *John F. Palmisano*, JPBC. 1990 NW 156th Avenue, Beaverton, Oregon 97006.

Although they nest inland, Marbled Murrelets spend the majority (>98 percent) of their life in the near–shore marine environment where they reach sexual maturity and obtain virtually all of their food requirements—including food brought inland for nesting chicks. Governmental decisions to list the murrelet as a threatened species, and to propose critical habitat, have failed to adequately consider the significance of the marine environment. Specifically, that natural and human–influenced marine conditions can markedly reduce murrelet individual survival, reproductive rates, and population abundance. Natural factors include oscillations in ocean productivity and associated fluctuations in the abundance of murrelet and prey populations. Human influences include incidental fishing losses, oil spills, competition for food, policies that increase population abundance of competitor and predator species, and disturbance from commercial, recreational, and military activities. Because many marine conditions are influenced by human activities, potential adverse effects could be minimized by protecting near–shore marine areas critical to murrelet survival. Humans may be unable to control natural factors, but they can manage related natural resources during unproductive periods to favor murrelets. Human–directed actions intended to reduce abundance of competitor and predator species, and thus increase prey availability while reducing stress and predation, could help minimize adverse effects of natural events.

AN INTEGRATED PREDATOR MANAGEMENT PROGRAM TO PROTECT BREEDING SNOWY PLOVERS. *Michael W. Parker*, U.S. Fish and Wildlife Service, San Francisco Bay National Wildlife Refuge, Post Office Box 524, Newark, California, 94560; and *Gary W. Page, John S. Warriner*, and *Jane C. Warriner*, Point Reyes Bird Observatory, 4990 Shoreline Highway, Stinson Beach, California, 94970.

Snowy Plover (*Charadrius alexandrinus nivosus*) nest success has been limited by non-native red fox (*Vulpes vulpes regalis*) predation at the Salinas River National Wildlife Refuge (SRNWR) and adjacent lands. Between 1988 and 1990 approximately 47 percent of plover nests were lost to red fox predation at the SRNWR, and nest success was only 21% between 1986 and 1990. Since May 1991, predator exclosures have been installed around individual plover nests on the SRNWR and adjacent lands. Predator exclosures proved successful at increasing nest success; in 1992 plover nest success was 80 percent at the SRNWR. Exclosures did not protect plover chicks beyond the hatching stage because chicks are precocial and leave the protection of the exclosures within hours of hatch. Fledging success was approximately 19 percent at the SRNWR in 1992. Our data linked an increased mortality of adult breeding plovers, whose nests were protected by exclosures, to non-native red foxes. Predator control was initiated in August 1993 to improve fledging success and reduce the adult mortality. Preliminary results suggest that this integrated approach, which combines predator exclosures with the removal of non-native mammals, can be successful at increasing Snowy Plover production.

ALTERING ECOLOGICAL INTERACTIONS BY HABITAT MODIFICATION: A RESTORATION TECHNIQUE FOR COMMON MURRES. *Julia K. Parrish*, Dept. of Zoology, Univ. of Washington, Seattle, WA 98195.

Seabird populations suffer from a variety of natural and human–induced sources of mortality and loss of lifetime reproductive output. On the outer coast of Washington state, Common Murres, *Uria aalge*, have been declining due to a combination of factors including El Niño, the Tenyo Maru oil spill, and gillnet by–catch. At present, murres are only reproductively active on Tatoosh Island. On this colony, reproductive success had been severely depressed by interactions between murres and Bald Eagles, *Halieetus leucocephalus*, because the latter indirectly facilitates egg predation, which has led to reproductive failure. Because predator removal is unfeasible, and creation of "traditional" habitat is difficult, we have designed a manipulation which upgrades existing habitat by modulating community interactions. A pilot study of our temporary modification, the "silk forest," indicated that murre response to eagles was mediated, with a resulting increase in egg production. Manipulations which take advantage of innate tendencies (such as gregarious nesting) and augment the natural protection afforded by the system, are an effective and cost–efficient way of stabilizing populations. In this case, altering the balance between murres and their predators may allow time for other more broadly–based conservation strategies to take effect.

MUDDY WATERS: SEABIRD MORTALITY FOLLOWING THE *EXXON VALDEZ* OIL SPILL. *Julia K. Parrish*, Dept. of Zoology, Univ. of Washington, Seattle, WA 98195.

The *Exxon Valdez* oil spill has left us with vivid images of oil–covered seabirds and a general impression that the environment was devastated. For seabirds, these impressions are bolstered by scientific assertions that half a million birds were killed, the majority of which were murres. Initially, bird mortality projections ranged from 100,000 to 300,000. By 1993, the mortality model had been refined and total bird mortality increased to 375,000. Estimates reported in the popular science press and college textbooks were even higher. There is no doubt that many seabirds were killed; 30,000 carcasses is the largest number ever recovered following an iol spill. Assessing mortality impacts, however, requires careful science accompanied by accurate pre–

spill information on population status. For murre populations in the path of this spill, much of the necessary information was rudimentary, or lacking entirely. Science clearly has a pivotal role to play in assessing injury and culpability, but the expectation that scientists can clearly delineate cause and effect given little or no data is unrealistic. While it is essential that scientific results be translated for general consumption, it is imperative that findings not be sensationalized or exaggerated, especially in inherently emotional situations.

DEVELOPMENT OF A PREDATOR MANAGEMENT PLAN: AN ECOSYSTEM APPROACH. *Mark Alan Pavelka*, U.S. Fish and Wildlife Service, Carlsbad, CA, 92008.

The goal of most predator management plans is to limit or reduce the impacts of predation on the reproductive success of target species by removal or exclusion of predatory animals. In cases where the primary predators are native species this approach has led to the creation of "outdoor zoos" where the target species are "farmed" and isolated from elements of the surrounding ecosystem. An alternate approach is to consider the role of each species, or group of species, in the ecosystem and develop a plan which strives to restore the functional integrity of that system. This approach requires an understanding of the natural predator-prey dynamics, and an acceptance that some predation will be permitted. The difficulties lie in defining the limits of natural predation and determining the balance between acceptable loss and long term population stability. Implementation strategies other than removal (for native species), such as site restoration or behavior modification of individual predators, must also be considered to prevent further degradation to the system. The U.S. Fish and Wildlife Service is using this approach to develop a plan for managing predators in the vicinity of California Least Tern (*Sterna antillarum browni*) nesting colonies.

DISTRIBUTION, MOVEMENTS, AND POPULATION STATUS OF CRAVERI'S MURRELET: IMPLICATIONS FOR ECOLOGY AND CONSERVATION. *Robert L Pitman, Lisa T. Ballance, Stephen Reilly*, SW Fisheries Science Center, P.O. Box 271, La Jolla, CA 92038; and *Mike Force*, 2304 Prince Albert St., Vancouver, B.C., Canada V5T 3W5.

We censused marine birds throughout the Gulf of California and off the west coast of Baja California, Mexico, July to November 1993. The total population size for Craveri's Murrelet (*Synthliboramphus craveri*) was estimated to be 21,872 birds (95% CI: 8,405; 56,915). The majority of sightings (54%) were of paired birds (mean group size = 2.6; SE = 0.23) and nearly all (90.3%, n = 353) occurred in a 250 X 50 km area over the continental shelf break off Sinaloa, Mexico. Few were in the northern and western Gulf where breeding islands are located; almost none were present along the west coast of Baja. We argue that year-round pairing, precocial young, and rapid departure from the Gulf after breeding are adaptations that allow murrelets to complete their breeding cycle rapidly and take their chicks to distant, more productive feeding grounds. This allows this alcid to breed in waters that are, in general, much less productive relative to higher latitudes where the remaining members of the family are found. Because a large proportion of an already small Craveri's Murrelet population appears to occur in such a restricted area at the end of the breeding season, this species is particularly at risk to environmental disturbances, either natural or human-induced.

PIGEON GUILLEMOTS AS BIOINDICATORS OF NEARSHORE ECOSYSTEM HEALTH. *Alexander K. Prichard* and *Daniel D. Roby*, Alaska Coop. Fish and Wildlife Res. Unit, Univ. of Alaska, Fairbanks, AK 99775; *Lawrence K. Duffy* and *R. Terry Bowyer*, Institute of Arctic Biology, Univ. of Alaska, Fairbanks, AK 99775.

We are currently evaluating Pigeon Guillemots (*Cepphus columba*) breeding in Alaska as bioindicators of contaminants in neritic food webs. Guillemots are well-suited for this purpose because breeding pairs are widely dispersed and feed on nearshore demersal fishes. Average productivity of 62 nests monitored in Kachemak Bay was 0.4 fledglings/nest (Mayfield method). Low egg survival (50%) and hatching rates of surviving eggs (765) were responsible for poor overall hatching success (38%); 57–69% of chicks that hatched survived to fledging. Predation was a major cause of nest failure. Blood samples were collected from breeding adults and nestlings at 20 d and 30 d post-hatch. We analyzed serum for levels of several biomarkers of contaminant exposure, including haptoglobins and immunoglobulins. Haptoglobin values ranged from 0 to 282 mg/dl (mean – 103, SD – 62.7), and mean levels differed among nests, but not between _ and _–chicks. Haptoglobin levels did not differ among colonies, sampling dates, or nestling ages, nor were haptoglobin levels correlated with nestling growth performance. These baseline biomarker values will aid future assessment of contaminant exposure.

IMPORTANCIA DEL ESTUDIO DE LAS AVES PARA DAR ALTERNATIVAS DE CONSERVACION EN LAS ISLAS MARIETAS, MEXICO. *Fanny Rebón, Laura Mora y Nora Carrera*, Laboratorio de Vertebrados, UNAM. Ozuluama 20-101 Condesa 06100 México D.F.

Anteriormente a las islas de México solamente se les daba el crédito de ampliar la Zona Económica Exclusiva del país. Actualmente se les reconoce como importantes reservas naturales, por sus endemismos, topografía y condiciones climáticas que las hacen importantes laboratorios biológicos. En el pacífico mexicano existe más de la mitad del territorio insular nacional. Las Islas Marietas, Bahía de Banderas, son un ejemplo de la riqueza ornitológica debida a la abundancia de recursos de la zona. La presente contribución tiene como objetivos destacar la importancia biológica del área, señalar los principales problemas en torno a su conservación y proponer la formación de un grupo para el monitoreo y conservación de las islas. Para evaluar las condiciones que presentan las islas, se visitaron desde marzo de 1987 realizando entrevistas a pobladores de la localidad más cercana y observaciones de la actividad humana en torno a ellas. Se encontraron colonias reproductoras de tres especies de aves, que al parecer, son las más grandes registradas para México. Se detectaron ciertos riesgos que las aves enfrentan para sobrevivir, destacando la perturbación del habitat por el turismo. Con los datos obtenidos, se continúa el estudio encaminado a encontrar estrategias para la protección y uso de las islas. Concluimos con algunas propuestas para cumplir este punto.

COLONIZATION OF CREATED HABITAT BY TWO ALBATROSS SPECIES

AT MIDWAY ATOLL. *Scott A. Richardson,* P.O. Box 1644, Olympia, Washington 98507; and *Marilyn Sigman,* Box 335, Oceanside, Oregon 97134.

The colonization response of Laysan (*Diomedea immutabilis*) and Black–footed (*Diomedea nigripes*) albatrosses to newly–available nesting habitat was measured at Midway Atoll from 1990 to 1994. Chainlink fencing around a 2800–m2 plot had excluded albatrosses for decades prior to its removal during year 1 of the study. Laysan Albatrosses rapidly exploited the habitat, with 21 nests during year 1, 92 in year 2, and 150 in year 4. Seven Black–footed Albatross nests were found in year 2, and 39 in year 4. The number of Laysan nests within a surrounding 2–m swath declined from 120 to 42 with the colonization of the plot. Only one Black–foot nest was within 2 m of the plot during years 1 and 2, although the local area supported very high densities. The Laysan:Black–foot ratio was greater in the plot (18.2: similar to the island–wide ratio) than in the local area during year 2, but dropped to 3.8 (comparable to the local ratio) by year 4. Most pioneering Laysans spilled into the plot from within 2 m, reflecting the species' strong nest–site fidelity. Delayed colonization of the plot by Black–foots suggests similar or stronger nest–site fidelity, a low rate of recruitment, or both.

ERADICATING FERAL CATS FROM ISLA ISABEL, MEXICO. *Ma. Cristina Rodríguez* and *Hugh Drummond.* Laboratorio de Conducta Animal, Centro de Ecología. UNAM.

Feral cats (*Felis catus*) were introduced more than 60 years ago to Isla Isabel, México, where they prey heavily on Sooty Terns (*Sterna fuscata*), spiny (*Sceloporus clarcky*) and whiptail lizards (*Cnemidophorus costatus*). In 1991 cats killed 25% of the 1358 sooty terns nesting in the island, as well as an undetermined number of chicks, thereby causing the desertion of the whole colony which failed to fledge a single chick. These figures suggest, using optimistic calculations, that the largest Sooty Tern colony in the Mexican Pacific will face local extinction in approximately 15 years. We intend to completely eliminate the cats' population within 18 months, using fish-baited Tomahawk traps and subsequently shooting at cats who avoid the traps.

Censuses to monitor the numbers of Sooty Terns, spiny and whiptail lizards before, during and after the eradication of cats will permit an assessment of the campaign's effectiveness. Another potential effects of eradicating cats, which will be monitored, is the establishment of seabird species hitherto absent from the island.

PREDATORS AND ANTIPREDATOR BEHAVIOR OF SOOTY TERNS NESTING UNDER DENSE VEGETATION. *Jorge E. Saliva,* U. S. Fish and Wildlife Service, Box 491 Boquerón, Puerto Rico 00622, U.S.A. and *Joanna Burger,* Dept. of Biology, Rutgers University, P.O. Box 1059, Piscataway, New Jersey, 08855, U.S.A.

Although most Sooty Terns (*Sterna fuscata*) nest in open areas where they are exposed to predators, in some Caribbean islands they nest under dense vegetation. Sooty Terns nesting under dense vegetation at Culebra Island did not react to predators flying above the canopy of the dense vegetation where they nested. However, terns perched on the vegetation reacted with different antipredator behaviors according to the type of predator present. Hawks exerted a stronger antipredator response than either egrets or gulls. Cats were more active at night, primarily at one end of the colony. Vegetation provided an effective means to prevent incubating and brooding adults from leaving their nests unattended, thus reducing aerial predation and thermal stress, and increasing their breeding success.

PEST MANAGEMENT IN NEW ZEALAND—ENTERING A NEW ERA. *Alan Saunders,* Manager, Threatened Species Unit for Director–General Department of Conservation, Conservation Sciences Center, P.O. Box 10–420, 58 Tory Street, Wellington, New Zealand.

New Zealand conservation managers have made important advances in recent years in their ability to successfully translocate threatened species to "safe" islands and to eradicate pest mammals from islands. The development of second generation anticoagulants rodenticides to eradicate rodents from islands represents a major breakthrough. In the last decade rapid progress has been made on refining poison application techniques so that rodents can now be eradicated from islands larger than 200 hectares. Proposals are currently being developed to eradicate rodents from islands up to 3,000 hectares. Important conservation benefits have already been noted following eradication operations.

In recognition of the importance of pest animals eradications in contributing to the protection of New Zealand's biodiversity, the Department of Conservation has initiated a number of processes to plan and coordinate future activities. A national biodiversity strategy is being prepared as a basis for making more objective conservation management decisions. National island management guidelines are being compiled to identify goals and objectives and to allow for islands to be classified for various conservation uses. An island research strategy is also being prepared which will identify strategic areas for investigation so that management may be directed for greatest conservation benefit. A national islands management coordinator has been appointed to insure project managers are communicating effectively and that increasingly complex programmes are integrated. Feasibility plans which critically evaluate the costs and benefits of restoration programmes, and operational plans identifying tasks, time frames, costs and resources are now being used to guide management and as a basis for on–going consultation. The information needs of key "stakeholders" must be identified and met so that long–term public "ownership" of restoration programmes may be achieved.

DEVELOPMENT AND TRAINING OF THE OIL SPILL WILDLIFE RESPONSE TEAM (OSWRT) IN CALIFORNIA. *Thomas G. Schuster, William J. Sydeman,* and *Gary W. Page,* PRBO 4990 Shoreline Highway, Stinson Beach, CA 94970, and *Paul Kelly,* Office of Oil Spill Prevention and Response, California Department of Fish and Game, P.O. Box 944209, Sacramento, CA 94244–2090.

The Oil Spill Wildlife Response Team (OSWRT) was designed and developed for the state of California by PRBO and OSPR–CDFG during the fall of 1994. The team was developed to (i) respond to acute oil spills in a timely fashion, (ii) estimate mortality and the effects of oil pollution on marine wildlife in an expeditious manner, (iii) provide information to trustee agencies, (iv) guide unified command in providing information to the public, and (v) man-

age voluminous information that could ultimately be used for wildlife injury assessments. Team members, selected on the basis of expertise in the identification of seabirds, and accurate data collection, are from state, federal, and non–governmental organizations. A protocol and form developed for collecting data on dead or debilitated seabirds will be presented. We urge further coordination between the states and federal agencies in preparation for future oil spills along the west coast of North America.

EFFECTS OF RAT (*RATTUS RATTUS*) PREDATION ON BONIN PETREL (PTERODROMA HYPOLEUCA) REPRODUCTIVE SUCCESS. *Nanette W.H. Seto*, U.S. Fish and Wildlife Service, P.O. Box 50167, Honolulu, Hawaii, 96850.

Island avifaunas, particularly seabirds, are vulnerable to predation by introduced rats. *Rattus rattus* was introduced to Midway Atoll National Wildlife Refuge, NWHI in 1943 and has caused local extinctions or reductions of several species of seabirds. Since the rat introduction, the population of Bonin Petrels has declined from 500,000 birds in the 1930s to an estimated 5,000 nesting pairs in 1979. I examined the effect of rat predation on Bonin Petrels' reproductive success in areas of varying rat activity as controlled by the rodenticide "Vengeance." During this study, I developed a portable, miniature camera/video system that allowed viewing of burrow contents for petrel nesting activity and evidence of rat predation. The petrels were most vulnerable to rat predation during the egg stage of their nesting season, and I observed 100% egg loss in an area of extremely high rat activity. Rodenticide application appeared to effectively reduce rat density and increase Bonin Petrel reproductive success. Bonin Petrel reproductive success was observed to be higher in areas of high burrow density. This work provides the refuge manager with information on the interactions between the Bonin Petrel and the black rat and contributes to a conservation management plan for the Bonin Petrel on Midway.

RETURN OF THE KILLER BUBBLES: INTERACTIONS BETWEEN ALCIDS AND FISH SCHOOLS. *Fred Sharpe*, Dept. of Biological. Sciences. Simon Fraser Univ. Burnaby. BC V5A1S6.

The objective of this study was to continue investigations into the interactions between schooling fish and foraging alcids both in the laboratory and in the open water environment of northern Puget Sound. Methods involved the use of sonar, underwater video, and simulated alcid predators on captive fish schools. The underwater video supported earlier findings that rhinoceros auklets and ancient murrelets bubble extensively when foraging on herring and sandlance schools. One hypothesized function of these bubbles is the maintenance the school as a compact group near the ocean surface, thus preventing shoal expansion which is the first step towards escape from the surface. A second function of the bubbles may be to entice the school to expend their fast–start response prematurely. A third hypothesized benefit of bubbling may be to elicit frantic shoaling behavior, which results in the displacement of members from the school due to the formation of a strong vertical outflow of water from the school. The attacking alcids selectively capture individuals from this outflow jet. Laboratory experiments conducted at Bamfield Marine Stations using an artificial alcid predator and captive fish schools provided some support for these hypotheses. A video of underwater feeding behavior of wild alcids will be presented.

WEIGHT RECESSION AND DEVELOPMENTAL PATTERNS OF PIGEON GUILLEMOTS ON SOUTHEAST FARALLON ISLAND, CALIFORNIA. *Michael T. Shultz* and *William J. Sydeman*, PRBO, 4990 Shoreline Highway, Stinson Beach, CA 94970.

We examined patterns of weight recession in Pigeon Guillemot chicks in relation to growth and variation in food availability from 1989–1994. Chick weight recession was apparent after age 35 days in most years. Weight recession averaged 5–7% of the maximum (i.e. asymptotic) weight attained. Weight recession was more pronounced in years of moderate to high food availability, and for chicks hatching early in the season and with relatively high growth rates. Weight recession lasted up to 15 days for chicks which eventually fledged in a healthy state (i.e. weight > 350 g). The role of pre–fledging weight recession will be discussed in relation to the varied breeding strategies of alcids.

TUFTED PUFFIN REPRODUCTIVE SUCCESS: PROPOSED AT–SEA AND COLONY INTERACTIONS. *Joanna L. Smith*, Department of Biology, University of Victoria, Victoria, B.C. V8W 2Y2.

In 1994, the reproductive success of Tufted Puffins, *Fratercula cirrhata* (Pallas) was re–examined on Triangle Island, the largest puffin colony in B.C. with 25,000 breeding pairs. Productivity was measured on two plots on Puffin Rock: occupancy was found to be 50% (n=80) (the lowest occupancy since 1984), hatching success 25%, fledging success 20%, with overall reproductive success 5%. Egg size was 71.1±2.4 by 48.8±1.4mm (n=32). Midway through chick rearing, starved chicks were found dead on the surface of the colony and attendance fell quickly to near–zero; at this time, numerous food loads were lost to Glaucous–winged Gull kleptoparasitism. Observations taken at–sea found that foraging behaviours could be associated with activity near the colony. Historically, this population of Tufted Puffins has shown extreme inter–year variation in productivity. Factors such as prey dynamics, nest site quality, kleptoparasitism, mate choice variation and intra–/interspecific competition for suitable breeding locations on Puffin Rock are proposed as influential in reproductive success. This preliminary study will be expanded to establish a marked population of birds for long–term monitoring as part of the demographic studies that will be conducted at this seabird research station.

ALASKA'S RAT INTRODUCTION PREVENTION PROGRAM. *Arthur L. Sowls*, Alaska Maritime NWR, Homer, AK 99603 and *Joe E. Brooks*, U.S. Department of Agriculture, Denver Wildlife Research Center, Denver, CO 80225.

Norway rats are already present on at least 24 Alaskan islands and will certainly get introduced to more without a preventive program. Shipwrecks pose an on-going threat to almost all islands including some of the largest seabird colonies in the northern hemisphere. The Pribilof Islands are at additional risk because of expanding commercial development that includes new harbors.

In order to protect island wildlife, the U.S. Fish and Wildlife Service is forming a shipwreck response team to prevent rodent introductions. Rodenticides are considered a vital tool and a waiver authorizing their use has been applied for from the Environ-

mental Protection Agency. We are currently conducting training, stashing supplies, and arranging logistics.

A cooperative program has been setup in the Pribilof Islands to prevent rat infestations. The program utilizes a network of bait/trap stations in both harbors, rodent control ordinances, vessel inspection, and rat prevention on fish processors and cargo vessels. It also includes public and industry awareness campaigns and training.

In the next few years, rats are planned to be removed from Shemya Island in the western Aleutians Islands. Techniques will probably be similar to those developed in New Zealand.

RATS: PAST DAMAGE AND PRESENT THREATS TO ALASKA SEABIRDS. *Art Sowls* and *Vern Byrd.* Alaska Maritime NWR, 2355 Kachemak Bay Dr., Suite 101, Homer, AK 99603.

Norway rats have been accidentally introduced to at least 22 Alaska islands (Bailey and Kaiser 1993). The impacts of rats on seabird islands in Alaska have not been clearly documented, but comparisons of bird populations on similar islands with and without rats provides a basis for understanding. It is clear that rats extirpate most species of burrow nesting seabirds; storm-petrels, Cassin's Auklet, and Tufted Puffin. In addition, they prey on, but may not extirpate other species (e.g. auklets, shorebirds, and passerines).

In Alaska most introductions of rats happened during WWII. The danger of introduction by ship wrecks continues today. Furthermore, recent harbor and commercial fishing development has greatly increased the chances of rats establishing on the Pribilof Islands.

The Fish and Wildlife Service is beginning to address this threat by: 1) coordinating with other state and federal agencies, 2) an information and training effort, 3) a preventive program with the Pribilovians which includes trap and bait stations, a possible ship inspections program, and structural innovations to the harbor, etc. and 4) requesting EPA authorizations to use rodenticides to respond to ship wrecks and preparing a ship wreck response team. Ideas and suggestions for further actions are requested.

BREEDING STATUS OF TERNS AND BLACK SKIMMERS NESTING AT SOUTH SAN DIEGO BAY. *Doreen Stadtlander* and *John K. Konecny*, U.S. Fish and Wildlife Service, Carlsbad, CA 92008.

Although San Diego Bay has been subjected to severe pressure from development in the form of dredging, filling, and water front construction, man-made dikes in the extreme southern portion of the Bay support a unique assemblage of nesting seabirds. Prior to our two years of nest monitoring, systematic surveys to document breeding seabird populations had not been conducted since the early 1980's. In 1993, we estimated the minimum number of breeding paris (and hatching success) to be 326 Black Skimmers (68.9%), 280 Caspian Terns (77.3%), 312 Elegant Terns (77.1%), 10 Royal Terns (90%), and 10 Gull-billed Terns (79.2%). Predation and inclement weather were the main factors affecting hatching success in 1993. For most species, the number of breeding pairs was similar during 1994 with two notable exceptions: a 78% decline in Elegant Tern breeding pairs, and the complete absence of breeding Royal Terns. The Federally listed endangered California Least Tern was also monitored as part of this study in 1994 and we estimated 52 breeding pairs. Predation was again the main cause for hatching failure in most species. Our data will be used to support National Wildlife Refuge status for the south Bay which is presently under consideration.

ESTIMATES OF MARBLED MURRELET ABUNDANCE IN OREGON AND NORTHERN CALIFORNIA BASED ON MARINE SURVEYS. *Craig S. Strong, Bradford S. Keitt, William R. McIver, Clifford J. Palmer, Jeff Jacobsen, Ian Gaffney, Ron LeValley,* and *Charles J Striplen.* Crescent Coastal Research/Mad River Biologists, 7700 Bailey Rd. Crescent City, CA 95531.

Marbled Murrelets were counted in the nearshore waters of Oregon and northern California in order to assess population size and distribution. Surveys in Oregon were made from a boat, from low-flying light aircraft, and with a telescope from shore in 1992 and 1993. Approximately 1,500 km and 1,900 km of boat transects encompassing the states coastline were completed in 1992 and 1993, respectively. Six aerial surveys of the Oregon coastline were conducted. In 1994 two boat transects from the Oregon border to Point Arena, (38o 57" N) California were completed, with additional transects sampling murrelet distribution offshore.

In Oregon, Marbled Murrelets were most abundant in the central region, between Cascade Head and Cape Arago. They were concentrated closer to shore in 1992 than in 1993. In both years there was an apparent shift to the north by late July. Population estimates from vessel transect data ranged from 14,840 to 23,273 birds for all of Oregon, using strip and line transect methods. Estimates based on air and shore surveys were far lower than for vessel surveys and were not considered accurate. Estimates for northern California, using the same methods in 1994, will be presented.

PLASTICS IN ALBATROSSES 1993–1994: A FACTOR IN CHICK MORTALITY AND POSSIBLE SOURCE OF DIOXIN AND FURAN RESIDUES. *Cheryl L. Summer, Heidi J. Auman, James P. Ludwig, Paul D. Jones, John P. Giesy.* The SERE Group, Ltd., Box 556, Eureka, MI 48833, ESR Environmental, Lower Hutt, New Zealand, and Michigan State University, East Lansing, MI 48824.

The load of plastics carried by Laysan Albatross chicks at Midway Atoll was measured carefully in the 1993 and 1994 year cohorts of chicks. Mean weights of plastic objects and fragments recovered from large chicks that died in June and July were 32.3 and 23.8 g. in 1993 and 1994, respectively. Chicks that were mechanically injured (usually broken wings) averaged <11 grams of plastics suggesting that elevated plastics loads played a role in the death of some chicks. Body weights and fat condition in the chicks that died (with greater plastics loads) were significantly lower than in chicks mechanically injured. Partly burned or melted plastic fragments were found among plastic residues recovered from the albatrosses suggesting that partially burned plastics in oceanside dumps may serve as transport mechanisms and sources of highly toxic dioxins and furans. These toxins are easily produced in low temperature (300–500°C) burning in the presence of metals and a chlorine source, and may be incorporated into the melted globs of plastic which float on the surface until eaten by albatrosses. Experiments to confirm plastics as a dioxin source are in process.

RECOLONIZATION, DIET, AND DEMOGRAPHY OF NEARSHORE AND OFFSHORE POPULATIONS OF RHINOCEROS AUKLETS IN CENTRAL CALIFORNIA. *William J. Sydeman, Michelle Hester,* and *Elizabeth B. McLaren,* PRBO, 4990 Shoreline Highway, Stinson Beach, CA 92970.

Rhinoceros Auklets (re)colonized Southeast Farallon (37°N) and Ano Nuevo (36°N) islands in the early 1970s and 1980s, respectively. Southeast Farallon is located 42 km west of the coastline, whereas Ano Nuevo is within 2 km of the mainland. The population at Southeast Farallon increased throughout the 1980s and has since stabilized. The Ano Nuevo population continues to grow. Demography (reproductive success and adult survival) and diet have been studied on the Farallones since 1986 and on Ano Nuevo since 1992. Productivity on Ano Nuevo (_40%) is lower than Southeast Farallon (_65%). Diet composition varied between locations with anchovies dominating at Ano Nuevo and rockfish at Southeast Farallon, but diet composition varied annually at both locations. Notably, sardines were used by birds at both sites in 1993 (and by Common Murres in 1994), signifying recovery of this nearly extirpated stock and a new prey resource for seabird populations of the region. Survival was estimated via program SURGE. Rhinoceros Auklets are the only species of seabird increasing in this region. Factors explaining this "anomalous" population trend will be discussed.

RED FOX IMPACTS AND MANAGEMENT IN SOUTH SAN FRANCISCO BAY. *Jean E. Takekawa, Elaine Harding Smith,* and *Joy Albertson,* U. S. Fish and Wildlife Service, San Francisco Bay National Wildlife Refuge, Post Office Box 524, Newark, California, 94560.

Non-native red fox (*Vulpes vulpes regalis*) predation has had a severe impact on many ground-nesting birds in south San Francisco Bay since the mid-1980s, including the endangered California Clapper Rail (*Rallus longirostris obsoletus*)(Albertson et al. (in prep.), USFWS unpubl. data). Rail numbers fell to a low of approximately 300 birds in south San Francisco Bay in 1991-92; all or portions of nesting colonies of Caspian Terns (*Sterna caspia*), herons and egrets, and California Gulls (*Larus californicus*) were also lost (USFWS and SFBBO, unpubl. data). A predator management program was designed to reduce intensive predator impacts in areas crucial for California Clapper Rails, as well as some colonial nesting birds. The predator management program was designed in order to be as selective and humane as possible, while retaining effectiveness. Predator management was implemented in 1991, including the use of predator barriers, trapping, and shooting.

Preliminary results indicate a dramatic increase in the number of rails to 600 in 1992-93 and the partial recovery of some colonial nesting birds following the implementation of predator management. We describe predator management planning and environmental compliance needed for implementing such programs.

AVOIDING THE PROBLEMS OF FRAGMENTATION BY CONSERVING NATURAL FRAGMENTS: THE BENEFITS OF RESTORING AND PROTECTING SMALL ISLANDS. *Bernie R. Tershy,* Conservation International México, Sea of Cortez Ecosystem Program, 63 Altos, Col. Miramar, Guaymas, Son 85455, México, and Section of Neurobiology & Behavior, Cornell University, Ithaca, NY 14853; and *Donald A. Croll,* Institute of Marine Sciences, University of California, Santa Cruz, CA 95064.

Most existing reserves are too small and too fragmented for pre–historic ecological and evolutionary processes to continue unhindered by direct human intervention. Unfortunately, human demographic, economic, and sociopolitical forces do not support establishing large, interconnected protected areas. One way to circumvent this disparity between biological necessity and political feasibility is to restore and protect small islands such as the >200 islands and offshore rocks in NW México. Small islands are relatively discrete ecosystems that are important to the conservation of biological diversity for four reasons: 1) they have a large percentage of endemic species and subspecies; 2) they are important breeding areas for seabirds, pinnipeds, and sea turtles; 3) many small islands are not inhabited by humans and are relatively inaccessible to markets; and 4) the species and communities on islands have evolved in natural fragments. Thus, by restoring and protecting small islands we can maintain functioning, unmanaged ecosystems, with high densities of large vertebrates and many endemic species. Furthermore, these ecosystems can be preserved with relatively minor expenditures for land acquisition or conflicts with local human populations. Small islands are vulnerable to four types of human perturbations: 1) habitat destruction due to economic activities such as guano mining and timber extraction: 2) over–exploitation of animals due to commercial or subsistence hunting and egging; 3) disturbance of colonial breeding vertebrates, and other animals by visitors; and 4) the introduction of exotic species– the largest cause of recorded extinctions. We recommend research, education, and management steps which will advance island conservation efforts; and outline the use of regional island conservation databases, to prioritized islands for preservation, restoration, or management based on their human use, biological importance, and their amount of ecological degradation.

A BREEDING RECORD OF *STERNA ANTILLARUM* IN SOUTHERN SONORA: IMPLICATIONS FOR MANAGEMENT IN ESTERO DEL SOLDADO. *Marisol Tordesillas,* CECARENA ITESM–Campus Guaymas. A.P. 484. Guaymas, Sonora, México. Present address: 1120 E. Copper, Tucson, AZ 85719.

This work presents the first documented breeding record of *S. antillarum* in southern Sonora. van Rossem and Hachisuka (1937) predicted that *S.a. mexicana* were either breeding or preparing to do, but found no evidence of eggs or chicks, probably because they were in the area too early in the season. Eight years later, van Rossem (1945) published an extensive review of the birds of Sonora without confirming the breeding of *S. antillarum.* This paper documents the presence of a Least Tern breeding colony at Estero del Soldado (27°56'N–110°01'W) during 1992 and 1993. The colony was established in salt flats at the northern end of the estero. The first nests were observed May 31 of 1992. The colony was visited three times (June 2, 8 and 29) in 1992 and five times (May 30, June 6, 11, 15, and 28) in 1993. A total of 8 active nests, 12 eggs and 10 chicks were counted in 1992, and 9 active nests, 15 eggs and 6 chicks in 1993. I used the presence of nesting seabirds as an argument to modify the buffer zone limits between a proposed tourism development and the estero, resulting in the relocation of a planned golf course.

MALE-BIASED SEX RATIO IN A MARINE BIRD WITH REVERSED SIZE DIMORPHISM. *Roxana Torres* and *Hugh Drummond*, Centro de Ecología UNAM, Apartado Postal 70-275, México D.F. 04510.

According to Fisher's hypothesis progeny sex ratios should be biased toward the less expensive sex when the cost of rearing males and females differ. Blue-footed booby (Sula nebouxii) females are larger and roughly 25% heavier than males, thus presumably more costly to rear. We sexed and monitored daily survival of 751 individually marked chicks until fledging (approximately 90 days). Sex ratios at hatching (56%) and at fledging (56%) were male-biased in agreement with Fisher and under the assumption that daughters cost more than sons. No evidence of facultative sex ratio adjustment was found.

A WRECK OF COMMON MURRES IN THE GULF OF ALASKA DURING EARLY 1993, AND METHODS USED TO ESTIMATE TOTAL MORTALITY. *Thomas I. Van Pelt* and *John F. Piatt*, National Biological Survey, 1011 E. Tudor Rd., Anchorage, AK 99503.

Following a massive wreck of Common Murres (*Uria aalge*) during early 1993, we documented reported carcass recoveries throughout the Gulf of Alaska. In order to refine estimates of total mortality, we monitored the deposition and subsequent disappearance of 398 beachcast murre carcasses during a 100-day period on two beaches in Resurrection Bay, Alaska. Deposition of carcasses declined logarithmically with time after the original event. Persistence rates increased logarithmically over time, in part because fresh carcasses were more likely to be removed between counts than older carcasses. Scavenging appeared to be the primary cause of carcass removal, followed by burial in debris or sand. Based on these data, we present a general method for extrapolating the number of carcasses cumulatively deposited on beaches from single visits. Applying this method to the wreck, and then using extrapolation factors based on other data to account for unsurveyed beaches and for carcasses lost at sea, we estimate that a minimum of 120,000 murres died in this wreck. Determining the magnitude of mortality events is a vital first step in understanding their effects on populations, and in addressing restoration questions.

ERADICATING UNWANTED ANIMALS FROM ISLANDS. *Dick Veitch*, C.O. Ecological Restoration, Aukland Conservancy, Private Bag 68-908, Cnr. Karangahape Road & Liverpool Street, Newton, Auckland, New Zealand.

In New Zealand we have gained experience during the course of 118 eradication operations involving 14 species of pest animals on 94 islands. Knowledge of the biology of the target species has enabled target-specific capture methods, baits and lures to be developed. The methods chosen for each eradication operation need to be the best to remove the target animal rapidly. Delays during an operation often allow food resources to increase and hence efficiency of animal removal to decrease. The chosen eradication method should be used at a time in the life cycle of the target animal when it is most vulnerable—usually a hunger period. Similar knowledge of non-target animals is needed to help the eradication action avoid undue impacts. All action taken and results observed should be recorded but care needs to be taken to avoid diversion of attention away from the eradication task. Determination by the project manager to complete the task is identified as a key factor in the success of an operation. Protecting the island from future invasion is an integral part of the operation.

DIVING PERFORMANCE OF MALE AND FEMALE JAPANESE CORMORANTS. *Yutaka Watanuki*, Lab. Applied Zool., Fac. Agriculture, Hokkaido University, Sapporo, Japan 060; *Akiko Kato* and *Yasuhiko Naito*, National Institute of Polar Research, Itabashi-ku, Tokyo, Japan 173.

Sexual size difference is reported in a variety of seabirds and it may cause sexual variation of foraging behavior. Diving ability of breath-holding divers appears to be limited by their body size since body size determines oxygen capacity and metabolic rate during diving. Japanese Cormorants are foot-propelled divers foraging benthic fish as well as pelagic fish. They show large sexual dimorphism; males (3.14 kg) and 24% bigger than females (2.53 kg). We studied their diving behavior by using micro data loggers during their chick rearing seasons at Teuri I, Hokkaido. males dived deeper (15.1 m) and longer (37 sec) than females (7.2 m and 24 sec). Maximum dive depth and duration attained by males were also greater than those by females. Dive duration depended linearly on dive depth both in males and females but males spent relatively shorter time for diving if they dive to the same depth as females. These indicate that the diving capacity of males is greater than that of females. Therefore, male and female cormorants have to be considered as different indicators of marine environments.

REDUCING THE RISK OF ALIEN SPECIES INTRODUCTIONS TO ISLANDS. *Marc A. Webber, Elizabeth N. Flint, Duane K. McDermond, Cynthia A. Newton*, U.S. Fish and Wildlife Service, Honolulu, HI, 96850.

Island ecosystems are always at risk from unnatural invasions of animals and plants. Many seabird nesting islands have been effected by accidental or intentional introductions of aliens, most notably rats and cats. However, the impact of alien plants and insects on colonies is poorly known, infrequently considered and deserves more attention. Visitation of islands for seabird research and conservation activities poses a serious threat to these fragile ecosystems, and ironically, to the seabirds themselves.

Preventing introductions of species known to thrive in an island's environment requires additional care when traveling between islands. Everyone visiting and working on islands should develop and aggressively implement a plan to prevent alien introductions. Measures that reduce risks of new introductions during visits include: designate a team member to implement and police the plan; educate researchers and transport crews to insure cooperation; dedicate gear and clothing (especially footwear) for each island; use easily cleaned and inspected impermeable sealable containers; ban produce and sproutable seeds that could become established; freeze or fumigate supplies; inspect equipment that cannot be frozen or fumigated; and safeguard against transfer of vessel borne pests to stored gear and landing boats.

OPPORTUNITIES FOR SEABIRD RESTORATION THROUGH THE NATURAL RESOURCE DAMAGE ASSESSMENT PROCESS. *Daniel Welsh*, U.S. Fish and Wildlife Service, Sacramento Field Office, 2800 Cottage Way, Room E-1803, Sacramento, CA 95625; and *Roger Helm*, U.S. Fish and Wildlife Service, Region 1,

Eastside Federal Complex, 911 NE 11th Avenue, Portland, OR 97232–4181.

Oil spills and hazardous releases from Superfund sites have negatively impacted seabirds populations along the Pacific Coast. Natural Resource Damage Assessment provisions of Federal environmental legislation (Clean Water Act, Oil Pollution Act, and CERCLA) enable natural resource trustees to sue responsible parties for costs of restoring these injured resources. Ultimate success of the litigation depends to a large extent on the quality of scientific data documenting injuries to natural resources and on the merits of proposed restoration activities. This presentation will describe the process the U.S. Fish and Wildlife Service uses to carry out Natural Resource Damage Assessments and to implement restoration projects with settlement funds.

UTILIZATION BY CALIFORNIA LEAST TERNS OF A NEWLY CREATED NESTING SITE. *Adam Whelchel*, Wetlands Research Associates, Inc. 2169–G East San Francisco Blvd., San Rafael, CA 94901; and *Kathy Keane*, P&D Technologies, P.O. Box 5367, Orange CA 92613; and *Jack Fancher*, United States Fish and Wildlife Service, 2730 Loker Avenue West, Carlsbad, CA 92008.

One of the primary objectives of the draft California Least Tern Recovery Plan (currently under revision) is the establishment of nesting colonies in a minimum of 20 coastal wetland ecosystems. Although approximately 42 nesting sites are currently known, many are used irregularly and/or receive minimum management and protection. The general trend has thus been toward protection and management of large nesting colonies at the expense of smaller, less stable nesting sites; in 1993, 82% of least tern productivity statewide was attributed to seven nesting sites. Least tern researchers and managers have focused recent efforts therefore on the creation of new sites to buffer the local effects of predation and human disturbance, as well as to provide opportunities for renesting. Toward this end, the first of five sites at Batiquitos Lagoon in northern San Diego County was created in March 1994 with the removal of approximately 2.1 acres of ice plant (Carpobrotus sp.), importation of sand, and installation of fencing. Seventy–two pairs of least terns produced an estimated 68 fledglings at the site in 1994, far exceeding numbers and productivity recorded in unprotected sites throughout the lagoon over the past 16 years.

FERAL GOAT AND FERAL PIG ERADICATION FROM SAN CLEMENTE ISLAND, CALIFORNIA. *Clark S. Winchell*, Natural Resources Office, P.O. Box 357040, Naval Air Station North Island, San Diego, CA 92135–7040 USA.

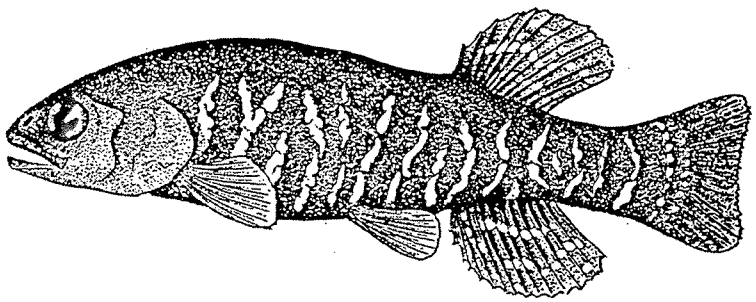
In 1994 the U.S. Navy program to eradicate feral goats (*Capra hireus*) and pigs (*Sus scrofa*) from San Clemente Island was completed. This program spanned nearly 22 years, employing many different strategies to complete its goal. The majority of the presentation will focus on the removal of feral goats, which was initiated in 1972, as an effort to protect endemic species from extinction. By the summer of 1989, nearly 29,000 had been removed. Between 1989 and 1991 a "Judas" goat program was implemented to remove a remnant population of goats. A herd, located by a "Judas" goat, was not removed until individuals comprising that herd were identified. After all individuals were accounted for by removal, a two year program was designed to confirm the eradication of goats was complete. The "Judas" technique permitted the final eradication of approximately 200 goats, and was used for three years to eradicate goats and then two years to confirm eradications. Data will be presented illustrating the movement patterns of goats and how this influenced management decisions. Radio collared goats released into areas where other goats existed behaved differently than those released into areas to confirm the absence of feral goats. Efforts to remove feral pigs were secondary to those for goats, until the late 1980's when an organized program was implemented. Pigs were eradicated using constant and systematic hunting pressure from both the air and ground. More than 1,000 pigs were removed under this program. Once pigs could not be located by hunters, dogs were used to verify their absence. This check phase spanned 18 months, and stratified short deliberate search patterns of dogs overlapping the large home range movements of pigs. A review of this 10–plus year process will be presented, with reference to both political and biological considerations influencing an animal damage control program.

POPULATION TRENDS OF SEABIRDS WINTERING IN KODIAK ALASKA—A FIFTEEN YEAR STUDY. *Denny Zwiefelhofer*, U.S. Fish and Wildlife Service, Kodiak National Wildlife Refuge, P.O. Box 825, Kodiak, AK 99615 and *Douglas J. Forsell*, U.S. Fish and Wildlife Service, 177 Admiral Cochrane Dr., Annapolis, MD 21401.

We conducted shipboard surveys of marine birds in Uyak and Uganik Bays on the western shore of Kodiak Island each February since 1980. Birds were censused within 300 m strip transects of 10 minutes duration run from shore to shore. The same cruise tracts were censused each year resulting in about 135 transects covering about 110 km2 or 19 percent of the surface area of the bays.

Population increases were seen in Horned Grebes, Red–necked Grebes, and Glaucous–winged Gulls. Relatively stable populations were found for loons, cormorants, Mew Gulls, Common Murres, and Marbled Murrelets. Pigeon Guillemots have declined by over 50 percent over the past 15 years.

Bird abundance is the result of a number of factors including tradition, weather, food abundance, reproductive success, and the *Exxon Valdez* oil spill. All species except cormorants showed moderate declines following the *Exxon Valdez* Oil Spill. Little oil actually entered these bays and most birds had departed for breeding areas by the time the oil arrived.



Bulletin Board

Nominations for the 1996 Pacific Seabird Group Lifetime Achievement Award or Special Achievement Award

Please send your nomination for the 1996 PSG Lifetime Acheivement Award or a Special Achievement Award to the PSG Chair (Mark Rauzon) by 15 May 1995. Please prepare a short 1-page description of the individual's contributions to the study and conservation of Pacific seabirds for review by the PSG Executive Council. If your nominee is selected, you must be prepared to conduct a short presentation at the November 1995 PSG/CWBS meeting in Victoria, British Columbia, and write a summary of the individual's achievements for Pacific Seabirds

California Seabird Coordination Meetings

On 12 December 1994, the fourth California Seabird Coordination Meeting was hosted by NOAA-GFNMS (National Oceanic and Atmospheric Administration - Gulf of the Farallones National Marine Sanctuary [Jan Roletto]) and NBS-CPSC (National Biological Service - California Pacific Science Center [Harry Carter]) at the GFNMS office in San Francisco. These informal meetings have been held in the late fall for the last few years and are designed to update colleagues and other organizations on various seabird research and management activities in California that occurred in the preceding year and that are planned for the following year. Possible joint projects and pooled funding were discussed. Representatives of the following groups attended the fourth meeting: U.S. Fish and Wildlife Service (San Francisco Bay NWR), University of California Davis, National Park Service (Channel Islands National Park & Western Region), Point Reyes Bird Observatory, California Department of Fish and Game (Oil Spill Prevention and Response, Wildlife Management Division, & Non-Game Bird Program), Minerals Management Service (Pacific Region), Pacific Seabird Group (Chair), California State University (Moss Landing Marine Laboratory), NOAA (GFNMS, Channel Islands National Marine Sanctuary), and NBS-CPSC. The December 1994 meeting notes and a list of recent publications and reports on seabirds in California can be obtained by contacting: Jan Roletto, Gulf of the Farallones National Marine Sanctuary, Fort Mason, Building #201, San Francisco, CA 94123 (phone 415-556-2587; FAX 415-556-1419). The next meeting will be hosted by PRBOand again will be held at the GFNMS office in San Francisco in late fall 1995. To receive information on the next meeting, contact: Bill Sydeman, Point Reyes Bird Observatory, 4990 Shoreline Highway, Stinson Beach, CA 94970 (phone 415-868-1221; FAX 415-868-1946; email wjsydeman@aol.com).

Fisheries Management for Fishermen: A Manual for Helping Fishermen Understand the Federal Management Process

The Auburn University Marine Extension and Research Center and Sea Grant Extension Program recently released a publication that provides fishermen with a general, concise overview of the federal management process (56 pages). The publication is designed to help fishermen understand both the biological basis of regulation as as well as the regulatory process.

Information needed to become involved in the management process is also included, such as the addresses and phone numbers of Regional Fishery Management Councils, NMFS Regional Offices, and Interstate Fishery Commissions.

The publication is a result of research partially sponsored by the Mississippi-Alabama Sea Grant Consortium and NOAA, Office of Sea Grant, Department of Commerce, and is available at no cost. For order information contact Deborah McArdle, Marine Advisor at the Sea Grant Extension Office, 105 E. Anapamu #5, Santa Barbara, CA 93101; Phone: 805-568-3330; e-mail: damcardle@ucdavis.edu.

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Published Proceedings of Symposia of the Pacific Seabird Groups

At irregular intervals the Pacific Seabird Group holds symposia at its annual meetings. The published symposia are listed below. Available symposia may be purchased by sending a check or money order (in US Dollars) to Jan Hodder, Treasurer, Pacific Seabird Group, Oregon Institute of Marine Biology, University of Oregon, Charleston, Oregon 97420 USA. Prices include postage (surface rates) and handling.

SHOREBIRDS IN MARINE ENVIRONMENTS. Frank A. Pitelka (Editor). Proceedings of an International Symposium of the Pacific Seabird Group, Asilomar, California, January 1977. Published June 1979 in, Studies in Avian Biology Number 2. Out of print.

TROPICAL SEABIRD BIOLOGY. Ralph W. Schreiber (Editor). Proceedings of an International Symposium of the Pacific Seabird Group, Honolulu, Hawaii, December 1982. Published February 1984 in, Studies in Avian Biology Number 8. $12.00.

MARINE BIRDS: THEIR FEEDING ECOLOGY AND COMMERCIAL FISHERIES RELATIONSHIPS. David N. Nettleship, Gerald A. Sanger, and Paul F. Springer (Editors). Proceedings of an International Symposium of the Pacific Seabird Group, Seattle, Washington, January 1982. Published 1984 as, Canadian Wildlife Service, Special Publication. Out of print.

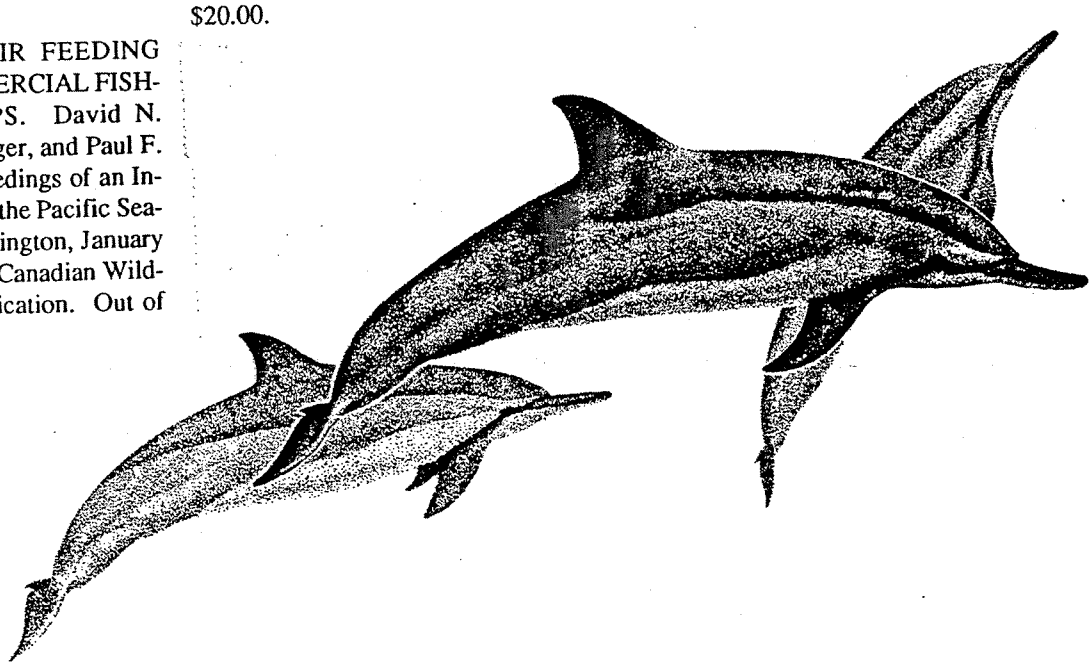
ECOLOGY AND BEHAVIOR OF GULLS. Judith L. Hand, William E. Southern, and Kees Vermeer (Editors). Proceedings of an International Symposium of the Colonial Waterbird Group and the Pacific Seabird Group, San Francisco, California, December 1985. Published June 1987 in, Studies in Avian Biology Number 10. $18.50.

AUKS AT SEA. Spencer G. Sealy (Editor). Proceedings of an International Symposium of the Pacific Seabird Group, Pacific Grove, California, December 1987. Published December 1990 in, Studies in Avian Biology Number 14. $16.00.

STATUS AND CONSERVATION OF THE MARBLED MURRELET IN NORTH AMERICA. Harry C. Carter, and Michael L. Morrison (Editors). Proceedings of a Symposium of the Pacific Seabird Group, Pacific Grove, California, December 1987. Published October 1992 in, Proceedings of the Western Foundation of Vertebrate Zoology Volume 5, Number 1. $20.00.

THE STATUS, ECOLOGY, AND CONSERVATION OF MARINE BIRDS OF THE NORTH PACIFIC. Kees Vermeer, Kenneth T. Briggs, Ken H. Morgan, and Douglas Siegel-Causey (Editors). Proceedings of a Symposium of the Pacific Seabird Group, Canadian Wildlife Service, and the British Columbia Ministry of Environment, Lands and Parks, Victoria, British Columbia, February 1990. Published 1993 as, Canadian Wildlife Service, Special Publication, Ministry of Supply and Services, Canada, Catalog Number CW66-124-1993E. Free. Write: Publications Division, Canadian Wildlife Service, Ottawa, Ontario, K1A OH3, Canada.

BIOLOGY OF MARBLED MURRELETS - INLAND AND AT SEA. S.K. Nelson and S.G. Sealy (Editors). Proceedings of a Symposium of the Pacific Seabird Group, Seattle, Washington, February 1993. Published in 1994 in, NORTHWESTERN NATURALIST Volume 75, Number 3. $20.00.



Pacific Seabird Group Committee Coordinators

Contact committee coordinators for information and activities of committees and how you can participate.

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