

## PSG2000 MEETING SCHEDULE

### THURSDAY

Early Morning (800-1000) – **WELCOME AND PLENARY SESSION**

800-820 Welcome, Introduction

820-910 *Climate Change and the California Current*. **John McGowan**

910-1000 *Seabird Research in California: What Have We Learned in the Past 50 Years?*

**William J. Sydeman**

Morning Break (1000-1030)

Late Morning (1030-1200) **SEABIRD OCEANOGRAPHY**

Chair:

1030-1050 *Effects of El Niño Events on Cormorant Breeding Populations in the Southern California Bight*. **Gerard J. McChesney\***, Harry R. Carter, Franklin Gress, William R. McIver, John W. Mason, Thomas W. Keeney, and Paul R. Kelly

1050-1110 *Beyond the Shelf Break: Overlap of Zooplankton Distributions and Foraging Locations of Breeding Cassin's Auklet from Triangle Island, BC*. **D.F. Bertram\***, D. Mackas, D. Welch, S. Boyd, and J. Ryder

1110-1130 *A Retrospective Assessment of Primary Productivity in the Bering Sea as Indicated by Stable Isotope Ratios in Seabirds*. **Grace E. Abromaitis\***, Donald M. Schell, and Alan M. Springer.

1130-1150 *Impact of an El Niño Event on Marbled Murrelet Diet and Fecundity in Central California*. **Benjamin H. Becker\***, and Steven R. Beissinger

Lunch (1200-1330)

Early Afternoon (1330-1500) **SEABIRD OCEANOGRAPHY**

Chair:

1330-1350 *Nestling Diets of Rhinoceros Auklets and Tufted Puffins at Three Colonies in Alaska*. **Verena. Gill\***, Scott Hatch, Leslie Slater, Josh Adams, and Hannahrose Nevins

1350-1410 *Wintering Razorbills, Alcatorda, and Auk Assemblages in the Lower Bay of Fundy, Eastern Canada. Results from Two Winter Surveys 1997/98 and 1998/99*. **F. Huettmann\*** and A.W. Diamond

1410-1430 *Comparison of Breeding Biology of Rhinoceros Auklets on Two Central California Islands*. **Julie A. Thayer\***, Michelle M. Hester, and William J. Sydeman

1430-1450 *Proximal and Ultimate Factors Determining Annual and Decadal Variation in Population Dynamics of Adelie Penguins in the Ross Sea: A Demographic Model*. **Nadav Nur\***, David G Ainley, Peter R Wilson, Kerry J Barton, Grant Ballard, Stanley S Jacobs, and Josefino C Comiso

Afternoon Break (1500-1530)

Late Afternoon (1530-1730) **FORAGING ECOLOGY**

Chair:

- 1530-1550 *Rissa "pelagicus": Multi-day Incubation Bouts and Foraging Trips of Breeding Redlegged Kittiwakes.* **Dean Kildaw\*** and Sharon Loy
- 1550-1610 *Foraging Ecology and Diving Behavior of Thick-Billed Murres: Associations of Foraging Patterns, Dive Depths and Prey Selection During Chick Rearing.* **Kerry Woo\***, Anthony J. Gaston, Silvano Benvenuti and Luigi Dall-Antonia
- 1610-1630 *Depth and Time Dependent Aerobic Diving Limit (ADL): Diving Metabolic Rate as a Function of Buoyancy.* **Erpur S. Hansen**
- 1630-1650 *Diving in Magellanic Penguins: Comparisons and Contrasts.* **Brian G. Walker\*** and P. Dee Boersma
- 1650-1710 *Supplemental Feeding of Black-legged Kittiwakes: Evidence for Early Season Food Limitation.* **Scott A. Hatch\***, Verena A. Gill, and Charla M. Sterne
- 1710-1730 *Spatial Foraging Patterns of Three Penguin Species in the South Atlantic.* **David L. Stokes\*** and P. Dee Boersma

**FRIDAY**

Early Morning (800-920) **SPECIATION AND NATURAL HISTORY**

Chair:

- 800-820 *Two Special Seabirds, the Nazca Booby and Madeiran Storm Petrel, and a Tribute to Luis Monteiro.* **Vicki Friesen\***, David Anderson, Tammy Steeves, Bob Furness and Luis Monteiro
- 820-840 *On the Evolution of Common Murre, *Uria aalge*.* **Kenneth I. Warheit\***, Vicki L. Friesen, and Tim P. Birt
- 840-900 *Novel Sequences of Flight Feather Molt in Sooty Shearwaters and Northern Fulmars.* **Christopher W. Thompson\***, Scott A. Hatch, Mathias Leu, Kirsten Brennan, Belen Roca, and Bernhard Krausse
- 900-920 *Olfactory Sensitivity of Foraging Procellariid Seabirds in Unimak Pass, Alaska.* **Beverly A. Agler\***, Gabrielle A. Nevitt, and George L. Hunt, Jr

Morning Break (920-940)

Late Morning (940-1200) **SEABIRD CONSERVATION: FISHERIES & PREDATORS**

Chair:

- 940-1000 *Use of a Population Model to Assess the Effects of Feral Cats on Black-Vented Shearwaters, Natividad Island, Mexico.* **Bradford Keitt\***, Bernie Tershy, and Don Croll
- 1000-1020 *When Indirect Effects Dominate: Bald Eagle Interactions with Common Murres.* **JULIA K. PARRISH\***, Michele Marvier, and Robert T. Paine
- 1020-1040 *Control of Nocturnal Predators at Tern Restoration Islands.* **Stephen W. Kress\*** and Donna M. Ramil

- 1040-1100 *The World's Largest Caspian Tern Colony: A Review of Dynamics in the Pacific Coast Population.* **David P. Craig\***, Daniel D. Roby, Donald E. Lyons, and Ken Collis
- 1100-1120 *Caspian Tern Management in the Columbia River Estuary.* **Daniel D. Roby\***, David P. Craig, Donald E. Lyons, and Ken Collis
- 1120-1140 *Solutions to the Bycatch of Seabirds in Alaska Sablefish Longline Fisheries.* **Edward F. Melvin\***, Kimberley S. Dietrich, Owen Hamel, and Julia K. Parrish
- 1140-1200 *A National Plan of Action for Reducing the Incidental Catch of Seabirds in Longline Fisheries.* **Kim Rivera**

Lunch (1200-1330)

Early Afternoon (1330-1500) **BREEDING BIOLOGY**

Chair:

- 1330-1350 *Functional Significance of Sexual Dimorphism in Wandering Albatrosses.* **Scott A. Shaffer\***, Henri Weimerskirch, and Daniel P. Costa
- 1350-1410 *Corticosterone Levels of Gulls at Two Sites Suggest Differences in Habitat Quality.* **Ann E. Edwards\***, P. Dee Boersma, and John C. Wingfield
- 1410-1430 *Differential Post-breeding Mortality of Adult Common Murres from Oregon Breeding Colonies in 1997-1999.* Christopher W. Thompson, **Thomas P. Good\***, Kirsten Brennan, Monique Wilson, Belen Roca, and Bernhard Krausse
- 1430-1450 *Body Mass Variation in Marbled Murrelets in British Columbia, Canada: Is it Adaptive?* **Cindy L. Hull\***, Brett Vanderkist, Lynn Lougheed, Gary Kaiser and Fred Cooke

Afternoon Break (1500-1530)

- 1530-1610 *An Experimental Test of Egg Neglect Patterns in Rhinoceros Auklets.* **L.K. Blight\*** and T.D. Williams
- 1610-1630 *Timing of Fledging in Pigeon Guillemots.* **George J. Divoky\***, Andrew Hovey, and Daniel Roby
- 1630-1650 *Parental Provisioning Behavior of Tufted Puffins, *Fratercula cirrhata*, During a Successful Reproductive Year.* **Carina Gjerdrum\*** and D.F. Bertram
- 1650-1710 *Nestling Growth in Antarctic Fulmarine Petrels.* **Peter J. Hodum\*** and Wesley W. Weathers
- 1710-1730 *Parental Energy Expenditure During Brood Rearing in Black-legged Kittiwakes.* **Patrick Jodice\***, Daniel Roby, David Irons, Robert Suryan, Henk Visser and Kathy Turco

**SATURDAY**

Early Morning (800-1000) **RADIO TELEMETRY**

Chair:

- 800-820 *Evidence of Renesting in the Marbled Murrelet: Inferences From Radio Telemetry.* **Russell Bradley**
- 820-840 *At-Sea Foraging Distributions of Cassin's Auklets Breeding at Triangle Island, B.C.* **W. Sean Boyd\***, Douglas F. Bertram, John L. Ryder, and Steven G. Shisko
- 840-900 *Colony Attendance Patterns of Radio-marked Cassin's Auklets at Triangle Island, British Columbia.* **John L. Ryder\***, Douglas F. Bertram, and W. Sean Boyd
- 900-920 *Demography of the Desolation Sound Marbled Murrelet Population.* **Fred Cooke\***, Lynn Loughheed, and Russell Bradley
- 920-940 *Foraging Distances of Radio-Marked Marbled Murrelets in Southeast Alaska.* **S. Kim Nelson\***, Darrell L. Whitworth, and Scott H. Newman
- 940-1000 *Foraging Patterns of Caspian Terns in the Columbia River Estuary.* **Donald E. Lyons\*** and Daniel D. Roby
- 1000-1020 *What a Drag: Behavioral Effects of Radio-Marking Common Murres.* **Nathalie Hamel\*** and Julia Parrish

Morning Break (1030-1100)

Late Morning (1100-1200) **CONSERVATION: REHABILITATION, HABITAT, RESTORATION, & OUTREACH**

Chair:

- 1100-1120 *Post-Release Survival of Common Murres, *Uria aalge*, Following the Stuyvesant Oil Spill: Preliminary Results.* **Scott H. Newman\***, Richard T. Golightly, Harry R. Carter, and Jonna Mazet
- 1120-1140 *Research on Captive Pigeon Guillemots at the Alaska SeaLife Center.* **Andrew K. Hovey\***, George J. Divoky, and Daniel D. Roby
- 1140-1200 *Landscape and Seascape Patterns Associated with Marbled Murrelet Offshore Abundance.* **Sherri L. Miller\***, Carolyn B. Meyer, and C.J. Ralph

Lunch (1120-1330)

Early Afternoon (1330-1510) **CONSERVATION: REHABILITATION, HABITAT, RESTORATION, & OUTREACH**

Chair:

- 1330-1350 *Considerations of Pelagic Protected Areas.* **K David Hyrenbach\***, Karin A. Forney, and Paul K Dayton
- 1350-1410 *Common Murre Re-Colonization at Devil's Slide Rock, California: Social Attraction Techniques and Initial Recolonization Patterns.* **Michael W. Parker\***, Jennifer A. Boyce, Elizabeth B. McLaren, Stephen W. Kress, Harry R. Carter, Richard T. Golightly and Susan E. Schubel

- 1410-1430 *"Seabirds as Guinea Pigs" -the Pacific Ocean Biological Survey Program and Offensive Biological Weapons Testing.* **Mark J. Rauzon\*** and Rick Steiner
- 1430-1450 *Seabird Conservation in the Cook Islands.* **Harry R. Carter\*** and Deborah J. Carter
- 1450-1510 *Preaching to a New Choir: COASST and Citizen Science.* **Todd Hass\*** and Julia K. Parrish

Afternoon Break (1510-1530)

Business Meeting

#### POSTER TITLES AND AUTHORS

1. *At-Sea distribution of Radio-marked Cassin's Auklets, Breeding at Prince Island, California in 1999.* **Josh Adams\***, John Y Takekawa, Harry R Carter, Darrell L Whitworth, and Gerard J McChesney
2. *The Adrenocortical Response to Stress in Younger Versus Older Leach's Storm-Petrels.* **Joseph G. Baker\*** and Kathleen M. O'Reilly
3. *Low Productivity: The Main Cause of a Population Decline in Red-legged Kittiwakes at St. George Island, Alaska.* **G. Vernon Byrd\*** and Jeffrey C. Williams
4. *The Relationship of Reproductive Success of Black-Tailed Gull Breeding on Teuri Island and Habitat Structure.* **Michiyo Chochi\*** and Yutaka Watanuki
5. *Changes in Diet of Terns and Skimmers Nesting at the Bolsa Chica Ecological Reserve in Southern California: Possible Responses to Climate Change and Shifts in Prey Populations.* Michael H. Horn and Wasila M. Dahdul\*
6. *Disturbance and Predation at a Common Murre Colony, Point Reyes Headlands, California.* **Christine D. Hamilton\***, Michael W. Parker, and Jennifer A. Boyce
7. *Distribution of Marbled Murrelets in Monterey Bay, California.* **Laird A. Henkel\*** and Josh Adams
8. *Feeding Strategies of Peruvian, Blue-footed and Masked Boobies in Their Sympatric Distribution Area, Lobos de Tierra Island, Northern Peruvian Coast.* **Jaime Jahncke\*** and Elisa Goya
9. *Development and Ranking of Conservation Options for Marbled Murrelets on the Sunshine Coast.* **Toby L Jones\*** and Irene A Manley
10. *Barren Islands Seabird Monitoring: An Update.* **Arthur B. Kettle\***, David G. Roseneau, and G. Vernon Byrd
11. *Foraging Effort of Breeding Pigeon Guillemots: Are High Quality Prey Harder to Catch?* **Michael Litzow\***, Julian Fischer, Greg Golet, and John Piatt
12. *Effects of Possible Changes in the St. Lawrence Island Polynya on a Top Benthic Predator, the Spectacled Eider.* **James R. Lovvorn\***, Jacqueline M. Grebmeier, and Lee W. Cooper
13. *Radar Surveys of Marbled Murrelets on the Northwest Coast of Vancouver Island.* **Irene Manley\*** and Catherine Conroy
14. *Seabird Habitat Recovery Through Rat Eradication at Anacapa Island, Channel Islands National Park.* **Paige L. Martin\***, Gregg Howald, Bernie Tershey, and Kate Faulkner

15. *Sand Lance Habitat Modeling for Prince William Sound, Alaska.* **William D. Ostrand\***, Tracey A. Gotthardt, Shay Howlin, John Kern, Evelyn D. Brown, and Martin D. Robards
16. *Genetic Structure and Geographic Variation in Global Populations of the Black-Legged Kittiwake, *Rissa tridactyla*.* **Anoma Patirana\***, Vicki L. Friesen, and John Chardine
17. *Sampling Marbled Murrelets at Sea: Are Two Heads Better Than One?* **Martin G. Raphael\***, Diane M. Evans, and Randall J. Wilk
18. *Population Monitoring of Seabirds at Vandenberg Air Force Base, 1999.* **Dan Robinette\*** and William J. Sydeman
19. *Factors Affecting the Recovery of Common Murres Nesting on the Castle/Hurricane Rock Complex.* **Nora A. Rojek\*** and Michael W. Parker
20. *Oceanographic Factors Influencing the Phenology and Reproductive Success of the Xantus' Murrelet on Santa Barbara Island, California.* **Jennifer E. Roth\*** and William J. Sydeman
21. *Pattern of Recolonization by a Central California Common Murre Colony After Four Years of Using Social Attraction Techniques, 1996-1999.* **Victoria M. Slowik\***, Michael W. Parker, Stephen W. Kress, Harry R. Carter, Richard T. Golightly, and Jennifer A. Boyce
22. *Protecting Alaska's Islands from Rodent Introductions.* **Arthur L. SOWLS**
23. *Beringian Seabird Colony Catalog.* **Shawn W. Stephensen**
24. *Parental Foraging Effort and Offspring Growth in Adelie Penguins: Individual Variation.* **Akinori Takahashi\***, Yutaka Watanuki, Akiko Kato, and Yasuhiko Naito
25. *South San Diego Bay Salt Works Acquisition and Planned Restoration for Fish and Wildlife.* Jack Fancher and **Jill Terp\***
26. *Breeding Chronology and Reproductive Status of the Marbled Murrelet in Desolation Sound, B.C.* **Laura McFarlane Tranquilla\***
27. *Sexual Selection, Tail Streamer Function and Demography of Red-tailed Tropicbirds at Tern Island, French Frigate Shoals, Northwestern Hawaiian Islands.* **Allison Veit\***
28. *Resting Metabolic Rate in Four Antarctic Fulmarine Petrel Species.* **Wesley W. Weathers\***, Karen Gerhart, and Peter J. Hodum
29. *Status and Conservation of the Xantus' Murrelet in Mexico.* Bradford Keitt, **Anna Weinstein\***, Bernie Tershy, and Don Croll
30. *Dynamics and Modeling of Red-legged Kittiwake Populations at Buldir I., Alaska.* **Jeffrey C. Williams\*** and G. Vernon Byrd
31. *Should the National Park Service Allow Egg Harvesting at a Seabird Colony?* **Stephani Zador\*** and John Piatt

## **A Retrospective Assessment of Primary Productivity in the Bering Sea as Indicated by Stable Isotope Ratios in Seabirds.**

Grace E. Abromaitis\*, Donald M. Schell, and Alan M. Springer.

Institute of Marine Science, University of Alaska Fairbanks, abromait@ims.uaf.edu

We used carbon isotope ratios in thick-billed murre muscle and feathers to test the hypothesis that a decrease in seasonal primary productivity has occurred in the Bering Sea. Recent studies have shown phytoplankton stable carbon isotope ratios are directly related to cellular growth rates. Following photosynthesis, carbon isotope ratios incorporated into the phytoplankton are conserved as they are passed up the food web to consumers. We analyzed muscle tissue and feathers from thick-billed murre for 13 years between 1976-1999. Isotope ratios in newly grown feather carbon indicate diet at that time versus muscle carbon with a longer integration time. Feather samples show variability between rachis and vanes. The carbon isotope ratios ranged between -16.96 and -19.54 ppt and suggest decadal scale changes in primary productivity. From 1976-present, mean carbon isotope ratios are significantly lower for 1977, 1985, and 1998 and higher for 1976 and 1992. In contrast, stable nitrogen isotope ratios showed no significant change over the same period, indicating no concurrent shifts in trophic level. Declining carbon isotope ratios without declining nitrogen isotope ratios indicate a change in primary productivity in the Bering Sea ecosystem.

## **At-Sea distribution of Radio-marked Cassin's Auklets, Breeding at Prince Island, California in 1999**

Josh Adams\*, John Y Takekawa, Harry R Carter, Darrell L Whitworth, and Gerard J McChesney

U.S. Geological Survey & Moss Landing Marine Laboratories, Moss Landing, California  
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In 1999, we initiated a study of the at-sea distribution of radio-marked Cassin's Auklets in southern California. Thirty-five auklets were captured at nest sites on Prince Island. We determined sex of marked birds by chromosomal analyses of blood. Most radio positions (89%; N=377) occurred at sea; incubating birds were located on Prince Island. The number of locations per individual averaged  $11.6 \text{ km} \pm 1.6 \text{ SE}$  (range=0-27 km). Auklet locations were concentrated north of the colony ( $14 \text{ km} \pm 0.5 \text{ SE}$ ; range=1-76 km) and did not differ by sex. Auklets counted on low-elevation aerial seabird surveys conducted throughout the Southern California Bight in May 1999 closely matched the distribution of radio-marked auklets. Spatially consistent at-sea distribution of auklets between March and July 1999 coupled with early and protracted breeding and multiple breeding attempts by individual birds probably indicated abundant and persistent prey available near Prince Island. Prey conditions were influenced by early upwelling conditions off Point Conception in late 1998. Strong upwelling and cold water conditions persisted through June 1999.

## **Olfactory Sensitivity of Foraging Procellariid Seabirds in Unimak Pass, Alaska**

Beverly A. Agler\*<sup>1</sup>, Gabrielle A. Nevitt<sup>1</sup>, and George L. Hunt, Jr<sup>2</sup>

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<sup>2</sup> University of California, Irvine, California

Procellariiform seabirds are known for their sense of smell, yet few behavioral experiments have addressed whether tube-nosed birds use olfactory cues to forage at sea. We describe results from controlled, shipboard experiments performed in Unimak Pass, Alaska. Two buoys were placed 100 m from the ship; one was scented with an odor, while the other was unscented. We used three odors: cod liver oil, pyrazine, and DMS. We recorded numbers of seabirds that approached within a 10-m radius of either buoy for 30 min. We observed Sooty and Short-tailed Shearwater, Northern Fulmar, Glaucous-winged Gull, and Tufted Puffin within 10 m of either buoy. Shearwater spp. approached all three of the scented buoys significantly more often than the unscented control buoys. Northern Fulmar approached the buoys scented with cod liver oil and pyrazine significantly more. Glaucous-winged Gull and Tufted Puffin approached the scented buoys as often as the unscented buoys for cod liver oil and DMS. Pyrazine was the only odor approached significantly by all species. These results support previous findings that some species of Procellariiformes use olfactory cues to forage.

## **The Adrenocortical Response to Stress in Younger Versus Older Leach's Storm-Petrels**

Joseph G. Baker\* and Kathleen M. O'Reilly

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We studied the effect of age on the adrenocortical response to capture stress in a breeding population of Leach's Storm-Petrels, *Oceanodroma leucorhoa*, at Kent Island, New Brunswick from June 3 to July 24, 1999. We captured 147 individuals and drew serial blood samples (40  $\mu$ l each) at 3, 15, 30, 60, and 90 min after initial disturbance. Radioimmunoassays for corticosterone were performed on plasma samples. For each of five age classes, the corticosterone level peaked at 30 min after capture. Older individuals had a significantly lower stress response than younger individuals ( $p = 0.037$ , regression). However, when the total exposure to corticosterone was calculated (area under the curve), the age classes were not significantly different. Baseline levels of corticosterone (within 3 min of capture) did not vary with age ( $p = 0.74$ ). These results are consistent with previous data showing a negative correlation between age and the adrenocortical response to stress.

## **Impact of an El Niño Event on Marbled Murrelet Diet and Fecundity in Central California**

Benjamin H. Becker\* and Steven R. Beissinger

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El Niño events typically reduce the availability of zooplankton to coastal marine predators in the California Current system. This variation in food availability appears to impact the fecundity rates of several species of seabirds. We investigated these short-term climatic impacts on the food sources of an endangered coastal seabird, the Marbled Murrelet. We used stable isotope analysis of nitrogen and carbon isotopes in prey tissues and murrelet feathers to infer variability in primary food sources (zooplankton and fishes) between El Niño and non-El Niño years. Murrelet diets appeared to include more zooplankton during the pre-breeding stage of non-El Niño years, which were associated with higher murrelet fecundity. During El-Niño years, zooplankton were less represented in the bird's pre-breeding diet, and fecundity was significantly lower.

## **Beyond the Shelf Break: Overlap of Zooplankton Distributions and Foraging Locations of Breeding Cassin's Auklet from Triangle Island, BC.**

D.F. Bertram\*, D. Mackas, D. Welch, S. Boyd, and J. Ryder.

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To investigate the causal basis for patterns of seabird feeding distributions we couple fisheries oceanography, radio telemetry and colony based research. We examined the marine distributions of breeding Cassin's Auklet from their largest colony on Triangle Island, B.C. using aerial telemetry in 1999. Concurrently, zooplankton was sampled at 16 stations along a cross shelf transect in the vicinity of the seabird colony. The majority of the birds were concentrated SW of the colony 40-75 km offshore, parallel to, but well off (35 -50 km) the shelf break in deep water (1500m - 2000m). During May, large bodied copepods dominated the nestling diet. Zooplankton samples collected in May indicated that large bodied copepods were located primarily beyond the shelf break demonstrating overlap with the radio-tagged parent seabirds. Satellite images suggest that the zooplankton rich waters off the shelf break were physically displaced by the extensive freshwater runoff from unusually heavy snowfalls the previous winter. We predict that 2000 will be more similar to 1998 and that the birds will be located closer to the colony than we observed in 1999.

## **An Experimental Test of Egg Neglect Patterns in Rhinoceros Auklets**

L.K. Blight\* and T.D. Williams

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Many birds interrupt incubation in order to spend time away from the nest. For Passeriformes, these excursions usually last only minutes. For seabirds, egg neglect may last a day or more, allowing parents to increase foraging time. Egg neglect in alcids is reportedly most common early in incubation, corresponding with slower embryonic growth. To test whether developmental constraints of older embryos have selected against neglect late in incubation, we experimentally chilled two separate groups of Rhinoceros Auklet eggs. Eggs were chilled to ambient temperature for 48 hours at 7 or 30 days of age, and survivorship for the two groups recorded. We also examined the effect of experimental neglect on hatchling size and incubation period length. Data for newly-hatched experimental chicks were compared with those of controls. We found no difference in morphometrics or hatchability among chicks from experimental and control eggs. However, experimentally chilled eggs hatched an average of two days later than controls. Our results suggest that for some seabird embryos, survival is not affected by age at neglect; parent birds may neglect at any stage of incubation. Decreased neglect as incubation progresses may instead be explained by increased parental investment in the embryo over time.

## **At-Sea Foraging Distributions of Cassin's Auklets Breeding at Triangle Island, B.C.**

W. Sean Boyd\*, Douglas F. Bertram, John L. Ryder, and Steven G. Shisko

Pacific Wildlife Research Centre, Canadian Wildlife Service, sean.boyd@ec.gc.ca

We conducted a radio-telemetry study to determine the at-sea foraging distributions of Cassin's Auklets breeding at Triangle Island, British Columbia. Our goal was to evaluate the utility of proposed boundaries for a Marine Protected Area (MPA) around the Scott Island group, a region recently identified as an Important Bird Area (IBA). During the chick-rearing period in June 1999, 39 adults were captured and fitted with small transmitters. We conducted aerial surveys over the open ocean to locate these marked individuals during two survey periods, 9-10 and 23-24 June. During these periods, most marked birds were detected in a relatively small area 40-75 km southwest of Triangle Island in waters >1000 m deep and well outside the proposed MPA boundary. This distribution pattern was consistent across the two survey periods and especially across days during the second period. Similar telemetry work is being proposed for June 2000 to verify if this pattern holds across years.

## **Evidence of Renesting in the Marbled Murrelet: Inferences From Radio Telemetry**

Russell Bradley

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Renesting, a second breeding attempt after an early season failure, is common in some seabird species but never observed in others. Renesting has never been previously documented in Marbled Murrelets. Standardized, daily helicopter telemetry was used to determine breeding chronology and habitat use of individual Marbled Murrelets in Desolation Sound, British Columbia during the 1999 breeding season. Data from a male bird, whose mate was not radio marked, suggest strong evidence of renesting. It appears that initial egg laying occurred on ~8 May with nest failure after ~8 days. The nest site was located by helicopter prior to failure. 14 days after assumed nest failure, activity patterns show initiation of a second incubation cycle. The new nest site was located in the same forest patch as the original nest location. This site was inaccessible from the ground so it was impossible to determine whether both breeding events used the same platform or tree. Telemetry inferences suggest that a ~30 day incubation period occurred during the second breeding attempt. While fledging success is unknown, ground based telemetry at dusk and dawn near the nest patch and along the bird's suspected flyway suggest the nest was active late in chick rearing.

## **Low Productivity: The Main Cause of a Population Decline in Red-legged Kittiwakes at St. George Island, Alaska**

G. Vernon Byrd\* and Jeffrey C. Williams

Alaska Maritime National Wildlife Refuge, Homer, Alaska, Vernon\_Byrd@fws.gov

More than 70% of the world's red-legged kittiwakes breed at St. George Island, Pribilof Islands, Alaska. Periodic counts of birds on index plots indicate the population has declined between 1976 and 1999. Productivity (chicks fledged per nest site) has been estimated annually during this 24-year period, and a simple population model was constructed to evaluate whether the observed population decline could have been caused primarily from inadequate recruitment due to low reproductive success. Model parameters included the average adult survival rate (estimated from a study at Buldir Island), and the average juvenile survival rate from fledging to age 1 (this parameter was varied in the model throughout a range obtained for black-legged kittiwakes in the North Pacific Region). The initial age distribution was set arbitrarily, but after the initial run, the average age composition of the four most recent years was used to initiate additional runs. Population curves generated from model simulations were similar to the curve generated from observations on plots. This outcome suggests that inadequate productivity, instead of excessive adult mortality, was the major reason for population declines.

## **Seabird Conservation in the Cook Islands**

Harry R. Carter\* and Deborah J. Carter

U.S. Geological Survey & Humboldt State University, Harry\_Carter@usgs.gov

In November 1999, we visited two seabird nesting islands in the southern Cook Islands in the South Pacific Ocean and discussed seabird conservation issues with local residents and government biologists. Eight seabird species breed at Takutea Island (including 2,000 pairs of Red-tailed Tropicbird) which has been protected as a wildlife sanctuary since 1950 by the Polynesian chiefs of Atiu Island. Small numbers of seabirds breed at Maina Island (and other islands within the Aitutaki Island lagoon) which has been visited frequently for several decades. Nine seabird species (including 200,000 and 8,500 pairs of Sooty Tern and Lesser Frigatebird, respectively) breed at Suvarrow Island, a national park since 1978 in the northern Cook Islands. Seabird conservation in the Cook Islands has been largely conducted through traditional methods of protection of natural resources and use of seabirds for food by local Polynesian peoples, but management of several colonies may be shared with the national government in the future. Baseline numbers of nesting seabirds at Takutea and Suvarrow were documented in 1985-1992 but other colonies are not well described. Additional efforts are needed to document, monitor, and protect seabird colonies in the Cook Islands, given increasing impacts at seabird colonies from tourism, harvesting, and other factors.

## **The Relationship of Reproductive Success of Black-Tailed Gull Breeding on Teuri Island and Habitat Structure**

Michiyo Chochi\* and Yutaka Watanuki

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Black-tailed Gulls, *Larus crassirostris*, breed in the coastal region around the Japanese archipelago. Teuri Island (44°25'N, 141°19'E), northern Japan, has one of largest colonies of this species. In 1987, about 30,000 pairs bred mainly on the southwestern part of the island. In 1994, the number had decreased to 14,000 pairs and about 30% of them had moved to the middle of western edge. Moreover, the reproductive success of the gull is low for this period. At present, the dominant plant species on Teuri Island is a 70-100 cm tall grass which has spread in area since the previous survey. Black-tailed Gulls seem to avoid breeding in the taller grass habitat. To research the relationship between reproductive success of the gull and habitat structure, we compared the reproductive success in tall habitat and in short habitat in 1998 and 1999. In both years, gulls nesting in shorter grass habitat had higher reproductive success as compared to conspecifics nesting in tall grass. During the fledging period, both chicks and parents were covered by tall grasses. This affected reproductive success and gulls avoided nesting in the tall grass habitat.

## **Demography of the Desolation Sound Marbled Murrelet Population**

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A population of between 3000-5000 Marbled Murrelets, *Brachyrhamphus marmoratus*, has been studied at Desolation Sound in the Strait of Georgia, BC. since 1991. Using Capture/Mark/Recapture CMR approaches we have estimated survival and recruitment rates of this population. In addition the use of radio telemetry has allowed us to monitor nest success of 57 active nests during the summers of 1998 and 1999. From these nests we can also calculate nesting success and fecundity of the population. Using these data we provide the latest estimates of population growth rate for this species.

## **The World's Largest Caspian Tern Colony: A Review of Dynamics in the Pacific Coast Population**

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Nesting distribution, survivorship, and mechanisms of population expansion in the Pacific Coast Caspian Tern were examined through a review of colonial breeding records and the analysis of 145 band recoveries of birds banded as juveniles between 1975-1999. Dramatic redistribution and growth have occurred in the population since it was last comprehensively reviewed in 1981. The Pacific population has doubled since 1981, apparently all by intrinsic growth. Although some colonies have vanished (e.g. coastal Washington), there are currently more breeding locations than there were 20 years ago. Growth at individual colonies, especially those in the Columbia River estuary, likely has resulted from extensive recruitment of birds from the other colonies in the Pacific coast region. This study reconfirms the previously documented low philopatry of this population. The Columbia River estuary colonies (Rice Island and E. Sand Island) account for 70-75% of current Pacific Coast population (13,000 pairs). The Rice Island colony of 8000+ pairs is probably the largest colony ever recorded in the world. Factors promoting the concentration of breeding terns in the Columbia River estuary are discussed.

## **Changes in Diet of Terns and Skimmers Nesting at the Bolsa Chica Ecological Reserve in Southern California: Possible Responses to Climate Change and Shifts in Prey Populations**

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The Bolsa Chica Ecological Reserve in southern California has been the nesting site of several species of tern and the Black Skimmer in recent years. We have documented changes in diet of these birds, based on dropped fish, that appear to be related in part to ocean warming and shifts in abundance and distribution of their prey. For the Elegant Tern diet, the ratio of Northern Anchovy to Pacific Sardine, two major prey items, declined steadily from 24.8:1 in 1993 to 0.6:1 in 1997, paralleling a decline in the cooler-water anchovy and an increase in the warmer-water sardine. However, in 1998, this tern failed to nest at the site and, in 1999, reverted to a diet marked by a 25:1 anchovy-sardine ratio. This apparent reversal in diet was not paralleled by a reversal in abundance of the anchovy and sardine, but may have been related to inshore-offshore differences in distribution of these two prey species. Caspian Tern and Black Skimmer, with more diverse diets than Elegant Tern, shifted gradually toward fewer anchovy and more sardine in their diets from 1993 to 1998.

## **Timing of Fledging in Pigeon Guillemots**

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Nocturnal fledging in seabirds has apparently evolved to reduce the risk of predation at seagoing. For species lacking post-fledging parental care, such as Pigeon Guillemots, seagoing is the beginning of an independent existence and could be expected to be sensitive to a variety of selective pressures. We examined the fledging of 60 Pigeon Guillemot chicks raised at the Alaska SeaLife Center as part of a study of restoration of populations following the *Exxon Valdez* Oil Spill. Chicks older than 29 days had their nest boxes moved to a platform where they could both leave their box and fledge. The daily feeding regimen was unchanged. Activities of chicks were recorded on videotape from sunset to sunrise. The majority of fledging occurred late in the twilight period just before darkness was complete. Fledging in a relatively restricted period in late twilight, rather than throughout the period of darkness, could have evolved for a number of reasons. Twilight fledging might assist the fledgling's visual orientation during seagoing while maximizing the time between fledging and sunrise. The latter would allow departure from the nesting area while predation risks are low and maximize the period of acclimatization to the marine environment before initiating foraging at sunrise.

## **Corticosterone Levels of Gulls at Two Sites Suggest Differences in Habitat Quality**

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Long-lived seabirds face trade-offs between reproduction and survival. As breeding conditions worsen, concentrations of the stress hormone - corticosterone - rise, directly decreasing parental investment. Thus, corticosterone levels are an indicator of cumulative stress and parental investment. In this study, we measured body condition, egg loss, predator visitation, and corticosterone levels of Western/Glaucous-winged Gulls nesting in Grays Harbor, Washington (GH) and the Columbia River estuary (CRE). Gulls nest in two habitats within each colony: sand and vegetation. All measures were worse at GH relative to CRE, but did not appear markedly different between habitat types. The exception was egg loss, which was greater only in GH sand versus vegetation habitat. In short, GH is an inferior breeding location for gulls. In the CRE, efforts are underway to reduce Caspian Tern consumption of salmon smolts by relocating the world's largest Caspian Tern colony from CRE to GH. Our findings suggest that breeding conditions are inferior in GH relative to CRE. Thus, tern reproductive success, and possibly site fidelity, may also be poor in GH.

## **Two Special Seabirds, the Nazca Booby and Madeiran Storm Petrel, and a Tribute to Luis Monteiro**

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We have found evidence that two species of tropical seabirds each represent two reproductively isolated populations. Masked Boobies in the eastern Pacific occur in two distinct forms: boobies breeding in the Galapagos Islands and Malpelo have orange bills, whereas those at most other colonies have yellow bills. These two types also differ in morphometrics, vocalizations, and feeding habits, and mate disassortatively at Clipperton Island (Pitman and Jehl 1998). We found that cytochrome b sequences of orange- and yellow-billed types are distinct, and that the orange-billed forms may be more closely related to boobies from the Caribbean. Band-Rumped Storm Petrels, *Oceanodroma castro*, in the Azores breed in two temporally segregated populations: hot- and cool season breeders. Morphology and vocalizations of these populations are distinct, and Monteiro and Furness (1998) suggested that the hot-season population may have arisen from the cool season population through sympatric speciation. We have found that cool and hot season populations are genetically distinct. Whether the origin of the hot-season population represents a case of sympatric speciation remains to be determined.

## **Nestling Diets of Rhinoceros Auklets and Tufted Puffins at Three Colonies in Alaska**

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Opportunistic sampling by the authors includes 20 colony-years of data on the nestling diets of Rhinoceros Auklets in three widely separated colonies in Alaska. In some colonies and years we obtained comparative information on Tufted Puffins diets. The principal prey of Rhinoceros Auklets (>25% by weight in one or more locations and years) included sandlance, capelin, greenling, sablefish, and salmon. Principal prey of Tufted Puffins were sandlance, pollock, prowfish, sablefish, and herring. Though sandlance are keystone prey of both species in the Gulf of Alaska, Rhinoceros Auklets took larger and older individuals on average than Tufted Puffins sampled concurrently. During four consecutive years in the 1990s, sandlance availability near Middleton Island, north-central Gulf of Alaska, dropped to low levels, as indicated by the diets of both puffin species. Other temporal changes in the Gulf since 1978 include increasing use of pollock and sablefish. Juvenile salmon comprised more than 50% of the nestling diet of Rhinoceros Auklets at Middleton in one year. Puffins are prime candidates for long-term ecological monitoring in the Gulf because of information they can furnish on vital forage species and early life stages of several species of commercial importance.

## **Parental Provisioning Behavior of Tufted Puffins, *Fratercula cirrhata*, During a Successful Reproductive Year**

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Life history theory states that the level of parental investment is a result of a trade-off between present and future reproduction. The theory predicts that investment decisions are based on the value of the current brood relative to the value of the parent's own future reproduction. To examine the relationship between parental investment and nestling age and size in 1999, I measured nestling growth rates and parental provisioning rates of Tufted Puffins breeding on Triangle Island, British Columbia. In contrast to the total reproductive failures experienced between 1994 and 1998, fledging success for 1999 was estimated at 88%. Provisioning rates increased with nestling age and declined late in the nestling period. Provisioning rates for the first 10 days of nestling growth did not explain the variation in chick mass at day 10, suggesting variation in the quality and/or quantity of prey species fed to the nestlings. Parents feeding with low quality bill loads had higher provisioning rates, longer chick-rearing periods, and fledged nestlings with lower peak and fledging masses. Given the potential costs associated with provisioning, parental investment decisions may change during years when food is less available.

## **Differential Post-breeding Mortality of Adult Common Murres from Oregon Breeding Colonies in 1997-1999**

Christopher W. Thompson, Thomas P. Good\*, Kirsten Brennan, Monique Wilson, Belen Roca, and Bernhard Krausse

In June 1997, many adult murres abandoned their breeding colonies in Oregon and died on the central outer coast of Washington. Seventy-nine percent were females, differing significantly from the normal 1:1 sex ratio. Two causes may explain this: (1) both sexes die at the same rate, but females disperse before and/or at a greater rate than males from Oregon colonies, and/or (2) both sexes disperse similarly, but females die at a greater rate than males. In 1998, data from beach-cast murres collected throughout the summer on both the south and central outer Washington coast indicated that mortality rates did not differ between sexes on the south versus central coast, i.e., sex-biased mortality was not due to differential dispersal; however, female mortality decreased from 100% in mid-June to about 30% by late July. This could result from (1) inherent asymmetries in reproductive costs early versus late in the breeding season, or (2) stressors associated with El Niño in 1997 and 1998 differentially affected males versus females. Data from beach-cast murres in 1999, a non-El Niño year in which murres in Oregon reproduced well, were similar to data in 1997 and 1998, suggesting that high female and male mortality early and late in the breeding season, respectively, is due to the high cost of egg-production by females and care of fledglings by males.

## **What a Drag: Behavioral Effects of Radio-Marking Common Murres**

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Radio-telemetry is an increasingly popular method for assessing animal habits. However, the success of telemetry studies depends on the reaction of the animal to the tag, including attachment method. In this pilot study, we compare the effectiveness of two attachment methods of radio-transmitter attachments on Common Murres, *Uria aalge*, nesting on Tatoosh Island, Washington. In 1997, we fixed 8 transmitters with epoxy glue to the back feathers of murres. In 1999, we used subcutaneous anchor transmitters on 5 murres. All birds were monitored from blinds fitted with one-way mirrored windows offering close, clear views. Behavioral effects of tagging were monitored by comparing marked birds to non-marked controls. In half-hour intervals we recorded dominant behavior every five minutes, as well as all instances of chick feeding and fighting. Pair switching, fish type, and fish size were also recorded. An automated receiver recorded proportion of time on and off the colony for all tagged birds. Retention time was significantly shorter for glue tags than subcutaneous anchor tags. Transmitters alter the on and off colony behavior of Common Murres. Marked birds spent significantly more time on colony, switched off with foraging mates less than expected, and brought back fewer fish. Whether these short-term behavioral effects translate into larger demographic costs is unknown.

## **Disturbance and Predation at a Common Murre Colony, Point Reyes Headlands, California**

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In 1999, we quantified disturbance by predators and competitors at five Common Murre subcolonies at Point Reyes Headlands, California. A total of 211 disturbance events (180 ground and 31 aerial) were recorded during 153.5 hours of observations. Roosting Brown Pelicans (competitor for limited space) caused only 15.2 % of the total disturbances, but half of these flushed murre. In contrast, Common Ravens (predator of eggs and chicks) caused 68.2% of the total disturbances, but only a quarter of these flushed murre. Ground disturbances were primarily caused by harassment from predators (Common Ravens, 41.7%; Western Gulls, 38.9%) and presence of competitors (Brown Pelicans, 17.2%). Aerial disturbances were primarily caused by predators (Common Ravens, 83.9%; Western Gulls, 9.7%), while disturbances caused by competitors was minimal (Brown Pelicans, 3.2%). During observations, Western Gulls scavenged 12 eggs, and Common Ravens scavenged or depredated 7 eggs and 4 chicks. Brown Pelican disturbances may have contributed to an increase in predation by Common Ravens (acting as opportunistic predators), and to the early abandonment of Cone Rock. Although disturbance events impacted productivity in recent years, it appears as if these events had only a minimal effect in 1999.

## **Depth and Time Dependent Aerobic Diving Limit (ADL): Diving Metabolic Rate as a Function of Buoyancy**

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Aerobic diving limit is defined as the time it takes to deplete the available oxygen stores during a dive, and has been calculated by dividing the available oxygen stores by the diving metabolic rate (DMR). Many species of avian divers have been shown to consistently surpass ADL thus defined. In contrast, a diverse body of evidence suggests that aerobic diving is predominant. In this talk it is argued that DMR is a function of buoyancy which depends on depth. Based on this, ADL is reconceptualized to be a function of depth and diving speed. This “new” ADL is calculated for two exemplary species - Adelie Penguin and Common Murre - showing that both species predominantly dive aerobically, in contrast to the older conceptualization. Other aspects of deep diving are also speculated.

## **Preaching to a New Choir: COASST and Citizen Science**

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COASST (Coastal Observation And Seabird Survey Team) is a Washington-based beached bird survey program designed to couple "hard science" with "public outreach." Most COASST volunteers are regular folks, drawn from local communities and lacking field experience with birds--so, you may ask, "Can they collect good data?" They can. We attribute their early success in beached bird identification to use of COASST's unconventional field guide--one that minimizes jargon, promotes deductive reasoning, and displays carcasses of 50 West Coast species in living (!) color. The guide leads users through step-wise distinctions, from general to more specific characters. Volunteers start by distinguishing bird "families" by unique foot-types; a first step in narrowing the range of candidates (footless birds can still be categorized using the Wing Chord Index). Then, through a series of dichotomous choices on the applicable "Family Foot-type" page, the candidates are narrowed further. The guide then asks them to search for diagnostic species-specific traits, and provides criteria for further discrimination of sex-, age-, or season-specific plumages. Despite observers' unfamiliarity with dead birds before training, their success rate during preliminary surveys has been very high (>90% in cases confirmed by photographs or expert observers).

## **Supplemental Feeding of Black-legged Kittiwakes: Evidence for Early Season Food Limitation**

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On average, only 65% of adult Black-legged Kittiwakes produce eggs in Alaskan colonies, and 50% of potential productivity is sacrificed in the pre-egg stage. In 1996, we began supplemental feeding studies of kittiwakes on Middleton Island, where chronic failure has resulted in an 80% decline in numbers since 1981. From 1996-1998, the evidence for early (pre-egg) versus mid-season (incubation and chick-rearing) food limitation was equivocal. In 1999, however, responses of fed and unfed groups clearly indicated a pattern of early season food shortage and relative food abundance during incubation and chick-rearing. Middleton is located near the continental shelf edge, and kittiwakes in spring rely on mesopelagic prey such as lanternfish, squid, euphausiids, and polychaetes—a carryover of the feeding style they may employ throughout the winter. In late May or June, however, a shift in diet occurs toward nearshore forage species such as sandlance, capelin, and juvenile pollock. That food base supports incubation and chick-rearing, whereas the deep oceanic feeding system supports adult prelaying conditioning and egg production. Variation in the timing of nest failure and responses to supplemental feeding suggest that either system can fail independently of the other in a given year.

## **Distribution of Marbled Murrelets in Monterey Bay, California**

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Marbled Murrelets are regularly observed in northern Monterey Bay, California, yet few directed surveys have been conducted in the area. Information on winter distribution in Monterey Bay is particularly lacking. Knowledge of winter distribution of Marbled Murrelets is important for the conservation of the species. Monterey Bay is approximately 20-km south of the southernmost breeding area of murrelets. Birds from this southern sub-population probably move into the protected waters of Monterey Bay in winter months. We conducted 19 line-transect surveys in Monterey Bay between February 1999 and February 2000. Most murrelets moved into northern Monterey Bay in November, and departed in April. Direct counts of murrelets regularly exceeded 100 birds on during winter surveys. The total number of birds using northern Monterey Bay in winter may exceed 300. Most sightings throughout the year are of pairs. Creek and river plumes and tidal and rip fronts may affect the distribution of murrelets. We also summarize historic and opportunistic sightings of murrelets in Monterey Bay, and discuss specific locations of importance to the species.

## **Nestling Growth in Antarctic Fulmarine Petrels**

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We measured nestling growth rates in Snow Petrels, *Pagodroma nivea*, Cape Petrels, *Daption capense*, Antarctic Petrels, *Thalassoica antarctica*, and Antarctic Fulmars, *Fulmarus glacialisoides*, during three consecutive breeding seasons. Growth rates of all four dimensions (mass, wing chord, tarsus length, and culmen length) did not vary interannually for any of the species. Absolute growth rates for all four species increased as a function of adult mass and were at least 50% higher than predicted allometrically (range = 156-215% of predicted). Growth patterns, after controlling for body size, were similar for all four species despite considerable interspecific size differences. Peak mass, age at peak mass, and fledging age did not vary between seasons for any of the species. Growth constants (k) for body mass, calculated from logistic curves, ranged from 0.136 (Antarctic Fulmar) to 0.169 (Antarctic Petrel). Growth constants for all dimensions showed no consistent interspecific differences. Consistency in nestling growth across all four species and three breeding seasons, despite differences in diet composition, suggests that interannual variation in relative food availability may not regularly constrain nestling fulmarine petrel growth.

## **Research on Captive Pigeon Guillemots at the Alaska SeaLife Center**

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Pigeon Guillemot populations in Prince William Sound have failed to recover from declines after the Exxon Valdez Oil Spill. Post-spill studies indicate that reduced availability of high-lipid, schooling forage fish and increased stress and/or physiological effects associated with continued exposure to residual oil may be limiting recovery. In 1999, eggs (n=70) and chicks (n=28) were collected from Pigeon Guillemot nests. Hatching success varied by collection site and year, apparently due to differences in egg-handling. Survival of chicks collected from the wild was higher than chicks hatched in captivity. Overall fledging success of eggs and chicks raised in captivity was 61%. Most mortality occurred during the egg stage. Chicks raised on a restricted diet of low-lipid fish (juvenile pollock) had lower growth rates than chicks raised on high-lipid fish (juvenile herring), but fledging mass and wing length were similar. Chicks raised on an ad-lib diet of herring did not grow faster than chicks on the restricted herring diet. Chicks fed two small doses of weathered Prudhoe Bay Crude Oil in food suffered no mortality and had similar growth rates to controls. Analysis of blood collected from chicks for biomarkers of oil exposure is in progress.

**Wintering Razorbills, *Alca torda*, and Auk Assemblages in the Lower Bay of Fundy, Eastern Canada. Results from Two Winter Surveys 1997/98 and 1998/99.**

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Wintering areas of Razorbills, *Alca torda*, in the Northwest Atlantic are poorly known. Small numbers breed at the mouth of the Bay of Fundy. Beginning in early winter, many Razorbills begin to appear off Grand Manan Island (44.7° N, 66.8° W), Eastern Canada, certainly many more than can be accounted for by local breeders. During the winter 1997/98 we conducted standardized surveys for seabirds on 26 days between November and March on which up to 53,000 auks were counted off Grand Manan. Extrapolation from the numbers of auks identified to species suggest that ca. 52,000 Razorbills may have been encountered during a transect 23 January (ca. 74% of the North American population). This number dropped eight days later to 64 identified Razorbills, suggesting strong movement patterns of auks in the Gulf of Maine region. A distinct core zone of auk distribution was found around the Old Proprietor Shoals, but auk numbers fluctuated. Winter 1998/99 we did specific GPS-georeferenced surveys to collect bird samples and to investigate the extent of distribution patterns; simultaneous land-based counts from four locations were also carried out; results are presented and discussed.

## **Body Mass Variation in Marbled Murrelets in British Columbia, Canada: Is it Adaptive?**

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Body mass was measured in Marbled Murrelets, *Brachyramphus marmoratus*, from May - August, 1994 - 1998 at Desolation Sound, and Mussel Inlet during June 23 - July 12, 1997, British Columbia, to assess seasonal, sexual, site and intra-annual variation, and to test whether mass was lost due to reproductive stress or to reduce the cost of flight. Birds were captured with mist-nets (all years at Desolation Sound), and by night-lighting (at Mussel Inlet and at Desolation Sound during 1997 and 1998). Birds were sexed using a molecular technique, and fecundity of females in 1997 was determined from plasma levels of egg-yolk precursors. Adult males were  $203.7 \pm 14.8$  g,  $n = 495$  (juveniles  $166.6 \pm 28.8$  g,  $n = 31$ ) and females were  $201.2 \pm 20.5$  g,  $n = 344$  (juveniles  $148.3 \pm 23.5$  g,  $n = 20$ ). Females declined in mass during the egg-laying period, but when fecund females were removed, or when the data were analyzed post-laying, no declines were found. There was no support for mass loss due to reproductive stress or to minimize the cost of flight. Marbled Murrelets are probably more income than capital breeders, and mass may be maintained at a constant (possibly near optimal) level throughout the breeding season.

## **Considerations of Pelagic Protected Areas**

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While there is a need for Marine Protected Areas (MPAs) in the open ocean, little consideration has been given to their design and implementation because marine systems are dynamic and relatively unpredictable. We offer a review of the major issues involved in pelagic reserve design in hopes of stimulating future discussions, research, and management actions. Nearshore MPAs are often based on terrestrial models in which the physical features are fixed or predictable. In these situations, the objective is to preserve static habitats or sessile species. Conversely, important differences arise from the unique, dynamic properties of many open ocean habitats. Here the issues of scale and predictability interact with the extreme mobility exhibited by many marine species. Thus, pelagic reserve concepts will require new designs and management approaches including dynamic reserve boundaries and large buffers around habitat hotspots. Additionally, effective conservation measures will have to scale up the preservation of isolated hotspots by protecting large-scale physical features vital for far-ranging pelagic species. We consider the following oceanographic habitats for the implementation of pelagic reserves: (1) fixed, (2) persistent, and (3) ephemeral hydrographic features.

## **Feeding Strategies of Peruvian, Blue-footed and Masked Boobies in Their Sympatric Distribution Area, Lobos de Tierra Island, Northern Peruvian Coast**

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The feeding ecology of Peruvian (*Sula variegata*), Blue-footed (*S. nebouxii*) and Masked Boobies (*S. dactylatra*) was studied on Lobos de Tierra Island, at the northern edge of the Peruvian Upwelling System, from May 1996 to June 1998, a period when changing oceanographic conditions affected prey availability: 1996 was a cold water period and 1997-1998 was an El Niño event. The three species showed different responses to changes in the surrounding marine environment. Peruvian Boobies fed exclusively on Peruvian anchovies, *Engraulis ringens*, during 1996 and 1997. Blue-footed and Masked Boobies fed extensively on this prey during 1996, less so in 1997, and no anchovies were found in their diet in 1998. In 1997-1998, Blue-footed Boobies switched to coastal fishes other than anchovies, and Masked Boobies fed almost exclusively on oceanic prey species. Changes in regurgitate mass and mean number of prey items in regurgitates were also observed. Results suggest that the abundance and availability of fish prey species, mainly Peruvian anchovies, determines thresholds where booby species change foraging strategies to avoid possible competition on available resources.

## **Parental Energy Expenditure During Brood Rearing in Black-legged Kittiwakes.**

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We examined energy expenditure of Black-legged Kittiwakes raising young in Prince William Sound, Alaska. We used the doubly-labeled water method to measure field metabolic rates (FMR) of 81 chick-rearing kittiwakes at the Shoup Bay and North Icy Bay colonies in 1997 and 1998. We sought to determine if parental energy expenditure shifted spatially or temporally. Measures of FMR varied greatly among individuals (range 1.81 - 4.61 ml co<sub>2</sub> g<sup>-1</sup> h<sup>-1</sup>). We observed a significant interactive effect of colony and year on FMR with Shoup Bay kittiwakes showing no difference in FMR between years (mean = 3.248 ml co<sub>2</sub> g<sup>-1</sup> h<sup>-1</sup>) and Icy Bay kittiwakes showing a significant difference in FMR between years (1997 = 3.002 and 1998 = 3.420 ml co<sub>2</sub> g<sup>-1</sup> h<sup>-1</sup>). Along with FMR, kittiwake productivity in Icy Bay in 1998 was higher than in any of the other colony-by-year classes we observed. This elevated productivity appeared to be associated with a localized improvement in prey availability and we suspect this affected FMR as well. We also found a positive relationship between FMR and brood size that was not dependent upon colony or year.

## **Development and Ranking of Conservation Options for Marbled Murrelets on the Sunshine Coast**

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The Marbled Murrelet is a provincially red-listed species in British Columbia and the population on the Sunshine Coast is considered to be the most at risk. The BC Government developed the Identified Wildlife Management Strategy in 1999 to manage nesting habitat for the Marbled Murrelet as part of its Forest Practices Code. Murrelet habitat is to be managed through the designation of large patches (>200 hectares) of suitable murrelet habitat called Wildlife Habitat Areas (WHAs). To assist with the implementation of this strategy, we developed a process to identify and rank habitat for Marbled Murrelets in the Sunshine Coast Forest District. Our objective here is to explain the current management policies, identify major concerns and demonstrate how current policy is insufficient in maintaining murrelet habitat. Major concerns include: 1) the majority of areas (58%) have less than the recommended minimum target of 10% old-growth, 2) no impact on the timber supply is allowed for murrelet WHAs, 3) WHAs can only be designated in inoperable forests which often contain poor quality murrelet habitat, 4) half of the potential WHAs identified contain approved cut-blocks.

## **Use of a Population Model to Assess the Effects of Feral Cats on Black-Vented Shearwaters, Natividad Island, Mexico.**

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Introduced predators on islands are a leading cause of local and global avian extinctions. Seabirds are likely to be particularly vulnerable to predation because of life history characteristics including low adult mortality, low fecundity, and extended breeding period. We studied the life history and breeding biology of Black-vented Shearwaters in order to examine its vulnerability to introduced feral cats. We report the first detailed data for this species on population size, breeding phenology, chick growth, and mortality. We estimated feral cat predation on shearwaters from an allometric equation for mammalian energetics. We created a demographic model to evaluate effects of different cat populations on the shearwater population's annual growth rate. In 1997, 76,570 pairs of Black-vented Shearwaters bred. Incubation and chick rearing lasted 51 and 69 days, respectively. We estimated shearwater annual population growth to be 1.006 without cat predation. Factoring in cat predation, we estimated that annual growth rate declines approximately 4% for every 20 cats in a population of 150,000 birds. Persistence times of bird colonies decrease dramatically both with an increase in the feral cat population and with decreasing initial bird population.

## **Barren Islands Seabird Monitoring: An Update**

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To study the response of seabirds to changes in food availability and quality during the breeding season, from 1995 to 1999 we collected data annually on several breeding and foraging parameters of surface-feeding (Black-legged Kittiwake) and diving (Common Murre and Tufted Puffin) seabirds at the Barren Islands, Alaska. Breeding parameters included nesting dates, reproductive success, and chick growth rate; foraging parameters were adult nest attendance and foraging trip duration, and chick feeding frequency and meal size. During the field seasons sea surface temperature was continuously recorded. We monitored the prey base by examining chick diets and by beach seining. A related study conducted hydroacoustic and trawl surveys to obtain additional information on the food web. Preliminary results indicate that during the summer of 1999, nesting was early and productivity and chick growth were average-to-high for murres and puffins. Kittiwakes nested late and produced a low-to-average number of fledglings, although chicks grew at normal rates. The proportion of sand lance in beach seine catches was much lower than in previous years and the sea surface lacked previously typical warming intervals. The proportion of capelin in puffin bill loads has increased during this five-year project. This poster compares some preliminary results of this study.

***Rissa "pelagicus": Multi-day Incubation Bouts and Foraging Trips of Breeding Redlegged Kittiwakes***

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Like most seabirds, kittiwakes are monogamous with sexes sharing equally parental responsibilities of nest attendance and nestling provisioning. As a component of a larger investigation of the foraging and reproductive ecology of Red-legged Kittiwakes in the South Eastern Bering Sea, we monitored patterns of nest attendance of this species during the 1993-95 breeding seasons using tail-mounted transmitters and remote signal-logging systems. Comparable studies of nest attendance patterns of Black-legged Kittiwakes in Britain, the Gulf of Alaska, and Prince William Sound report average durations of attendance and absence (= foraging) of approx. 12 hrs during incubation (rarely exceed 24 hrs), and no greater than 4 hrs during brood rearing. In contrast, we found that Red-legged Kittiwake attendance bouts averaged 2+ days during early incubation (4- and 5-day stints were not uncommon!), 24 hrs during late incubation and the first week of brooding, and approx. 12 hrs from then until mid-brooding (approx. 20 days old). We propose that the extreme duration of Red-legged Kittiwake attendance (and foraging) bouts is adaptive because it enhances the efficiency of pelagic foraging on lipid-rich myctophid fishes by reducing the transit time between breeding sites and distant, oceanic foraging areas.

## **Control of Nocturnal Predators at Tern Restoration Islands**

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Following removal of nesting Herring and Great Black-backed Gulls and use of social attraction techniques, endangered Roseate Terns and state-listed Common and Arctic Terns have recolonized former Maine nesting islands.. However, tern restoration islands located near the mainland are frequently predated by Great Horned Owls and Black-crowned Night-herons. We attribute chronic Black-crowned Night-heron predation of most newly hatched terns at Stratton Island to a single specialist heron. Attempts to modify this behavior through "conditioned taste aversion" and other non-lethal methods either failed or proved marginally successful. Night-heron predation decreased this colony to 193 pairs by 1993, but five years after removal of the heron in 1994, the colony has increased to 1121 pairs of Common and Arctic Terns and 100 pairs of Roseate Terns. In the absence of night-heron predation, the colony now experiences sustained high productivity. Between 1993 and 1999, ten Great Horned Owls were live-trapped from Jenny Island and Pond Island NWR, Maine. Nine were banded and released over 80 km away and did not return, but one owl released just 64 km away returned to Pond Island. Control of individual predators requires intensive effort, but the approach is necessary because lone predators can undermine the success of tern restoration projects.

## **Foraging Effort of Breeding Pigeon Guillemots: Are High Quality Prey Harder to Catch?**

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Previous studies have shown that Pigeon Guillemots achieve higher rates of reproductive success when they feed their chicks lipid-rich schooling fish instead of low-lipid demersal fish. Yet Pigeon Guillemots may feed their chicks mostly demersal fish even in situations when they apparently have access to abundant schooling fish. We hypothesized that the benefits conveyed to chicks by a diet rich in schooling fish may be offset to some degree by an increase in adult foraging effort that is required to capture schooling prey. For instance, the location of schooling fish may be less predictable between consecutive foraging trips than the location of demersal fish, so schooling prey might require more effort to locate and capture than demersal prey. We compared the foraging behavior of pigeon guillemots preying on schooling and demersal fish by attaching radio transmitters to breeding adults in the Gulf of Alaska and following them in boats during foraging trips. We collected data on the duration of surface and dive intervals, distance traveled from the nest, foraging site fidelity, foraging site depth, and prey capture rates.

## **Effects of Possible Changes in the St. Lawrence Island Polynya on a Top Benthic Predator, the Spectacled Eider**

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The Spectacled Eider, a diving duck listed as Threatened under the Endangered Species Act, is a principal top predator on benthos southwest of the St. Lawrence Island polynya in the Bering Sea. During winter, these birds dive to depths of 40-60 m in subfreezing water among leads in shifting pack ice, and the high costs of foraging require high intake rates at the bottom. Densities of clams are very high southwest of the polynya, because of high supply of organic matter (OM) to the benthos in a rather well-defined area. This OM may be supplied by production and brine-rejection currents in the polynya, by ice algae deposited locally by late-melting ice, or by production deposited at other times and transported to the area by brine-rejection or other currents. Sampling over several decades suggests that the benthic community has shifted from larger to smaller species of clams, along with changes in grain size and organic content of sediments. We here describe development of an empirically-based computer model of the foraging energetics of Spectacled Eiders, to assess effects of an altered prey base on their overwinter survival and body condition. We also explore integration of the energetics model with physical and biological models of polynya function, to examine how interdecadal weather changes might be linked to the population energetics of this Threatened top predator and its prey.

## **Foraging Patterns of Caspian Terns in the Columbia River Estuary**

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Caspian terns breeding in the Columbia River estuary have been shown to rely upon juvenile salmonids for up to 75% of their diet. In 1999, as part of a long-term management effort, a portion of the estuary population was attracted to a former colony site at East Sand Island (River Mile 5). Using radio-telemetry, the foraging patterns of individuals breeding at this colony were compared to individuals from the Rice Island (River Mile 21) colony, where terns have nested since 1986. Tail-mounted radio-transmitters were attached to thirty terns trapped on Rice Island and twenty-two trapped on East Sand Island and foraging birds were tracked from an airplane and using tracking stations at fixed locations within the estuary. During the brood-rearing period, East Sand Island terns foraged primarily in marine areas, where presumably alternative prey occurred, and Rice Island terns foraged significantly more in freshwater areas of the river, where presumably the forage base is primarily juvenile salmonids. These foraging patterns are consistent with mate and chick feeding observations at each colony indicating 41% less salmonids in diets of terns breeding at East Sand Island.

## **Radar Surveys of Marbled Murrelets on the Northwest Coast of Vancouver Island**

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Radar surveys of Marbled Murrelets were completed on Northwest Vancouver Island to estimate the population size and distribution in this region. 32 watersheds were surveyed with high frequency marine radar to count birds flying inland. Relationships between murrelet counts and watershed habitat features were examined using a subset of 20 watersheds. Murrelet counts were significantly and positively correlated with a number of variables describing the amount of old-growth forest occurring in these watersheds. The amount of old-growth forest at low elevation (<600m or Matlow) was the most highly correlated variable, and explained a significant proportion of the variation in dawn counts. Murrelet density was estimated as Maximum predawn radar count/hectares of low elevation old growth forest (Matlow). Murrelet density was low, ranging from 0.064 to 0.102 birds/ha Matlow forest (95% CI). Murrelet density was not correlated with the amount of remaining forest or habitat loss, suggesting that murrelets do not increase their nesting density in response to habitat loss. Radar surveys are an appropriate method for monitoring murrelet populations in much of the remote coastline of British Columbia. Additional radar surveys could increase our understanding of how nesting murrelets respond to changes in habitat availability.

## **Seabird Habitat Recovery Through Rat Eradication at Anacapa Island, Channel Islands National Park**

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Through rat eradication Channel Islands NP and Island Conservation & Ecology Group will endeavor to restore island populations of seabirds including Ashy Storm-Petrels, Xantus' Murrelet, Cassin's Auklet and Brown Pelican to historic numbers. Additionally it is expected that intertidal species, herpetofauna, island deermice and various flora will respond favorably to the removal of rats. Steep topography and an endemic deermouse subspecies (*Peromyscus maniculatus anacapae*) present special challenges for rat eradication, therefore, we propose: 1. to use aerial broadcasting as a method to distribute rodenticide bait (the anticoagulant, brodifacoum, at 20 ppm), 2. to apply the rodenticide during late Fall when both rat and deermouse populations are low and to avoid nesting Brown Pelicans, 3. a trial bait drop be conducted on East Anacapa Island first. If evaluated favorably, follow up one year later with a simultaneous bait drop on West and Middle Anacapa Islands, 4. to protect native deermouse populations by having "insurance populations" on the island(s) not being treated at the same time, 5. to monitor and document effectiveness of the eradication, 6. initiate a program to prevent future introductions of non-native species.

## **Effects of El Niño Events on Cormorant Breeding Populations in the Southern California Bight**

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We examined the effects of El Niño conditions in 1983, 1986, 1992-93, and 1998 on breeding populations of Brandt's (BRCO), Double-crested (DCCO), and Pelagic (PECO) cormorants in the Southern California Bight (SCB) using mainly: 1) aerial photographic surveys of breeding population size ("numbers") at several colonies throughout the SCB (1991-1998); and 2) boat and ground surveys of numbers and reproductive success ("productivity") at Anacapa Island (1980-1998). El Niño years were significantly correlated with reductions in numbers of BRCO and PECO at most islands. For BRCO, this correlation was greatest at islands where upwelling is typically greater. For DCCO, El Niño years were correlated with reductions in numbers at Anacapa Island and at all colonies combined only. El Niño years also were significantly correlated with reductions in productivity of DCCO and PECO at Anacapa Island. El Niño events in the 1980s and 1990s had great influence on SCB cormorant populations by leading to reduced recruitment, increased mortality, and/or colony shifting. Various anthropogenic factors (especially human disturbance) also affected cormorant populations at certain colonies.

## **Climate Change and the California Current**

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The role of climate -ocean variation and the consequences to marine populations is not well understood. A 50yr. spatially extensive, study of the California Current has shown that there have been significant interannual and interdecadal changes in the hydrography of this system. These have had major biological effects in terms of a decrease in secondary production, species range shifts and structural changes in pelagic and benthic communities. If, as we think, the frequency of the disturbances is increasing, there is cause fo great concern for the status of our coastal and oceanic ecosystems. These should be carefully monitored.

## **Solutions to the Bycatch of Seabirds in Alaska Sablefish Longline Fisheries**

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Seabird mortalities occur in longline fisheries as seabirds feed on sinking baits when the gear is deployed. All Alaska longline fisheries face closure or limitation due to the potential hooking mortality of short-tailed albatross, an internationally endangered species, and now operate under new regulations borrowed from other nations. In order to develop Alaska specific solutions to seabird bycatch, we compared seabird and fish catch rates among two seabird deterrent strategies and a control in the IFQ sablefish fishery in the Gulf of Alaska and Aleutian Islands in May and June of 1999. Deterrents were selected in collaboration with fishers and included lines with added weight to increase sink rates (.23 kg of lead every 10 meters) and a surface deterrent, paired streamer lines (tori lines). Seabird abundance and behavior (bait attacks per minute) were also quantified during each set. General Linear Modeling (GLM) techniques were used to compare catch rates among treatments (ANOVA), and to explore linkages between catch rates, seabird presence and activity, and physical factors. Preliminary results indicate that compared to controls paired streamer lines were more effective at reducing seabird bycatch (90%) than were weighted lines (35%).

## **Landscape and Seascape Patterns Associated with Marbled Murrelet Offshore Abundance**

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We studied the broad-scale landscape and seascape patterns associated with offshore abundance of the Marbled Murrelet in a study area that extended from Coos Bay, Oregon to Monterey Bay, California. Old-growth forest fragmentation and marine habitat variables were measured in nine sub-regions of the study area. Using linear regression, we determined relationships between the habitat variables and offshore murrelet population estimates. Offshore distributions of murrelets were strongly related to the amount of old-growth forest fragmentation inland. Murrelets were most abundant offshore of large blocks of contiguous old-growth forest within a matrix of relatively abundant mature, coniferous or hardwood second-growth forests. Marine habitat associated with more murrelets had less rocky coastline. In our model, marine habitat was relatively unimportant compared to inland habitat in determining murrelet abundance offshore.

## Foraging Distances of Radio-Marked Marbled Murrelets in Southeast Alaska

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We radio marked seven female and two male Marbled Murrelets, *Brachyramphus marmoratus*, and followed their movements through the inner passages of Southeast Alaska during the breeding season in 1998. Six of the nine murrelets were detected inland in the early morning hours between 24 June and 17 July. Inland visits for each individual were consistent to a particular location, but short in duration, which precluded locating potential nest sites. We recorded 46 locations at sea up to 124 km ( $x = 78 \pm 27$  km) from inland sites between 19 June to 16 July. The majority of murrelets were located at sea in western Icy Strait, a productive feeding area at the mouth of Glacier Bay. This study provides the first direct evidence that murrelets in Southeast Alaska are consistently traveling considerable distances between potential nesting and foraging areas. In addition, the consistent inland attendance patterns we observed provide the first documentation that failed or post-breeding birds attend potential nesting sites. These findings have important implications for murrelet conservation and management efforts in Southeast Alaska.

## **Post-Release Survival of Common Murres, *Uria aalge*, Following the Stuyvesant Oil Spill: Preliminary Results**

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In September 1999, the Stuyvesant dredge vessel spilled at least 2100 gallons of intermediate fuel oil outside Humboldt Bay, CA. Over 1200 seabirds, including 500 common murres, were captured alive and brought in for rehabilitation. Approximately 1 month after the spill, 31 rehabilitated and 25 control murres (all adults) were radio-marked using the subcutaneous anchor technique, and released at the mouth of Humboldt Bay to evaluate post-release survival and behavior. Rehabilitated murres had been cleaned, rehabilitated, assessed as "healthy", radio-marked, and released within 17-21 days (1 exception) while control murres were radio-marked and released within 24 hours. From October-December 1999, murres have been subsequently located by aircraft 1-2 times per week via systematic aircraft flights ranging from Monterey Bay, CA to Puget Sound, WA, and as far as 25 miles offshore. After approximately 70 days post-release, 22 of 31 (71%) rehabilitated murres and 24 of 25 (96%) control murres are presumed to have survived, already suggesting much higher survival than previous studies have claimed. Murres are presumed to be alive because no mortality signals have been detected, however, all birds are not located during each flight suggesting that murres have made extensive movements thus far and they are moving in and out of the tracking range. Conversely, 9 of 31 rehabilitated murres and 1 of 25 control murres have been confirmed dead. Five of these carcasses have been recovered. These findings are only preliminary results and much more analyses are needed to fully interpret the ongoing data collection.

## **Proximal and Ultimate Factors Determining Annual and Decadal Variation in Population Dynamics of Adelie Penguins in the Ross Sea: A Demographic Model**

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Population size of breeding colonies of Adelie Penguins in the Ross Sea has been tracked since 1959. These censuses demonstrate marked differences in trend between decades, as well as marked variation in size between years. We developed a demographic model to examine mechanisms responsible for such fluctuations, based on previous studies of banded Adelie Penguins breeding in the Ross Sea. We conclude that change in overwinter survival rates of adult and/or immatures (over the course of years or decades) is a necessary component explaining observed fluctuations in population size. Specifically, a population crash in the late 1980's was likely a result of poor adult survival in those years. We also examined environmental factors that may explain the observed fluctuations in population size. Extensive sea-ice in winter was correlated with reduced population growth of breeding colonies five years later, as a result of (presumed) decrease in juvenile survival. The five year time lag corresponded to that predicted by the population model. Ice extent was, in turn, related to variation in the Southern Oscillation index.

## **Sand Lance Habitat Modeling for Prince William Sound, Alaska**

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We sought to model habitat selection by Pacific sand lance, *Ammodytes hexapterus*, by examining their distribution in relation to water depth, distance to shore, bottom slope, bottom type, distance from sand bottom, and shoreline type. We determined bottom type by re-analyzing previously collected hydroacoustic data with sediment classifying software, which was calibrated with substrate samples collected during the summers of 1998 and 1999. Through both logistic regression and classification tree analysis, we compared the characteristics of known sand lance locations to randomly selected sites. All models indicated a strong selection for shallow water by sand lance with weaker association between distribution and shoreline type, distance to shore, bottom slope, and distance to the nearest sand bottom. All sand lance locations were at depths < 60 m and 93 % occurred at depths < 40 m. We used the classification tree to determine potential sand lance habitat within the APEX study areas of Prince William Sound. We then developed a map of potential sand lance habitat and compared that coverage to independent data on sand lance locations collected by aerial observation.

## **Common Murre Re-Colonization at Devil's Slide Rock, California: Social Attraction Techniques and Initial Recolonization Patterns.**

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In 1996, social attraction techniques (decoys, mirrors, and broadcast vocalizations) were first used to attract Common Murres to attend Devil's Slide Rock (DSR), California, as part of a seabird restoration program aimed at recolonization of this recently-extirpated colony (i.e., breeding had not occurred for about 10 years). Potential breeding habitat was divided into blocks and decoys were deployed at different densities in plots (located within blocks). We recorded the presence or absence of murres on DSR and within the decoy colony using a scan sampling technique. Murres were observed to use the restoration site on a daily basis and 6 pairs laid eggs resulting in 3 chicks fledging. Data were analyzed using logistic regression to model presence of murres with 4 spatial variables (block, plot, sub-plot, density) and one temporal variable (season). Block, sub-plot, density and season were significant variables in the model ( $p < 0.0001$ ). Interpretation of the model suggests that murres were present in high and low density plots near the center of DSR. Continued and increased breeding and attendance in 1997-1999 has further supported and refined this interpretation.

## **When Indirect Effects Dominate: Bald Eagle Interactions with Common Murres**

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Population viability of long-lived, low fecundity animals, such as seabirds, is generally characterized by sensitivity to adult survival and relative insensitivity to reproductive output. For this reason, management and conservation efforts are often directed towards reducing adult mortality sources. On Tatoosh Island, Washington State's only known breeding colony of Common Murres experiences several sources of adult mortality including gillnet fisheries, occasional oil spills, and predation. However, population decline over the last decade is most completely explained by none of these mortality sources, but instead is a result of eagle-facilitated egg predation by resident Glaucous-Winged Gulls and Northwestern Crows. A simple demographic model shows that direct effects of eagles (i.e. predation on adult murres) only accounts for 20% of modelled population decline, whereas the addition of indirect effects (i.e. reproductive depression) accounts for the remaining 80%. This study highlights three areas of emerging conservation concern. First, indirect effects can account for a large fraction of population change. Second, colonies which were once a demographic source can turn into sinks, or even traps. Third, effective multispecies management becomes increasingly difficult when the successful restoration of high trophic level consumer, such as eagles, generate subsequent declines in their prey species.

## **Genetic Structure and Geographic Variation in Global Populations of the Black-Legged Kittiwake, *Rissa tridactyla***

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Black-legged kittiwakes are small, pelagic cliff-nesting gulls with a sub-arctic and arctic breeding distribution. Generally, two subspecies are recognized; *R. tridactyla pollicaris* which is confined to the North Pacific and *R. tridactyla tridactyla* which is restricted to the north Atlantic. Studies examining plumage variation in the North Atlantic have illustrated colony specific differences in melanism. This observation in combination with the philopatric nature of this species suggests that significant genetic differences and restricted gene flow may exist among kittiwakes from different colonies. The primary objectives of this study is to determine the extent of genetic structuring and evolutionary histories of Atlantic *tridactyla* and Pacific *pollicaris* colonies using mitochondrial DNA (control region) and nuclear DNA (introns). Genetic variation was assayed by single stranded conformational polymorphism analysis (SSCPs) and direct sequencing of haplotypes. Preliminary results from the 3' end of the control region show low haplotypic diversity of Atlantic populations suggesting that they may have experienced a series of bottlenecks in the recent past. Furthermore, we found no overlap between Atlantic and pacific haplotypes supporting previous subspecies designations. Statistical analyses provided further evidence for genetic structuring of haplotypes within and between ocean basins and non-random segregation of sequence variation.

## **Sampling Marbled Murrelets at Sea: Are Two Heads Better Than One?**

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Marine surveys for Marbled Murrelets are conducted using a variety of methods. Differences among methods affect population estimates and indices of productivity. To aid in the development of a standardized protocol for monitoring under the Northwest Forest Plan, we tested: (1) one observer versus two; (2) density estimates from perpendicular-distance versus radial-distance calculations; (3) variation in observer accuracy in estimating perpendicular and radial distances, and (4) the spatial distribution and detectability of adult murrelets versus juveniles, which could affect productivity indices. Across observers, the percent of murrelets missed by a single observer (20%) rather than in a team (16%) was not significantly different, but varied for individuals. Sea surface conditions and glare may influence observer performance as much as the number of observers. Direct estimates of perpendicular distance were slightly better than estimates of radial distance in most tests. Direct estimates were more precise than radial estimates, but both were biased. If observers estimate azimuths, radial estimates will have greater error. Detectability of adults and juveniles did not differ, but distribution patterns differed in some years. Implications for a monitoring design are discussed.

## **"Seabirds as Guinea Pigs" -the Pacific Ocean Biological Survey Program and Offensive Biological Weapons Testing.**

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The Pacific Ocean Biological Survey Program (POBSP) was a well-known scientific effort in the 1960s to document basic tropical seabird distribution and ecology and indigenous bird diseases in the Central and North Pacific Ocean. The program was administered by the Smithsonian Institute. Recently declassified documents indicate that the U. S. Army funded the program to locate areas where offensive biological weapons could be safely tested. In the 1964 secret project "Shady Grove", Q fever and tularemia (rabbit fever) were dispersed in aerosol tests from jets over the ocean near Johnston Atoll. On Howland and Baker Islands, project "Magic Sword" occurred, testing the efficacy of mosquitoes as disease vectors for humans. The released mosquitoes were disease-free. Feral cats appeared in 1966 after the U. S. military visited the islands, presumably cats were introduced to control the abundant mice. The cats were present until Doug Forsell et al. (USFWS) eradicated them in the late 1970s. I review the history of germs, mice, rats, crabs, cats and seabirds on these remote tropical islands.

## **A National Plan of Action for Reducing the Incidental Catch of Seabirds in Longline Fisheries**

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Concerns about the incidental catch of seabirds in the world's longline fisheries led to the endorsement of the International Plan of Action for Reducing the Incidental Catch of Seabirds in Longline Fisheries (IPOA-S) by the Food and Agriculture Organization of the United Nations' Committee on Fisheries in February 1999. The voluntary IPOA-S applies to States with longline fisheries and would be implemented through the development of individual National Plans of Action, no later than early 2001. The U.S. NPOA-S contains the following themes: 1) Regional assessments of seabird interactions with longline fisheries; 2) If a problem exists, then actions should be taken--data collection; prescription of mitigation measures; research and development; and outreach about seabird bycatch; 3) Annual regional reports on the status of NPOA-S implementation; 4) Cooperative efforts between NMFS and FWS on seabird bycatch issues and research; and 5) A national commitment to advocate the development of National Plans of Action within international fora. By working cooperatively, fishermen, managers, regional fishery management councils, scientists, and the public will use this national framework to achieve a balanced solution to the seabird bycatch problem, promoting continuing sustainability of our national marine resources.

<sup>1</sup> SIAWG members include: Therese Conant, Kathy Cousins, Alvin Katekaru, David Kerstetter, Kim Rivera, Dean Swanson, Robin Tuttle (NMFS); Al Manville, Kent Wohl (USFWS); Stetson Tinkham (State Dept.)

## **Population Monitoring of Seabirds at Vandenberg Air Force Base, 1999**

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In 1999 we began the first year of a long-term program to monitor the population dynamics and breeding biology of seabirds breeding at Vandenberg Air Force Base (VAFB). Because VAFB is near the southern limit of the breeding ranges for many seabird species, it is important that seabird colonies at VAFB be monitored closely and annually for many years. Changes in seabird populations tend to be more pronounced near the end of a given species' breeding range. Although population changes are largely impacted by natural factors such as food availability, disturbance by humans may also exert a major influence. At VAFB, the human activities that are potentially most threatening to seabirds are offshore oil drilling and sonic disturbances produced by rocket launches. Beginning on April 23, we identified the locations of various sub-populations of seabirds breeding from just south of Point Sal (34° 53' 55"N) to Rocky Point (34° 33' 45"N). During these surveys, we were successful in locating and estimating breeding populations of Pigeon Guillemots, pelagic cormorants, Brandt's Cormorants, Black Oystercatchers, and Western Gulls. We also observed Rhinoceros Auklets on various occasions, but we did not confirm their breeding activity at VAFB. We estimated a total of 1200 seabirds breeding at VAFB in 1999.

## **Caspian Tern Management in the Columbia River Estuary**

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The large Caspian Tern colony on Rice Island consumed about 10.8 million juvenile salmonids, or approximately 11% of the out-migrating smolts that reached the Columbia River estuary in 1998. In 1999 we attempted to relocate part of the Rice Island tern colony (rivermile 21) to East Sand Island (rivermile 5). After restoration of 8 acres of nesting habitat on East Sand Island, tern decoys, audio playback systems, and selective gull removal were used to encourage terns to nest on the new site. Concurrently, silt fencing was erected on 65% of the former tern colony site on Rice Island to further encourage terns to shift to East Sand Island. Despite greatly reduced colony area, close to the same number of terns nested on Rice Island in 1999 as in 1998 (about 8,000 pairs). Rice Island terns continued to consume mostly young salmon (75% of prey). About 1,400 pairs of Caspian Terns nested at the new colony site on East Sand Island, where approximately 1,600 -1,700 chicks were raised (more than twice the nesting success of terns nesting on Rice Island). Terns nesting on East Sand Island consumed 41% fewer salmonids than terns nesting on Rice Island.

## **Factors Affecting the Recovery of Common Murres Nesting on the Castle/Hurricane Rock Complex**

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Central California populations of Common Murres declined rapidly during the 1980's due to gill net mortality, oil spills, and a severe El Niño event. While numbers have increased substantially in most areas in the 1990's, the Castle/Hurricane Colony Complex (Monterey County) has only recovered to about 52% of pre-decline numbers. Since 1997, we have observed anthropogenic and natural disturbances (i.e., murres responded by "head bobbing" or flushing) while monitoring the attendance and breeding success of these colonies as part of the Common Murre Restoration Project. Low flyovers and close approach by fishing boats occurred more frequently and resulted in increased flushing compared to observations at other nearshore murre colonies concurrently monitored in Central California. Natural disturbances caused by "space competitors" (e.g., Brandt's Cormorants, Brown Pelicans) and potential predators (e.g., Peregrine Falcons, Western Gulls) were more localized per event. The short-term and long-term consequences of these disturbances on murre population size, breeding success, or timing of breeding are difficult to measure. Any effects probably are additive to continuing mortality from gill-net mortality and oil pollution which also are affecting the recovery of these colonies.

## **Oceanographic Factors Influencing the Phenology and Reproductive Success of the Xantus' Murrelet on Santa Barbara Island, California**

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Many studies have shown a correlation between seabird phenology and reproductive success and measures of food availability. Prior work has demonstrated a correlation between the timing of Xantus' Murrelet clutch initiation and anchovy abundance. We use monitoring data from Santa Barbara Island, oceanographic data from surrounding waters, and fisheries data from the Southern California Bight (CalCOFI program) to further investigate factors influencing Xantus' Murrelet breeding biology. We look at the influence of anchovy abundance at different times of the pre-breeding and breeding seasons and in different areas of the Bight, as well as factors such as water temperature, upwelling indices, wind speed, and air temperature.

## **Colony Attendance Patterns of Radio-marked Cassin's Auklets at Triangle Island, British Columbia**

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The colony attendance patterns of breeding radio-marked Cassin's Auklets were monitored during the chick rearing period in 1999. Thirty nine adults were captured and fitted with transmitters and a data collection computer (DCC II) was used to monitor the arrival and departure times of individuals over a three week period. We examined individual timing of visitation and duration of time spent at the colony to assess patterns of provisioning in relation to parental sex, chick age, and variation in weather. In general, daily attendance patterns showed that most adults arrived at the colony between 23:00 and 00:30 h and departed between 03:30 and 04:30 h. We discuss the importance of quantifying colony attendance patterns for refining methods of estimating population trends using radar monitoring.

## Functional Significance of Sexual Dimorphism in Wandering Albatrosses

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Wandering Albatrosses, *Diomedea exulans*, exhibit sexual segregation of foraging zones. Males feed in sub-Antarctic waters while females' forage at lower latitudes in sub-tropical zones. We investigated whether sexual size dimorphism and its effects on flight performance could explain the differences in at-sea distribution of each sex. We measured adult body mass, maximum girth, wing span, and wing area of 16 females and 20 males at a breeding colony in the Crozet Archipelago, southwestern Indian Ocean. On average, males were 20.4% heavier ( $9.44 \pm 0.58$  kg) and 7.3% larger in girth ( $88.0 \pm 3.1$  cm) than females. The wings of males were also 4.5% longer ( $311 \pm 4$  cm) and had 7.5% more area ( $6260 \pm 265$  cm<sup>2</sup>) compared to females but aspect ratio was not significantly different between sexes. Overall, wing loading was 12% greater in males which means they would be more constrained to foraging in areas with the strongest winds such as the sub-Antarctic regions. Furthermore, the difference in wing load combined with significant differences in body size impacts the quantity of food that each sex delivers to its chick. Consequently, sexual dimorphism has profound effects on chick provisioning strategies and the division of labor between the sexes.

## **Pattern of Recolonization by a Central California Common Murre Colony After Four Years of Using Social Attraction Techniques, 1996-1999**

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In early 1996, social attraction equipment (i.e., decoys, mirrors, and broadcast vocalizations) was deployed at Devil's Slide Rock, California, to restore breeding at a recently extirpated colony of Common Murres. From 1996 to 1999, combined numbers of "territorial" and "breeding" sites increased from 11 to 86. "Territorial" sites (i.e., present on 15% of the observation days) often preceded "breeding" sites (i.e., where egg-laying was observed) in the following 1-2 years at the same or nearby site. In 1996, territorial and breeding sites were established in four of the twelve decoy areas. By 1999 sites were established in eleven of the decoy areas, as well as, outside of decoy areas. As a result of the change in numbers and location of sites in 1999, formerly separated breeding murres became linked, increasing the nesting density at the colony. In this poster we will examine annual growth of the colony in relation to location of sites, proximity of sites to social attractants, and proximity of sites to prior year sites.

## **Protecting Alaska's Islands from Rodent Introductions**

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Rats/house mice will be introduced to additional Alaskan islands unless preventive measures are taken. The Alaska Maritime refuge has a program to deal with this threat:

- 1) Pribilof Islands Prevention - harbors at St. Paul and St. George are likely paths for rodent invasion. Defenses set up in 1993 have been expanded and improved. These consist of maintaining traps and poison stations, community education, local shipwreck response capabilities, expelling infested vessels, and development of regulations. To date, several rats have been killed in preventive stations at St. Paul, and there is no evidence of rats becoming established. The local communities are taking ownership in the program.
- 2) Shipwreck Response - personnel have been trained and response kits have been developed. Rodenticides are the primary tool, but their use would be limited to bait stations. Due to the ruggedness of many islands, we plan to pursue permits for aerial poison dispersal.
- 3) Outreach - rodent-free ships pose no threat! Through direct contact with the shipping industry, newspaper advertisements, and distribution of free rodent prevention kits, efforts are being made to clean up vessels. These activities have centered around ships using the Pribilof Islands, and appear to be effective. This program may be expanded to other areas of coastal Alaska.

## **Beringian Seabird Colony Catalog**

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The U.S. Fish and Wildlife Service, Anchorage, Alaska in cooperation with the Institute of Biological Problems of the North, Magadan, Russia combined seabird colony data and created the Beringian Seabird Colony Catalog (Catalog) computerized database. The Catalog stores current and historical data on breeding population size, species composition, and location data of 1,759 Alaskan and 453 Russian Far East seabird colonies. Forty-seven species are listed and colony sizes range from a few pair to 5.75 million birds. The Catalog consists of a relational database program linked to a geographic information system. Catalog products include computer files, data reports, and detailed maps showing colony location and sizes. The Catalog can also be accessed via the Internet. Create maps, download data, and view a video or photograph of a colony or bird species. Learn about seabird species, projects, and personnel. We welcome review of existing data and encourage observers to send new data.

## **Spatial Foraging Patterns of Three Penguin Species in the South Atlantic.**

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We used satellite telemetry to determine foraging locations of Magellanic, Rockhopper, and Gentoo penguins nesting in close proximity on New Island in the Falkland Islands during the 1998-99 penguin breeding season. The three species showed marked differences in foraging range and location. During incubation, the two Gentoos we tracked were usually within 10 km of the colony, and were never detected more than 25 km away. The three tracked Magellanics foraged slightly farther away, generally within 25 km, but as far as 90 km. The five tracked Rockhoppers took long foraging trips, with most one-way distances exceeding 250 km. During late chick-rearing, two of the seven Rockhoppers we tracked took long trips (>340 km maximum distance from colony). The remaining Rockhoppers and the three Magellanics tracked in this period were seldom more than 20 km from the colony. All Rockhoppers that took long trips passed through a designated marine zone of potential economic development. The differences in foraging location found in this study may reflect diet differences among these three species. The diversity of foraging locations among the species, along with inter-annual foraging location differences within species, presents a complex challenge for seabird conservation in the region.

## **Parental Foraging Effort and Offspring Growth in Adelie Penguins: Individual Variation.**

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Offspring growth rates of Adelie Penguins varied markedly among pairs at a same colony within a breeding season. To examine how parental foraging behavior affects growth rate of their chicks, we monitored diving behavior of parents, foraging trip duration, and chick mass for 17 pairs in 1996/97 at Syowa St., Antarctica. The frequency of meal delivery was positively correlated to brood growth rate. Parental foraging effort (% time spent under water) per day varied significantly among pairs (25-60 % time of a day), during chick guarding period. Individual parents tended to keep their own foraging effort levels constant. However, the foraging effort levels of individual parents could not explain the differences in offspring growth rates among pairs. The results suggest variation in offspring growth may be related to parental feeding efficiency or energy allocation to self and offspring, rather than foraging effort.

## **South San Diego Bay Salt Works Acquisition and Planned Restoration for Fish and Wildlife**

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The U.S. Fish and Wildlife Service, employing a team from Refuges, Coastal, and Endangered Species programs, has accomplished the acquisition of 800 acres of the Western Salt Works in South San Diego Bay. This acquisition of private property, currently operated as salt evaporation ponds, will allow valuable improvement in fish and wildlife habitats, particularly for nesting seabirds, endangered California least tern, and threatened western snowy plover. Existing biological diversity and colonial nesting seabird nesting activity is protected by management of these lands as a National Wildlife Refuge. Salt making may be modified or eventually cease and biologically "dead" areas may be restored to high habitat value wetlands. With the expected termination of commercial salt production, restoration of hundreds of acres of tidally influenced wetlands, mudflats, and salt marsh may be accomplished after a restoration plan has been completed. A wide variety of migratory shorebirds and seabirds would benefit by restoration of tidal flats and seasonal ponds, and secure, high tide loafing and foraging areas. An additional 600 acres of State-owned salt works lands may also be converted out of solar salt making into fish and wildlife habitats. This 1400-acre site has become part of a new National Wildlife Refuge and been designated as a regionally significant part of the Western Hemisphere Shorebird Reserve. This acquisition will help reverse the southern California trend of coastal wetland loss and degradation by removing an industrial use, replacing it with a National Wildlife Refuge and high value fish and wildlife habitats.

## **Comparison of Breeding Biology of Rhinoceros Auklets on Two Central California Islands**

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In California, Rhinoceros Auklets were once plentiful, but the population disappeared for unknown reasons in the mid 1800's. A recolonization began in the 1970s, and it is estimated that three islands, Castle Rock, the Farallon Islands, and Año Nuevo Island, now provide nesting habitat for approximately 90% of the California breeding population. We investigated population dynamics, occupancy rates, and compared pairs breeding in artificial sites to those breeding in natural sites to determine reproductive performance on Año Nuevo Island and Southeast Farallon Island. We also looked at regulatory factors of population dynamics such as overall reproductive performance and survival in relation to changes in prey availability. Since 1987, Rhinoceros Auklet chicks on offshore Farallon Island have been fed at least 21 different prey species, 15 of which have also been fed to chicks on nearshore Año Nuevo since 1993, however, the proportions of species differ between the two sites. We will discuss implications of documenting the changes in prey availability and selection among years has for evaluating auklet reproductive performance as well as the status of forage fish stocks in central California.

## **Novel Sequences of Flight Feather Molt in Sooty Shearwaters and Northern Fulmars**

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Few detailed studies have been done on flight feather molt on procellariids; most have focused solely on primary molt, and all have concluded that primaries are replaced in sequential order from the innermost (P1) to outermost (P10) primary. However, Sooty Shearwaters and Northern Fulmars both replace their primaries in a sequence that has not been described in any bird species previously: Primary molt typically begins at P2, and progresses proximally to P1 and distally to P10. Secondary molt is initiated at three nodes, first at an inner node (S20 or S21 in shearwaters, S18-S19 in fulmars) progressing proximally to the innermost secondary and distally to S16-15. Shortly after molt begins at the inner node, secondary molt begins at a middle node (S5) and progresses proximally to S14-S15. Soon after initiation at the middle node, molt begins at the third and outermost node (S1), and progresses proximally to S4. Molt of rectrices is typically highly asymmetrical and seemingly random. Shearwaters nearly always replace all of their flight feathers during molt; they also usually molt their remiges quite symmetrically, and exhibit little variation in sequence of secondary molt. In contrast, fulmars frequently fail to replace all their secondaries (or rectrices), and the sequence of secondary molt often is asymmetric and rather variable.

## **Breeding Chronology and Reproductive Status of the Marbled Murrelet in Desolation Sound, B.C.**

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A thorough understanding of breeding biology includes knowledge of breeding chronology of a species. Traditional methods of observation of seabirds at their colonies to understand the breeding biology are not possible for the Marbled Murrelet, which nests in old growth forests, not in colonies. Their nests are difficult to find and widely dispersed. Breeding biology of the Marbled Murrelet is currently being investigated using two nontraditional methods, including radiotelemetry and physiological analyses of plasma. An egg yolk precursor, vitellogenin (VTG), is detected in blood plasma and used to predict when the female bird is forming an egg. However, analysis of VTG cannot identify breeding males or breeding females that are no longer producing eggs. Other physiological methods to identify these birds are currently being investigated, including the analysis of the hormone prolactin in the role of parental care for both sexes. This study will use physiological methods to identify breeding individuals, and stages in the breeding chronology, such as egg-production and chick-rearing. I will test these predictions by comparing breeding status assessed from plasma analyses with breeding status determined by telemetry, for those birds which receive both treatments. This will also allow an assessment of the impact of capture and handling on reproductive success, in which all birds found to be non-breeding using radiotelemetry should also be non-breeders according to physiological analyses.

## **Sexual Selection, Tail Streamer Function and Demography of Red-tailed Tropicbirds at Tern Island, French Frigate Shoals, Northwestern Hawaiian Islands**

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Tropicbirds have the most elongate tail streamers displayed by any bird, and in one species, the Red-tailed Tropicbird the central tail feathers are both elongated and colored bright red, yet no study has investigated the function. Streamers formed by elongated central tail feathers are hypothesized to be the product of sexual selection because they may have no clear aerodynamic function but instead serve as ornaments displayed during the breeding season for mate attraction and intra-sexual competition. I will use field experiments and observations to test whether this hypothesis could explain the evolution of tropicbird tails. My project will: 1) quantify patterns of variation of tail streamers; 2) quantify how tail streamers are used in sexual displays; and 3) use manipulation experiments to test sexual selection and aerodynamic function. The proposed work will be one of only a few studies examining the sexually selected role of an ornament displayed by both sexes. My study will be conducted March to August 2000/2001. I will also quantify local population size of breeding and non-breeding birds, productivity, and by resighting and recapturing previously marked birds quantify survival rates.

## **Diving in Magellanic Penguins: Comparisons and Contrasts**

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Dive data collected from male (n=12) and female (n=4) Magellanic Penguins instrumented with time-depth recorders (TDRs) during two breeding seasons (1995-96 and 1996-97) at Punta Tombo, Argentina showed birds can dive to a maximum depth of 91 m (average = 72.6m) and maximum duration of 4.6 min (average = 3.2 min). Using average dive depth and dive duration of individual birds we found no significant differences in diving behavior between the two study years, but did detect diving differences within different stages of the breeding seasons (Incubation - Early Chick - Late Chick). We also found significant differences in diving behavior between the sexes, and determined that these intersexual differences are related to body size: the largest penguins (males) dived deeper and longer, on average, than smaller (female) birds. That males can dive consistently deeper and longer than females may benefit males while searching for food, especially when prey are not abundant or when birds are in direct competition for prey resources with fisheries or other species. If a male foraging advantage exists, this may contribute to the male-biased sex ration observed in Magellanic Penguins at Punta Tombo.

## **On the Evolution of Common Murre, *Uria aalge***

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We summarize data from three sources (fossils, molecules, skeletal morphometry) and propose a phylogeographic/morphological hypothesis for the evolution of Common Murre. The fossil record of murre is incomplete, but suggests that *Uria* evolved in the Pacific or Arctic Ocean at least 13-7 million years ago (mya), and moved into the Atlantic Ocean sometime later than 7-4 mya. The earliest fossil murre from the Atlantic is relatively young (12,000 ya), and may be referable to a Recent species of murre. Although *Uria* may have evolved in the Pacific, an analysis of cytochrome b sequences suggests that Common Murre evolved in the Atlantic 4.5-3 mya (estimated divergence between Common and Thick-billed Murres) and moved into the Pacific perhaps as recently as 450,000 ya (estimated divergence between Recent Atlantic and Pacific Common Murres). Analyses of control region sequences, microsatellite loci, and morphological data suggest that Common Murres in the Pacific are geographically structured, although weakly, and the pattern of this structure is complicated and locus-dependent. Based on these data, we submit that a subspecific taxonomic revision may be necessary to more appropriately delineate evolutionary units. Finally, morphological differences in the relative size and shape of skeletal elements (in particular the wing and skull) between Common Murres in the north Pacific/Alaska and the eastern Pacific indicate that a difference in adaptive regimes may exist between these two regions.

## Resting Metabolic Rate in Four Antarctic Fulmarine Petrel Species

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We measured resting metabolic rates at air temperatures between ca. -5 and 30°C in Snow Petrels, *Pagodroma nivea*, Cape Petrels, *Daption capense*, Antarctic Petrels, *Thalassocia antarctica*, and Antarctic Fulmars, *Fulmarus glacialisoides*. We measured 7 age classes for each species: adults, and nestlings that were 3, 8, 15, 28, 35, and 42 days old. Basal metabolic rate (BMR) and thermal conductance of adults averaged, respectively, 140% and 100% of values predicted allometrically for nonpasserine birds. Minimum metabolic rates of unfasted nestlings aged 15-42 days averaged, respectively, 97 and 98% of predicted adult BMR in Antarctic petrels and snow petrels versus 119% and 126% of predicted in Antarctic fulmars and cape petrels. Nestlings of the southerly breeding snow petrel and Antarctic petrel were relatively well insulated compared with nestlings of other high-latitude seabirds. Adult lower critical temperature was inversely related to body mass and differed by < 2°C from that predicted allometrically. Lower critical temperature declined with age from 14 to 22°C in 3-day-old nestlings, reached a minimum at maximal nestling mass, and then increased with weight recession. Nestling lower critical temperature was close to mean air temperature from the end of brooding until fledgling in the three surface nesting species.

## **Status and Conservation of the Xantus' Murrelet in Mexico**

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The Channel Islands and Pacific islands of Baja California are ecologically similar, sharing a large number of plant and animal species. Most of these islands contain important seabird breeding colonies and significant research and funding for conservation has been focused on the Channel Islands. However, the Baja California Islands have received much less attention. For example, the Xantus' Murrelet, whose primary threat is introduced mammals on breeding islands, is a California species of special concern and Mexican threatened species. While their distribution and abundance on the Channel Islands has been extensively studied, their status in Mexico is unknown. Here we report on the breeding distribution of Xantus' Murrelets in Mexico and efforts to restore their breeding islands. Xantus' Murrelets were found on nine of the 14 Mexican islands surveyed. Over the last five years the Island Conservation & Ecology Group has removed introduced mammals on seven of 13 islands formerly or currently used by Xantus' Murrelets. Only Coronado Sur, Guadalupe, and Natividad Islands still have introduced mammals, and removal projects are underway on Natividad and Coronado Sur. Long-term planning is needed to remove introduced mammals from Guadalupe to protect the seven seabird species breeding there, including the *hypoleucus* subspecies of Xantus' Murrelet.

## **Dynamics and Modeling of Red-legged Kittiwake Populations at Buldir I., Alaska**

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Buldir I., Alaska is home to a about 6% of the world's population of Red-legged Kittiwakes. Red-legged Kittiwake numbers have doubled at Buldir from the 1970s to the 1990s in contrast to the declines in the Pribilof Islands where the majority of the world's population breeds. From 1988 to 1999, over 300 breeding adult Red-legged Kittiwakes have been individually banded and resighted. Mean overwinter survival during the period was 98% and ranged from 94-100%. Resighting probability was approximately 90%. Nest site fidelity was high and most individuals remained within 10 m of their original site during the study. We tested several survival-recapture models using program MARK and found that a time-dependent survival and recapture model best supported the data. A simple population model (see Byrd and Williams) with several assumptions was constructed to evaluate whether current population levels are sufficient to maintain population equilibrium.

## **Foraging Ecology and Diving Behavior of Thick-Billed Murres: Associations of Foraging Patterns, Dive Depths and Prey Selection During Chick Rearing.**

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Investigation into the diving behavior and foraging ecology of Thick-billed Murres was carried out at Coats Island, Nunavut over the course of the breeding season in 1999. With the use of electronic, bird borne depth and activity recorders we are able to quantify foraging behavior of adult breeding birds. Dive recorders were attached to the back of selected individuals with the use of cable ties and deployed for 1 to 5 days at a time. In association with dive recorder deployment, observations of individuals returning to the colony with prey items for chicks were also recorded. From this data we were able to measure the timing and duration of individual foraging trips and dive patterns. We were also able to associate foraging patterns with specific prey items. From this data we aim to relate differences in the patterns of dive behavior and diving depths of individuals with prey species delivered to the colony in relation to sex and time of day.

## **Should the National Park Service Allow Egg Harvesting at a Seabird Colony?**

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Balancing subsistence needs of Native peoples with conservation poses a challenge for resource managers in many parts of Alaska. We present a current example of the role of seabird research in developing management strategies. For the Tlingit people of southeast Alaska, South Marble Island in Glacier Bay National Park is a traditional site for harvesting seabird eggs, primarily those of glaucous-winged gulls. Harvesting is currently not sanctioned, but the National Park Service is considering allowing limited harvesting. The decision-making process is complicated by multiple factors and influences: (1) the gulls suffer high egg predation from bald eagles, (2) forest succession may restrict future colony size, (3) harvesting of eggs has been ongoing despite the closure (4) harvesting contradicts the formal mission of the National Park Service, and (5) subsistence issues in Glacier Bay are politically contentious. In 1999 we began a 2-year study on the effects of egg harvesting on the gull population. The scope of this study includes modeling the effects of egg predation on hatching success, determining the physiological cost (stress response) in birds that re-lay eggs, and predicting long-term trends for the population based on historical trends. The study is designed to provide a biological basis for the management decision.