CORRELATING SEABIRD MOVEMENTS WITH OCEAN WINDS: LINKING SATELLITE TELEMETRY WITH OCEAN SCATTEROMETRY

Josh Adams*,1,2, and Stephanie Flora3. 1U.S. Geological Survey, Western Ecological Research Center, Moss Landing Marine Laboratories, 8272 Moss Landing Road, Moss Landing, CA, 95039 USA, josh_adams@usgs.gov; 2Department of Zoology, University of Otago, Dunedin, New Zealand; 3Physical Oceanography Laboratory, Moss Landing Marine Laboratories, 8272 Moss Landing Road, Moss Landing, CA 95039 USA

Satellite telemetry studies of seabirds are now common and have revealed impressive flight capabilities and extensive distributions at sea. Linking seabird movements with environmental conditions over vast expanses of the world’s open ocean, however, remains difficult. Seabirds of the Order Procellariiformes (e.g., petrels, albatrosses, and shearwaters) depend largely on wind and wave energy for efficient flight. We present a new method for quantifying the movements of far-ranging seabirds in relation to ocean winds measured by the SeaWinds scatterometer onboard the QuikSCAT satellite. We apply vector correlation to evaluate how the trajectories (ground speed and direction) for five procellariiform seabirds outfitted with satellite transmitters are related to ocean winds. Individual seabirds (Sooty Shearwater, Pink-footed Shearwater, Hawaiian Petrel, Grey-faced Petrel, and Black-footed Albatross) all traveled predominantly with oblique, isotropic crossing to quartering tail-winds (i.e., 105° to 165° in relation to birds’ trajectory). Entire track line trajectories were significantly correlated with co-located winds. Greatest correlations along 8-day path segments were related to wind patterns during birds’ directed, long-range migration (Sooty Shearwater) and movements associated with mega-scale meteorological phenomena, including Pacific Basin anticyclones (Hawaiian Petrel, Grey-faced Petrel) and eastward-propagating north Pacific cyclones (Black-footed Albatross). We suggest that vector correlation can be used to quantify movements for any marine vetebrate when tracking and environmental data (winds or currents) are of sufficient quality and sample size. Vector correlation coefficients can then be used to assess population- or species-specific variability and used to test specific hypotheses related to how animal movements are associated with fluid environments.

RECENT POPULATION TRENDS IN WESTERN DOUBLE-CRESTED CORMORANTS: RESULTS FROM AN UPDATED STATUS ASSESSMENT

Jessica Y. Adkins*, Daniel D. Roby, Donald E. Lyons, Karen N. Fischer, Timothy Marcella, Yasuko Suzuki, Peter Loschl, and Daniel Battaglia, USGS - Oregon Cooperative Fish and Wildlife Research Unit, Department of Fisheries and Wildlife, Oregon State University, Corvallis, OR, jessica.adkins@oregonstate.edu

Since the most recent status assessment for the entire Pacific Coast population of Double-crested Cormorants (Phalacrocorax auritus) was published in 1995 by Carter et al., the distribution of this population across its breeding range has changed dramatically. This is primarily due to the increase in the breeding population in the Columbia River estuary, which grew from 6,200 pairs in 1997 to up to 13,800 pairs in 2007. Preliminary estimates for British Columbia, Washington, Oregon, and California suggest the current Pacific Coast breeding population of Double-crested Cormorants is ca. 26,000 breeding pairs. This is an increase of ca. 9,000 breeding pairs from Carter et al. (1995). Most of this increase can be attributed to the Columbia River estuary, which currently accounts for approximately 45% of Pacific Coast breeding pairs. In contrast to this growth, numbers in coastal British Columbia, Washington, and parts of California have declined. The 2009 breeding estimate in coastal British Columbia is down ca. 80% from a peak of 1,981 breeding pairs in 1987 (Moul and Gebauer 2002). The 2009 coastal
Washington breeding estimate is down 51% from the 1992 estimate of 1,618 breeding pairs (Carter et al. 1995). And the 2008 estimate of 1,625 breeding pairs in Northern California is down from the 2003 estimate (2,437 breeding pairs; Capitolo et al. 2004), but similar to the estimate for 1989-1991 (1,633 breeding pairs; Carter et al. 1995). Increasing bald eagle (*Haliaeetus leucocephalus*) populations and episodic human disturbance may be important factors causing declines in some regions.

**FORAGING ECOLOGY AND DIET COMPOSITION OF CASPIAN TERNs IN SAN FRANCISCO BAY**

Lindsay Adrean*, Daniel D. Roby¹, Ken Collis², Donald E. Lyons¹, S. Kim Nelson¹, and Daniel Battaglia³; ¹USGS Oregon Cooperative Fish and Wildlife Research Unit, Oregon State University, 104 Nash Hall, Corvallis, OR 97333 USA, lindsay.adrean@oregonstate.edu; ²Real Time Research, 53 SW Roosevelt Avenue, Bend, OR 97702 USA; ³Oregon Cooperative Fish and Wildlife Research Unit, Oregon State University, 104 Nash Hall, Corvallis, OR 97333 USA

The largest breeding colony of Caspian Terns (*Hydroprogne caspia*) currently resides in the Columbia River estuary and numbers approximately 10,000 pairs. The impact of this colony on survival of out-migrating, threatened and endangered juvenile salmonids has caused resource managers to attempt to relocate most of these terns to areas outside of the estuary. One proposed relocation site is Brooks Island in San Francisco Bay, which currently supports a Caspian Tern breeding colony of ca. 800 pairs. Based on studies conducted during 2003-2005, however, Sacramento River salmonids are a part of the diet at this colony, and fisheries managers are concerned that relocated terns could reduce survival of ESA-listed salmonids in the Bay Area. In 2008 and 2009 we collected diet composition information and used radio telemetry to investigate the foraging ecology of Caspian Terns nesting on Brooks Island. Diet composition data indicated that consumption of salmonid smolts has increased from 3% of prey items in 2005 to 10% in 2008 and 2009. Several popular foraging sites were in close proximity to new release sites for non-listed hatchery-raised Sacramento River Fall Chinook.

**TRAPPING AND BAND RECOVERY OF CALIFORNIA LEAST TERNS AT SAN DIEGO BAY COLONIES, 2008-2009**

Jeff Allen*, Elizabeth Copper², and Robert T. Patton², ¹Department of Biology, Willamette University, 900 State St., Salem, OR 97301, USA, jhallen@willamette.edu; ²Avian Research Associates, 830 Orange Ave., Ste. K, Coronado, CA 92118, USA

Although the population of the federally endangered California Least Tern (*Sternula antillarum browni*) has increased significantly over the past 20 years, fledgling production has remained low since 2001. It appears that aging and mortality of the majority of the breeding population may surpass productivity and replacement by younger breeders, threatening a rapidly accelerating decline in breeding pairs. Trapping of previously banded adults nesting at each colony around San Diego Bay was conducted in order to estimate an age profile of the population and to determine feasibility of a larger scale trapping project. During the 2008 and 2009 breeding seasons, 185 previously banded birds and 67 un-banded birds were trapped. Ages ranged from two-years old to 21, with average age of eight to nine years. As anticipated, birds nesting at their natal colony accounted for the highest percentage of the bands recovered, followed by individuals nesting at a different colony but still within the San Diego Bay colony complex, those from Mission Bay or elsewhere in San Diego County, and the lowest percentage had been recruited from Orange and Los Angeles County sites.
CONSERVATION BIOLOGY: WHY MOST OF US ARE INTO SEABIRDS

Daniel W. Anderson, University of California, Department of Wildlife, Fish, & Conservation Biology, Davis, CA 95616 USA, danderson@ucdavis.edu

Almost forty years ago, one of our early Lifetime Achievement Award (LAA) recipients, Jim Bartonek, with L. W. Sowl (1974), called seabirds “Alaska’s most neglected resource.” This was largely true for most of the world’s seabirds. Now, seabird conservation and seabird biology are at the forefronts of marine biology and natural history in many disciplines. Both aspects, seabird study and seabird conservation, have strong roots in the Pacific Seabird Group and other seabird-oriented organizations, worldwide. John Croxall, another PSG Lifetime Achievement Award recipient, stressed the importance of conservation as a lifetime goal of all seabird biologists and managers. And, as recently stressed by John Weins (at the most recent national conference of The Wildlife Society, 20-24 Sept. 2009), the “pure” science of [seabird] ecology and the applied science of [seabird] conservation are in reality a single continuum of interests and activities. The seabird biologist usually perches somewhere in the middle of this continuum. This person has strong roots in conservation that involve the protection, preservation, restoration, and study of the ecology, physiology, and behavior of seabirds and their populations, no matter which sub-discipline is involved. It behooves us to remain active and committed in the now-well-established activities of seabird study and conservation, the life-blood of PSG itself.

KITTLITZ’S AND MARBLED MURRELET STATUS AND TRENDS IN KENAI FJORDS NATIONAL PARK, ALASKA

Mayumi Arimitsu*, John Piatt, and Tom Van Pelt, 1U.S. Geological Survey, 3100 National Park Rd, Juneau, AK 99801 USA, marimitsu@usgs.gov; 2U.S. Geological Survey, 4210 University Dr., Anchorage, AK 99508 USA; 3U.S. Geological Survey [currently North Pacific Research Board], 1007 West 3rd Avenue, St 100, Anchorage, AK 99501 USA

Kittlitz’s murrelets (Brachyramphus brevirostris) and marbled murrelets (B. marmoratus) have undergone significant declines within core areas of their populations in coastal Alaska. During summers of 2006-2008, we conducted surveys in marine waters adjacent to Kenai Fjords National Park in order to estimate the current population of Brachyramphus murrelets, and examine seasonal variability in their distribution in the upper fjords. We also compared current breeding population estimates to historical data. Based on an average of point estimates for mid-season coastwide surveys, we estimate the current population of Kittlitz’s murrelets at 658 (SE ± 172) individuals, and marbled murrelets at 6329 (SE ± 1389) individuals. Kittlitz’s murrelets were concentrated at the heads of three fjords with significant glacier influence, whereas marbled murrelets were widely distributed in nearshore areas throughout Kenai Fjords. Our estimates of Kittlitz’s and marbled murrelet breeding populations fluctuated annually in a similar manner, with lowest population estimates in 2007, and highest population estimates in 2006. Trends in Kittlitz’s and marbled murrelets population are difficult to assess owing to highly variable counts among years, perhaps in part to large-scale movements of birds around coastal waters of the Gulf of Alaska.

FORAGING HABITAT OF KITTLITZ’S MURRELET IN KENAI FJORDS NATIONAL PARK, ALASKA

Mayumi Arimitsu*, John Piatt, Nicola Hillgruber, and Erica Madison, 1U.S. Geological Survey, 3100 National Park Rd, Juneau, AK 99801 USA, marimitsu@usgs.gov; 2U.S. Geological Survey, 4210 University Dr.,
Kittlitz’s murrelet (*Brachyramphus brevirostris*) is a small seabird often associated with glacial fjords and now a species of concern for the U.S. Fish and Wildlife Service due to declining populations. We characterized Kittlitz’s Murrelet foraging areas in Kenai Fjords National Park, Alaska, by studying prey availability and oceanography. We conducted monthly oceanographic, hydroacoustic, trawl, beach seine, and marine bird surveys from June-August, 2007-2008. High sediment load from glacial river runoff shaped the marine ecosystem of Kenai Fjords. Submerged moraines (sills) helped to isolate inner fjord habitat from oceanic influence, promoting cool, fresh, stratified, and silt-laden waters. Silty glacial runoff limited light availability to chlorophyll near tidewater glaciers, but zooplankton abundance was enhanced in the surface waters, perhaps due to the absence of a photic cue for vertical migration. Zooplankton community structure was influenced by glacial features and varied along an increasing temperature gradient over the summer. Acoustic measurements suggested that low density aggregations of fish and zooplankton were available in the surface waters near glacial river outflows where murrelets typically forage. Dense fish aggregations moved into the fjords by August. Kittlitz’s murrelets were more likely to occur near glaciers, in deeper water, and in areas with higher acoustic biomass. In Kenai Fjords, Kittlitz’s murrelet at-sea distribution was limited to areas that were influenced by turbid glacial outflows, where low light conditions and greater availability of near-surface prey occurred.

**CURRENT AND HISTORICAL INFORMATION ON KITTLITZ'S MURRELETS IN THE RUSSIAN FAR EAST**

Yuri B. Artukhin*, Peter S. Vyatkin¹, Alexander V. Andreev⁵, Nikolay B. Konyukhov⁵, and Thomas I. Van Pelt⁴; ¹Kamchatka Branch of Pacific Institute of Geography FED RAS, Rybakov pr. 19a, Petropavlovsk-Kamchatsky 683024 Russia, artukhin@mail.kamchatka.ru; ²Institute of Biological Problems of the North, Portovaya 18, Magadan 685000 Russia; ³Severtsov Institute of Ecology and Evolution RAS, Leninsky pr., 33, Moscow 119071 Russia; ⁴North Pacific Research Board, 1007 West Third Avenue, Anchorage, AK 99501 USA

The Kittlitz’s murrelet (*Brachyramphus brevirostris*) is one of the rarest seabirds in North-Eastern Asia. The species is widely distributed in the Chukchi and Bering Seas, where it is found from Longa Strait to Kamchatsky Gulf, and also in the northern Sea of Okhotsk. However, the actual breeding range is poorly known. Only four nests have been found in the region (all were located on inland alpine habitats). The species' wintering areas are also not well understood; the northern boundary of winter distribution lies along the Sirenikovskaya polynya near the southern coast of Chukotka. Wintering birds have also been recorded near South Kamchatka and North Kuriles. We provide an overview of the distribution, status, and trends of Kittlitz’s Murrelet breeding populations in the Russian Far East. Our assessment is based on surveys conducted by the authors from the 1970s to the 2000s, with a total survey distance of more than 10,000 km. These surveys covered the main breeding area of the Kittlitz’s Murrelet. The highest densities were observed in the coastal waters of the South Chukotka Peninsula and the eastern and southern parts of the Koryak Highlands. In the Sea of Okhotsk, the species occupies about 500 km of coastline from Amakton Bay to Tavatum Bay, with a total estimate of about 500 breeding pairs. The Asian coast may support the main part of the world population of Kittlitz's Murrelet, and expansion of surveys, research, and monitoring of this species is important for its conservation.

**PREY CHOICES IN CALIFORNIA LEAST TERNS—AN HISTORICAL PERSPECTIVE**
Pat Baird*1, Tyler Willsey1, Mel Kirkby2, and Greg McMichael3; 1 Centre for Wildlife Ecology, Simon Fraser University, 8888 University Drive, Burnaby, B.C. V5A 1S6 Canada, pabaird@sfu.ca; 2University of British Columbia, 2329 West Mall, Vancouver, B.C. V6T 1Z4 Canada; 3University of North Texas, Institute of Applied Sciences, 1155 Union Circle #310559, Denton, TX 76203-5017 USA

We studied the foraging ecology of the endangered California Least Terns, (*Sternula antillarum browni*), for almost two decades, and found that their prey from the late 1980’s through mid-1990, changed little over this time. During our follow-up study in 2009 we found that the suite of prey items had changed and diversified from that of the ‘80’s to ‘90’s. We also found that chicks and adults consumed different sizes and proportions of prey from each other, as was expected from studies of other seabirds, although the sizes of prey had not changed from earlier decades. This change in prey types in 2009 from those in the ‘80’s and ‘90’s may be due to climate changes, to a change in the range or depth of the fish prey, or to more offshore foraging by the terns in 2009.

**FORAGING CHOICES IN CALIFORNIA LEAST TERNS—THE MORE THINGS CHANGE....**

Pat Baird1, Tyler Willsey*1, Mel Kirkby2, and Greg McMichael3; 1Centre for Wildlife Ecology, Simon Fraser University, 8888 University Drive, Burnaby, B.C. V5A 1S6 Canada, pabaird@sfu.ca; 2University of British Columbia, 2329 West Mall, Vancouver, B.C. V6T 1Z4 Canada; 3University of North Texas, Institute of Applied Sciences, 1155 Union Circle #310559, Denton, TX 76203-5017 USA

We mapped foraging locations of the California Least Tern (*Sternula antillarum browni*) in San Diego in 2009 and from 1993-1996. For both time periods, where birds foraged depended on which stage of the breeding season they were in: courtship, egg, chick, and fledgling. Foraging offshore became important when adults were less tied to an incubating or feeding schedule, and local foraging became very important during the chick stage. The broad habitats where the birds foraged had not changed over a 13-16 year period. This fact makes it easier for managers in their decisions to protect habitat for this endangered species.

**ASSESSING FORAGING TRIP DURATION OF LITTLE AUKS: PITFALLS AND PLUSSES OF PIT TAGS**

Nell Baldwin*1, Zachary W. Brown2, Derek Buchner1 and Nina Karnovsky1, 1Pomona College, Department of Biology, 175 W. 6th Street, Claremont, CA 91711-6324 USA, nwb02005@mymail.pomona.edu; 2Ocean Biogeochemistry Lab, Stanford University, 397 Panama Mall, Stanford, CA 94305-2215 USA

Little auks (*Alle alle*) nest in rock crevices and breed in large colonies in the Atlantic sector of the Arctic. In recent years oceanographic conditions along the west coast of Spitsbergen, Norway have been highly variable. Foraging trip duration reflects food availability and oceanographic conditions of the feeding area. The purpose of this study was to compare two different methods of estimating foraging trip duration of little auks breeding on the southwest side of Spitsbergen. Historically, direct observations of marked birds coming and going to their nests have been done to estimate foraging trip duration. In 2007 we also used Passive Integrated Transponder (PIT) tags to estimate foraging trip duration. We compared PIT-tag data from two little auks (164 foraging trips recorded, 24 days of operation) and observations of 41 marked little auks (128 foraging trips observed, 72 hours of observation). We found that PIT tags overestimated foraging trips by an average of 40 minutes because little auks spend a significant portion of their time in the colony, but not in their nests where their PIT tags would be registered. However, PIT tags had the advantage of recording for long periods of the breeding season. The PIT tag data reflected the bimodal distribution of foraging trip durations with multiple short trips interspersed with single long trips.
The observational data reflected a more unimodal pattern because many long trips ended after the 24 hour or 48 hour observation periods ended.

**CONSERVATION GENETICS OF KITTLITZ’S MURRELET**

Tim P. Birt*, Dan MacKinnon, John F. Piatt and Vicki L. Friesen, Department of Biology, Queen’s University, Kingston, ON K7L 3N6 Canada, vlf@queensu.ca; U.S.G.S., Alaska Science Center, 1011 East Tudor Road, Anchorage, AK 99503 USA

Information about the distribution of genetic variation within and among local populations is important for successful of declining species. For example, if local populations differ genetically, they should be managed separately since they are probably demographically isolated. We are comparing variation in the mitochondrial control region and a number of microsatellite loci among Kittlitz’s murrelets (Brachyramphus brevirostris) from throughout the breeding range to measure the extent of i) inbreeding within local populations, ii) divergence among local populations, and iii) gene flow among local populations. To date we have found that control region sequences of Kittlitz’s Murrelets from the Aleutian Islands are distinct from those from mainland Alaska. The level of sequence divergence indicates that no female-mediated gene flow occurs between these regions, and that murrelets from the two regions should be managed as separate units. Analysis of variation in nuclear DNA is currently underway to confirm the control region results.

**HOME RANGE SIZE AND DAILY MOVEMENTS OF MARBLED MURRELETS DURING THE BREEDING SEASON IN WASHINGTON STATE**

Thomas D. Bloxton, Jr.* and Martin G. Raphael, U.S.D.A. Forest Service, Pacific Northwest Research Station, 3625 93rd AVE SW, Olympia, WA 98512 USA, tbloxton@fs.fed.us

We radiotagged 157 adult Marbled Murrelets (Brachyramphus marmoratus) during the breeding season in coastal marine waters of Washington from 2004-2008. We attempted relocations by using fixed-wing aircraft five days per week from the time of tagging early in the breeding season until August when batteries died. We calculated home range size for the 126 birds that had at least 20 relocations by using the 100% Minimum Convex Polygon (MCP) method, computed with land included and also with land excluded. Number of relocations per bird averaged 39 (range 20-69) and was not correlated with range size for those birds with ≥ 20 points. Range sizes with land included varied from 13 km² to 7,816 km² (mean = 1,260 km², median = 787 km²) while those calculated with land excluded varied from 13 km² to 3,215 km² (mean = 764 km², median = 549 km²). Daily movement distances by individual birds ranged from 0 to 152 km with a mean daily movement of 10 km. Range sizes and daily movements were smallest in 2004, and larger and highly variable from 2005-2008. Delayed upwelling in 2005 may explain the larger ranges and daily movements compared with 2004. Birds likely had to travel further to find prey in 2005. We found no range size differences between the sexes or between breeders and non-breeders.

**ACOUSTIC MEASURES OF ACTIVITY AS AN INDEX OF RELATIVE ABUNDANCE AT SEABIRD COLONIES**

Abraham L. Borker*, Matthew W. McKown, Josh T. Ackerman, Collin A. Eagles-Smith, Donald A. Croll, and Bernie R. Tershy Department of Ecology and Evolutionary Biology, University of California Santa Cruz, 100 Shaffer Road, Santa Cruz, CA 95060 USA, aborker@ucsc.edu; U.S. Geological Survey,
Seabirds are ecologically important and face conservation threats in marine and terrestrial ecosystems. Monitoring programs to assess seabird populations and measure the success of conservation actions are hampered by the remoteness of many seabird colonies and the global scale of the problem. Innovative technology may now make it possible to remotely monitor seabird colonies at scale. Automated acoustic sensors offer a low-cost, low-impact method for monitoring seabirds. Here we tested the efficacy of acoustic sensors to measure relative seabird abundance at colonies.

We deployed acoustic sensors to record ambient acoustic activity at 9 Forster’s Tern (Sterna forsteri) breeding colonies (20-108 pairs) in South San Francisco Bay. Sensors recorded 1 of every 10 minutes, 24h/day, for an average of 90 days during the 2009 breeding season (~220 hours/unit). We used an automated method (spectrogram cross-correlation) to detect and count tern vocalizations from recordings (correlation > 0.4). We calculated mean calling rates (calls/min) at different time scales and compared these to nest counts at colonies. Our results show a significant relationship between colony size (mean nests) and acoustic activity (calls/min). Furthermore, our method discriminates between adult and fledgling vocalizations, implying that acoustic sensors might be useful for comparing chick production among colonies/years. Acoustic monitoring of seabird colonies is a promising method for documenting relative population size, inter-annual changes, and detecting rare or elusive species such as burrow/crevice nesting birds. Quantifying the relationship between acoustic activity and relative abundance is a fundamental step in designing effective acoustic monitoring programs for seabirds.

SEASONAL CHANGES IN AT-SEA DISTRIBUTION OF XANTUS’S MURRELETS AND THEIR PREY NEAR SANTA BARBARA ISLAND, CALIFORNIA

Kristen Boysen*, Darrell Whitworth2, Harry Carter3, Laurie Harvey4, and Nina J. Karnovsky*

1Pomona College, Department of Biology, 175 W. 6th St., Claremont, CA 91711 USA, knb12006@mymail.pomona.edu; 2California Institute of Environmental Studies, 3408 Whaler Ave., Davis, CA 95616 USA; 3Carter Biological Consulting, 1015 Hampshire Rd., Victoria, BC V8S4S8 Canada; 4Montrose Settlements Restoration Program, Channel Islands National Park, 1901 Spinnaker Dr., Ventura, CA 93001 USA

As part of examining long-term success of Xantus’s murrelet (Synthliboramphus hypoleucus) restoration at Santa Barbara Island, we assessed at-sea distribution of Xantus’s murrelets during the incubation period. We compared Xantus’s murrelet densities to zooplankton densities and oceanographic conditions within the foraging area near the island. To measure Xantus’s murrelet densities and distributions, we counted murrelets using the strip width survey method. We surveyed seven radial transects extending to 20 kilometers offshore of the island while aboard the NOAA ship R/V Shearwater in April and May 2009. At stations positioned along transects, we made zooplankton net tows and Conductivity Temperature Depth casts. Sea surface temperatures in April averaged 14 degrees Celsius and in May 16 degrees Celsius. Densities of euphausiids and other zooplankton were higher in May than April. Overall, prey for Xantus’s murrelets appeared to be abundant. Xantus’s murrelets were found consistently over colder waters during both months, suggesting that they preferred prey in this area.

DIVERGENT DIVING BEHAVIOR DURING LONG AND SHORT FORAGING TRIPS IN THE LITTLE AUK (ALLE ALLE)

Zachary W. Brown*, Jorg Welcker2, Ann M.A. Harding3,4, Wojciech Walkusz5,6, and Nina J. Karnovsky*

1Stanford University, 473 Via Ortega Rm. 140, Stanford, CA 94305, zwbrown@stanford.edu; 2Norwegian Polar Institute, Polarmiljøsenteret, N-9296 Tromsø, Norway; 3Alaska Pacific University,
We investigate for the first time the diving behavior of seabirds undertaking short and long foraging trips. Little auks (*Alle alle*), small zooplanktivorous alcids of the high Arctic, have recently been shown to utilize this bimodal foraging strategy. Because short and long trips are thought to serve different purposes (chick-provisioning near the colony and self-feeding at distance, respectively) we hypothesized that foraging differences would be apparent, both in terms of water temperature and diving characteristics. We tested this hypothesis using Time Depth Recorders (TDRs) at three colonies along the Greenland Sea. Significant foraging differences were apparent between short and long trips: in general, ambient water temperatures differed (indicating that long trips are indeed used to reach distant foraging grounds), and dives were deeper and more V-shaped on long trips, with ample rest that presumably aided digestion and assimilation during self-feeding. Conversely, short trips were characterized by intensive foraging to gather a chick meal, with more dives per dive bout, more U-shaped dives, and lower resting time. The costs of seeking distant foraging grounds are likely to affect both the adult, by increasing the energetically expensive long trip activities of flying and deep diving, and the chick, by decreasing provisioning rate. These effects were most pronounced among birds at the colony with warmer oceanographic conditions. Thus, increasing temperatures in the Arctic may have energetic consequences for little auks.

FACTORS AFFECTING THE AVAILABILITY OF POTENTIAL NEST PLATFORMS FOR MARBLED MURRELETS IN BRITISH COLUMBIA

Alan E. Burger*1, Robert A. Ronconi2, Michael P. Silvergieter3, Irene A. Manley3, David B. Lank3, Catherine Conroy3, Volker Bahn4 and Alvin Cober5, 1Department of Biology, University of Victoria, Victoria, BC, V8W 3N5, Canada; 2Department of Biology, Dalhousie University, Halifax, NS, B3H 4J1, Canada; 3Centre for Wildlife Ecology, Simon Fraser University, Burnaby, BC, V5A 1S6, Canada; 4Department of Biological Sciences, Wright State University, Dayton, OH 45435, USA; 5British Columbia Ministry of Environment, Queen Charlotte, BC, V0T 1S0, Canada

Most Marbled Murrelets (*Brachyramphus marmoratus*) nest on mossy pads in old-growth canopies. We know very little about the size and species of trees most likely to provide nest platforms or the conditions which favour the development of thick epiphyte mats. From past habitat studies in British Columbia we collated data on 29,783 trees at 1412 sites in 170 watersheds in six coastal regions. We used correlation and regression trees (CART) applied to a range of variables to classify and predict platform availability (limbs or deformities >15 cm in diameter). Tree diameter (DBH) was the most important predictor of platform availability in the pooled data and within each region. In most regions platforms become available at DBH > 60 cm, but larger trees are needed on East Vancouver Island (> 96 cm) and the Central Coast (> 82 cm). Other regional predictors of platforms included tree height, tree species, and to a lesser extent elevation, slope and latitude. Sitka spruce (*Picea sitchensis*), Douglas-fir (*Pseudotsuga menziesii*) and yellow cedar (*Chamaecyparis nootkatensis*) were consistently more likely to provide platforms, western red-cedar (*Thuja plicata*) was consistently less likely, while firs (*Abies amabilis* and *A. grandis*) and hemlocks (*Tsuga mertensiana* and *T. heterophylla*) showed region-specific capabilities to provide platforms. Most (72%) trees providing platforms had epiphytes (mainly moss) covering one third or more of branch surfaces and 81% had intermediate or thick epiphyte mats. Mistletoe deformities were a minor source of platforms in British Columbia. Our data facilitate prediction and management of suitable nesting habitat for murrelets.
THE USE OF SOCIAL ATTRACTION TO SPEED THE RECOLONIZATION RATE OF NOCTURNAL SEABIRDS IN THE ALEUTIAN ISLANDS, ALASKA

Rachel T. Buxton* and Ian L. Jones, Department of Biology, Memorial University of Newfoundland, St. John’s, Newfoundland, A1B 3X9 Canada, r.buxton@mun.ca

The scientific literature is replete with studies that outline the devastating effects of introduced predators on island ecosystems, particularly on colonial ground nesting seabirds. Although eradicating non-native predators and protecting island ecosystems from further anthropogenic disturbance is important, it often represents only a first step in restoring extirpated seabird populations. Many seabirds use social cues (the visual, auditory, and olfactory presence of breeding conspecifics) when selecting safe nesting habitat. When colonies are extirpated, these cues that indicate nesting site quality are destroyed. In the Aleutian Islands, Alaska we tested various social attraction techniques as a method to encourage re-colonization of Leach’s (*Oceanodroma leucorrhoa*) and Fork-tailed Storm-petrels (*O. furcata*); two seabirds whose populations were devastated by introduced fox predation and have been slow to return after eradication. Attraction to conspecific call playback was tested by broadcasting playback treatments adjacent to a mist-net and attraction to conspecific odor was tested using a t-maze design. Finally we combined these two cues with artificial burrows to test whether birds would be more likely to enter and inhabit them depending on treatment. Both species of storm-petrel were strongly attracted to conspecific call playback; Fork-tailed Storm-petrels were significantly attracted to conspecific odor while Leach’s Storm-petrels were significantly repulsed by conspecific odor; and both cues combined caused storm-petrels to enter but not inhabit artificial burrows. We will discuss the implications of these results, including the application for innovating protocols to encourage re-colonization and restoration of seabird colonies in the Aleutian Islands after eradication of introduced foxes.

MONITORING AVIAN POPULATIONS USING AUTOMATED ACOUSTIC RECORDING DEVICES: APPLICATIONS FOR ISLANDS RESTORATION

Rachel T. Buxton*, Ian L. Jones, Jeff Williams, and Heather L. Major, 1,2 Department of Biology, Memorial University of Newfoundland, St. John’s, Newfoundland, A1B 3X9 Canada, r.buxton@mun.ca; 3Alaska Maritime NWR, 95 Sterling Highway, Ste. 1, Homer, Alaska 99603 USA; 4Centre for Wildlife Ecology, Department of Biological Sciences, Simon Fraser University, 8888 University Dr., Burnaby, BC, V5A 1S6 Canada

Nocturnal seabirds breeding on isolated islands pose challenges to conventional monitoring techniques, resulting in their frequent exclusion from population recovery studies. We evaluated the effectiveness of automated acoustic recording devices (Song Meters) and associated recognition software (Song Scope) as a unique method of indexing recovering avian populations after the removal of introduced predators in the Aleutian Islands, Alaska. Across the Aleutian chain, predator eradication is thought to be the first step in island restoration, however, some seabirds, especially colonial burrow-nesters have been slow to return, the reasons for which are poorly understood. We deployed a total of 19 Song Meters on six islands across the western Aleutian archipelago, throughout the 2008 and 2009 summer seasons. Of these six islands, four had differing time periods since fox eradication (Nizki/Alaid 1969, Amatignak 1991, Kasatochi 1984, and Little Sitkin 2000), while one (Buldir) never had predators introduced, and one (Kiska) has introduced rats. Additionally Kasatochi was an active colony until a catastrophic volcanic eruption in 2008. We detected intense night-time activity of Fork-tailed (*Oceanodroma furcata*) and Leach’s Storm-petrels (*O. leucorrhoa*), and both activity and successful nesting of Ancient Murrelets (*Synthliboramphus antiquus*) on islands thought to be abandoned due to fox farming. Additionally, the devices recorded 17 other bird species including the Aleutian Cackling Goose, (*Branta hutchinsii leucopareia*) also adversely
affected by introduced predators. Overall, acoustic monitoring provided an excellent opportunity to quantify vocal behaviour of uncommon and difficult-to-measure populations of bird species in varying states of recovery.

**USING STABLE ISOTOPES TO INFER DIETS IN SIX COMMONLY BREEDING SEABIRDS AT THE NEAR ALEUTIAN ISLANDS, ALASKA**

*Douglas Causey, Naomi A. Bargmann, and Veronica M. Padula, University of Alaska Anchorage, Department of Biological Sciences, 3211 Providence Drive, Anchorage Alaska 99508 USA, afdc@uaa.alaska.edu*

Research over two decades indicates that seabird populations are decreasing in the most western group of islands in the Aleutians (the Near Islands), while they are relatively stable in all of the other regions of the Aleutians. Gyral currents, like the one found in this region, tend to create a distinct oceanographic ecosystem with its own marine fauna, upper-water food web, and ecological dynamics. These tidal/current gyral systems could be a major force driving the ecological structuring of the Near Islands fish and plankton populations. Climate change has dramatically affected the direction, strength, and biological oceanography of Aleutian currents over time, and there is a growing body of evidence that indicates these changes are continuing to strengthen. If there is a direct connection between the climate change forcing, food prey, and seabird foraging; then diet analysis should provide evidence that Near Island seabirds are ecologically decoupled from the other Aleutian populations. Using 6 commonly breeding species of seabirds, we will create a multifactor stable isotopic picture (δ15N, δ13C, δ2H, δ18O, δ34S) to infer diets and foraging areas. Results from the δ15N and δ13C stable isotope analysis of feathers, muscle, liver, kidney and heart represent pioneering research for this region that will give us a multidimensional and temporally discrete look at the proxies determining the trophic level of seabird diets. Deep longitudinal analysis of seabirds collected from the same location should allow quantification of diet and food web dynamics through timescales sufficiently long to present putative effects by climate change.

**BETWEEN TARMAC AND A HARD PLACE, FOSTERING SEABIRD BREEDING ON HABITAT ISLANDS, A SOUTHERN CALIFORNIA LAND MANAGER’S PERSPECTIVE**

*Brian E Collins* U.S. Fish and Wildlife Service, San Diego National Wildlife Refuge Complex, 1080 Gunpowder Point Drive, Chula Vista, CA 91910 USA, brian_collins@fws.gov

Seabird breeding site management in southern California presents land managers with intense challenges. The historical loss of available natural nesting habitat combined with intense human land use pressures, abrupt edge effects, diminished resource and watershed health, and climate change driven change to ecosystem support capacities leads to dynamic instabilities in given wildlife population’s abilities to occupy, survive and reproduce in the remaining breeding habitats available to them. We face an uncertain future in our attempts to implement effective seabird conservation regionally that will require continued determination and commitments to maintaining practices that have proven effective, but will also require fluidity and flexibility in management approaches as conditions continue to change into the future. The current milieu of resource agency mandates, funding acquisition processes, established management practices and other legal and policy mandates makes timely adjustments to management prescriptions difficult to achieve. Land managers will always be faced with making decisions based on incomplete knowledge, but scientific studies can help focus management priorities. This presentation focuses on a discussion of how best to optimize the societal tools available for scientists, land managers,
conservationists and resource agency personnel to collaborate effectively to provide wildlife conservation stewardship in a complex and changing natural and cultural environment.

INTEGRATING SEABIRD VULNERABILITY, ENDANGERMENT, AND FUNCTIONAL ROLE TO PRIORITIZE INVASIVE SPECIES ERADICATIONS

Donald A Croll*, Bernie R Tershy1, Stacey L Buckelew2, Reina Heinz1, Erin McCreless1, and Kelly M Newton1; 1Department of Ecology & Evolutionary Biology, University of California Santa Cruz, Long Marine Lab, Center for Ocean Health 100 Shaffer Rd, Santa Cruz, CA 95060 USA, croll@biology.ucsc.edu; 2Island Conservation, 100 Shaffer Rd, Santa Cruz, CA 95060 USA

Seabirds are important marine predators that are important in structuring marine food webs, and play an important functional role on land by transporting nutrients from marine ecosystems. Due to their low fecundity and sensitivity to human impacts, they are the most threatened group of marine species, representing 25% of marine extinctions and 30% at some risk of extinction. Although they range widely at sea most seabirds are dependent on islands and isolated coasts where they often form dense breeding colonies that may contain the majority of the global population of the species. Seabirds are both most vulnerable at these colonies and adjacent waters but here often simple conservation actions can make a big difference. Invasive animals are the largest cause of seabird endangerment and extinction (25-30% of impact) - directly through predation, disturbance and competition for space, and indirectly via changes in vegetation, soil compaction and erosion. Fortunately, these impacts can be reversed. Invasive animals have been successfully eradicated from over 625 islands, often followed by significant seabird population recoveries. Yet approximately 10^4 islands contain invasive mammals and successful eradication projects require significant financial investment. Consequently, prioritization is necessary to increase the efficiency with which limited seabird conservation dollars are used. We provide a conceptual framework that integrates a seabird’s vulnerability to a given invasive species, their vulnerability to global extinction and their likely contribution to ecosystem function to identify priority islands for invasive species eradication.

COLLISION-AVOIDANCE BEHAVIOR OF HAWAIIAN PETRELS AND NEWELL’S SHEARWATERS IN THE HAWAIIAN ISLANDS

Robert H. Day*, Brian A. Cooper2, Todd J. Mabee2, Jon H. Plissner2, Peter M. Sanzenbacher2, and Alicia E. Oller3; 1ABR, Inc.—Environmental Research & Services, P.O. Box 80410, Fairbanks, AK 99708-0401 USA bday@abrininc.com; 2ABR, Inc.—Environmental Research & Services, P.O. Box 249, Forest Grove, OR 97116-0249 USA; 3Tetratech EC, 1750 SW Harbor Way, Suite 400, Portland, OR 97201 USA

We studied collision-avoidance responses of Hawaiian Petrels (Pterodroma sandwichensis) and Newell’s (Townsend’s) Shearwaters (Puffinus auricularis newelli) to transmission lines on Kauai Island, Hawaii, in 1992–2002 and responses of Hawaiian Petrels to communications towers on Lanai Island in 2007–2008. Hawaiian Petrels responded to transmission lines significantly more often (19.3% of the time) than Newell’s Shearwaters did (7.4%) and responded significantly more often with increasing proximity to a transmission line, whereas Newell’s Shearwater showed little variation in response rates by distance. All petrels and shearwaters exhibiting responses successfully avoided colliding with a transmission line, whereas one Newell’s Shearwater that did not respond did collide. On Kauai, Hawaiian Petrels mostly responded to transmission lines by changing flight velocity and flight altitude, whereas Newell’s Shearwaters mostly responded by changing flight direction and flight altitude. Hawaiian Petrels on Lanai responded to communication towers most often by changing flight direction and flight altitude.
On Lanai, Hawaiian Petrels responded to towers 38.8% of the time and responded significantly more often with increasing proximity to a tower; however, all 26 petrels flying directly toward towers on Lanai exhibited collision-avoidance behavior. Mean response distances to the two towers on Lanai did not differ significantly, although the towers differed in size and shape, but response distances were significantly smaller during fog than during fog-free conditions. A large proportion of individuals of both species detect and avoid human-made structures, although Hawaiian Petrels respond to them more often than Newell’s Shearwaters do.

THE STATUS AND DISTRIBUTION OF KITTLITZ’S MURRELET IN NORTHERN ALASKA

Robert H. Day*1, Adrian E. Gall1, George J. Divoky2, and Nora A. Rojek3, 1ABR, Inc.—Environmental Research & Services, P.O. Box 80410, Fairbanks, AK 99708-0401 USA bday@abrinc.com; 2Friends of Cooper Island, 652—32nd Avenue East, Seattle, WA 98112 USA; 3U.S. Fish and Wildlife Service, Fairbanks Fish and Wildlife Field Office, 101—12th Avenue, Room 110, Fairbanks, AK 99701 USA

The northern range of the subarctic Kittlitz's Murrelet extends into the Arctic Basin in the Chukchi and Beaufort seas. Little is known about the distribution and abundance of the species in this region due to a paucity of sampling and the apparently small size of the population. We conducted observations and compiled information on the distribution and abundance of Kittlitz's Murrelets in the Chukchi and Beaufort seas of northern Alaska. The species has been recorded in the area from April through early October. At least five nests have been located in arctic Alaska, all on mountainous scree slopes. Potential nesting habitat in the region seems limited and becomes unavailable north of approximately Cape Beaufort on the Alaska side. On the Russian side, it breeds on Wrangel Island and as far northwest on the mainland as Cape Schmidt or Cape Billings. The species has been recorded in low numbers over much of the eastern Chukchi Sea as far north as Point Barrow, and there now are two recent records from the Beaufort Sea. We evaluate spatial at-sea patterns with respect to oceanographic and other environmental variables. The persistence of this population in a previously-glaciated area is of interest, given the species’ dependence on tidewater glaciers in the Gulf of Alaska and current concerns about how it will be affected by disappearing glaciers.

SURVIVAL OF REHABILITATED SURF SCOTERS (MELANITTA PERSPICILLATA) OILED DURING THE COSCO BUSAN SPILL ON SAN FRANCISCO BAY COMPARED TO UNOILED CONTROL GROUPS

Susan E. W. De La Cruz*1, John Y. Takekawa1, Kyle Spragens1, Rick Golightly2, Gregory Massey3, Laird Henkel4, R. Scott Larsen3, and Michael Ziccardi1, 1U.S. Geological Survey, Western Ecological Research Center, San Francisco Bay Estuary Field Station, Vallejo, CA 94592 USA, susan_wainwright@usgs.gov; 2Department Of Wildlife, Humboldt State University, Arcata, CA 95521 USA; 3Wildlife Health Center, School of Veterinary Medicine, University of California, Davis, CA 95616 USA; 4Office of Spill Prevention and Response, California Dept. of Fish and Game, 20 Lower Ragsdale Drive, Suite 100, Monterey, CA 93940 USA

On 7 November 2007, the M/V Cosco Busan released approximately 58,000 gallons of bunker oil into the San Francisco Bay (SFB) near the Oakland-San Francisco Bay Bridge. Surf scoters (Melanitta perspicillata) were the most affected bird species in this incident, and more than one thousand scoters were treated by the Oiled Wildlife Care Network in Cordelia, California. To evaluate post-release survival and the effects of rehabilitation on scoters, we compared winter survival of oiled and rehabilitated birds to that of 2 control treatment groups: un-oiled, rehabilitated; and un-oiled, non-rehabilitated scoters. Birds from each group were radio-marked and released in SFB. We conducted aerial
telemetry flights 2 to 3 times a week for a total of 31 flights between 16 December 2007 and 7 April 2008 to determine location and mortality status of all marked birds. We used a live encounter – dead recovery modeling procedure in Program MARK to model surf scoter winter survival and used Akaike’s Information Criterion (AICc) to rank and compare 22 candidate fate models. The best-fitting model, as well as the three other models that received AICc weights, indicated that the probability of survival differed among treatment groups and over encounter occasions, and that there was an interaction between treatment group and time. We averaged across all models to determine cumulative winter survival estimates for each of the three treatment groups. The resulting estimates were 37.1% for oiled and rehabilitated, 62.2% for un-oiled and rehabilitated, and 73.0% for un-oiled and non-rehabilitated scoters.

VESSLE-SPECIFIC SEABIRD BYCATCH IN ALASKA DEMERSAL LONGLINE GROUNDFISH FISHERIES, 2004-2007

Kim S. Dietrich1 and Shannon M. Fitzgerald*2, 15026 9th Ave NE, Seattle, WA 98105 USA, kdiet@myuw.net; 2NOAA Fisheries, Alaska Fisheries Science Center, 7600 Sand Point Way NE, Seattle, WA 98115 USA

The annual incidental bycatch of seabirds by demersal groundfish longline vessels in Alaska has ranged between 4,100 and 26,300 during the period 1993 through 2006. However, average annual bycatch has declined by 73% during the years 2002-2006 as compared to bycatch from the late 1990s. Despite the reductions resulting from mandatory mitigation requirements, seabirds continue to be caught at higher rates than would be expected given results of controlled studies that demonstrated bycatch reductions of nearly 100% with paired streamer lines. We characterize recent seabird bycatch data (2004-2007) from the Alaska demersal longline fisheries and analyze factors influencing seabird bycatch for two fisheries - Pacific cod (Gadus macrocephalus) and sablefish (Anoplopoma fimbria). Previous analyses of 1995-2000 bycatch data showed that individual vessel was the single most important factor explaining seabird bycatch rates in Alaska longline fisheries. Certain vessels consistently caught a higher proportion of birds across years and fisheries. Our results demonstrate that a few individual vessels continue to be responsible for the majority of seabird bycatch. Six vessels out of 39 contribute 38% of all birds caught in the cod demersal longline fishery when sampled rates are extrapolated to hooks deployed in observed sets. Based on this analysis, we recommend a variety of methods to further reduce seabird bycatch by longline vessels in Alaska.

INCREASING MATES IN A DECREASING POPULATION: BLACK GUILLEMOTS DISPLAY POLYGNY WITH DECREASED NEST COMPETITION BUT WITH NO SHORT-TERM BENEFITS

George J. Divoky. Friends of Cooper Island, 652 32nd Ave. East, Seattle, WA 98112 USA, divoky@cooperisland.org

Observations conducted at a Black Guillemot (Cepphus grylle) colony in northern Alaska over the last three decades have found that in a period of population decline and decreased recruitment, some male nest-site owners form and maintain pair bonds with females at two adjacent nest sites. This polygynous behavior was first observed in the mid 1990s when a population that had occupied all 200 nest boxes decreased by approximately one quarter over a period of five years. Since then small number of males (<2 percent per year) have participated in courtship displays, copulation and nest and mate defense at two adjacent nest sites, occupied by different females. Maximum distance between the two nest sites has been ten meters. While the polygynous male typically abandoned one of the nests and its female after egg-
laying, in one case a male incubated eggs in both nests for a short period of time. No hatching has occurred at a nest abandoned by a polygynous male, despite incubation by the female. In one instance, one female did not lay eggs and the male defended both sites and both females through incubation, only committing to the active nest after hatching. No apparent short-term benefits accrue to the polygynous males since their annual reproductive output is not increased, and could be decreased, by the polygynous behavior, as both sexes share incubation and chick-provisioning duties. Maintaining pair bonds with two experienced females at two nest sites could have long-term benefits, however, for dealing with loss of either.

CAUGHT IN THE CLIMATE CHANGE PINCH: NEAR COMPLETE BLACK GUILLEMET NESTING FAILURE DUE TO NORTHTWARD SHIFT IN A SUBARCTIC NEST COMPETITOR AND A SOUTHWARD SHIFT IN AN ARCTIC NEST PREDATOR

George J. Divoky, Friends of Cooper Island, 652 32nd Ave. East, Seattle, WA 98112 USA, divoky@cooperisland.org

Recent reductions in summer sea ice in the western Arctic have been among the most dramatic examples of the effects of rising global temperatures. Increases in the amount and duration of open water, and associated increases in SST, have allowed subarctic species to expand ranges northward, while arctic species dependent on pack ice experienced drastic reductions in habitat. A Black Guillemot (Cepphus grylle) colony in northern Alaska has experienced decreases in population and productivity over the last two decades, apparently from reduced availability of prey associated with pack ice. In 2009 this colony experienced near complete breeding failure due to ongoing range changes in a subarctic nest competitor, the Horned Puffin (Fratercula corniculata) and an arctic nest predator, the Polar Bear (Ursus maritimus). Horned Puffins were rare in the region until the 1970s and first bred at the colony in 1986. Visits by Polar Bears during the breeding season were rare (two sightings) from 1975-2001, but have occurred annually since 2002. In 2009 nonbreeding Horned Puffins prospecting nest sites displaced 8 percent of the 263 guillemot eggs while Polar bears ate or broke 11 percent. Loss of nestlings to both species was substantially higher with Horned Puffins killing 44 percent of the 183 guillemot chicks while Polar Bears ate or killed 48 percent. Only a single guillemot chick fledged from the colony in 2009, surviving a Horned Puffin visit that killed its sibling and two unsuccessful Polar Bear assaults on its nest site. Similar nesting failures are anticipated in future years with continuing loss of summer pack ice.

PREY SELECTION AND PLASTIC INCIDENCE IN PACIFIC NORTHERN FULMARS (FULMARUS GLACIALIS) COLLECTED IN MONTEREY BAY IN 2003

Erica Donnelly*1,2, Hannah Nevins1,2 and James T. Harvey1, 1Moss Landing Marine Laboratories, 8272 Moss Landing Road, Moss Landing, CA 95039 USA, edonnelly@mlml.calstate.edu; 2California Department of Fish and Game – Marine Wildlife Veterinary Care and Research Center, 1451 Shaffer Road, Santa Cruz, CA 95060 USA

Fulmars forage in Monterey Bay during the winter months. Northern Fulmar diet includes cephalopods, fish, commercial fishery offal, and scavenged marine mammal carcasses. Fulmars are opportunistic feeders that forage at the surface, and often ingest plastic and other debris mistaken for prey. We examined stomach collected from beach cast birds found in 2003 (n = 15). Stomach contents were sorted into the lowest taxonomic groupings based on beaks or other hard parts. Cephalopod beaks were identified to the species using the lower rostral lengths (LRL) and comparing the physical characteristics to a reference beak collection. Plastic was sorted into subcategories and enumerated. Incidence of total plastic was 100% (mean # = 7.9), user plastic 100% (mean # = 6.9) and industrial pellets 25% (mean # =
1). Six cephalopod families were identified, but Gonatidae dominated the diet. Cephalopod identifications, total number, and average LRL measurements were as follows: *Gonatus pyros* (28, 3.1 mm), *Gonatus onyx* (15, 3.5 mm), *Gonatus californiensis* (8, 4.0 mm), *Gonatus berryi* (7, 4.0 mm), *Gonatus spp.* (5, 3.2 mm), *Chiroteuthis calyx* (4, 3.2 mm), *Taonius borealis* (3, 4.1 mm), *Taonius spp.* (3, 4.3 mm), c.f. *Galiteuthis pacifica* (2, 2.7 mm), *Chranchiid spp.* (1, n/a), c.f. *Cirrothauma spp.* (1, 1.7 mm), *Octopoteuthis deletron* (1, 5.3 mm), *Loligo opalescens* (1, n/a), unidentified (3, n/a). Pacific Northern Fulmar diet has not been described in California in over a decade. These results indicate a high incidence of plastic and reliance on *Gonatus* spp. during the non-breeding season.

**ASSESSING EFFECT OF THE 2008 ERUPTION OF KASATOCHI ISLAND ON MARINE BIRDS AND THEIR AT-SEA DISTRIBUTIONS**

*Gary S. Drew*, U.S. Geological Survey, Alaska Science Center, 4210 University Drive, Anchorage, AK 99508 USA, gdrew@usgs.gov

Kasatochi Volcano, an island volcano located in the central-Aleutian chain, erupted on August 27th 2008. The resulting ash and pyroclastic flows blanketed the island, covering terrestrial habitats to an average depth of 15-20 meters. The rarity of an eruption of this magnitude on a small island means there are few comparative studies and that this was a unique opportunity to investigate volcanic impacts on the terrestrial and marine environments used by marine birds. U.S. Geological Survey, in partnership with the Alaska Maritime Wildlife Refuge, began an integrated study to assess the eruptions’ effects. We visited Kasatochi Island in June and July of 2009 to document marine bird occurrence on the island, and survey the local marine environment. Although it is unlikely that the eruption resulted in the immediate deaths of many adult birds, the burial of former colony sites must have seriously limited or eliminated annual reproduction. Crested Auklets (*Aethia cristatella*) and Least Auklets (*Aethia pusilla*), the two most common species on previous surveys, were present in large numbers, both on the island and at sea. The main Crested and Least Auklet colony was visited on foot, and at-sea distributions were mapped and compared with 1996 and 2003 surveys of the area. Preliminary results indicate at-sea distributions and abundances were similar to those prior to eruption. Future marine bird use of the island and surrounding areas will depend on the interaction between the rate of erosion (exposing nesting sites), migration, and mortality.

**INTERTIDAL HABITAT USE AND MANAGEMENT OF SEABIRDS ON A COASTAL ISLAND IN SOUTH CAROLINA**

*Lisa Eggert*¹, and *Patrick Jodice*²; ¹Department of Forestry and Natural Resources and South Carolina Cooperative Fish & Wildlife Research Unit, Clemson University, Clemson, SC 29634, USA, lfergus@clemson.edu; ²USGS South Carolina Cooperative Fish & Wildlife Research Unit and Department of Forestry and Natural Resources, Clemson University, Clemson, SC 29634, USA

Management plans for seabirds on the east coast often close nesting areas but not adjacent intertidal habitat. Intertidal areas are used by birds for activities including foraging, loafing, and rearing of young and by people for recreational activities. In this study, our goal was to examine intertidal bird use in relation to human use and a suite of readily identifiable habitat characteristics that could easily be incorporated into management plans. We conducted 17 surveys of intertidal areas of a coastal island in South Carolina from May to October 2007 and 2008. The island supports a large community of sea- and shorebirds and intertidal areas are accessible to the public year-round. Over 30 waterbird species were counted, including Brown Pelican (*Pelecanus occidentalis*), Black Skimmer (*Rynchops niger*), and several species of terns, gulls, shorebirds, and wading birds. Mean species richness in survey plots was
8.5 ± 5.3 species and ranged from 3-25 species. The abundance of most species and species groups was significantly affected by interactions of the independent variables, including human use, beach slope, distance to colonies, and presence of dunes and offshore sandbars. The strength and direction of the relationships between habitat characteristics and bird use varied among species and species groups. These findings suggest that a management plan intended to increase the level of protection afforded to seabirds using intertidal areas may be difficult to design and implement because of the complex and inconsistent habitat associations observed in this study.

SPATIAL AND TEMPORAL VARIATION IN PREY USE OF COMMON MURRES AT TWO DISJUNCT COLONIES IN THE CALIFORNIA CURRENT SYSTEM

Lisa E. Eigner*, Richard T. Golightly†, and Gerard J. McChesney‡, 1Department of Wildlife, Humboldt State University, Arcata, CA 95521 USA, lee7@humboldt.edu; 2U.S. Fish and Wildlife Service, San Francisco Bay NWRC, 9500 Thornton Ave., Newark, CA 94560 USA

We compared prey of Common Murres (Uria aalge) at two colonies in the California Current System during 2006 and 2007. We examined whether prey use differed between locations and investigated how foraging ecology affects murre productivity. Identification of prey brought by murres to Devil’s Slide Rock and Castle Rock National Wildlife Refuge was facilitated with a remote controlled video system. Prey use differed significantly between colonies (2007) and between years at Devil’s Slide Rock. A Northern anchovy (Engraulis mordax)/Clupeid species category comprised 85% of prey items identified at Devil’s Slide in 2006 and 65 % in 2007, while at Castle Rock in 2007 smelt species (Osmeridae) comprised 53% of prey identifications. Additionally, prey size was significantly larger at Devil’s Slide than Castle Rock. In 2006, murres at Devil’s Slide bred later, had lower fledging and breeding success than in 2007. In 2007, mean egg-laying date occurred one week earlier at Castle Rock than Devil’s Slide. Castle Rock murre pairs spent less time in co-attendance than murres at Devil’s Slide. Lower energetic content of prey and availability of prey near the Castle Rock colony may have contributed to the observed difference in murre foraging effort between colonies. Fledging success was lower at Castle Rock than at Devil’s Slide in 2007, but provisioning rates and breeding success were similar between colonies.

BREEDING STATUS AND DIET TRENDS OF LEAST TERN COLONIES IN THE SAN FRANCISCO BAY ESTUARY

Meredith L. Elliott *, Susan Euing ‡, and David L. Riensche ‡, 1PRBO Conservation Science, Marine Ecology Division, 3820 Cypress Drive, #11, Petaluma, CA 94954 USA, melliott@prbo.org; 2U.S. Fish and Wildlife Service, Alameda Point, P.O. Box 159, Alameda, CA 94501 USA; 3East Bay Regional Park District, P.O. Box 5381, Oakland, CA 94605 USA

The two largest colonies of the California least tern (Sternula antillarum browni) in the San Francisco Bay area, Alameda Point and Hayward, are located 10 miles from one another. The Alameda Point colony is located on the former Naval Air Station, Alameda and has grown at an average rate of 9.7% per year since its inception in 1976. The long-term breeding success average is 0.86 fledglings produced per breeding pair; trends have indicated an increasing breeding success through the 1980s, declining success through the 1990s and the early 2000s, and an increasing trend in the last five years. The Hayward colony is located on an island created from dredge materials; since its creation in 2001, it has been enhanced with additional substrate materials, vegetation management, and social attraction devices. Least terns began appearing at this island in 2004, and successful breeding attempts have been observed since 2006. This colony has grown at an average rate of 76.8% per year. The long-term breeding success average is 0.76 fledglings produced per breeding pair, and trends indicate a declining breeding success since 2007.
Dropped fish have been collected from both colonies, and silversides (family Atherinopsidae) are the dominant dropped prey at both sites. Hayward terns forage more on nearshore species in the shallow marsh waters near their breeding site; Alameda terns forage on a greater variety of species found in both shallow and deeper waters in Central and South Bay waters.

DOUBLE-CRESTED CORMORANT DECLINES IN SAN FRANCISCO BAY

Meredith L. Elliott1*, Mark Rauzon1,2, Jennifer E. Roth1, and Kathy Hieb3, 1 PRBO Conservation Science/Marine Ecology Division, 3820 Cypress Drive, #11, Petaluma, CA 94954 USA, melliott@prbo.org; 2 Laney College, Geography Department, 900 Fallon Street, Oakland, CA 94607 USA; 3 California Department of Fish and Game, Bay-Delta Region, 4001 N. Wilson Way, Stockton, CA 95205 USA

The number of breeding pairs of Double-crested Cormorant (Phalacrocorax auritus) in San Francisco Bay has precipitously declined in recent years. Two of the largest colonies reside on the San Francisco-Oakland Bay Bridge (SFOBB) and the Richmond-San Rafael Bridge (RSRB). Annual counts of nests on both bridges since 1988 show peak nesting in 2000 on the RSRB (669 nests) and in 2007 on the SFOBB (814 nests). Since these peaks in the number of nests, counts varied interannually but declined, with the sharpest decline in 2009. In only three years (from 2007 to 2009), we observed reductions of 65% and 90% on the RSRB and the SFOBB, respectively, in estimated numbers of breeding pairs. Coincidentally, Brandt’s Cormorant (Phalacrocorax penicillatus) colonies in the Bay (Alcatraz Island) and along the coast of central California also experienced reduced or arrested breeding, in addition to increased mortality. There are many reasons being considered for the drop in breeding Double-crested Cormorant numbers, including disturbance (from the new eastern span of the SFOBB and RSRB seismic maintenance), contaminants affecting breeding success, and movement to other breeding sites. However, food shortage also may be an important factor. The northern anchovy (Engraulis mordax), a common forage fish with a high lipid content, had anomalously low abundance in the Bay during the 2008 and 2009 cormorant breeding seasons, which coincided with the steep drop in breeding numbers. A more detailed study of this once abundant seabird species is planned to better understand the observed declines.

CYCLIC MASS MORTALITY OF COMMON EIDERS AT CAPE COD, MA: AN ONGOING PUZZLE

Julie C. Ellis*, Sarah J. Courchesne, Valerie I. Shearn-Bochsler, and Michelle Stantial, Tufts University, Cummings School of Veterinary Medicine, 200 Westboro Road, North Grafton, MA 01536 USA, julie.ellis@tufts.edu

For several decades, cyclic mortality events involving hundreds to thousands of Common Eiders (Somateria mollissima) have been reported on the beaches of Cape Cod in Massachusetts. Though these events are conspicuous and generate public concern, no systematic investigation of the duration, magnitude, cause or population-level significance had been performed. A particularly large die-off event occurred during the summer and fall of 2007. Both male and female adults were found dead or dying on beaches in and around Wellfleet, MA. We conducted necropsies on eiders collected from beaches; we also obtained eiders shot by hunters near the same beaches. Previous studies suggested that intestinal parasites (acanthocephalans) were the main cause of eider mortality in prior die-offs. Our findings indicate that parasitism played either a very minor or no role in the mortality events that occurred in 2007. Samples and whole cadavers were submitted to the National Wildlife Health Center (NWHC) where a virus was isolated from a subset of birds collected during the 2007 event; this virus is now thought to be a novel paramyxovirus and is currently under investigation. Mortality events occurred again in spring and
STATUS OF THE MARBLED MURRELET IN THE NORTHWEST FOREST PLAN AREA: TEN YEARS OF POPULATION MONITORING

Gary Falxa*¹, Jim Baldwin², Thomas D. Bloxton, Jr.³, Monique Lance³, Sherri L. Miller⁴, Scott F. Pearson³, Martin G. Raphael⁵, and Craig Strong⁶; *¹U.S. Fish and Wildlife Service, 1655 Heindon Road, Arcata, CA 95521 USA, gary_falxa@fws.gov; ²U.S. Forest Service, 800 Buchanan Street, West Annex Building, Albany, CA 94710-0011, USA; ³Washington Department of Fish and Wildlife, Wildlife Program, 7801 Phillips Road SW, Tacoma, WA 98498 USA; ⁴U.S. Forest Service, Pacific Southwest Research Station, 1700 Bayview Drive, Arcata, CA 95521 USA; ⁵U.S. Forest Service, Pacific Northwest Research Station, 3625 93rd Avenue SW, Olympia, WA 98512-9193 USA; ⁶Crescent Coastal Research, P.O. Box 2108, Crescent City, CA 95531 USA

The Northwest Forest Plan is an ecosystem management plan for federal forest lands in the Pacific Northwest. To evaluate the Plan’s effectiveness in conserving species associated with forests, we monitored Marbled Murrelet (Brachyramphus marmoratus) populations annually from 2000 to 2009 in near-shore marine waters associated with the Plan Area. We sampled murrelets from boats in coastal waters off Washington, Oregon, and northern California south to San Francisco Bay, using line transects and distance estimation. We divided the sample area of about 8,800 km² into five geographic subareas (conservation zones). From 2000 to 2009, population estimates for the area ranged from 17,400 to 23,700 birds, with a 2009 estimate of 17,800 (95% confidence interval: 14,200 to 21,300). We evaluated population trends for 2 time series: 2000-2009 and 2001-2009, excluding 2000 data from the second analysis because of potential biases associated with logistical problems that year. We found a population decline over the Plan area for both series. The estimated average rate of annual decline for the Plan area was 2.4% (standard error: 0.82%) for 2000-2009, and 3.8% (standard error: 0.49%) for the 2001-2009 series. The annual rate estimates suggest a total decline during the analysis period of about 20% based on the 2000-2009 time series, or about 27% based on 2001-2009 data. Trend analyses at finer spatial scales are preliminary due to low power, but evidence for declines is strongest in northern Washington and northern Oregon.

SEABIRDS RESTORATION PROGRAM ON MEXICAN ISLANDS

Maria Félix-Lizárraga *¹, Alfonso Aguirre-Muñoz¹, Marlenne Rodríguez-Malagón¹, Araceli Samaniego-Herrera¹, Luciana Luna-Mendoza¹, Antonio Ortiz-Alcaraz¹, Julio Hernandez-Montoya¹, José Barredo-Barberena¹, Federico Méndez-Sánchez¹ and Humberto Berlanga²; *¹Grupo de Ecología y Conservación de Islas, A.C., Ave. López Mateos 1590-3 Fracc. Playa Ensenada, Ensenada, Baja California, 22880, México, maria.felix@conservaciondeislas.org; ²CONABIO, Ave. Liga Periférico – Insurgentes Sur, Núm. 4903, Col. Parques del Pedregal, Delegación Tlalpan, 14010, México, D.F.

Invasive species has caused 20 vertebrates extinctions in Mexican islands. To prevent more extinctions, 55 populations of 12 mammals were eradicated from 31 islands. 147 endemic taxa and 227 bird breeding colonies were protected. Techniques range from the traditional —trapping and ground hunting— to the most sophisticated —aerial hunting, bait aerial broadcast, DGPS, telemetry and GIS use—. Regarding seabirds, recolonization and increase of reproductive success has been recorded. An ongoing seabird social attraction project takes place on Asunción (43ha) and San Roque (37ha) islands, with the support of fall 2009. Necropsies by NWHC showed anemia and emaciation as causes of death in one bird; the novel virus was detected in the other bird, but cause of death remains unknown. We are working with several agencies to develop an improved protocol for disease investigation in order to determine the significance of these mortality events to Common Eider populations in New England.
fishermen local communities and government agencies. These islands were nesting places for Black-vented Shearwater (Puffinus opisthomelas), Xantus’s Murrelet (Synthliboramphus hypoleucus), Cassin’s Auklet (Ptychoramphus aleuticus), Heermann’s Gull (Larus heermanni) and Elegant Tern (Thalasseus elegans). Cats and rats on Asunción and San Roque decimated and extirpated seabirds; being removed by 1995, now are safe islands for birds to return. A seabird restoration project started in 2008, using social attraction: Elegant Tern and Heermann’s Gull decoys, broadcasting of vocalization playbacks, and mirrors. Elegant Tern interactions with decoys were recorded; there were also attempts by Heermann’s Gulls to nest next to the social attraction systems. The recolonization of Cassin’s Auklet and Brown Pelicans (Pelecanus occidentalis) was confirmed as well as the attempt of Craveri’s Murrelet (Synthliboramphus craveri) to nest. The accumulated data set the basis to develop a long term seabird restoration project. The support of the California de San Ignacio fishermen cooperative and the El Vizcaino Biosphere Reserve staff has been invaluable.

A PILOT PROJECT ON SEABIRD INTERACTIONS WITH PARAVANE GEAR ON AN ALASKAN GROUNDFISH TRAWL CATCHER PROCESSOR

Shannon M. Fitzgerald*1, Todd Loomis2, and Jeff A. Pesta3; 1NOAA Fisheries, Alaska Fisheries Science Center, 7600 Sand Point Way NE, Seattle WA 98115 USA, shannon.fitzgerald@noaa.gov; 2Cascade Fishing, Inc., 3600 15th Ave W, Seattle WA 98119 USA; 3411 Riley Drive, Northfield, MN 55057 USA

Because seabirds attend vessels to take advantage of fish discharge, they could possibly come into contact with various cables such as the trawl warps, third wires (a net-monitoring device hard-wired to the headrope), and paravanes (net-monitoring device that receives an acoustic signal). North Pacific Groundfish Observers have noted mortalities associated with trawl warps and third wires but we have little information on paravanes, which are deployed at the end of a boom alongside vessels. This study is the first work in the North Pacific on seabird interactions with paravane gear. Project goals were: (1) learn about the basic usage of paravane gear, (2) obtain baseline information on seabird interactions with the paravane gear, and (3) attempt to develop and deploy at least 3 different types of mitigation measures. These goals were met during a trip August 8 through 16, 2009. There were 40 15-minute observation sessions (20 with mitigation, 20 without). Interaction rates varied from 0 to 138 per session. No mortalities or injuries were observed. Nearly all interactions were by Northern Fulmars (Fulmaris glacialis) and were of the paravane cable itself rather than the various lines supporting or controlling the paravane boom. Black-footed albatross (Phoebastria nigripes) were in attendance around the ship but did not approach the vessel closely and were not seen to interact with the paravane gear.

EFFECTS OF A PARTIAL DIET OF PIPEFISH, A LOW-QUALITY PREY, ON THE GROWTH OF CAPTIVE ELEGANT TERN (THALASSEUS ELEGANS) CHICKS

Tyler J. Flisik* and Mike H. Horn, Department of Biological Science California State University, Fullerton, 800 N. State College Blvd., Fullerton, CA 92831-3599 USA, tylerjohn@csu.fullerton.edu

The recent increase of pipefish in the diets of seabirds nesting in both southern California and eastern Scotland has raised concern about the effects of this low-quality prey on growth rate and fledging success of these energy-demanding birds. The effects of pipefish in the diet of the Elegant Tern (Thalasseus elegans) was investigated by raising chicks in the laboratory on a diet of 10% bay pipefish (Syngnathus leptorhynchus) and 90% northern anchovy (Engraulis mordax), a diet based on the prey composition and provisioning rate of this tern. We predicted chicks fed 10% pipefish would weigh less at fledging (35 days posthatch) than chicks fed 100% northern anchovy. Chicks were raised from day 9 to day 35 post-hatch on one of three diet treatments (n=8): (1) 100% northern anchovy for the entire trial period, (2) 10%
pipefish and 90% anchovy for 16 days, then 100% anchovy for the remaining 10 days of the trial period, and (3) 10% pipefish and 90% northern anchovy for the entire trial period. Specific body growth and wing growth did not differ among the three treatments. These findings indicate that Elegant Tern chicks may be able to buffer the apparent negative effects of low-quality prey if high-quality prey species remain sufficiently prominent in the diet. Ongoing analysis of chick lipid content, organ mass, and gut passage time may, however, reveal negative impacts of pipefish on tern post-fledging survival.

HOW MANY NEEDLES IN THE HAYSTACK? APPLICATION OF MARK-RECAPTURE METHODS TO ESTIMATE AVIAN PREDATION ON JUVENILE SALMONIDS IN CENTRAL CALIFORNIA

Danielle Frechette*, Ann-Marie K. Osterback, Jonathan W. Moore, Morgan H. Bond, Sean A. Hayes, Scott A. Shaffer, and James T. Harvey, 1Moss Landing Marine Labs, 8272 Moss Landing Rd, Moss Landing CA, 95003 USA, dfrechette@mlml.calstate.edu; 2Center for Ocean Health, 100 Shaffer Road, University of California, Santa Cruz, CA 95060 USA; 3School of Aquatic Fishery Sciences, 1122 NE Boat St, Seattle, WA 98105 USA; 4Department of Biological Sciences, San Jose State University, One Washington Square, San Jose CA 95192 USA

In central California, coho salmon (Oncorhynchus kisutch) are endangered and steelhead (O. mykiss) are threatened, under the U.S. Endangered Species Act. Until recently, the role of bird predation in limiting recovery of coho and steelhead in central California has been overlooked. The NOAA Southwest Fisheries Science Center uses Passive Integrated Transponders (PIT tags) to monitor population biology and marine survival of these species. Año Nuevo Island (ANI), an important rookery and roosting site for several species of piscivorous seabirds, has been scanned annually for PIT tags since 2006. To date, 196 unique PIT tags (annual mean = 49, SD =17) have been detected, indicating that avian predation may represent a significant source of mortality for central California salmonids. Tags on ANI represent fish tagged between 2003 and 2009 in 5 watersheds in Santa Cruz and San Mateo counties. Tags are not removed from the island and may be detected on subsequent trips, allowing calculation of tag abundance using mark-recapture methods. POPAN, a variation of the Jolly-Seber model, estimated abundance and net entry of tags on to ANI. Entry of tags on ANI primarily occurs by deposition by Western Gulls (Larus occidentalis) through regurgitation. A total of 434 detections were incorporated into the model, producing a tag abundance estimate of 244 (SE = 10.9) and estimates of annual tag deposition ranging from 21 (SE = 10.2) to 93 (SE = 12.5). These estimates improve our understanding of the effect that avian predators have on recovery of central California coho and steelhead.

PLUMAGE PATTERNS OF THE JAPANESE MURRELET IN THE SETO INLAND SEA

Tadashi Fujii*, Daisuke Hashiguchi, Kaori Fujii, and Atsushi Suzuki, 1 Institute of Biotic Community, 1-8-7 Nishiohsawa, Higashihiroshima, 739-0037 Japan, ibc@urban.ne.jp; 2Wildlife Conservation Laboratory, 1-2-40-402 Miyahara, Yodogawa-ku, Osaka, 532-0003 Japan; 3Asia Air Survey Co.,Ltd., 1-8-30 Tenmabashi, Kita-ku, Osaka, 530-6029 Japan

We observed Japanese Murrelet (Synthliboramphus wumizusume) in the western part sea area of the Seto Inland Sea in November, 2009 from July, 2008. We recorded pictures of the individuals which we confirmed. And we analyzed a change of the moulting based on those pictures. All the individuals which we observed during May from December were breeding plumage. In June, we observed the individuals which molted in non-breeding plumage from breeding plumage with individuals of the breeding plumage. We confirmed the individuals which half of the flight feather lacked. We guessed that these individuals cannot fly. Even the individuals which a flight feather lacked did not lack the tail feathers. In July, there
was not the individual of complete breeding plumage. There were individuals of the various plumages which seemed to moult. They are regarded as juveniles and adult birds. The individual moulting with flight feathers was not confirmed. There were a lot of individuals that tail feathers seemed to moult. The individuals that these tail feathers were incomplete were regarded as moulting adult birds. Because there is the example which tail feathers of the juvenile approximately completely mature into in June that is one month later of the leaving the nest. The individuals recorded in August and September were non-breeding plumage. We confirmed the individuals which moulted in breeding plumage from non-breeding plumage and individuals of the non-breeding plumage from October to November. These individuals had variation in the timing of moulting.

INFLUENCE OF WATER MASSES ON THE DISTRIBUTION AND ABUNDANCE OF SEABIRDS IN THE NORTHEASTERN CHUKCHI SEA

Adrian E. Gall*1, Robert H. Day1, and Caryn Rea2, 1ABR, Inc.—Environmental Research & Services, PO Box 80410, Fairbanks, AK 99709 USA, agall@abrinc.com; 2ConocoPhillips Company Alaska, Inc., P.O. Box 100360, Anchorage, AK 99510-0360 USA

We examined the seasonal and spatial variation in the distribution and abundance of seabirds in the northeastern Chukchi Sea near two proposed oil prospects. During the seabird surveys, we sampled a total of 6,037 km of transects during 417 h of observation. We had sufficient detections to generate density estimates for eight species after correcting for species-specific differences in detection rates. Procellariids were the most abundant species-group recorded during 2008, primarily because of large flocks of Short-tailed Shearwaters (Puffinus tenuirostris) that moved through both study areas in early fall; larids and alcids were the next most-abundant species groups recorded. Total density was highest in early fall, when 16 species collectively accounted for 71 birds/km² in the Klondike study area and 15 species collectively accounted for 73 birds/km² in the Burger study area. Seasonal and spatial patterns of species abundance and composition were similar between the NPPSD historical data (1975–1981) and the 2008 data, although species richness was higher in 2008. The Klondike study area appears to be a pelagically-dominated system affected by water associated with the Central Current, and the Burger study area appears to be a benthically-dominated system affected by water associated with a gyre over Hannah Shoal. Diving alcids that forage on zooplankton dominated in Klondike, whereas surface-feeding larids and procellariids and deep-diving seaducks and loons dominated in Burger. We propose that the structure of the seabird community differs substantially between the two study areas and that these differences reflect oceanographic differences between the two study areas.

THE 2009 CENTRAL CALIFORNIA BRAND'T S CORMORANT (PHALACROCORAX PENICILLATUS) DIE-OFF AND BREEDING FAILURE EVENT

Corinne Gibble1,2*, Hannah Nevin1,2, Gerry McChesney3, Lisa Eigner4, Sandra Rhoades4, Phil Capitolo5, Shannon Lyday6, Jamie Hall6, Jan Roletto7, Jaime Jahncke8, Sara Acosta8, Pete Warzybok9, Russ Bradley9, Bill Merkle9, Krysten Schuler10, and Michele Bellizzi11, 1Moss Landing Marine Laboratories, 8272 Moss Landing Road, Moss Landing, CA 95039 USA, cgibble@mlml.calstate.edu; 2California Department of Fish and Game (MWVCR), 1451 Shaffer Road, Santa Cruz, CA 95060 USA; 3US Fish and Wildlife Service, San Francisco Bay National Wildlife Refuge Complex, 9500 Thornton Ave., Newark, CA 94560 USA; 4Humboldt State University, Dept. of Wildlife, Arcata, CA 95521 USA; 5University of California, Institute of Marine Sciences, 100 Shaffer Road, Santa Cruz, CA, 95060 USA; 6Farallones Marine Sanctuary Association, P.O. Box 29386, San Francisco, CA 94129 USA; 7Gulf of the Farallones National Marine Sanctuary, 991 Marine Dr., San Francisco, CA 94129 USA; 8PRBO Conservation Science, 3820 Cypress Drive #11, Petaluma, CA 94954 USA; 9Golden Gate
An unprecedented mortality event (April-July) and breeding failure of Brandt’s Cormorants (*Phalacrocorax penicillatus*; BRAC) occurred along the central California coast during spring 2009, indicated by increased stranding records from systematic beach surveys and records from parks, local rehabilitation centers, state and federal resource agencies, and colony monitoring studies. This event primarily impacted the Gulf of the Farallones and Monterey Bay areas. Other species such as loons, grebes, and sea lions were also affected. Beach surveys documented the greatest monthly encounter rates on record for BRAC in May (Gulf of the Farallones, 1.7 birds km\(^{-1}\); Monterey Bay, 8.1 birds km\(^{-1}\)). At central California BRAC colonies there were significant reductions in attendance, delayed breeding, and extremely low productivity. At coastal BRAC colonies (Monterey Bay, Gulf of the Farallones), breeding birds were completely absent or present in very low numbers. At three monitored colonies with attendance, breeding phenology ranged 16-33 days later than average and productivity ranged 44-88% below average. On the South Farallon Islands, attendance was the lowest on record (11% of normal) and productivity was zero. Preliminary results from statewide aerial surveys indicate that colonies to the north and south of this region appeared less affected. Necropsies of 54 BRAC confirmed the majority of these birds were adults (87%), emaciated, and no pathogens were detected. These results combined with oceanographic surveys and fishing reports, indicate a substantial lack of forage fish in the central California nearshore waters despite high spring upwelling and cold sea surface temperatures.

**DIVING BEHAVIOR OF WEDGE-TAILED SHEARWATERS**

*Julia Gleichman*\(^1\), *David Hyrenbach*\(^2\), and *Nina J. Karnovsky*\(^1\), \(^1\)Pomona College, Department of Biology, 175 W. 6th St., Claremont, CA 91711 USA, jsg12006@mymail.pomona.edu; \(^2\)Hawaii Pacific University, Marine Science, 41-202 Kalaniana’ole Hwy., Waimanalo, HI 96795 USA

Wedge-tailed shearwaters (*Puffinus pacificus*) are known to forage near the surface of the ocean, often in association with subsurface predators such as skipjack tuna. However, prior studies using capillary tubes have recorded dives of up to a mean maximum depth of 14m. To examine the frequencies of shearwater diving and their diving depths in detail, we attached time-depth recorders to 4 wedge-tailed shearwaters provisioning chicks on Lehua Island, Hawaii. The time depth recorders measured temperature and pressure at 5-second intervals during the entire deployment and every 0.5 seconds during some dives (depth > 1.5m). All four individuals dove to depths greater than 1.5m and the maximum depth recorded was 21.8m. While two of the individuals made a single dive over the 42 hr deployment, the other two birds engaged in multiple dive bouts. On one dive to 10.4m, we estimated that the descent rate was 1.67 m/s and the ascent rate was 1.11 m/s. We were unable to distinguish the different activities of the shearwaters based on the TDR temperature measurements because of the similarity in ocean and air temperatures. While time depth recorders were useful in elucidating the details of diving behavior in these birds, we recommend that salt water switches be used in the future to facilitate more detailed time-budget analyses of their time at sea.

**SPECTERS IN THE SOUND: MORTALITY OF MARINE BIRDS FROM DERELICT FISHING GEAR IN PUGET SOUND AND THE NORTHWEST STRAITS**

*Thomas P. Good*\(^*1\), *Jeffrey June*\(^2\), *Michael Etnier*\(^3\), and *Ginny Broadhurst*\(^4\), \(^1\)Northwest Fisheries Science Center, NOAA Fisheries, 2725 Montlake Blvd. E., Seattle, WA 98112 USA, tom.good@noaa.gov; \(^2\)Natural Resource Consultants, Inc., 4039 21st Avenue West, Suite 404, Seattle, WA 98199 USA;
Derelict fishing gear is lost or abandoned commercial and recreational fishing nets, lines, pots, and traps that sit on the ocean bottom or float underwater. Derelict nets can remain in the marine environment for years, killing a variety of marine bird species. Since 2002, we have documented the capture and mortality of marine birds by derelict fishing nets during recovery and removal operations in Puget Sound and the Northwest Straits in Washington State (USA). Specimens collected during gear recovery are identified and enumerated as nets are recovered, during laboratory necropsies, and using osteological characters from skulls and post-cranial material. In the more than 1000 derelict nets recovered, 502 individual birds of at least 12 species have been documented, some of which are of local or national conservation concern. Of the specimens identified to genus, the majority (82%) were cormorants; more than half of those identified to species were Brandt’s (Phalacrocorax penicillatus), followed by Pelagic (P. pelagicus) and Double-crested (P. auritis). Mortality of marine birds appears to be related to net location, habitat, net type, size, age, and the extent to which the net was suspended open upon recovery. Ongoing derelict gear recoveries are being analyzed to parameterize models to more fully estimate seabird mortality over time as well as to identify potential hotspots for marine birds (MPAs, roosting areas, wildlife refuges). These analyses will further our understanding of the impact of mortality from derelict fishing gear on marine birds.

GULL-BILLED TERN (GEOCHELIDON NILOTICA VANROSSEMI) DIET AND HABITAT USE OF SAN DIEGO BAY

*Katharine Goodenough*, and *Rebecca Lewison*, Department of Biology, San Diego State University, 5500 Campanile Avenue, San Diego, CA 82162 USA, kate goedenough@gmail.com

Considerable concern has been raised regarding the impact of gull-billed tern intra-guild predation on California least terns (Sternula antillarum browni) and Western snowy plovers (Charadrius alexandrinus nivosus), two species listed under the Endangered Species Act. Although monitoring efforts for these Species of Conservation Concern have provided anecdotal information on gull-billed tern predation, there has been little effort to quantify predation intensity. With the use of VHF radio telemetry and stable isotope analysis on gull-billed terns nesting and foraging in San Diego Bay, this project will develop individual home ranges and diet breadth for gull-billed terns during the 2010-11 breeding seasons. Telemetry data will provide movement patterns and habitat use in and around least tern and plover colonies. The isotope data will be incorporated into a multi-source mixing model to determine food source proportions and their importance in the gull-billed tern diet. With changing climatic conditions and continued habitat loss and fragmentation occurring in southern California, there is a potential for gull-billed tern recruitment and range movement further north along the Pacific coastline. These potential range movements may lead to increased conflicts with California least tern and western snowy plover management. Obtaining spatial and temporal data on gull-billed terns at the San Diego colony will identify the foraging patterns these birds are utilizing, specifically considering how the ranges change over the nesting season, and provide much needed empirical data on the potential demographic impact for conservation management strategies.

OFFSHORE FORAGING BEHAVIOR AND ECOLOGY OF ROSEATE (STERNA DOUGALLII) AND COMMON TERNS (S. HIRUNDO)

*Holly Goyert*, City University of New York Graduate Center and College of Staten Island, Department of Biology, Building 6S Room 143, 2800 Victory Boulevard, Staten Island, NY 10314 USA, hgovert@gc.cuny.edu
Despite numerous studies of Roseate (Sterna dougallii) and Common Terns (S. hirundo) at their breeding grounds, relatively little is known about their offshore foraging behavior and ecology. To address this, I used three approaches: first, I collected data on nest provisioning rates and prey species composition; second, I quantified the direction of departure and return for terns commuting to and from nests; and third, I conducted shipboard surveys of terns offshore. I observed the nest provisioning and commuting trajectories at Bird Island, in Buzzards Bay, Massachusetts, during the breeding season (May-July 2009). During the post-breeding season (August-September), I observed the distribution of terns at sea, aboard National Oceanic and Atmospheric Administration vessels in the Northwest Atlantic. Roseate Terns were more specialized than Common Terns in both prey diversity and foraging zones. They relied primarily on sand lance (Ammodytes), and fed chicks significantly longer fish, less often, than Common Terns. Mean directions of Roseate Tern departures were significantly correlated with mean directions of returns in the same sampling period, and Roseates showed foraging fidelity to the Southeast of Bird Island, in the vicinity of Woods Hole. Roseate and Common Terns differed significantly from each other in their directions of departure and return. At sea, Roseate Terns were sighted up to 80 km offshore, whereas Common Terns were sighted up to 280 km offshore. On the 29th of September, a mixed species flock of 400 adult and juvenile Roseate and Common Terns was observed feeding 80 km Northeast of Cape Cod.

CRYING WOLF? ARE BLACK-FOOTED ALBATROSS REALLY ENDANGERED?

Craig S. Harrison, 4953 Sonoma Mountain Road, Santa Rosa, CA 95404, charrison@hunton.com

The Center for Biological Diversity petitioned the Fish & Wildlife Service to list black-footed albatrosses (Phoebastria nigripes) as endangered or threatened under the Endangered Species Act. The Service found that listing may be warranted due to inadequate regulations to minimize mortality in longline fisheries as well as the ingestion of DDE and PCBs. However, standard statistical techniques analyzing publicly-available nesting data from 1992-2008 show increasing populations at Midway Atoll and French Frigate Shoals and stability at Laysan Island. The Laysan population may have decreased since the 1950s as the Midway population increased. Japanese populations are increasing. Current DDE and PCB levels do not threaten albatross existence. Recent DDE egg levels (1.55 mg/kg) are 2.6 times the levels in wedge-tailed shearwaters (Puffinus pacificus) and 5% of the levels that caused complete reproductive failures in brown pelicans (Pelecanus occidentalis). Recently published studies on contaminant levels in fat cannot be correlated to concentrations in eggs and are not helpful to assess conservation status. The following information is needed: (1) since the 1950s, has breeding habitat improved on Midway compared to Laysan Island? (2) is nesting habitat at Laysan Island degrading for this species? (3) what are the levels of PCBs and DDE in eggs or blood plasma throughout the species’ range? and (4) are reproductive failures due to eggshell thinning occurring anywhere? Forty years ago Harvey Fisher found oceanic conditions can cause temporary declines in nesting effort and these fluctuations continue today. How would listing this species advance seabird conservation?

ALCID BREEDING HABITAT RESTORATION ON SANTA BARBARA ISLAND, CALIFORNIA

Annie L. Harvey *, Darrell L. Whitworth ², and Harry R. Carter ³, ¹Montrose Settlements Restoration Program, Channel Islands National Park, 1901 Spinnaker Dr., Ventura, CA 93001, USA, laurie_harvey@nps.gov; ²California Institute of Environmental Studies, 3408 Whaler Ave, Davis, CA 95616 USA; ³Carter Biological Consulting, 1015 Hampshire Rd., Victoria, BC V8S4S8 Canada
At Santa Barbara Island, most breeding Cassin’s Auklets (*Ptychoramphus aleuticus*) were extirpated by cat predation and other factors in the early 20th century; breeding Xantus’s Murrelets (*Synthliboramphus hypoleucus*) have declined since the 1970s, with impacts from high depredation by deer mice (*Peromyscus maniculatus*) and barn owls (*Tyto alba*), as well as other factors. Extensive past grazing and introduced plants have limited natural vegetation to the island perimeter. As part of the Montrose Settlements Restoration Program, plant habitat restoration has been underway since 2007 to provide additional breeding habitat and more natural breeding conditions for murrelets and auklets. Initial plant restoration was implemented in three sites along the northeastern portion of the island adjacent to murrelet nesting areas and later expanded to include areas on the western portion of the island adjacent to Elephant Seal Point where small numbers of auklets bred in 1977-94. A social attraction system for auklets was deployed near northeast plant restoration plots in January 2009. Nest monitoring, shoreline nest searches, and at-sea spotlight surveys were used to assess population size, reproductive success, and distribution of murrelets and auklets. Murrelet hatching success in 2009 was relatively low, similar to 2007-08 breeding seasons. Extended spotlight surveys were conducted in 2009 to provide a baseline to identify future trends. While no evidence of nesting auklets was found during limited 2007-08 surveys, small numbers of nesting birds were found during more extensive surveys at past breeding areas at Elephant Seal Point and Sutil Island in 2009.

**DIEL SHIFTS IN MARBLED MURRELET DISTRIBUTION AT-SEA IN PORT SNETTISHAM, SOUTHEAST ALASKA**

*Trevor B. Haynes*¹, ², ³, *S. Kim Nelson*¹, ², *Scott H. Newman*¹, ⁴, ¹ Wildlife Trust, 460 West 34th Street, 17th Floor, New York, NY 10001 USA, ² Oregon Cooperative Fish and Wildlife Research Unit, Oregon State University, Department of Fisheries and Wildlife, 104 Nash Hall, Corvallis, OR 97331 USA, ³ Current Address: School of Fisheries and Ocean Sciences, University of Alaska Fairbanks, Fairbanks, AK 99775-7720 (t.haynes@sfos.uaf.edu), ⁴ Emergency Centre for Transboundary Animal Diseases, Animal Health Division, Food & Agriculture Organization of the United Nations, Viale delle Terme di Caracalla, Rome, 00153 ITALY

Little is known about seabird distributions at night. Densities of Marbled Murrelets (*Brachyramphus marmoratus*, hereafter “murrelets”) were compared during night and day in two regions of Port Snettisham, near Juneau, Southeast Alaska. Murrelets moved from a shallower, more protected region, used during the day for foraging and staging for inland flights (night densities = 15 ±13 murrelets.km⁻²; day densities = 172 ± 67 murrelets.km⁻²), to a deeper, more exposed region during dark hours (night densities = 113 ± 61 murrelets.km⁻²; day densities = 41 ± 23 murrelets.km⁻²). The number of fish prey schools and prey relative abundance were significantly higher at night in the inner region compared with the outer region (2.2 times more prey schools and 3.8 times higher prey relative abundance), suggesting that murrelets were not redistributing themselves to forage on fish prey. We suggest that avoidance of predators such as Bald Eagles (*Haliaeetus leucocephalus*) and Great Horned Owls (*Bubo virginianus*) is a more likely explanation why murrelets move away from daytime use areas at night.

**GLOBAL DISTRIBUTION AND CONSERVATION OF THREATENED SEABIRD BREEDING ISLANDS**

*Reina Heinz*¹, ², *Bernie Tershy*¹, *Kelly Newton*¹, *Sarah Horwath*², and *Donald Croll*¹, ¹ University of California, Santa Cruz, 100 Shaffer Road, Santa Cruz, CA 95060 USA, ambrogina.r@gmail.com; ²Ecology, Evolution and Marine Biology, University of California Santa Barbara, Santa Barbara, CA 93106 USA.
Seabirds play important functional roles in marine and terrestrial ecosystems, yet they are the most threatened group of marine animals with 27% of species at some risk of extinction. The most significant threats to seabirds occur on their breeding islands where, in many cases, effective conservation actions are feasible. To guide island-based seabird conservation actions, we developed a database of current breeding islands for the 92 species of seabirds listed by the International Union for the Conservation of Nature as threatened (categories Critically Endangered, Endangered and Vulnerable combined). All threatened seabird breeding populations (n = 630) can be protected with conservation action on 417 islands in 33 countries. At least one population of each species can be protected on only 56 islands in 20 countries. The greatest concentration of threatened breeding seabirds are found on islands within the Southwest Pacific oceanic region with Campbell Island, New Zealand containing the greatest number of threatened species (n = 9). Unlike most threatened biodiversity which is concentrated in the third world tropics, most threatened seabird breeding colonies are concentrated in wealthy countries with well developed conservation infrastructure (67% of colonies are found in New Zealand, France, United Kingdom and United States). The small number of islands where threatened seabirds breed and their concentration in relatively wealthy countries, make colony-based protection of threatened seabirds a unique conservation opportunity.

**IMPACTS OF NATURAL PETROLEUM SEEPS ON MARINE BIRDS IN CALIFORNIA**

*Laird Henkel*¹, *Michael Ziccardi*², and *Marida Martin*¹. ¹California Dept. of Fish and Game, Office of Spill Prevention and Response, 20 Lower Ragsdale Drive, Suite 100, Monterey, CA 93940 USA, lhenkel@ospr.dfg.ca.gov; ²Oiled Wildlife Care Network, Wildlife Health Center, University of California, Davis, CA 95616 USA

Contamination by petroleum is a major source of mortality for marine birds. While much oil contamination occurs from large spills and other anthropogenic causes, as much as 50% of crude oil entering oceans each year may come from natural seeps. The Santa Barbara Channel in southern California contains some of the most productive oil seeps in the world (up to 20,000 metric tons per year), and oiled birds are often recovered here during winter months. In an exceptional event in January 2005, more than 1,500 oiled birds, primarily Western/Clark’s grebes (*Aechmophorus occidentalis/A. clarkii*), were recovered here, apparently as a result of natural seep oil flushed out of the Santa Clara River. We used monthly reports of live miscellaneous oiled birds reported to the California Oiled Wildlife Care Network, in conjunction with chemical analyses to determine the source of the oil, to assess the magnitude and spatial and temporal trends of oiling of marine birds as a result of natural seeps. Between July 2005 and June 2009 (4 years), an average of 219 (+ 96 SD) live oiled birds were reported per year. Almost all oiled feather samples analyzed from this period were determined to be Monterey Formation crude oil, likely from natural seeps. Based on rough extrapolation, we estimate that more than 1,000 birds are likely contaminated by natural seep crude oil in California in a typical year. Rates of oiled bird reports peak during winter, and are likely related to an increase in seep activity after heavy rainfall.

**THE TIMING OF LOON SPRING MIGRATION OFF CENTRAL CALIFORNIA, 1994 THROUGH 1996**

*Annette E. Henry*¹*, Richard A. Rowlett*, Jenna M. Borberg*, and Lisa T. Ballance¹; ¹NOAA Fisheries, Southwest Fisheries Science Center, La Jolla, CA, 92037 USA; annette.henry@noaa.gov; ²Oregon State University, Corvallis, OR, USA 97331

Three species of loons, Pacific (*Gavia pacifica*), Common (*G. immer*), and Red-throated (*G. stellata*), make a spring migration northward along the Pacific coast from their wintering areas to breeding grounds.
In 1994-1996 we monitored their migration at Piedras Blancas, CA using 10x and 25x power binoculars as well as eye. In addition to the number of migrants counted by species, effort, wind speed and direction, sightability, and visibility were recorded. Migrants were observed daily from 18 March through 02 June; the peak migration period varied by species; and 15 April through 06 May with more than 75% of the migration occurring in this 3-week period. Overall, no annual differences in migration phenology were detected. Daily migration rates were heaviest during the morning hours. The rate of migration was inversely correlated to wind speed, yet wind direction did not seem to influence the rate of migration. The standardized rate of loons observed varied from year to year and by species. The migration rate of Red-throated Loons increased each year of this study; the rate of Common and Pacific Loons increased from 1994 to 1995; Common Loons then decreased in 1996 to a rate lower than observed in 1994 while Pacific Loons decreased, however the rate was higher than observed in 1994. Pacific Loons were, by far, the most abundant migrant. Although our study did not detect much variability, this time series may prove valuable for monitoring climate change effects on the timing of loon migration.

ALBATROSS APPETITE FOR PELAGIC PLASTICS: PATTERNS ACROSS THE NORTH PACIFIC AND RELATIONSHIP TO ORGANIC CONTAMINANTS

Robert W. Henry III1, Suhash Harwani2, Donald A Croll1, Bernie R Tershy1, June-Soo Park2, Myrto Petreas2, Scott A Shaffer1, Michelle A Kappes1, Yann Tremblay1, Daniel P. Costa1, Cynthia Vanderlip3, Charles Moore4, 1Department of Ecology & Evolutionary Biology, University of California Santa Cruz, Long Marine Lab, Center for Ocean Health 100 Shaffer Rd, Santa Cruz, CA 95060 USA, henry@biology.ucsc.edu; 2Environmental Chemistry Laboratory, Department of Toxic Substances Control, California Environmental Protection Agency, 700 Heinz Avenue, Berkeley, CA 94710 USA; 3State of Hawaii Department of Land and Natural Resources, Division of Forestry and Wildlife, 2135 Makiki Heights Dr., Honolulu, HI 96822 USA; 4Algalita Marine Research Foundation, 148 Marina Drive, Long Beach, CA 90803 USA

We analyzed macro (anthropogenic marine debris) and micro (organic) contaminant exposure in Laysan (Phoebastia immutabilis) and black-footed (Phoebastia nigripes) albatrosses throughout most of their North Pacific breeding range. Geographic segregation in foraging location amongst breeding populations was ascertained using a 5 year dataset of foraging tracks from various colony locations. Examination of 407 boluses collected from Laysan (central and Eastern Pacific colonies) and black-footed (central Pacific colonies) chicks revealed that central Pacific black-footed albatross chicks had the highest mean plastic debris volume levels (82.4 ± 48.2 ml bolus\(^{-1}\), 1.5 and 5 times those found central Pacific Laysan (55.4 ± 39.6 ml bolus\(^{-1}\)) and Eastern Pacific Laysan (17.1 ± 21.3 ml bolus\(^{-1}\)) albatross chicks, respectively. Organic contaminant analyses (Sum DDTs, other pesticides, and PCBs) of blood samples collected from black-footed and Laysan adults breeding in the central Pacific (Tern Island) and adult Laysans breeding in the Eastern Pacific (Guadalupe Island) revealed that central Pacific black-footed albatrosses had the highest levels of contaminants (120.9 ± 32.7 ng/ml plasma), followed by Eastern Pacific Laysans (75.4 ± 43.1 ng/ml plasma). Central Pacific Laysan albatrosses had the lowest levels of organic contaminants (34.8 ± 23.47 ng/ml plasma). Overall ranking of plastic incidence across populations (central Pacific BFAL>central Pacific LAAL>Eastern Pacific LAAL) was different than that for organic contaminant concentrations (central Pacific BFAL>Eastern Pacific LAAL>central Pacific LAAL). Results show differences in contaminant exposure, with high levels of macro contaminants in the central Pacific vs. high levels of micro contaminants in the Eastern Pacific.

DESIGNING ECOLOGY: RECONSTRUCTING SEABIRD HABITAT ON AÑO NUEVO ISLAND
Nesting habitat for burrowing seabirds is being improved on Año Nuevo Island to mitigate mortalities from oiling and from extensive habitat alterations during past human use. This endeavor faces challenges common to many island restoration projects, as well as some unique factors. To address both the technical and ethical challenges of habitat manipulation for conservation, we are combining scientific experimentation with applications of design and visual arts. In addition to native plant restoration and soil stabilization, this project includes two main design elements. To exclude California sea lions (*Zalophus californianus*) from critical burrowing areas, we are constructing a series of Habitat Ridges that are designed to increase nesting space for breeding seabirds. In addition, we are working with students at the California College of the Arts to design new Nest Modules that will provide stable sites for Rhinoceros Auklets (*Cerorhinca monocerata*) while the native flora is recovering. We established design criteria to reduce the long-term ecological footprint of this project in the face of a finite funding period and the desire to reduce human disturbance on the island. This project highlights the role of artists and designers in structuring common perceptions of the "natural" world, with particular emphasis on restoration ecology.

**WINTERING HABITAT USE PATTERNS BY THREATENED PINK-FOOTED SHEARWATERS**

*Peter J. Hodum*¹, *K. David Hyrenbach*², and *Josh Adams*³, ¹Oikonos – Ecosystem Knowledge, P.O. Box 1932, Benicia, CA 94510 USA, peter@oikonos.org; ²Marine Science Program, Hawai‘i Pacific University, Kaneohe, HI, 96744 USA; ³U.S. Geological Survey, Western Ecological Research Center, Moss Landing Marine Laboratories, Moss Landing, CA 95039 USA

The Pink-footed Shearwater *Puffinus creatopus*, a Chilean endemic, has IUCN Vulnerable status due to its restricted breeding range and possible declining populations. In addition to colony-based threats, there is concern about possible interactions with commercial fisheries (i.e., bycatch, prey competition) and acute and chronic pollution at sea (i.e., oil spills, food-web biomagnification). To determine movement and habitat use patterns on their North American wintering grounds, we deployed solar-powered satellite transmitters on five Pink-footed Shearwaters of unknown age and breeding status captured in the Santa Barbara Channel, California in late June 2009. Tag duration ranged from 114 to >135 days, with the five individuals covering a mean distance of 8200 km. The birds overwintered in the California Current System (CCS; 22 – 48° N), with two individuals traveling north to Oregon and Washington and three remaining in the Southern California Bight. Within the CCS, the birds utilized slope (depth: 201-1000m) and shelf (depth < 200m) habitats, with an average of 66% and 32% of locations originating from these depth domains, respectively. During the southward migration, all birds traveled along the shelf/shelf-break to the southern tip of Baja California and then rapidly transited tropical and sub-tropical waters to reach the coast of South America. The birds migrated through territorial waters of six nations: Costa Rica, Panama, Colombia, Ecuador, Peru and Chile. Our results suggest that shelf/shelf-break waters, areas of high fishing and shipping activity, are fundamentally important to this species both on the wintering grounds and along their migratory routes.
TESTING ASSUMPTIONS AND ACCOUNTING FOR UNCERTAINTY IN *BRACHYRAMPHUS* MURRELET SURVEYS

Steven T. Hoekman¹, Brendan J. Moynahan², Mark. S. Lindberg³, Lewis C. Sharman⁴, and William F. Johnson²

¹Institute of Arctic Biology, University of Alaska, Fairbanks, AK 99775 USA; ²Glacier Bay National Park and Preserve, 3100 National Park Road, Juneau, AK 99801 USA; ³Institute of Arctic Biology, University of Alaska, Fairbanks, AK 99775 USA; ⁴Glacier Bay National Park and Preserve, P.O. Box 140, Gustavus, AK, 99826 USA

In support of monitoring efforts for Kittlitz's murrelets (*Brachyramphus brevirostris*), we tested the critical assumption of line transect sampling that probability of detection near the center line = 1, assessed efficacy of 1 versus 2 observers, and developed methods for estimating density in face of uncertainty in detection and identification of murrelets. During July 2009, we conducted boat-based line transect surveys in Glacier Bay, Alaska, which contains both Kittlitz's and marbled murrelets (*B. marmoratus*). Because similarity in appearance complicates identification, we recorded observations by species or as unidentified. For some transects, we randomly assigned 1 or 2 observers and/or included an independent observer, who assessed whether observers detected groups initially located near (<30 m) the center line. We found probability of detection near the center line was high (mean ± SE; 0.94 ± 0.03). Encounter rates (groups/km) increased by >50% with 2 observers (3.6 ± 0.5) versus 1 (2.3 ± 0.5) and probability of identification increased by 20% with 2 observers (0.51 ± 0.02) versus 1 (0.42 ± 0.02). Probability of identification for groups near the center line was 0.71 ± 0.03. Both undetected and unidentified groups near the center line violate the critical assumption of line transects and contribute to under-estimation of density. We show how accounting for uncertainty in detection and identification can increase accuracy of density estimates and facilitate comparisons across space and time. We suggest utilizing 2 observers to increase efficiency of line transects.

RESTORATION OF ENDANGERED SEABIRDS IN THE MAIN HAWAIIAN ISLANDS

Nick Holmes¹, Cathleen Bailey², Fern Duvall², Holly Freifeld³, Darcy Hu⁵, Megan Laut⁴*, Jay Penniman⁶, Chris Swenson⁷, and Lindsay Young⁸

¹Kauai Endangered Seabird Recovery Project, University of Hawaii, PO Box 458, Waimia, HI 96796 nick.holmes@hawaii.edu; ²Haleakala National Park, PO Box 369 Makawao HI 96768; ³Division of Forestry and Wildlife, Department of Land and Natural Resources, 54 South High Street, Wailuku, Hawaii 96793; ⁴Pacific Islands Fish and Wildlife Office, US Fish and Wildlife Service, 300 Ala Moana Blvd, Honolulu, HI 96850; ⁵Hawaii National Park, PO Box 52, HI 96718; ⁶Maui Nui Seabird Recovery Project, University of Hawaii, 54 South High Street, Wailuku, Hawaii 9679; ⁷US Fish and Wildlife Service Pacific Region, 911 NE 11th Avenue, Portland, OR 97232; and ⁸Pacific Rim Conservation, 3038 Oahu Avenue Honolulu, HI, 96822

The complexity and urgency of restoration and recovery of Hawaii’s two endemic Procellariiformes, the threatened Newell’s shearwater *Puffinus newelli* and endangered Hawaiian petrel *Pterodroma sandwichensis*, presents many significant challenges in the main Hawaiian Islands. The current breeding range of both species is restricted to high elevation refugia, and is considered to be a fraction of a more widespread prehistoric distribution. Populations at extant colonies face the threats of predation by non-native mammals, habitat modification by invasive plants, and ‘fallout’ (artificial light attraction or collision with anthropogenic structures). Of concern, population indicators of Newell’s shearwaters on their primary breeding locale of Kaua’i, suggest a decline of approximately 75% along the eastern and south regions during the past fifteen years, including extirpation of three previously known colonies. Developments and the challenges for restoration and recovery of these endemic seabirds at colony sites, including collaborative efforts with watershed protection projects on Kaua’i and Lana’i, effects of long-running predator control programs at Haleakalā and Hawaii National Parks, implementation of social
attraction projects and planning for chick translocation. Current habitat restoration techniques that will prove integral to future restoration of Newell’s shearwaters and Hawaiian petrels and many other seabird species include results from recent trial aerial rodenticide drops on Lehua and Mokapu Islets off of Kaua`i and Moloka`i respectively, and plans for Hawai`i’s first rodent-proof fence at Ka`ena Point on O`ahu.

**NOCTURNAL STRIP-TRANSECT SURVEYS: NEW METHODS TO ELUCIDATE DISTRIBUTION AND FORAGING PATTERNS OF PELAGIC SEABIRDS**

*Brian A. Hoover*1, Luke D. Whitman2, and Kathy J. Kulet3, 1Moss Landing Marine Labs, 8272 Moss Landing Road, Moss Landing, CA 95039 USA bhooover@mlml.calstate.edu; 2Dept. of Fisheries and Wildlife, Oregon State University, Corvallis, OR 97331 USA; 3U.S. Fish and Wildlife Service, 1011 E. Tudor Rd., Anchorage, AK 99503 USA

Most at-sea seabird surveys are conducted during diurnal periods, and current methods are dependent on optimal visibility and environmental conditions. Consequently, few nocturnal surveys have been conducted, and little is known about pelagic seabird distributions at night. We describe an exploratory protocol using 3X night-vision monoculars, walkie-talkies, and coordinated team effort to successfully survey seabirds in the southern and eastern Bering Sea. From July-August 2009 we conducted 24 nocturnal surveys constituting 21.3 hours, and compared the density, species diversity, and distribution patterns of the seabird assemblage with comparable diurnal surveys conducted during the same cruise. Based on our detection distance at night, we standardized the spatial scale of our diurnal observations to 100-meter bins during analysis, to permit more accurate comparisons. Taxonomic resolution was compromised at night, and seabirds with uniformly dark plumage were recorded at lower densities than during daylight hours. Northern Fulmars (*Fulmarus glacialis*) and Fork-tailed Storm Petrels (*Oceanodroma furcata*) showed a strong nocturnal bias, possibly reflecting an attraction to boat lights. Murres (*Uria sp.*) and kittiwakes (*Rissa sp.*) showed equal or enhanced densities at night over identical spatial scales, suggesting nocturnal foraging. Related diet studies support our observations that murres and kittiwakes were feeding at night. While there are clear species-specific limitations, we suggest that further refinement of this technique may provide novel perspectives on the distribution, foraging, and provisioning patterns of many seabird species.

**PREY DELIVERED BY THE CALIFORNIA LEAST TERN TO ITS NESTING COLONY AT THE SEAL BEACH NATIONAL WILDLIFE REFUGE, 1996-2009**

*Michael Horn*1, Charles Collins2, and Jeanette Hendricks3*, 1Department of Biological Science, California State University Fullerton, 800 North State College Blvd, Fullerton, CA 92834 USA, mhorn@fullerton.edu; 2Department of Biological Sciences, California State University, Long Beach, 1250 Bellflower Blvd, Long Beach, CA 90840 USA

Dropped fish samples were collected from a nesting colony of California Least Terns (*Sternula antillarum browni*) over eight breeding seasons spanning 1996-2009 at the Seal Beach National Wildlife Refuge in southern California. These samples were collected opportunistically during visits to the colony. More than 400 fish were collected during the eight seasons, and a total of 18 different species identified from the dropped fish samples. The samples were represented by mainly bay-estuarine species—topsmelt (58.3%) and California killifish (10.0%), and secondarily by coastal pelagic fishes—Pacific sardine (10.8%) and northern anchovy (4.8%). Greater than 75% of these dropped fish ranged in size from 51 to 80 mm standard length. Overall, our results match well with those from other locations and regions in terms of prey type, size, and habitat. Whether in the Gulf of California or the Pacific coast, California
Least Terns feed on small (50-100 mm) bay-estuarine and coastal pelagic fishes with the main foraging habitats and prey species influenced by the distance of the nesting colony to the ocean.

**COMPARISON OF ELECTRIC FENCE CONFIGURATIONS USED FOR PREDATOR MANAGEMENT AT A LEAST TERN COLONY IN CENTRAL CALIFORNIA**

*Julie Howar* and *Dan P. Robinette*, PRBO Conservation Science, Vandenberg Field Station, 205 North H Street Suite 217, Lompoc, CA 93436 USA, jhowar@prbo.org

The California Least Tern (*Sternula antillarum browni*) is an endangered colonial seabird that nests on open sandy beaches, leaving it vulnerable to coyote predation. The Least Tern management team at Vandenberg Air Force Base, California maintains electric fences around its tern colony to deter coyotes. To be an effective deterrent, fence voltage must be maintained at >3.0 kV. Maintaining this voltage is relatively easy during clear and sunny weather conditions, but becomes a challenge when conditions deteriorate. We tested three fence configurations for their ability to maintain voltage under varying weather conditions: 1) solar powered with battery back-up to maintain overnight voltage, 2) solar/battery set-up with a voltage regulator to increase battery life, and 3) ‘hard-wired’ with power from a nearby facility. All three configurations showed quadratic relationships between voltage and time of day, with voltage being lowest at dawn and dusk. We did not measure overnight voltage, but assumed it was similar to dawn voltage. While dawn and dusk voltage was usually >3.0 kV, overcast weather conditions could result in voltage reductions to <3.0 kV on both solar configurations. The hard-wired configuration consistently maintained voltage >3.0 kV. Of the environmental variables measured, air temperature explained most variability in fence voltage. All three configurations were effective in deterring coyotes; however, coyotes were occasionally able to breach the fence regardless of configuration. Overall, electric fences are effective management tools, greatly reducing the need for lethal predator management.

**TOWARDS STEADY STATE ECONOMY (SSE) SEASCAPES: WHY, WHAT, HOW, AND URGENCY IN TIMES OF GLOBALLY MISSED 2010 CBD (CONVENTION OF BIOLOGICAL DIVERSITY) TARGETS**

*Falk Huettmann*, EWHALE lab, University of Alaska, Fairbanks, Alaska 99775 USA

Seascapes are globally affected by the human economy like never before. Seabirds have to cope with such an environment, and millions of seabirds are affected on sea as well as on land, and during their long-distance migrations. This makes for a huge animal care problem alone, besides hugely modified ecosystems, and massively declining, and some exploding and inflated, populations. Food chains are widely modified and lost their original resilience. Here I provide a theoretical foundation for why the human economy needs to be fully included in meaningful seabird studies, e.g. for a science-based Adaptive Management. Secondly, I present findings from a Meta-Analysis that assesses 20 factors for seabird well-being and wilderness of the ocean system. These findings show that the majority of factors are clearly related to human economy, namely economic growth. Lastly, I show that the global lack of resourcefulness in the future leads naturally to a more stable and less invasive Steady State Economy, and that Macro Reforms are required to satisfy the many and increasing needs of the biotic and abiotic world in times of climate change, and globally missed targets of the Convention of Biological Diversity (CBD).

**MONITORING PELAGIC SEABIRDS IN ALASKA FOR A SUSTAINABLE MANAGEMENT: A CONSTRUCTIVE CRITIQUE**
Environmental monitoring is widely discussed and of major relevance for a sustainable management, but according to the scientific literature, it is rarely achieved well. To determine an appropriate solution for this, sufficient funding is rarely distributed. Even if funding exists, many powerless concepts get applied, and data are mismanaged or even lost. Alaska offers a diverse setting, and makes a great test case for this situation. Here, we will review current data and initiatives that monitor seabirds at sea in Alaskan waters. This presentation is based on several peer-reviewed publications and public databases, and over 6 years of analyzing seabirds and databases in coastal Alaska, the Bering Sea, the Arctic, and adjacent seas (Sea of Okhotsk and western Canada). The results show that data merging, density estimates, meaningful metadata, digital formats, online data delivery, data sharing and statistical power are currently not well addressed. Secondly, powerful modeling methods which are essential for obtaining large-scale estimates of detection, population trends, impacts, by-catch and future scenarios, are widely missing. This presentation will conclude with a constructive, scientific debate on how to improve the current situation towards reaching sustainability, based on ‘best available’ science, good practices and global urgency.

DATA MINING AND QUANTIFYING VOCALIZATIONS OF LEACH’S STORM PETREL (OCEANODROMA LEUCORHOA) WITH MACHINE LEARNING ALGORITHMS

Leach’s Storm Petrel (Oceanodroma leucorhoa leucorhoa) is one of the most widely distributed seabirds in the Northern Hemisphere. O.l leucorhoa are found in the Aleutian Islands and on the east coast of Newfoundland, separated by ~ 8,030 km with no known mixing between populations. Vocalizations play a large role in conspecific interactions due to the colonial, nocturnal habits of this abundant seabird. Geographic variation of the chatter call vocalization between Buldir Island, Alaska, and Gull Island, Newfoundland was examined for the 2006 breeding season. Data mining techniques such as Machine Learning Algorithms offer a fast and accurate method for pre-screening data and immediate quantification of complex datasets that have multiple inputs, and can examine interactions between multiple variables with relative ease. Here, Random Forests by Salford Systems has been used to assess and quantify differences between chatter calls on Buldir and Gull Islands. Such methods can be used on large scale datasets to quantify, scientifically, how vocalizations vary geographically between subpopulations, and can therefore fine-tune hypotheses, and give us some idea how evolution or environment affects vocalizations in a larger meta-population. The huge potential of these techniques warrants more applications beyond pure ecology.

DISTRIBUTION OF STORM PETRELS IN THE NORTH PACIFIC AS MODELED WITH GIS AND RANDOM FORESTS

DISTRIBUTION OF STORM PETRELS IN THE NORTH PACIFIC AS MODELED WITH GIS AND RANDOM FOREST
Distribution modeling is an important tool for conservation managers in a variety of different fields. Storm Petrels in the North Pacific breed on a variety of islands in the North Pacific, particularly on the Aleutian island archipelago and forage far out at sea where they are subject to various forcing caused by changes in either local or regional oceanography. In order to better predict species distributions, complex algorithms and modeling techniques are required to accurately and quantitatively describe interactions between the ecosystem and the species or group in question. Using data from the North Pacific Pelagic Seabird Database and environmental data layers downloaded freely from the internet and a model of the biogenic compound dimethylsulfide, models of storm petrel (*Oceanodroma*) species (Leach’s storm petrel (*Oceanodroma leucorhoa*) and Fork-Tailed storm petrel (*Oceanodroma furcata*)) during the breeding season have been created using ArcGIS and the machine learning algorithm Random Forests by Salford systems. By iteratively removing predictor variables in the analysis, the best model was determined using an independent subset of the data with an ROC analysis. The models are available freely with metadata and can be used for a variety of conservation analysis studies.

**DEMOGRAPHICS OF WINTERING WESTERN AND CLARK’S GREBES: INSIGHTS INTO DIFFERENTIAL WINTERING AND OIL SPILL IMPACTS**

*Diana Humple*1,2, Hannah M. Nevins3, Elizabeth Phillips3,4, Corinne Gibble3, Laird Henkel5, Kati Boylan2, and Derek Girman2. 1PRBO Conservation Science, 3820 Cypress Drive # 11, Petaluma CA 94954 USA, dhumble@prbo.org; 2Sonoma State University, 1801 E Cotati Ave, Rohnert Park, CA 94928 USA; 3Moss Landing Marine Laboratories, 8272 Moss Landing Road, Moss Landing, CA 95039 USA; 4Oregon State University-CIMRS & NOAA Fisheries – NWFSC, Pt. Adams Research Station, 520 Heceta Place, Hammond, OR 97121 USA; 5California Department of Fish and Game Office of Spill Prevention and Response, 20 Lower Ragsdale Drive, Suite 100, Monterey, CA 93940 USA

Differential wintering of age and sex classes has been found in many migratory species, and can have important conservation implications. If population-limiting events such as oil spills predominantly impact one age or sex class due to their greater prevalence in a wintering region, demographic ramifications to breeding populations are possible. We examined age and sex ratios of wintering Western Grebes (*Aechmophorus occidentalis*) and Clark’s Grebes (*A. clarkii*) killed in three coastal California events: two oil spills, the September 1997 Kure spill in Humboldt Bay and the January 2005 Ventura Oiled Bird Incident in southern California; and the November 2007 plumage-fouling red tide event in Monterey Bay. Mortality of Western Grebes was greatest from VOSBI. Birds were sexed and aged by examining gonads and bursa of Fabricius during necropsies (n=256) or sexed with chromobox-helicase-DNA-binding genes (n=58), and bursa involution was evaluated against another age proxy, gonad maturity. Age and sex patterns varied, and indicate some degree of differential wintering or local partitioning. Western Grebes were comprised of 91% immatures in the Kure spill, compared with 21% in VOSBI. In the Monterey Bay event, 65% of Western Grebes were female (driven by a skewed sex ratio in immatures), compared with 24% of Clark’s Grebes. Although VOSBI Western Grebes lacked an overall skewed sex ratio, immatures were male-biased (78%). Opportunities to examine demographic patterns in oiled wildlife are often overlooked but can be critical to our understanding of oil spill impacts, and provide critical assessment of such parameters in wintering seabirds.

**SIN (SEABIRD INFORMATION NETWORK) IS ON-LINE AND GROWING**
The Seabird Information Network (SIN) is a simple web-based information network that provides immediate information on seabird productivity, especially breeding failures. The objective was to provide a tool for seabird researchers to share information directly upon coming out of the field. This data portal was first tabled four years ago and now is on-line and ready for your information. The platform is easy to use and requires only a few clicks of the mouse to put your information on the web. Information can instantly be compared to other sites up and down the coast and even from different oceans. The portal provides an immediate picture of how seabirds are doing and how widespread a breeding failure might be. This information is of interest to seabird researchers, the media and fisheries and oceanography people who are starting to appreciate seabirds as indicating change in the marine ecosystem. This project is a joint effort by the Circumpolar Seabird Group, the Circumpolar Biodiversity Monitoring Program and the United Nations Environmental Program - World Conservation Monitoring Centre, and Geoconnections. Current countries that are involved include the US, Canada, Russia, Greenland, Iceland, Faroe Islands, UK, Norway, Sweden, and Finland. We plan to expand this to the entire globe for the World Seabird Conference. We are also working on a Global Network of Seabird Colony Inventory Information.

OCEAN PROCESSES INFLUENCING SEABIRDS AND THEIR PREY IN THE GULF OF THE FARALLONES

Jaime Jahncke*, Jennifer Roth, Russ Bradley, Meredith Elliott, and Pete Warzybok, PRBO Conservation Science, 3820 Cypress Drive #11, Petaluma, CA 94954, USA, jjahncke@prbo.org

The California Current System is one of the most productive regions in the world’s oceans and may be drastically impacted by climate change. The effects of climate change are difficult to predict, but will likely lead to an overall reduction in biological production that will affect species at all levels of the marine food web. We assessed effects of ocean conditions on seabirds by (1) evaluating trends in ocean conditions and seabird breeding parameters and (2) examining underlying seabird - ocean climate relationships using 35 years of data from a breeding colony in central California. In addition, we examined relationships between ocean conditions and marine bird prey availability during the breeding season. We assessed the effects of ocean conditions on zooplankton and fish abundance by relating prey abundance in the diet to ocean conditions at the time of prey harvest from the ocean. We compared these results with previous analyses that examine relationships between ocean climate and timing of nesting and reproductive success of marine birds in Central California. This work enhances our understanding of how ocean climate affects seabirds and their prey in the Gulf of the Farallones, improving our ability to make predictions about how climate change may affect prey and predators in the California Current.

NON-BREEDING CALIFORNIA BROWN PELICAN MANAGEMENT POST-DELISTING

Deborah L. Jaques*, Harry R. Carter, Phillip J. Capitolo, 1Pacific Eco Logic, 375 3rd St., Astoria, OR 97103 USA, djaques.pel@charter.net; 2Carter Biological Consulting, 1015 Hampshire Rd., Victoria, BC V8S4S8 Canada; 3University of California, Inst. Mar. Sci., 100 Shaffer Rd., Santa Cruz, CA 95060 USA
The California Brown Pelican (*Pelecanus occidentalis californicus*) was removed from the endangered species list on November 11, 2009 after about 40 years in specially protected status. We discuss what listed status meant to protection of Brown Pelicans away from breeding colonies on the west coast over the last few decades and how management actions, roost site restoration, monitoring, and research may change after delisting. Additional documentation, protection, monitoring, and research on pelicans throughout the non-breeding range in California, Oregon and Washington are needed for sound management of the species.

**MARINE BIRD STRANDING EVENT DUE TO A HARMFUL ALGAL BLOOM PRODUCING A NOVEL PROTEIN SURFACTANT: KILLER FOAM**

*David A. Jessup*, *Melissa Miller*, *Hannah M. Nevins*, *Elizabeth Phillips*, and *Raphael Kudela*;

1California Department of Fish and Game, Marine Wildlife Veterinary Care and Research Center, 1451 Shaffer Rd., Santa Cruz, CA 95060 USA, djessup@ospr.dfg.ca.gov; 2Moss Landing Marine Laboratories, 8272 Moss Landing Road, Moss Landing, CA 95039 USA; 3Ocean Sciences Department, University of California-Santa Cruz, Santa Cruz, CA 95060 USA

In November 2007, a series of beaching events involving more than 500 marine birds of various species occurred within Monterey Bay over approximately 3 weeks. Affected birds presented with wet feathers, were weak and hypothermic and had slimy pale yellow-green fluid fouling feathers along the waterline. Birds beached in 3 distinct pulses that corresponded temporally with the presence of a large dinoflagellate bloom just offshore. With light washing and supportive care, birds recovered, suggesting that the product was nontoxic. The event was ultimately traced to the dominant dinoflagellate in red tide, *Akashiwo sanguine*. Decomposition of *Akashiwo* elicited large quantities of a dimer protein of the same composition and molecular weight (MW 1231) as protein recovered from feathers of affected birds, but which was not present on unaffected birds. Wave action and agitation produced surface foam that when spread on normal feathers, acted as an effective wetting agent. This phenomenon could be reproduced under laboratory conditions with cultures of *Akashiwo*. The event occurred just following seasonal migration of many species into Monterey Bay area. It affected primarily northern fulmars (*Fulmarus glacialis*); of which approximately half died. Significant mortality in surf scoters (*Melanitta perspicillata*) and Clark’s (*Aechmophorus clarkii*) and western grebe (*A. occidentalis*) added to large numbers of these species killed by the concurrent Cosco Busan oil spill. This is the first report of an ostensibly nontoxic, but harmful algal bloom (HAB) caused by a dinoflagellate surfactant protein impacting marine birds. In 2009 similar events were reported off Washington and Oregon.


*Nathan Jones*, *Brian Hoover*, *Kathy Kuletz*;

1U.S. Fish and Wildlife Service, 1011 East Tudor Road, annettMS 201, Anchorage, AK 99503 USA, njones@mlml.calstate.edu; 2Moss Landing Marine Laboratories, Vertebrate Ecology Lab, 8272 Moss Landing Road, Moss Landing, CA 95039 USA

We studied the foraging ecology of Black-Legged Kittiwakes (*Rissa tridactyla*), and Thick-Billed Murres (*Uria lomvia*) in the central and southern Bering Sea during July and August 2008 and 2009. We surveyed strip transects to quantify distribution and abundance, and collected foraging birds at sea to assess diet. In both years murres occurred in greatest concentrations nearest the Pribilof Islands and in deep waters over Pribilof Canyon, and kittiwake concentrations were greatest over Pribilof Canyon and off the continental shelf break W-SW of St. Paul. In 2009, kittiwake concentrations increased to the W-
NW of St. Paul on the continental shelf. In the NE Aleutian region in 2009 both species were most concentrated near the Bogoslof Island seabird colony. The times at which the birds were collected, and the species present in their stomachs, indicated that birds were foraging primarily between 9 pm and 9 am. In 2008, euphausiids (*Thysanoessa* spp) dominated the diet of murres (89.3% biomass), whereas myctophids (*Stenobrachius* spp) dominated the diet of kittiwakes (91.7% biomass). In 2009 a preliminary subsample of murres (n=21) yielded a more varied diet of: eelpout (*Lycodes* spp), squid (family: Gonatidae), smoothtongue (*Leuroglossus* spp), and amphipods (*Themisto libellula*). In the coming months we will process the remaining 124 birds collected at sea in 2009, and analyze diet across regions and years. We will then compare diet to measures of the available prey base to explore links between seabird distribution, diet, and the dynamics of their forage base.

**BREEDING ECOLOGY OF KITTLITZ’S MURRELET AT AGATTU ISLAND, ALASKA, IN 2009: PROGRESS REPORT**

Robb S. A. Kaler1*, Leah A. Kenney1, John F. Piatt2, Jeff. C. Williams1, and G. Vernon Byrd1, 1Alaska Maritime National Wildlife Refuge, 95 Sterling Highway, Suite 1, Homer, AK 99603 USA rsakaler@yahoo.com; 2Alaska Science Center, U.S. Geological Survey, 4210 University Dr., Anchorage, AK 99508 USA

We report the results of Kittlitz’s murrelet (*Brachyramphus brevirostris*) chick growth rates, adult provisioning and reproductive success at Agattu Island, Alaska, in 2009. Of 14 nests monitored, 13 had a known fate. Daily nest survival during the incubation stage was 0.989 ± 0.030, and the probability an egg would survive the 30 d incubation period was 0.708 ± 0.126. Daily nest survival for the nestling stage was 0.932 ± 0.080, and the probability a chick survived the 30 d brood-rearing period was 0.119 ± 0.103. Nest survival from clutch initiation to fledging was 0.085 ± 0.077. The only cause of nest failure during incubation was abandonment by adults after eggs failed to hatch (23%, three of 13 eggs). No nests were lost due to predation of eggs. The main cause of nest failure during the nestling period was either exposure to inclement weather or starvation (70%, seven of ten chicks were found dead in the nest). Of 3 surviving chicks, 1 was depredated (<3 d post-hatching), and two (20%) fledged from the nest at days 29 and 38. Time-lapse cameras were deployed at 5 nests. Average number of nest visits by adults/nest ranged from 2.5 to 9.3 visits per day and ranged from 9-20 min. Monitoring duration ranged from 2 to 29 days. In addition to 14 active nests, we located 25 additional murrelet nests which had been used in previous years (i.e., pre-2009). Crews at Agattu have now identified and taken measurements for 63 Kittlitz’s murrelet nests.

**IN PURSUIT OF PLANKTON: THE FORAGING BEHAVIOR OF CASSIN’S AUKLETS IN THE GULF OF THE FARALLONES**

Nina J. Karnovsky*1, Eleanor M. Caves1, Pete Warzybok2, Russell W. Bradley2, Meredith L. Elliot2, Benjamin Saenz3, Charlotte Chang1, Jaime Jahncke2; 1Pomona College, Department of Biology,175 W. Sixth Street, Claremont, CA 91711 USA, nina.karnovsky@pomona.edu; 2PRBO Conservation Science, 3820 Cypress Drive #11, Petaluma, CA 94954 USA, 3Stanford University, Ocean Biogeochemistry Lab, 397 Panama Mall, Stanford, CA 94305-2215 USA

The purpose of this study was to investigate linkages between Cassin’s auklet (*Ptychoramphus aleuticus*) foraging, prey abundance, and ocean conditions in the Gulf of the Farallones. We hypothesized that Cassin’s auklets foraging when krill densities are high, make fewer dives, dive to shallower depths, and have shorter dive bouts than during periods when fish prey are more abundant. We tested this hypothesis in May and June of 2008 by affixing small Time Depth Recorders to provisioning adults.
breeding on Southeast Farallon Island. We programmed the Time Depth Recorders to record temperature and pressure every five seconds and when diving, every 0.2 seconds. To determine what the Cassin’s auklets were feeding their chicks, we collected chick diet samples from adults. We coordinated Time Depth Recorder deployment with oceanographic cruises aimed to assess distribution and abundance of auklets and krill in relation to ocean conditions in the Gulf of the Farallones. In 2008, we found more larval fish and fish eggs in auklet diets during May dive depths were greater during this month. In June, Cassin’s auklets made longer, shallower dives and krill were consumed more frequently. When krill in chick diets increased in June, they also became more abundant in the Tucker Trawl samples. Cassin’s auklets were closely associated with the shelf break in May and were found over a broader area in June. We found no effect of the Time Depth Recorders on chick growth.

ACCURATE PREDICTIONS OF PELAGIC SEABIRD POPULATIONS WITH DISTANCE SAMPLING, BLACK BOXES AND PUBLIC DATA: OVERCOMING TRADITIONAL REGRESSION MODELS AND PARSIMONY

Daisuke Kawai, Caroline Fox, Kathy Heise, Paul C. Paquet and Falk Huettmann
Raincoast Conservation Foundation, 2506 Beacon Avenue, Sidney, BC V8L 1Y2, Canada, des.kawai@gmail.com, Faculty of Environmental Design, University of Calgary, Calgary, AB, Canada, Institute of Arctic Biology, University of Alaska, Fairbanks, AK 99775-7000, USA

Characterizing spatial distribution and abundance is essential for understanding the ecology of species and assessing risk factors relating to adverse influences from human activities. Accordingly, traditional regression models are often used to predict animal abundance and distribution. Although favoured for development of spatially explicit predictive models, methodological problems associated with regression models are unresolved. These include multicollinearity and assumption of linearity between predictive and response variables. Consequently, new data mining approaches deemed more robust than traditional regression models are now being used in other fields such as economics and medical science. We conducted systematic transects in coastal British Columbia to estimate abundance and distribution of marine birds. We applied model-based Distance Sampling to estimate densities of animals on transects. Abundances and distribution surfaces were then constructed by using a traditional regression model, Generalized Additive Model (GAM); and two data mining approaches, Random Forests and TreeNet. Available environmental data were used for spatial models as predictors. Data mining approaches showed higher predictive accuracy than results from the GAM. Finally, predictive abilities were compared among the models. Model building efficiency was very high using data mining, which is free from prediction variable selections and other fine-tuning processes. These processes took considerable time and effort for the GAM. Moreover, data mining approaches are also free from strong statistical assumptions of parametric modeling. In conclusion, we strongly recommend using data mining approaches, such as Random Forests or TreeNet, for spatial prediction of animal distributions.

STATUS OF THE CALIFORNIA LEAST TERN: POPULATION TRENDS AND INDICATORS FOR THE FUTURE

Kathy M. Keane and Nathan Mudry
Keane Biological Consulting, 2892 N. Bellflower Blvd. #480, Long Beach, CA 90815 USA, keanebio@yahoo.com

Following listing under the federal and state endangered species acts, the California least tern increased from an estimated 664 nesting pairs in 1976 to over 7,000 in 2008. However, the majority of the increase occurred during the 1990’s. Although nesting site protection efforts have continued at similar levels in recent years, productivity has declined, resulting in reduced recruitment into the population. Higher
levels of predation at some nesting sites, as well as fluctuations in numbers and timing of appearance of preferred prey species, are implicated in higher levels of mortality. Thus, although the least tern population has increased substantially from its pre-listing numbers, continued management will be required to ensure continued reproductive success and long-term survival.

OVERVIEW OF CALIFORNIA LEAST TERN FORAGING

*Kathy M. Keane* and *Nathan Mudry*, Keane Biological Consulting, 2892 N. Bellflower Blvd. #480, Long Beach, CA 90815 USA, keanebio@yahoo.com

The California least tern feeds in both saltwater and freshwater habitats on small (10 cm or less) prey fish, and is reported to feed primarily in shallow water habitats. However, recent foraging studies indicate that a substantial amount of foraging occurs offshore in deep-water habitats. In addition, changes in foraging activity, and higher levels of non-predator-related chick mortality, suggest that populations of preferred prey species, primarily juvenile northern anchovy, topsmelt and other juvenile fish, have declined or are appearing later in the nesting season.

THE EFFECT OF BREEDING HABITAT SELECTION ON THE REPRODUCTIVE SUCCESS OF RHINOCEROS AUKLETS ON DESTRUCTION ISLAND, WASHINGTON

*Emma Kelsey*¹, *Peter Hodum*¹, and *Scott Pearson*², ¹Biology Department, University of Puget Sound, 1500 N. Warner, Tacoma, WA 98416 USA, ekelsey@pugetsound.edu; ²Wildlife Research Division, Washington Department of Fish and Wildlife, 1111 Washington Street SE, 5th Floor, Olympia, WA 98501-2283 USA

Habitat selection, which can be affected by a variety of biotic and abiotic factors, has the potential to influence the reproductive success and survival of a species. Studies have shown that in surface-nesting seabirds, higher quality birds obtain better nesting sites within a colony and, thus, have a greater probability of reproductive success. Possible impacts of habitat selection on the reproductive success of burrow-nesting seabirds are less well understood. Rhinoceros Auklets (*Cerorhinca monocerata*), burrow-nesting, colonial seabirds, are a model species with which to test questions of breeding habitat selection. In this study, I examined the reproductive success of Rhinoceros Auklets in relation to habitat selection on Destruction Island, off the outer coast of Washington. I used a variety of parameters (including slope angle, aspect, and vegetation) to characterize different habitats. I compared burrow density and reproductive success as a function of habitat type. No significant difference was found in occupancy levels and auklet reproductive success in different types of vegetation cover ($x^2=0.003$, df=2, $p>0.05$). Reproductive success was high (>88%) for occupied burrows in all habitat types. Breeding habitat and non-habitat sites were not distributed uniformly around the island ($z=3.956$, $p=0.014$), with breeding habitat located primarily on the south and west sides of the island. Slope angles in breeding habitats varied greatly, ranging from 18-85°. Auklets thus appear to choose nest sites based on aspect and slope rather than other habitat variables.

DESIGN CONSIDERATIONS FOR ACCURATE, POWERFUL SURVEYS OF BRACHYRAMPHUS MURRELETS IN ALASKA

*Matthew Kirchhoff*¹, Audubon Alaska, 441 West 5th Ave., Suite 300, Anchorage AK 99501. mkirchhoff@audubon.org
I discuss the influence of different survey types (strip versus line), different sampling designs (zig-zag, shoreline, random), and different survey dates (May-August) on *Brachyramphus* survey results in southeast Alaska. In general, line transects yield higher, and more accurate, density estimates than strip transects. Transects that follow a meander 100 m from the shore, risk missing a high percentage of Murrelets, especially Kittlitz’s Murrelets, and are biased low. Transects that do not have known start- and end-points are difficult to replicate precisely, and are susceptible to bias. Both source of bias can be overcome by orienting transects so they sample *across* the nearshore density gradient, and by using fixed start and end points. Murrelet surveys show low precision for a variety of reasons, including weather-related detection and bird movement (flux). Replicate surveys will always increase statistical power. Surveys conducted in July, when a high percentage of birds are on the water, yielded the lowest coefficients of variation, and the highest power to detect trends. A modified snapshot approach to counting flying birds is offered. However, trend analyses using birds counted “on the water” may be the simplest solution to the problems posed by flying birds.

**DISTRIBUTION, STATUS, AND TRENDS OF KITTLITZ’S MURRELETS IN SOUTHEAST ALASKA**

Michelle L. Kissling*1, Paul M. Lukacs2, Scott M. Gende3, Kathy Kuletz4, Nicholas R. Hatch1, Sarah Schoen1, and Susan Oehlers5; 1U.S. Fish and Wildlife Service, 3000 Vintage Blvd., Suite 201, Juneau, AK 99801 USA, michelle_kissling@fws.gov; 2Colorado Division of Wildlife, 317 W. Prospect Rd., Fort Collins, CO 80526 USA; 3National Park Service, Glacier Bay Field Station, 3100 National Park Road, Juneau, AK 99801 USA; 4U.S. Fish and Wildlife Service, 1011 East Tudor Rd., Anchorage, AK 99503 USA; 5U.S. Forest Service, PO Box 327, Yakutat, AK 99689

We conducted a region-wide assessment of the distribution, abundance, and trend (where possible) of Kittlitz’s Murrelets (*Brachyramphus brevirostris*) during the breeding season in Southeast Alaska (excluding Glacier Bay Proper). We surveyed for Kittlitz’s Murrelets at sea in six population centers from 2002-2009 including repeated surveys in Icy Bay, along the Malaspina Forelands, and in Yakutat Bay where previous survey data existed, and new surveys from Cape Yakataga to Icy Bay (Lost Coast), in the Tracy Arm Wilderness Area (south of Juneau), and from Yakutat Bay to Cross Sound (Outer Coast). We also compiled known nest records and opportunistic observations of Kittlitz’s Murrelets in unsurveyed areas of the region. The distribution of Kittlitz’s Murrelets in Southeast Alaska is geographically clustered with highest densities found in glacial-influenced waters in Icy Bay, Malaspina Forelands, Yakutat Bay, and Cape Fairweather (Outer Coast); lower densities of this species occur on the Lost Coast, southern section of the Outer Coast, and the Tracy Arm Wilderness Area. With few exceptions, Kittlitz’s Murrelets were only found in marine waters adjacent to tidewater glaciers, in glaciated fjords, and near outflows of glacial streams. We conducted a meta-analysis to estimate population size and to evaluate the status of Kittlitz’s Murrelets in Southeast Alaska.

**COMMUNICATION BEHAVIOR OF HIGHLY SOCIAL SEABIRD CRESTED AUKLET (**AETHIA CRISTATELLA**): KEYS TO INDIVIDUALITY AND CALLER' QUALITY IN TRUMPET CALLS**

Anna V. Klenova*1, Victor A. Zubakin2,3, Ilya A. Volodin1,4, Elena V. Zubakina3, and Elena V. Volodina4, 1Department of Biology, Moscow State University, Vorobiovo Gori, 1/12, 119899, Russia, klenova2002@mail.ru; 2Severtsov Institute of Ecology and Evolution RAS, Russia; 3Russian Bird Conservation Union, Russia; 4Scientific Research Department, Moscow Zoo, Russia
Crested auklets are monogamous seabirds breeding in dense seashore colonies and using for communication all possible channels. Their well-developed olfactory and visual behavior was investigated in details; however vocal performances are poorly studied. We investigated keys to individuality and caller quality in trumpet calls – complex vocalizations, performed as advertising displays by males and rarely by females. In 2008 and 2009 we recorded 677 calls, from 31 individually color-banded DNA-sexed male crested auklets on Talan Island (Okhotsk Sea, Russia). Trumpet calls included two parts: the high-frequency introduction and the main part with 2-7 low-frequency bark-like notes alternated with 1-4 high-frequency notes. Discriminant analysis with 9 time and frequency parameters included into analysis, showed 96.9% correct assignment to individual (22 males, 4-10 calls per male). Found individual differences were stable within season and from year to year (crossvalidation analysis). We found no significant correlation between acoustic parameters of trumpet calls and morphometric measures (weight; lengths of wing, leg, and beak) of caller males (p>0.05). However we found that the higher-rank males, calling at the higher roosting places produced trumpet calls with longer main parts and lower in frequency notes of the main part relative to those of males calling at the lower roosting places (23 vocal duels, MANOVA, F1,22=8.31, p=0.008 and F1,22=17.24, p<0.001). We conclude that trumpet calls of crested auklets are individually distinctive and potentially could provides information about individuality and quality of a caller and together with specific odor and ornamentation appears to be important component of complex social behavior of this species.

VARIATION IN BASELINE CORTICOSTERONE LEVELS OF BREEDING ATLANTIC PUFFINS (FRATERCULA ARCTICA)

Amy-Lee Kouwenberg*, Megan E. Rector*, Donald W. McKay, and Anne E. Storey

We investigated the dynamics of baseline corticosterone (CORT) levels of Atlantic Puffins (Fratercula arctica) breeding in Witless Bay Ecological Reserve, Newfoundland from 1998 to 2003. We found that baseline corticosterone levels for puffins in our study were significantly higher during the pre-laying stage of breeding than in the early and mid chick-rearing stages. Corticosterone levels did not differ between early and mid chick-rearing. Also, we did not find a significant effect of year or an interaction between year and season for the puffins in our study, which suggests that the seasonal pattern in baseline corticosterone was consistent over different years, despite annual variation in the timing of prey arrival. These results suggest that baseline corticosterone in puffins may be influenced by stress of burrow defense and egg production. As well, the absence of a change in baseline corticosterone from early to mid chick-rearing contrasts with findings for common murres (Uria aalge) breeding nearby in the same years. In these murres, baseline corticosterone levels were higher in early chick-rearing in a year when capelin (Mallotus villosus) arrived after hatching had commenced. Taken together, the results for common murres and Atlantic puffins suggest that puffins' longer chick-rearing period (as compared to murres) may buffer puffins from the stress associated with low prey availability in early chick-rearing.

THE SCIENCE AND ART OF SEABIRD RESTORATION: LESSONS LEARNED FROM THE GULF OF MAIN AND BEYOND

Stephen W. Kress*, Seabird Restoration Program, National Audubon Society, 159 Sapsucker Woods Road, Ithaca, NY 14850 USA, skress@audubon.org
Seabird chick translocation and social attraction (decoys and sound recordings) can help to repopulate historic nesting sites and restore ranges that have contracted due to human influence. These seabird restoration techniques can supplement protection, control of predators and substrate/vegetation management which alone may have a lower chance of success or take much longer without these methods. Case studies with Common Terns in the Gulf of Maine and Caspian Terns in the Columbia River demonstrate that species with limited natal site philopatry are excellent candidates for colony restoration using social attraction, especially where populations are increasing and where the restoration site is close to a large source colony. In contrast, species with strong philopatry, such as Northern Gannet, are less likely to respond to social attraction methods. Case restoration studies with highly philopatric Atlantic Puffin and Cahow demonstrate that these are better candidates for chick translocation, especially because of small, local populations. Chick translocations are inappropriate for species such as terns and gulls which receive post fledging care. Projects for highly philopatric species will benefit from a combination of both translocation and social attraction methods. It may take a decade or more to establish a new colony using chick translocation, but social attraction may lead to colonization within the same year that decoys and sound are deployed. After recolonization, long term management and funding may be necessary to sustain restored populations. These methods have been used for restoration projects in at least twelve countries for 50 seabird species.

**COMPARISON OF FIVE SOCIAL ATTRACTION COMMON MURRE RESTORATION PROJECTS**

*Stephen Kress*1, *Michael Parker*2 *Harry Carter*3, *Gerry McChesney*4, *Koji Ono*5, *Richard Golightly*6, *Scott Hatch*7, *C. Scott Hall*8; and *Susan Schubel*9 1 National Audubon Society, Seabird Restoration Program, 159 Sapsucker Woods Road, Ithaca, NY 14850 USA, skress@audubon.org; 2 Carter Biological Consulting, 1015 Hampshire Rd., Victoria, BC V8S4S8, Canada; 3 1500 Libertado Court NW, Los Lunas, NM 87031 USA; 4 U.S. Fish and Wildlife Service, San Francisco Bay National Wildlife Refuge Complex, P.O. Box 524, Newark, CA 94560 USA; 5 Wildlife Div., Kushiro Nature Conserv. Office, Min. Environ., Kushiro Dist. Unit Gov. Bldg. 4F, Saiwaicho 10-3, Kushiro, 085-8639 Japan; 6 Dept. of Wildlife, Humboldt State University, Arcata, CA 95521 USA; 7 USGS, Alaska Science Center, 4210 University Dr., Anchorage, AK 99508; 8 Seabird Restoration Program, National Audubon Society, 118 High St., Suite 2 #26, Belfast, ME 04915 USA; 9 Seabird Restoration Program, National Audubon Society, 11 Audubon Road, Bremen, ME 04551 USA

Social attraction devices (decoys, mirrors and sound recordings) were deployed at four historic colony sites in the United States and one site in Japan to restore nesting Common Murres (*Uria aalge*). At Devil’s Slide Rock (California) and Middleton Island (Alaska), murres nested in the first year of deployment, but did not nest at nearby San Pedro Rock after 7 years of social attraction. It took murres 17 years to recolonize Matinicus Rock (Maine), yet only five years following deployment at Teuri Island, the last active colony in Japan where only about 15 murres still attended. Here, social attraction equipment was deployed in 2003 and eggs were laid in 2008. These different responses illustrate how variations in distance to active murre colonies, population status, lapsed time since past breeding and predators influence outcomes. At Devil’s Slide Rock, murres had not bred for 10 years prior to social attraction, but rapid recolonization of six pairs in 1996 suggests that some birds survived and returned to the site. In contrast, murres last nested at San Pedro Rock in 1908 and predatory Common Ravens (*Corvus corax*) were present during the restoration attempt. Murres last bred at Matinicus Rock in 1883 and the nearest colony is more than 100 miles north. Here, social attraction equipment was in place from 1992 through 2009 as nonbreeders slowly increased prior to the first egg in 2009. These outcomes demonstrate variable responses of murres to social attraction and show that recolonization may take a decade or more, especially where a colony is long extinct and predators are present.
THE BIG PICTURE IN ALASKA: A BROADSCALE PERSPECTIVE ON PREDATOR-PREY DYNAMICS ON THE BERING SEA SHELF

Kathy J. Kuletz*1, Elizabeth A. Labunski1, Patrick Ressler2, Anne Hollowed2, and Mike Sigler3, 1U.S. Fish and Wildlife Service, 1011 E. Tudor Road, Anchorage, AK 99503 USA, Kathy_kuletz@fws.gov; 2NOAA Fisheries, Alaska Fisheries Science Center, 7600 Sand Point Way NE, Seattle, WA 98115 USA; 3NOAA Fisheries, Alaska Fisheries Science Center, 17109 Point Lena Loop Road, Juneau, AK 99801 USA

During the breeding season, seabirds are obligate central place foragers, resulting in a tension between their breeding requirements and ability to track prey. We examined the broadscale relationship between prey (age-1 walleye pollock \(T\)eragra chalcogramma\) and euphausiids) and two abundant seabirds, the surface-feeding black-legged kittiwake (\(Rissa tridactyla\)) and pursuit-diving thick-billed murre (\(Uria lomvia\)). We conducted concurrent surveys of birds and prey from a 76m vessel over 3 years, 2007-2009 in June-July, on the Bering Sea shelf of Alaska. Annual strip-transect coverage for seabirds was ~ 9,000 km, and acoustic sampling of prey was ~15,000 km. Both bird species had high densities near colonies (St Matthew and Pribilof islands), indicative of foraging range constraints. In every year kittiwakes were more widespread than murres, with greater use of the middle and the northern shelf. Murres were spatially more consistent among years and, except near St Matthew, concentrated on the outer and southern shelf. Murre distribution matched best with euphausiids while the kittiwake’s matched best with pollock. The interannual variation in kittiwake distribution suggests they may be more responsive to, or controlled by shifts in pollock distribution, possibly affecting kittiwake breeding success. Murre abundance was highest over the Pribilof Canyon on the shelf edge, which was not a hotspot for euphausiids or pollock. A related study found that murres in this area were feeding at night on vertically migrating micronekton from deep waters. By examining how broadscale changes in prey affect seabird distribution, we hope to develop predictive models for the Bering Sea under changing conditions.

DECLINES IN KITTLITZ’S AND MARBLED MURRELETS IN PRINCE WILLIAM SOUND, ALASKA: DEALING WITH UNCERTAINTY

Kathy J. Kuletz*1, Bryan Manly2, Chris Nations2, and David Irons1, 1U.S. Fish and Wildlife Service, 1011 E. Tudor Road, Anchorage, AK 99503 USA, Kathy_kuletz@fws.gov; 2Western EcoSystems Technology Inc., 2003 Central Avenue, Cheyenne, WY 82001 USA

Prince William Sound (PWS), Alaska, has a long-term at-sea survey dataset by which to monitor populations of the Kittlitz’s murrelet (\(Brachyramphus brevirostris\)) and marbled murrelet (\(B. marmoratus\)). \(Brachyramphus\) murrelets were not, however, always identified to species, especially before 1998. Detecting trends for a rare species is difficult if it can not be easily separated from a related, abundant species. \(Brachyramphus\) murrelets showed declines in PWS, but marbled murrelets (2004 population = 35,657 ± 7809 birds; 95 % CI) greatly outnumbered Kittlitz’s (2004 population = 778 ± 516), so trends for Kittlitz’s were less certain. We used data from 9 surveys (July of 1972 and 1989-2004) to develop models that incorporated unidentified murrelets and predicted population trends. Model predictions reasonably fit field survey estimates and substantiated observed trends of identified birds. The marbled murrelet population declined ~ 5% per annum, a total of 85 % since 1972, or 63 % since 1989; predicted quasi-extirpation (< 100 birds) is in year 2120. Kittlitz’s declined 17.7 % per annum since 1972 (a total of 99 %), or by 30.8 % per annum since 1989 (a total of 88 %); predicted quasi-extirpation was year 2006, however, subsequent surveys in 2005 and 2007 estimated ~ 2,500 Kittlitz’s. We therefore incorporated the new data into the models to examine differences in predicted trends. Both \(Brachyramphus\) species continue to be at risk. Our results highlight the importance of maintaining long-
term and consistently implemented monitoring programs to identify species-specific trends, in order to inform policy decisions and conservation efforts.

**POPULATION STATUS AND TRENDS OF KITTLITZ’S MURRELETS IN KACHEMAK BAY AND COOK INLET, ALASKA**

*Kathy J. Kuletz*, *SUZANN G. SPECKMAN*, *ELIZABETH A. LABUNSKI*, and *JOHN F. PIATT*;

1U.S. Fish and Wildlife Service, 1011 E. Tudor Road, Anchorage, AK 99503 USA, *kathy_kuletz@fws.gov*; 2Alaska Biological Center, U.S. Geological Survey, 4210 University Dr,ANCHORAGE, AK 99508 USA

In Lower Cook Inlet (LCI), Alaska, the Kittlitz’s murrelet (*Brachyramphus brevirostris*) co-exists with the similar and more abundant marbled murrelet (*B. marmoratus*). Detection of trends in abundance, using small boat surveys, has been confounded by the low proportion of birds identified to species in some historic surveys. In 1993, LCI was estimated to have 3,353 (CI=1635-5071) Kittlitz’s murrelets, but few *Brachyramphus* were identified to species in that survey. LCI surveys in 1996-1999 found lower densities for *Brachyramphus* murrelets, but data were insufficient to test for change in the Kittlitz’s population. Kachemak Bay, a large embayment of LCI, was surveyed in July 2005-2007 to obtain population estimates, which were 1,937 (SD ± 1075) Kittlitz’s and 10,595 (SD ± 964) marbled murrelets. In Kachemak Bay, we were also able to compare historic to recent survey data for June and August. In June, between 1993 and 2005-2006, densities of *Brachyramphus* did not show a significant decline, due to high densities in the north outer bay in 2006. However, in August, between the two decadal periods of 1988–1999 and 2004–2007, Kittlitz’s densities declined significantly by 43% (-18% per annum). In Kachemak Bay we recommend continued monitoring for Kittlitz’s murrelets in the south inner and north outer bay, with peak adult numbers attainable in mid-late July, and juvenile densities best obtained 6-24 August. Because murrelets move between Kachemak and LCI, a complete LCI survey should be conducted to gauge regional population trends, ideally incorporating the 1993 and 1999 transects.

**COMPARISON OF AT-SEA NUMBERS AND DISTRIBUTION OF XANTUS’S MURRELETS NEAR SANTA BARBARA ISLAND, CALIFORNIA, IN 1976 AND 2009**

*Augie Lagemann*1, *Darrell Whitworth*2, *Harry Carter*3, *Laurie Harvey*4, and *Nina Karnovsky*1;

1Pomona College, Department of Biology, 175 W. 6th St., Claremont, CA 91711 USA, ral02006@mymail.pomona.edu; 2California Institute of Environmental Studies, 3408 Whaler Ave., Davis, CA 95616 USA; 3Carter Biological Consulting, 1015 Hampshire Rd., Victoria, BC V8S4S8 Canada; 4Montrose Settlements Restoration Program, Channel Islands National Park, 1901 Spinnaker Dr., Ventura, CA 93001 USA

To assist in the assessment of population status and foraging conditions for an on-going restoration project, we examined at-sea numbers and distribution of Xantus’s murrelets (*Synthliboramphus hypoleucus*) at Santa Barbara Island, California and compared them to those found in 1976. Using the NOAA ship *R/V Shearwater*, we conducted seven radial transects within a portion of the foraging area near the island during the incubation period in 2009 and compared distribution and densities to similar radial transect data obtained in 1976. Xantus’s murrelet numbers were higher within the study area in 1976 than in 2009. This finding may reflect a reduction in Xantus’s murrelet population size at this colony or a shift in foraging distribution, with a greater proportion of birds foraging farther from the island in 2009. In 1976, Xantus’s murrelets may have foraged closer to the island when Northern Anchovies (*Engraulis mordax*) were abundant there. In both years, highest densities of murrelets were consistently found along the western side of the island, where colder waters occurred and prey resources
may be more abundant or more available. Other data being gathered to help assess current population status include nest monitoring, nest surveys, spotlight surveys, and at-sea captures.

CITIZEN SCIENCE CORMORANT MONITORING IN SONOMA AND MENDOCINO COUNTIES, CALIFORNIA – THE VALUE OF MULTIPLE LOCATION MONITORING

Ron LeValley*, Mad River Biologists, P.O. Box 332, Little River, CA, USA, ron@madriverbio.com

In 2007, The Sea Ranch Task Force, in cooperation with the Bureau of Land Management and the Madrone Audubon Society, began monitoring a nesting colony of approximately 100 nests of Brandt’s Cormorant (*Phalocrocorax penicillatus*) and other seabird species on Gualala Point Island in northern Sonoma County, California in response to a local fireworks display that adversely affected reproductive success the year before. In 2008 they expanded this effort to include aerial photographic monitoring of a second island with approximately 250 nests, Fish Rocks, in southern Mendocino County. In 2009 volunteers from Mendocino Audubon Society extended the monitoring to a third Brandt’s Cormorant Colony of about 400 nests off the Mendocino Headlands and two Pelagic Cormorant colonies, one on Point Cabrillo and one at the entrance to the Noyo Harbor each with about 20 nests. This basic monitoring, performed primarily by local volunteers and using high resolution photography, has revealed interesting annual variation in colony location and provided valuable data on reproductive success of these cormorants that aids in our understanding of ocean conditions as it relates to seabird nesting in Northern California. Reproductive success of these cormorants in 2009 was substantially better than in previous years at the Gualala Point and Fish Rocks colonies and was very high at the Mendocino colonies, in sharp contrast to nesting success at major colonies on the Farallon Islands and Alcatraz Island. This effort illustrates the value and cost effectiveness of citizen science efforts and photographic techniques for seabird monitoring.

RESTORATION OF SEABIRDS ON SAN NICOLAS ISLAND BY REMOVING FERAL CATS

Annie Little*, Grace Smith1, Brad Keitt1, and David Garcelon4, 1U.S. Fish and Wildlife Service, 6010 Hidden Valley Road, Carlsbad, CA 92011 USA, annie_little@fws.gov; 2U.S. Navy, NAWCWD Sustainability Office, Code 52F000ME, Bldg. 53A, Point Mugu, CA 93042 USA; 3Island Conservation, 100 Shaffer Road LML, Santa Cruz, CA 95060 USA; 4Institute for Wildlife Studies, P.O. Box 1104, Arcata, CA 95518 USA

Located off the coast of southern California, U.S. Navy-owned San Nicolas Island supports several threatened and endangered species and provides important nesting habitat for the western gull (*Larus occidentalis*) and Brandt’s cormorant (*Phalacrocorax penicillatus*). After five years of planning, the Montrose Settlements Restoration Program and U.S. Navy, in partnership with Island Conservation and the Institute for Wildlife Studies, initiated an intensive effort in 2009 to remove feral cats (*Felis silvestris catus*) from San Nicolas Island. The goal of this project is to restore seabird nesting habitat and protect native fauna by completely removing this non-native predator. As part of this comprehensive program, the U.S. Fish and Wildlife Service and U.S. Navy entered into a Memorandum of Agreement with The Humane Society of the United States (HSUS). From June to October 2009, over 50 feral cats were trapped, removed from the island, and transferred to the HSUS for permanent care at an enclosed facility in Ramona, CA. An extensive mitigation program was also put in place to offset any injuries to the endemic island fox related to the trapping effort. It is our goal to successfully complete the project in 2010.
Environmental conditions influence seabirds, their prey, and the trophic relationship between them. We examined the relationship between climate conditions, primarily the Pacific Decadal Oscillation (PDO), and Caspian tern (Hydroprogne caspia) consumption of juvenile salmonids (Oncorhynchus spp.), a prey species of conservation concern, in the Columbia River Estuary over the years 2000 – 2008. We found that negative winter/spring PDO conditions were associated with subsequently larger tern colony size, a greater proportion of salmonids and a lower proportion of anchovies (Engraulis mordax) and other marine fishes in the tern diet, and a greater overall consumption of salmonids by terns. Conversely, positive PDO conditions were associated with a smaller tern colony, less diet reliance on salmonids, and reduced salmonid consumption. We hypothesize that along the Pacific Coast, poor near-shore ocean conditions may reduce Caspian tern overwinter survival and/or breeding propensity, resulting in fewer breeders, and may also attract marine forage fish into estuaries earlier and in greater numbers where they provide a prey alternative to salmonids. An additional consequence of climate conditions, summer river flow, was also related to salmonid consumption by estuarine Caspian terns. In years with high flows, marine prey were less prevalent in tern diets, presumably because high flows prevented these fish from entering, or lingering, in the Columbia River estuary. In summary, climate conditions play an important role in modulating predation on particular prey types by piscivorous seabirds and understanding these trophic relationships may benefit management of seabirds and their prey moving into warmer climate conditions.

Kittelitz’s murrelet (Brachyramphus brevirostris) (KIMU) is adapted for life in glacial-marine ecosystems and about 68% of subarctic Alaska populations (~16,000 birds) are concentrated in the belt of glaciated fjords from Glacier Bay to the Kenai Peninsula. Most of the remaining 32%, however, are scattered in pockets along coastal waters of the NW Gulf of Alaska (14%) and Aleutian Islands (18%), usually in proximity to remnant glaciers or recently deglaciated landscapes. Approximately 2300 KIMU are concentrated in seven large embayments along the Alaska Peninsula where adjacent ice-fields feed silt-laden water into the bays. On adjacent Kodiak Island, where only small remnants of ice remain today, KIMU observations at sea are scarce and populations are small. However, birds have been observed around the entire archipelago and about 20 nest-sites have been found in recent years. In the Aleutians, KIMU are found in relative abundance only at a few islands, especially those with long, complex shorelines, high mountains, and remnant glaciers. The largest population (~1600 birds) of KIMU outside the Gulf of Alaska is found on Unalaska Island, which also supports the greatest concentration of glaciers in the Aleutians. Significant numbers are also found at Atka (~750), Adak (~300), and Attu (~300) islands. Smaller numbers have been reported from other islands, such as Unimak, Umnak, Amlia, Kanaga, Tanaga, Kiska, and Agattu (where dozens of nest-sites have been located in recent years). Trend data are extremely limited: a few land and water-based counts at Adak and Attu suggest little change in KIMU populations.
VARIABILITY IN ATTENDANCE DECISIONS BY A COLONIAL SEABIRD

Heather L. Major*1, Rachel T. Buxton2, and Ian L. Jones2, 1Centre for Wildlife Ecology, Department of Biological Sciences, Simon Fraser University, 8888 University Dr., Burnaby, BC V5A 1S6, Canada hmajor@sfu.ca; 2Department of Biology, Memorial University of Newfoundland, St. John’s, NL A1B 3X9, Canada

Decisions to attend and care for young made by breeding individuals are arguably a trade-off between survival and current reproductive success, where colony attendance and a successful breeding attempt increase overall lifetime fitness while death eliminates both current and future offspring. On the other hand, Prospecting individuals, make colony attendance decisions based on the trade-off between survival and overall lifetime reproductive success, where colony attendance may lead to a successful future-breeding attempt but death eliminates all chances of producing offspring. Thus, prospectors have more to lose than adults when attending colonies during risky environmental conditions and should be more risk averse than adults. Additionally, differences in physical habitat features between colonies may lead to different risk perception and changes in colony attendance during different environmental conditions. We evaluated whether colony attendance decisions change depending on life-history stage and local physical habitat attributes by comparing patterns of colony attendance in nocturnal burrow-nesting Ancient Murrelets (Synthliboramphus antiquus) between prospectors and adults and Haida Gwaii and the Aleutian Islands. Using an information theoretic approach we found that, prospectors attending colonies in Haida Gwaii decreased attendance with increased adjacent ocean wave height, and adults in the Aleutian Islands decreased attendance with decreased light intensity. Conversely colony attendance decisions by adults in Haida Gwaii and prospectors in the Aleutian Islands were not influenced by any of the factors tested.

INTERANNUAL VARIATION OF TOP PREDATORS AND PREY ABUNDANCE ON GEORGES BANKS (NORTHWEST ATLANTIC)

Marie C. Martin*1,2, Richard R. Veit2, and Michael J. Jech3, 1Graduate Center, 365 Fifth Avenue, NY City, USA, entre casteaux@hotmail.com; 2Department of Biology, College of Staten Island, City University of New York, 2800 Victory Boulevard, NY 10314 USA; 3NOAA National Marine Fisheries Service, Northeast Fisheries Science Center, Woods Hole, MA 02543, USA

We have been monitoring seabird and marine mammal abundance on George’s banks since 2006 during the hydroacoustic Atlantic Herring surveys (NOAA/ National Marine Fisheries Service). The surveys were conducted in September and October at the same period, aboard the Research Vessel NOAA Delaware II on Georges Banks and Gulf of Maine, Northeast of United States. I present here the interannual variability of both seabirds and marine mammals observed on the surveys from 2006 to 2009, and relate this variability to the abundance of Atlantic herring (Clupea harengus), which is a primary prey for most of these predators. I also explored whether increases of species over the past years may be related to increasing ocean temperatures or other oceanographic parameters. The Georges Banks ecosystem is influenced by hydrographic events such as Gulf Stream warm or cold core rings, which could explain for example, increase of Cory shearwater (Calonectris diomedea) in the northern waters. I have looked at the abundance fluctuation for seabird and mammal species from year to year. We can definitely see an interesting pattern for species composition changes. In a second time, we did overlay top predator with Atlantic herring abundance (Clupea harengus) to understand the relation between predators and prey during the spawning season of Atlantic herrings.
SCORPION ROCK SEABIRD HABITAT RESTORATION: NATIVE PLANT COMMUNITY RESTORATION TO ENHANCE NESTING HABITAT FOR CASSIN’S AUKLETS (PTYCHORAMPHUS ALEUTICUS)

David Mazurkiewicz*1, Josh Adams2, and A. Laurie Harvey1; 1Channel Islands National Park-Montrose Settlements Restoration Program, 1901 Spinnaker Drive, Ventura, CA 93001 USA, david_mazurkiewicz@nps.gov; 2U.S. Geological Survey and Moss Landing Marine Laboratories, 8272 Moss Landing Road, Moss Landing, CA 95039 USA

Introduced non-native plant species on California’s Channel Islands can greatly affect seabird nesting habitat quality. Scorpion Rock, located off the north-east end of Santa Cruz Island in the Channel Islands National Park, is an important seabird nesting location. The presence of invasive non-native plant species on Scorpion Rock has resulted in decreased abundance and quality of nesting habitat for burrow nesters such as Cassin’s Auklets (Ptychoramphus aleuticus) as well as other seabirds. The plant community structure prior to restoration efforts was comprised of approximately 90% exotic, annual species, primarily crystalline ice plant (Mesembryanthemum crystallinum), cheeseweed (Malva parviflora) and nettle-leaved goosefoot (Chenopodium murale). Removal of non-native, invasive vegetation and the restoration of a native perennial Coastal Sage Scrub community on Scorpion Rock is helping to provide better soil structure, nesting conditions, and cover for seabirds utilizing this location. The outplanting and maintenance of over 5,000 plants on Scorpion Rock from 2008 to present has resulted in the reestablishment of a native plant community. Examination and testing of control methods for the invasive species present on Scorpion Rock as well as the development of remote site restoration techniques has been helpful for other habitat restoration projects on the Channel Islands.

SPATIAL FACTORS AFFECTING REPRODUCTIVE SUCCESS OF COMMON MURRES AT A RESTORED COLONY IN CALIFORNIA

Gerard J. McChesney*1, Julie L. Yee2, William M. Perry3, Michael W. Parker1,4, Richard T. Golightly5, Harry R. Carter6, and Stephen W. Kress7, 1U.S. Fish and Wildlife Service, San Francisco Bay NWRC, 9500 Thornton Avenue, Newark, CA 94560 USA, gerry_mcchesney@fws.gov; 2U.S. Geological Survey, Western Ecological Research Center, 3020 State University Drive East, Sacramento, CA 95819 USA; 3U.S. Geological Survey, Western Ecological Research Center, 6924 Tremont Road, Dixon, CA 95620 USA; 41500 Libertado Court NW, Los Lunas, NM 87031 USA; 5Humboldt State University, Department of Wildlife, 1 Harpst Street, Arcata, CA 95521 USA; 6Carter Biological Consulting, 1015 Hampshire Road, Victoria, BC V8S 4S8 Canada; 7National Audubon Society, 159 Sapsucker Road, Ithaca, NY 14850 USA

We examined spatial factors affecting reproductive success of Common Murres (Uria aalge) at Devil's Slide Rock, California, in 2000-2005. This formerly extirpated colony was restored using social attraction techniques in 1996-2005. Spatial factors were examined both GIS and regression techniques. Variables examined included nearest murre breeding neighbors, murre density, nearest Brandt’s Cormorant (Phalacrocorax penicillatus) nests, social attraction equipment, rock walls, pelican disturbance zones, egg-lay date, and slope. Global Moran’s I spatial analyses showed significant spatial autocorrelation between murre nest sites for egg-lay date (all years), hatching success (3 years), fledging success (1 year), and breeding success (all years). Clustering of murre nests with similar egg-lay dates and high breeding success were found within the densest portion of the colony, which was also the first area of the rock to be recolonized in 1996. Logistic regressions found that variables affecting success differed between reproductive parameters; hatching and breeding success had more significant variables than fledging success. Regression trees provided comparison to logistic regressions and helped delineate the most important variables for each parameter. Significant variables included: 1) for hatching success, pelican
disturbance zone, murre density, distance to nearest murre breeding neighbors, and distance to nearest
cormorant nests; 2) for fledging success, distance to nearest cormorant nests and distance to nearest murre
breeding neighbors; and 3) for breeding success, egg-lay date x year, year, distance to nearest murre
breeding neighbors x year, and pelican disturbance zone. Results assist interpretation of the restoration
project’s success and have implications for other such projects.

RESTORATION OF ASHY STORM-PETRELS (OCEANODROMA HOMOCHROA) AT SANTA
CRUZ ISLAND, CALIFORNIA, IN 2006-09

William R. McIver*, A. Laurie Harvey, and Harry R. Carter. 1U.S. Fish and Wildlife Service, 1655
Heindon Road, Arcata, CA 95521 USA, bill_mciwer@fws.gov; 2Montrose Settlements Restoration
Program, Channel Islands National Park, 1901 Spinnaker Road, Ventura, CA 93001 USA; 3Carter
Biological Consulting, 1015 Hampshire Road, Victoria, BC V8S 4S8 Canada

Restoration of Ashy Storm-Petrels (Oceanodroma homochroa) at Santa Cruz Island, California, is being
conducted through the Montrose Settlements Restoration Program to address reduced nesting numbers
and reduced reproductive success from organochlorine pollutants, light pollution from squid boats,
enhanced predation by native island spotted skunks (Spilogale gracilis amphiala), and human
disturbance. Baseline monitoring began in 2006 but built upon earlier data gathered since 1995. In 2008,
26 artificial nest sites were deployed on Orizaba Rock: 1) to improve reproductive success by reducing
abandonment or high avian predation; and 2) to increase numbers of breeding birds at this small rock.
Cement/cinder roof tiles were placed atop a layer of fine pumice and sand to create inexpensive and
durable artificial nest sites. Vocalizations were broadcast at night from April-August in 2008-09. Eggs
were laid in 4 and 6 artificial sites in 2008 and 2009, respectively. Hatching success for artificial sites was
50% in 2008 and 67% in 2009, similar to natural sites. Many adults at Bat Cave were killed by skunks in
2005 but remaining birds have relatively high reproductive success. At Cavern Point Cove Caves, only 2
nests were found in 2009, about 10% of numbers prior to skunk predation in 2008. No skunks were noted
in 2009 and skunk traps were deployed. Skunk predation was not noted in 1995-2004 in sea caves.
Reproductive success at Cave of the Birds’ Eggs and Dry Sandy Beach Cave has remained relatively
high. Signs were deployed at sea caves to protect nesting areas.

INDIVIDUAL AND SEXUAL VARIATION IN THE BURROW CALLS OF THE JUAN
FERNANDEZ PETREL PTERODROMA EXTERNA

Matthew McKown*, 1Department of Ecology and Evolutionary Biology, University of California Santa
Cruz, 100 Shaffer Road, Santa Cruz, CA 95060 USA, mwmckown@ucsc.edu

Recognition of individuals is an important component of social interactions among animals.
Sexual and individual variation in vocal signals, and recognition based on this variation has been reported
in numerous seabirds. An ability to measure the call features that encode sexual and individual identity
could provide researchers with a low-cost, non-invasive method for censusing rare seabirds. To assess
sexual and individual variation in the calls of Juan Fernandez Petrels (Pterodroma externa), I measured
12 features of burrow vocalizations recorded from marked birds in a large colony on Isla Alejandro
Selkirk, Chile. Burrow calls were sexually dimorphic, as confirmed by molecular tests of sex. Six call
measures varied significantly among individuals (F9,10 >16.88, p<0.001), and all 12 measures contained a
total of 3.06 bits of individual information. Two multivariate classification techniques, linear
discriminant function analysis and probabilistic neural networks, correctly classified 77% and 71% of the
calls from 14 individuals, respectively. Both classification techniques made more errors when classifying
greater numbers of individuals and when fewer calls were used to train the classification functions. These
results indicate the difficulty of detecting and classifying “novel” individuals entering the population for whom there are no training calls in the data set. This suggests that it would be difficult to use vocal individuality as a reliable census tool for rare petrel species. Still, burrow vocalizations are an efficient, non-invasive method for determining burrow occupancy and a simple way to determine nest attendance patterns within breeding pairs.

SUMMARY OF 2007 CALIFORNIA LEAST TERN MORTALITY EVENT IN ALAMEDA POINT COLONY

Melissa Miller¹, Bradd Barr², Meredith Elliott³, Susan Euing⁴, David A. Jessup¹, Greg Massey⁵, Hannahrose M. Nevins¹,⁶ and Elizabeth M. Phillips¹,⁶, ¹Marine Wildlife Veterinary Care and Research Center, California Dept. of Fish and Game, 1451 Shaffer Road, Santa Cruz, CA 95060 USA, mmiller@ospr.dfg.ca.gov; ²California Animal Health and Food Safety Laboratory, School of Veterinary Medicine, University of California Davis, CA 95616 USA; ³PRBO Conservation Science, 3820 Cypress Drive #11, Petaluma, CA 94954 USA; ⁴US Fish and Wildlife Service, Alameda Point and Antioch Dunes NWR, P.O. Box 159, Alameda, CA 94501 USA; ⁵OWCN-UC Davis Wildlife Health Center, Davis, California 95616 USA; ⁶Moss Landing Marine Laboratories, California State Universities, Moss Landing, CA 95039 USA

We summarize an unusual mortality event affecting the California Least Tern colony at Alameda Point, San Francisco Bay, CA, USA. In July 2007, colony biologists reported increased numbers of debilitated and dead tern fledglings. Affected birds exhibited head rolling, loss of motor control, an inability to fly, and “star gazing” behavior. Fifteen dead fledglings were necropsied and four live birds were rehabilitated at the International Bird Rescue and Research Center in Cordelia, CA. Necropsied birds were emaciated and some had hemorrhages and other lesions in the heart and brain. Laboratory testing excluded botulism, domoic acid intoxication, or infection by West Nile virus or avian influenza as possible causes. Importantly, some live birds receiving oral Pedialyte® containing B complex vitamins demonstrated rapid clinical improvement, suggesting that nutritional deficiencies were an underlying cause of this event. Potential causes of nutritional deficiencies are diverse and include changes in prey type, quality, size and abundance and exposure to pollutants that can antagonize or inhibit nutrient function. While the Alameda Point colony has documented fluctuating annual mortality for chicks, fledglings, and adults, findings from this event suggest that nutritional deficiencies may be an important contributor to mortality in this population. If this population is borderline nutritionally deficient, then the most rapidly growing and highly stressed members (eg. fledglings) might manifest disease at higher frequencies than older age classes. If our hypothesis is confirmed, rapid response in the form of cheap, oral or injectable supplements could significantly reduce mortality of this endangered species during future events.

PINK-FOOTED SHEARWATERS (PUFFINUS CREATOPUS) OFF CANADA’S WEST COAST: SEASONAL DISTRIBUTION PATTERNS AND CHARACTERISTICS OF MARINE AREAS WHERE THEY HAVE BEEN OBSERVED

Ken Morgan¹, and Alicia Newbury², ¹Canadian Wildlife Service, Environment Canada, c/o Institute of Ocean Sciences, 9860 W. Saanich Road, Sidney, BC V8L 4B2 Canada, ken.morgan@dfo-mpo.gc.ca; ²Canadian Wildlife Service, Environment Canada, 5421 Robertson Road, RR #1, Delta, BC V4K 3N2 Canada

Pink-footed Shearwaters (Puffinus creatopus) are listed as Threatened in Canada under the Species At Risk Act. Although encountered as far north as the central Bering Sea, there are relatively few records of this Chilean-breeding species north of the British Columbia / Alaska border. As part of Canada’s Pink-
footed Shearwater recovery plan, we are conducting a retrospective analysis of observations of the species from 28 years of surveys (1982 through 2009). Here we characterize the distribution patterns in Early (May-July) and Late (August-October) Occupancy Periods (OPs); and describe some of the biophysical/oceanographic characteristics of the marine areas where the species was encountered. Throughout the entire OP, Pink-footed Shearwaters were found over or along the edge of the continental shelf; and less frequently, over deeper waters. During the Early OP, they were found almost exclusively in the southern portion of Canada’s Exclusive Economic Zone (i.e., south of 52°N). Although they were observed north of 52°N in the Late OP, they remained far more abundant in the southern portion. Pink-footed Shearwaters occurred in a relatively narrow zone based upon distance from shore and water depths, but over a wide range of near surface temperatures and salinities. Preliminary analysis suggests that during the Early OP Pink-footed Shearwaters occur more frequently in shallower areas with relatively cold and moderately saline waters. During the Late OP, there is the suggestion that they associate more with deeper, warmer and more saline waters.

RESPONSE OF NON-BREEDING SOOTY SHEARWATERS (PUFFINUS GRISEUS) TO SPATIAL AND TEMPORAL VARIABILITY IN WINDS WITHIN THE CALIFORNIA CURRENT SYSTEM

Melinda S. Nakagawa*, Josh Adams*, Erika E. McPhee-Shaw†, and James T. Harvey‡, 1Moss Landing Marine Laboratories, 8272 Moss Landing Road, Moss Landing, CA 95039 USA, mnakagawa@mlml.calstate.edu; 2U.S. Geological Survey, Western Ecological Research Center, Moss Landing Marine Laboratories, 8272 Moss Landing Road, Moss Landing, CA 95039 USA

Sooty Shearwaters (Puffinus griseus) are the most abundant avian predator in the California Current System (CCS); however, their movements during the upwelling (non-breeding) season have not been well studied. They often forage in huge flocks (>100,000) and consume massive amounts of forage fish, potentially impacting fish availability for other marine predators. We examined the at-sea movements of non-breeding shearwaters in the CCS during the upwelling season of 2008. We attached satellite transmitters to 28 birds in June–July 2008 in three previously documented high-use shearwater areas: Columbia River Plume (CR, n = 7), Monterey Bay, (MB, n = 12) and Santa Barbara Channel (SB, n = 9). Shearwaters displayed coordinated movements in response to changes in oceanographic conditions. Birds tagged in CR departed the CR region dispersing on July 5–6 (86% of CR birds), concurrent with a sudden change from downwelling favorable winds to upwelling favorable winds that persisted for ~2 weeks. The CR birds appeared to seek out other regions (e.g., known upwelling shadow regions) when upwelling favorable winds were present in CR, and did not return for the remainder of the season. By mid-July, most birds from all three sites aggregated in Morro and San Luis Bays and remained there through September. Forty percent of birds tagged in MB and 44% of birds tagged in SB made forays northward to CR and MB before leaving for the southern hemisphere. All tagged birds displayed a coordinated return migration, leaving southern California between September 29 and October 12.

COLLABORATION WITH LARGE WILDLIFE REHABILITATION GROUPS TO IDENTIFY MORBIDITY AND MORTALITY EVENTS

Heather E. Nevill, and Julie Skoglund*, International Bird Rescue Research Center, P.O. Box 2816, Fort MacArthur Station, San Pedro, CA 90731 USA, hnevill@ibrrc.org

Along the west coast of the United States, there is a strong network of wildlife rehabilitation organizations that responds to morbidity and mortality events in seabirds. Some of these organizations are
large and well organized, with detailed medical records and established husbandry and medical protocols. Routinely collected data for individual birds include species, sex and age (where possible), serial blood values (hematocrit, buffy coat, total serum protein), and serial body weights. Organizations may have dedicated necropsy facilities, carcass freezers, and ultra-low temperature freezers for biologic sample storage. Data generated at these facilities are underused in reporting and investigating epornitics, often because rehabilitation facilities lack the resources and expertise to bring data to publication. There is also frequently a delay in collecting diagnostic samples from live birds and carcasses, often because it is difficult for rehabilitation staff to find time in the midst of a crisis to identify interested researchers. To more quickly respond to morbidity and mortality events, our organization is interested in establishing relationships with more researchers interested in population dynamics, toxicology and infectious disease of marine birds.

DEMOGRAPHY OF MORTALITY FACTORS AFFECTING MARINE BIRDS IN CENTRAL CALIFORNIA, 2005 — 2009

Hannahrose M. Nevins*, Elizabeth M. Phillips¹, Corinne M. Gibble¹, James T. Harvey¹, Scott R. Benson¹, David A. Jessup², Melissa A. Miller², Amy Wells², Kelly M. Newton³, and Tanja S. Zabka⁴, ¹Moss Landing Marine Laboratories, 8272 Moss Landing Road, Moss Landing, CA 95039 USA, hnevins@mlml.calstate.edu; ²California Department of Fish and Game, Office of Spill Prevention and Response, Marine Wildlife Veterinary Care and Research Center, 1451 Shaffer Road, Santa Cruz, CA 95062 USA; ³Center for Ocean Health, UC Santa Cruz, CA 95062 USA; ⁴The Marine Mammal Center, Sausalito, CA USA

During 2005 — 2008, we quantified mortality of marine birds based on deposition rates from BeachCOMBERS beach survey program, intake records from the two rehabilitation centers (Monterey SPCA, IBRRC), and systematically necropsied fresh marine birds submitted by these programs, rehabilitation centers and wildlife agencies in Santa Cruz, Monterey and San Luis Obispo Counties in central California. We estimated monthly estimate relative abundance of focal species based on sea survey densities (2005-2007). Our main objective was to quantify mortality factors affecting marine birds in the area. Marine birds have been historically affected by both natural and human-related sources of mortality, particularly oil pollution. It has been suggested that infectious diseases are an overlooked or undocumented source of mortality for these species. In total we examined over 1200 birds representing 42 species and 13 families, including loons, grebes, tubenoses, sea ducks, and alcids. The majority of cases were attributed to environmental conditions affecting food supply (40-60%), infectious (10-30%), trauma (~10%), fishery interaction (5-10 %), oiling (5 -10 %), biotoxins (5-10 %), or plastic (1%). Interannual variability in mortality factors was greatly influenced by two stochastic die-off events, in 2005, 2007, and 2009. We compared demographic data for the most common species, Common Murres (Uria aalge) and Brandt’s Cormorants (Phalacrocorax penicillatus), among mortality events occurring in different seasons. Seasonal differences greatly influenced the proportion of age and sex ratios of birds affected. These demographic data suggest that the timing of future mortality events may greatly influence population-level impacts.

FISH PREY OF PYGOSCELIS PENGUINS IN THE ANTARCTIC PENINSULA REGION

Elizabeth Ng*, Amy Briggs¹, Wayne Z. Trivelpiece², and Nina J. Karnovsky¹, ¹Pomona College, Department of Biology, 175 W 6th St., Claremont, CA 91711 USA, elizabeth.ng@pomona.edu; ²Southwest Fisheries Science Center, Antarctic Ecosystem Research Division, 3333 North Torrey Pines Court, La Jolla, CA 92037-1022 USA
Decreasing sea ice extent in the Antarctic Peninsula region has been linked to marked reduction in stocks of the keystone krill species, *Euphausia superba*. Krill are major prey for a variety of predators, specifically *Pygoscelis* penguins and pelagic fish. Although *Pygoscelis* penguins—Chinstrap penguins (*P. antarcticus*), Gentoo penguins (*P. papua*), and Adélie penguins (*P. adeliae*)—consume primarily krill, fish can account for up to 16 percent of their diets by mass. The fish component of penguin diets may become increasingly important as krill populations decline in number and quality. Certain fish species may become less important dietary components as the fish themselves, particularly pelagic species, may be affected by altered krill and ice availability. Here, the fish component of the diets of Gentoo, Chinstrap, and Adélie penguins residing in two Antarctic study sites on the Antarctic Peninsula, South Shetland Islands, was characterized for the 2007 to 2009 breeding seasons. The species of fish prey items were determined from otoliths isolated from stomach samples. Chinstrap penguins primarily consumed the pelagic species, such as *Electrona antarctica* and *Notolepsis coartsii*. The diets of Adélie penguins were also dominated by pelagic and benthopelagic species, including *Pleuragramma antarcticum*, *Electrona antarctica*, and *Chaendodraco wilsoni*. The diets of Gentoo penguins exhibited the most variability, with both pelagic species (e.g. *Pleuragramma antarcticum*) and benthic species (e.g. *Trematomus newnesii*) represented. The benthic feeding habits of Gentoo penguins may contribute to recent increases in their numbers, while pelagic feeding Chinstrap and Adélie penguin populations are experiencing declines in the region.

**USING TOP PREDATORS AND HABITAT FEATURES TO IDENTIFY ‘HOTSPOTS’ IN THE CALIFORNIA CURRENT**

*Nadav Nur, Jaime Jahncke*, Julie Howar, Mark Herzog and John Wiens*, PRBO Conservation Science, 3820 Cypress Drive #11, Petaluma, CA, 94954, USA, jjahncke@prbo.org

The California Current System (CCS) is a highly productive eastern boundary current system extending from Vancouver Island, British Columbia, to Baja California. This ecosystem has suffered depletion of its fisheries and depressed productivity, creating an urgent need for management efforts to protect important foraging areas for fish and wildlife. However, critical foraging areas within the CCS have not yet been adequately identified. We modeled bird abundance based on habitat features determined by bathymetry and oceanography and developed statistical models to identify ‘hotspots’ throughout the CCS where no survey data existed. These ‘hotspots’ can be used to help develop a network of potential marine reserves. We used Bagged Decision Trees for analysis, controlling for spatial and temporal differences in the onset of upwelling, and basin scale oceanographic conditions. We modeled 19 bird species (5 of conservation concern) and 4 mammals, assessing a large geographic area with rich temporal variation (within year, between year). Models account for a large proportion of variability; validation results were generally strong. Bathymetric variables were most important in explaining location of ‘hotspots’ at this large scale. At finer spatial scales, oceanography probably plays a bigger role in helping define size and exact location of an MPA.

**WINTER MOVEMENTS OF BLACK-LEGGED KITTIWAKES FROM THREE COLONIES IN THE BERING SEA**

*Rachael A. Orben*∗, Rosana Paredes‡, Daniel D. Roby‡, David, B. Irons‡, Richard Phillips‡, and Scott A. Shaffer‡; ∗Department of Ocean Sciences, Long Marine Lab, University of California Santa Cruz, CA 95060 USA, rorben@ucsc.edu; ‡Department of Fisheries and Wildlife, 104 Nash Hall Oregon State University Corvallis, OR 97331-3803 USA; †U.S. Fish and Wildlife Service, 1011 East Tudor Road, MS 341, Anchorage, AK 99503 USA; ‡British Antarctic Survey, High Cross, Madingley Road, Cambridge CB3 0ET UK; †Department of Biological Sciences, San Jose State University, One Washington Square,
Seabirds are central place foragers during reproduction, but are otherwise free from this constraint. Although there is much interest in using seabirds as indicators of change in marine ecosystems, most of this effort has focused on breeding birds, while little is known about seabird distribution, behavior, and habitat use during the non-breeding season. Here we present winter movements of Black-legged Kittiwakes (Rissa tridactyla) from three breeding colonies in the Bering Sea: St. Paul and St. George, in the Pribilof Islands, and Bogoslof Island, 350 km to the south. Seventy-four geolocation loggers were deployed on chick-rearing kitiwakes in 2008 and 36 were retrieved in 2009. Birds from all three colonies overwintered throughout much of the North Pacific, outside the Bering Sea. Individuals left the Bering Sea in October and returned in March. Kittiwakes exhibited four broad patterns of winter distribution: 67% of birds had pelagic distributions in the central North Pacific, 14% traveled to waters off Japan, 12% remained semi-coastal and followed the Aleutian Islands west to Russian waters, and two birds from St. Paul Island traveled to oceanic regions in the eastern North Pacific. In contrast to foraging distribution during breeding, there was no obvious link between breeding colony of origin and winter distribution. The long-held assumption of similar effects of winter stress on survival of seabirds from a particular colony is not supported by the unexpectedly wide over-wintering distribution of individuals from each of these three seabird colonies.


Rosana Paredes*, Ann Harding†, David. B. Irons‡, Daniel D. Roby§, Rachael Orben¶, Vernon Byrd†, Heather Renner†, Kathy Kuletz‡ and Robert Suryan*. 1Department of Fisheries and Wildlife, 104 Nash Hall, Oregon State University, Corvallis, Oregon 97331-3803 USA, u92rp@mun.ca; 2Alaska Pacific University, Environmental Science Department, 4101 University Drive, Anchorage, AK 99508; 3U.S. Fish and Wildlife Service, 1011 East Tudor Road, MS 341, Anchorage, AK 99503 USA; 4Ocean Sciences Department, University of California Santa Cruz, Long Marine Lab, 100 Shaffer Road, Santa Cruz, CA 95060 USA. 5Alaska Maritime National Wildlife Refuge, U.S. Fish and Wildlife Service, 95 Sterling Highway, Suite 1, Homer, AK 99603 USA. 6 Hatfield Marine Science Center, Oregon State University 2030 S.E. Marine Science Dr. Newport, Oregon 97365 USA

Warming of the southeastern Bering Sea shelf and spatial and temporal changes in sea-ice coverage over the last decade may have profound influences on the Bering Sea ecosystem. The goal of this study was to investigate the foraging behaviour of seabirds nesting at three Bering Sea colonies and use these data to detect and interpret future changes in the marine environment. In 2009, we used state-of-the-art GPS loggers in combination with activity loggers and time-depth recorders to track and identify feeding areas of Black-legged Kittiwakes (Rissa tridactyla; n=54) and Thick-billed Murres (Uria lomvia; n=48) nesting in two continental shelf colonies (St. Paul and St. George Island) and one oceanic colony (Bogoslof Island). Tracks from all three islands were not random with respect to direction; instead, birds selected specific regions for foraging. Interestingly, there was virtually no overlap in foraging tracks among seabirds nesting on the three islands, despite being within foraging range of each other. Distances to foraging areas were greater for shelf colonies (St. George > St. Paul) than for the oceanic colony (Bogoslof). Kittiwakes had significantly lower breeding success in shelf colonies than the oceanic colony, but no differences were found for murres. In summary, a clear division of foraging areas was found among colonies in a relatively poor food year for piscivorous seabirds in the Bering Sea. Intra-specific competition and differences in foraging capacity (surface-forager vs. diving-forager) for accessing key prey (pollock, myctophids, sandlance, euphausiids) may explain these results.
The Western Gull-billed Tern (Gelochelidon nilotica vanrossemi) was first documented in coastal California in 1985 and nesting in South San Diego Bay confirmed in 1987. Implementation of increased monitoring and management of the colony has resulted in an increase from 11 minimum estimated pairs with 29 nests in 1999 to 57 minimum pairs with 78 nests in 2009, as well as increased fledgling production. The species had remained focused around San Diego Bay with rare sightings in Orange and Los Angeles Counties, and the northernmost record in Santa Barbara County in 1990. However, sightings in Orange and Los Angeles Counties have increased in recent years and in 2009 there were records from the San Francisco Bay area. Depredation of chicks of the federally endangered California Least Tern (Sternula antillarum browni) by Gull-billed Terns had been reported by 1992 in San Diego County. Over the past four years, documented predation by Gull-billed Terns has more than doubled each year. In 2009, predation was confirmed in Orange County, and over 10 percent of Least Tern chicks hatched at San Diego Bay colonies were documented to have been taken by Gull-billed Terns.
NATIONAL PARK, ALASKA

John Piatt*, Mayumi Arimitsu², Gary Drew³, Erica Madison¹, and James Bodkin¹; ¹U.S. Geological Survey, 4210 University Dr., Anchorage, AK 99508 USA, jpiatt@usgs.gov; ²U.S. Geological Survey, 3100 National Park Rd, Juneau, AK 99801 USA

About 3000 Kittlitz’s murrelet (Brachyramphus brevirostris) (KIMU), or about 15% of the Alaska population, reside in Glacier Bay National Park during summer along with some tens of thousands of marbled murrelets (B. marmoratus) (MAMU). Boat-based surveys of all marine birds and mammals conducted irregularly in Glacier Bay between 1991 and 2008 suggest that populations of both KIMU and MAMU declined quickly by more than 65-75% during the 1990s. The decline of KIMU may have stopped in the early 2000s, whereas MAMU may still be declining at a slower rate. Sampling design and counting protocols varied among years and investigators. This complicates interpretation of trends and introduces systematic changes in bird census data that are unrelated to bird population changes. However, densities of other common taxa (e.g., seaducks, terns, gulls, guillemots, etc.) observed on Glacier Bay surveys remained similar or increased through the 1990s and 2000s, except for harbor seal (Phoca vitulina), which also declined markedly in the 1990s. This suggests that despite changes in sampling design and protocol, at-sea surveys provide a robust estimate of marine bird populations in Glacier Bay, and we must look elsewhere for an explanation of apparent declines in Brachyramphus murrelets. Widespread rapid declines of murrelets, harbor seals and Steller sea lions (Eumetopias jubatus) in Alaska during the 1980s-1990s, followed by stability in the 2000s, suggest large-scale influences, perhaps related to climate-induced cycles in food supply.

THICK-BILLED MURRES AS INDICATORS OF CHANGING CLIMATIC CONDITIONS

Jennifer Provencher*, Anthony J. Gaston², and Patrick O’Hara³, ¹University of Victoria, Department of Biology, PO Box 3020, Station CSC, Victoria, BC, V8W 3N5, Canada, jennipro@uvic.ca; ² Science and Technology Branch, National Wildlife Research Centre, Raven Road, Carleton University, Ottawa, ON, K1A 0H3, Canada; ³ Canadian Wildlife Service, Box 6000 9860 W Saanich Rd. Sidney, BC, V8L 4B2, Canada

Climate change has a wide range of effects with the potential to cause broad changes in marine ecosystems. The Arctic is predicted to be one of the most highly impacted areas, with average temperatures increasing by as much as 3-5°C. As temperatures rise, Arctic sea ice is disappearing earlier each year, leading to changes in the ocean environment. Thick-billed murres (Uria lomvia) were collected at colonies in the Eastern Canadian Arctic to examine changes that may have taken place in Arctic marine food webs over the past three decades. The birds are used as samplers of the marine environment, and as integrators of the environmental changes that are occurring. Zooplankton and otoliths are being examined in murre stomachs, and the results compared to data collected from the same colonies in the 1970s and 1980s.

PREY DISTRIBUTION OF CHICK PROVISIONING ATLANTIC PUFFINS (FRATERCULA ARCTICA): A SEASONAL AND INTER-ANNUAL COMPARISON

Megan E. Rector*, Carolyn J. Walsh, and Anne E. Storey, Cognitive & Behavioural Ecology, Memorial University of Newfoundland, St. John’s, NL, A1B 3X7, Canada, meg.rector@gmail.com

We examined changes in the proportions of different prey species fed to Atlantic Puffin (Fratercula arctica) chicks over the nestling period on Gull Island, Witless Bay Ecological Reserve, Newfoundland.
The late arrival and low abundance of spawning capelin (*Mallotus villosus*) during the 2009 breeding season is reflected in a short peak in the proportion of capelin delivered to puffin nestlings during the middle chick rearing period, followed by an increase in the proportion of Sandlance (*Ammodytes dubius*) in puffin chick diet. Capelin has historically been described as the preferred prey of chick provisioning Atlantic Puffins in the Northwest Atlantic and has been shown to comprise up to 95% of chick diet. In 2009, capelin comprised only 18% of observed chick feeds. Over the past decade, changes in capelin distribution, later timing of spawning, and decreased capelin size have been observed. We compared the proportion of Capelin, Sandlance, and various species of larval fish and invertebrates in chick diet in years of higher (2001-2002) and lower (2009) capelin availability. Upon quantifying the odds of observing various fish species during chick feeding we found significant changes in prey distribution between these years. These results highlight the decreasing proportion of capelin and increasing importance of other fish species in puffin chick diets.

**THE USE OF DIGITAL IMAGERY TO IMPROVE TRAINING, ACCURACY, AND EFFICIENCY IN SEABIRD DIET ANALYSIS**

Lauren H. Reinalda*1, Jeannette E. Zamon2, and Elizabeth M. Phillips3. 1Pacific States Marine Fisheries Commission, Pt. Adams Research Station, Hammond, OR, USA. lauren.reinalda@noaa.gov; 2Pt. Adams Research Station, NOAA-Fisheries, Hammond, OR, USA. 3Cooperative Institute for Marine Resources Studies, Pt. Adams Research Station, Hammond, OR, USA

Seabird diet analysis frequently requires identification of bones and other hard parts to classify prey remains. Learning bone identification can be time consuming and overwhelming if one has no prior experience. The use of published keys and guides is helpful; however these resources are frequently limited to the identification of otoliths and large head bones. The use of a disecting microscope with an attached digital camera allows observers to manipulate magnification and lighting to highlight bone features which are otherwise difficult or impossible to see directly through an objective. As a result, in addition to any otoliths or head bones that are present, smaller, non-standard diagnostic bones can now be used to provide a more complete picture of diet composition. Digital imaging also speeds up training and quality control by allowing multiple observers to view the same image and observers can compare bones from multiple samples without physically mixing the specimens. Digital images also facilitate sharing of specimens with others who are not on site. Results show the combined use of digital imaging and non-standard diagnostic bones improves the accuracy of diet analysis (e.g. prey type, minimum prey number), especially for diet samples obtained with non-lethal methods such as regurgitation or lavage. Compilation of a digital image database for common prey types may be a useful research tool for seabird biologists.

**COUNTING THE COUNTLESS II: ESTIMATING AUKLET ABUNDANCE ON ST. GEORGE ISLAND**

Heather M. Renner*1, and Martin Renner2. 1Alaska Maritime National Wildlife Refuge, 95 Sterling Highway, Suite 1, Homer, AK 99603 USA, heather_renner@fws.gov; 2School of Fisheries and Aquatic Sciences, University of Washington, 1122 Boat St NE, Seattle, Washington 98105 USA

Least Auklets (*Aethia pusilla*) are among the most abundant seabirds in North Pacific, breeding in huge colonies in the Bering Sea, Sea of Okhotsk, and Aleutian Islands. However, estimates of abundance anywhere are rare and highly variable, sometimes differing by an order of magnitude. Auklets nest underground in rock crevices, making them difficult to count. During the breeding season, adults are present on land during daily activity periods when they socialize above their nesting crevices. In 2008, snow persisted unusually late on the St. George Island colony, until a time when typically birds would be
beginning to lay eggs. Auklets continued to attend the colony, socializing atop the snow, where the dark birds were clearly visible against the background -- providing a unique opportunity for a photo-based count of birds. Thirty overlapping photos were digitally stitched together, and dots were placed atop each bird by three counters. Individual dots were digitally counted using ImageJ, providing a count of 91,780. The photo count is likely an underestimate of birds attending the colony that day, because some portions of the colony were snow free and auklets were very hard to see in those places. Also the real number of birds in the photo is less than the true number of birds using the colony, because certainly not all birds were photographed. However, this minimum estimate may be relatively close to true number of birds using the colony. We compare the count to a previously-presented population estimate based on colony mapping, attendance counts and spatial interpolation.

RESTORING CENTRAL CALIFORNIA SEABIRD COLONIES BY LINKING MARINE PROTECTED AREAS TO MANAGEMENT, MONITORING AND OUTREACH EFFORTS

Karen Reyna*, Sage Tezak1, Mai Maheigan1, Gerard J. McChesney2, and Jennifer Boyce3, 1Gulf of the Farallones National Marine Sanctuary, 991 Marine Dr., The Presidio, San Francisco, CA 94129 USA, Sage.Tezak@noaa.gov; 2United States Fish and Wildlife Service, San Francisco Bay National Wildlife Refuge Complex, 9500 Thornton Ave., Newark, CA 94560 USA; 3NOAA Restoration Center, 501 W. Ocean Blvd., Suite 4470, Long Beach, CA 90802 USA

In central California, seabird restoration efforts have been underway at certain sites for many years (Parker et al. 2007, McChesney et al. 2009). Mortality in gill nets and oil spills, as well as avian and human disturbance at breeding colonies, are main factors that have impeded recovery of some colonies (Carter et al. 2001, Rojek et al. 2007, McChesney et al. 2009). Human disturbance continues to occur and impact seabird colonies in many coastal areas (Carter et al. 1998, McChesney et al. 2009). Three main types of human disturbance to breeding seabirds in California include: close approaching boats, low-flying aircraft and people accessing near-shore colonies from the land. The Seabird Protection Network (Network) addresses human disturbances near critical breeding and roosting seabird colonies along the central California coast. These efforts are accomplished through an organized outreach program combined with law enforcement and other seabird management actions. The Network has been instrumental in establishing a network of marine protected areas (MPAs) in central California, which include no-access zones near key seabird colonies. These zones protect the water surrounding breeding colonies and are designed to prevent negative human interactions with wildlife. Coupling MPAs with effective outreach, enforcement and monitoring aids in the protection of marine wildlife. The effectiveness of each MPA is measured using six benchmarks to assess performance. Addressing human impacts on a local, regional and state level will benefit the health of seabird populations and other marine wildlife. The Network framework can be easily applied to other regions.

ADAPTIVE MANAGEMENT FOR CONTROL OF RIVER OTTER (LONTRA CANADENSIS) AT A SMALL LEAST TERN NESTING COLONY IN THE SAN FRANCISCO ESTUARY

Dana K. Riggs*, and Jason Yakich, WRA, Inc. 2169-G. East Francisco Boulevard, San Rafael, CA 94901 USA, riggs@wra-ca.com

A downward trend was observed in the population of a small California least tern (Sternula antillarum browni) nesting colony located on 0.5-acre of gravel spit in the upper San Francisco Estuary beginning in 2002. This decline prompted re-evaluation of predator management priorities to determine the reason for the decline. Predation by terrestrial mammals had been identified as the primary factor in poor least tern reproductive success from 2002 to 2005 at the site. In March 2007, we conducted aggressive vegetation
removal on the site to reduce predator cover. By May, several large unidentified mammal scat piles were observed in the immediate vicinity of six abandoned least tern nests. In March 2008, fencing at the landward end of the spit was extended four feet into the surrounding waterway to better exclude terrestrial mammals. However, nest abandonment was observed again in May along with new unidentified mammal scat piles. We examined the scat from this area and found a high composition of shell material. Combined with incidental observations of river otter (*Lontra canadensis*) utilizing the site, we hypothesize that this species may be a primary reason for the recent decline due to competing use of the site and/or predation of eggs. In 2009, a fence was installed to exclude otters from the nesting area. Further monitoring will determine if the new exclusion fence will be effective in excluding otters in the future.

**NOAA FISHERIES’ NATIONAL SEABIRD PROGRAM—WHAT HAS IT BEEN UP TO? AND WHERE IS IT GOING?**

*Kim S Rivera*, *Nicole LeBoeuf*, *Samantha Brooke*, 1NOAA Fisheries, National Seabird Coordinator, Alaska Region, PO Box 21668, Juneau, AK 99802 USA, *Kim.Rivera@noaa.gov*; 2NOAA Fisheries, Office of International Affairs, 1315 East-West Highway, Room 12659, Silver Spring, MD 20910 USA; and 3NOAA Fisheries, Office of Science and Technology, Assessment and Monitoring Division, 1315 East-West Highway, Room 12659, Silver Spring, MD 20910 USA

Seabirds are important indicators of marine ecosystem health and are of increasing interest and study by NOAA scientists and managers. Seabird abundance and distribution can inform scientists about oceanic conditions, prey abundance, climate change, and contaminants. Therefore, as NMFS (National Marine Fisheries Service) continues to address seabird bycatch in NMFS-managed fisheries, it is also concerned about the long-term ecosystem effects of seabird bycatch both domestically and in fisheries conducted in many areas of the world’s oceans. Whereas the primary trust responsibilities for seabirds rests with the U.S. Fish & Wildlife Service (USFWS), NMFS plays a significant role in seabird conservation and, particularly in the long-term health of species which are vulnerable to fishery impacts. Through direct observation and fisheries management actions, NMFS exercises its responsibility to protect seabirds through various statutory authorities and agency policies. With this in mind, in September 2009, the NMFS National Seabird Program held a workshop in Seattle, Washington to kickoff the development of a seabird implementation plan for action at both the national and regional levels. The intent of the Plan is to: 1) describe and provide insights regarding NMFS seabird activities and important partnerships with other management entities including the USFWS, 2) guide future NMFS management and science activities, and 3) provide input to the NMFS long-term planning and budget process. At the workshop, representatives from NMFS regions, science centers, and headquarters offices came together with invited seabird experts from around the nation to discuss NMFS’s existing work on seabirds and discuss the ways forward.

**DIET, ADULT COLONY ATTENDANCE, AND REPRODUCTIVE SUCCESS AT A LEAST TERN COLONY IN CENTRAL CALIFORNIA**

*Dan P. Robinette*, PRBO Conservation Science, Vandenberg Field Station, 205 North H Street Suite 217, Lompoc, CA 93436 USA, *drobinette@prbo.org*

The California Least Tern (*Sternula antillarum browni*) is a small colonial seabird with a limited foraging range during the breeding season. When threatened by a potential predator, adults within the colony respond by taking flight and cooperatively chasing off the predator. We tested the hypothesis that adult colony attendance and reproductive success are affected by local prey availability. We collected data on diet, colony attendance, and reproductive performance at the Purisima Point colony in central
California from 2001-2009. Diet was dominated by northern anchovies (*Engraulis mordax*), juvenile rockfish (*Sebastes spp.*), and Pacific saury (*Cololabis saira*), with the contribution of each species varying among years. Reproductive performance was highest during years when diet was dominated by anchovies and/or rockfish and lowest in years dominated by saury. Mean annual adult colony attendance was positively correlated with the occurrence of anchovy and rockfish in the diet and negatively correlated with the occurrence of saury. Anchovy and rockfish are abundant in nearshore waters while saury occur further offshore. Our results suggest that terns breeding at the Purisima Point colony are forced to forage farther offshore during years of poor nearshore anchovy and rockfish availability. Offshore foraging bouts are energetically taxing to adults and reduce provisioning rates to chicks. This likely contributes to the low reproductive success observed in years when saury dominate the diet. Additionally, low adult colony attendance during poor anchovy/rockfish years likely leaves the colony vulnerable to avian predators that should be successfully chased off during years of high colony attendance.

**CONSERVATION OF *AECHMOPHORUS* GREBES: MIGRATORY SEASONAL SEABIRD RESTORATION INLAND THROUGH LACUSTRINE-WETALND HABITAT ASSESSMENT, HABITAT PROTECTION, AND LIMITATION OF DISTURBANCES**

Kristofer M. Robison*1,3, Renee E. Weems1,3, Daniel W. Anderson2,3, and Franklin Gress3, 1Department of Wildlife, Fish, and Conservation Biology, University of California, Davis, One Shields Ave, Davis, CA 95616 USA,  kmrobison@ucdavis.edu; 2Professor Emeritus, University of California, Davis, One Shields Ave, Davis, CA 95616 USA; 3California Institute for Environmental Studies, 3408 Whaler Ave, Davis, CA 95616 USA

*Aechmophorus* grebes (Western and Clark’s Grebes, *Aechmophorus occidentalis*, and *A. clarkii*, respectively, hereafter referred to as ‘grebes’) are migratory, “seasonal seabirds” with ecological connectivity that integrates the marine environment with inland lacustrine (reservoir- and lake-wetland) systems. Their basic ecology is continually being studied and important conservation needs have been identified in both systems. Grebes are regularly impacted by oil in the marine environment, but few restoration possibilities exist to conserve them in marine ecosystems; other than oil spill cleanups and rehabilitation of individuals. Effective population conservation is more feasible for grebes at their inland breeding sites where associated conservation activities have now been practiced on a small scale since 2004. We have studied multiple forms of disturbance at these inland lakes, any of which, if lessened, could enhance grebe nesting success and ultimately increase grebe populations. In California, drought is a frequent form of disturbance which is difficult to mitigate, especially when combined with water management activities. We recognize that active conservation and restoration, whether through habitat acquisition, protection, manipulation or restoration, along with elimination of disturbances (as well as extensive outreach) cost time and money. Yet, these traditional wildlife management techniques are some of the most beneficial options for comprehensive grebe conservation. Oil spill mitigation has led to a more encompassing conservation effort: but effective inland conservation efforts will be largely ineffective if grebes continue to be lost through oil spills and other large mortality events in the marine environment.

**CORMORANT CONNECTIVITY: POST-BREEDING DISPERSAL OF DOUBLE-CRESTED CORMORANTS FROM A LARGE COLONY AT THE MOUTH OF THE COLUMBIA RIVER**

Daniel D. Roby1, Karen N. Courtot1, Jessica Y. Adkins1, Donald E. Lyons1, Timothy Marcella1, Stefanie Collar1, Lauren Reinalda2, D. Tommy King3, and R. Scott Larsen4. 1USGS-Oregon Cooperative Fish and Wildlife Research Unit, Department of Fisheries and Wildlife, Oregon State University, Corvallis, OR
Using satellite-telemetry, we investigated post-breeding movements and dispersal of Double-crested Cormorants (*Phalacrocorax auritus*) nesting on East Sand Island, Oregon to over-wintering areas. Most post-breeding cormorants moved to the north along the Washington coast to over-winter in Puget Sound, Strait of Juan de Fuca, Strait of Georgia, and San Juan Islands. A minority moved to the south and over-wintered in the San Francisco Bay region or Salton Sea. Most post-breeding cormorants roosted at active or historical breeding colonies, although some were tracked to coastal and inland sites along rivers that have not been identified as breeding colonies. These tracking data demonstrate direct connectivity between the Double-crested Cormorant colony at East Sand Island, which has experienced tremendous growth over the last two decades, and colonies to the north (several coastal Washington and Puget Sound colonies) and to the south (several San Francisco Bay colonies, Mullet Island in Salton Sea) that have experienced declines over the same time period. Our results support the hypothesis that some cormorants nesting on East Sand Island originated from declining breeding colonies, especially colonies in coastal Washington. Tracking results, however, suggest relatively little connectivity between the East Sand Island colony and colonies south of San Francisco or east of the Cascades. Roosting sites utilized by tagged cormorants may help identify potential locations and/or suitable habitats for future colony enhancement to encourage nesting by double-crested cormorants, if redistribution of a portion of the East Sand Island colony to alternative colony sites is deemed necessary by management agencies.

THE INFLUENCE OF VEGETATION GROWTH, DUNE HABITAT, AND ENCLOSURE FENCING ON NEST SITE SELECTION AND PRODUCTIVITY OF LEAST TERNs

*Thomas P. Ryan*¹ and *Stacey M. Vigallon*², ¹Ryan Ecological Consulting, 135 N. Meridith Ave, Pasadena, CA 91106 USA tryanbio@gmail.com; ²Los Angeles Audubon Los Angeles Audubon, 7377 Santa Monica Blvd, West Hollywood, CA 90046 USA

This study was conducted response to questions surrounding vegetation and dune management plans that called for mechanical plant and dune removal prior to the nesting season at the Venice Beach Least Tern Colony, Marina del Rey, California. In prior years, biologists noted California Least Terns (*Sternula antillarum browni*) nesting in the dunes among vegetation and questioned this plan. We found the Least Terns that nest here prefer areas with 5 and 40 percent vegetation cover, with a height of 5 to 10 cm tall. Terns nested in higher densities in areas where manual vegetation removal occurred prior to the nesting season. Terns nested in higher densities within the dunes that formed within the previous enclosure area. The Terns had a strong tendency to place their nests more than 40 m from the nearest fence, and more than 60 m from the east fence. Avian predators, including the American crow, tend to stage their foraging on the colony from the buildings approximately 50 m east the enclosure fence. We created a site-specific management plan that recommends preserving and creating dunes, select vegetation management in the dunes, and manual vegetation removal from vegetated flat.

PREDATION AND EGG INCUBATION AT A MARBLED MURRELET NEST IN NORTHERN CALIFORNIA

*Stephanie R. Schneider*, and *Richard T. Golightly*, Department of Wildlife, Humboldt State University, 1 Harpst St., Arcata, CA 95521 USA, srs42@humboldt.edu
Detailed observations of Marbled Murrelet (Brachyramphus marmoratus) nests are difficult due to tree height and behavior. A single Marbled Murrelet nest was continuously monitored with a video camera for 9 consecutive breeding seasons (2001-2009). During 2009, no egg was laid but on 1 occasion a banded murrelet landed at the nest-site. In 2008, a nest was initiated and failed. Prior to 2008, the nest was successful 2 times, failed 3 times, and nesting was not detected in 2 years. Incubatory exchange, co-attendance, egg neglect, and additional incubatory behaviors were quantified for this nest using video collected during 2008. In 2008, the egg survived for 29 – 31 days before being killed by a Steller’s Jay. An egg was laid at the same exact nest-site for 5 consecutive breeding seasons, and nesting occurred on the same branch for 6 of 9 seasons. Banded in 2001, the female murrelet of the pair is known to be at least 10 – 12 years old. Every 24 hours, one member of the breeding pair relieved the other from incubatory duties. On average, the timing of this exchange was characterized by arrival of one bird at 41min 53sec ± 1min 06sec (x¯ ± SE; n=25) and departure of the other bird at 41 min 43 sec ± 56sec (n=23) following sunrise. Less than 3 min of co-attendance and 4 cases of egg neglect were observed over 29 days of observation. Egg-turning rates and alert incubation postures were also described.

THE BEST OF TIMES AND THE WORST OF TIMES: THE ROLE OF EXTRINSIC AND INTRINSIC FACTORS IN SHAPING COMMON MURRE (URIA AALGE) CHICK DIET

Michael B. Schrimpf*, and Julia K. Parrish, School of Aquatic and Fishery Sciences, 1122 NE Boat Street, Box 355020, Seattle WA 98105, USA, schrimpf@u.washington.edu

During the breeding season, the prey returned by foraging seabird adults to their chicks is potentially constrained by both extrinsic (e.g. bottom-up physical forcing) and intrinsic (e.g. chick age) factors. This study compares the relative influence of these two sets of factors in shaping the diet of Common Murre (Uria aalge) chicks on Tatoosh Island, Washington, USA (48° 23.5’ N x 124° 44.2’ W). Direct observations of adults feeding prey to chicks from 1996 to 2009 show that certain years can differ markedly in the proportion of certain major prey species delivered, total diet diversity, and energy return rate, resulting in both “good” and “bad” years from a chick’s perspective. Ocean conditions at various temporal and spatial scales are analyzed to explain these differences in years. Within single seasons, older chicks generally receive more large, energy rich prey than younger chicks, but this relationship breaks down in some years. These patterns point to a possible trade-off between extrinsic and intrinsic factors, such that murres cater their foraging to the needs of the chick, but only when ocean conditions allow for it.

UNCHARTED WATERS: THE FIRST FLIGHTS OF FLEDGLING HAWAIIAN ALBATROSSES

Scott A. Shaffer1,2*, Yann Tremblay1, Michelle A. Kappes3, Elizabeth N. Flint3, John Klavitter4, Barry Christenson6, and Daniel P. Costa1; 1 Dept of Ecology and Evolutionary Biology, University of California, Santa Cruz, CA 95060 USA; 2 Dept of Biological Sciences, San Jose State University, San Jose, CA 95192 USA, scott.shaffer@sjtu.edu; 3 USFWS, NWHI National Wildlife Refuge Complex, Honolulu, HI 96850 USA; 4 USFWS, Midway Atoll National Wildlife Refuge, HI USA

When albatross fledglings depart from their nests, they venture to sea with no prior experience and no parental guidance. Thus, it is unclear how fledglings know where to find food, what to eat, or even how to go about catching food - a phenomenon true of many marine vertebrate species. We documented the first flights of 22 fledging black-footed (Phoebastria nigripes) and 2 Laysan (P. immutabilis) albatrosses tracked from Midway Atoll, Northwest Hawaiian Islands in 2006, 2007, and 2008. Using 20-35 gram duty-cycled transmitters attached to feathers on the birds' back, we tracked birds for 8 to 126 days, post departure. The duration of tracking was quite variable but more than half the birds were tracked for
durations greater than two months. The initial direction of dispersion ranged from Northwest to Northeast, and was likely facilitated by prevailing winds. On average, fledglings traveled 160 km/day, which is considerably slower than adults tracked using the same technology. The average maximum distance (i.e. dispersal) from the Atoll was 1,990 km and fledglings traveled an average of 9,995 km (max 13,807 km) before transmitters stop reporting albatross locations. The distribution at sea was similar to adults tracked over the same time period. The information obtained was highly valuable because the initial dispersion behavior, trajectories, and travel rates were previously unknown and indicated a consistent east-west pattern similar to adults despite the inexperience of the fledglings.

WHEN ALBATROSSES IGNORE SCIENTIFIC LITERATURE: PROBLEMS USING PLUMAGE CLASS AND BURSA SIZE TO AGE BIRDS KILLED IN LONGLINE FISHERIES

Jo Smith*, Ken Morgan2 and Ann Edwards3. 1Birdsmith Ecological Research, 185-911 Yates St, Victoria BC V8V 4Y9 Canada (current address: The Nature Conservancy, 1917 1st Ave, Seattle, WA 98101), joanna_smith@tnc.org; 2Canadian Wildlife Service, Box 6000, Sidney BC V8L 4B2 Canada; 3University of Washington, Box 355020, Seattle, WA 98195 USA

The main purpose of this study was to begin characterising the age and sex of black-footed albatrosses (Phoebastria nigripes) accidentally killed by demersal longline fisheries in Canada. Thirteen albatross carcasses were salvaged from commercial halibut (Hippoglossus stenolepis) and sablefish (Anoplopoma fimbria) fisheries operating in British Columbia waters between May-August 2002 and May-October 2003. The sex ratio was equal between male and female (7:6) and all birds were in excellent body condition prior to death (up to 10 mm of fat under skin). Only three albatross had a visible bursa, each thin-walled and less than 225 mm². Moult patterns of flight feathers P6-P10 suggested that all birds were immature (<3 years) yet one bird matched adult plumage characteristics published in literature; the majority of birds were moulting body feathers. Secondary to age and sex, we recorded stomach contents and found that all but one stomach contained plastic, squid beaks or commercial bait, but that plastic ingestion was relatively minor (0-12 small fragments/individual). Recovering fisheries bycatch carcasses is important for characterising mortality so that demographic parameters can be estimated for this long-lived species. We found that the lack of a clear relationship between bursa and plumage class created difficulties in assigning ages to black-footed albatrosses, an important factor in determining the affect of fisheries mortality using population projection models.

NEGOTIATION STRATEGIES OF BREEDING COMMON MURRES

Linda S. Takahashi*,1, Anne E. Storey2, and Carolyn J. Walsh2, 1Cognitive and Behavioural Ecology Program, Memorial University of Newfoundland, St. John’s, NL A1B 3X9 Canada, linda.takahashi@mun.ca; 2Department of Psychology, Memorial University of Newfoundland, St. John’s, NL A1B 3X9, Canada

We studied patterns of colony co-attendance, the time the pair spends together, in Common Murres Uria aalge in Witless Bay, Newfoundland. Traditionally, co-attendance time is described as involved in pair bonding and social loafing. However, this time may also be used for negotiating parental duties within the pair. We investigated individual differences in behaviours during co-attendance time. Normally, the returning bird brings a fish and exchanges chick brooding with its partner, who then departs. Sometimes a partner does not return with a fish, or, if it does, the mate continues to brood and the returning bird leaves again. We propose that such sequences reflect within-pair conflict. When returning birds did not bring fish, co-attendance time was greater than when fish was brought in. Also, latency to exchange brooding duties was longer for visits without fish compared to visits with fish. When no fish is
brought in, the returning bird initiates allopreening more often than the brooder. These actions suggest that there is a conflict of interest between the mates, such that the brooding bird may be attempting to monopolize this less effortful parental duty. As a consequence, allopreening and other activities not associated with brooding and feeding may be a way in which the birds communicate to each other about their condition and negotiate self-interest conflicts within the pair.

WHY ARE RHINOCEROS AUKLETS (*CERORHINCA MONOCERATA*) NOCTURNAL ON THE SOUTHERN KURIL ISLANDS?

Maria Ushakova, Severtsov Institute of Ecology and Evolution, Russian Academy of Science, Moscow, Russia, ushakovam@gmail.com

The rhinoceros auklet is strictly nocturnal on the Southern Kurils. These auks can be both diurnal and nocturnal. There is no common opinion on nocturnality causes. We observed rhinoceros auklet breeding patterns and behavior in 2002-2005. Kleptoparasitism and predation avoidance theories were tested. Diurnal auks never suffered from predation here. However, the first arrivals of the rhinoceros auklet colony occurred only after all activity of other species of diurnal birds stopped. The Theuri Island colony had more than 40% of rhinoceros auklets suffer from kleptoparasitism, but despite that arrived long before the darkness. That is why kleptoparasitism can not be the reason for nocturnal behavior. Due to the abundance of predators present, it seemed to make sense for the birds to hide in the darkness. However, why are other species of auklets nesting there diurnal? We found that rhinoceros auklet (in contrast to other auks here) show high social activity during the entire night. Every specimen spent 4-6 hours outside their burrows every night. Fifteen-day old nestlings approached burrow entrances and may go outside. In such circumstances both adult birds and their nestlings would be easy prey for predators should their activities be diurnal. High surface social activity in both adults and nestlings is possible only in the darkness when they are out of reach of predators. So it is precisely their high social activity that explains the nocturnal way of life in their colonies, otherwise successful breeding of this very social species could not occur on the Kurils.

RETROSPECTIVE ANALYSIS OF TROPHIC LEVEL IN A TROPICAL SEABIRD COMMUNITY OF THE EASTERN PACIFIC WARM POOL

L. Ignacio Vilchis*1,2,* and Lisa T. Ballance1,2, 1Scripps Institution of Oceanography, 9500 Gilman Dr, La Jolla, CA 92093-0227, USA, lvilchis@ucsd.edu; 2National Marine Fisheries Service, Southwest Fisheries Science Center, 8604 La Jolla Shores Drive, La Jolla, CA 92037-1508 USA

Understanding mechanisms driving past population changes can help us interpret contemporary population trends. Therefore, gauging ecological effects of climate is of paramount importance to ecologists. With the goal of gauging effects of the Pacific Ocean’s 1976-77 regime shift to a tropical and pelagic community of seabirds, we retrospectively analyzed historical specimens for stable carbon (δ¹³C) and nitrogen (δ¹⁵N) isotopes in a suite of ecologically and phylogenetically diverse group of seabirds from the eastern Pacific warm pool. We found significant declines in feather δ¹³C (~1‰ over the 46 years), while feather δ¹⁵N did not change with time. The changes in feather δ¹³C were guild specific, with species dependent on subsurface predators decreasing while species that fed independently from subsurface predators did not. Without a concurrent change in δ¹⁵N a prey-switching scenario is unlikely. Instead, our results suggest a decrease in average phytoplankton growth rates over time. We hypothesize that phytoplankton growth rates declined with a drop in productivity in the eastern Pacific warm pool caused by a more stratified water column and reduced vertical mixing.
YOLK FATTY ACIDS AS A PROXY FOR ESTIMATING DIETS OF FEMALE SPECTACLED EIDERS

Shiway W. Wang¹,*; Tuula E. Hollmén²,³; and Sara J. Iverson⁴; ¹Sedna Ecological, Inc., PO Box 74280, Fairbanks, AK 99707 USA, sedna.ecological@gmail.com; ²Alaska SeaLife Center, 301 Railway Avenue, PO Box 1329, Seward, AK 99664 USA; ³School of Fisheries and Ocean Sciences, University of Alaska Fairbanks, PO Box 757220, Fairbanks, AK 99775 USA; ⁴Department of Biology, Dalhousie University, 1355 Oxford Street, Halifax, NS B3H 4J1 Canada

Fatty acid (FA) signature analysis has been used to study foraging ecology and food webs in marine ecosystems. This powerful method provides information about diets over an extended time period (e.g., 2-4 weeks), rather than just the most recent meal as with most traditional approaches. We conducted feeding experiments to validate the use of egg yolk FAs as a proxy to infer diets of captive female spectacled eiders (Somateria fischeri). In 2008, birds (n = 5) were fed a diet of 85% Mazuri and 15% silverside for 210 days. In 2009, birds (n = 5) were fed a diet of 85% Mazuri and 15% supplements of clam, krill, mussel, and silverside for 346 days. Egg yolk samples were collected from fertile and infertile eggs. From a long-term feeding period, we assessed the quantitative characteristics of FA deposition from diet to egg yolk and developed calibration coefficients (CCs) for individual FAs. We found that yolk CCs differed from those for adipose tissue from the same species. Additionally, there were no differences in yolk FA signatures between infertile and fertile eggs. Using quantitative FA signature analysis, we were able to estimate diets of captive female spectacled eiders from egg yolk. We conclude that the use of infertile eggs can provide a less invasive method than collection of adipose tissues to infer diets of breeding female eiders in the wild.

TRACING DIET IN EIDERS USING STABLE ISOTOPES OF INDIVIDUAL FATTY ACIDS

Shiway W. Wang¹,*; Suzanne M. Budge²; Tuula E. Hollmén³,5; and Matthew J. Wooller⁴,5; ¹Sedna Ecological, Inc., PO Box 74280, Fairbanks, AK 99707 USA, sedna.ecological@gmail.com; ²Department of Process Engineering and Applied Science, Dalhousie University, PO Box 1000, Halifax, NS B3J 2X4 Canada; ³Alaska SeaLife Center, 301 Railway Avenue, PO Box 1329, Seward, AK 99664 USA; ⁴Alaska Stable Isotope Facility, Water and Environmental Research Center, University of Alaska Fairbanks, Fairbanks, AK 99775 USA; ⁵School of Fisheries and Ocean Sciences, University of Alaska Fairbanks, Fairbanks, AK 99775 USA

Recently, carbon stable isotopes of individual fatty acids (FA) have been used to trace these biomarkers in consumers. This novel approach to food web studies combines two established methods of stable isotope analysis and FA analysis. FA sources with distinct stable isotope ratios can be used as a general measure of relative contribution of those sources. We are conducting feeding experiments to validate the use of FA specific stable carbon isotopes in blood serum and adipose tissue as dietary tracers in captive spectacled (Somateria fischeri) and Steller’s eiders (Polysticta stelleri). Our objectives are to 1) determine the extent of molecular fractionation that dietary FAs experience during fat deposition and mobilization, 2) create a mixing model incorporating information from molecular fractionation in eiders, and isotopic ratios of specific FAs in typical dietary end-members, and 3) test this model on samples preserved from a previous study. On Day 0, adult male spectacled (n = 8) and Steller’s eiders (n = 8) started on a diet of 83% Mazuri sea duck formula, 4% clam, 4% krill, 6% mussel, and 3% silverside. Blood samples were collected from all eiders at 2, 4, and 6 months, and adipose tissue samples were collected at 6 months after the start of the feeding trial. In the future, we aim to use the information from this study to gain a better understanding of habitat use and diets of wild populations.
EFFECTS OF OIL SPILLS ON SHOREBIRDS: A REVIEW

Nils Warnock, Oiled Wildlife Care Network, Wildlife Health Center, One Shields Ave, University of California, Davis CA 95616 USA, ndwarnock@ucdavis.edu

Post-release studies of rehabilitated oiled wildlife are still relatively rare. Even rarer are studies looking at the effects of oil spills on shorebirds, despite the fact that shorebirds can be impacted during spills. For instance, during the 2007 Cosco Busan spill in San Francisco Bay, a site of Hemispheric importance to shorebirds, at least 20 different species of shorebirds were observed with oil on parts of their body, including the endangered Snowy Plover. Combining all shorebird species, the percent of shorebirds that were scanned and seen in San Francisco Bay with visible oil on them ranged from 4-14 %. There are very few studies that have looked at the effects of oil on shorebirds and even fewer that have been able to relate survival of shorebirds to degree of oiling. This presentation will summarize data on the effects of oil on shorebirds and suggest areas of future study.

DIET OF BRANDT’S CORMORANTS (PHALACROCORAX PENICILLATUS) DURING THE NON-BREEDING SEASON IN THE MONTEREY BAY AREA

Lisa A. Webb* and James T. Harvey, Moss Landing Marine Laboratories, 8272 Moss Landing Road, Moss Landing, CA 95039 USA, lwertz@mlml.calstate.edu

Brandt’s Cormorants (Phalacrocorax penicillatus) are abundant, year-round residents in central California, yet only two non-breeding season diet studies have been conducted in Monterey Bay, both with small sample sizes (Baltz and Morejohn 1977, n=6; Talent 1984, n=11). These studies found up to seven species of fishes and one cephalopod in the non-breeding season diet; however, only three species of fishes were common to both studies. This may indicate diet plasticity in Brandt’s Cormorants or may be an artifact of brief and isolated sample collections. In the present study, regurgitated pellets were collected once or twice per month from September through March at two or three roosting locations (2006-07: Año Nuevo Island and Moss Landing Jetty and 2007-08: Año Nuevo Island, Moss Landing Jetty, and Monterey Jetty). Pellets (n=180) were sieved and prey remains were identified to the lowest taxonomic level possible. Preliminary results indicate prey diversity is two to three times greater than previously reported; however, on average only two prey items were in each sample indicating short-term specialization. Northern anchovy (Engraulis mordax) was the most frequently consumed prey occurring in 64.3% of the samples and comprising up to 93.2% of the diet by number. Other species that occurred in greater than 5.0% of the samples include speckled sanddab (Citharichthys stigmaeus), Sebastes sp., Pacific sanddab (Citharichthys sordidus), sculpin sp., and salmonids. Prey diversity was variable within and among sampling dates, but in general was least at Año Nuevo Island, intermediate at Moss Landing Jetty, and greatest at Monterey Jetty.

GARBAGE MAKES MORE GLAUCOUS GULLS

Emily L. Weiser*¹, and Abby N. Powell², ¹Department of Biology and Wildlife, University of Alaska Fairbanks, PO Box 756100, Fairbanks, AK 99775 USA, emily.l.weiser@gmail.com; ²U.S. Geological Survey, Alaska Cooperative Fish and Wildlife Research Unit, PO Box 757020, Fairbanks, AK 99775 USA
Glaucous Gulls are abundant predators in northern Alaska and may benefit from garbage as a supplemental food source, but this benefit has never been quantified. In 2008 and 2009, we studied Glaucous Gull diet and reproduction at eight to ten breeding colonies in northern Alaska. Among colonies, garbage occurred in zero to 85% of pellets and food remains, and average fledging success ranged between zero and 2.9 chicks per pair. Random forest analysis indicated that garbage occurrence in diet samples produced during the chick-rearing was the most important of 22 variables considered in explaining variance in fledging rate. In both 2008 and 2009, there was a significant positive linear correlation between garbage occurrence during the chick-rearing period and fledging rate \((r^2 = 0.87, p < 0.001; \text{ and } r^2 = 0.77, p < 0.001, \text{ respectively})\). This demonstrates that Glaucous Gull reproductive output is enhanced by the garbage available in some developed areas. If more garbage becomes available as a result of further development, gull populations may increase. This could negatively affect the gulls’ natural prey species, including birds of conservation concern.

**USING STABLE ISOTOPE ANALYSIS TO EVALUATE BIASES IN CONVENTIONAL DIET SAMPLES**

*Emily L. Weiser*1, and *Abby N. Powell*2, 1Department of Biology and Wildlife, University of Alaska Fairbanks, PO Box 756100, Fairbanks, AK 99775 USA, emily.l.weiser@gmail.com; 2U.S. Geological Survey, Alaska Cooperative Fish and Wildlife Research Unit, PO Box 757020, Fairbanks, AK 99775 USA

Conventional diet samples such as pellets are often easily collected, but their utility is limited due to biases resulting from varying prey digestibility. Stable isotope ratios of tissues are unbiased representations of an organism’s diet and can be used to infer dietary contributions of potential prey. We collected and analyzed pellets and food remains from the chick-rearing period at six Glaucous Gull colonies in northern Alaska; we also collected gull chick feathers and analyzed them for stable carbon and nitrogen isotope ratios. We used these feather isotope ratios, prey isotope signatures from previous studies, and diet-feather isotopic discrimination values from the literature in a Bayesian isotope mixing model (MixSIR). Conventional estimates of prey contributions to diet at each colony did not fall within the modeled 99% confidence interval in 8% of cases, with contributions of birds, garbage, and rodents overestimated in some pellets and food remains. Conventional samples thus provided a reasonably accurate representation of gull diet in this system. Pellets and food remains also provided more specific information than isotope analysis about the bird species and age classes present in gull diets. This information is necessary for assessing the role of gulls as predators of species of conservation concern.

**SEABIRDS OF THE WESTERN TROPICAL INDIAN OCEAN: DISTRIBUTION, RELATIVE ABUNDANCE, AND COMPARISONS WITH THE SEABIRD COMMUNITY OF THE EASTERN TROPICAL PACIFIC**

*Tara S. Whitty*1, *Lisa T. Ballance*2, *Jessica V. Redfern*2, *Robert L. Pitman*2, and *Mike Force*2, 1Scripps Institution of Oceanography, 9500 Gilman Dr. Mail Code 0208, La Jolla, CA 92093-0208 USA, tara.whitty@gmail.com; 2Southwest Fisheries Science Center, 333 North Torrey Pines Court, La Jolla, CA 92037 USA

Seabird survey data from the oceanic western tropical Indian Ocean (WTIO) were collected from the NOAA research vessel M. BALDRIDGE during 91 days at sea, March - July 1995, using standard 300m strip-transect methods. 4012 sightings were recorded of 54 species; 538 flocks were observed, of which 140 were multispecies flocks. Sooty Tern (*Sterna fuscata*) was the most abundant species (8319 individuals). The four next most abundant species were Procellariids: Audubon’s Shearwater (*Puffinus
Iherminieri; 2506 individuals), Persian Shearwater (P. persicus; 1712 individuals), Flesh-footed Shearwater (P. carneipes; 1672 individuals), and Wilson’s Storm Petrel (Oceanites oceanicus; 1079). The boobies, tropicbirds, and frigatebirds were less abundant; the most abundant among them were Masked Booby (Sula dactylatra; 246 individuals), Red-footed Booby (S. sula; 51 individuals), and Red-billed Tropicbird (Phaethon aethereus; 60 individuals). This species composition contrasts with the eastern tropical Pacific (ETP), where Procellariids are the most abundant group and sulids are far more diverse and abundant. Seabird density also differs between the two tropical systems; overall and species-specific density was far lower in the WTIO than the ETP. Relative to the ETP, the WTIO is characterized by lower surface productivity and low abundance of surface-schooling tuna. Because tropical seabirds rely heavily on tuna to make prey available at the surface, this factor alone may largely account for the difference in diversity and density between the two ecosystems. Other factors underlying the relatively low seabird density in the WTIO may include the small number of islands (many sustaining heavy human impact) in the region.

PARTIAL RECOVERY OF THE XANTUS’S MURRELET AFTER RAT ERADICATION AT ANACAPA ISLAND, CALIFORNIA

Darrell Whitworth*, Harry Carter1,2, Josh Koepke1, Laurie Harvey3, and Frank Gress1, 1California Institute of Environmental Studies, 3408 Whaler Ave, Davis, CA 95616 USA, darrell_whitworth@arezzoweb.it; 2Carter Biological Consulting, 1015 Hampshire Rd., Victoria, BC V8S4S8 Canada; 3Montrose Settlements Restoration Program, Channel Islands National Park, 1901 Spinnaker Dr., Ventura, CA 93001 USA

Xantus’s Murrelet (Synthliboramphus hypoleucus) nest monitoring was conducted at Anacapa Island, California from 2000-09 to assess murrelet hatching success and population trends prior to and after the eradication of Black Rats (Rattus rattus) in 2002. Murrelet hatching success has nearly doubled from 44% pre-eradication (2000-02) to 87% post-eradication (2003-09), with rat depredation on eggs eliminated as the main cause of nest failure. Improved hatching success likely has contributed strongly to population growth in sea caves, where the number of clutches laid has increased nearly three-fold from 11 clutches pre-eradication to 30 clutches post-eradication. Murrelets also have begun to nest in shoreline areas outside sea caves, where 22 nest sites were documented in 2003-09 in areas where none were known prior to 2002. However, extensive surveys in October 2009 found no evidence of colony expansion into apparently suitable breeding habitats on the upper portions of Anacapa Island, suggesting: a) more time is needed for the population to grow and expand into these habitats; b) continued aversion to these areas may be occurring due to persistent evidence of former occupation by rats; or c) the upper island may not be preferred breeding habitat. Complete population recovery may take several more decades and require further enhancement of murrelet breeding habitats to encourage expansion into upper island habitats to attain highest population levels. Continued annual monitoring is desirable to further document colony recovery and better assess murrelet population trends at Anacapa Island.

ASHES TO ASHES: DESTRUCTION AND SUBSEQUENT RESPONSE OF A SEABIRD COLONY AFTER THE VOLCANIC ERUPTION OF KASATOCIHI ISLAND

Jeffrey C. Williams*, Brie A. Drummond, and G. Vernon Byrd, Alaska Maritime National Wildlife Refuge, US Fish and Wildlife Service, 95 Sterling Highway Ste 1, Homer, AK 99603 USA, Jeff_Williams@fws.gov

Kasatochi Island, located in the central Aleutian Islands, was one of nine annual monitoring sites in the Alaska Maritime National Wildlife Refuge and supported a rich community of seabirds, including
hundreds of thousands of auklets, storm-petrels, and gulls. The island erupted on 7 August 2008, burying the entire surface under meters of ash and pyroclastic flow material. We made four brief visits to Kasatochi during the summer of 2009 to document response of wildlife one year later. Early in the season, large numbers of seabirds returned to Kasatochi and nearshore distributions of seabirds appeared similar to pre-eruption patterns. However, loss of nesting habitat prevented successful breeding. Auklets were observed copulating on the water and socializing on the surface as usual, but without nesting crevices, birds appeared disoriented, landing and socializing in areas far from the original colony and laying eggs futilely in the water or on the flat surface of the ash. Glaucous-winged gulls appeared to flourish initially from the auklets' confusion, nesting along beaches and preying heavily on auklet adults and eggs, but by August all nests had been abandoned or destroyed by the rapidly-eroding coastline. Song meters recorded the nocturnal presence of storm-petrels, whiskered auklets, and ancient murrelets throughout the season but we found no evidence of breeding attempts. There was no sign of shorebirds or terrestrial passerines that had existed on the island prior to the eruption. Recovery of the seabird colony at Kasatochi will likely depend on the speed of surface erosion to re-expose nesting habitat.

SPATIAL AND TEMPORAL VARIATION OF KITTLITZ'S AND MARBLED MURRELETS IN GLACIER BAY: IMPLICATIONS FOR SURVEY DESIGN

Sadie K. Wright¹, Matthew Kirchhoff², John Lindell³, John Hodges ⁴, and Melanie Smith²; ¹Alaska Department of Fish and Game, 1255 W. 8th Street, Juneau, AK 99801 USA, sadie.wright@alaska.gov; ²Audubon Alaska, 441 West 5th Avenue, Suite 300, Anchorage, AK 99501 USA; ³P.O. Box 501, Bayfield, WI 54814 USA; ⁴318 Coleman Street, Juneau, AK 99801 USA

We replicated at-sea surveys for Brachyramphus murrelets originally established by the U.S. Fish and Wildlife Service in 1993 in Glacier Bay, Alaska. The 1993 survey was conducted 23-24 June. In 2009 one vessel and crew replicated the survey twice (3-6 July, and 7-10 July), and a second vessel and crew conducted the survey once (3-9 July). We observed substantial variation in both the density and distribution of murrelets among the 4 surveys. In 2009 there was a significant difference in the 2 population estimates from back-to-back surveys conducted by the same vessel and crew under similar weather conditions. Variability in density and distribution may be due to tidal stage and flow, food availability, time of day, and weather. There is also evidence of significant emigration from, and immigration to, Glacier Bay by large numbers of murrelets. Multiple annual surveys are recommended for this area in order to obtain a stable, reliable estimate of the annual summer populations of Kittlitz’s and marbled murrelets. Additional surveys utilizing uniform methodology will strengthen our understanding of murrelet trends in Glacier Bay. Until a better monitoring plan is installed, the 1993 survey methodology provides an easily repeatable means for monitoring of murrelets in Glacier Bay.

INTERANNUAL DIFFERENCES IN THE BIMODAL FORAGING STRATEGY OF THE LITTLE AUK (ALLE ALLE)

Derek Young*, Julia Gleichman, and Nina J. Karnovsky. Department of Biology, Pomona College, 175 W 6th St., Claremont, CA 91711 USA, djy02005@mymail.pomona.edu

The west coast of Spitsbergen is currently undergoing large scale changes as a result of climate change. Little auks are planktivorous seabirds that respond to variations in oceanographic conditions. We studied the foraging behavior of little auks breeding at Hornsund Fjord, Spitsbergen in 2007 and 2008. We used activity loggers to characterize differences in their foraging behavior between years. Little auks used a bimodal foraging strategy, whereby they alternated trips of short duration with trips of significantly longer duration. They showed differential responses in their short and long foraging trips to altered
foraging conditions between years. Long-trips were longer in the second year of the study; birds spent more time diving and resting. The times allocated toward these two activities both increased, which suggests that time spent resting on the ocean surface may be necessary to recuperate from time spent diving. The duration of short-trips did not change between years, but the proportion of short-trip time allocated to resting increased in 2008 while that allocated to diving decreased. In the case of short-trips, some of the time spent resting on the sea surface may represent unallocated “free” time when conditions are good.

RESOURCE PARTITIONING BY SYMPATRIC BOOBIES IN THE CENTRAL PACIFIC OCEAN

*Hillary S. Young*, Scott Shaffer, Douglas J. McCauley, Dave Foley, Rodolfo Dirzo, and Barbara Block

Sympatric species with similar ecological requirements and differences in body size would be expected to need to partition resources to coexist. For sexually dimorphic species, we expect resource partitioning by gender as well as by species identity. However it is difficult to document species and sexual resource partitioning in marine ecosystems, given the intractability of these systems and the vagility of many marine animals. Here, we examine the foraging behavior and prey selection of two congeneric and coexisting seabird species, masked (*Sula dactylatra*) and red-footed boobies (*Sula sula*) on Palmyra Atoll. These seabirds exhibit substantial size dimorphism between species and between sexes within species. Pronounced interspecific differences in foraging patterns were observed with high resolution GPS tracking, with the smaller red-footed boobies conducting longer foraging trips (in both time and distance). Red-footed boobies also had more frequent landings on the sea surface, slower mean and max travel speeds, and more westerly trip azimuths. The electronic tagging was complimented with diet and stable isotope analyses that indicated distinctions in prey selection. Masked boobies foraged on prey with a less pelagic δ¹³C signature compared to red-footed boobies. No gender differences were identified in any foraging parameters. The mechanisms for maintenance of these pronounced differences in niche partitioning across species is not explicitly examined, but is more consistent with a physiological, rather than a competitive source.

SEABIRD ATTRACTION TO FISHING TRAWLERS RELATIVE TO DISCARD TYPE

*Stephani G. Zador*, and *Shannon M. Fitzgerald*

The potential for spatial and temporal overlap of seabirds and the groundfish trawl fishery in Alaska waters is influenced in part by the attractiveness of the vessels to the birds. Seabirds are attracted to vessels as a source of food via the fishery discards. The composition of discharged material from Alaska groundfish trawl vessels varies from whole discarded fish to heads, offal macerated to 1 cm chunks, and watery slurry containing little fish matter, depending on the processing capabilities on board. Understanding the relative attractiveness of the discharged material is important for assigning relative risk
of interaction among trawl vessels. We conducted a study to measure the relative attractiveness of discard type to seabirds. This study relied on volunteer efforts from fisheries observers to count the numbers of seabirds feeding within discharge plumes alongside trawl vessels. Observers recorded the numbers of birds, discharge type, and concurrent vessel activity. The study was designed to perform on multiple platforms with multiple observers and require little time or specific bird knowledge. The results suggest that the season during which observations were made and the discard type had the greatest influence on the number of birds feeding in plumes. Thus, migratory patterns or breeding phenology may also be important factors in determining how many seabirds are feeding in discharge plumes, and therefore in the vicinity of trawl gear and exposed to the risk of mortality.

**REDUCING MORBIDITY AND MORTALITY OF OIL-AFFECTED SEABIRDS - ADVANCES IN OILED WILDLIFE REHABILITATION PROTOCOLS AND TECHNIQUES**

*Michael Ziccardi* and *J. Gregory Massey*, Oiled Wildlife Care Network, Wildlife Health Center, University of California, Davis, CA 95616 USA

Large-scale impacts of oil spills to wildlife (primarily bird species) have been reported in the past century, causing widespread morbidity and mortality in affected animals at an individual level and, arguably, at population levels in certain circumstances. More recently, large-scale wildlife responses worldwide have been mounted by professional animal care organizations, leading to opportunities to provide input into developing improvements in the knowledge and understanding of the effects of oil on wildlife, as well as methods to better care for affected animals. Research to date has focused on a number of different fronts, primarily focused at understanding the effects of oil on wildlife at a physiological level, but has been limited thus far on the development of better rehabilitation methods to care for oil-affected wildlife. Therefore, the purpose of this presentation is to review these advances in rehabilitation techniques of oiled birds to better identify knowledge gaps for directing future research, with particular emphasis on biomedical concerns (such as general health diagnostics, general therapeutics, and animal-human-health issues), husbandry techniques (such as captivity stress, nutrition, and housing), and cleaning (such as techniques, water requirements, products, and methods).