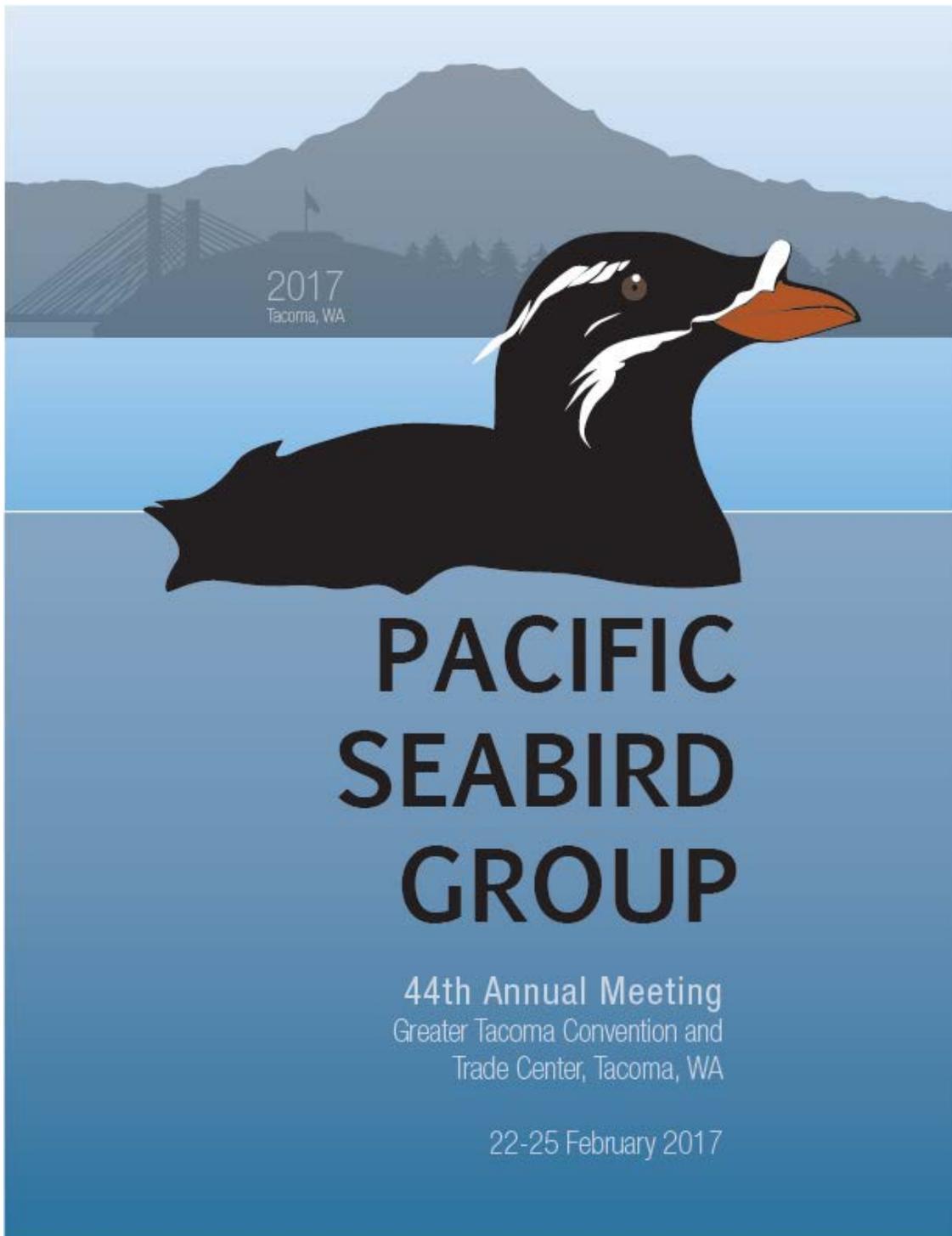


# ABSTRACTS



Compiled by N. Karnovsky and D. Bachman

## Comparative flight altitudes of Hawaiian albatrosses

Rachael Orben<sup>1</sup> Scott Shaffer<sup>2</sup> Robert Suryan<sup>1</sup>

<sup>1</sup>Oregon State University, Hatfield Marine Science Center.

<sup>2</sup>San Jose State University, One Washington Square, San Jose, CA 95192-0100.

Off-shore wind energy development is under consideration for coastal waters of the United States, including the California Current and the main Hawaiian Islands, that are within the foraging range of North Pacific albatrosses (*Phoebastria* spp.). Therefore, a detailed understanding of albatross flight altitude is needed to develop wind turbine collision risk models. To study albatross flight behavior, including flight altitude, we simultaneously attached GPS data loggers and integrated three-axis accelerometers (25 Hz) and altimeter data loggers to the backs of Black-footed (*P. nigripes*) and Laysan (*P. immutabilis*) albatrosses (<3% of body mass). Chick-brooding black-footed albatrosses (n = 11) and Laysan albatrosses (n = 12) were tracked from their breeding colony on Midway Atoll NWR in January 2016 (~50 bird-days of data). Black-footed albatrosses predominately foraged to the south of Midway, while Laysan albatrosses predominately foraged to the north. Flight altitudes were calculated by first identifying on-water events and subsequent flight bouts, then using the altimeter data to determine relative changes in ambient air pressure (range: 971-1022 mbar) for calculating altitude. On average both species flew 12 m above the median waterline. Variation in flight altitude will be related to flight behavior (e.g. out-bound, in-bound, searching), type of flight (e.g. dynamic soaring, flapping flight), diel patterns, and wind speed to better understand when birds reach altitudes that put them at risk for collision with wind turbine blades. Further modeling can then assess impact risk associated with turbine size and location. (Talk)

One big family: high connectivity among Elegant Tern (*Thalasseus elegans*) breeding colonies revealed through population genomic analysis

Gabriela Perez<sup>1</sup> Andres Aguilar<sup>1</sup> Katherine Goodenough<sup>2</sup> Micheal Horn<sup>3</sup> Robert Patton<sup>4</sup>  
Enrico Ruiz<sup>5</sup>

<sup>1</sup>Department of Biological Sciences, California State University, Los Angeles, CA 90032-8201.

<sup>2</sup>Department of Biology, University of Oklahoma, University of Oklahoma, 730 Van Vleet Oval, Room 314 Norman, Oklahoma 73019.

<sup>3</sup>Department of Biological Science (MH-282) California State University, Fullerton P.O. Box 6850 Fullerton, CA 92834-6850.

<sup>4</sup>Avian Research Associates, 830 Orange Ave Ste K Coronado CA 92118.

<sup>5</sup>Departamento de Zoología, Instituto Politécnico Nacional, Prolongación de Carpio y Plan de Ayala s/n, Miguel Hidalgo, Santo Tomás, 11340 Ciudad de México, CDMX, México.

<sup>6</sup>Instituto de Ciencias Marinas y Pesqueras, Universidad Veracruzana, Miguel Hidalgo 616, Ro. Jamapa, 94290 Boca del Ro, Ver., México.

Population genetic structure can aid in setting conservation and management strategies by characterizing populations on local or regional scales. The Elegant Tern (*Thalasseus elegans*) has a restricted breeding range, with 90% nesting populations found on Isla Rasa in the Gulf of California (Mexico). Low marine productivity and warm oceanographic anomalies, such as El Niño, have caused northward expansion of Elegant Tern breeding colonies into southern California (Port of Los Angeles, Bolsa Chica Ecological Reserve, and San Diego Bay National Wildlife Refuge). The southern California nesting populations are known to exist as a single population, however, it was unknown if the Baja California birds were genetically distinct especially with chances of mixing occurring. Restriction-site associated DNA sequencing (RADseq) was used to analyze 3,826 single nucleotide polymorphisms from 65 Elegant Terns sampled across all four breeding sites. Our analysis revealed little population structure, with non-significant genetic differentiation among sites. We also found no association of individuals in a principal components analysis and individual-based clustering failed to resolve any groups. Discriminant analysis of principal components suggests subtle clustering of individuals by breeding site, however, further examination of the data indicates this may be a statistical artifact. These results suggest a strong degree of connectivity (gene flow) among the Gulf of California and southern California colonies. Our findings indicate that Elegant Tern breeding colonies are highly fluid and that breeding colonies in southern California will be crucial to the species ability to withstand short and long-term oceanic changes. (Talk)

## COORDINATED PROVISIONING IN A PELAGIC SEABIRD WITH VARIABLE FORAGING STRATEGIES

Chris Tyson<sup>1</sup> Holly Kirk<sup>2</sup> Annette Fayet<sup>2</sup> Emiel Van Loon<sup>3</sup> Tim Guilford<sup>3</sup>

<sup>1</sup>University of California, Davis, CA 95616, One Shields Avenue Davis, CA 95616.

<sup>2</sup>University of Oxford, South Parks Road, Oxford, OX1 3PS, UK.

<sup>3</sup>University of Amsterdam, Science Park 904, 1090GE Amsterdam, The Netherlands.

In long-lived species, care-giving parents are expected to balance their own condition with that of their offspring. Dual foraging, in which long trips for self-maintenance are alternated with short trips for offspring care, is a unique behavioral adaptation for managing these conflicting demands that is displayed by many seabird species. While dual foraging is thoroughly studied, it entails a complication that is seldom discussed: if parents independently employ a dual foraging strategy, chicks might be abandoned for extended periods when long trips coincide. Whether partners coordinated their provisioning behavior, however, is largely unknown. To investigate this possibility, we used radio frequency identification readers coupled with passive integrated transponder tags to record extended sequences of foraging trips for breeding Manx shearwaters (*Puffinus puffinus*). Our results show a pattern of foraging trips that indicates a high level of coordination between parents, which facilitates consistent provisioning of their offspring. Additionally, we show that the propensity for pairs to coordinate declines across the chick rearing period. Given the potential costs of not coordinating, we expect this behavior to be widespread among dual foraging species. (Talk)

## ESTIMATING REPRODUCTIVE SUCCESS USING TWO SURVEYS PER SEASON: VALIDATION WITH MAGELLANIC PENGUINS

Ginger Rebstock<sup>1</sup> Dee Boersma<sup>1</sup>

<sup>1</sup>University of Washington, Dept. of Biology, Box 351800, Seattle, WA 98195-1800.

<sup>2</sup>Global Penguin Society, University of Washington, Department of Biology, Box 351800, Seattle, WA 98195-1800.

<sup>3</sup>Wildlife Conservation Society, 2300 Southern Blvd, Bronx, NY 10460.

Fecundity is an important demographic variable in wildlife populations, but it is difficult, time-consuming, and expensive to measure. For seabirds, reproductive success is commonly estimated from two surveys of a colony, one during incubation or egg laying and one during late chick rearing. We used 33 years of data on Magellanic Penguins (*Spheniscus magellanicus*) at a large colony (~200,000 nests) at Punta Tombo, Argentina, to validate this method. We compared reproductive success from two surveys with reproductive success from nests checked throughout the breeding season. Two surveys usually underestimated reproductive success in good years and overestimated it in average years (nonlinear relationship,  $R^2 = 0.90$ ). The results agreed within 15% in only seven of 18 years. Males in a varying percentage of occupied nests counted in early October surveys failed to get mates, and a varying percentage of chicks died after early January surveys each season. If surveys were done on the optimal dates (26-30 October and 26-30 January), and the percentage of chicks too light to fledge was subtracted, the relationship was linear ( $R^2 = 0.94$ ) and the results agreed within 15% in 25 of 29 years. Variability in the timing and synchrony of breeding caused the results to differ by > 15% in a few years. Knowledge of the species breeding biology and proper timing of the surveys is critical to obtaining reliable estimates of reproductive success from two surveys. (Talk)

## DIET OF BRANDTS CORMORANTS (*PHALACROCORAX PENICILLATUS*) DURING BREEDING SEASON: A NOVEL APPROACH

Heather Robinson<sup>1</sup> Julie Thayer<sup>1</sup>

<sup>1</sup>Farallon Institute, 101 H Street.

Diet of the Brandts Cormorant (*Phalacrocorax penicillatus*) breeding population on Alcatraz Island, California was determined for 2014 and 2015 using two methods. Regurgitated pellets and complete nests were collected on two dates in 2014 (4 Sept and 17 Sept) and one date in 2015 (17 Sept) once all chicks had left colonies, to reduce disturbance to nesting birds. Preliminary results identified 25 prey taxa including 23 teleost fishes and 2 cephalopods. Diet was dominated by Northern Anchovy (*Engraulis mordax*) and Speckled Sanddab (*Citharichthys stigmaeus*), with Plainfin Midshipman (*Porichthys notatus*), English Sole (*Parophrys vetulus*), and Staghorn Sculpin (*Leptocottus armatus*) rounding out the top five important species by number and mass. Determining seabird diet using a combination of pellet and nest samples is a novel approach with the potential to provide a balanced representation of prey consumed during the full breeding period, which can be up to 6 months for cormorants. In contrast, diet determined from pellets likely represents only a very recent time period prior to collection, as pellets are often blown off narrow cliff ledges or disintegrate through trampling and/or exposure to the elements in open seabird breeding colonies, precluding an accumulation through time. However, due to disturbance issues it is often unfeasible to collect pellets at regular intervals throughout the breeding season. Results from nests and pellets are compared and correlated to fisheries-independent sampling in the region. (Talk)

## KID-FRIENDLY: FACTORS AFFECTING BREEDING SUCCESS OF CASPIAN TERNS ON EAST SAND ISLAND IN THE COLUMBIA RIVER ESTUARY

Olivia Bailey<sup>1</sup> Daniel Roby<sup>2</sup> Donald Lyons<sup>1</sup> Yasuko Suzuki<sup>1</sup> Peter Loschl<sup>1</sup> Kirsten Bixler<sup>1</sup>

<sup>1</sup>Oregon Cooperative Fish & Wildlife Research Unit, Department of Fisheries and Wildlife, 104 Nash Hall, Oregon State University, Corvallis, OR 97331-3803 USA.

<sup>2</sup>U.S. Geological Survey - Oregon Cooperative Fish & Wildlife Research Unit, Department of Fisheries & Wildlife Research Unit, 104 Nash Hall, Oregon State University, Corvallis, OR 97331-3803 USA.

Caspian Terns (*Hydroprogne caspia*) breeding on East Sand Island (ESI) in the Columbia River estuary exhibit high philopatry to this colony site. Before the 2015 breeding season, the area of available nesting habitat on the colony was reduced from 1.5 to 1.0 acres. Factors such as timing of nest initiation, past breeding experience, and nest site location on the colony may influence individual breeding success. We evaluated how these factors influence Caspian Tern nesting success by monitoring banded individuals during the 2015 and 2016 breeding seasons. Multiple logistic regression models were fitted and compared using AIC. Preliminary model results suggest that in 2015 and 2016, birds with no previous breeding experience had a lower probability of nesting success than those with at least one year of experience (2015:  $p < 0.01$ , 2016:  $p < 0.1$ ) on ESI. There was also weak evidence that late nesting birds had a lower probability of breeding success than early nesters ( $p < 0.1$ ) in both seasons. Breeding success in 2015 did not predict an individual's breeding success in 2016. There was no difference in breeding success between birds that had multiple nesting attempts in the 2016 season and those with just one nesting attempt. Knowledge of individual factors affecting breeding success at ESI may aid in predicting which individuals will be selected for as available nesting habitat continues to decrease at this largest and most productive colony for the species in western North America. (Talk)

Breeding distribution and status of Markhams Storm-Petrel (*Oceanodroma markhami*) in northern Chile

Rodrigo Barros<sup>1</sup> Ronny Peredo<sup>1</sup> Fabrice Schmitt<sup>1</sup> Fernando Medrano<sup>1</sup> Rodrigo Silva<sup>1</sup> Her-  
aldo Norambuena<sup>1</sup>

<sup>1</sup>Red de Observadores de Aves y Vida Silvestre de Chile, Julio Prado 1144, Depto 31. Provi-  
dencia, Chile.

Markhams Storm-Petrel (*Oceanodroma markhami*) is a storm petrel endemic to the Humboldt Current off South America. Currently is categorized as Data Deficient by the International Union for Conservation on Nature, given the poorly knows about their breeding colonies. Between 2013 and 2015, the breeding distribution and status of this storm petrel were surveyed along the Arica-Parinacota (18°22' S) to Antofagasta (22°02' S) regions in Atacama Desert, northern Chile. Also, we surveyed the breeding pairs in this colonies. A total of five non-previously recorded breeding colonies and another four probably breeding colonies of Markhams Storm-Petrel were recorded. Our results increase the known breeding distribution of Markhams Storm-Petrel in ca. 270 km to the south. Preliminary counts suggest that Salar Grande and Pampa Camarones could be the most important breeding areas for this species in the world. Almost eight threats for the species were recorded and a considerable number of fledgling died every season. So the protection of some breeding sites and the reduction of threats are critical for Markhams Storm-Petrel conservation. (Talk)

EGG TURNING BEHAVIOR AND EGG TEMPERATURE IN RELATION TO MERCURY CONTAMINATION OF FORSTER'S TERNS (*STERNA FORSTERI*)

Gregory Taylor<sup>1</sup> Joshua Ackerman<sup>2</sup> Scott Shaffer<sup>1</sup>

<sup>1</sup>San Jose State University, 1 Washington Sq, San Jose, CA 95192.

<sup>2</sup>U. S. Geological Survey, Dixon Field Station, 800 Business Park Drive, Suite D, Dixon, CA 95620.

Several avian species exhibit reduced hatching success as a result of mercury contamination, but the mechanism by which this occurs is unknown. We examined egg turning rates and egg temperatures in relation to egg mercury contamination of Forsters terns (*Sterna forsteri*) in San Francisco Bay. Here, we used artificial eggs containing a data logger with a 3-D accelerometer, a magnetometer, and temperature thermistor to monitor parental in-cubation behavior (sampled at 1 Hz) of 186 tern nests. Overall, adults turned their eggs an average of 3.8 ± 0.8 turns per hour, which is nearly two times higher than that of other seabirds. Egg turning rates also increased with nest initiation date and egg temperature. Changes about the yaw axis (side-to-side egg movements) were the most prominent aspect of egg turning (176 ± 1.8 degrees/hour). Despite the high variability in egg turning rates among individuals (SD = 0.8 turns/hour), the rate of turning was not correlated with mercury concentrations in surrogate eggs collected from the same nest. Our results indicate that egg turning rates in Forsters terns are high, but unrelated to mercury contamination. (Talk)

## LIVING AT THE EDGE: A 10-YEAR TIMESERIES OF COMMON MURRES NESTING AT A LARGE COLONY IN THE CALIFORNIA CURRENT

Stephanie Schneider<sup>1</sup> Richard Golightly<sup>1</sup>

<sup>1</sup>Humboldt State University, Arcata, CA 95521 USA.

To compensate for a variable environment, chick-rearing Common Murres (*Uria aalge*) adjust the amount of time they spend together at the colony to adequately provision their young and maintain relatively high fledging success. When prey are abundant, chick-rearing pairs can spend up to half of the day together (co-attendance) at the colony and, as prey become scarce, co-attendance is reduced. The time allocation of chick-rearing murres over ten years (2006-2016) was quantified to assess the relationship between co-attendance, chick provisioning, fish stealing, and fledging success at Castle Rock National Wildlife Refuge, one of the largest murre colonies south of Alaska. Between 2006 and 2013, murres were in co-attendance during 2.90.6% of daylight hours, and chicks were left unattended during 5.43.5% of daylight hours. The amount of time spent in co-attendance was positively correlated with chick provisioning rates ( $P=0.008$ ) and was negatively correlated with the occurrence of fish stealing ( $P=0.01$ ). Chicks that fledged were fed 2.6 times more often than sites where chicks perished ( $P=0.007$ ). Additionally, 3.71.0% of prey were stolen from sites that fledged chicks, whereas 28.618.4% of prey were stolen from sites where chicks eventually perished. Relative to other murre colonies in the California Current and elsewhere, co-attendance at Castle Rock was extremely low. The time allocation of murres at Castle Rock suggests that chick-rearing individuals have maximized their efforts to adequately provision chicks and may lack the behavioral capacity to further compensate for further reductions in prey availability. (Talk)

Variation in reproductive success and MHC based mate choice in male Leachs storm-petrels (*Oceanodroma leucorhoa*)

Brian Hoover<sup>1</sup> Sarah Jennings<sup>1</sup> Scott Edwards<sup>2</sup> Yung Wa Sin<sup>2</sup> Gabrielle Nevitt<sup>1</sup>

<sup>1</sup>University of California Davis, Department of Neuroscience, Physiology and Behavior, One Shields Avenue, University of California Davis, CA 95616 USA.

<sup>2</sup>Harvard University, Department of Organismic and Evolutionary Biology, Harvard University, 26 Oxford Street, MA 02138 USA.

Procellariiformes are long-lived pelagic foragers that typically raise one chick every year or every other year, and their slow-growing chicks require prolonged care prior to fledging. Consequently, both parents must contribute equally towards incubation and provisioning in order to successfully fledge a chick. This reproductive ecology suggests that mate choice is a critical life history decision, and both males and females should select mates based on advantageous traits that may increase fitness. We examined mate choice patterns in a small burrow-nesting seabird, the Leachs storm-petrel (*Oceanodroma leucorhoa*), using a highly variable immunogenetic marker, the Major Histocompatibility Complex (MHC). Variability in MHC markers is known to influence individual body odor, and may impact recognition and mate preference. Using a robust five-year dataset (n=1350 genotyped individuals) from Bon Portage Island, Nova Scotia, we found a positive relationship between variation in female reproductive quality and increasing heterozygosity at a MHC class IIB locus. This relationship appears to be associated with significant disassortative mate choice decisions observed in male storm-petrels. Variability in female reproductive success may be due to an increased physiological load on females during the breeding season, which may compromise the reproductive viability of certain genotypes or cause males to actively avoid certain genotypes during mate selection. This study supports the role of mate choice in maintaining high levels of MHC variability in a wild population, and suggests that mate choice associations in Leachs storm-petrel may be based on interactions between MHC genotype, physiology, and reproductive investment (i.e. burrow building in males). (Talk)

## THE WARM BLOB AND A COLD SEA: LARGE-SCALE TROPHIC PERTURBATIONS IN THE ALEUTIAN ISLANDS

Douglas Causey<sup>1</sup> Veronica Padula<sup>1</sup> Shiway Wang<sup>1</sup>

<sup>1</sup>Dept Biological Sciences, University of Alaska Anchorage, Anchorage, AK.

The Arctic regions are experiencing rapid change in marine and terrestrial environments from many sources, primarily caused by climate change and anthropogenic impacts of increased development and pollution. Several endemic species, such as Red-faced Cormorants (*Phalacrocorax urile*) are currently undergoing dramatic population declines, likely related to climate-related change in food availability and trophic structure of the local marine environment. In this study, we are analyzing the constituent stable isotopes (eg. H, C, N, O, S) of blood and feather samples collected from 16 avian species collected in the far Western Aleutian Islands (eg., Near, Rat, and Delarof Islands) since 2000. Our preliminary results indicate that the community-wide spatial and temporal dynamics of marine bird ecosystems are far greater in the last decade (2009 – 2016) than has been evident over recent decades. We also find that the magnitude of change is lesser here in the low Arctic (e.g., western Aleutian Islands 53N) compared to High Arctic coastal marine ecosystems (e.g., 78N). In particular, we show that the ecological patterns observed within such widespread arctic species as puffins (*Fratercula* spp.), Northern Fulmars (*Fulmarus glacialis*), and Black-legged Kittiwake (*Rissa tridactyla*) indicate diets are strongly perturbed on small geographic and temporal scales of 101 km and decades. Moreover, we find that the variance in environmental and ecological parameters is increasing rapidly over time. We hypothesize that these fine-scale changes are related to mid-scale oceanographic and trophic-level changes (eg., the Warm Blob), in addition to larger-scale perturbations possibly related to a cascade of climate-related factors (Talk)

MONSTER NINO: CASCADING EFFECTS OF RECENT ENVIRONMENTAL  
CHANGE ON ENDANGERED TERNS AND THREATENED PLOVERS IN SOUTHERN  
CALIFORNIA

Gabriela Ibarguchi<sup>1</sup> Travis Wooten<sup>1</sup> Rachel Smith<sup>1</sup> Katrina Murbock<sup>1</sup> Maggie Post<sup>1</sup> Lisa Nordstrom<sup>1</sup> Ignacio Vilchis<sup>1</sup> Ron Swaisgood<sup>1</sup>

<sup>1</sup>San Diego Zoo Institute for Conservation Research, 15600 San Pasqual Valley Rd., Escondido, CA, 92027.

In combination with on-going climate change, the ENSO (El Niño Southern Oscillation) event of 2015-2016 has already been identified as one of the strongest since 1950 based on the Oceanic Niño Index. This event has been a major driver of unusual conditions in the marine environment and extreme weather events affecting coastal habitat and estuaries. For at-risk species breeding in these environment, rapid changes can cause breeding failure due to immediate and direct effects such as habitat loss including severe erosion and flooding, and indirect impacts such as shifts in prey availability and species distributions, and potential impacts on health. Here we provide overviews of the impacts of recent environmental change and the 2015 - 2016 ENSO event at two key sites for two species at risk breeding in Southern California: the California Least Tern (*Sternula antillarum browni*) and Western Snowy Plover (*Charadrius nivosus nivosus*)

## LINKING AT-SEA CONDITIONS WITH THE COAST-WIDE CASSIN'S AUKLET MASS MORTALITY EVENT OF 2014-2015

Jeannette Zamon<sup>1</sup> Laura Bliss<sup>2</sup>

<sup>1</sup>NOAA Fisheries, Northwest Fisheries Science Center, Pt. Adams Research Station, PO Box 155, Hammond, OR 97121 USA.

<sup>2</sup>Ocean Associates, Inc., 6212 Crow Lane, Austin, TX 78745.

During 2014-2015 the California Current Ecosystem was affected by a pool of anomalously warm surface waters whose temperatures were 1-3C above the long-term average. These conditions - referred as The Blob in popular media and many scientific circles - were associated with major perturbations across all trophic levels in the ecosystem, including an unprecedented, publicly-visible die-off of Cassin's auklets (*Ptychoramphus aleuticus*). We examined the geographic centroids of the at-sea distribution of auklets to determine whether or not there were significant changes in the June marine distribution and abundance of auklets prior to (2003-2012) and during the manifestation of the Blob in 2014-2015 off the coasts of Oregon and Washington. Additionally, we compared surface hydrographic parameters (e.g. pycnocline depth, mean surface layer temperature) to auklet density to look for evidence that auklets may have had to make deeper dives in 2015 to reach the pycnocline where their planktonic prey are thought to be found. To date all inferences about this auklet mortality event have come from analyses of beach-cast birds; this study of at-sea distribution of live auklets provides a novel marine perspective on potential causes and consequences of the 2014-2015 mortality event. (Talk)

## WHAT'S IN A WRECK? ELUCIDATING THE PATTERN(S) OF UNUSUAL MORTALITY EVENTS

Jennifer Lang<sup>1</sup> Julia Parrish<sup>2</sup>

<sup>1</sup>School of Aquatic and Fishery Science, University of Washington, 1122 NE Boat St, Seattle, WA 98105.

<sup>2</sup>Coastal Observation and Seabird Survey Team, 1122 NE Boat Street Seattle, WA 98195.

Massive mortality events of seabirds, referred to as seabird wrecks, appear to be on the rise. Examination of regional-to-local patterns of wrecks, relative to baseline beaching patterns, may help to elucidate causality, as well as predict when, where, and what species would be involved in future wrecks. We used data from 34 beaches on the outer coasts of Washington and Oregon, monitored monthly for 11 years by volunteers for the Coastal Observation and Seabird Survey Team (COASST), to estimate beach-specific baselines of carcass encounter rate, and statistically identify unusual mortality events (UMEs). Using generalized additive models and an iterative threshold approach, we identified 165 surveys with a range of heightened encounter rates. UMEs were further delineated into low (LUME), high (HUME), and mass mortality (MME) carcass beaching events dependent on the regional pattern. We explored whether event-specific characteristics (event duration and spatial distribution; species diversity and seasonality) and carcass-specific measures (location detected on the beach; carcass freshness) differed as a function of intensity. HUMEs and MMEs documented heightened carcass encounter rates that spanned across several beaches or months, typically involving prolific species of the area or unexpected species beaching at heightened volume at the wrong time of year. LUMEs documented heightened encounter rates when natural mortality is typically dampened. Our results suggest that UMEs consistently involve higher proportions of intact carcasses than baseline surveys, and are a function of the natural history of common species, regional and beach-specific baseline patterns, and the extent and duration of local forcing factors. (Talk)

## MOTU NUI: AN EASTER ISLAND (RAPA NUI) SEABIRD REFUGE

Guillermo Luna-Jorquera<sup>1</sup> Marcelo Flores<sup>2</sup> Pedro Lazo Hucke<sup>3</sup> Paula Plaza Ramirez<sup>1</sup> David Duffy<sup>4</sup>

<sup>1</sup>Ecología y Diversidad de Aves Marinas Facultad de Ciencias del Mar Universidad Católica del Norte, Larrondo N 1281, Coquimbo, Chile.

<sup>2</sup>Dpto. de Ecología y Biodiversidad, Universidad Andres Bello, República 440. Oficina 18 Universidad Andres Bello Santiago, CHILE .

<sup>3</sup>Corporación Nacional Forestal (CONAF), Rapa Nui, Chile.

<sup>4</sup>Pacific Cooperative Studies Unit, University of Hawaii, 3190 Maile Way, Honolulu HI 96822 USA.

Easter Island (Rapa Nui, Isla de Pascua) 3700 km west of Chile is one of the few islands available for nesting seabirds in the southeast Pacific. Paleontological research shows a rich marine avifauna, but the current avifauna is much reduced and restricted to two major areas: the moai quarry on the main island and Motu Nui, a 3.5 ha island 1.3 km offshore. Motu Nui was the focus of the bird man cult. Fifteen species now nest on the motu and it is the easternmost breeding site for a number of seabird species such Black-winged Petrel (*Pterodroma nigripennis*), Christmas Shearwater (*Puffinus navitatis*), Henderson Petrel (*Pterodroma atrata*) and Herald Petrel (*Pterodroma heraldica*). Challenges include invasive species such as the Argentinian ant (*Linepithema humile*), an introduced predator the Chimango Caracara (*Milvago chimango*), and alien vegetation, as well as fishing pressure from foreign vessels operating illegally in Chilean waters. Motu Nui is the focus of on-going research by Chilean researchers, focusing on restoration of nesting sites of the Sooty Terns (*Sterna fuscata*), the focus of the birdman cult, understanding the nesting preferences and seasonality of the different breeding seabird species, and determining the relative importance of foraging over tuna schools (*Tunnus* spp.) and over seamounts. (Talk)

EARLY SUCCESS IN LONG-TERM MONITORING OF PROTECTED HAWAIIAN  
PETREL BREEDING HABITAT

Jenni Learned<sup>1</sup> Jay Penniman<sup>1</sup>

<sup>1</sup>Maui Nui Seabird Recovery Project, PO Box 903, Makawao, HI 96768.

The Hawaiian Petrel (*Pterodroma sandwichensis*, HAPE) is a federally endangered, na-tive Hawaiian seabird that has suffered severe population decline as a result of predation and habitat loss. Substantial effort has been put into protecting and restoring HAPE on the Hawaiian islands in recent decades. The largest known breeding colony is located on Maui on the slopes of Haleakala above 2,000 m within Haleakala National Park. To assess the effectiveness of predator control and habitat restoration on HAPE recovery, we are tracking the reproductive success of the birds while monitoring rat, mongoose, and feral cat activity within a 946 ha ungulate-proof enclosure within the Nakula Natural Area and Kahikinui Forest Reserves. We predict that consistent monitoring and predator control will have a positive effect on HAPE reproductive success within the protected area. After completion of the ungulate-proof fencing in 2014, above-ground plant biomass and rat activity within the enclosure increased. However, mongoose activity decreased and feral cat activity has remained constant, likely as a result of active predator trapping. The number of HAPE burrows with successfully fledged chicks increased from 13% in 2015 to 38% in 2016. Our results support the assertion that active management of protected areas can have a rapid and positive impact on vulnerable seabird species. Future monitoring will include plant community surveys and regular surveys for new HAPE burrow establishment. (Talk)

## PELAGIC CORMORANT STATUS

Ron LeValley<sup>1</sup>

<sup>1</sup>LeValley Photography, P.O. B ox 332, Little River CA 95456.

Ron LeValley, in conjunction with the California Coastal National Monument (CCNM), Mendocino Coast Audubon Society, the Sea Ranch Stewardship Taskforce and other groups, has continued monitoring Pelagic Cormorant (*Phalacrocorax pelagicus*) colonies in the Mendocino County region of northern California (CA) for the 7th year. Citizen scientists have volunteered to monitor known colonies. More volunteers and sites have been added to the project, and more than 15 sites with 5 to 25 nests each are now being monitored for reproductive success. The 2015 season was poorly productive compared to the past six years, with many of the colonies lacking any nests this year. Ron will present a summary of the past 7 years of data. Ron is collaborating with others up and down the Pacific Coast to compile a broad assessment of Pelagic Cormorant. (Talk)

## SPATIOTEMPORAL PATTERNS OF CORVID DISTRIBUTION AND ABUNDANCE IN AREAS OCCUPIED BY MARBLED MURRELETS

Joseph Northrup<sup>1</sup> James Rivers<sup>1</sup> S. Kim Nelson<sup>2</sup> Daniel Roby<sup>1</sup> Lindsay Adrean<sup>1</sup> Matthew Betts<sup>1</sup>

<sup>1</sup>Department of Forest Ecosystems and Society Oregon State University, 321 Richardson Hall Corvallis, OR 97331.

<sup>2</sup>Department of Fisheries and Wildlife Oregon State University, 104 Nash Hall Corvallis, OR 97331.

<sup>3</sup>US Geological Survey-Oregon Cooperative Fish and Wildlife Research Unit, 104 Nash Hall Corvallis, OR 97331.

The Marbled Murrelet (*Brachyramphus marmoratus*) has declined across much of its range and currently is listed as threatened in the conterminous United States under the Endangered Species Act. One of the primary suspected causes of murrelet declines is low recruitment due to nest predation, particularly by corvids. Understanding the spatiotemporal patterns of murrelet nest predator distribution and abundance, and drivers of overlap with murrelet habitat is thus a critical management need. We modeled the abundance and distribution of corvids known or suspected to prey upon murrelet nests (Stellers Jay, Common Raven, American Crow and Gray Jay) over a 30-y period across the range of murrelets in California, Oregon and Washington. We examined the relationships between temporal changes in corvids and dynamic measures of landscape (e.g., forest loss) and climate change (e.g., temperature increases). We used resulting models to predict changes in corvid distribution and abundance in areas known to be occupied by murrelets to infer potential changes in the risk of nest predation. The influence of landscape and climate change on corvid distribution and abundance varied by species, with most corvids increasing in areas of greater warming and human-caused land-use change. Our models predicted that Stellers Jays and Common Ravens increased over the last 30 years in areas occupied by murrelets (0.8% per year for Stellers Jay and 4.4% per year for Common Raven), although there was variability among sites. Important next steps include assessing whether areas with predicted increases in corvids correspond to areas of greater murrelet declines. (Talk)

## WHAT HAPPENS AFTER? POST-RELEASE MOVEMENTS AND SURVIVAL AMONG GROUNDED NEWELL'S SHEARWATER FLEDGLINGS

Andre Raine<sup>1</sup> Josh Adams<sup>2</sup> Tracy Anderson<sup>3</sup> Reginald David<sup>4</sup> Megan Vynne<sup>1</sup> Mike McFarlin<sup>1</sup>

<sup>1</sup>Kauai Endangered Seabird Recovery Project, 3900 Hanapepe Rd, Hanapepe, Kauai, HI 96716.

<sup>2</sup>US Geological Survey, Western Ecological Research Center, Santa Cruz Field Station, 2885 Mission St. Santa Cruz, CA 95060.

<sup>3</sup>Save Our Shearwaters, Kauai Humane Society, P.O. Box 3330 Lihue, HI 96766 .

<sup>4</sup>Rana Biological Consulting, Inc, P. O. Box 1371, Kailua, Kona, Hawaii 96745-1371.

The Save Our Shearwaters (SOS) is a well-established seabird rescue and rehabilitation program initiated on Kauai in 1979. Its primary focus is endangered seabirds, the majority collected by the public and handed over to the program for assessment, rehabilitation and release. Since its inception, over 35,000 seabirds have passed through the program, mainly Newells Shearwater (*Puffinus newelli*) fledglings grounded by light attraction. Understanding impacts of grounding is vital to help guide and maximise the efficacy of rescue and rehabilitation efforts. This is however challenging, as birds are released out to sea as fledglings and ultimately return to remote montane colonies, most of which are not monitored – rendering band recoveries to assess survival impossible. Evaluating post-release survival provides one option to gain unique information to help evaluate the effects of grounding. We attached satellite transmitters to Newells Shearwaters during two years and tracked their post-release movements at sea. In 2014, we tracked 12 fledglings recovered by SOS. In 2016, we tracked 6 fledglings recovered by SOS and 6 birds that fledged directly from a colony in Upper Limahuli Preserve; two breeding adults from the same colony were also tracked. In 2016 we also tracked an adult Hawaiian Petrel (*Pterodroma sandwichensis*) rehabilitated by SOS after colliding with a powerline. We describe the results of these tracking efforts, and discuss how these data help (i) assess the impact of light attraction and subsequent grounding, (ii) understand post-fledging dispersal and (iii) assess the effectiveness of rehabilitation. To conclude, we ask, what more information is needed to evaluate post-release survival? (Talk)

## CURRENT STATUS AND PLANS FOR SEABIRD CONSERVATION AND MANAGEMENT ON THE ISLAND OF LĀNA'I

Rachel Sprague<sup>1</sup> Andre Raine<sup>2</sup>

<sup>1</sup>Pūlama Lāna'i Department of Natural Resources, 1331 Fraser Ave., P.O. Box 630310, Lanai City, HI 96763.

<sup>2</sup>Kaua'i Endangered Seabird Recovery Project, 3900 Hanapepe Rd., Hanapepe, Kauai 96716.

Lāna'i is the sixth largest of the Hawaiian Islands and the smallest publicly accessible inhabited island in the archipelago. Starting in the 1870s, the island experienced heavy ranching and agricultural use (at one time being the worlds largest pineapple plantation), as well as significant native habitat degradation from non-native ungulates and other invasive species. While the resulting habitat loss led to the near-extirpation of native forest birds, the island is still home to native seabirds, including significant populations of endangered Hawaiian Petrels (*Pterodroma sandwichensis*) and a large colony of Wedge-tailed Shearwaters (*Ardenna pacifica*). Pūlama Lāna'i (the private company managing ~98% of the island), is building on past work to protect and manage the islands seabird colonies. For the last two years Pūlama Lāna'i has worked with the U.S. Fish & Wildlife Service, Kaua'i Endangered Seabird Recovery Project, and other partners to: 1) update distribution maps of Hawaiian Petrel colonies using song meters and auditory surveys, 2) monitor active petrel burrows within selected colonies to assess seabird activity and predator interactions using cameras, 3) census the Wedge-tailed Shearwater colony and determine colony breeding success, 4) control mammalian predators and invasive plants around key seabird colonies, and 5) monitor for other seabird species. While Lāna'i still holds important seabird colonies, it faces significant challenges from invasive predators and habitat loss. Our current work is helping to direct conservation actions going forward, with a focus on increasing predator control (especially for cats and rats) and improving native habitats to ensure a future for Lāna'i's seabird colonies. (Talk)

## EFFECTS OF OCEANIC VARIABILITY ON BREEDING POPULATION OF GREATER CRESTED TERN AND CHINESE CRESTED TERN IN EAST CHINA SEA

Hung Chung Hang<sup>1</sup> Chen Shui-Hua<sup>2</sup> Yuan Hsiao-Wei<sup>1</sup> Chang Le-Ning<sup>1</sup> Fan Zhong-Yong<sup>2</sup>  
Lu Yi-Wei<sup>2</sup>

<sup>1</sup>Department of forestry and resource conservation, National Taiwan University, R312a, No. 1, Sec. 4, Roosevelt Rd..

<sup>2</sup>Zhejiang Museum of Natural History, No.6 in the Westlake Cultural Plaza, Hangzhou, Zhejiang .

The Chinese Crested Tern (*Thalasseus Bernsteinii*) was listed as “Critically Endangered” in the IUCN Red List. Matzu and Penghu in Taiwan, Wuzhishan and Jiushan in Zhejiang and Muan-Gun in Korea are confirmed as their breeding sites worldwide. Based on our investigation at Matsu, Wuzhishan Jiushan since 2000, the CCT always breed sympatrically with the Greater Crested Terns (*T. bergii*, GCT) among these islands, and their population fluctuation also shown a strong positive correlation. However, in 2008-2016 we found both CCT and GCT frequently abandoned their nests at the beginning of the breeding season. The reason may be because both GCT and CCT feed on small pelagic fish and might be sensitive to food availability which related to ocean environment around the colony. We use Sea Surface Temperature (SST), SST Anomaly, chlorophyll-a concentration, and precipitation to examine the GCT and CCTs breeding population trends in East China Sea. The results showed that the GCT and CCT population declined when the SST was below or above 25C, and correlated positively with the chlorophyll-a concentration in July. Further study should base on these oceanographic parameters to predict potential breeding colony of CCT in East China Sea. (Talk)

Measuring nearshore recovery of seabird islands following rodent eradication at the Mercury Islands, New Zealand

Lyndsay Rankin<sup>1</sup> Holly Jones<sup>1</sup>

<sup>1</sup>Northern Illinois University, 1425 W. Lincoln Hwy., DeKalb, IL, 60115.

Seabirds drive the bottom-up control of many island food webs by depositing large amounts of nutrient-rich guano into the islands in which they breed. This is threatened by invasive species, with rodents as a primary cause of seabird mortality. The destructive effects from introduced rodents have led to a widespread attempt to eradicate them from islands, resulting in the slow return of breeding seabirds and recovery of soil, plant, and spider nutrient levels. However, little is known about ecosystem response to rodent eradications in the nearshore systems. This project examines the nearshore recovery of seabird islands within the Mercury Islands chain in northern New Zealand. These islands vary in invasion and eradication history from those never invaded to those previously eradicated of rodents in 1986 and recently eradicated in 2014, which is directly related to seabird density. Macroalgae surveys indicate significantly higher species richness and diversity on never invaded islands, followed by previously and recently eradicated islands. Algal stable isotope measurements detected enrichment in  $\delta^{13}\text{C}$  and  $\delta^{15}\text{N}$  from previously eradicated and never invaded islands.  $\delta^{15}\text{N}$  was also significantly higher at a depth 1 m compared to measurements from 2-5 m, indicating that stable isotope enrichment is due to nutrient subsidies from guano runoff. These results indicate that macroalgal diversity and stable isotope levels increase with increasing seabird densities, which is directly related to time since eradication. This research could validate a new cost- and time-effective method of monitoring seabird islands undergoing restoration that minimizes disturbance to the already fragile ecosystem. (Talk)

## REDISCOVERY OF LEAST KNOWN BREEDING SITES FOR SEABIRDS IN EAST COAST MALAYSIA

Abdulmaula Hamza<sup>1</sup> Chee Ho Wong<sup>1</sup> Amirrudin Ahmad<sup>1</sup>

<sup>1</sup>University Malaysia Terengganu, School of Marine and Environmental Sciences, Gong Badak Campus 21030 Kuala Terengganu, Malaysia.

Information on breeding marine avifauna in East coast Malaysia is scarce; egg collection by locals in the past centuries is believed to have driven many species to extinction. Recently the diversity and spatial distribution of breeding seabirds in islands around Pulau Redang was studied from March to August 2015. Black-naped tern (*Sterna sumatrana*) and Bridled tern (*Onychoprion anaethetus*) were the main seabird species breeding in the area. Two small islands/islets were found to host nests of these two species, Pulau Kerengga Kecil and Pulau Ling (or Cupak island) while one island (Pulau Paku Kecil) found to host a single species colony, the Black-naped tern. Nest and adult counts were made during four visits to the colonies between March and August 2015. Three nests of the Pacific reef egret, *Egretta sacra* were also found at Pulau Ling coinciding with the tern breeding season. The rediscovery of these colonies can provide new research and conservation opportunities in studying the movements of the two tern species during and after monsoon season, chick diet structure and how it can be affected by fishing and tourism activities. On the other hand it may provide new ecotourism activity (e.g., watching seabirds) for Redang Marine Park, however such activity should be carefully designed due to the sensitivity of tern colonies to human disturbance. Fishing (impact on food availability) and tourism (marine traffic, visitation, snorkelling and diving activities) in addition to old tradition of egg collection by locals are the most affecting factors on the breeding success and the future status of these rare species in the East Coast waters. (Talk)

## SPATIAL ECOTOXICOLOGY UNDER CLIMATE CHANGE: TRACKING MERCURY CONTAMINATION ACROSS ARCTIC MARINE FOOD WEBS

Jerome Fort<sup>1</sup> David Gremillet<sup>2</sup> Hallvard Strom<sup>3</sup> Maria Gavrilov<sup>4</sup> Olivier Gilg<sup>5</sup> Rune Dietz<sup>6</sup><sup>1</sup>Littoral Environnement et Socités (LIENSs), .<sup>2</sup>Centre d'Ecologie Fonctionnelle et Evolutive (CEFE), .<sup>3</sup>Norwegian Polar Institute, .<sup>4</sup>Arctic and Antarctic Research Institute (AARI), .<sup>5</sup>Biogosciences – Université de Bourgogne - CNRS, .<sup>6</sup>Aarhus University, .

Arctic marine ecosystems are threatened by increasing risks of chemical contamination under the combined effects of climate change and human activities. Rapid change of the cryosphere is for instance releasing large amounts of contaminants trapped in sea-ice, permafrost and terrestrial glaciers over the last decades. Sea-ice disappearance is opening new shipping areas to polluting human industries. The general warming of ocean water masses is affecting the cycle of some contaminants, thereby increasing exposure of marine organisms. In that context, providing a large-scale and comprehensive understanding of the Arctic marine food-web contamination is essential to better apprehend impacts of anthropogenic activities and climate change on the exposure of Arctic species and humans to contaminants. Among contaminants which could have high impacts on Arctic organisms, biodiversity and ecosystems, mercury (Hg) has raised major environmental concerns. Based on a large, pan-Arctic scale approach combining Hg analyses with biotelemetry, and by using the seabird community as bio-indicator of the environmental global contamination, we aim at (1) monitoring spatio-temporal variations of Hg in Arctic biota. (2) Defining Arctic hotspots of Hg contamination and highlighting sensitive areas that require particular attention and protection. (3) Identifying non-Arctic sources of Hg contamination for migratory Arctic predators (Talk)

Plastics in the Pacific: assessing risk from marine debris on seabirds in the California Current

Thomas Good<sup>1</sup> Jameal Samhour<sup>1</sup> Blake Feist<sup>1</sup> Chris Wilcox<sup>2</sup> Jaime Jahncke<sup>3</sup> Scott Shaffer<sup>4</sup>

<sup>1</sup>Northwest Fisheries Science Center, 2725 Montlake Blvd. E., Seattle, WA 98112.

<sup>2</sup>Commonwealth Scientific and Industrial Research Organisation, Oceans and Atmosphere Business Unit, CSIRO, Hobart, TAS 7001, Australia.

<sup>3</sup>Point Blue Conservation, 3820 Cypress Drive #11, Petaluma, CA 94954.

<sup>4</sup>San Jose State University, One Washington Square, San Jose, CA 95192.

Seabird populations worldwide face many threats, including fisheries bycatch, invasive species, pollution, and global climate change. Assessing risk to seabirds from anthropogenic threats requires high-quality data on both seabird distribution and relevant pressures; these can then be used to quantify exposure and sensitivity to those pressures. This risk assessment framework has been used for several ecosystem components as part of the California Current Integrated Ecosystem Assessment to varying degrees, including select Pacific basin seabirds. An initial assessment of the relative exposure of seabird species to a suite of pressures in the California Current revealed higher scores for wide-ranging, climatological pressures and lower scores for coastal and point-source pressures. The exposure analysis also revealed a disconnect between available datasets on pressures along the U.S. west coast and those relevant for seabirds. We thus conducted a focused assessment of the risk posed by marine debris to 16 seabird species throughout the California Current. We characterized exposure by overlapping predicted seabird density from habitat association modeling with predicted density of marine plastics and quantified sensitivity scores based upon behavioral and life history traits. Overall risk from marine debris was greatest for wide-ranging species and lowest for nearshore species, consistent with published ingestion studies. Moreover, debris density outside the California Current is markedly greater, which does not bode well for those wide-ranging, pelagic species. Mitigating this continuing risk for seabirds requires international efforts that extend beyond the California Current to countries throughout the Pacific Basin. (Talk)

## CHARACTERIZATION OF MARINE DEBRIS INGESTED BY PROCELLARIIFORMES

Ruth Kaz<sup>1</sup><sup>1</sup>University of Washington, 1122 NE Boat Street, Box 355020, Seattle WA 98195-5020.

Marine debris is a threat to the environment, especially wildlife, being vulnerable to entanglement, entrapment and ingestion of debris. Ingestion of plastics by a range of seabird species is well documented. In particular, Procellariiformes are known to ingest and retain high loads of marine debris. Three species of Procellariiformes, northern fulmar (*Fulmarus glacialis*), black-footed albatross (*Phoebastria nigripes*), and Laysan albatross (*Phoebastria immutabilis*), stomach contents (northern fulmar) and bolus contents (albatross) were evaluated for marine debris composition. Objects were characterized using the Coastal Observation and Seabird Survey Teams (COASST) Marine Debris Protocol. The most prevalent color in both northern fulmar and albatross samples was white. Albatross samples consisted of 47.5% monofilament line while northern fulmars consisted of 58.4% hard plastic fragments. The ingested objects differed between species in color, size, and plastic type. These differences invite new questions: do certain species choose to ingest debris with certain characteristics, or are those characteristics variably available in the environment? The answer has important implications for addressing the impacts of marine debris ingestion by seabirds. (Talk)

## WORKING PARENTS IN AN UNPREDICTABLE SEA: CASSINS AUKLET TIME BUDGETS DURING THE BREEDING SEASON

Gail Gallaher<sup>1</sup> Meredith Elliott<sup>2</sup> Pete Warzybok<sup>2</sup> Russell Bradley<sup>2</sup> Jaime Jahncke<sup>2</sup> Andre Cavalcanti<sup>1</sup> Nina Karnovsky<sup>1</sup>

<sup>1</sup>Pomona College, 175 W. 6th St. Claremont CA 91711 USA.

<sup>2</sup>Point Blue Conservation Science , 3820 Cypress Drive, Suite 11, Petaluma, CA 94954.

The purpose of this study was to use time-depth recorders to understand how and why the time budgets of Cassins auklets (*Ptychoramphus aleuticus*) breeding on the Farallon Islands vary over the course of the breeding season. Previous studies have shown close links between oceanographic conditions such as upwelling and the timing of when Cassins auklets initiate breeding. Foraging behavior is another way seabirds respond to variations in oceanographic conditions and prey availability. We hypothesized that in months with lower krill density, Cassins auklets increase their foraging effort to obtain enough prey to support them-selves and their growing chick. We predicted that in months with low krill density, Cassins auklets would spend more time flying, more time diving, and less time resting. To test this hypothesis, from 2008-2015, we attached time-depth recorders to 127 nesting Cassins auklets on Southeast Farallon Island, for a total of 5824 hours at sea, over 339 day-long trips. With a Python program, we divided time at sea into periods of diving, flying, and resting. We used monthly estimates of krill density around the Farallon Islands from ACCESS Cruises. We found that Cassins auklets decreased diving and flying from May through July and rested more as the season progressed. However, average monthly krill density was not a significant predictor of diving, flying, or resting. Therefore, other factors such as chick energetic demands or shifting foraging locations likely contribute to the seasonal variation in time budgeting observed in Cassins auklets. (Talk)

When being an opportunist is not beneficial

Katharine Goodenough<sup>2</sup> Robert Patton<sup>3</sup> Julio Lorda<sup>4</sup> Eli Bridge<sup>1</sup>

<sup>1</sup>Oklahoma Biological Survey, 111 E. Chesapeake St., Norman, OK 73019.

<sup>2</sup>University of Oklahoma, 730 Van Vleet Oval, Rm 314, Norman, OK 73019.

<sup>3</sup>Avian Research Associates, 4444 La Cuenta Drive, San Diego, CA 92124.

<sup>4</sup>Tijuana River National Estuarine research Reserve, 301 Caspian Way, Imperial Beach, CA 91932.

Coastal estuaries are some of the most productive and complex ecosystems in the world that form a continually changing dynamic interface between terrestrial, fresh water, and marine systems. Dietary opportunism is thought to be beneficial because it allows for flexibility in diet strategies. Species that can take advantage of ephemeral food sources should have an advantage of over strict specialists, yet there may be costs to such a strategy if available food sources prove harmful. In May 2013, the San Diego Gull-billed Tern (*Gelochelidon nilotica*) breeding colony was struck by a mortality event that killed between 85-91% of the breeding population. Necropsies completed by the USGS National Wildlife Health Center and CDFW- Marine Wildlife Veterinary Care and Research Center found the cause of mortality to be peritonitis caused by the trophically transmitted parasite, *Proflicollis altmanti*. Ongoing research points to one prey item, the mole crab (*Emerita analoga*) as the potential vector of disease because of its role as an intermediate host to *P. altmanti*. Following the mortality, we implemented invertebrate beach sampling to complement diet research on Gull-billed Terns within their foraging range. Results over four years reveal a strong inverse relationship between mole crab availability and dietary breadth. Terns responded to the reduced mole crab availability by adding more prey species. Although parasite infection rates are reduced due to decreased intermediate host availability, shifts in the Gull-billed Tern diet may have long term consequences of lowering reproductive success if replaced prey are of lower energetic quality. (Talk)

## HIGH INDIVIDUAL VARIATION IN THE FORAGING ECOLOGY OF BREEDING COMMON MURRES

Julia Gulka<sup>1</sup> Gail Davoren<sup>1</sup> Robert Ronconi<sup>2</sup>

<sup>1</sup>University of Manitoba, Winnipeg, Manitoba R3T 2N@.

<sup>2</sup>Canadian Wildlife Service, Environment and Climate Canada, Dartmouth, Nova Scotia, B2Y 2N6.

Off the east coast of Newfoundland, breeding common murres (*Uria aalge*) primarily feed on capelin (*Mallotus villosus*) and, thus, understanding how this prey selection impacts individual-level variation in foraging behaviour is key to understanding population dynamics. During July 2016, we examined the short-term consistency in foraging ecology of six chick-rearing common murres off the northeast Newfoundland coast using GPS tracking technology. Ship-based surveys revealed ephemeral, pre-spawning shoals of capelin were persistently present within foraging ranges south of the colony. Using 3-8 foraging trips per murre over 5-7 days, we compared inter- and intra-individual variation in foraging trip parameters, including trip duration, total distance travelled, maximum distance from the colony, number of dives per hour, and maximum dive duration. Most variation in foraging parameters was explained by variation within-individuals (75-100 %) rather than among-individuals, revealing that there was low temporal consistency in foraging behaviour within individuals but overall, individuals had similar foraging behaviour. Similarly, core foraging areas on each foraging trip (i.e. 40 % kernel density contour) overlapped on average 35.2 % (range: 24.2-55.3%) among individuals, whereas only 9.1% of the core foraging areas overlapped among foraging trips within an individual (range: 2.1-34 %). Overall, even when preferred prey can be persistently located in a specific area within foraging ranges, individual murres varied their behaviour greatly. These findings suggest that murre foraging behaviour is highly flexible, which may result in a high ability to behaviourally buffer changes in the abundance and behaviour of prey. (Talk)

## OCEANOGRAPHIC DRIVERS OF PREY AVAILABILITY IN TROPICAL SYSTEMS

FIONA MCDUIE<sup>1</sup> MARK MILLER<sup>1</sup> SCARLA WEEKS<sup>2</sup> BRADLEY CONGDON<sup>1</sup><sup>1</sup>JAMES COOK UNIVERSITY, PO BOX 6811, CAIRNS QLD 4870 AUSTRALIA.<sup>2</sup>UNIVERSITY OF QUEENSLAND, St Lucia, QLD 4072, Australia.

There is relatively substantive knowledge of the mechanisms driving prey availability to upper predators in temperate marine systems but less so for the tropics. Breeding wedge-tailed shearwaters (*Ardenna pacifica*) of the Great Barrier Reef (GBR) use locations 'at-distance' from the colony when self-provisioning during long foraging trips. We deployed PTT satellite transmitters on adult shearwaters over four breeding seasons to identify preferred foraging locations. They were characterised by overlaying high resolution, oceanographic data to understand mechanistic drivers. Foraging locations were always greater than 300km (maximum 1400km) from the Heron Island colony, in the Coral Sea. Site use varied among years but specific locations were reused within and among seasons. Foraging sites are in deep water proximal to steep bathymetric gradients/seamounts. In most years sites were strongly influenced by low to moderately positive sea level anomalies and moderate current speeds. Combined, these characteristics unambiguously describe use of local to meso-scale upwellings, eddies and frontal systems adjacent to seamounts or other topography and highlight their importance for enhancing prey availability to shearwaters at convergences and eddy peripheries. Such features commonly display increased biodiversity and facilitate prey aggregation and use by sub-surface predators such as tuna. Interestingly, this foraging activity is not correlated with elevated primary productivity. Most foraging sites are outside the GBR Marine Park and this information helps identify potentially important at-sea foraging areas for chick-rearing seabirds that are chronically under-represented in conservation strategies for pelagic species. (Talk)

## NICHE WIDTH VARIATION OF THE ALEUTIAN TERN: INSIGHTS FROM STABLE ISOTOPE ANALYSIS

Shiway Wang<sup>1</sup> McKenna Hanson<sup>1</sup> Veronica Padula<sup>1</sup> Douglas Causey<sup>1</sup>

<sup>1</sup>University of Alaska Anchorage, USA

The Aleutian tern (*Onychoprion aleutica*) is an especially vulnerable seabird with a global population size at only ~31,000, with only ~5,500 birds estimated in Alaska. Changes in prey communities may decrease the resilience of this already declining seabird to stressors such as climate-induced changes in the marine environment. We used stable isotope analysis to better understand the foraging ecology of this enigmatic species. We also used Stable Isotope Bayesian Ellipses in R (SIBER) to examine relative niche width over time and among colonies. Isotopes ( $\delta^{13}\text{C}$  and  $\delta^{15}\text{N}$ ) were analyzed from feathers of Aleutian terns collected from five breeding colonies in Yakutat, Alaska in 2010, 2011, 2012 and 2015. We found that the mean  $\delta^{13}\text{C}$  and  $\delta^{15}\text{N}$  values did not differ among colonies or years within colonies. However, results from the SIBER analysis revealed some inter-annual and geographic differences in relative niche widths. Our results indicate that although Aleutian terns from the Yakutat colonies were foraging from the same food webs, there was some inter-annual and geographic variation in their diets. We recommend continued sampling of terns and their prey at these and other colonies in Alaska. Longer-term monitoring of their diets will improve our understanding about how Aleutian tern food webs respond to changes in the marine environment, anticipate possible effects on terns and help devise appropriate ecosystem based management strategies for them as needed. (Talk)

## ACCELERATED ENERGY INTAKE INCREASES SURVIVAL RATES OF BLACK OYSTERCATCHER BROODS

Brian Robinson<sup>1</sup> Laura Phillips<sup>3</sup> Abby Powell<sup>4</sup>

<sup>1</sup>University of Alaska Fairbanks, Department of Biology and Wildlife, PO Box 756100, Fairbanks, AK 99775.

<sup>2</sup>U.S. Geological Survey, Alaska Science Center, 4210 University Dr., Anchorage, AK 99508.

<sup>3</sup>Denali National Park and Preserve, PO Box 9, Denali Park, AK 99775.

<sup>4</sup>U.S. Geological Survey, Florida Cooperative Fish and Wildlife Research Unit, PO Box 110485, Gainesville, FL 32611.

Black Oystercatchers, a species of conservation concern, depend on marine intertidal prey resources that are changing as a result global climate change. To understand the relationship between oystercatchers and their prey, we conducted a study in southcentral Alaska in 2013 and 2014 examining diet, feeding rates, brood growth and survival. To determine the importance of diet on brood survival, we modeled daily survival rates of broods as a function of energy intake rate and other ecological factors. We hypothesized that broods fed at accelerated energy intake rates would grow faster and fly earlier, thereby being less vulnerable to predators and have higher survival rates. Consistent with our prediction, broods with higher intake rates had higher growth rates and daily survival rates. The best-supported model indicated that survival varied by energy intake rate, brood age, and daily precipitation. To understand how adults meet the increasing nutritional needs of developing chicks, we examined delivery rates, prey composition and size as a function of brood age. Delivery rates differed by age, however, the composition and size classes of prey fed to chicks by their parents did not, indicating that adults respond to the energetic needs of broods by increasing parental effort rather than switching prey. Collectively, these results demonstrate the importance of diet and provisioning to broods. Given the consequences of reduced energy intake on survival, changes in the abundance and composition of intertidal macroinvertebrates as a result of climate change may have significant impacts on Black Oystercatcher populations. (Talk)

## DIET OVERLAP AND INTER-ANNUAL VARIATION OF SYMPATRIC SHEARWATERS DURING THE NON-BREEDING SEASON

Paloma Carvalho<sup>1</sup> Gail Davoren<sup>1</sup>

<sup>1</sup>University of Manitoba, 66 Chancellors Cir, Winnipeg, MB, Canada R3T 2N2.

Every year, thousands of non-breeding great (*Ardenna gravis*) and sooty shearwaters (*Ardenna grisea*) aggregate on the northeast Newfoundland coast nearby spawning sites of a key forage fish species, capelin (*Mallotus villosus*). To investigate dietary overlap of these sympatric shearwaters during their non-breeding season, great (n=79) and sooty shearwaters (n=43) were captured at sea on the northeast Newfoundland coast during July-August, 2014 and 2015. Blood was sampled for stable isotope analysis ( $\delta^{15}\text{N}$ ,  $\delta^{13}\text{C}$ ), which was separated into red blood cells (RBC), representing diet over 3-4 weeks, and plasma, representing diet over the last 3-5 days. Stable isotope signatures of RBC and plasma were similar for both species, but plasma signatures differed between years within species. During 2015, stable isotope signatures of plasma varied more among individuals (wider niche breadth) for both species (Median Bayesian standard ellipse areas for great: 0.85 and 2.722 and sooty: 1.12 and 2.742 in 2014 and 2015, respectively) and both species had lower mean  $\delta^{15}\text{N}$  (great: 11.661.65; sooty: 12.001.37) and  $\delta^{13}\text{C}$  ratios (great: -22.711.54; sooty: -22.591.24). This variation in short-term diet is consistent with shearwaters feeding on alternative prey (e.g., sandlance, herring) during 2015 when capelin arrival in the study area was delayed (July 20) relative to 2014 (July 5). These findings illustrate a high niche overlap between great and sooty shearwaters during their non-breeding season, which shifted similarly when availability of their primary prey (capelin) varied, suggesting the potential for competition under limited prey conditions during summer in coastal Newfoundland. (Talk)

LONG-DISTANCE EFFECTS OF GROWING WHITE-TAILED SEA EAGLE (*HALIAEETUS ALBICILLA*) POPULATIONS ON DUTCH BARNACLE GOOSE (*BRANTA LEUCOPSIS*) MIGRATION TIMING

Marinde Out<sup>1</sup> Ronald Ydenberg<sup>1</sup>

<sup>1</sup>Simon Fraser University, 8888 University Drive, BC V5A 1S6.

The Russian barnacle goose (*Branta leucopsis*) winters in the Netherlands and breeds in Northern Russia. After departing from the Netherlands for spring migration, geese used to stop for ca. three weeks in the Baltic, but since the 1990s, they delay their departure from the Netherlands with a month and only stay in the Baltic for ca. seven days. The goal of this study was to test two hypotheses why barnacle geese are delaying spring migration. Are geese coping with more food competition in the Baltic as a result of population growth and habitat loss? Or has staying in the Baltic become too dangerous because of growing white-tailed sea eagle (*Haliaeetus albicilla*) numbers? By comparing goose feeding behaviour, giving up densities and time budgets in the Netherlands (low eagle density) and the Baltic (high eagle density) I tested these hypotheses. Results show that geese are more vigilant and leave more food behind in the Baltic than in the Netherlands, indicating that the increased danger from eagles might cause the altered migration timing in spring. Finding out why geese are changing their migration traditions will bring us closer to solutions for the increasing agricultural damage and political conflict surrounding the large goose populations in Western Europe. (Talk)

## Thick-billed murres forage more efficiently in well-stratified waters

Nobuhiko Sato<sup>1</sup> Nobuo Kokubun<sup>2</sup> Takashi Yamamoto<sup>2</sup> Dale Kikuchi<sup>2</sup> Yutaka Watanuki<sup>3</sup>  
Alexander Kitaysky<sup>4</sup>

<sup>1</sup>SOKENDAI (The Graduate University for Advanced Studies), 10-3 Midori cho, Tachikawa, Tokyo, Japan.

<sup>2</sup>National Institute of Polar Research, Tokyo, Japan.

<sup>3</sup>Hokkaido University, Hokkaido, Japan.

<sup>4</sup>University of Alaska, Fairbanks, Alaska, USA.

Thermocline is an important oceanographic structure that might affect prey distribution for diving marine predators. Previous studies have shown that some diving seabirds frequently dive to the depths near thermocline, however these studies have rarely examined actual feeding events in relation to the depths of thermocline. We studied the foraging behaviour of thick-billed murre (*Uria lomvia*) breeding on St. George Island, in southeast-ern Bering Sea, over three breeding seasons (2013 ~ 2015). We used bird-borne video and depth-temperature-acceleration loggers to investigate the relationship between feeding rates and ocean thermal structures. In the video footages of 229 dives, we observed 1,469 feeding events (major prey item: juvenile walleye pollock). These feeding events were also detected as typical changes in swaying acceleration with high sensitivity (78.8 %). By applying the feeding detection method to whole acceleration data sets, we found that murres dove more frequently (86.6 % of all dives), and captured prey more often (1.1 vs. 0.8 feeding events /10 sec.) in stratified waters than in mixed waters. Dive scale feeding rate (number of feed-ing events / dive duration) were high (1.8 feeding events /10 sec.) when murres dove near the thermocline depths, and decreased as murres dove deeper below thermocline. These results suggest that thermocline likely facilitated the aggregations of prey in dense patches at relatively shallow depths, and benefited foraging murres. (Talk)

## Forage Fish Abundance in Common Tern Diets, and its Implications for Seabird Populations

Aspen Ellis<sup>1</sup> Paula Shannon<sup>2</sup><sup>1</sup>University of Michigan, 500 S State St, Ann Arbor, MI 48109.<sup>2</sup>Project Puffin, 159 Sapsucker Woods Rd. Ithaca, NY 14850.

Overfishing and climate change are affecting the abundance and phenology of fish world-wide. These changes can have massive effects on both human use of fisheries and marine ecosystems. There is ample evidence that forage fish availability and seabird colony health and success are correlated. Based on visual observations of chick provisioning at a Common Tern (*Sterna hirundo*) colony during fieldwork, we predicted that the abundance of primary forage fish, Atlantic herring (*Clupea harengus*) and hake/four-beard rockling (*Urophycis tenuis/Enchelyopus cimbrius*) had declined, whereas poorer food items like butterfish (*Peprilus triacanthus*) and invertebrates had increased. However, this observation has not been tested quantitatively. Here, we use long-term monitoring data from feeding studies and productivity studies to test the abundance of the forage fish in Common Tern diets from 2002-2016 on Jenny Island, Maine, and consider what it means for seabird productivity. We found that there is a significant decline of hake in Common Tern diets over the study period, though trends in the abundances of Atlantic herring, butterfish, and invertebrates, as well as the productivity of Common Terns, do not appear to have changed significantly. While the declines of hake and the possible declines of Atlantic herring are in line with our predictions, these results are inconclusive for determining whether the diet quality of Common Terns is declining, and if putative declines are affecting overall colony health. However, the declines that were found could have alarming implications for the future health and success of the North Atlantic populations of Common Terns and other seabirds. (Talk)

U.S. FISH AND WILDLIFE SERVICE CALIFORNIA CURRENT SYSTEM (CCS) SEABIRD SURVEY PROTOCOL FRAMEWORK PROJECT

William Bridgeland<sup>1</sup> Kevin Kilbride<sup>2</sup> Roberta Swift<sup>3</sup>

<sup>1</sup>USFWS, Bandon Marsh NWR, 83673 North Bank Lane, Bandon, OR.

<sup>2</sup>USFWS, R1 Inventory and Monitoring Program, Branch of Refuge Biology, Division of Natural and Cultural Resources, 1211 SE Cardinal Court, Suite 100 Vancouver, WA 98683.

<sup>3</sup>Migratory Birds and Habitat Program, USFWS - Pacific Region 911 NE 11th Ave. Portland, OR 97232.

The USFWS Pacific Regions leadership has recognized the critical need for comprehensive data on the range-wide status and trends of Pacific seabird populations to conserve these species in the face of anthropogenic threats. Accordingly, they have approved the establishment of a Pacific Seabird I&M Program (PSP) with the overall goal of coordinating the collection of seabird population information with conservation partners currently monitoring Pacific seabirds. The PSP will fulfill the long-recognized need for consolidation and standardization of data from disparate sources so it can be managed and analyzed to create a CCS-wide picture of breeding seabirds. To justify the considerable investment this new program will entail and demonstrate the feasibility of the approach proposed for the PSP, USFWS is conducting a 12-month demonstration project called the CCS Seabird Survey Protocol Framework Project. In November 2016 a workshop of about 50 seabird scientists and managers representing federal and state government agencies and many NGOs was held to obtain their input on the objectives and implementation of the project. The decision was made to produce a protocol framework for coordinated population monitoring of common murre (*Uria aalge*) and Brandts cormorant (*Phalacrocorax penicillatus*) throughout the CCS that standardizes data collection methods, data analyses, data management, and reporting. This presentation will describe the PSP, summarize the results of the workshop, and report on the status of the Protocol Framework document scheduled to be completed in 2017. (Talk)

## ENVIRONMENTAL LEARNING STRATEGY TO PRESERVE SEABIRD ISLANDS IN MEXICO: THE CASE OF EL VIZCANO BIOSPHERE RESERVE.

Mara Felix-Lizrraga<sup>1</sup> Yuliana Bedolla-Guzmn<sup>1</sup> Alfonso Aguirre-Muñoz<sup>1</sup> Mariam Latofski-Robles<sup>1</sup> Cynthia Jauregui-Garca<sup>1</sup> Joana Bielschowsky de Aguirre <sup>1</sup>

<sup>1</sup>GRUPO DE ECOLOGIA Y CONSERVACION DE ISLAS, A.C, maria.felix@islas.org.mx.

Mexico is leading island restoration activities worldwide. Several strategies such as invasive species eradication, habitat restoration, seabird restoration, scientific research, policies and environmental learning, are implemented. All the projects are linked and developed according to the specific needs regions of the country. Environmental learning is a transversal activity, and it has been implemented since the Seabird Restoration Program started in the Biosphere Reserve El Vizcano, Baja California, Mexico. An environmental education plan was proposed with the Mexican Fund for the Conservation of Nature and several activities were carried out. The approach was the social construction of a local identity. We conducted Environmental Culture Weeks in Baha Asuncin, Guerrero Negro and Natividad Island in three different years. During the events, local artists come together with biologists to develop the activities, which were modified according to the target community. Mural painting, drawing, songwriting, storytelling, theater, and sculpture were the artistic activities linked with environmental learning. Moreover, biosecurity workshops for fishing cooperatives were conducted. The communities took whole advantage of these events and truly enjoyed the experience. The network between seabird biologists and local communities are strengthened through the arts. In total, 400 people attended the events in Baha Asuncin, 1200 in Guerrero Negro and 80 on Natividad Island. A new paradox is created for the Mexican islands, with the collaboration and formulation of projects built from the local communities to be implemented widely (Talk)

## THE CHANGING ROLE OF RED-LEGGED KITTIWAKES IN THE SUBSISTENCE CULTURE OF THE PRIBILOF ISLANDS, ALASKA

Romano Marc<sup>1</sup> Lauren Divine<sup>2</sup> Sharon Mercurief<sup>3</sup> Heather Renner<sup>1</sup>

<sup>1</sup>Alaska Maritime National Wildlife Refuge, 95 Sterling Highway, Suite 1, Homer, AK 99603 .

<sup>2</sup>Aleut Community of St. Paul Island, 4720 Business Park, Anchorage, AK 99503 .

<sup>3</sup>St. George Traditional Council, 1 Zapadni Rd, St George, AK 99591 .

The red-legged kittiwake (*Rissa brevirostris*) is a rare seabird confined to only four major nesting locations, all in the Bering Sea. The majority of the global population nests on the Pribilof Islands, Alaska, where they are also an important subsistence food resource for residents of the Aleut villages of St. Paul and St. George. The kittiwake population on both islands declined precipitously from the mid-1970s through the late 1980s, and while the population has largely rebounded on St. George, the population on St. Paul continued a decline through 2008 that has only recently showed signs of stabilizing. Due to concern that population decline may impact the use of the species as a subsistence resource, the U.S. Fish and Wildlife Service partnered with the Aleut Community of St. Paul Island and the St. George Traditional Council to determine the role of red-legged kittiwakes in the subsistence culture of the two communities. We collected Traditional Knowledge (TK) through recorded, face to face interviews with local subsistence hunters. The TK interview questions covered a variety of topics ranging from subsistence hunting practices to kittiwake population information, and the cultural significance of the species. The interviews revealed that despite waning participation in the hunt there is still a demand for kittiwakes as a subsistence resource, particularly among village elders. Here we present the results from the interviews and discuss reasons for the decline of participation in the hunt. We also discuss the current role of the species in subsistence harvest and compare it to the most recent subsistence harvest information from 1994. (Talk)

COMPLEXITIES OF PREDATOR CONTROL AROUND ENDANGERED SEABIRD COLONIES  
IN A WILDERNESS SETTINGKyle Pias<sup>1</sup> Andre Raine<sup>2</sup><sup>1</sup>Hono O Nā Pali Seabird Mitigation Project, 1544 Haleukana Street, Bay 2, Lihue, HI 96766.<sup>2</sup>Kaua'i Endangered Seabird Recovery Project, .

Hono O Nā Pali Natural Area Reserve is an important breeding site for the federally threatened Newells Shearwater (*Puffinus newelli*), the federally endangered Hawaiian Pe-trel (*Pterodroma sandwichensis*) and the federally endangered Band-rumped Storm-Petrel (*Oceanodroma castro*). Breeding colonies of these seabirds elsewhere on the island of Kaua'i face threats from anthropogenic sources such as light pollution and power-line strikes. While the colonies in Hono O Nā Pali are relatively unaffected by such threats given the lack of human habitation and infrastructure on the northwest coast of the island, they do face predation from a variety of invasive species including feral cats (*Felis catus*), black rats (*Rattus rattus*), feral pigs (*Sus scrofa*), and Barn Owls (*Tyto alba*). Here we explore the factors that complicate predator control in a wilderness setting (environment and terrain, non-target trap interactions, cultural and political considerations, and low-target species densities) and offer some solutions to these complexities. (Talk)

## POPULATION TRENDS OF ALASKAN SEABIRDS, 1974-2016

Aaron Christ<sup>1</sup> Heather Renner<sup>1</sup> Stephani Zador<sup>2</sup>

<sup>1</sup>Alaska Maritime National Wildlife Refuge, 95 Sterling Highway, Suite 1, Homer, Alaska 99603.

<sup>2</sup>Resource Ecology and Fisheries Management Division, Alaska Fisheries Science Center, NMFS, NOAA, 7600 Sand Point Way NE, Seattle, WA 98115.

While many individual seabird colonies have well-described population trends, few meta-analyses are available to aggregate trends at ecologically meaningful scales. Yet several studies have published disconcerting analyses suggesting large declines of seabird populations worldwide. We compiled available population trend data (1974 to 2016) from 17 seabird species at 33 Alaskan colonies. Data types vary, from full colony censuses (of breeding birds) to counts of adults or nests on index plots (cliff and surface nesters), to counts of occupied burrows (burrow nesters), to birds socializing near to nesting colonies (crevice nesters). We expanded upon previously presented work using multivariate autoregressive state-space (MARSS) models to incorporate the finer spatial scale trends of hundreds of individual plots rather than only aggregated colony indices and counts. We examine the trade-off of increased parameters and variability with the expanded information from using all available, often irregularly replicated, plot data rather than excluding all but complete sets of index plots and counts for each colony. We further examine differences in observational error for birds with disparate nesting strategies (e.g. cliff nesters, burrow nesters) due to different sampling regimes as well as whether species or ecoregion are primary sources of process error. Preliminary results indicate little structure in the time series beyond individual colonies and a unified process error, with most colonies showing a slight decline. (Talk)

## Seabird Studies Must Consider Sex

Natasha Gownaris<sup>1</sup> Dee Boersma<sup>1</sup><sup>1</sup>Penguin Sentinels, University of Washington, Seattle, Washington 98105.

Punta Tombo, Argentina is the worlds largest breeding colony (~200,000 breeding pairs) of Magellanic penguins (*Spheniscus magellanicus*) and has declined an average of 1%/year since 1987, with lack of food believed to be a major cause. Using 33 years of banding data on 45,000 known-age penguins, we developed a mark-recapture model with two levels of uncertainty in state assignment (breeding state and sex). We had two goals, to: 1) understand the drivers of the colonys decline, and 2) show the importance of including sex in demographic studies. Only 20% of mark-recapture studies in the past decade consider sex, despite methodological solutions to dealing with sex uncertainty. Sex was a major driver of variance in survival, with males showing annual juvenile survival rates as high as 1.7 times that of females. The sex survival gap was smaller in older birds, but female survival was lower than male survival in over 80% of cases. These results help to explain our findings that the sex ratio at Punta Tombo has increased significantly over time, from 1.2 (M:F) in 1987 to 2.5 in 2015, and has been coupled with a significant decline in male breeding propensity. Population trajectory simulations show that assuming average survival provides misleading information on population health. We argue that inter-sexual variation in survival is likely caused by variation in size, storage capacity, and surface to volume ratio, which influence energetics and diet. Consequently, climate change may have disproportionate effects on females in seabird species where females are smaller than males. (Talk)

## RED-FACED CORMORANT POPULATION DECLINE IN THE PRIBILOF ISLANDS, ALASKA.

Ryan Mong<sup>1</sup> Greg Thomson<sup>1</sup> Marc Romano<sup>1</sup>

<sup>1</sup>Alaska Maritime National Wildlife Refuge, 95 Sterling Highway, Suite 1, Homer, AK 99603 USA.

Red-faced cormorants (*Phalacrocorax urile*), are a poorly studied species for which even the most basic biological information is largely unavailable for throughout the majority of their range. Assessment of their population trends has proven difficult due to the remote nature of their colonies and their apparent lack of breeding site fidelity. Boat-based surveys of cormorants for the Pribilof Islands archipelago were conducted in 2005 and again in 2015. Surveys specifically targeting cormorants were not conducted in the Pribilofs prior to 2005 nor between 2005 and 2015, with the exception of St. Paul Island which was surveyed annually from 2012-2016. A decrease in the number of nests (53%) and adults and immature birds (56%) was observed between the 2005 and 2015 surveys. Proportional decreases were observed among each of the islands surveyed (St. Paul, St. George, Walrus and Otter). Given the isolation of the Pribilofs it is likely that changes in the red-faced cormorant population in the Pribilof Islands are not significantly driven by immigration or emigration. Thus, the reduction in nests and individuals observed between 2005 and 2015 may represent a serious decline in the Pribilof Islands red-faced cormorant population. (Talk)

ASSESSING KITTLITZS AND MARBLED MURRELET ABUNDANCE AT SITES IN  
SOUTHEAST ALASKA, AND THEIR APPLICABILITY FOR LONG-TERM MONITOR-  
ING

Kelly Nesvacil<sup>1</sup> Michelle Kissling<sup>2</sup> Paul Lukacs<sup>3</sup> Grey Pendleton<sup>1</sup>

<sup>1</sup>Division of Wildlife Conservation, Alaska Department of Fish and Game, P.O. Box 115526  
Juneau, AK 99811.

<sup>2</sup>Marine Mammals Management, U.S. Fish and Wildlife Service, 3000 Vintage Blvd., Suite  
201 Juneau, AK 99801.

<sup>3</sup>Wildlife Biology Program, College of Forestry & Conservation, University of Montana, Mis-  
soula, MT 59812.

We estimated the abundance of Kittlitzs murrelets (*Brachyramphus brevirostris*) and marbled murrelets (*B. marmoratus*) at several sites in southeast Alaska in June-July 2016. We also assessed the utility of some of these areas to be used for long-term monitoring of at-sea murrelet abundance. Currently, only one area of southeast Alaska has long-term monitoring for *Brachyramphus* murrelets and the addition of other high density sites could aid in determining larger abundance trends for the region. All sites surveyed in 2016 had been previously surveyed for murrelets, thus have historic data to build upon for the estimation of trends in a long-term monitoring program. In 2016, we surveyed each site twice using distance sampling, and applied similar methods and utilized the same transects as any previous surveys to allow for comparison of data among years. We will present at-sea abundance estimates from 2016 and compare them to previous years data in the same study sites. We will also report whether detectability varied by site, species, year, weather, sea state, or a combinations of these factors. Trend estimates for each area will be presented where possible, and we will present recommendations for long-term monitoring program design and objectives based on precision of the data and site logistics. (Talk)

## BURROW PLOTS SURVEYS OF STORM-PETRELS: EXPLORING LONG-TERM DATA FROM AIKTAK ISLAND, ALASKA TO DETERMINE WHAT BURROW MONITORING TELLS US ABOUT POPULATION TRENDS

Nora Rojek<sup>1</sup>

<sup>1</sup>Alaska Maritime National Wildlife Refuge, 95 Sterling Highway, Suite 1, Homer, Alaska 99603.

Long-term burrow plot surveys for density and occupancy of fork-tailed and Leachs storm-petrels (*Oceanodroma furcata* and *O. leucorhoa*), which co-exist at many colonies, have been conducted by the Alaska Maritime National Wildlife Refuge at several annual monitoring sites. At Aiktak Island, in the eastern Aleutians, intensive monitoring was initiated in 1995, with 17 plots surveyed since 2000. Aiktak Island is an important long-term monitoring site for storm-petrels because the Unimak Pass area provides important breeding habitat for burrow nesting seabirds, as well as has potential for impacts due to high levels of fishing and vessel traffic. Occupied burrow density has significantly increased from 2000 to 2016 ( $R^2 = 0.46$ ,  $F = 11.8$ ,  $p = 0.004$ ). The pattern of occupancy rates, with a low in 2002, is consistent at other Aleutian islands. The data indicate that the number of breeding storm-petrels at Aiktak Island is either stable or increasing, which defers from indications that Leachs storm-petrels are declining in other Pacific locations. However, we are challenged by the usefulness of current methods to detect trends, and particularly by inter-annual observer bias. We will discuss problems encountered and seek improvements for future monitoring and protocol standardization across sites. (Talk)

## FOOTLOOSE AND FANCY-FREE: SURVIVAL, AGE AT FIRST RETURN AND BREEDING IN CASPIAN TERNS

Yasuko Suzuki<sup>1</sup> Daniel Roby<sup>2</sup> Donald Lyons<sup>1</sup> Pete Loschl<sup>1</sup> Timothy Laws<sup>1</sup> Kirsten Bixler<sup>1</sup>  
Ken Collis<sup>3</sup>

<sup>1</sup>Oregon Cooperative Fish & Wildlife Research Unit, Department of Fisheries and Wildlife, Oregon State University, Corvallis, OR USA.

<sup>2</sup>U.S. Geological Survey-Oregon Cooperative Fish & Wildlife Research Unit, Oregon State University, Corvallis, OR USA.

<sup>3</sup>Real Time Research, Inc. , Bend, OR USA.

We estimated apparent juvenile and adult survival, age at first return to the breeding grounds, and age at first breeding in Caspian Terns (*Hydroprogne caspia*) at colonies in the U.S. Pacific Northwest based on 11 years (2006-2016) of data analyzed in a mark-resight framework. Some of the colonies in the study area have been subject to management to mitigate the impact of tern predation on ESA-listed salmon smolts. The study area consisted of 4 sub-regions: (1) a very large colony where tern nesting habitat has been incrementally reduced since 2008, (2) a region with two established tern colonies where nesting habitat has been limited since 2014 but where alternative nesting habitat was available at nearby colonies, (3) a region where islands have been built to provide nesting habitat to compensate for management elsewhere, and (4) a region with ephemeral colonies but no management to benefit salmonids. When parameters were estimated region-wide, age at first return to the breeding grounds was as young as 2 years old with a median age of 4 years old. Survival from fledging to 2 years old was 0.50 with greater annual survival (> 0.85) at the age of 3 years or older. Youngest age at first breeding was 3 years old with low (<0.05) recruitment probabilities at the ages of 3-4 years. Median age at first breeding was 6 years old. Evaluation of parameters within sub-regions revealed that age at first breeding was older at the very large colony experiencing incremental habitat reduction, compared to other sub-regions. These demographic parameters are vital for developing a reliable population model, and the results suggest the importance of including parameters estimated during a variety of management conditions. (Talk)

## COLONY SIZE INFLUENCES FIDELITY IN A COLONIAL NESTING SEABIRD

Aly McKnight<sup>1</sup> Erik Blomberg<sup>1</sup> David Irons<sup>2</sup> Cynthia Loftin<sup>3</sup> Shawn McKinney<sup>3</sup>

<sup>1</sup>Department of Wildlife, Fisheries and Conservation Biology, University of Maine, Orono ME 04469.

<sup>2</sup>US FWS - MBM, Anchorage AK 99503.

<sup>3</sup>US Geological Survey, Maine Cooperative Fish and Wildlife Research Unit, Orono ME 04469.

Most seabirds breed colonially and exhibit considerable breeding site fidelity over the course of their long lifespans. Initial colony selection therefore can be a high-stakes proposition, however, factors contributing to recruitment and subsequent fidelity remain unclear. We used multi-state capture-recapture models to test hypotheses explaining apparent fledgling survival, natal colony recruitment, and apparent post-recruitment survival in Black-legged Kittiwakes at a south-central Alaska colony over 20 years. Our top models showed that apparent fledgling survival declined overall and that the variation was driven by cohort-specific factors but was not explainable by post-fledging wind and climate conditions. Independent resighting efforts suggest the decline resulted partially from increased fledgling dispersal in later years. Recruitment was primarily age-dependent, with no detectable effect of early life experience or annual changes in colony size, colony productivity, winter Pacific Decadal Oscillation index values, winter Nino 3.4 values, or non-breeding season wind or sea surface temperatures in the northern Gulf of Alaska. We estimated an average recruitment age of 6.7 years, consistent with the estimate for another Gulf of Alaska colony, and supporting the idea, presented by other authors, that Pacific kittiwakes exhibit a more conservative life history strategy than Atlantic counterparts. Variation in apparent survival of recruits was cohort-specific and did not correlate with age or annual changes in the factors listed above. Instead, apparent survival of recruits was best explained by colony size during a cohorts second year, suggesting a degree of negative density dependence in post-recruitment fidelity. (Talk)

## IS AGE IN THE EYES AND FEET OF A PENGUIN?

P. Dee Boersma<sup>1</sup> Kathryn Wellington<sup>1</sup> Katie Holt<sup>1</sup> John Samaras<sup>2</sup> Ginger Rebstock<sup>1</sup> Caroline Cappello<sup>1</sup>

<sup>1</sup>University of Washington, Department of Biology, University of Washington, Department of Biology, Box 351800, Seattle, WA 98185-1800.

<sup>2</sup>Woodland Park Zoo, 5500 Phinney Ave. N. Seattle, WA 98103.

Knowing the age structure of a population improves demographic models, but birds lack structures, such as teeth and otoliths, used to age other animals. Marking and following large numbers of individuals is required to know the age structure of a penguin population beyond the distinction between juvenile and adult plumage. In a large population of Magellanic penguins (*Spheniscus magellanicus*) at Punta Tombo, Argentina, we coded eye and foot color. The penguins ranged from less than one year to more than 28 years of age. We examined iris pattern and color, defining distinct eyes as reddish-colored irises with concentric red and pink rings and indistinct eyes as dark-brown irises. More than 75% of 2-3 year-old Magellanic penguins had distinct eyes, compared to 50-75% of 4-6 year-olds, 25-50% of 7-20 year olds, 10-25% of 21-24 year olds, and <10% of 25+ year olds (n=3262). Foot color progressed from mostly white to mottled to mostly black. We also examined foot color in a small known-age zoo population of Humboldt penguins (*Spheniscus humboldti*). In Humboldt penguins, feet became mostly black within a year of hatching, but continued to darken slowly with age (n=44, maximum age=25 years). In Magellanic penguins, feet took several years to become mostly black (n=190). Nestlings had mostly white feet with small specks of black (n=16). About 88% of adults 3-11 years old had mottled or mostly black feet, while the remaining 12% had white or fully black feet (n=90). 24 of 25 adults 23 years or older had black or almost black feet. Individual variation in both eyes and feet prevents aging an individual with a high degree of certainty, but a population may be split into broad adult age classes based on eye and foot color. (Talk)

## POPULATIONS TRENDS OF COMMON MURRES AND BRANDT'S CORMORANTS IN THE GULF OF THE FARALLONS 1999-2016

Cassie Bednar<sup>1</sup> Gerard McChesney<sup>2</sup> Phillip Capitolo<sup>3</sup> Michael Parker<sup>4</sup> Harry Carter<sup>2</sup> Pete Warzybok<sup>4</sup>

<sup>1</sup>Humboldt State University, Dept. of Wildlife, 1 Harpst St, Arcata, California 95521 USA.

<sup>2</sup>U.S. Fish and Wildlife Service, San Francisco Bay National Wildlife Refuge Complex, 1 Marshlands Rd. Fremont, California 94555 USA.

<sup>3</sup>Institute of Marine Sciences, University of California, Santa Cruz, 1156 High St, Santa Cruz, CA 95064 USA.

<sup>4</sup>Point Blue Conservation Science, 3820 Cypress Dr #11, Petaluma, CA 94954 USA.

The Common Murre (*Uria aalge*) and Brandts Cormorant (*Phalacrocorax penicillatus*) are two of the most abundant breeding seabirds in the Gulf of the Farallones. Following partial recovery from extensive commercial eggging in the 19th century, in the mid-20th century this population again declined rapidly in the mid-1980s as a result of gill-net and oil spill mortality. The regional Brandts Cormorant population declined following the strong 1982-83 El Niño. We examined trends in Gulf of the Farallones breeding populations of Common Murres and Brandts Cormorants for the period 1999-2016, the years following the 1997-98 El Niño event and beginning with the oceanographic regime shift of 1999. Data used were from annual aerial photographic surveys of most breeding colonies and other surveys at the South Farallon Islands. Common Murre annual breeding population sizes ranged from 128,000 to 415,000 birds. Significant population increases ranging 4.0%-19% per annum were found at all but one of seven colonies. Increases can be attributed to reduced fishery related and oil spill mortality as well as relatively high survivorship and recruitment resulting from productive foraging conditions. Brandts Cormorant annual breeding population sizes ranged from 2,600 to 40,000 breeding birds. Although no significant trends were found for the period, nearly all colonies showed a pattern of increase between 1999 and 2007 followed by an abrupt decline. After 2010, numbers began recovering at most colonies to levels recorded in the earlier part of the time series. The increase and rapid decline of the regions Brandts Cormorants has been linked to changes in northern anchovy (*Engraulis mordax*) abundance. (Talk)

## THE SUCCESSFUL SEABIRD RESTORATION ON MEXICAN ISLANDS

Yuliana Bedolla-Guzman<sup>1</sup> Alfonso Aguirre-Muñoz<sup>1</sup> Federico Mendez-Sanchez<sup>1</sup> Antonio Ortiz-Alcaraz<sup>1</sup> Julio Hernandez-Montoya<sup>1</sup> Evaristo Rojas-Mayoral<sup>1</sup>

<sup>1</sup>Grupo de Ecología y Conservación de Islas, A.C.

<sup>2</sup>U.S. Fish and Wildlife Service.

<sup>3</sup>NOAA Restoration Center.

<sup>4</sup>Cornell Lab of Ornithology.

<sup>5</sup>National Audubon Society.

Mexican islands are key breeding, feeding and resting sites for a third of the seabirds worldwide. On some of these islands, seabird populations were extirpated by invasive mammals and impacted by DDT and oil spills. Over the past two decades, we have been conducting a restoration program including the removal of invasive mammals, followed by social attraction techniques to attract back seabirds, habitat restoration, applied research, island biosecurity and environmental learning. We are currently working with 31 seabird species on 25 islands, with a focus in NW Mexico: Baja California Pacific, Gulf of California, and Archipelago de Revillagigedo. Our results are encouraging, some extirpated populations have returned to their breeding sites and decremented populations have increased their numbers after the eradication campaigns and implementation of social attraction techniques. Social attraction systems have been effective since the first year. We have generated scientific and baseline information non-existent until now essential for appropriate decision making for species management. The development of specialized capacities in this seabird priority region, the team-work of a skillful and experienced staff, the everyday on-site presence of conservation as a social actor, and the persistent collaboration with government agencies, both from Mexico and USA, academic institutions, and fishing cooperatives have been key for the project's success. The work with local communities on island biosecurity issues has been important to maintain the conservation gains. These encouraging achievements highlight the relevance of comprehensive, long-term conservation programs to effectively restore seabirds on Mexican islands. (Talk)

STATUS OF ENDANGERED BRYANS SHEARWATERS AND MANAGEMENT OF BIRD BREEDING ISLANDS IN THE OGASAWARA ISLANDS IN JAPAN.

Kazuo Horikoshi<sup>1</sup> Hajime Suzuki<sup>1</sup> Hayato Chiba<sup>1</sup> Kazuto Kawakami<sup>2</sup>

<sup>1</sup>Institute of Ornithology, Nishimachi, Chichijima, Ogasawara-mura, Tokyo, JAPAN.

<sup>2</sup>Forestry and Forest Products Research Institute, Matunosato1, Tukuba-shi, Ibaraki-ken, JAPAN.

The Bryans shearwater (*Puffinus bryani*) was described as a new species in 2011 based on a specimen from the Midway atoll. However, no information has been reported in the Hawaiian Archipelago since 1991. Two alive birds were rescued and four carcasses were found in the Ogasawara Islands in Japan between 1997 and 2011. Then, we have started to investigate the distribution and habitat preference using the acoustic recording units. So far, we have succeeded to record the voices at least at four inhabited islands in the two island groups, and we confirmed the breeding birds at one island. The Bryans shearwaters visit the islands during winter season (November through May). The breeding sizes of each island seem to be very small and alien rats might affect the survival of the endangered shearwater seriously. Eradication programs of alien mammals and forest restoration in the seabird breeding islands have been launched gradually by government agencies. (Talk)

## AN INVASIVE MOUSE POPULATION COULD THREATEN SEABIRD RECOVERY AT JARVIS ISLAND NATIONAL WILDLIFE REFUGE

S. Hunter<sup>1</sup> Stefan Kropidlowski<sup>1</sup> Elizabeth Flint<sup>1</sup>

<sup>1</sup>US Fish and Wildlife Service, Marine National Monuments of the Pacific, 300 Ala Moana Blvd. Rm # 5-231, Honolulu, HI 96850.

The number of small seabirds documented using Jarvis Island National Wildlife Refuge has increased after predator eradications but is likely still limited by the presence of an invasive mammal. Jarvis is located in the Pacific Ocean Equatorial Dry Zone. Rodents were introduced during early explorations and cats (*Felis catus*) arrived in the mid 1930s. The cats exterminated the rats (*Rattus exulans*) but then turned to seabirds and their eggs for food. Cats were eliminated at Jarvis by 1990, but the mouse (*Mus musculus*) population persisted. Released from competition and predation, mouse numbers dramatically increased. A biological assessment in 2015 measured mouse densities of 40 mice per hectare on Jarvis. After a wet spring in 2016 the population exploded to 200 mice/ha. The 2016 assessment also noted the presence of breeding Tropical, Christmas, and Wedge-tailed Shearwaters (*Puffinus bailloni* & *nativitatis*; *Ardenna pacifica*), Blue Noddies (*Procelsterna cerulea*), Brown Noddies (*Anous stolidus*), and Sooty and Gray-backed Terns (*Onychoprion fuscatus* & *lunatus*), as well as, prospecting Polynesian Storm-Petrels (*Nesofregetta fuliginosa*) and for the first time Bulwers Petrels (*Bulweria bulwerii*). Smaller ground-nesting and burrowing birds are especially at risk from mouse attacks and egg depredation, but even bigger birds, such as one of the largest breeding colonies of Masked Boobies (*Sula dactylatra*), are at risk during the brooding and chick stages. High mouse densities and fluctuating food availability due to high rainfall during ENSO years could threaten globally important seabird populations necessitating mouse eradication at Jarvis Island National Wildlife Refuge in the Remote Islands Marine National Monument. (Talk)

## THE STATUS OF THE COMMON MURRE AT TEURI ISLAND, JAPAN

Shin Matsui<sup>1</sup> Yasunori Takenaka<sup>2</sup>

<sup>1</sup>Hokkaido Seabird Center, Kita 6-jo 1-chome, Haboro, Tomamae, Hokkaido, 078-4116, Japan.

<sup>2</sup>Japan Ministry of the Environment, Kita 6-jo 1-chome, Haboro, Tomamae, Hokkaido, 078-4116, Japan.

The only remnant breeding colony of the Common Murre (*Uria aalge*) remains at Teuri Island, Japan. Only a few birds exist at this colony which held about 8,000 murre in 1963. Since 2003, the Japan Ministry of the Environment has used a social attraction system, including murre decoys and a sound system playing recorded murre calls, to attract and encourage Common Murres to continue breeding on Teuri Island. Since 2009, Common Murres have bred on the island only in a shallow cave set within a cliff adjacent to a small seastack known as Akaiwa Rock. Fledging success is attributed to predation of eggs and chicks by Slaty-backed Gulls (*Larus schistisagus*) and Jungle Crows (*Corvus macrorhynchos*). Since 2011, the Japan Ministry of the Environment has controlled these avian predators visiting the murre breeding site to avoid extinction of the mures out of Japan. Although the proportion of fledglings per egg in 2008-2010 was only 33%, that in 2011-2016 with predator control was 77%. Since 2012, we have monitored murre activity at the site. In 2016, to attract Common Murres, the sound system broadcasting murre calls was installed 20 m below the cave, in which fifty-two decoys were set in the past. They monitored murre behavior inside the cave using four remote CCD cameras from April to July. Sixteen breeding pairs were recorded to have laid an egg between early May and early June. Sixteen eggs hatched between June 10th and July 10th. At least thirteen chicks fledged from early July to mid-July (one chick was depredated by Jungle Crow; fledging success of two chicks were unknown). For the six year period of 2011 to 2016 with predator control, between 7 and 13 Common Murre chicks have fledged from the cave every year. (Talk)

## Acoustic monitoring of seabirds before and after rat eradication on Haida Gwaii

Carita Bergman<sup>1</sup> Luke Halpin<sup>2</sup>

<sup>1</sup>Gwaii Haanas National Park Reserve and Haida Heritage Site, Skidegate, BC , 60 Second Beach Road, Skidegate BC PO Box 37, Queen Charlotte BC V0T 1S0.

<sup>2</sup>Halpin Wildlife Research, 2020 Haro St., Vancouver, BC.

Night Birds Returning, a restoration project designed to eradicate invasive rats on islands that once flourished with nesting seabirds, successfully achieved rat-free status on 3 of 4 islands in the archipelago of Haida Gwaii, as of 2015. Historic seabird surveys based on burrow counts indicated that nesting seabirds were extirpated on these islands prior to rat eradication. We planned to monitor seabird recovery using acoustic recorders to target three vocal species that use the islands: Ancient Murrelets (*Synthliboramphus antiquus*), Cassins Auklets (*Ptychoramphus aleuticus*), and Fork-tailed Storm-petrels (*Oceanodroma furcata*). We gathered night time recordings during the peak of the breeding season for these species, and evaluated presence/absence of the target species during their peak of vocal activity. Recordings were made both for two years before restoration, and two years after restoration. Given historical information, we expected not to find evidence of breeding seabirds prior to restoration. In fact, recordings proved that remnant populations of seabirds still used the islands. We compare acoustic measures using a BACI design to examine seabird response to eradication. We plan to implement long term monitoring using the same technology, as it is expected that recovery of seabird breeding populations may not be apparent for up to a decade. (Talk)

## ARCTIC SEABIRDS WORK HARDER TO GAIN LESS WHEN ICE LEAVES EARLY

Kyle Elliott<sup>1</sup> Tony Gaston<sup>1</sup><sup>1</sup>McGill University.<sup>2</sup>Environment Canada.

Ice provides a key habitat for Arctic food webs and earlier ice melt can negatively impact many Arctic animals, especially at the receding southern edge of the range. If negative impacts are due to bottom bottom-up effects, with ice-associated prey being rarer or more difficult to capture, then predators would be expected to either expend more energy and/ or gain less energy when foraging. To examine how earlier ice melt affects the costs of obtaining food for an Arctic seabird, we monitored the demography, diet and foraging behaviour of thick-billed murre (*Uria lomvia*) between 1987 and 2013. The proportion of the main ice-associated prey, Arctic cod (*Boreogadus saida*), in the diet of seabirds declined over 27 years and, within each year, with time since 50% ice coverage. In years when Arctic cod was seldom observed in murre diets, offspring grew slower while adults delivered less energy per day, weighed less and had lower overwinter survival, despite expending more energy, spending more time submerged and spending more time at the bottom phase of each dive. Predator behaviour acted as an early warning signal for demographic changes demonstrating that a warmer Arctic increases the costs and reduces the gains associated with foraging for pagophilic predators. (Talk)

FORAGING NICHE SEPARATION OF ADELIE (PYGOSCELIS ADELIAE) AND GENTOO (P. PAPUA) PENGUINS DURING THE BREEDING SEASON AT PALMER STATION, ANTARCTICA

Pickett Erin<sup>1</sup> Bill Fraser<sup>2</sup> Donna Patterson<sup>2</sup> Megan Cimino<sup>3</sup> Ari Friedlaender<sup>1</sup>

<sup>1</sup>Oregon State University, .

<sup>2</sup>Polar Oceans Research Group, .

<sup>3</sup>Scripps Institution of Oceanography - UC San Diego , .

The Western Antarctic Peninsula is one of the most rapidly warming regions on Earth and is experiencing a poleward climate migration. This transition from a polar to sub-polar environment has resulted in a range expansion of the ice-intolerant gentoo penguin (*Pygoscelis papua*) and a coincident decline of ice-obligate Adelle penguins (*P. adeliae*) at Palmer Station, Anvers Island. Ecologically similar species that share a limited prey resource must occupy disparate foraging niches in order to co-exist. Therefore, the aim of this study was to determine the extent of spatial and dietary niche segregation between Adelle and gentoo penguins during the breeding season at Palmer Station. This research was conducted across six austral breeding seasons, from 2010-2015, which allowed for an investigation of the consistency of niche overlap in the context of resource variability. This study was conducted using a twofold methodological approach involving biotelemetry and diet sampling. While substantial overlap was observed in the diets of Adelle and gentoo penguins, who consumed primarily Antarctic krill, these results show that Adelle and gentoo penguins partitioned this shared prey resource through horizontal and vertical segregation of their core foraging areas. No evidence was found to suggest that climate-induced sympatry of Adelle and gentoo penguins has resulted in competition for prey and the subsequent differing population trajectories. Rather, other physical and biological changes to the ecosystem due to the rapidly changing climate around the Antarctic Peninsula may have stronger influences on the current trends of these two species in this region. (Talk)

## The Ice Ecology of Kittlitz's Murrelet

John Piatt<sup>1</sup> Mayumi Arimitsu<sup>1</sup> Kathy Kuletz<sup>2</sup> Sarah Schoen<sup>1</sup> Gary Drew<sup>1</sup> Brielle Heflin<sup>1</sup>

<sup>1</sup>USGS Alaska Science Center, 4210 University Dr., Anchorage AK 99603.

<sup>2</sup>US Fish and Wildlife Service, 1011 E Tudor Rd, Anchorage AK 99503.

Kittlitz's Murrelet (KIMU), a small seabird in the auk family, evolved in Beringia during the early Pleistocene and thrives in icy-cold environments. Present-day breeding populations are associated with glaciated coastal areas of the Gulf of Alaska (GOA) and Bering Sea. Many aspects of the ecology are closely associated with ice, both on land and at sea. Nesting habitat is found almost exclusively on recently de-glaciated landscapes, usually in spatial association with active glacial fields, sometimes even on glacial ice itself. However, it is not the ice, but the barren, rocky, predator-free setting that benefits breeding birds. During the summer in the Gulf of Alaska, > 80% KIMU forage in close (<20 km) proximity to glacial river outflows at sea and short (<20 km) flying distances to ice fields on land. Most KIMU forage in icy cold waters downstream of tidewater glaciers and glacial outflows, and are specialized for foraging in turbid, light-limited surface strata. After breeding, KIMU migrate into the Bering and Chukchi seas, and by winter are found foraging in polynyas and ice-edge habitats in the Bering Sea. Thus KIMU are among a select few northern seabirds that appear to be truly pagophilic, using habitats influenced by both glacial-ice and sea-ice throughout its annual life cycle. (Talk)

## Predator Foraging Altering the McMurdo Sound Preyscape

Benjamin Saenz<sup>1</sup> David Ainley<sup>2</sup> Kendra Daly<sup>1</sup> Stacy Kim<sup>3</sup> Erin Conlisk<sup>2</sup> Dennis Jongsomjit<sup>4</sup><sup>1</sup>University of South Florida, Tampa FL.<sup>2</sup>H.T. Harvey & Associates, Los Gatos CA.<sup>3</sup>Moss Land Marine Laboratories, Moss Landing CA.<sup>4</sup>Point Blue Conservation Science, Petaluma CA.

Growing evidence indicates that the Ross Sea, Antarctica, food web is structured as a 'wasp-waist' system, in which krill and fish constitute the restriction between upper and lower trophic levels. The availability of these prey appears to be affected by top-down pre-dation, and to have minimal coupling with primary productivity processes. We investigated this issue further by quantifying prey abundance, depth and distribution along the McMurdo Sound fast-ice edge, using an ROV equipped with acoustic and fluorescence sensors and a CTD equipped with a fluorometer, while logging the foraging behavior of Adelie Penguins as well as the abundance of trophically competing cetaceans and seals. Early in the study period, concentrations of seals and Emperor Penguins coincided with a location at which high abundance of an under-ice dwelling fish occurred; these predators disappeared with reduction in that prey abundance and/or the arrival of seal and penguin-eating killer whales. The diet of Adlie Penguins changed from 100% krill to 50% krill-fish upon the arrival of minke and fish-eating killer whales. Penguin diving depth did not change, nor did their foraging range from a colony, as has been observed previously. However, the prevalence of mid-water dwelling forage fish decreased within the penguins foraging range. Apparently, penguins and cetaceans appear to have targeted the high-energy dense fish instead of krill, and as a result changed prey availability. Our study brings added support for a food web in which top-down forcing is as important as primary production, having implications for managing fisheries in the region. (Talk)

IS SEA-ICE MARGINAL HABITAT FOR LITTLE AUKS (*Alle alle*)?

Francoise Amelineau<sup>1</sup> David Gremillet<sup>1</sup> Ann Harding<sup>2</sup> Wojciech Walkusz<sup>3</sup> Remi Choquet<sup>1</sup>  
Jerome Fort<sup>4</sup>

<sup>1</sup>CEFE, CNRS , 1919 route de Mende, 34293 Montpellier, France.

<sup>2</sup>Environmental Science Department, Alaska Pacific University, 4101 University Drive, Anchorage, AK 99508, USA.

<sup>3</sup>Institute of Oceanology, Polish Academy of Sciences, Powstancow Warszawy 55, 81-712 Sopot, Poland.

<sup>4</sup>LIENSs, UMR 7266 CNRS-Universit de La Rochelle, La Rochelle, France.

The Arctic is warming twice as fast as the rest of the world, with drastic consequences for the cryosphere and associated ecosystems. Although the impact of sea-ice loss on obligate ice-associated species is evident, it is more difficult to appreciate the importance of sea-ice for species that do not rely permanently on it. Our objective was to evaluate the importance of sea-ice for the little auk (*Alle alle*), a small Alcid breeding in the North Atlantic Arctic and known to feed in the marginal ice zone when accessible. Little auk ecology was studied for 11 years in East Greenland, where ice conditions are highly variable between years. We monitored diving effort (time-depth recorders), foraging location (GPS), diet, chick growth and adult body condition. Little auks fed at the same location with/without sea-ice and took advantage of local productivity driven by bathymetric features. However, their diving effort was higher when sea-ice was absent, probably reflecting the disappearance of their feeding habitat underneath the ice. Prey species brought back to the chick also differed, with a correlation between pagophilic amphipods found in the diet and sea-ice concentration. Chick growth was not impacted by sea-ice concentration, but we found a decline in adult body condition over time, reflecting changes occurring in their ecosystem. Overall, our integrative study points to complex responses of little auks to the disappearance of their sea-ice habitats in the North Atlantic Arctic. (Talk)

## ESTIMATING ANNUAL AND LIFETIME REPRODUCTIVE PERFORMANCE OF KNOWN-AGE ADELIE PENGUINS: AN EXPLORATION OF LIFE HISTORY THEORY

Peter Kappes<sup>1</sup> Katie Dugger<sup>2</sup> Grant Ballard<sup>3</sup> David Ainley<sup>4</sup> Phil Lyver<sup>5</sup> Alexander Fraser<sup>6</sup>

<sup>1</sup>Oregon Cooperative Fish and Wildlife Research Unit, Department of Fisheries and Wildlife, Oregon State University, 104 Nash Hall Oregon State University Corvallis, OR 97331-3803.

<sup>2</sup>U.S. Geological Survey, Oregon Cooperative Fish and Wildlife Research Unit, Department of Fisheries and Wildlife, Oregon State University, 104 Nash Hall Oregon State University Corvallis, OR 97331-3803.

<sup>3</sup>Point Blue Conservation Science, 3820 Cypress Drive #11 Petaluma, CA 94954.

<sup>4</sup>H.T. Harvey and Associates, 983 University Avenue Building D Los Gatos, CA 95032.

<sup>5</sup>Landcare Research, P.O. Box 69040 Lincoln 7640, New Zealand.

<sup>6</sup>Institute for Low Temperature Science, Hokkaido, University, Institute of Low Temperature Science, Hokkaido Univ., Kita-19, Nishi-8, Kita-ku, Sapporo 060-0819, Japan.

Life history theory posits that natural selection results in individuals optimizing the allocation of resources to maximize lifetime reproductive output. Because an individual's residual reproductive value decreases with age, life history theory predicts that iteroparous breeders should maximize their fitness by allocating investment between current and future reproduction. Various hypotheses have been proposed to explain observed patterns of age-based reproductive performance. These explanations and mechanisms are not necessarily mutually exclusive and in combination can produce a variety of age-related patterns. Because both within-individual (e.g. intrinsic: experience, senescence; extrinsic: habitat, environment) and between-individual change (e.g. selective appearance and disappearance of phenotypes) influence fecundity, disentangling these effects can help us understand the patterns they produce. Ultimately, studies of age-dependent reproductive performance should take into account individual heterogeneity in life histories and encompass the entire lifespan of the individual. Differences in individual quality, age, or experience are not always evident under average environmental conditions; thus, life history studies of age-dependent reproductive success should incorporate and account for responses associated with the full range of environmental conditions. We used a 20-year mark-resighting data set of known-age Adelie Penguins (*Pygoscelis adeliae*) to investigate patterns in individual age-based fecundity and lifetime reproductive success. Our study encompassed a range of sea ice conditions, in order to investigate hypotheses proposed to explain age-based fecundity patterns and lifetime reproductive performance. (Talk)

The effects of the multi-decadal decline of Arctic sea ice on a resident ice-obligate seabird

George Divoky<sup>1</sup>

<sup>1</sup>Friends of Cooper Island.

Mandts Black Guillemot (*Cephus grylle mandtii*), one of the few Arctic ice-obligate seabirds, has been studied annually since 1975 at a colony on Cooper Island, Alaska. During the course of the study, summer sea ice extent has decreased by almost half and sea ice volume by two-thirds. These reductions have had major impacts on the ice-adapted species that depend on the cryopelagic ecosystem associated with sea ice and also through increasing SST through radiative warming of now ice-free waters. The effects of sea ice loss on the Cooper Island colony include 1) a 50 percent decrease in the breeding population from a high of 200 pairs in 1989, 2) reduced breeding success and recruitment, 3) dramatic increases in nestling starvation and brood reduction and 4) an annual shift from the ice-associated Arctic Cod (*Boreogadus saida*) to lower quality nearshore demersals. Decreasing summer ice also facilitated range shifts in a subarctic nest competitor, Horned Puffin (*Fratercula corniculata*) and nest predator, Polar Bear (*Ursus maritimus*), resulting in large-scale loss of eggs and nestlings that required replacing the wooden boxes with plastic cases. Arctic sea ice is predicted to continue its decline with disappearance of summer sea ice anticipated in the near future. The persistence of the Mandts Black Guillemot colony on Cooper Island will depend on the species ability to adapt to a subarctic ice-free environment. (Talk)

Seasonal changes in the at sea distribution and abundance of marine birds near shipping lanes around southern Vancouver Island.

Douglas Bertram<sup>1</sup> Mark Maftei<sup>1</sup> Cliff Robinson<sup>2</sup> Patrick O'Hara<sup>1</sup>

<sup>1</sup>ECCC c/o Institute of Ocean Sciences, 9860 W Saanich Rd, PO Box 6000, Sidney BC.

<sup>2</sup>Dept of Geography, University of Victoria, Victoria, BC.

Baseline information on marine distribution and abundance of marine birds are needed to evaluate their current status in relation to threats from potential increases in tanker traffic near Southern Vancouver Island. We conducted monthly, boat-based, at-sea surveys between Sidney BC and Victoria BC from November 2015 - November 2016 to examine seasonal variation during the year. Our study area includes the Sidney Channel Important Bird Area as well as the Shoal Harbour and Victoria Harbour Migratory Bird Sanctuaries, which are all close to major shipping lanes. With the recent approval for the proposed expansion of the Kinder Morgan Trans-mountain pipeline to Burnaby, tanker traffic is expected to increase seven fold in our study area. Additional increases in shipping in the Salish Sea are also expected from the expansion of Liquefied Natural Gas projects and the Delta Port expansion on Roberts Bank. We present data for all of the marine bird groups observed but focus on fish eating alcids, Rhinoceros Auklet (*Cerorhinca monocerata*), Common Murre (*Uria aalga*), Pigeon Guillemot (*Cepphus columba*) and Marbled Murrelet (*Brachyramphus marmoratus*) with attention to marine sub tidal habitats and other local features which support key forage fish species, Pacific Sand Lance (*Ammodytes personatus*) and juvenile Pacific Herring (*Clupea pallasii*). (Talk)

## Marine bird distribution and abundance in relation to herring spawning activity in the Salish Sea

Jenna Cragg<sup>1</sup> Douglas Bertram<sup>2</sup>

<sup>1</sup>Ministry of Forests, Lands and Natural Resource Operations.

<sup>2</sup>ECCC c/o Institute of Ocean Sciences.

Marine bird populations are heavily attracted to the annual herring spawning activity in the spring in the Salish Sea. The spatial and temporal pattern of herring spawn has shifted over the last century in the Salish Sea, becoming concentrated in time and space along the coast of east Vancouver Island. We conducted point counts for marine birds in the area currently used by herring to spawn, at 24 stations from Nanaimo to Campbell River. The counts were conducted at weekly intervals prior to, during, and after the herring spawning seasons in 2015 and 2016. In 2015, 9 surveys were conducted weekly from 13 February -14 April, with 172,960 birds of 57 species counted. In 2016, 8 surveys were conducted from 16 February-8 April, with 114,529 individuals of 61 species counted. The lower bird abundance in 2016 appears to be related to the shorter duration and reduced area of the herring spawn. Spawns were only observed over 3 weeks and at 5 sites in 2016, compared to a duration of 5 weeks over 10 sites in 2015. In 2015, counts ranged from a minimum of 13,687 to a peak of 36,833 during the spawn period, with abundances over 20,000 birds in four of the five weeks. During the 2016 spawn period, bird abundances remained relatively constant, and ranged from 14,803 to 18,917. The abundance of some species differed dramatically between years, such as Glaucous-winged gulls (12,561 fewer birds counted in 2016), and scoter species (30,050 fewer scoters counted in 2016). To evaluate interdecadal changes we will contrast our recent results with surveys conducted by the Canadian Wildlife Service in 1998 using the same methods. (Talk)

## Unusual Rhinoceros Auklet Mortality Event in the Salish Sea

Karen Devitt<sup>1</sup> Victoria Bowes<sup>2</sup> Anthony Redford<sup>2</sup> Helen Schwantje<sup>3</sup> Dan Shervill<sup>4</sup> Laurie Wilson<sup>4</sup>

<sup>1</sup>Bird Studies Canada, 5421 Robertson Rd #RR1, Delta, BC V4K 3N2.

<sup>2</sup>British Columbia Ministry of Agriculture, 1767 Angus Campbell Rd, Abbotsford, BC V3G 2M4.

<sup>3</sup>BC Ministry of Forests, Lands and Natural Resources, PO BOX 9338 Stn Prov Govt, Victoria, V8W 9M1.

<sup>4</sup>Environment and Climate Change Canada, Canadian Wildlife Service, 5421 Robertson Rd #RR1, Delta, BC V4K 3N2.

<sup>5</sup>Coastal Observation and Seabird Survey Team, University of Washington, 1122 NE Boat St., Seattle WA 98103.

<sup>6</sup>U.S. Geological Survey, National Wildlife Health Center, 6006 Schroeder Road, Madison, Wisconsin, 53711 USA .

From May to September 2016, volunteers involved in standardized beached-bird surveys (British Columbia Beached Bird Survey, Coastal Observation And Seabird Survey Team) as well as the general public reported unusually high numbers of Rhinoceros Auklet (*Cerorhinca monocerata*) carcasses on beaches ringing the eastern end of the Strait of Juan de Fuca, with highest concentrations close to Protection Island National Wildlife Refuge (USA). Over 99% of the Rhinoceros Auklet population breeds in two colonies in the Salish Sea, of which Protection Island (USA), at 72,000, is the largest. These birds forage in both U.S. and Canadian waters. In total, 793 carcasses including both adults and juvenile were reported, which at its peak in July/August represented rates of carcass deposition 30-70 times higher than normal. Post-mortem exams were conducted on 44 birds in Canada and 11 birds in the US. Carcasses examined in Canada were in fair body condition and died from bacterial septicemia. Bacterial cultures yielded growth from Bisgaard taxon 14 and 40 (within the Pasteurellaceae family). Carcasses examined at the USGS National Wildlife Health Center were emaciated and also died with bacterial septicemia. Cultures from these birds yielded growth from Bisgaard taxon 32 and 40. These taxa are poorly characterized, however, Bisgaard taxon 40 has been found previously in gulls, Bisgaard taxon 14 in ducks, and Bisgaard taxon 32 in hawks. To our knowledge, these bacterial taxa have not been involved in past seabird mortality events. Investigation into this event is ongoing. This event demonstrates the importance of standardized citizen science surveys and cross-border collaboration when monitoring coastal seabirds. (Talk)

## WHERE HAVE ALL THE FORAGE FISH GONE? ANOMALOUSLY POOR RHINOCEROS AUKLET BREEDING SEASON SUGGESTS CHANGES IN FORAGE FISH AVAILABILITY

Peter Hodum<sup>1</sup> Scott Pearson<sup>2</sup> Thomas Good<sup>3</sup>

<sup>1</sup>University of Puget Sound, Biology Department, 1500 N Warner St, Tacoma, WA 98416.

<sup>2</sup>Washington Department of Fish and Wildlife, 1111 Washington St SE, Olympia, WA 98501.

<sup>3</sup>NOAA Fisheries, Northwest Fisheries Science Center, 2725 Montlake Boulevard East Seattle, WA 98112.

The effectiveness of using seabirds as indicators of marine conditions is predicated on the idea that focal species are sensitive to changes in environmental parameters. Species with more behavioral plasticity may be less sensitive to and presumably buffered from a wider range of environmental conditions, thereby compensating for potential perturbations in the system. Rhinoceros Auklet (*Cerorhinca monocerata*) breeding populations in Washington State typically show little interannual variability in reproductive parameters, suggesting that they are relatively insensitive to the range of conditions that they typically experience. However, the 2016 breeding season on Protection Island (PI), WA, in the Salish Sea was highly anomalous. Compared with data from 2007-2015, burrow occupancy (the proportion of burrows that were reproductively active) and hatching success (chicks/egg) in 2016 did not differ from previous years. Nestling survival and fledging rates (0.49), however, were significantly lower than both the 10-year mean value (0.77) and the lowest single season value (0.70 in 2015). In contrast, none of the reproductive parameters from Destruction Island, on the outer Washington coast, differed from long-term mean values. Nestling provisioning on PI was significantly reduced from previous years, with adults bringing back more fish per bill load, 5.4 in 2016 vs. 3.2 between 2006-2015, but less than half the normal weight per bill load, 14.9g in 2016 vs. a mean range of 30-32g between 2006-2015. Developmental rates of chicks were retarded and necropsied chicks showed evidence of starvation. These results suggest a significant perturbation to the availability of forage fish in the region during the 2016 breeding season. (Talk)

## LIFE IN THE BIG CITY – CASPIAN TERNS IN THE SALISH SEA REGION

Timothy Lawes<sup>1</sup> Kirsten Bixler<sup>1</sup> Daniel Roby<sup>2</sup> Donald Lyons<sup>1</sup> Peter Loschl<sup>1</sup> Yasuko Suzuki<sup>1</sup>

<sup>1</sup>Oregon Cooperative Fish and Wildlife Research Unit, Department of Fisheries & Wildlife, Oregon State University, 104 Nash Hall, Oregon State University, Corvallis, OR 97331-3803 USA.

<sup>2</sup>U.S. Geological Survey – Oregon Cooperative Fish and Wildlife Research Unit, 104 Nash Hall, Oregon State University, Corvallis, OR 97331-3803 USA.

Caspian Terns (*Hydroprogne caspia*) have nested in the Salish Sea region since at least the mid-1990s, and possibly before. During this time, terns have had to adapt to changes in habitat availability and have often selected novel urban habitats for roosting and nesting. Breeding colony locations range from Commencement Bay in WA to the Fraser River Delta in BC. Colonies have formed in major metropolitan areas on rooftops of waterfront buildings, on moored barges, and on the ground of abandoned commercial areas near the water. Terns have also used more traditional nesting habitats such as low-lying islands or sandy spits. Urban colonies have experienced disturbances from human activities and intentional elimination of potential habitat, whereas colonies at more natural sites have been limited by vegetation encroachment, tidal flooding, and native predators. Since 1999, the number of Caspian Tern breeding pairs in the Salish Sea region have fluctuated between ca. 215 to 1,870 ( $x = 823$  pairs) in response to these disruptions. Band re-sight records from 2008-2016 indicate that terns raised at Salish Sea colonies are predominately returning to the region as adults (3 years old), but that interchange with the greater Pacific Flyway population also occurs. Despite breeding site limitations, the Salish Sea has supported a nontrivial proportion (up to ca. 16%) of the Pacific Flyway breeding population of Caspian terns in some years. As management efforts to reduce conflicts with fisheries continue to displace terns in the Columbia Basin, and as drought conditions limit nesting potential in the arid portions of the Flyway, the Salish Sea is likely to continue attracting terns in search of foraging and nesting opportunities. (Talk)

## MARBLED MURRELET DENSITY AND PRODUCTIVITY IN THE SAN JUAN ISLANDS, WASHINGTON, 1995 TO 2012

Teresa Lorenz<sup>1</sup> Martin Raphael<sup>1</sup>

<sup>1</sup>Pacific Northwest Research Station, 3625 93rd Ave SW.

Information on marbled murrelet (*Brachyramphus marmoratus*) trends and productivity in the Salish Sea is important for planning recovery efforts in Washington and British Columbia. We analyzed data on murrelet densities and productivity from marine surveys conducted in the San Juan Islands, 1995 to 2012. Each year, 170 km of shoreline were surveyed repeatedly during five to eleven 10-day intervals between May 12 and August 19. Observers recorded numbers of murrelets in five plumage classes. We estimated murrelet densities using program DISTANCE and murrelet productivity using ratios of hatch-year to after-hatch-year birds. Murrelet densities were highest in 1998 and 2005, which were years of unusual oceanic events; the winter of 1997-1998 was one of the largest El Nino events on record, while 2005 was a year of delayed upwelling. This may indicate that the San Juan Islands contained relatively high quality foraging habitat during years when conditions along the coast were poor. Productivity ratios showed less variation among years and we did not observe strong trends, either increasing or decreasing. If adults and juveniles have similar immigration patterns, this indicates that murrelet reproductive success in the region did not change appreciably over the 17-year survey period. However, these assumptions must be tested before conclusions on murrelet reproductive success are made, especially because telemetry studies have shown that murrelets commonly move to and from the San Juan Islands. (Talk)

## PROPOSED TRANSBOUNDARY BIRD METRICS WITHIN A SUITE OF SALISH SEA ECOSYSTEM HEALTH INDICATORS

Holly Middleton<sup>1</sup> Cecilia Wong<sup>2</sup>

<sup>1</sup>Pacific Wildlife Foundation, Reed Point Marina, Module 1, PO Box 12, 850 Barnet Highway, Port Moody, BC V3H1V6.

<sup>2</sup>Environment and Climate Change Canada, 201-401 Burrard Street, Vancouver, BC V6C3S5.

Canada and the US have joint responsibilities to protect birds and their habitat under the Migratory Birds Convention Act. The objective of this study is to develop transboundary bird indicators for the Salish Sea ecosystem. Metrics of the health of bird communities within a suite of food web and abiotic indicators can reflect the state of ecosystem health. A hierarchical framework by Kershner et al (2011), previously used to select marine bird indicators for Puget Sound environmental reporting, will be applied. As the Puget Sound and Georgia Basin are contiguous within the Salish Sea ecosystem, metadata from bird monitoring studies within the transboundary Salish Sea ecosystem will be compiled and evaluated against common indicator selection criteria. This evaluation will be conducted through consultation with Salish Sea bird experts and researchers involved in studies identified through the metadata compilation. Earlier reports including Canadian Wildlife Service Occasional Papers and more current publications on the occurrence, abundance and life history of birds in the Salish Sea will be reviewed for supplemental information to support a state of knowledge synthesis. From this consultation and synthesis, bird indicators will be proposed to indicate the health and sustainability of Salish Sea bird communities. (Talk)

## ARE THE SALISH SEAS SEABIRDS AND MARINE MAMMAL POPULATIONS LINKED TO THOSE IN THE CALIFORNIA CURRENT?: IMPLICATIONS FOR LOCAL MECHANISMS DRIVING POPULATION TRENDS

Scott Pearson<sup>1</sup> Martin Raphael<sup>2</sup> Monique Lance<sup>1</sup>

<sup>1</sup>Washington Department of Fish and Wildlife, 1111 Washington St. SE, Olympia, WA 98501.

<sup>2</sup>US Forest Service PNW Research Station, 3625 93rd Ave SW , Olympia, WA 98512.

The Salish Seas marine bird and mammal community is composed of over 70 and 29 species respectively that are relatively abundant and highly dependent upon marine resources for survival. The relative abundance of these species changes dramatically throughout the year due to differences in the timing and extent of residency by migratory, over-wintering and local breeding populations. Evidence suggests that several over-wintering bird species in particular have declined precipitously over the last several decades. To provide additional insights into the health of Salish Sea seabird and marine mammal populations, we examine trends in seven piscivorous species over the past 15 years and our results indicate that populations of three species were relatively stable, two were increasing, and two were decreasing. For these same species, we also compare Salish Sea and California Current trends to determine whether or not the observed population changes are unique to the Salish Sea and found only significant trends within the Salish Sea (both increases and decreases). Finally, we assess the degree to which these marine ecosystems and their bird populations are linked by examining species-specific correlations between the California Current and Salish Sea and found the populations to be fluctuating independently. To gain insights into mechanisms driving Salish Sea population changes we qualitatively compare our breeding season results with results from our previous work on over-wintering populations suggesting very different trends between wintering and over-wintering populations. This comparison provides insights into various life history traits, such as diet and local breeding, on observed population trends. (Talk)

## Nocturnal Space Use by Surf Scoters (*Melanitta perspicillata*) and Crude Oil Spill Response Planning in the Salish Sea

Lindsey Hamilton<sup>1</sup> Joseph Evenson<sup>2</sup> Dina Roberts<sup>1</sup>

<sup>1</sup>The Evergreen State College, Program on the Environment, The Evergreen State College, 2700 Evergreen Parkway, Olympia, WA 98505, United States.

<sup>2</sup>Washington Department of Fish and Wildlife, Washington Department of Fish and Wildlife, 7801 Phillips Rd. SW. Lakewood, WA 98498, United States.

<sup>3</sup>University of California, Santa Cruz, Department of Ecology and Evolutionary Biology, University of California, Santa Cruz, 1156 High St, Santa Cruz, CA 95064, United States.

Sea duck movement, habitat use and population data are primarily collected during diurnal periods, constructing a biased understanding of their ecology and distribution. Diurnal distribution data currently guide conservation and management decisions regarding the recently declined population of surf scoters (*Melanitta perspicillata*) wintering in Puget Sound. To understand nocturnal distributions of surf scoters, our study determined habitat characteristics of nocturnal use areas in the Salish Sea, determined influencing factors of selection of nocturnal use, and developed a predictive model to estimate likely nocturnal use areas to assess vulnerabilities to potential oils spills. We used surf scoter location data collected from Platform Terminal Transmitter (PTT) and spatial layers in a GIS to identify characteristics of nocturnal locations and to measure distances traveled between diurnal and nocturnal use areas. We developed a use versus pseudo-non-use resource selection design, using logistic regression, and Akaike's information criterion (AIC) to create a predictive model for nocturnal scoter presence in the Salish Sea. We found that distance to shore, water depth, tidal current and vessel traffic were strong predictors of nocturnal presence. Surf scoters traveled an average of 3,967 m between diurnal and nocturnal habitats, and mean distance traveled varied depending on local geography. Nocturnal use sites were characterized by greater distances from shore and deeper water; scoters avoided areas with strong tidal currents and heavy shipping traffic. These newly identified nocturnal habitat requirements expand on the knowledge of surf scoter winter ecology and provide sea duck management guidance in the Salish Sea, including information to improve oil spill response preparedness. (Talk)

## FISHING GEAR INJURIES IN CALIFORNIA BROWN PELICANS ADMITTED FOR REHABILITATION 2002-2015

Rebecca Duerr<sup>1</sup> Julie Skoglund<sup>1</sup>

<sup>1</sup>International Bird Rescue, PO Box 2171, Long Beach, CA 90801.

Brown Pelicans are frequently admitted for rehabilitation at International Bird Rescue (IBR)s two clinics in California serving the greater San Francisco Bay and Los Angeles areas. From 2002-2015, 5026 Brown pelicans were admitted, and 1206 (23.9%) were determined to have fishing gear injuries including punctures, lacerations, and constriction wounds. Proportions of pelicans entering care with fishing gear injuries ranged from 8-47% annually and averaged 24% over all years (27% for HY, 23% for AHY). Many birds admitted had already had harmful objects such as fishing gear removed; if the cause of an injury was not mentioned in transfer paperwork the case was included in our results if it conformed to typical presentation of cause-specific injuries (e.g. linear constriction injury at a pelicans patagium). Less overtly caused injuries (e.g. wing fractures or miscellaneous wounds) were not included. Consequently, results should be considered a conservative accounting of fishing gear-related injuries as wounds of unknown origin were not included. These birds often require several weeks of intensive wound management followed by weeks to months of post-recovery conditioning, especially if there was a significant patagium injury affecting flight, or hooks caused abscesses in legs or wings or chest. These pelicans often have up to five significant wounds undergoing management simultaneously. Of the 1206 BRPE cases of fishing gear injuries, 656 were released (55%), and 9 birds were placed/transferred. Released pelicans spent an average of 35 days in care (SD = 26 days, range 0-325 days). All birds were federally banded prior to release. (Talk)

## SEABIRD BYCATCH AND MITIGATION EFFORTS IN ALASKA FISHERIES SUMMARY: 2007 THROUGH 2015

Anne Marie Eich<sup>1</sup> Kristin Mabry<sup>1</sup> Sadie Wright<sup>1</sup> Shannon Fitzgerald<sup>2</sup>

<sup>1</sup>NOAA Fisheries, PO Box 21668, Juneau, AK 99802.

<sup>2</sup>Alaska Fisheries Science Center, 7600 Sand Point Way N.E., Building 4 Seattle, Washington 98115.

Fishermen sometimes catch and discard animals they do not want, cannot sell, or are not allowed to keep. This is known as bycatch. In waters off Alaska, hook-and-line (sometimes called longline) fishing vessels use seabird avoidance measures that minimize seabird bycatch; no such measures are required for vessels fishing with trawl or pot gear. Despite these avoidance measures, seabirds are caught unintentionally as bycatch in certain commercial fisheries off Alaska. NOAA's National Marine Fisheries Service (NOAA Fisheries) is responsible for managing coastal and marine habitats through statutory authorities and agency policies. Additionally, NOAA Fisheries views seabirds as important ecosystem indicators and monitors seabird bycatch in many Federal fisheries for changes of interest to scientists and managers. Seabird populations can indicate the state of marine and coastal ecosystems. Changes in seabird bycatch could reveal long-term ecosystem effects or changes in coastal and marine habitats that seabirds depend on for various life stages. A summary of a recently published report will be presented describing seabird bycatch and mitigation efforts in Alaska fisheries. This report reviews seabird bycatch in commercial groundfish and halibut fisheries in the exclusive economic zone off Alaska from 2007 through 2015. (Talk)

## COMMUNITY ENGAGEMENT STRATEGIES FOR PROMOTING SEABIRD BYCATCH REDUCTION IN COMMERCIAL FISHERIES

Amanda Gladics<sup>1</sup> Edward Melvin<sup>2</sup> Robert Suryan<sup>3</sup>

<sup>1</sup>Oregon Sea Grant, OSU Extension - Clatsop County, 2001 Marine Science Dr., Rm 210, Astoria, OR 97103.

<sup>2</sup>Washington Sea Grant, Box 355020 Seattle, WA 98105.

<sup>3</sup>Oregon State University, Hatfield Marine Science Center, 2030 SE Marine Science Dr., Newport, OR 97365.

Engaging fishermen in collaborative conservation allows fishermen and scientists to become equal partners in the development of sustainable fisheries solutions. These benefits are substantial especially in situations that require behavioral change on the part of the fishing community or when research findings may spur additional regulation. However, engaging with communities comes with both challenges and costs to researchers and regulators, including the potential for apathy or hostility from the community, the need to invest in long-term relationships, and substantial time commitments. We present a framework for evaluating the need for, understanding best practices of, and avoiding pitfalls in community engagement during seabird bycatch research and outreach efforts. We will share insights, challenges and lessons learned while engaging and conducting collaborative research with longline fishermen to decrease bycatch of seabirds off the U.S. West Coast and Alaska. Our engagement strategy focused on personal interactions with the research team and connecting with fishermen in familiar, non-threatening settings including on the docks and on their own vessels. Key themes that guided our interactions included respect for the experiential knowledge of fishermen, focusing on common ground and objectives, and understanding the myriad of competing constraints fishermen face to maintain both sustainable ecosystems and sustainable livelihoods (Poster)

## The Devil is in the Detail: Trends in Albatross Bycatch Rates in Alaskan Longline Fisheries

Edward Melvin<sup>1</sup> Kim Dietrich<sup>1</sup> Robert Suryan<sup>2</sup> Amanda Gladics<sup>3</sup><sup>1</sup>Washington Sea Grant, Seattle, WA.<sup>2</sup>Oregon State University, Newport, OR.<sup>3</sup>Oregon Sea Grant, Astoria, OR.

Prompted by what appears to be a recent increasing trend in NMFS estimates of total albatross mortality in Alaska demersal longline fisheries and a lack of bycatch rate information since 2006, we conducted retrospective analyses of albatross bycatch data from the North Pacific Groundfish and Halibut Observer Program (1993 to 2015) to identify drivers, possible alternative management options, and useful metrics for annual bycatch reporting. We calculated standardized albatross bycatch rates (birds per million hooks; BPUE) derived from the observer sample with no extrapolations and calculated mean rates for multiple strata (target fishery, processing type, year, month, time-of-day, area, and vessel). We then used a zero-inflated negative binomial modeling approach to assess which factors are most influential on albatross bycatch rates. Results show that the annual means of albatross BPUE decreased by 89% following the voluntary adoption of bycatch mitigation (streamer lines) in 2002, and, unlike estimates of total albatross mortality, have remained stable through 2015. Our apriori assumptions were that the lack of agreement in annual trends of albatross BPUE and estimated bycatch may be due to an increase in fishing effort, or that the extrapolation methodology used for all catch species may not be robust for rare events. Results show that ignoring strata, especially target species, can yield misleading trends and that night setting of longlines could reduce albatross bycatch dramatically, although with potential increase in bycatch of Northern Fulmars (*Fulmarus glacialis*). Reporting both BPUE and estimated catch is important to evaluate progress toward albatross conservation. (Talk)

## SEABIRD INTERACTIONS IN THE HAWAII DEEP AND SHALLOW SET LONGLINE FISHERIES IN 2015

John Peschon<sup>1</sup> Sarah Ellgen<sup>2</sup>

<sup>1</sup>Pacific Islands Regional Office, Observer Program, National Marine Fisheries Service, NOAA, 1845 Wasp Blvd., Honolulu, HI 96818.

<sup>2</sup>Pacific Islands Regional Office, National Marine Fisheries Service, Sustainable Fisheries Division, 1845 Wasp Blvd., Honolulu, HI 96818.

The Pacific Islands Regional Office (PIRO) National Marine Fisheries Service (NMFS) attempts to reduce, as practicable, interactions between Hawaii pelagic longline fishing operations and seabirds. The observer program at PIRO has monitored the Hawaii pelagic longline fisheries since 1994. NMFS observers have documented seabird interactions (hook-ings or entanglements) with the following species: black-footed Albatross (*Phoebastria ni-gripes*), Laysan albatross (*Phoebastria immutabilis*), sooty shearwaters (*Puffinus griseus*), unidentified shearwater species (*Puffinus spp.*), brown boobies (*Sula leucogaster*), red-footed boobies (*Sula sula*), and northern fulmars (*Fulmarus glacialis*). Since 2000, NMFS provided 20% observer coverage in the deep-set fishery and, since 2004, 100% observer coverage in the shallow-set fishery. In 2004, NMFS implemented seabird handling and mitigation measures and these measures have significantly reduced interactions. In 2015, NMFS observers recorded 213 interactions with seabirds: 132 interactions in the deep-set fishery and 81 interactions in the shallow-set fishery. In 2015, most (86%) seabirds were dead in the deep-set fishery, while the shallow set fishery most seabirds (80%) were caught and released alive. (Talk)

## Mitigating seabird and seaduck bycatch in fisheries under the Arctic Migratory Bird Initiative (AMBI)

Jennifer Provencher<sup>1</sup> Amie Black<sup>2</sup> Mark Mallory<sup>1</sup> Grant H Gilchrist<sup>2</sup>

<sup>1</sup>Acadia University, 33 Westwood Ave, Nova Scotia, Canada.

<sup>2</sup>Environment Canada, 1125 Colonel By Drive, Raven Road, Ottawa, Ontario, Canada.

The Arctic Migratory Bird Initiative (AMBI) is a project under the Arctic Councils Conservation of Arctic Flora and Fauna (CAFF) working group that aims to increase the conservation status of Arctic breeding migratory birds throughout their range. While AMBI consists of four global flyways, one of the objectives in the Circumpolar Flyway is to reduce and mitigate seabird and seaduck incidental bycatch in fisheries in Arctic regions, especially in areas where fisheries are expected to increase in the coming decades as the extent of summer sea ice decreases. One region of particular interest is the Davis Strait/Baffin Bay region, where initial estimates of seabird bycatch show some of the highest levels of seabird mortality per unit of effort in all of Atlantic Canada. While only a relatively small number of ships currently fish in the region the lack of any mitigation techniques, the use of baited gill nets, and fishing activity within the foraging range of northern fulmar colonies make these growing fisheries a concern for seabird populations. Assessments of seabird take by gillnets in other regions are also underway, providing some of the first estimates for this fishery. While there is little AMBI bycatch work currently occurring in the Pacific, we are taking learning from past Pacific-focused research on bycatch to inform the Arctic work. Lastly, as CAFF is in the decision-making process on how to formulate the second phase of AMBI starting in 2019, we are exploring what research priorities should be highlighted. (Talk)

## SEABIRD BYCATCH BY THE PURSE-SEINE SMALL PELAGIC FISHERY IN THE CENTRAL GULF OF CALIFORNIA.

Enriqueta Velarde<sup>1</sup> Gabriela Garca-Alberto<sup>2</sup> Ernesto Gastelum-Nava<sup>3</sup> Daniel Anderson<sup>4</sup>

<sup>1</sup>Instituto de Ciencias Marinas y Pesqueras, Universidad Veracruzana, Hidalgo 617, Col. Ro Jamapa, Boca del Ro, Veracruz, Mxico, CP 94290.

<sup>2</sup>Independent Consultant, .

<sup>3</sup>Comunidad y Biodiversidad, A.C., Isla del Peruano 215, Col. Lomas de Miramar, Guaymas, Sonora, Mxico, CP 85448..

<sup>4</sup>Wildlife, Fish and Conservation Biology Department, University of California Davis, 1088 Academic Surge, One Shields Avenue, Davis, California 95616.

Fishing gear is one of the most important causes of seabird mortality. An observers program was carried out between 2013-2014 onboard ships of the small-pelagic fishery from Sonora, which operates in the Guaymas Basin and Midriff Island Region, Gulf of California, certified as sustainable by the Marine Stewardship Council. This work is in collaboration with the fishing industry, fisheries authorities, NGOs and Mexican and US researchers. Interactions of seabirds with the fishing gear have resulted in seabird death, Injury, and plumage impregnated with fish oil. It is known that birds with oiled plumage die within minutes or days. Plumage has a microstructure that constitutes a specialized protection allowing the birds to thermo-regulate, is impermeable (hydrophobic), and forms a continuous surface that sustains flight. The smallest amount of oil on the water surface is absorbed by the plumage, drastically altering its microstructure, resulting in the loss of these abilities and, eventually, death. Based on the results of the program and extrapolating to the total number of fishing trips performed by the fleet within the observation period of 17 months, it was estimated that the highest effects, from among the 18 seabird species affected by the incidental catch during fishing operations, are experienced by the Brown Pelican (*Pelecanus occidentalis*), with an estimated 19,430 individuals, followed by the Blue-footed Boobie (*Sula nebouxii*) with 3,083 individuals, and the Brown Boobies (*S. leucogaster*) with 1,927 individuals. Effect varies with date and fishing zone. These mortality rates endanger the populations of these seabird species, which nest in islands within the fishing area. (Talk)

## Status and Conservation of Waved Albatross

Hannah Nevins<sup>1</sup> Giovanni Suarez Espin<sup>1</sup> Kate Huyvaert<sup>2</sup> Joanna Alfaro Shigueto<sup>3</sup> Jeffrey Mangel<sup>3</sup> Nigel Brothers<sup>4</sup> Felipe Vallejo<sup>5</sup> Cristina Muller<sup>5</sup>

<sup>1</sup>American Bird Conservancy.

<sup>2</sup>Colorado State University.

<sup>3</sup>ProDelphinus, ProDelphinus, Lima, Peru.

<sup>4</sup>Marine Ecology & Technology, Marine Ecology & Technology, Wogong Beach, Australia.

<sup>5</sup>Equilibrio Azul, Equilibrio Azul, Puerto Lopez, Ecuador.

We present a current update on the overall conservation status of IUCN-listed Critically Endangered Waved Albatross (*Phoebastria irrorata*) including current assessment of threats on land and sea. We present colony monitoring, disease assessment, population status, and current threats at two of the three known colony sites: Española Island Galapagos and La Plata. Results suggest that both colonies have experienced declines in the last ten years in monitored areas. Non-native black rat occur on La Plata, but the documented impact to the few nests (2 in 2016) remains unknown. At sea the greatest threats continue to be fishery bycatch, including interactions with small vessel fisheries using hand-deployed demersal long-lines in coastal Ecuador and driftnets Peru. Data suggest a high risk of bycatch, but uncertainty in mortality estimates are due to limited observer effort. In Peru, targeted harvest of albatross was reduced through outreach and intervention to fishing communities. Disease appears to not be a population-level threat currently, but surveillance for mosquito-borne should continue as methods of detection improve and warming climate conditions increase risk. Finally, we report on positive benefits of conservation actions to date. Recent efforts include invasive species management, bycatch mitigation devices, fishermen outreach and education, government-led and international initiatives to bring understanding of this species and its threats under active management. We identify our future priorities for research and conservation. (Talk)

Terrestrial and marine foraging strategies of gulls in northern Germany, North and Baltic Seas

Stefan Garthe<sup>1</sup> Rahel Borrmann<sup>1</sup> Anna-Marie Corman<sup>1</sup> Leonie Enners<sup>1</sup> Philipp Schwemmer<sup>1</sup>  
Yes<sup>1</sup>

<sup>1</sup>Kiel University, Hafentoern 1, 25761 Buesum, Germany.

Breeding populations of gulls in northern Germany show substantial and on-going changes at both North and Baltic Sea coasts. Long-term data on diet show a general trend indicating changes from marine prey to terrestrial prey. Over the last few years, we GPS-tracked Lesser Black-backed, Herring, Great Black-backed and Common Gulls during the breeding period and analysed their foraging behaviour. We demonstrate and compare the extent to which the species use the main foraging habitats 'open sea', 'tidal flats of the Wadden Sea' and land. In contrast to historic analyses of prey remains and seabirds at sea counts, our tracking data clearly show that many of the tracked individuals nowadays make intensive use of terrestrial sites. In particular, Common Gulls at the Baltic Sea exclusively foraged at the mainland, while Herring and Lesser Black-backed gulls exhibited a dual foraging strategy using terrestrial sites and intertidal flat and the open sea, respectively. Only Great Black-backed gulls foraged entirely on intertidal mudflats or tidal creeks of the Wadden Sea. Overall, the investigated species differed in diet, foraging behaviour and foraging habitat choice, but colony location also plays an important role. Our data also show that individuals made intensive use of the anthropogenic landscape and seascape. (Talk)

Foraging behaviour of the Great-Black-Backed Gull (*Larus marinus*): GPS telemetry reveals individual differences in habitat use

Laurie Maynard<sup>1</sup> Robert Ronconi<sup>2</sup>

<sup>1</sup>University of Manitoba.

<sup>2</sup>Environment Canada.

Feeding behaviour of large Laridae have been studied for decades, primarily focusing on dietary reconstructions and behavioural observations on feeding grounds, but little is known about individual-level foraging habits. The recent development of GPS tracking technologies, however, has allowed new information on individual-level foraging behaviour. We provide the first known tracking data of Great Black-Backed Gull (*Larus marinus*), whereby GPS tracking devices were deployed on three incubating adults on Devils Island in Nova Scotia during May 2016. Foraging behaviour differed greatly among individuals, primarily due to individual preferences for feeding habitat. One individual spent 77% of its time foraging in coastal environments, whereas the second spent more than 50% of its time in urban or marine habitats and was also the only one visiting freshwater lakes inland. The last individual was the only one going to salt marshes (over 25% of the time). Although there were noticeable differences in habitat preferences and individual specialization, foraging distance and duration did not differ significantly among individuals, but nest attendance did. This pilot study suggests that there may be high variation in foraging behaviour among individuals and indicates that GPS technology can shed light on unanswered questions about the foraging behaviour of large gulls. While dietary studies have presented Great Black-backed Gulls as generalists at the population level, telemetry data may reveal strong behavioural and habitat specialization at the individual level. (Talk)

Seabird responses to supplemental food supply shifts in relation to variable natural prey biomass

Laurie Maynard<sup>1</sup> Paloma Carvalho<sup>1</sup> Gail Davoren<sup>1</sup>

<sup>1</sup>University of Manitoba.

On the coast of Newfoundland, an important food source for seabird is capelin (*Mallotus villosus*), a forage fish. It migrates inshore to spawn in July and migrates back offshore in August, resulting in a dramatic shift of biomass. This provides natural experimental conditions to assess how the foraging behaviour of multiple seabird species shifts under changing prey biomass. In summer 2015 and 2016, we investigated how Laridae and Procellariidae vary their response to supplemental food supply under high and low capelin biomass in coastal Newfoundland. To do this, we conducted an at-sea experiment, where the number of each species within ~150 m of a boat was recorded during a 10-minute experimental period, when supplemental food was provided every 30 seconds, along with control periods before and after. The mean number of birds (all species combined) near the boat was significantly higher during the experimental periods relative to controls. The mean number of birds during the experimental period was significantly lower when capelin biomass was high (10.47 ± 5.60) relative to low (53.45 ± 22.32). When capelin biomass was low, Herring gulls (*Larus argentatus*) were numerically dominant over Great Black-Backed Gulls (*L. marinus*), Greater Shearwaters (*Ardenna gravis*), Sooty Shearwaters (*A. griseus*), Northern Fulmars (*Fulmarus glacialis*) and immature gulls (*Larus spp.*). When capelin biomass was high, all species decreased proportionally similar, except for a slight increase for Northern Fulmars. Findings indicate that seabirds shift their foraging behaviour to rely on other food sources when capelin availability is limited in coastal Newfoundland and suggests that species interactions will change under varying capelin biomass (Talk)

SPATIOTEMPORAL HABITAT USE OF FORAGING WESTERN GULLS (*LARUS OCCIDENTALIS*)

Scott Shaffer<sup>1</sup> Pete Warzybok<sup>2</sup> Russell Bradley<sup>2</sup> Corey Clatterbuck<sup>3</sup> Emily Kelsey<sup>4</sup> Josh Adams<sup>4</sup>

<sup>1</sup>San Jose State University, Department of Biological Sciences, One Washington Square, San Jose, CA.

<sup>2</sup>Point Blue Conservation Science, Petaluma, CA.

<sup>3</sup>San Diego State University, Department of Biology, San Diego, CA.

<sup>4</sup>USGS, Western Ecological Research Center, USGS, Santa Cruz, CA.

Western gulls (*Larus occidentalis*) consume a wide range of marine and terrestrial foods. However, the foraging patterns and habitat selection (ocean or land) of western gulls is not well understood, despite their ubiquity in coastal California. Here, we used GPS loggers to compare the foraging behavior and habitat use of western gulls breeding at two island colonies in central California. Gulls from Southeast Farallon Island (SEFI; N = 41 gulls) conducted more oceanic trips (N = 90) of shorter duration (3.8 3.3 SD hrs) and distance away (27.1 20.3 SD km) than trips to the mainland (N = 41) which were nearly 4x longer and 2x farther away. In contrast, gulls from Año Nuevo Island (ANI; N = 20 gulls) foraged at sites on land more frequently than at sea (103 land trips vs. 42 ocean trips) but trip durations (means 3.6 vs. 2.9 hrs, respectively) and distances (means 20.8 vs. 20.6 km, respectively) did not differ significantly by foraging habitat type. Despite its more distant proximity to the mainland, gulls from SEFI visited more sites on land (25 sites) and in dense urban habitats (i.e. the city), compared to gulls from ANI (6 sites), which all visited the same landfill along largely undeveloped coastline. The total home range of gulls from SEFI (14,230 km<sup>2</sup>) was 4.5x larger than that of gulls from ANI, consistent with greater resource competition resulting from a larger abundance of seabirds at SEFI. Overall, gulls from SEFI were away foraging longer than gulls from ANI (22% vs. 7.5%, respectively), which impacts the defense of territories and attempts at nest predation by conspecifics. This may explain why chick productivity is lower at SEFI, and can provide insight into urban gull population growth. (Talk)

The Juan de Fuca Eddy – a critical stopover site for migrating Sabine's gulls (*Xema sabini*).

Shanti Davis<sup>1</sup> Mark Maftei<sup>1</sup> Mark Mallory<sup>1,2</sup>

<sup>1</sup>High Arctic Gull Research Group, High Arctic Gull Research Group, Victoria, BC, Canada.

<sup>2</sup>Acadia University, Department of Biology, Acadia University, Wolfville, NS, Canada.

Sabine's gulls (*Xema sabini*) undertake spectacular long distance migrations, travelling more than 28,000 km annually from the circumpolar Arctic to wintering areas in the southern hemisphere. Our study used geolocators ( $n = 33$ ) to quantify the migration routes and timing of individual birds, identify important stopover areas used during migration, and define the extent of their Pacific wintering area. Analysis of the movements of these individuals revealed that Sabine's gulls exploit areas of elevated marine productivity along their migration route. In particular, the Juan de Fuca Eddy off the west coast of Vancouver Island was identified as the most important stopover site for this species in the Pacific. This area was used by 100% of the tagged birds for an average of 31 days during southbound migration, and by 92% of the tagged birds for an average of 9 days during northbound migration. The unique currents and bathymetry in this area create a large semi-permanent cyclonic eddy that is responsible for massive upwelling of deep, nutrient-rich water rising up from the Juan de Fuca Canyon. The cold, upwelled water spreads over an extensive and shallow bank at the edge of the continental shelf, creating exceptionally favourable conditions for foraging seabirds, whales, and fish. Protection and management of the Juan de Fuca Eddy is of particular concern given that the main area of productivity lies directly on the approaches to the Salish Sea, which is the only access to several main seaports on the West Coast. The Juan de Fuca Eddy is protected as part of the Olympic Coast National Marine Sanctuary on the U.S. side, however similar protection on the Canadian side does not currently exist. (Talk)

## SHEARWATERS IN THE NORTHERN CALIFORNIA CURRENT: COMBINING ENVIRONMENTAL PREDICTORS WITH SATELLITE TELEMETRY AND AT-SEA ABUNDANCE

Josh Adams<sup>1</sup> Jonathan Felis<sup>1</sup> Max Czapanskiy<sup>1</sup> Jennifer Schulien<sup>2</sup> Bill Henry<sup>1</sup>

<sup>1</sup>U.S. Geological Survey, Western Ecological Research Center.

<sup>2</sup>University of California Santa Cruz.

Where seabirds are of concern, Marine Spatial Planning can benefit if telemetry data can be used to improve seabird abundance estimates at sea in areas not surveyed directly. Here, we combine traditional vessel-based surveys of seabird density at sea with measures of individual space-use derived from telemetry. We used aerial survey data and satellite telemetry to compare at-sea habitats and environmental factors influencing the non-breeding distribution and abundance patterns among non-resident Pink-footed (PFSH, *Ardenna creatopus*) and Sooty (SOSH, *A. grisea*) shearwaters. These two congeners occupied different habitats at sea. PFSH abundance was greater in fall compared to summer, and was usually concentrated over outer continental shelf and slope waters. SOSH was the most abundant species in summer and second most abundant in fall. In June 2011, SOSH were most abundant over inner-shelf and slope waters; most were observed over shelf waters off Washington and over slope waters off northern Oregon. Fewer SOSH were observed in July 2012 than in June 2011 and average densities were less. Models to predict SOSH abundance indicate substantial interannual variability in habitat-use, and seasons within years were more similar in model form. In 2011 (June & October), SOSH abundance related to oceanography (plume & upwelling shadows, warmer SST, fronts, and chlorophyll; in 2012 (July & September), abundance related to geography and low chlorophyll persistence. PFSH abundance in fall was less related to oceanographic variables, but had strong relationship with the shelf-break. The addition of satellite telemetry-derived space-use improved models used to predict abundance patterns at sea. (Talk)

## AT-SEA RANGING BEHAVIOR OF RED-TAILED TROPICBIRDS AND POTENTIAL FOR INTERACTION WITH OFFSHORE WIND ENERGY INFRASTRUCTURE IN HAWAII

Jonathan Felis<sup>1</sup> Josh Adams<sup>1</sup> Emma Kelsey<sup>1</sup> Max Czapanskiy<sup>1</sup> Eric VanderWerf<sup>2</sup> David Pereksta<sup>3</sup>

<sup>1</sup>US Geological Survey, 2885 Mission St, Santa Cruz, CA 95060.

<sup>2</sup>Pacific Rim Conservation, Honolulu, HI.

<sup>3</sup>Bureau of Ocean Energy Management, Camarillo, CA.

Red-tailed Tropicbirds (RTTR; *Phaethon rubricauda*) are common in the tropical and sub-tropical Indo-Pacific; however, little is known about at-sea ranging behavior and no tracking data for this species have been published. Approximately one third of the global breeding population nests in Hawaii, primarily throughout the northwestern Hawaiian Islands. Nesting in the main Hawaiian Islands (MHI) is restricted to steep coastal cliffs and offshore islets where non-native predators are limited or absent, although these sites may become more important as rising sea levels pose an increasing threat to low lying atolls. Interest in renewable energy development is increasing around MHI and could pose threats to RTTR. White-tailed Tropicbirds (*Phaethon lepturus*), which nest farther inland in MHI and have similar behavior and flight-styles as Red-tailed Tropicbirds, have been killed in collisions with existing terrestrial wind energy infrastructure, indicating potential that both species could be negatively affected by offshore wind energy development. We GPS-tracked adult chick-rearing RTTR on Kauai and Lehua Islet (n=49, 2014-16) and on Oahu (n=10, 2015) to collect basic and previously unknown information about their foraging ecology. Foraging trip durations ranged from short, within-day trips to longer, multi-day excursions (up to 8 days), when individuals traveled up to ~700 km from colonies. Using a behavioral classification scheme, we identified important transiting and foraging areas at-sea and quantified spatial overlap with three lease requests for offshore wind energy development near Oahu. Additionally, we investigated using GPS-derived flight heights to assess risk of collision of RTTR with wind turbines. (Talk)

The establishment of offshore wind farms in the North Sea and the consequences for seabirds, marine conservation and spatial planning

Stefan Garthe<sup>1</sup> Katharina Fliessbach<sup>1</sup> Nele Markones<sup>1</sup> Bettina Mendel<sup>1</sup> Sabine Mueller<sup>1</sup>  
Verena Peschko<sup>1</sup> Henriette Schwemmer<sup>1</sup>

<sup>1</sup>Kiel University, Hafentoern 1, 25761 Buesum, Germany.

After almost a decade of discussions on possible effects, offshore wind farms have now been established in the German sector of the North Sea. Currently, 11 wind farms are in use, 6 under construction and another 20 have been consented. Data on seabirds were collected from research projects, from the German marine biodiversity monitoring as well as from construction and operational wind farm monitoring obligations. Very recent aerial and ship-based post-construction survey data show that some seabird species exhibit substantial displacement from the wind farm sites; this is most obvious for Red-throated Loons (*Gavia stellata*). In contrast, Lesser Black-backed Gulls (*Larus fuscus*) were frequently visiting the wind farms. Simultaneously, several seabird species breeding on the offshore island Helgoland were tracked by GPS tags. Common Murres (*Uria aalge*) showed clear avoidance of wind farms, while Northern Gannets (*Morus bassanus*) and Black-legged Kittiwakes (*Rissa tridactyla*) exhibited individually varying responses with a clear trend of being displaced from wind farms. Both data sets show that ship traffic, often in relation to the wind farms, is another major source of disturbance. Consequences for marine conservation and spatial planning are shown based on these recent findings. (Talk)

## The risk of rodent introductions from shipwrecks to seabirds on Aleutian and Bering Sea islands

Martin Renner<sup>1</sup> Eric Nelson<sup>2</sup> Jordan Watson<sup>3</sup> Alan Haynie<sup>3</sup> Aaron Poe<sup>4</sup> Martin Robards<sup>5</sup>

<sup>1</sup>Tern Again Consulting. .

<sup>2</sup>Alaska Maritime NWR.

<sup>3</sup>NOAA Fisheries AFSC.

<sup>4</sup>Aleutian and Bering Sea Islands LCC.

<sup>5</sup>Wildlife Conservation Society.

<sup>6</sup>US Geological Survey, Pacific Island Ecosystems Research Center.

Accidental introductions of rodents, often from shipwrecks, present one of the greatest threats to indigenous island biota. Here we use a comprehensive database of shipwrecks in Western Alaska to model the frequency of shipwrecks per island, taken as a proxy for the likelihood of rodent introductions, using physical variables, and the intensity of nearby shipping traffic and activity as predictors. Using data from 1950 to 2014, we found that shipwrecks were particularly common in the 1980s to early 2000s, with a major peak in wrecks during the late 1980s. Amount of shipping activity within 5 km of an island was the strongest predictor of shipwrecks, followed by the strength of tidal currents and density of large-vessel traffic. Islands with the highest frequency of shipwrecks are all in the eastern Aleutians, including Unimak, Unalaska, and Akun Islands. By contrast, the largest seabird colonies are in the western Aleutian and Pribilof Islands, including Buldir, Kiska, and Saint George islands. Multiplying the frequency of a shipwreck by the number of seabirds breeding per island provides a measure of risk. The risk of rodent introductions from shipwrecks to seabirds was then greatest for Saint George (Bering Sea), Buldir (Western Aleutians) and Saint Matthew islands (Bering Sea). Keeping these high-risk islands rodent free should be a conservation priority. Most islands with a high predicted frequency of shipwrecks already have established rodent populations and therefore few remaining seabirds. Of those islands with established rodent populations, Attu and Kiska Islands would make suitable targets for eradication, given their relatively low expected frequency of shipwrecks for their size. (Talk)

## ECONOMIC DEVELOPMENT AND MARINE PROTECTION USING MARINE SPATIAL PLANNING: GLOBAL TRENDS AND RELEVANCE TO SEABIRD CONSERVATION

Joanna Smith<sup>1</sup>

<sup>1</sup>TNC Canada, PO Box 535, Smithers, BC

Seabirds are wide ranging predators that use a variety of physical and biological features in the ocean for foraging, and are constrained seasonally by the distribution of suitable terrestrial habitat for breeding. For at least the last 50 years, threats to seabirds include fisheries bycatch, depleted prey populations, introduced species on the colonies, and pollution or toxins. Numerous efforts have been made to avoid, minimise or remove these threats including bycatch reduction techniques, fisheries restrictions or closures, invasive species eradication, and reducing plastic pollution. With increasing concerns about the present and future impacts of climate change, nations are making commitments to reduce greenhouse gas emissions and dependency on fossil fuels, exploring alternative energy sources. The offshore wind energy sector is one of several rapidly growing fields, capturing wind potential in coastal and offshore habitats. Permit applications must be evaluated with respect to environment impacts and other policy or legal requirements, with threats to seabirds one of the several ecological concerns that must be addressed. Meanwhile, other agencies are tasked with responding to national commitments for biodiversity protection such as the Convention on Biological Diversity target of 10 percent marine protection by 2020. A key question for decision makers is how to increase the use of renewable energy sources and simultaneously identify areas for marine protection? In this presentation, I will provide a global review of marine spatial planning and techniques for how multiple objectives for future economic development and marine protection for seabirds and other species are addressed in these processes. (Talk)

## USE OF MARINE BIRD DISTRIBUTION MODELS BY REGIONAL OCEAN COUNCILS FOR SPATIAL PLANNING

Arliss Winship<sup>1</sup> Brian Kinlan<sup>2</sup> Jesse Cleary<sup>3</sup> Corrie Curtice<sup>4</sup> Patrick Halpin<sup>3</sup> Emily Shumchenia<sup>5</sup>

<sup>1</sup>NOAA NOS NCCOS Biogeography Branch, Silver Spring, MD, USA and CSS-Dynamac, Fairfax, VA, USA.

<sup>2</sup>NOAA NOS NCCOS Biogeography Branch, Silver Spring, MD, USA.

<sup>3</sup>Marine Geospatial Ecology Lab, Duke University, Durham, NC, USA.

<sup>4</sup>Marine Geospatial Ecology Lab, Duke University Marine Lab, Beaufort, NC, USA.

<sup>5</sup>Northeast Regional Ocean Council, USA and E&C Enviroscape, RI, USA.

The Northeast and Mid-Atlantic Regional Planning Bodies (RPBs) are partnerships between state governments, the federal government, federally recognized tribes, and regional fishery management councils to coordinate management of US Atlantic coastal and ocean resources. Characterizing the ecosystem is a fundamental component of ocean planning, so the RPBs have worked with our Marine-life Data and Analysis Team (MDAT) to compile information on the spatial distributions of 151 marine fish, bird, and mammal species. Maps of marine bird spatial distributions were derived for 40 species from habitat-based predictive models. The suite of maps for each species included seasonal and annual long-term relative probability of occurrence and relative abundance along with multiple indicators of uncertainty in the model predictions. To inform multi-species planning individual species maps were further aggregated on the basis of ecology, distribution, conservation status, and sensitivity to stressors. Maps of total relative abundance and species richness were derived for each species group. An avian expert working group was convened and consulted by MDAT throughout the process, providing input on the choice of maps, species, and species groups. The maps are publicly available and can be viewed and explored through the RPBs online data portals. The maps provide fundamental information about the spatial distribution of marine birds that can inform ocean planning along the US Atlantic coast. (Talk)

## FLEET DYNAMICS: TOWARDS UNDERSTANDING THE WHERE, WHEN and WHY OF FISHER BEHAVIOUR

Pamela Michael<sup>1</sup> Chris Wilcox<sup>1</sup> Geoffrey Tuck<sup>2</sup> Alistair Hobday<sup>2</sup> Peter Strutton<sup>3</sup>

<sup>1</sup>CSIRO-UTas Quantitative Marine Science Program, Institute for Marine and Antarctic Studies, University of Tasmania, Hobart, Tasmania, Australia.

<sup>2</sup>CSIRO, Oceans and Atmosphere, Hobart, Tasmania, Australia.

<sup>3</sup>Australian Research Council Centre of Excellence for Climate System Science, University of Tasmania, Hobart, Tasmania, Australia.

Spatial management of the marine environment requires considering multiple users, often balancing the aims of conservation and fisheries interests. However, the response of fishers to change is notoriously difficult to predict. Increasing the understanding of fisher behaviour by modelling fleet dynamics can enable more informed spatial management decisions by identifying how fishers decide where and when to fish. The current range of fleet dynamics approaches generally requires high-resolution, vessel-specific information and detailed economics, constraining their application to high-seas fleets. Using the Japanese and Taiwanese pelagic longline fleets in the southern Indian Ocean as examples, we present an approach to modelling fleet dynamics when detailed information on fleet economics and vessel-specific information are lacking. We quantify the mean and variability of target species catch per unit effort (CPUE) and the relative value and cost of fishing in different areas. Using linear mixed models, we identify fleet-specific effort allocation strategies most related to observed effort. The Japanese fleets strategy targets high-value species and minimizes the variability in CPUE of the primary target species. Conversely, the Taiwanese strategy indicated flexible targeting of a broad range of species, fishing in areas of high and low variability in catch, and minimizing costs. This flexible approach provides a marine spatial planning tool for researchers and managers to understand the historical and better predict the future response of fishers to change. (Talk)

## SPATIALLY-EXPLICIT POPULATION DYNAMICS: INCORPERATING BYCATCH AND ENVIROMENTAL VARIATION

Pamela Michael<sup>1</sup> Robin Thomson<sup>2</sup> Christophe Barbraud<sup>3</sup> Karine Delord<sup>3</sup> Sophie de Grissac<sup>3</sup>  
Alistair Hobday<sup>2</sup> Peter Strutton<sup>1, 4</sup> Geoffer Tuck<sup>2</sup> Henri Weimerskirch<sup>3</sup> Chris Wilcox<sup>2</sup>

<sup>1</sup>CSIRO-UTas Quantitative Marine Science Program, Institute for Marine and Antarctic Studies, University of Tasmania, Hobart, Tasmania, 7004, Australia.

<sup>2</sup>CSIRO, Oceans and Atmosphere, Hobart, Tasmania, 7001, Australia.

<sup>3</sup>Centre d'Etudes Biologiques de Chize, CNRS / Univ La Rochelle, Villiers en Bois, 79360, France.

<sup>4</sup>Australian Research Council Centre of Excellence for Climate System Science, University of Tasmania, Hobart, Tasmania, 7004, Australia.

The trajectory of a seabird population is the result of many factors, including bycatch, demographic feedbacks, and environmental variation. Management of seabird populations can benefit from understanding how, where, and when each of these factors interact with the focal population. Here we use an integrated modelling framework concurrently estimates the impact of environmental conditions, fisheries bycatch, and density-dependence. This model is structured by age-class, breeding stage, with a 5 × 5 spatial and monthly temporal scale to a black-browed albatross (*Thalassarche melanophrys*) population breeding on Kerguelen Island. The model quantifies the bycatch of each of five super-fleets (fleets grouped by gear-type and reported bycatch rates): (i) Japanese mitigated pelagic longline, (ii) other pelagic longline, (iii) legal demersal longline, (iv) trawl, and (v) illegal, unreported and unregulated (IUU) demersal longline. A decline in the albatross population occurred between the mid-1990s through the early 2000s. Our analysis attributes the majority of modelled bycatch to the IUU demersal longline fleet near Kerguelen during the breeding season, for this time period. Including sea-surface temperatures during the incubation period indicated that warm temperatures during this period favour high breeding success. This integrated, spatially-explicit modelling framework can inform managers of key interactions and direct the design of managed areas and critical experiments. (Talk)

## LONG-TERM STUDIES OF BREEDING SEABIRDS IN THE COLUMBIA RIVER ESTUARY: TRANSFORMATIVE CHANGE AND RESPONSIBLE FORCING FACTORS

Daniel Roby<sup>1</sup> Donald Lyons<sup>2</sup> Yasuko Suzuki<sup>2</sup> Jessica Adkins<sup>2</sup> Peter Loschl<sup>2</sup> Timothy Lawes<sup>2</sup>

<sup>1</sup>U.S. Geological Survey – Oregon Cooperative Fish and Wildlife Research Unit, Oregon State University, 104 Nash Hall, Corvallis, OR 97331-3803.

<sup>2</sup>Oregon State University, 104 Nash Hall, Corvallis, OR 97331-3803.

In the last 40 years, populations of several colonial seabird species in the Columbia River estuary have gone from small and insignificant to globally significant, while other species have colonized the estuary for the first time in recorded history. Over the last 20 years, we have investigated both top-down and bottom-up factors that influence the size and productivity of seabird colonies in the estuary. First, availability of secure sites for breeding colonies is a key limiting factor for a community of coastal seabirds whose nesting habitat has been disturbed, degraded, or destroyed by anthropogenic change. Second, restoration of declining populations of seabirds can be as simple as constructing islands or other suitable nesting habitat and providing social cues that counteract the neophobia of colonial seabirds. Third, the location, size, and productivity of coastal seabird colonies reflects a complex and dynamic interplay of both the availability of suitable nesting habitat and the proximity of adequate forage. Fourth, many coastal colonial seabirds are fugitives from predators such as Bald Eagles (*Haliaeetus leucocephalus*) and large gulls (*Larus* spp.) that gradually key in on large, perennial aggregations of ground-nesting seabirds, causing seabird colonies to shift frequently among sites or experience intense top-down effects from efficient predators. Fifth, seabird recovery has now proceeded sufficiently for some fisheries managers to label these and other piscivorous colonial waterbirds as native invaders, and some are seeking extensive exceptions to protections afforded these species by the Migratory Bird Treaty Act. (Talk)

## RECOVERY OF ENDANGERED CALIFORNIA LEAST TERNS: MULTI-DECADAL PROGRESS AND CHALLENGES

Travis Wooten<sup>1</sup> Gabriela Ibarguchi<sup>1</sup> Katrina Murbock<sup>1</sup> Maggie Post<sup>1</sup> Rachel Smith<sup>1</sup> Amie Aguiar<sup>1</sup> Yes<sup>1</sup>

<sup>1</sup>San Diego Zoo Institute for Conservation Research, 15600 San Pasqual Valley Rd., Escondido, CA, 92027.

Long-lived seabirds adapted to variable environmental conditions often maintain resilient populations over time despite short-term declines during sub-optimal breeding years. For species at risk, recovery and resiliency are difficult to evaluate without long-term observations, a thorough knowledge about the ecology and natural history of the species, and in particular, awareness of trends in the face of increasing anthropogenic disturbance and climate change. The California Least Tern (*Sternula antillarum browni*), a federally listed species since 1970, has shown some recovery, but conservation efforts have been hampered in recent years. Here we examine our progress towards achieving recovery targets, our current challenges, and remaining critical knowledge gaps, through analyses of two decades of research and monitoring data from Southern California. (Talk)

## Long-term seabird studies on the Isle of May: changing times for North Sea seabirds

Sarah Wanless<sup>1</sup> Francis Daunt<sup>1</sup> Mike Harris<sup>1</sup><sup>1</sup>Centre for Ecology & Hydrology, Penicuik, UK, EH26 0QB.

The last fifty years have seen marked changes in the coastal environment around the UK, particularly the North Sea, with rising sea temperatures and increasing pressure from human activities such as fisheries, offshore renewable energy development and recreation. Seabirds form a major component of the marine predator community in the North Sea and long-term demographic, behavioral and dietary studies on the Isle of May have highlighted which species have been negatively affected by climate change and the industrial fishery for sandlance (the birds principal prey), and which species are potentially most at risk from extensive marine renewable developments planned for the region. Most species have exhibited declines in vital rates and breeding population size but there have been striking interspecific differences in the effects of temperature and extreme weather events and the extent of the impact of the industrial sandlance fishery. Long-term diet sampling has revealed that sandlance in the region decreased significantly in length-at-age and the importance of sandlance during the breeding season has declined particularly in common murre and European shags that provision their young with 1+ rather than 0 group fish. Methods to follow birds when they are away from the colony have highlighted previously unsuspected wintering areas of Isle of May birds, notably the extensive use of the east Atlantic by Atlantic puffins and a wintering hot-spot for black-legged kittiwakes off Newfoundland. Year-round logger deployments and live resightings have demonstrated high winter site fidelity and strong seasonal carry-over effects in black-legged kittiwakes and European shags. However, major knowledge gaps remain notably winter diet and moult, and how changing conditions will influence interactions between avian, mammalian and fish predators in the region. (Talk)

## A NEW DATABASE TO ELUCIDATE GLOBAL SEABIRD POPULATION TRENDS

Stephanie Avery-Gomm<sup>1</sup> Milani Chalopuka<sup>1</sup> Richard Fuller<sup>1</sup> Edd Hammill<sup>2</sup> Britta Hardesty<sup>3</sup>  
Michelle Paleczny<sup>4</sup> M. L. Palomares<sup>4</sup> Daniel Pauly<sup>4</sup> Chris Wilcox<sup>3</sup> Hugh P. Possingham<sup>1</sup>.

<sup>1</sup>University of Queensland, St Lucia, Queensland, Australia, 4072.

<sup>2</sup>Utah State University, Logan, Utah, 84322, United States.

<sup>3</sup>CSIRO, 3-4 Castray Esplanade, Hobart, Tasmania, Australia, 7004.

<sup>4</sup>Seas Around Us, University of British Columbia, 2202 Main Mall, Vancouver, British Columbia, Canada V6T 1Z4.

The planet faces a biodiversity extinction crisis, and seabirds are emblematic of this. Nearly a quarter of species are threatened with extinction, and a recent analysis indicated a 70% decline in the abundance of monitored seabird populations since 1950. These results are alarming given the important role seabirds play in island ecosystem function and resilience by acting as predators, scavengers, cross-ecosystem nutrient subsidizers, and ecosystem engineers. The wide-ranging, migratory nature of many seabird species necessitates that conservation occurs at an international scale, but efforts are often hindered by fragmented information on seabird population trends based on country-level or global-level assessments. To address this knowledge gap, we introduce a new global effort to collate data on monitored breeding seabird populations (i.e., surveyed > 5 times). This database collates 50+ existing sources and will support robust analyses of population change, as well the development of a spatially explicit model of how seabird population growth rates have changed over the past 65 years. These results will establish global patterns of seabird population change, including identifying hotspots of population decline, and knowledge gaps. Such information can provide the foundation for research that aims to identify drivers of seabird population declines and facilitate the coordination of effective conservation actions at a flyway scale (e.g., East-Asian Australasian Flyway). (Talk)

## DETECTING CHANGE IN SEABIRD DISTRIBUTIONS AT SEA IN ARCTIC AND SUB-ARCTIC WATERS OVER SIX DECADES

Carina Gjerdrum<sup>1</sup> Sarah Wong<sup>2</sup> Kasper Lambert Johansen<sup>3</sup> David Lieske<sup>4</sup> David Fifield<sup>5</sup>  
April Hedd<sup>5</sup>

<sup>1</sup>Environment Canada and Climate Change, Canadian Wildlife Service, Dartmouth, Nova Scotia, Canada.

<sup>2</sup>Department of Biology, Acadia University, Wolfville, Nova Scotia, Canada.

<sup>3</sup>Department of Bioscience, Aarhus University, 4000 Roskilde, Denmark.

<sup>4</sup>Department of Geography and Environment, Mount Allison University, Sackville, New Brunswick, Canada.

<sup>5</sup>Environment Canada and Climate Change, Science and Technology, St. Johns, Newfoundland and Labrador, Canada.

In the western North Atlantic and eastern Arctic, data on the distribution and abundance of seabirds at sea have been collected by the Canadian Wildlife Service from two main survey programs using ships of opportunity. The first, PIROP (Programme integre de recherches sur les oiseaux plagiques) collected quantitative information on seabird occurrence from 1965-1992 and the second, ECSAS (Eastern Canada Seabirds at Sea) from 2006-present. Combining the ECSAS data with data collected off the west coast of Greenland from 1988-2015 by the Danish Centre for Environment and Energy, we developed predictive models to investigate how ice cover and ocean processes influence the distribution thick-billed murre (*Uria lomvia*), northern fulmar (*Fulmarus glacialis*), dovekie (*Alle alle*), and black-legged kittiwake (*Rissa tridactyla*) in summer and autumn between Canada and Greenland. We used the PIROP data to examine how the distribution of these four species has changed over the last six decades. We discuss the results in relation to ocean climate variability, but also the challenges that exist when comparisons span such long time periods, including monitoring programs with changing priorities, differences in data-collection methodologies, and advances in technologies that are difficult to apply to historic datasets. (Talk)

## DENSITY DEPENDENCE AND CHANGES IN CARRYING CAPACITY OF ALASKAN SEABIRD POPULATIONS

Holly Goyert<sup>1</sup> Edward Garton<sup>1</sup> Brie Drummond<sup>2</sup> Heather Renner<sup>2</sup>

<sup>1</sup>Idaho Cooperative Fish & Wildlife Research Unit, University of Idaho, College of Natural Resources, Dept. of Fish and Wildlife Sciences, Moscow, ID 83843.

<sup>2</sup>Alaska Maritime National Wildlife Refuge, U.S. Fish and Wildlife Service, Homer, AK 99603.

Evidence for regulation of animal populations by negative density dependence is ubiquitous across the animal realm, and yet the dynamics of carrying capacity ( $K$ ) are often overlooked.  $K$  acts as a threshold below which population size tends to increase and above which it tends to decrease. Documenting changes in  $K$  is particularly important to population viability analyses (PVA). We reconstructed the population sizes of five long-lived seabird species in Alaska (AK), and analyzed their population dynamics from the past four decades. These species included four cliff nesters (Black-legged, *Rissa tridactyla*, and Red-legged Kittiwakes, *R. brevirostris*; Common, *Uria aalge*, and Thick-billed Murres, *U. lomvia*), and one burrow nester (Tufted Puffins, *Fratercula cirrhata*) with sparse data but high conservation concern. We evaluated a set of models that allowed for either density independence or density dependence, with or without a time trend in  $K$ . The best models indicated that these seabird populations behaved in a negative density-dependent fashion.  $K$  increased significantly for murrees, and remained relatively stable for Red-legged Kittiwakes. It decreased significantly (< 40%) for Black-legged Kittiwakes and Tufted Puffins, particularly in the Gulf of AK, following the 1989 Exxon Valdez oil spill. Our PVA suggests that, in the next 100 years, Tufted Puffins are over 80% likely to become extirpated from the small handful of colonies that are monitored in the Gulf of AK. Negative density dependence can help to prevent population crashes, but also suppress the recovery of contracted populations. Therefore, identifying population fluctuations around a changing  $K$  is essential to managing and conserving declining populations. (Talk)

## INTERRELATIONSHIPS AMONG OCEAN CLIMATE, ZOOPLANKTON TIMING AND ABUNDANCE, AND REPRODUCTION IN A ZOOPLANKTIVOROUS SEABIRD

Mark Hipfner<sup>1</sup> Moira Galbraith<sup>2</sup>

<sup>1</sup>Environment and Climate Change Canada, RR#1 5421 Robertson Road, Delta, BC, V4K 3N2.

<sup>2</sup>Fisheries and Oceans Canada, 9860 West Saanich Road, Sidney, British Columbia, V8L 4B2.

Triangle Island, British Columbia, lies within the transition zone between the California Current and Alaska Current systems. Zooplankton community composition varies across the bifurcation between these two marine systems, and is strongly affected by variation in ocean climate. Triangle Island also supports the largest and most diverse seabird breeding colony in Canadas Pacific, including ~40% of the global population of Cassins Auklet (*Ptychoramphus aleuticus*), a small, zooplanktivorous seabird. We have studied diet and demography of Cassins Auklets at Triangle Island from 1996 to 2016, a period of extreme variation in oceanographic conditions, and will combine these colony-derived data with regional zooplankton tow data covering the same period to provide new insight into how bottom-up processes limit reproduction in this seabird at this site. Most importantly, we will show how ocean climate influences both the abundance and the phenology of *Neocalanus cristatus*, a large, lipid-rich subarctic copepod, and how the resultant inter- and intra-annual variation in availability of this most important prey species has major consequences for population processes in the seabird. (Talk)

## Top- and mid-trophic level responses to ocean conditions off central California

Jaime Jahncke<sup>1</sup> Pete Warzybok<sup>1</sup> Meredith Elliott<sup>1</sup> Russ Bradley<sup>1</sup>

<sup>1</sup>Point Blue Conservation Science, 3820 Cypress Drive #11, Petaluma, CA, 94954.

We report on 45+ years of research on the Farallon National Wildlife Refuge, Central California. We assess how physical forcing at the regional (e.g., upwelling index and spring transition) and basin scale (e.g., the PDO, NPGO and ENSO) affect six species of seabirds and their main prey items. We used generalized linear models to assess how timing of breeding, breeding success, and main prey consumed by Farallon seabirds, respond to variability in spring transition, upwelling index, Southern Oscillation Index, Pacific Decadal Oscillation, and North Pacific Gyre Oscillation. We found that early spring transition was important for early breeding and both were important for high breeding success. La Niña-like (SOI) winters were important for early breeding, High NPGO winters were important for high breeding success for Cassins auklets and high prey availability. Strong spring upwelling appears important for high breeding success for cormorants, rhinoceros auklets and rockfish availability. Cool PDO springs were important for high breeding success for murrelets and high prey availability. In summary, seasonal variability (UI) and interannual variability (SOI) is important for timing of breeding, whereas inter-decadal variability (PDO and NPGO) is important for breeding success and prey availability. While we see increased variability in recent years, old-known relationships between climate, predator and prey still hold. Increased frequency of El Niño and changes in the onset and productivity of upwelling are expected to have the largest impacts on Farallon seabirds. (Talk)

Insights Regarding Climate Change and Fisheries from Long-term Restoration of Atlantic Puffin Colonies in the Gulf of Maine.

Stephen Kress<sup>1</sup> Paula Shannon<sup>1</sup> Christopher O'Neal<sup>2</sup>

<sup>1</sup>National Audubon Society, 159 Sapsucker Woods Road, Ithaca, NY 14850.

<sup>2</sup>Synovus, 1490 Distribution Drive, Suwanee, GA 30024 USA.

To assess the long-term outcomes of puffin restoration projects on the Maine coast, we monitored one or more of the following variables annually since 1993: chick diet, chick condition, productivity and cohort return rates. We examined the diet of Atlantic Puffin (*Fratercula arctica*) chicks at three mid-coast Maine, USA colonies during the years 2005-2016 and found that the puffins at each island have a distinct diet that has changed in recent years. White hake (*Urophycis tenuis*) is by far the most frequently delivered prey at each island. Atlantic herring (*Clupea harengus*) is the second most frequently delivered food, but has declined in recent years on two islands. In contrast, butterfish (*Poronotus triacanthus*), haddock (*Melanogrammus aeglefinus*) and redfish (*Sebastes* spp.) have increased in the puffin diet on all islands. The condition of puffin chicks, represented by the weight/wing chord ratio, declined significantly from 1993-2016. We demonstrate that puffin chicks with greater body weight experience a higher chance of post-fledging survival when compared to chicks with lower body weight. The years 2012-2013 were a period of extreme sea surface warming, during which time puffin hatching success and productivity sharply declined. This study provides new insight into changes in marine communities through examining changes in chick diet. We discuss our findings in relation to warming sea surface temperatures, recent climate-related decline in productivity of the Gulf of Maine and the impact of commercial fisheries on forage fish. (Talk)

## LONG-TERM SEABIRD DATA FOR A CHANGING ARCTIC

Elizabeth Labunski<sup>1</sup> Kathy Kuletz<sup>1</sup><sup>1</sup>U.S. Fish and Wildlife Service, 1011 E. Tudor Rd., Anchorage, Alaska 99503, USA.

Seabirds that inhabit dynamic Arctic regions are influenced by seasonal changes in sea ice coverage, water masses, and prey availability. Long-term changes in the environment have also occurred, and interest in offshore resources of the Chukchi and Beaufort seas requires that we evaluate the impact of development on marine birds. The North Pacific Pelagic Seabird Database (NPPSD) is an archive of historic marine bird survey data, with surveys in the 1970s and 1980s occurring during oil and gas exploration in Alaska. The U.S. Fish and Wildlife Service (USFWS) sought to update the data on seabirds in offshore waters of Alaska, and in 2006 began a long-term at-sea survey program to gather data on the distribution and abundance of seabirds. From 2006-2012 the At-Sea Program collected 27,408 km of survey data in the Chukchi and Beaufort seas, which was archived and published in the NPPSD v2. Surveys were continued through 2016, and will add an additional 22,661 km of survey coverage in the Arctic regions. Long-term seabird data from these regions is currently being incorporated into several multidisciplinary ecosystem studies in the Arctic including the Arctic Integrated Ecosystem Research Program, (Arctic IERP), Arctic Ecosystem Integrated Survey (Arctic EIS), Arctic Shelf Growth, Advection, Respiration and Deposition (ASGARD), Distributed Biological Observatory (DBO), and Arctic Marine Biodiversity Observation Network (AMBON). (Talk)

## 60,000 CARCASSES, 175 SPECIES, 500 SITES AND 4,000 PEOPLE: BEACHED BIRD PATTERNS IN A WARMING WORLD

Julia Parrish<sup>1</sup> Timothy Jones<sup>1</sup> Hillary Burgess<sup>1</sup>

<sup>1</sup>University of Washington.

Along the West Coast of North America, the Coastal Observation and Seabird Survey Team (COASST) collects standardized, effort-controlled, verifiable data on the identity, abundance and condition of beach-cast marine bird carcasses at sites from Mendocino, CA to Kotzebue, AK. For 17 years these data have created a baseline against which change - seasonal, catastrophic and chronic can be assessed. Here we examine the relative influence of ocean conditions (proxied by sea surface temperature anomaly) on the likelihood of catastrophic events, specifically mass mortality events (MME) where encounter rates are at least an order of magnitude above normal. Whereas MMEs were confined in time to every 4-6 years during the 1990s and 2000s, at present they are occurring at unprecedented frequency and intensity. Since the 2014 breeding season that followed the emergence of the Northeast Pacific Marine HeatWave, five distinct MMEs have occurred, three widespread and two restricted to a limited geographic region. Affecting planktivores and piscivores principally in the Alcidae, this trend suggests shifts in the location, energy content and predictability of prey resources in the northern Pacific, resulting in elevated mortality rates as well as shifts in seabird distribution. (Talk)

## LONG-TERM MONITORING ON HAIDA GWAII: USING AT-SEA SURVEYS TO DETERMINE DISTRIBUTION AND ABUNDANCE OF MARINE BIRDS OVER TIME

Vivian Pattison<sup>1</sup> Tony Gaston<sup>1</sup> Ayla Pearson<sup>1</sup>

<sup>1</sup>Laskeek Bay Conservation Society, PO Box 867, Queen Charlotte, BC, Canada V0T1S0.

The Laskeek Bay Conservation Society is a small community-based organization dedicated to ecosystem monitoring and to providing research opportunities for citizen scientists. One of our goals is to collect annual data using consistent, low-impact monitoring methods; at-sea surveys since 1990 have been one way in which we monitor seabirds in the Laskeek Bay area of the Haida Gwaii archipelago. By using easily understood methods we are able to utilize volunteers as assistants during at-sea surveys, and are able to combine seabird conservation through public outreach and education with tracking of trends in abundance and distribution of coastal and pelagic birds. Of special interest in our area are Ancient Murrelets (*Synthliboramphus antiquus*), a species listed as Special Concern in Canada and that breed on two of the islands of Laskeek Bay, and Marbled Murrelets (*Brachyramphus marmoratus*), an IUCN red-listed species that breed in the coastal forests adjacent to Laskeek Bay. Preliminary analysis of the 27 years of at-sea survey data demonstrates the seasonal changes in species composition and distribution throughout Laskeek Bay, which can inform us on species habitat preferences. For the Ancient Murrelet, we are also able to compare at-sea trends with trends estimated for colony numbers. A good baseline understanding of marine habitat use by seabirds is essential in an area where there is potential for local changes to both the marine and terrestrial environment, such as possible offshore tanker traffic, continued timber harvesting on the adjacent islands, and increased local boat traffic due to tourism. (Talk)

## STATUS AND TREND OF THE MARBLED MURRELET IN THE PACIFIC NORTHWEST

Martin Raphael<sup>1</sup> Gary Falxa<sup>2</sup> Deanna Lynch<sup>2</sup> Scott Pearson<sup>4</sup> Kim Nelson<sup>3</sup> Craig Strong<sup>5</sup>

<sup>1</sup>Pacific Northwest Research Station, 3625 93rd Ave SW, Olympia WA 98512.

<sup>2</sup>US Fish and Wildlife Service, U.S. Fish and Wildlife Service, Washington Fish and Wildlife Office, Branch of Listing, 510 Desmond Dr., Suite 102, Lacey, WA.

<sup>3</sup>Oregon Cooperative Fish and Wildlife Research Unit, Oregon State University, Department of Fisheries and Wildlife, 104 Nash Hall, Corvallis, OR 97331.

<sup>4</sup>Washington Department of Fish and Wildlife, 1111 Washington St. SE, 5th Floor, Olympia, WA 98501.

<sup>5</sup>Crescent Coastal Research, 7700 Bailey Road, Crescent City, CA 95531.

The Northwest Forest Plan (NWFP) was implemented, in part, to conserve and restore old-growth and late-successional forests that would contribute to the conservation and recovery of the marbled murrelet (*Brachyramphus marmoratus*). We summarize 20 years of data on populations and nesting habitat of the murrelet in the NWFP area. At the conservation-zone scale, there was strong evidence of a linear decline in the two conservation zones in Washington. We found little evidence of a linear trend in Oregon and California. We also modeled nesting habitat suitability and estimated there were about 2.5 million acres of potential nesting habitat over all lands at the start of the plan (1993). Most (90 percent) of potential nesting habitat in 1993 on federally-administered lands occurred within federal reserved-land-use allocations. A substantial amount (41 percent) of baseline habitat occurred on non-federal lands. We found a net loss of about 2 percent of potential nesting habitat from 1993 to 2012 on federal lands, compared to a net loss of about 27 percent on nonfederal lands. We conducted a multivariate analysis by using a boosted regression tree method to concurrently investigate the contributions of a suite of marine and terrestrial factors to at-sea murrelet abundance and trends. We found that numbers of murrelets are positively correlated with amounts and pattern (large contiguous patches) of suitable nesting habitat, and that population trend is most strongly correlated with trend in nesting habitat although marine factors also contribute to this trend. Model results suggest that conservation of suitable nesting habitat is key to murrelet conservation. (Talk)

## MURRE UPDATE: WIDESPREAD BREEDING FAILURES FOLLOWING WINTER MORTALITY EVENT

Heather Renner<sup>1</sup> Mayumi Arimitsu<sup>2</sup> Donald Dragoo<sup>1</sup> Holly Goyert<sup>3</sup> John Piatt<sup>2</sup> Nora Rojek<sup>1</sup>

<sup>1</sup>Alaska Maritime NWR, 95 Sterling Highway, Suite 1.

<sup>2</sup>USGS Alaska Science Center, Anchorage, AK.

<sup>3</sup>University of Idaho, Moscow, ID.

Common murre (*Uria aalge*) experienced complete reproductive failure at nearly all monitored colonies in the Gulf of Alaska and Bering Sea in 2016. This unprecedented event came after an unusually widespread and prolonged winter mortality event in 2015-2016 and was presumably linked to anomalously high ocean temperatures throughout the North Pacific beginning in winter 2014. At many colonies, zero to few murre attended nesting cliffs during the typical breeding period, which limited our ability to detect population-level effects of the winter die-off. Colonies where murre attempted to breed in 2016 laid eggs later than normal, and many experienced high rates of predation. We hypothesize that the reproductive failure in murre resulted from poor body condition prior to the breeding season after multiple years of food stress. Murre in the Aleutian Islands and Chukchi Sea fledged chicks at normal rates. Preliminary results from forage fish work in coastal areas of the Gulf of Alaska suggest favorable conditions for young-of-the-year forage fish including sand lance, herring and pollock during summer 2016. These fish, while abundant, are of lower energetic value than older age classes and they become available to predators later in the breeding season, compared to older age classes. Broad-scale analyses of murre breeding population trends indicate a stable or increasing population in Alaska over the last four decades. Continued monitoring of population status, breeding success and prey availability at colonies in coming years will provide an understanding of the population-level effects of recent anomalous ocean conditions on murre in Alaska. (Talk)

## ALTERNATE UNSTABLE STATES: DISTINGUISHING CONTRIBUTIONS OF BOTTOM-UP VS. TOP-DOWN CONTROL OF A SEABIRD COLONY

Robert Suryan<sup>1</sup> Bryan Black<sup>2</sup> Amanda Gladics<sup>3</sup> Cheryl Horton<sup>1</sup> Shawn Stephensen<sup>5</sup> Julia Parrish<sup>6</sup>

<sup>1</sup>Department of Fisheries and Wildlife, Oregon State University, Hatfield Marine Science Center, Newport, OR.

<sup>2</sup>University of Texas at Austin, Marine Science Institute, Port Aransas, TX.

<sup>3</sup>Oregon Sea Grant, Oregon State University, Astoria, OR.

<sup>4</sup>U.S. Fish and Wildlife Service, Monomoy National Wildlife Refuge, Chatham, MA.

<sup>5</sup>U.S. Fish and Wildlife Service, Oregon Coast National Wildlife Refuge Complex, Newport, OR.

<sup>6</sup>School of Aquatic and Fishery Sciences, University of Washington, Seattle, WA.

Many long term studies of seabird colonies have been conducted during a period when top predator populations were suppressed. However, the return of predators to the land- and seascape is impacting ecosystem functioning with particularly strong implications for seabird and other meso-predator populations. Counts of common murre (*Uria aalge*) at some colonies on the Oregon coast spanning over 100 years demonstrate that population sizes have fluctuated by orders of magnitude. Some of these population fluctuations were, in part, predator influenced (human and non-human), though, the underlying mechanisms of change remain equivocal. Targeted time series data collected during a period of increasing natural predator populations provide insight into the relative contribution of bottom-up and top down control of common murre at the Yaquina Head colony. Dietary species composition and stable isotope metrics remain predominantly influenced by local and basin scale bottom-up drivers. In contrast, phenology and reproductive metrics have switched from bottom-up to a combination of bottom-up and top-down control as predator populations and climate variability have increased. Top-down signals can be quantified and removed to reveal residual bottom-up influences on reproduction. Our results demonstrate the importance of interactions between these controlling factors on seabird colony dynamics and the need to record specific metrics to identify underlying mechanisms of seabird population variability in a changing climate. (Talk)

## SEABIRDS HELP TO INFORM FORAGE FISH TRENDS IN RELATION TO ENVIRONMENTAL CONDITIONS IN THE GULF OF ALASKA

Stephani Zador<sup>1</sup>

<sup>1</sup>National Oceanic and Atmospheric Association, Alaska Fisheries Science Center

Forage fish have an outsized trophic role in many marine ecosystems, supporting the transfer of energy from zooplankton to upper trophic fish, birds, and mammals. Despite this importance, robust estimates of forage fish abundance are often difficult to assess due to the lack of long-term surveys designed to capture forage fish. However, there are many marine predators that specialize in capturing forage fish. Just as survey nets have catchability biases, forage fish predators have selection biases. I hypothesized that integrating relative abundance data of forage fish in the diets of several species of groundfish and seabird predators may provide robust estimates of forage fish abundance trends. Furthermore, relationships between the common trends found among multiple imperfect samplers of forage fish and broad-scale environmental processes may be easier to detect and interpret. I used ~35 year time series of relative abundance of capelin (*Mallotus villosus*) and sand lance (*Ammodytes spp.*) from stomachs of arrowtooth flounder (*Atheresthes stomias*), Pacific cod (*Gadus macrocephalus*), pollock (*G. chalcogramma*), and Pacific halibut (*Hippoglossus stenolepis*) collected during trawl surveys and from chick-provisioning black-legged kittiwakes (*Rissa tridactyla*) and tufted puffins (*Fratercula cirrhata*) to determine common trends using Dynamic Factor Analysis. These trends were then analyzed first using change point analyses to test for regime shifts and then using cross-correlations to test for lagged correlations with temperature and climate indices. Results indicate that capelin abundance appears to be responsive to temporal trends, including the recent warm water event, the Blob, that occurred in the central Gulf of Alaska. (Talk)

Natural selection on morphology varies among years and by sex in Magellanic Penguins (*Spheniscus magellanicus*)

Laura Koehn<sup>1</sup> Jeffrey Hard<sup>3</sup> Elaine Akst<sup>5</sup> Dee Boersma<sup>2</sup>

<sup>1</sup>University of Washington School of Aquatic and Fishery Sciences, 1122 NE Boat St, Seattle, WA 98105.

<sup>2</sup>University of Washington Department of Biology, 24 Kincaid Hall, Seattle, WA 98105.

<sup>3</sup>Conservation Biology Division, Northwest Fisheries Science Center, 2725 Montlake Blvd E, Seattle, WA 98112.

<sup>4</sup>The Wildlife Conservation Society, 2300 Southern Blvd, Bronx, NY 10460.

<sup>5</sup>Molecular Genetics Laboratory, Smithsonian Conservation Biology Institute.

The evolution of morphology in a population reflects several factors, including the influence of environmental variability on natural selection. We estimated natural selection on, and heritability of, four individual morphological traits (bill length, bill depth, flipper length, and foot length) and two multivariate morphological traits in adult Magellanic Penguins (*Spheniscus magellanicus*) at Punta Tombo, Argentina, from 1983 to 2010. For the analysis of selection on each trait, we estimated both linear and quadratic selection gradients, based on the number of fledglings produced, for breeding males and females in each year. Estimates from animal models indicated that all six traits were heritable. Over 28 years, we detected no selection in 21 years for males and in 21 years for females. For the years in which we did detect selection, the direction and intensity of selection on traits varied, especially for females. We detected selection on primarily multivariate body size but also on male bill sizes and female bill and foot lengths. When there was selection in males, selection on body and bill sizes was mainly toward larger sizes and occurred in four of six years with high chick starvation. The absence of detectable selection on morphology in most years suggests that it is not tightly linked to fitness and that the dynamic environment where Magellanic Penguins live helps maintain morphological variation. The temporal variability in selection likely fosters stability of morphology through time, a pattern that might not be evident in short-term studies. (Talk)

## THE CALIFORNIA COOPERATIVE OCEANIC FISHERIES INVESTIGATION (CALCOFI): 30 YEARS OF AT-SEA SEABIRD OBSERVATIONS AND COUNTING

William Sydeman<sup>1</sup>

<sup>1</sup>Farallon Institute, Farallon Institute, Petaluma, CA.

In May 1987, R.R. Veit and J.A. McGowan initiated shipboard observations of seabirds as part of the seasonal, long-term fisheries oceanographic program known as CalCOFI. CalCOFI started in the early 1950s and was designed to provide ecosystem information for fisheries management, following the demise of the sardine fishery off California in the 1940s. Monthly ocean and plankton surveys from Mexico to Canada were conducted for many years before effort was reduced to seasonal surveys in the late 1960s. The CalCOFI - Seabird program has provided insight into climate - ecosystem variability on multiple time scales and including unidirectional climate change, spatial variability in community structure, trophic interactions and control of pelagic food webs, and the population biology of rare and abundant seabird species in light of various human activities in the southern California region. In this presentation, I review scientific contributions of the CalCOFI-Seabird program, provide examples of key research findings, and speculate on probable key issues for the next 30 years of at-sea seabird counts off southern-central California. (Talk)

## TESTING WHETHER UNMANNED AIRCRAFT SYSTEMS CAN BE USED TO LOCATE CRYPTIC NESTS OF THE MARBLED MURRELET.

Lindsay Adrean<sup>1</sup> Matthew Pickett<sup>2</sup> Brian Taggart<sup>3</sup> S. Nelson<sup>4</sup> Daniel Roby<sup>5</sup> Matthew Betts<sup>1</sup>

<sup>1</sup>Department of Forest Ecosystems and Society, Oregon State University, Corvallis, OR 97331.

<sup>2</sup>Collaborative Center for Unmanned Technologies, National Oceanic and Atmospheric Administration, Santa Barbara, CA 93109.

<sup>3</sup>Oceans Unmanned, Santa Barbara, CA 93109.

<sup>4</sup>Department of Fisheries and Wildlife, Oregon State University, Corvallis, OR 97331.

<sup>5</sup>US Geological Survey - Oregon Cooperative Fish and Wildlife Research Unit, Department of Fisheries and Wildlife, Oregon State University, Corvallis, OR 97331.

Technological advancements with unmanned aircraft systems (UASs) provide an emerging tool that can be used in many research contexts, potentially saving time, reducing costs, and minimizing risks to both scientists and the organisms they study. Nevertheless, there has been limited application of UASs for surveying wildlife, including tests of whether UASs can be used to locate cryptic wildlife within complex terrestrial habitats. In this study, we evaluated the efficacy of a UAS outfitted with a thermal imaging camera for locating nests of the threatened Marbled Murrelet (*Brachyramphus marmoratus*) in the Oregon Coast Range. We used a live, domestic quail (*Coturnix japonica*) housed in a wire cage to act as a surrogate for a murrelet nest, and we placed caged quail on suitable nest platforms in locations that were unknown to UAS operators. Operators then searched for surrogate nests using a DJI Phantom 4 quadcopter equipped with a FLIR Vue Pro 640 infrared thermal camera. Over the course of 5 days we conducted 13 independent flights, successfully locating quail in 85% of trials, with a mean time to discovery of 33 min (range: 4-64 min) for successful tests. Overhead and lateral vegetation cover was lower within the vicinity of surrogate nests that were detected, suggesting that greater vegetation density may have reduced our ability to locate surrogate nests. Our study indicates UASs were successful at locating surrogate murrelet nests sites under experimental conditions, and suggests they hold promise for detecting cryptic canopy-dwelling organisms within temperate forests. (Talk)

## DETAILS OF A CAT BARRIER FENCE TO PROTECT NESTING HAWAIIAN PETRELS ON MAUNA LOA, HAWAII

Kathleen Misajon<sup>1</sup> Darcy Hu<sup>2</sup> Jon Faford<sup>1</sup> Charlotte Forbes Perry<sup>3</sup> Rhonda Loh<sup>1</sup> Keola Medeiros<sup>1</sup>

<sup>1</sup>Hawai'i Volcanoes National Park, PO Box 52, Hawaii National Park, HI 96718.

<sup>2</sup>Pacific West Regional Office, National Park Service, PO Box 52, Hawaii National Park, HI 96718.

<sup>3</sup>Pacific Cooperative Studies Unit, University of Hawai'i, PO Box 52, Hawaii National Park, HI 96718.

In May 2016, Hawai'i Volcanoes National Park completed a 5 mile long cat barrier fence encircling 640 ac of the parks most important 'Uau or Hawaiian Petrel (*Pterodroma sandwichensis*) colony in a remote area at approximately 9000 on Mauna Loa. Planning and compliance for the fence started over 12 years ago, following earlier attempts to protect these endangered petrels by trapping predators. The fence, modified from a design developed by Arid Recovery in Australia, consists of a hogwire framework overlaid with 2 rows of PVC-coated hexagonal mesh. Mesh at the bottom forms a skirt barrier, while mesh at the top forms a flexible arch to prevent cats from climbing or jumping over. Construction took 30 weeks over four years because work was limited to January through May to avoid disturbance to nesting birds. The total cost was approximately 1M, or 200,000 per mile (38/foot, 124/meter), including 10% for helicopter transport of all fencing materials, equipment and crew. However, labor costs from the parks in-house, experienced fencing staff were notably lower than fencing projects elsewhere in the state. Recommendations for those considering a similar project include conducting advance trials to allow the crew to customize skirting techniques tailored to the specific substrate(s), realistic construction pacing to ensure crew safety, employing multiple approaches to minimize bird strike on the fence, and use of a monitoring technique that permits assessment of population changes following fence completion. (Talk)

## IF A SEABIRD CALLS IN THE WILDERNESS AND NO ONE IS THERE TO HEAR, ARE SEABIRDS STILL BREEDING?

Jay Penniman<sup>1</sup> Jennifer Learned<sup>1</sup> Matthew McKown<sup>2</sup>

<sup>1</sup>University of Hawaii/Maui Nui Seabird Recovery Project, PO Box 903, Makawao, HI 96768.

<sup>2</sup>Conservation Metric, Inc., 508 Buena Vista Avenue, Santa Cruz, CA 95060.

Seabirds were a dominant component of the Hawaiian Islands avifauna before arrival of *Homo sapiens*. Since that time, consumption for food and feathers by Polynesians, habitat alterations by Polynesians and Europeans, and introductions of alien mammals by both groups of humans have all contributed to the dramatic decline in seabird populations on the high Hawaiian Islands. Hawaiian petrel (*Pterodroma sandwichensis*), Newells shearwater (*Puffinus newellii*) and Band-rumped storm petrel (*Oceanodroma castro*) are all listed under the Endangered Species Act as endangered, threatened and endangered respectively. All three species nest in remote, heavily vegetated or barren rocky, difficult to access locations on steep slopes. Maintaining genetic and geographic diversity is a goal of the Newells Shearwater, Hawaiian Petrel, & Band-rumped Storm Petrel Recovery: Five Year Action Plan(USFWS, DOFAW, Univ. of HI). To achieve this goal we must locate these species in areas where we are not currently managing for them. Once located protection may be provided in situ or translocation to predator proof enclosures with social attraction may be considered. We used automated acoustic monitoring on three of the islands of Maui Nui (Maui, Molokai and Kahoolawe) to identify potential seabird active nesting locations. Recordings were also analyzed for presence of the introduced avian predator, Common Barn Owl (*Tyto alba*). Results varied from 0 to 3.208 calls per minute and varied across all islands. All species were recorded but not at every site. We describe the acoustic monitoring strategy, deployment and recovery methodology, acoustic environment, management implications and potential recovery actions. (Talk)

## RECENT MARBLED MURRELET RADAR COUNTS AND MARINE DENSITIES IN THREE CONSERVATION REGIONS OF BRITISH COLUMBIA

Bernard Schroeder<sup>1</sup> Kerry Woo<sup>2</sup> Trudy Chatwin<sup>3</sup> Douglas Bertram<sup>2</sup> Jenna Cragg<sup>3</sup>

<sup>1</sup>Bernard K Schroeder Consulting, 351 Howard Ave, Nanaimo, BC, V9R 3R8, Canada.

<sup>2</sup>Environment and Climate Change Canada, c/o Institute of Ocean Sciences, 9860 West Saanich Rd., P.O Box 6000, Sidney, B.C., V8L 4B2, Canada.

<sup>3</sup>Ministry of Forests, Lands and Natural Resource Operations, 2080 Labieux Rd, Nanaimo, BC V9T 6J9, Canada.

In British Columbia (BC) ornithological radar has become the standard tool for estimating population trends of Marbled Murrelets (*Brachyramphus marmoratus*). In 2014, 2015 and 2016 Marbled Murrelet numbers were estimated in three conservation regions Northern Mainland Coast, Southern Mainland Coast, West and North Coast Vancouver Island at 3 long-term radar monitoring stations in each of Douglas Channel, Desolation Sound and Clayoquot Sound, BC, nearest the respective murrelet capture zones for satellite tracking efforts in those regions. Marine line transect surveys were conducted to obtain a snapshot of murrelet densities in marine habitat and investigate relationships with radar counts using line transects between radar locations. The effort to continue trend monitoring was facilitated by collaboration between Environment and Climate Change Canada (ECCC) and BC Ministry of Forests, Lands and Natural Resource Operations (FLNRO). The work was conducted in support of related efforts by ECCC to quantify marine breeding and post-breeding locations and movements of Marbled Murrelets using solar satellite transmitters. The results demonstrate low correlation between at-sea densities, where murrelets are widely dispersed, and radar counts, where many murrelets concentrate flight paths at catchment entrances. Higher densities existed in mainland inlets farther from ocean where murrelets have fewer dispersal options. (Talk)

## TECHNIQUES, REFLECTIONS AND CARE PRACTICES FOR CONIBEAR STYLE MECHANICAL TRAPPING IN ARID TROPICAL ECOTYPES

Lynx Gallagher<sup>1</sup> Jay Penniman<sup>1</sup>

<sup>1</sup>University of Hawaii, PO BOX 903 .

Feral cats and mongoose/mustelids are well documented depredators of native species globally; the decline and extinction of endemic species on tropical islands is one of the clearest examples of the effects of these organisms. Mechanical trapping is often the first line of defense for mitigation or removal efforts concerning these introduced predators. Conibear (Belisle brand) 220 body-grip traps are one of a small number of kill traps approved by the New Zealand DOC for humane and effective trapping of feral cats and stoats. The common fallacy with mechanical trap use is that form equates function and that function is a constant. Traps, like all machines, need upkeep to maintain effect and their manufacturing is inconsistent. QA/QC in receipt of new traps and active awareness of trap decline within the field are paramount to achieve an effective trap regime. The main speaking points will address common care practices, safety options, the appropriate use of these traps to catch predators versus general techniques for capturing fur bearing animals, bait choice, and specific physical points that require maintenance or modifications to improve performance in arid highly corrosive environments. The goal for this talk is to clarify and illustrate practical trap use and to spare new users of these devices excessive time and effort pursuing disparate information. (Talk)

## COMPARING METHODS FOR ASSIGNING SEABIRD BEHAVIOR FROM ACCELEROMETER DATA: SIX OF ONE OR HALF A DOZEN OF ANOTHER

Allison Patterson<sup>1</sup> Kyle Elliott<sup>1</sup>

<sup>1</sup>McGill University, Department of Natural Resource Sciences, McGill University, Ste Anne-de-Bellevue Quebec, Canada H9X 3V9.

The behavior of seabirds at sea has long been a mystery. Accelerometers can solve some of those mysteries, as they collect activity data on seabirds at-sea at a high temporal resolution ( $< 1$  sec), can be relatively small (1-2 g), and are capable of recording data for up to 50 days. Combining accelerometry with other tracking data can provide a detailed record of what seabirds are doing and where they are doing it. These data present several challenges: large file sizes require significant computing power and there are numerous methods for assigning behaviors, which often require complex statistical techniques. The objective of this study was to assess the accuracy of different behavioral assignment methods for thick-billed murre (*Uria lomvia*), when the primary objective is to develop a basic time-activity budget. Four behaviors were identified using tri-axial accelerometer and depth data: colony, swimming, flying, and diving. We assessed the accuracy of each classification method relative to classifications from concurrent GPS tracking data. Four variables were used for classification: depth, wing beat frequency, pitch and overall dynamic body acceleration. Average accuracy for all methods was greater than 90%. Classification accuracy using a histogram segregation method was statistically significantly better than the expectation-maximization method; however, the absolute difference among methods was marginal ( $< 1\%$ ). Our results suggest that simple methods of behavioral classification can be as accurate for classifying basic behaviors as more complex approaches. Biologists primarily interested in studying seabird ecology should pick a method they are comfortable with and move on to more interesting questions. (Talk)

## TRACKING MIGRATION ROUTES OF A SURROGATE SPECIES, GREATER CRESTED TERNS IN MATSU, TAIWAN, FOR CHINESE CRESTED TERNS CONSERVATION

Le-Ning Chang<sup>1</sup> Hsiao-Wei Yuan<sup>1</sup> Chung-Hang Hung<sup>1</sup><sup>1</sup>National Taiwan University, No. 1, Sec. 4, Roosevelt Rd., Taipei 10617, Taiwan.

Chinese Crested Terns (*Thalasseus bernsteini*) are listed as a rare and endangered species on the IUCN Red List. Matsu and Penghu in Taiwan, Wuzhishan and Jiushan Archipelagos in Mainland China, and Muan in South Korea are the five areas confirmed to have a breeding population. Since 2000, we have investigated their population and breeding success at the Matsu Islands Tern Refuge. We found that Chinese Crested Terns co-habitat with the Greater Crested Terns (*T. bergii*) and the two terns populations have a significant relationship. It is believed that these two terns also migrate and over-winter together. However, the migration routes and wintering sites for terns are still unknown. In this study, we tracked 4 Greater Crested Terns tagged with satellite transmitters in 2016, and combined with the satellite tracking results of Greater Crested Terns (n=3) tagged in 2008, analyzed their migration routes. The result shows terns from the same colony took two different migration routes, one following the China coast moving southward and wintering in Vietnam, Thailand, and Myanmar; and the other following the China coast moving south-westward to winter in the Philippines. Possible stopover locations highlight the importance of Kinmen island in Taiwan, and the coast of Guangdong Province and Hainan island in China. We also found that Greater Crested Terns clearly target regions of high marine productivity. Hopefully we will be able to understand these two terns migration ecology, and set up and execute a cross-border conservation action plan. (Talk)

## USING SATELLITE TELEMETRY TO EXPLORE ELEGANT TERN THALASSEUS ELEGANS MOVEMENT PATTERNS ALONG THE EASTERN PACIFIC COAST

Katharine Goodenough<sup>1</sup> Robert Patton<sup>2</sup> Michael Horn<sup>3</sup>

<sup>1</sup>Department of Biology, University of Oklahoma, 730 Van Vleet Oval Rm 314, Norman, OK 73019.

<sup>2</sup>Avian Research Associates, 4444 La Cuentra Drive, San Diego, CA 92124.

<sup>3</sup>Department of Biology, California State University-Fullerton, 800 North State College Blvd, Fullerton CA 92831.

The Elegant Tern (*Thalasseus elegans*) is a pelagic foraging, coastal nesting seabird that has a narrow breeding range that shifts its distribution northward into the California Bight system during the late summer and autumn before migrating south to non-breeding locations in Central and South America. Over the last 13 years, there has been an expansion of the breeding range into Southern California at three managed locations: the South Bay Unit of the San Diego Bay National Wildlife Refuge (Saltworks), the Bolsa Chica Ecological Reserve (BCER), and Pier 400-Port of Los Angeles (POLA) from breeding grounds in northern Baja California. The California colonies have experienced 'big years' recently hosting a majority of the breeding population. With these newer colonies, historical data is not available to make the connection between reproductive success and locally available food resources. Additionally, why the terns first move north and then southward is an unanswered question, although we suspect it is food related. Using satellite telemetry, our research is focused to make the connection between breeding colony and foraging grounds in California and to document post-breeding dispersal, and migration routes for the Elegant Tern along the east Pacific Ocean basin. In 2015, we started a research project to test the Elegant Tern migration model and document linkages between foraging grounds and breeding colonies. Results of the ongoing telemetry indicate a clear connection to the Southern California Bight system in the late summer-autumn and document a coastal migration along the Pacific Coast to wintering grounds in Central America. (Talk)

## MOVEMENT PATTERNS AND HABITAT SELECTION OF BROWN PELICANS IN THE GULF OF MEXICO

Juliet Lamb<sup>1</sup> Yvan Satge<sup>1</sup> Patrick Jodice<sup>2</sup>

<sup>1</sup>Clemson University, G-27 Lehotsky Hall, Clemson, SC.

<sup>2</sup>USGS South Carolina Cooperative Fish and Wildlife Research Unit, G-27 Lehotsky Hall, Clemson, SC.

In marine environments, where animal movements usually occur far from land and out of sight, remote tracking data offers a useful tool for investigating individual behavior, habitat associations, and risk factors. We assessed year-round habitat selection and use by Brown Pelicans in the northern Gulf of Mexico based on three years of GPS data from 85 individuals. Using a Hidden Markov Model, we separated resident behavior, defined by slow movement through limited areas, from transient states in which animals moved quickly across large areas. We then evaluated resident habitat characteristics using a marginality analysis of remotely sensed environmental variables.

Most (>99%) of resident locations were less than 20 km from the nearest coastline. Within coastal regions, pelicans selected habitats with below-average salinity and above-average primary production. Selection on these characteristics was strongest during the breeding period, de-creasing during non-breeding. Conversely, non-breeding pelicans selected waters with below-average temperatures, while breeding-season locations reflected region-wide mean temperatures. Throughout the year, pelicans consistently preferred relatively shallow habitats close to coastlines and river mouths. Although previous studies have suggested that nearshore seabirds are influenced by both temperature and productivity of oceanic waters, salinity is an unusual component of seabird habitat selection and may be driven by an abundance of estuarine-dependent prey. This study offers insight into habitat features selected by nearshore seabirds in a subtropical environment, and provides a baseline for predicting occupancy, spatial overlap, and risk exposure across a regional metapopulation. (Talk)

RESULTS OF A STATEWIDE SURVEY FOR NEWELLS SHEARWATER, HAWAIIAN PETREL, AND BAND-RUMPED STORM PETREL

Lindsay Young<sup>1</sup> Eric VanderWerf<sup>1</sup> Megan Laut<sup>2</sup> Adam Vorsino<sup>2</sup> Jay Penniman<sup>3</sup> Hannah Nevins<sup>4</sup> Alex Wang<sup>5</sup> Nick Agarostis<sup>5</sup> Kathleen Misajon<sup>6</sup> Matthew Mckowen<sup>1</sup>

<sup>1</sup>Pacific Rim Conservation, PO Box 61827, Honolulu, HI, 96839 .

<sup>2</sup>U.S. Fish and Wildlife Service, Pacific Islands Office, Honolulu, HI .

<sup>3</sup>Maui Nui Seabird Recovery Project, Makawao, HI.

<sup>4</sup>American Bird Conservancy, The Plains, VA.

<sup>5</sup>State of Hawaii Natural Area Reserves System, Hilo, HI.

<sup>6</sup>National Park Service, Hawaii Volcanoes National Park, HI.

<sup>7</sup>Conservation Metrics, Santa Cruz, CA.

Hawaii's only two endemic seabirds, the Newells shearwater (*Puffinus newelli*; NESH) and Hawaiian petrel (*Pterodroma sandwichensis*; HAPE), and the Band-rumped storm petrel (*Oceanodroma castro*; BANP) are all listed under the Endangered Species Act. Threats include light attraction and fallout, collision with power lines, predation by alien species, and habitat degradation. In 2015, the USFWS produced a seabird habitat suitability model that identified potential locations across the state where all three species might be found. In 2016, we conducted surveys at sites on four islands identified by this model to confirm habitat suitability, determine the presence of ESA-listed seabirds and whether predator fencing was possible. We visited a total of 23 sites on Oahu, Maui, Molokai and Hawaii. During site assessment, we conducted visual and auditory surveys for NESH, HAPE, and BANP and deployed 38 song meters. ESA-listed seabirds were detected on all islands in varying densities. On Molokai, a single NESH call was recorded, and on Oahu NESH were detected at two sites, suggesting either prospecting birds or very small remnant breeding colonies. On Maui, both NESH and HAPE were detected at seven sites. On Hawaii Island, HAPE were detected at all three sites visited, NESH at one, and BANP at one site. For HAPE and BANP, the timing and incidence of call rates suggested active breeding on Hawaii. All islands contained large tracts of suitable habitat and several sites suitable for fencing, but the low densities of birds suggest the presence of predators continues to limit their breeding distribution. (Talk)

## FORAGING RHINOCEROS AUKLETS IN THE FARALLON ESCARPMENT: A SPATIAL ANALYSIS VIA GPS TRACKING TECHNOLOGY

Bradley Wilkinson<sup>1</sup> Jaime Jahncke<sup>2</sup> Pete Warzybok<sup>2</sup> Russell Bradley<sup>2</sup> Scott Shaffer<sup>1</sup><sup>1</sup>San Jos State University, 1 Washington Square, San Jose, CA 95192.<sup>2</sup>Point Blue Conservation Science, 3820 Cypress Drive, Petaluma, CA 94954.

Assessing local movement patterns and foraging habitat requirements are fundamental to making sound conservation and managerial decisions, particularly in complex and highly dynamic marine environments. In addition to hosting the largest seabird breeding colony in the contiguous United States, the Farallon Islands comprise the most sizeable population of rhinoceros auklets (*Cerorhinca monocerata*) within the southern terminus of their range. Using GPS tracking technology, marine space-use of chick-brooding auklets was assessed over the course of several weeks in 2015 and 2016. Analysis revealed primary zones of use in waters surrounding the breeding colony and beyond the shelf break to the southeast of the island. Unexpectedly, main areas of foraging occurred at bathymetries between 1000-2000m, deeper than was anticipated. The Farallon Escarpment appears to be a primary underwater feature determining auklet foraging habitat, with anecdotal evidence of submarine canyon features also contributing. Importantly, most of the at-sea distribution of breeding auklets is encompassed within National Marine Sanctuaries, although significant departures do occur. It is therefore important to continue evaluating the adequacy of such areas, particularly in response to variable climactic conditions, potential offshore energy development, and changing prey bases. (Talk)

## DIFFERENCES IN SHEARWATER AND MURRE DISTRIBUTIONS NEAR THE COLUMBIA RIVER PLUME DURING SPRING AND SUMMER

Elizabeth Phillips<sup>1</sup> Josh Adams<sup>2</sup> Jeannette Zamon<sup>3</sup> John Horne<sup>1</sup>

<sup>1</sup>University of Washington, School of Aquatic and Fishery Sciences, Box 355020, Seattle, WA 98195.

<sup>2</sup>U.S. Geological Survey, Western Ecological Research Center, 400 Natural Bridges Drive, Santa Cruz, CA 95060.

<sup>3</sup>NOAA Fisheries Pt. Adams Research Station, PO Box 155, Hammond, OR 97121.

Discharge from the Columbia River into the northern California Current creates a large, dynamic plume and multiple plume fronts. These nutrient-rich waters fuel primary and secondary production, supporting a diverse food web that includes small pelagic prey fish, large populations of Pacific salmon, marine mammals, and seabirds. Sooty shearwaters (*Ardenna grisea*), common murrelets (*Uria aalge*), and prey including northern anchovy (*Engraulis mordax*) and juvenile salmon (*Oncorhynchus* spp.) occur disproportionately in the Columbia River plume during May and June, indicating that the plume is a foraging area. The distributions of shearwaters and murrelets within the plume are not the same, and may relate to species-specific differences in foraging ecology, especially during the spring and summer when murrelets act as central place foragers. To quantify differences in shearwater and murrelet distributions, we used PTT satellite transmitter data to estimate Brownian bridge utilization distributions (BBUD) of each species. To evaluate associations with the dynamic plume, we compared BBUDs to predicted surface salinity values from a hindcast model of freshwater circulation. Greatest BBUD values for shearwaters were near the northern edge of the plume, regardless of plume size or location. Greatest BBUD values for murrelets were in central plume waters or to the south, nearest to breeding colonies. We did not observe consistent central place foraging behavior in the murrelet telemetry data, suggesting that other factors including access to shallower prey or niche partitioning, possibly due to interference competition, may be an important factor in the observed species-specific distributions. (Talk)

## TRACKING CALIFORNIA BROWN PELICANS INJURED IN THE REFUGIO BEACH OIL SPILL

Deborah Jaques<sup>1</sup> Kyra Mills<sup>2</sup> Bart Selby<sup>3</sup> Christine Fiorello<sup>2</sup> Michael Ziccardi<sup>2</sup>

<sup>1</sup>Pacific Eco Logic, Pacific Eco Logic, 375 3rd Street, Astoria, OR.

<sup>2</sup>Oiled Wildlife Care Network, School of Veterinary Medicine, Univ. of California Davis, Davis, CA 95616.

<sup>3</sup>256 Windsor Drive, San Carlos, CA.

The value of washing and rehabilitation of seabirds injured in oil spills continues to be challenged. Between September 2015 and November 2016 we conducted a field study to supplement satellite tracking of California brown pelicans (*Pelecanus occidentalis californicus*) affected by the May 2015 Refugio Beach Oil Spill (RBOS). Field work was designed to evaluate apparent fitness, behavior, and habitat use by the rehabilitated RBOS birds compared to other groups within their migratory range, using metrics such as molt progression, gular pouch color, associated group size, and occurrence of scavenging. Surveys were conducted at non-breeding sites from Washington state to Baja California, Mexico. Observation sites were partially determined using satellite data. The RBOS birds included 12 pelicans fitted with solar powered PTTs and 30 pelicans with color bands-only; other groups included 8 wild-caught non-oiled controls fitted with PTTs, other banded and unmarked pelicans. Field observations confirmed > 50% survival of individuals marked with bands-only at 1 year post-release, normal progression of molt and expression of breeding colors, association with large traditional communal roosts, and northern migration as far as the Columbia River, Oregon. Field sightings documented survival of several tagged birds that had lost their transmitters. Apparent survival of birds marked with color bands-only was better than for those with PTT tags; however, the study is ongoing. In this study, color marking and dedicated field survey effort helped to provide a more comprehensive understanding of post-rehabilitation survival of de-oiled pelicans. (Talk)

## MEXICOS NEWEST PROTECTED AREA: BAJA CALIFORNIA PACIFIC ISLANDS BIOSPHERE RESERVE

Alfonso Aguirre-Muñoz<sup>1</sup> Federico Mendez-Sanchez<sup>1</sup>

<sup>1</sup>Grupo de Ecología y Conservación de Islas, A.C. (GECI), Ensenada, Baja California, Mexico

Setting a benchmark for island conservation in Mexico with relevant benefits to global biodiversity during the United Nations Biodiversity Conference held in Cancun in December 2016, Mexico's President announced the creation of four new protected areas. Published on the Official Gazette of the Federation on December 7, 2016, a Presidential Decree established the 1.16-million-hectare Baja California Pacific Islands Biosphere Reserve. This Decree comes after 13 years since the Mexican conservation organization Grupo de Ecología y Conservación de Islas, A.C. (GECI), together with fishing cooperatives represented by its regional federation FEDECOOP, and backed by the Senate and the Congress of the Republic, requested Mexico's federal government to protect these islands and their surrounding waters. This new Reserve comprises 21 islands and 97 islets, including (from north to south): Coronado, Todos Santos, San Martín, San Jernimo, Cedros, San Benito, Magdalena, and Los Alijos. These islands host important and numerous seabird breeding colonies, and important pinniped refuges. On the San Benito islands alone, over 2-million seabirds breed annually. Due to the islands' importance for seabirds, during the past 15 years GECI eradicated invasive mammals from most of them, and has been implementing a long-term seabird restoration project with excellent outcomes. Far from a paper park, this new reserve validates and embraces the comprehensive conservation and restoration actions it. It also protects the fishing grounds of local artisanal cooperatives with almost a century of historic rights, in great benefit of their livelihoods sustainability. The California Current System creating a strong connectivity between this corridor of Mexican islands and the Channel Islands off California, USA is the basis for the ongoing, fruitful, and long-term binational collaboration in environmental conservation. (Talk)

## BEYOND ALLOMETRIC MODELS: FLIGHT COSTS OF RED-FOOTED BOOBIES VARY IN RESPONSE TO WIND CONDITIONS

Max Czapanskiy<sup>1</sup> Jon Felis<sup>2</sup> Emma Kelsey<sup>2</sup> Josh Adams<sup>2</sup><sup>1</sup>San Francisco State University, 3150 Paradise Dr, Tiburon, CA 94920.<sup>2</sup>U.S. Geological Survey, 400 Natural Bridges Dr, Santa Cruz, CA 95060.

Predictions of seabird flight costs based on allometric models are often greater than those observed in empirical studies, with the difference often attributed to efficient use of wind. For example, Red-footed Boobies (*Sula sula*) expend one-third the amount of energy in flight predicted by Pennycuick's allometric model (Ballance 1995) and Northern Fulmar (*Fulmarus glacialis*) field metabolic rate drops as wind speed increases (Furness & Bryant 1996). Using accelerometers to estimate instantaneous energetic costs, Amelineau et al. (2014) found Northern Gannets (*Morus bassanus*) reduced energy expenditure when flying with stronger tail winds after controlling for behavioral state. Most recent studies, however, relied on short deployments on temperate or polar species, yet tropical seabirds, inhabiting warmer waters with scarcer prey, have different energetic constraints. We tracked fifteen chick-provisioning Red-footed Boobies at Kilauea Point National Wildlife Refuge, Kauai with GPS and accelerometers for two months, sampling ~700 trips across a variety of wind conditions. We tested the hypotheses: (1) flight costs were least when transiting with strong tailwinds and (2) energetic costs showed less variance during transit than active searching/foraging. (Poster)

EXPERIENCE AND CONTAMINANTS IN RELATION TO INCUBATION BEHAVIOR OF WESTERN GULLS (*LARUS OCCIDENTALIS*) NESTING AT FARALLON NATIONAL WILDLIFE REFUGE

Lindsey Broadus<sup>1</sup> Pete Warzybok<sup>2</sup> Russell Bradley<sup>2</sup> Jaime Jahncke<sup>2</sup> Scott Shaffer<sup>1</sup>

<sup>1</sup>Department of Biological Sciences, San Jose State University, 1 Washington Sq, San Jose, CA 95192.

<sup>2</sup>Point Blue Conservation Science, 3820 Cypress Dr #11, Petaluma, CA 94954.

Most avian species turn their eggs during incubation, which is necessary for the proper progression of embryonic growth. In monogamous species, parents trade off egg turning responsibilities in order to allow one another to forage. Much is known about egg turning in the poultry industry, as being able to predict hatching success increases product numbers. However, little is known about egg turning in wild bird species. Western gulls (*Larus occidentalis*) are excellent candidate species to study egg turning behavior due to their multi-egg clutches and annual breeding attempts. Age and experience are factors that may influence this incubation behavior. Another element that may be affecting egg turning is lead contamination in gulls from the ingestion of paint chips. The objective of this study is to determine if age and lead contamination can independently have adverse effects on normal egg turning behavior. Having placed artificial eggs containing egg loggers into western gull clutches for part of the breeding season, we are now examining retrieved data on egg temperature and turning pattern consistencies, and comparing the data to egg lead levels, along with known ages and breeding experience of pairs of nesting gulls on Southeast Farallon Island. The data collected may emphasize a need for further application of egg loggers to address a variety of avian breeding behaviors influenced by experience and environmental factors. (Poster)

## TIMING OF REPRODUCTION IN SEABIRDS: LARGE-SCALE COMPARISONS, AND LINKS TO POPULATION DYNAMICS, CLIMATE AND LOWER TROPHIC LEVELS

Zofia Burr<sup>1</sup> Oystein Varpe<sup>1</sup> Sebastien Descamps<sup>3</sup> Tycho Anker-Nilssen<sup>4</sup> Tone Reiertsen<sup>5</sup> Kjell Einar Erikstad<sup>5</sup>

<sup>1</sup>The University Centre in Svalbard, 9171 Longyearbyen, Norway.

<sup>2</sup>Akvaplan-niva, Fram Centre, 9296 Troms, Norway.

<sup>3</sup>Norwegian Polar Institute, Fram Centre, 9296 Troms, Norway.

<sup>4</sup>Norwegian Institute for Nature Research, 7485 Trondheim, Norway.

<sup>5</sup>Norwegian Institute for Nature Research, Fram Centre, 9296 Troms, Norway .

<sup>6</sup>Centre for Biodiversity Dynamics, Department of Biology, Norwegian University of Science and Technology, 7491 Trondheim, Norway.

Phenology links species to their physical and biological environments. In seasonal environments, organisms are expected to optimally schedule reproduction within an annual range of environmental conditions. Latitudinal gradients generate a range of seasonality to which we can expect adaptations to have evolved, and can be used to explore drivers of timing strategies across species distribution ranges. This study quantifies and compares the timing of egg hatching in four seabird species (Atlantic puffin *Fratercula arctica*, black-legged kittiwake *Rissa tridactyla*, common guillemot *Uria aalge* and Brnrichs guillemot *U. lomvia*) covering a subarctic to Arctic latitudinal gradient along the Norwegian coast to Svalbard (65–79 N). There are species differences and spatial variability in timing, demonstrating that species-specific and local mechanisms are driving breeding timing. To further understand these mechanisms, we use our longest time-series to investigate temporal trends in breeding timing and atmospheric and oceanographic drivers of inter-annual variability. We further test for the effect of breeding timing on yearly breeding success. When mechanisms for timing are understood, phenology can be used as an indicator of environmental conditions. Conversely, as the environment changes, we can predict changes in timing and the subsequent consequences on breeding success. (Poster)

STATUS OF ALEUTIAN TERNS (*ONYCHOPRION ALEUTICA*) BREEDING IN THE KODIAK ARCHIPELAGO, 2014-2016

Robin Corcoran<sup>1</sup> Donald Lyons<sup>2</sup>

<sup>1</sup>U.S. Fish and Wildlife Service, Kodiak National Wildlife Refuge, 1390 Buskin River Rd., Kodiak, AK.

<sup>2</sup>Department of Fisheries and Wildlife, Oregon State University, 104 Nash Hall, Corvallis, OR.

Recent trend analysis of numbers of Aleutian Terns (*Onychoprion aleutica*) at colonies in Alaska indicates that this poorly known seabird has declined by almost 93% over the past three decades (Renner et al. 2015). Due to declines and a lack of information on basic ecological parameters, our goals for monitoring Aleutian Terns on Kodiak were to document intra-annual variability in colony size to inform future state-wide survey efforts, and to gather demographic data specifically related to breeding biology and nest success. Since 2013 we have surveyed 24 of the 28 Aleutian Tern colonies in the Kodiak Archipelago with a history of nesting, and three locations not previously documented. Aleutian Terns were nesting at only seven of the 24 known colonies, and we documented a total of 344 individual terns at ten colonies. This is a decline from counts conducted at several of these colonies from 1977-1978 when Aleutian Terns numbered 798-1465 individuals. During 2015-2016, we used digital game cameras to monitor nesting at six nests in two colonies, and captured images of Black-billed Magpies (*Pica hudsonia*) depredating two nests. Using preliminary information from the nest cameras the average daily nest survival was 0.85 which equated to 0.025 nest survival probability over the entire incubation period. Image analysis will allow us to calculate both nest attendance and adult vigilance rate. Clutch size for Aleutian Terns in 2016 (1.12 eggs, SE = 0.07, n = 25 nests) was lower than has been previously reported from Kodiak (range 1.35 – 2.00, n = 215 nests) and other sites in Alaska (range 1.4 – 1.85). (Poster)

## SPECIES-SPECIFIC EFFECTS OF THE 2015-16 EL NIÑO ON SEABIRDS BREEDING AT ISLA ESPAÑOLA, GALPAGOS

Jennifer Howard<sup>1</sup> David Anderson<sup>1</sup><sup>1</sup>Wake Forest University, Department of Biology, Winston Salem, NC 27103.

In the eastern tropical Pacific, climate change is predicted to increase the frequency of El Niño-Southern Oscillation warm events (El Niño), which reduce marine productivity, alter rain patterns, and have serious consequences for marine taxa. Seabirds vary in response to the same event, with some colonies entirely failing to reproduce while others are only mildly affected. We monitored reproductive success for a subcolony of > 400 breeding pairs of Nazca boobies (*Sula granti*), a tropical seabird, on Isla Española, Galpagos, Ecuador, between 1984 and 2016. We collected breeding data of swallow-tailed gulls (*Creagrus furcatus*) and red-billed tropicbirds (*Phaethon aethereus*) prior to (2004-2014) and during the 2015-16 El Niño. Ninety-nine percent of Nazca booby nests initiated in 1997 failed during the 1997-98 extreme El Niño and we predicted initially that the similar magnitude of the 2015-16 event would cause similar poor reproductive success for seabirds breeding on Isla Española. However, reproductive success of these seabirds was affected minimally during the 2015-16 El Niño. Nazca booby annual reproductive success was higher than average and red-billed tropicbird and swallow-tailed gull breeding was only delayed. Sea surface temperature anomalies in 2015-16 rose to levels comparable to the previous extreme El Niño in 1997-98, with unusually warm waters overlapping with peak nest initiation of Nazca boobies in December. However, several of the usual effects, such as a decrease in the easterly trade winds, a deepening of the thermocline, and an increase in rain, did not materialize on Isla Española, in contrast to the 1997-98 event. (Poster)

## EVALUATING SPACE USE AND REPRODUCTIVE SUCCESS OF THE THREATENED MARBLED MURRELET IN WESTERN OREGON

S. Kim Nelson<sup>1</sup> Joseph Northrup<sup>2</sup> Daniel Roby<sup>3</sup> Matthew Betts<sup>2</sup> Lindsay Adrean<sup>2</sup> James Rivers<sup>2</sup>

<sup>1</sup>Oregon State University, Department of Fisheries and Wildlife, Corvallis, OR 97331 USA.

<sup>2</sup>Oregon State University, Department of Forest Ecosystems and Society, Corvallis, OR 97331 USA.

<sup>3</sup>US Geological Survey, Oregon Cooperative Fish and Wildlife Research Unit, Oregon State University, Department of Fisheries and Wildlife, Corvallis, OR 97331 USA.

The Marbled Murrelet (*Brachyramphus marmoratus*) was once common along the coast of the northeastern Pacific from Alaska to central California, but has declined throughout much of its range due primarily to loss and fragmentation of nesting habitat. Currently, populations are thought to be limited by high rates of nest failure that limit recruitment. To aid in identifying, maintaining, and developing nesting habitat for this species, we launched a large-scale, long-term study of murrelet space use and reproductive success in western Oregon. This work includes (1) using existing landscape, murrelet, and avian nest predator data to determine the spatial scale(s) that predicts occurrence of nesting murrelets and assess risk from avian nest predators within murrelet nesting habitats; (2) at-sea marking of murrelets with telemetry tags to identify active nesting sites; (3) evaluating the efficacy of unmanned aerial vehicles (UAVs) to locate murrelet nests in occupied stands; and (4) testing whether conspecific attraction can attract murrelets to unoccupied by apparently suitable stands. Understanding more about murrelet nest-site characteristics, nest site fidelity, and the spatial and temporal patterns of murrelet nest predator distribution and abundance are crucial for forest management in Oregon. Given its scope, this project should improve our understanding of murrelet ecology and provide information needed for seeking a balance between conservation of murrelet nesting habitat and forest management practices. (Poster)

KITTLITZS MURRELET (*BRACHYRAMPHUS BREVIROSTRIS*) NESTING ECOLOGY  
ON KODIAK ISLAND, ALASKA, 2008-2016

Katelyn Stoner<sup>1</sup> Timothy Knudson<sup>2</sup> Robin Corcoran<sup>1</sup> James Lovvorn<sup>2</sup> Matthew Lawonn<sup>3</sup>  
John Piatt<sup>4</sup>

<sup>1</sup>U.S Fish and Wildlife Service, Kodiak National Wildlife Refuge, 1390 Buskin River Rd, Kodiak, AK.

<sup>2</sup>Department of Zoology and Center for Ecology, Southern Illinois University, 1125 Lincoln Drive, MC 6501, Carbondale, IL.

<sup>3</sup>U.S. Geological Survey, Oregon Cooperative Fish and Wildlife Research Unit, Oregon State University, Corvallis, OR.

<sup>4</sup>U.S. Geological Survey, Alaska Science Center, Anchorage, AK.

The Kittlitz murrelet (*Brachyramphus brevirostris*) is a rare seabird that breeds in Alaska and eastern Russia. Observed at-sea population declines in the 1990s and 2000s led to concerns about the status of the species. The opportunistic discovery of a Kittlitz murrelet nest in 2006 on Kodiak Island, Alaska prompted USFWS biologists to begin audio-visual surveys in potential nesting habitat. Surveys detected a high level of inland flight activity in the glacial refugium on the southwestern end of Kodiak Island. In 2008, Kodiak National Wildlife Refuge initiated a collaborative research project investigating KIMU breeding ecology in the refugium including: describing nest site characteristics, assessing the quantity and composition of chick diet, and measuring nest success. From 2008-2016, research teams searched suitable nesting habitat consisting of ultramafic rock outcrops and located 146 nests. On average, Kittlitz murrelet on Kodiak nest at high elevations (315 m) and steep slopes (32) with little vegetation (6% in 5-m-radius plot). Digital game cameras placed at most nests recorded incubation switches, prey deliveries, and nest fate. Prey deliveries to chicks consisted of 80.3% Pacific sand lance (*Ammodytes hexapterus*) and 19.1% capelin (*Mallotus villosus*). Chicks fledged at 33 (23%) of 146 discovered nests, but nest success varied widely year to year, from 0% in 2015 to 50% in 2013. The most frequent cause of nest failure was predation (48.3%), and the primary predator was red fox (*Vulpes vulpes*). These findings suggest important interactions between forage availability and predation as they impact Kittlitz murrelet breeding behavior and nest success. (Poster)

## COLONY WIDE BREEDING FAILURE OF RHINOCEROS AUKLETS ON TEURI ISLAND DURING 2014-2016

Mariko Yamamoto<sup>1</sup> Yutaka Watanuki<sup>1</sup>

<sup>1</sup>Graduate School of Fisheries Sciences, Hokkaido University, 3-1-1, Minato-cho, Hakodate, Hokkaido, 041-8611, Japan..

Long-term changes of marine environment and abundance of prey species affect the reproductive success of seabirds. We monitored prey, bill-load mass and breeding success of Rhinoceros auklets (*Cerorhinca monocerata*, RHAU) on Teuri Island, Japan since 1984. Bill-loads were collected from 10 birds every week (52-121 samples each year) and nest contents were monitored and chicks were weighed every 5 days (20-85 nests each year). Feeding frequency was estimated using an available equation. RHAU brought mostly Japanese anchovy (*Engraulis japonicas*: 65-95% in mass) to their chicks in 2006-2013 but in the recent three years (2014-2016) it declined (<6%). Instead, they brought back Japanese sand lance (*Ammodytes personatus*), arabesque greenling (*Pleurogrammus azonus*) and squids. Average bill-load mass in 2014-2016 (16-19 g) was smaller than that of 2004-2013 (26-36 g). Estimated feeding frequency in late June 2014-2016 (0.2-0.5 /day) was lower than that of in 2006-2013 (1.0-2.3 /day). Fledging success was 32-73 % in 2006-2013 but 0 % in 2014-2016. Mass of single fish and energy density of sand lance (7.4 g, 3.8KJ/g wet), greenling (19.2 g, 4.8KJ/g wet) and squids (14.8 g, 3.4KJ/g wet) were smaller than anchovy (31.1 g, 6.3KJ/g wet). Thus, in 2014-2016 RHAU brought less profitable prey and lower feeding frequency may indicate longer foraging distance. Although the crash of anchovy stock was not reported yet, this study indicates recent changes of distribution, migratory behavior or ecology of anchovy. (Poster)

## SHIFTS IN CROSS-SHELF DISTRIBUTION OF SEABIRDS IN THE NORTHERN GULF OF ALASKA UNDER DIFFERENT TEMPERATURE REGIMES, 2007-2015

Daniel Cushing<sup>1</sup> Kathy Kuletz<sup>2</sup> Russell Hopcroft<sup>3</sup> Seth Danielson<sup>3</sup> Elizabeth Labunski<sup>2</sup><sup>1</sup>Pole Star Ecological Research LLC, 220 2nd Ave South, Suite 209, Seattle, WA 98104.<sup>2</sup>US Fish and Wildlife Service, Migratory Bird Management, 1011 East Tudor Rd, MS 201, Anchorage, AK 99503.<sup>3</sup>Institute of Marine Science, School of Fisheries and Ocean Sciences, University of Alaska Fairbanks, 112 ONeill Building, 905 North Koyukuk Drive, Fairbanks, Alaska 99775.

In the northern Gulf of Alaska (GOA), conditions are dynamic, with strong seasonal and interannual variations. Oceanographic conditions can impact seabird foraging ability and can influence the prey base, and therefore affect seabird distribution. We examined a decade of seabird survey data along the Seward Line in the northern GOA to determine if cross-shelf distribution differed between cold and warm years. In two seasons, spring (May) and fall (September) we compared seabird densities between cold (2007, 2008, 2009, 2013) and warm (2010, 2014, 2015) years, and among four regions: Prince William Sound (PWS), inner shelf (IS), mid shelf (MS) and slope/oceanic (OC). Overall, seabird densities were higher during warm years, especially in fall. In warm springs, seabird densities were high in PWS and the IS, whereas in cold springs, densities were higher in the MS and OC, with particularly low densities of murrelets (*Brachyramphus* spp.), murrees (*Uria* spp.), and kittiwakes (*Rissa tridactyla*). Fulmars (*Fulmarus glacialis*), storm-petrels (*Oceanodroma* spp.), and albatrosses (*Phoebastria* spp.) consistently occupied the MS and OC during spring. During fall, seabird abundance was highest in warm years, with taxa such as kittiwakes, murrelets, murrees, cormorants (*Phalacrocorax* spp.), and gulls (*Larus* spp.) occupying PWS, and these along with puffins (*Fratercula* spp.) and shearwaters (*Ardenna* spp.) occupying the IS. Cold falls had the lowest densities for most taxa, with the exception of fulmars and albatrosses in the MS and storm-petrels and albatrosses in the OC. In general, the greatest differences in seabird abundance between cold and warm years occurred in PWS and the IS, which may provide an important refuge during warm years. (Poster)

## COULD LASERS DAMAGE ALBATROSS VISION? A REVIEW OF POTENTIAL RISKS

Arden Blumenthal<sup>1</sup> Edward Melvin<sup>2</sup> Esteban Fernandez-Juricic<sup>1</sup><sup>1</sup>Purdue University.<sup>2</sup>University of Washington.

Lasers have been suggested to have potential as non-lethal bird deterrents. However, little is known about the possible effects of lasers on marine birds. We reviewed the literature on the effects of lasers on vision and behavior to extrapolate predictions about the potential consequences for the visual acuity of albatrosses. A total of 31 case studies of humans, non-human primates, and rats were found for two laser types: continuous wave and q-switched lasers. For continuous wave lasers, we found that exposure decreased visual acuity between 11 and 49% with an average of a 24% decrease. For q-switched lasers, we found that exposure decreased visual acuity between 13% and 62% with an average of a 53% decrease. Using a combination of published information and extrapolated data of both albatross eye size and retinal ganglion cell densities, we estimated visual acuity in five albatross species. We then estimated the distance range at which an albatross flying above water would be able to distinguish prey 5-50 cm long as 114 - 1,145 m, respectively, and conspecifics 64-81 cm long as 1,466 - 1,855 m, respectively. With an averaged 36% decrease in visual acuity due to laser exposure, these detection distance ranges would be reduced to 74 - 736 m for prey and 942 and 1,192 m for conspecifics. Due to the crucial role vision plays in albatross foraging ability, these predicted changes could modify albatross flying trajectories, reduce food availability due to limited detection ability, and ultimately constrain home ranges. (Poster)

## WATERBIRD MONITORING AS A TOOL FOR ESTUARINE CONSERVATION: A CASE STUDY FROM HUMEDALES DE LA LAGUNA LA CRUZ, SONORA, MEXICO

McKenna Hanson<sup>1</sup> Lorayne Meltzer<sup>1</sup> Lindsay Adrean<sup>1</sup> Emily Clark<sup>1</sup> Abram Fleishman<sup>1</sup>

<sup>1</sup>Prescott College Kino Bay Center for Cultural and Ecological Studies, 151 Calle Cadiz y Puerto Vallarta, Baha de Kino, Sonora, Mexico.

The Prescott College Kino Bay Center for Cultural and Ecological Studies has been collecting waterbird census data along the central Sonoran coast of the Gulf of California since the late 1990s. Surveys have revealed that Humedales de la Laguna la Cruz, a 6,665-hectare negative estuary in Kino Bay, hosts an average waterbird species richness of 46 throughout the year and contains critical habitat for 162 waterbird species. However, commercial development over the last 15 years has surrounded the estuary with industrial shrimp aquaculture ponds that discharge effluent and negatively impact habitat. We used waterbird monitoring data collected from 2009-2011 to secure Important Bird Area and Wetland of International Importance (Ramsar) designations for this estuary. These data met many of the application criteria regarding avian use of the estuary; for example, at least 12 species including the Elegant Tern and Snowy Plover are present in numbers higher than 1% of their total populations, while 15 species, like the Reddish Egret, are listed as threatened. Since this estuary became a Ramsar site in 2013, the Center has collaborated with the Comisin Nacional de reas Naturales Protegidas and the Universidad de Sonora to enact conservation and management strategies; these strategies have led to increased community participation in conservation, subsidies for economic alternatives to fishing, legal protection of coastal habitat and increased educational opportunities in the region. We recommend waterbird monitoring combined with international conservation designations as first steps in expanding protections for waterbirds and estuaries and creating economic and social development opportunities for neighboring communities. (Poster)

## USING MOTION SENSING CAMERAS TO ASSESS PREDATORS OF JAPANESE MURRELETS

Nina Karnovsky<sup>1</sup> Yoshitaka Minowa<sup>2</sup> Yutaka Nakamura<sup>2</sup> Kuniko Otsuki<sup>2</sup>

<sup>1</sup>Pomona College, 175 W. 6th St. Claremont, CA 91711 USA.

<sup>2</sup>Marine Bird Restoration Group, 1-18 Ishida, Hokida, Fukushima-shi, Fukushima Prefecture 960-8163, Japan.

Every year large numbers of Japanese Murrelet (*Synthliboramphus wumizusume*) carcasses and depredated eggs are found on Birojima Island. The purpose of this project was to determine the types of predators that prey on Japanese murrelets on Birojima. We hypothesized that Large-billed crows (*Corvus macrorhynchos*) could be important predators of Japanese murrelets. In 2016, we set out cameras at 11 sites for varying amounts of time between early January until mid-July for a total of 908 camera trap days. The cameras took over 12,764 photos of 15 identifiable species of birds. At 8 sites both Japanese murrelets and at least one species of corvid was photographed. On April 11, 2016 a carrion crow (*Corvus corone*) was seen eating a Japanese murrelet. Later that day a carrion crow at that site was seen possibly stashing a Japanese murrelet carcass. The next day a carrion crow was seen with a carcass next to it and in the following week catching a Japanese murrelet. At another site, on April 12, 2016, a carrion crow was photographed catching a murrelet and the same behavior was repeated on the following day, and again on April 15th. In the following week at that site a carrion crow at that site was seen several times eating pieces of meat, with carcasses and with blood on its bill. Furthermore, on April 14, 2016 a Large-billed crow was photographed with a Japanese murrelet egg in its beak. Our study shows that both corvid species prey on Japanese murrelets. The carrion crows predatory behavior was unexpected. It is likely that a few individuals of both species have become specialists on Japanese murrelets. (Poster)

PUBLIC ENGAGEMENT IN SEABIRD CONSERVATION - OBSERVATIONS FROM  
NEWFOUNDLAND AND LABRADOR

Pierre Ryan<sup>1</sup>

<sup>1</sup>Environment and Climate Change Canada - Canadian Wildlife Service.

In 1981, I had the good fortune to help with studies of net mortality of seabirds; since then to help with response to the effects of oil pollution and hunting mortality on marine bird populations. My experience is that people in Newfoundland and Labrador who are close to the resource are curious and engaged especially so when we actively seek their help; their motivation and contributions are relevant and welcome; their perspective, skills and experience are often critical to the conduct of investigations. I dont think this unique to our area of the world.

It appears that we are in somewhat better shape at the moment at least for some species. A moratorium on ground fish harvest since 1992 reduced by-catch of seabirds; indicator(s) suggest that oil-related mortality has declined and the hunt of murre (Uria spp.) is regulated and considered sustainable at present.

Nevertheless, it is apparent that some Thick-billed Murre (*Uria lomvia*) and globally significant Storm Petrel (*Oceanodroma leucorhoa*) populations that breed here are in decline. The murre hunt likely affect shared populations and continued monitoring require co-operation to generate reliable harvest estimates . The economy of Newfoundland and Labrador is increasingly reliant upon offshore oil revenues and we are likely to see that activity and marine shipping continue; both presenting a risk of further oil mortality for seabirds. Evidence that ground fish stocks are recovering suggest the potential for future conflict between seabirds and fishing gear. I very much hope to learn from others at the PSG. (Poster)

## SELECTIVE MICROPLASTIC CONTAMINATION OF A PLANKTIVOROUS DIVING SEABIRD IN THE GREENLAND SEA

Francoise Amelineau<sup>1</sup> Delphine Bonnet<sup>2</sup> Olivier Heitz<sup>3</sup> Valentine Mortreux<sup>2</sup> Ann Harding<sup>4</sup> Nina Karnovsky<sup>5</sup>

<sup>1</sup>CEFE, CNRS, 1919 route de Mende, 34293 Montpellier, France.

<sup>2</sup>MARBEC, Universite de Montpellier, Montpellier, France.

<sup>3</sup>Departement de Chimie, Institut Universitaire de Technologie de Montpellier-Ste, Universite de Montpellier, Sete, France

<sup>4</sup>Environmental Science Department, Alaska Pacific University, 4101 University Drive, Anchorage AK 99508, USA

<sup>5</sup>Department of Biology, Pomona College, 175 W 6th St., Claremont, California 91711, USA.

Microplastics (MPs) have been reported in every ocean. Despite Arctic remoteness from major sources of plastics, several Arctic seabirds are contaminated, and recent studies suggest that Arctic sea-ice is a sink for MPs. Nonetheless, existing information for this area remains scarce. The aims of our study were (1) to quantify MPs in little auk (*Alle alle*) foraging area, and in their diet, and (2) to identify if there is a selective intake that could give clues on MP detection and intake process. Little auks are feeding on zooplankton while diving between 0-50m, and are expected to be less contaminated than surface or filter feed-ers. We conducted our study in the Greenland Sea where data on MP are nearly inexistent, for two breeding seasons with contrasting sea-ice concentrations (SIC): 2005 (high SIC) and 2014 (low SIC). Despite the remoteness of our study area, MP abundances were comparable to those of other oceans, with  $0.99 \pm 0.62 \text{m}^3$  in 2005 (high SIC), and  $2.38 \pm 1.11 \text{m}^3$  in 2014 (very low SIC). MP rise between 2005 and 2014 might be linked to a global increase in plastic production or to lower sea-ice extents in 2014, if MPs are released to the water column upon sea-ice melting. All birds had eaten MP filaments, with 9.99 and 8.99 pieces per chick meal in 2005 and 2014, respectively. Importantly, we found that little auks took more often light colored MPs, rather than darker ones, strongly suggesting an active contamination with birds mistaking MPs for their prey. Overall, we stress the great vulnerability of Arctic marine species to MP pollution in a warming Arctic, where sea-ice melting is expected to release high numbers of trapped debris. (Poster)

## SEX DIFFERENCES IN MERCURY CONCENTRATIONS OF RED-LEGGED KITTIWAKES DURING THE BREEDING AND NON-BREEDING SEASONS

Abram Fleishman<sup>1</sup> Rachael Orben<sup>2</sup> Alexis Will<sup>3</sup> Rosana Paredes<sup>4</sup> Alexander Kitaysky<sup>3</sup>  
Joshua Ackerman<sup>5</sup>

<sup>1</sup>Department of Biological Sciences, San Jose State University, One Washington Square, San Jose, CA 95192-0100.

<sup>2</sup>Department of Fisheries and Wildlife, Oregon State University, Hatfield Marine Science Center, 2030 SE Marine Science Dr., Newport, OR 97365, USA .

<sup>3</sup>Department of Biology and Wildlife, Institute of Arctic Biology, University of Alaska Fairbanks, Irving 311, Fairbanks, AK 99775.

<sup>4</sup>Department of Fisheries and Wildlife, Oregon State University, , Corvallis, OR 97365, USA .

<sup>5</sup>U.S. Geological Survey, Western Ecological Research Center, Dixon Field Station, 800 Business Park Drive, Suite D, Dixon, CA 95620, United States.

Animals that live at high latitudes are exposed to increasing mercury levels due to the poleward transport of mercury from anthropogenic sources. Mercury is a neurotoxin ingested by seabirds in contaminated food, and it can lead to altered behavior, reproductive failure, and increased mortality. We investigate mercury exposure in the Bering Sea endemic red-legged kittiwake (*Rissa brevirostris*). During the breeding season red-legged kittiwakes forage on deep-water lanternfish (Myctophidae), a mesopelagic prey rich in lipids, which may facilitate accumulation of high mercury levels. Mesopelagic prey species have been shown to have up to 400% more mercury than their shallow water counterparts. We hypothesize that: 1) during non-breeding, mercury loads are similar between sexes due to similarity in wintering range and diet; and 2) during breeding, there are sex differences because females eliminate mercury by depositing it into their eggs. We measured total mercury from whole blood and nuptial plumage sampled from breeding red-legged kittiwakes on St. George Island, Alaska in 2015 and 2016. Samples represent breeding (blood) and non-breeding (feathers) seasons. Kittiwakes sampled in 2015 had moderate mercury loads (mean  $\pm$  SD, non-breeding: 4.82  $\pm$  0.96 g/g dry weight (dw), breeding: 0.65  $\pm$  0.07 wet weight (ww)) above known thresholds for impairment in other bird species. Contrary to our prediction, non-breeding mercury loads were higher in females (5.34 $\pm$ 1.23 g/g dw, n=22) than males (4.52 $\pm$ 0.61 g/g dw, n=38), while there was no difference in loads during breeding. We also investigate non-breeding diet (stable isotopes) and foraging range (GLS tracks) to understand the observed sex differences in mercury loads. (Poster)

## MICROPLASTIC IN CASSIN'S AUKLETS FROM THE 2014 STRANDING EVENT

Hannah Floren<sup>1</sup> Gary Shugart<sup>1</sup><sup>1</sup>Slater Museum of Natural History, University of Puget Sound.

Oceanic plastic pollution poses a variety of ecological threats, including potential detrimental effects when plastic particles are ingested by marine birds. Types of plastic found in the digestive tracts of seabirds include industrial plastic pellets and five categories of post-consumer user plastics (van Franeker and Meijboom, 1985). Previous studies have found an increased amount of user plastic relative to industrial plastic in several seabird species. In our study, we examined whether the amount and type of plastic ingested by a planktivorous seabird, Cassin's Auklet (*Ptychoramphus aleuticus*), may be changing. Large storms that cause mass marine bird mortality provide an opportunity to assess regional patterns of oceanic plastic pollution. We surveyed the stomach contents of 170 Cassin's Auklets stranded along the Washington coast in 2014 and found that 44.8% of them contained plastic in their ventriculi, similar to previously reported values from the North Subarctic Pacific 35 years ago. Industrial pellets were found in 22.8% of all individuals, and accounted for only 28.1% of all the plastic pieces found; the other 71.9% of the pieces were user plastic. Industrial pellets tended to be larger than pieces of user plastic in the samples and accounted for 40.2% of total plastic weight. The industrial pellets in the auklets were significantly smaller than those found in a 2012 study of Northern Fulmars (*Fulmarus glacialis*) from the same region, suggesting either that Cassin's Auklets in the area are selecting smaller plastic particles or that plastic is retained in ventriculi and worn down. (Poster)

## USING FEATHERS TO DETERMINE TEMPORAL TRENDS IN PBDE LEVELS IN SEABIRDS

Amanda Johnson<sup>1</sup> Peter Hodum<sup>1</sup> Megan Gessel<sup>1</sup><sup>1</sup>University of Puget Sound, aejohnson@pugetsound.edu.

Eight million tons of waste and contaminants entered marine ecosystems globally in 2010. Hazardous contaminants called persistent organic pollutants (POPs) are released into the environment from this waste, predominantly from plastic debris, and undergo little to no degradation. Polybrominated diphenyl ethers (PBDEs) are one of these POPs and are an emerging concern because of their ability to biomagnify in marine food webs. Previous studies have indicated that seabirds have been affected by PBDEs and thus, they are an excellent study group to quantify PBDE concentrations in marine ecosystems and track their changes over time. However, previous studies have used invasive measures to determine PBDE levels in seabirds. It has been suggested that feathers could serve as a replacement for other tissues, like liver, that have been shown to provide reliable measures of PBDE concentrations. To assess the reliability of using feathers to quantify PBDE levels, we analyzed PBDE concentrations in breast feathers and livers of Common Murres (*Uria aalge*). We chemically extracted PBDEs from the livers and feathers and used GC/MS to quantify PBDE concentrations. If feathers prove to be reliable indicators of PBDE levels, seabird feathers can be used to determine current PBDE levels non-invasively in wild populations as well as track PBDEs over time. (Poster)

## MARINE PLASTIC POLLUTION AND SEABIRDS - MOVING BEYOND REPORTING TO USING STANDARDIZED APPROACHES TO MOVE TOWARDS ASSESSING EFFECTS

Jennifer Provencher<sup>1</sup> Stephanie Borrelle<sup>2</sup> Stephanie Avery-Gomm<sup>3</sup> Mark Mallory<sup>1</sup>

<sup>1</sup>Acadia University, 33 Westwood Ave, Nova Scotia, Canada.

<sup>2</sup>Auckland University of Technology, 55 Wellesley St E, Auckland, 1010, Auckland, New Zealand .

<sup>3</sup>University of Queensland, 4072, Brisbane, Queensland, Australia .

The vast volume of plastic pollution in the world's oceans is of increasing concern for marine life and ecosystems. Seabirds are top-predators in the marine environment, conspicuous, and possess attributes that reflect changes to marine ecosystems. The first observations of plastic ingestion by seabirds were reported more than 50 years ago and have increased exponentially since this time. While the majority of publications on plastic ingestion examine this phenomenon on seabirds focus on reporting ingestion metrics, our understanding of how plastic pollution affects seabirds is still in its infancy. Importantly, the lack of consistency in how plastic ingestion is quantified and reported is undermining our ability to determine the effects of plastics, and scale up impacts from emerging research. We review the current state of knowledge on plastic ingestion in seabirds, some spatial and taxonomic gaps, and outline recently published standardized methods that will help to facilitate the large scale synthesis studies needed to assess changes and impacts over time. (Poster)

## SIZE AND DYNAMICS OF MICROPLASTIC IN GASTROINTESTINAL TRACTS OF NORTHERN FULMARS AND SOOTY SHEARWATERS

Gary Shugart<sup>1</sup> Peter Hodum<sup>2</sup> Lydia Kleine<sup>1</sup> Alicia Terepocki<sup>2</sup> Alex Brush<sup>2</sup><sup>1</sup>Slater Museum of Natural History, University of Puget Sound, 1500 N Warner, Tacoma, 98416.<sup>2</sup>Dept. Biological Sciences, University of Puget Sound, 1500 N Warner, Tacoma, 98416.

We quantified microplastic ingested by Northern Fulmars (*Fulmarus glacialis*) found dead or stranded on WA/OR beaches during 2008-2013 and Sooty Shearwaters (*Puffinus griseus*) during 2011-2012. In fulmars, 89.5% (128/143) contained plastic averaging 13.3 pieces and 0.335 g. Incidence was 64% (16/25) in Sooty Shearwaters averaging 19.5 pieces and 0.461 g. Premanufactured resin pellets accounted for 8.5%/7 % pieces/mass g of fulmar and 34%/33% pieces/mass g of shearwater plastic. The percent of fulmars containing plastic did not differ among time periods although there was significant variation in plastic loads among years. In both species juveniles contained more plastic than sub-adults and adults. We found that fulmars housed in a plastic free environment in a rehabilitation facility did not have significant reduction in plastic over a median confinement of seven days. The average greatest dimension of plastic in ventriculi was 2-3 mm less than in proventriculi. Plastic in fulmar intestines averaged 1 mm less than in ventriculi, but was above the range of the smallest pieces found in ventriculi. Birds with plastic in proventriculi had significantly more ventricular plastic than those without proventricular plastic. This does not appear to be the result of a backup into proventriculi because the amount of plastic found in birds was well below capacity. We updated Ryans model of dynamics and propose that plastic throughput in procellariids occurs as an initial rapid reduction leaving a small amount in ventriculi. The implications for using plastic loads as bioindicators and the biological significance of ingested plastics are topics for discussion. (Poster)

## DIETARY NICHE WIDTH AND OVERLAP OF MULTIPLE MARINE PREDATORS AT A BIOLOGICAL HOTSPOT

Gail Davoren<sup>1</sup> Paloma Calabria Carvalho<sup>1</sup> Laurie Maynard<sup>1</sup> Julia Gulka<sup>1</sup> Edward Jenkins<sup>1</sup>  
Kelsey Johnson<sup>1</sup>

<sup>1</sup>Department of Biological Sciences, University of Manitoba, Rm 212B Biological Sciences Building, 50 Sifton Road, University of Manitoba, Winnipeg, Manitoba, R3T 2N2.

On the northeast Newfoundland coast, marine predators rely on capelin (*Mallotus villosus*), a dominant forage fish, as a food source. Capelin migrate into coastal regions to spawn during July, resulting in high abundance aggregations of predators ('hotspots') nearby spawning sites. During this period, we investigated the dietary overlap of multiple marine predators, including non-breeding great (*Ardenna gravis*) and sooty shearwaters (*Ardenna grisea*), breeding common murres (*Uria aalge*), herring gulls (*Larus argentatus*) and great black-backed gulls (*L. marinus*), along with humpback whales (*Megaptera novaeangliae*), using stable isotope analysis ( $\delta^{15}\text{N}$ ,  $\delta^{13}\text{C}$ ). We predicted high dietary overlap among predators, with isotopic signatures primarily reflecting capelin-based diets. Blood was sampled during July from shearwaters (great: n=36; sooty: n=20) at sea, parental murres (n=8) and gull chicks (herring: n=11; great black-backed: n=5) at nest sites, while humpback whale skin (n=30) was biopsied at sea. Stable isotope ratios, representing diets over 2-3 weeks, revealed varying niche breadth among species, quantified using standard ellipse areas in SIBER. This suggests that some predators (gulls) consumed other species (e.g., crab, mussels) when capelin was abundant, while others predators (murres) primarily consumed capelin. Isotopic niche overlap between species, calculated using nicheRover, also varied, with high dietary overlap between some species (shearwaters) and low overlap between others (gulls, murres). Findings suggest that although capelin is the primary forage fish during the summer, predators rely on capelin to varying degrees, likely resulting in species-specific responses to changes in capelin biomass. (Poster)

## NOVEL SPATIAL ANALYTICS REVEAL INFLUENCE OF PREY DEPTH UPON ALCID DISTRIBUTION IN A FJORD SYSTEM

Eric Keen<sup>1</sup> Chris Picard<sup>2</sup><sup>1</sup>Scripps Institution of Oceanography, 9500 Gilman Drive Mail Code 0208.<sup>2</sup>Gitga'at Lands and Marine Resources Department, 446 Hayiimisaxaa Way.

Systematic surveys of seabirds and their prey were conducted in Kitimat Fjord System, British Columbia, to compare prey patch preferences and test for habitat partitioning in four sympatric species of auks (f. Alcidae). Prey were sampled remotely with acoustic backscatter (33 and 200 kHz). Over 7 months of surveys in 2014 and 2015, we completed 2,291 km of strip-transect sampling and found 3,596 alcids. Species were distributed in an offshore-to-inland gradient within the fjord system, in this order: Cassins auklet (*Ptychoramphus aleuticus*), rhinoceros auklet (*Cerorhinca monocerata*), common murre (*Uria aalge*) and marbled murrelet (*Bracyramphus marmoratus*). Our dual (visual + acoustic) survey plan in this compartmentalized habitat allowed us to derive position curves, a novel spatial analytic that uses flight distances between transects to calculate the strength and spatial scale of bird-prey associations. Position curves revealed that birds were more strongly associated with shallow prey patches than high-volume prey patches. Spatial associations with high-volume patches were only apparent in marbled murrelet (33kHz) and Cassins auklet (200kHz). These associations occurred at restricted spatial scales (~20km) compared to those with patch depth. On average, alcids were found among the shallowest backscatter within a 15-40 km radius, depending on species. All of these trends were stronger in sitting birds than in flying birds. These findings highlight (1) the importance of prey patch characteristics other than volume, (2) the species-specificity of prey associations, and (3) the research value of dual survey design in discrete habitats such as fjords. (Poster)

## BEGGARS CANT BE CHOOSERS: SUCCESSFUL BREEDING ON A POOR QUALITY DIET

Alexa Piggott<sup>1</sup> Sam Stark<sup>1</sup> Higgins Brendan<sup>1</sup> David Irons<sup>2</sup> Daniel Roby<sup>3</sup>

<sup>1</sup>Oregon Cooperative Fish & Wildlife Research Unit, Department of Fisheries and Wildlife, 104 Nash Hall, Oregon State University, Corvallis, OR 97331-3803 USA.

<sup>2</sup>United States Fish and Wildlife Service, , 1011 East Tudor Road, Anchorage, Alaska, 99503, USA.

<sup>3</sup>U.S. Geological Survey – Oregon Cooperative Fish & Wildlife Research Unit, Department of Fisheries and Wildlife, 104 Nash Hall, Oregon State University, Corvallis, OR 97331-3803 USA.

Historically, the Naked Island Group (NIG) was home to about one-fourth of all nesting Pigeon Guillemots (*Cepphus columba*) in Prince William Sound, Alaska (PWS). However, decreases in high lipid forage fishes, mortality of adult guillemots following the Exxon Valdez oil spill, and nest predation following the introduction of American mink (*Neovison vison*) coincided with a ca. 99% decline in the nesting guillemot population at NIG over the past 40 years. We investigated nesting success and chick diet composition during the 2016 breeding season, following three winters of mink control on NIG. We found 41 active nests, an increase from 2014 and 2015 (11 and 28, respectively). Seventy-six percent of nesting pairs successfully fledged young, a success rate not observed at NIG since the early 1980s. This nesting success coincided with high proportions of juvenile lingcod (*Ophiodon elongatus*), a low-lipid prey that has been historically rare in the diet, which comprised 41% of prey items. High-lipid schooling forage fish made up only 17% of prey items. In contrast, observations of delayed, skipped, or failed breeding were recorded for Black-legged Kittiwakes (*Rissa tridactyla*) across PWS and Caspian terns (*Hydroprogne caspia*) in the Copper River delta. These observations suggest a general reduction in availability of quality forage fishes in PWS during the 2016 nesting season. Our results suggest that guillemots at NIG benefitted from being flexible in their prey choice and ability to respond to low availability of high-lipid fish by exploiting alternative prey. Additionally, high guillemot nesting success may be linked to reduced predation pressure from mink and low intraspecific competition for limited prey resources. (Poster)

ANALYSIS OF HISTORIC FORAGING ECOLOGY OF DECLINING TUFTED PUFFIN (*FRATERCULA CIRRHATA*) POPULATIONS IN WASHINGTON AND OREGONRobyn Thomas<sup>1</sup> Peter Hodum<sup>1</sup><sup>1</sup>University of Puget Sound , .

Seabird populations can be controlled by top-down (predation) and bottom-up (prey, oceanography, etc.) mechanisms. Tufted puffin (*Fratercula cirrhata*: TUPU) populations have declined significantly in the past decades in the California Current System (CCS). TUPUs are currently listed as Endangered by the state of Washington and are a candidate for listing at the federal level; however, drivers of their decline are poorly understood. Changes in diet quality and composition have been proposed as a mechanism of population decline, yet historic changes in diet have not been assessed for TUPU populations in the CCS. In this study, we used museum specimens to reconstruct historic TUPU diet using stable isotope analysis ( $\delta^{15}\text{N}$  and  $\delta^{13}\text{C}$ ). All specimens were from Washington and Oregon between the years of 1911 and 2012. In addition, we conducted a parallel analysis for a closely related sympatric species, the rhinoceros auklet (*Cerorhinca monocerata*: RHAU). Preliminary results suggest that TUPUs and RHAUs in Washington and Oregon have extensive trophic overlap. Additionally, trophic levels of TUPUs and RHAUs have remained constant over the last century, unlike what has been documented for Marbled Murrelets (*Brachyramphus marmoratus*) and Common Murres (*Uria aalge*). Although these preliminary results demonstrate that TUPUs in Washington and Oregon have not experienced a trophic shift, a change in abundance and availability of prey species over the past century cannot be discounted. (Poster)

## INTER-ANNUAL DIFFERENCES IN STABLE ISOTOPES AND CORTICOSTERONE IN FEATHERS OF A RARE NOCTURNAL SEABIRD

Sarah Thomsen<sup>1</sup>

<sup>1</sup>S i m o n F r a s e r U n i v e r s i t y

Scripps's Murrelets (*Synthliboramphus scrippsi*) are small nocturnal alcids that are endemic to the California Current and breed on only about 10 island groups worldwide. However, very little is known about their diet and foraging ecology compared to other seabirds in this region, in particular during the non-breeding season. Here, I examined whether large-scale differences in the marine environment were associated with changes in carbon and nitrogen isotopes and corticosterone in flight feathers that were grown during the non-breeding season over three different years. Feathers (n=107 individuals) were obtained from an opportunistic sample of adult birds found killed by predators on a breeding colony and represent conditions experienced during molting (May-Sept) in 2009, 2011, and 2012. In addition, feather CORT was measured in a subset of 24 individuals split evenly between the 2009 and 2012 samples. Carbon and nitrogen isotope values varied extensively between individuals and overlapped heavily among years. There were no significant differences in mean trophic level among years, as inferred by nitrogen isotope values. There were also no differences in feather CORT between years, however, feather CORT was weakly but negatively associated with trophic level within individuals, after controlling for sex and year. In contrast, mean carbon isotope values were significantly different between years and were moderately negatively correlated with summer zooplankton amounts, the NPGO index and upwelling. These results suggest that murrelets have highly flexible generalist diets but further study is needed to clarify the importance of marine environmental variability on diet and foraging ecology. (Poster)

## IMPACT OF LATE QUATERNARY CLIMATE CHANGE ON THE DEMOGRAPHIC HISTORY OF GULF OF CALIFORNIA SEABIRDS

Enrico Ruiz<sup>1</sup> Enriqueta Velarde<sup>2</sup> Andres Aguilar<sup>1</sup>

<sup>1</sup>Departamento de Zoología, Escuela Nacional de Ciencias Biológicas, Instituto Politécnico Nacional, Prolongación de Carpio y Plan de Ayala s/n, Col. Santo Tomás, CP. 11340, Ciudad de México, México.

<sup>2</sup>Instituto de Ciencias Marinas y Pesqueras, Universidad Veracruzana, Hidalgo 617, Col. Ro Jamapa, Boca del Ro, Veracruz 94290, México.

<sup>3</sup>Department of Biological Sciences, California State University Los Angeles, 5151 State University Drive, Los Angeles, CA 90032, USA.

Climate changes of the Late Quaternary Period (LQP) have been major drivers in the shaping of species distribution and abundance. We investigated if the demographic history of Heermanns Gulls (*Larus heermanni*) and Elegant Terns (*Thalasseus elegans*) reflects a history of population change consistent with past climate changes recorded in the Gulf of California in the LQP. We also explored whether the past climate changes affected demographic history of co-distributed marine organisms in a similar way as found for sea birds. We used mitochondrial DNA and performed a number of tests to reveal if demographic change occurred within the LQP. The results of three different approaches were consistent with a historical demographic expansion during the LQP. All analyses (Fus FS test, Tajimas D neutrality test, mismatch distribution analysis (MDA) and associated demographic parameters, and Bayesian Skyline plots (BSP)) were consistent with a model of population expansion for Heermanns Gulls and Elegant Terns. The expansion event was estimated at  $\sim 48,000$  years before present (yr BP) with the MDA, while the BSP showed population growth that began  $\sim 100,000$  yr BP and lasted until 45,000 yr BP. Associations between the demographic expansion of these seabird species and largescale ecological shifts or demographic expansions of other marine species were found, with a similarly timed expansion found in an important prey species for these two seabirds. This is a novel finding of species in a predator-prey system that have almost simultaneous demographic expansions, particularly in the highly productive marine region of the Gulf of California. (Poster)

## BEACH COMBERS REFLECTIONS ON SEABIRD MORTALITY EVENTS, 1997-2016

Jacqueline Lindsey<sup>1</sup> Emily Kelsey<sup>2</sup> Corinne Gible<sup>3</sup> Erica Donnelly-Greenan<sup>4</sup> Hannah Nevins<sup>5</sup>  
Scott Benson<sup>6</sup>

<sup>1</sup>Moss Landing Marine Laboratories, 8272 Moss Landing Rd, Moss Landing, CA 95039.

<sup>2</sup>U.S. Geological Survey, 400 Natural Bridges Drive Santa Cruz, CA 95060.

<sup>3</sup>California Department of Fish and Wildlife/Office of Spill Prevention and Response, 1451 Shaffer Road Santa Cruz, CA 95060.

<sup>4</sup>Oikonos Ecosystem Knowledge, 151 McAllister Way, Santa Cruz, CA 95060.

<sup>5</sup>American Bird Conservancy, P.O. Box 249 4249 Loudoun Ave. The Plains, VA 20198-2237.

<sup>6</sup>National Oceanic and Atmospheric Administration, 7544 Sandholdt Rd, Moss Landing, CA 95039.

For 19 years, Beach COMBERS (Coastal Ocean Mammal and Bird Education and Research Surveys) has conducted standardized monthly surveys of beachcast marine birds and mammals in Central California to assess trends in deposition and assist in the early detection of natural and anthropogenic mortality events. This long-term monitoring program started on beaches within the Monterey Bay National Marine Sanctuary, and by 2017 Beach COMBERS will have expanded to include 113 trained volunteers who survey monthly 112 km of beaches between Santa Cruz and Los Angeles, CA. Since our inception we have detected numerous mortality events in marine birds, using the baseline rates of seabird deposition km-1 month-1 to identify anomalies in seabird mortality across time and geographic region. Our collaboration with the OSPR Marine Wildlife Care and Veterinary Research Center (MWVCRC) seabird necropsy program has allowed us to identify the causes of mortality during some of these events, most recently including red tide impacts and starvation as a result of changed oceanographic processes. In collaboration with California Department of Fish and Wildlife/Office of Spill Prevention and Response, surveyors record and sample oiled carcasses, which have been analyzed to match source pollution events (e.g. shipwrecks, natural seeps). This citizen volunteer program combined with a science-based approach to investigating mortality and oiling events has allowed us to provide standardized data to determine underlying causes of seabird mortality along the west coast of the United States. (Poster)

## EXHIBITION OF NITROGEN SUPPLYING BY PISCIVOROUS BIRDS INTO PLANTS IN AN AQUARIUM: A PILOT EXPERIMENT OF CAPTIVE EGRET

Mami Kazama<sup>1</sup> Kentaro Kazama<sup>1</sup>

<sup>1</sup>Hokkaido University, 3-1-1 Minato-cho, Hakodate, Hokkaido, Japan.

Aquaria and zoos keeping many wild birds are expected to provide good opportunities for people to understand the importance of ecosystem functions/services. However, exhibitions and educations of those importance are not easy because it is difficult to demonstrate the ecosystem functions/services under captive environments generally. In the present study, to demonstrate nitrogen supplying by captive piscivorous birds as their feces into terrestrial planting in a closed cage at an aquarium, we measured nitrogen stable isotope ratio ( $\delta^{15}\text{N}$ ;  $^{15}\text{N}/^{14}\text{N}$ ) of soils and plants in a cage of 3 Little Egrets fed  $^{15}\text{N}$ -riched marine fishes, every 3 months during 18 months, and compared to those of 6 Spotbill Ducks fed  $^{15}\text{N}$ -poor synthetic diet. In a month after the start of the study, we increased the number of the egrets to 7, to increase the nitrogen supplying by the egrets. Although  $\delta^{15}\text{N}$  of soils and plants were higher in the duck cage than the egret cage at the start,  $\delta^{15}\text{N}$  in the egret cage increased rapidly after the egret increasing and became higher than the duck cage at the end of the study. These results indicates that nitrogen supplying by piscivorous birds into plants can be demonstrated and exhibited even in a closed cage at the aquaria. (Poster)

## EXPERIENTIAL LEARNING IN MARINE ORNITHOLOGY AT OREGON STATE UNIVERSITY

Donald Lyons<sup>1</sup> Robert Suryan<sup>2</sup> Rachael Orben<sup>2</sup> G. Albertson<sup>2</sup>

<sup>1</sup>Oregon State University, 104 Nash Hall, Corvallis, OR 97331-3803.

<sup>2</sup>Oregon State University, 2030 SE Marine Science Dr., Newport, OR 97365.

Oregon State University (OSU) now offers three undergraduate courses with a focus on experiential learning in marine ornithology: a weekend introduction to marine birds and mammals, a junior-level four week summer immersive course on the ecology of marine and estuarine birds, and a senior and graduate level course focusing on research methods used in the study of marine bird and mammal behavior and physiology. Field learning opportunities include the capture, banding, and morphometric measurements of Western Gulls (*Larus occidentalis*), monitoring of Pigeon Guillemot (*Cepphus columba*) nest boxes, introduction to colony monitoring of Common Murres (*Uria aalge*) and Pelagic and Brandts Cormorants (*Phalacrocorax pelagicus* and *P. penicillatus*), beached bird surveys following the COASST protocol, and an introduction to vessel-based seabird survey techniques. Lab exercises use real, raw data, where students analyze dive characteristics and estimate aerobic dive limits, quantify central place foraging of breeding birds, explore the trade-offs of time-activity and daily energy budgets, and estimate prey consumption by the Oregon coast seabird community. All courses are taught at OSUs Hatfield Marine Science Center in Newport, Oregon, and are part of a larger and expanding program in marine studies and experiential education. Across the three courses, annually up to 88 students can gain exposure to marine birds, with additional research internship opportunities available by arrangement. Flexible enrollment and tuition policies, short residence requirements, and affordable on-site housing at the science center allow students from a variety of locations (e.g., other universities, distance learners) to participate. (Poster)

## A MULTI-DECADAL STUDY OF PRE-BREEDING SURVIVAL OF BLACK GUILLEMOTS IN A RAPIDLY CHANGING ARCTIC

George Divoky<sup>1</sup> Christophe Barbraud<sup>2</sup>

<sup>1</sup>Friends of Cooper Island, 652 32nd Ave East, Seattle, WA.

<sup>2</sup>Centre d'Etudes Biologiques de Chize, 405 Route de Prisse la Charriere, 79360 Villiers-en-Bois, France.

Our understanding of demographic processes in seabird populations is mainly based on analyses of traits of the adult component of populations. Early-life demographic traits are poorly known mainly for methodological reasons. Yet, survival of juvenile and immature individuals is critical for recruitment into the population and thus for the whole population dynamic. This bias currently restrains our ability to fully understand population dynamics of seabirds. We used a multi-decadal data set (1975-2015) of a long-lived species, Mandts Black Guillemot (*Cepphus grylle mandtii*), obtained at Cooper Island in Arctic Alaska where all fledglings have been banded since 1975. Mandts Black Guillemot is one of the few arctic ice-obligate seabirds. Its breeding and nonbreeding habitat have undergone dramatic changes during the time-series of our database and the colony has declined by 50% in the last 25 years. Using capture-mark-recapture multi-state models we estimate juvenile and immature survival and test for age and individual effects on these parameters. We also investigated the effect of fledging body condition on juvenile survival and the environmental factors potentially driving this demographic trait using climatic covariates. Our preliminary analysis found capture probabilities increased from age 1 to age 7, stabilised at age 8, varied as a function of year. Recruitment probability increased from  $0.021 \pm 0.060$  at age 2 to  $0.300 \pm 0.031$  at age 5, stabilised at  $0.453 \pm 0.025$  at age 6. Age at recruitment was correlated with early fledging. There was no effect of fledging date or body condition on juvenile survival (Poster)

## EL NIÑO, THE BLOB, AND EGG CANNIBALISM IN GLAUCOUS-WINGED GULLS

James L. Hayward<sup>1</sup> Shandelle M. Henson<sup>2</sup>

<sup>1</sup>Department of Biology, Andrews University, Berrien Springs, Michigan USA

<sup>2</sup>Departments of Mathematics and Biology, Andrews University, Berrien Springs, Michigan USA

We studied egg cannibalism in Glaucous-winged Gulls (*Larus glaucescens*) breeding at Protection Island, Washington between 2006 and 2014 for 7 field seasons. Four of these seasons were preceded by relatively high local sea surface temperatures (SST; 9.0–9.3°C) associated with El Niño events. During each such season, egg cannibalism was relatively high (21–42%). By contrast, during the three years of “normal” SSTs (8.6–8.8°C), egg cannibalism was relatively low (14–17%). Typically, high SSTs are associated with low marine productivity. Thus we hypothesized that high levels of egg cannibalism during years of high SST were due to low food availability. The 2015 and 2016 field seasons were preceded by the highest SSTs during our 9-year study (10.0°C), yet egg cannibalism was relatively low in 2015 (17.3%) and very low in 2016 (11.7%). Both 2015 and 2016 were accompanied by the existence of “The Blob”, an enormous mass of warm water located in the northeast Pacific Ocean which precipitated significant regional weather and ecosystem perturbations. Although gulls nesting on Protection Island seemed to thrive during these years, other marine birds such as alcids experienced high mortality. Currently we cannot offer a mechanistic explanation for these differences, except to note that feeder fish populations appeared surprisingly robust around Protection Island despite (or because of?) The Blob. (Talk)

THE LIFE AND TIMES OF SEA RANCH SEABIRDS: REPRODUCTIVE SUCCESS AND PHENOLOGY BEFORE, DURING AND AFTER THE 2015 EL NIÑO.

Kyle Jensen<sup>1</sup> Ellen Harris<sup>1</sup> Ramoncito Caleon<sup>1</sup> Diane Hichwa<sup>2</sup> Nina Karnovsky<sup>1</sup>

<sup>1</sup>Pomona College, 175 W. 6th St. Claremont, CA 91711 USA.

<sup>2</sup>Madrone Audubon, PO Box 1911, Santa Rosa, CA 95402.

The purpose of this project was to compare the reproductive success and phenology of Western gulls (*Larus occidentalis*) and Pelagic cormorants (*Phalacrocorax pelagicus*) breeding in The Sea Ranch, Sonoma County, California over a three year period. During the summers of 2014, 2015, and 2016, oceanographic conditions of the California Current varied greatly, with 2015 having El Niño conditions. We hypothesized that seabirds have higher breeding success rates and earlier phenology during non-El Niño conditions. We tested this hypothesis by observing seabirds through spotting scopes and binoculars. We noted nest establishment date and tracked chick development stages from hatching to fledging for each nest. Our study sites were Gualala Point Island, where we observed Western gulls, and Breakers Reach, where we observed Pelagic cormorants. We found that Western gulls had fewer chicks and a smaller percentage of chicks fledged during and after the El Niño. In 2014, nests had an average of 2.7 chicks per nest, whereas in 2015 and 2016, nests had an average of 0.9 and 1.6 chicks per nest. Western gulls also established their nests later during the El Niño, but hatched the first chicks within the same week each year. In contrast, Pelagic cormorants hatched chicks later in 2015 and 2016 (June 22nd-August 23rd) in comparison to 2014 (May 8th-August 16th). Pelagic cormorants also hatched more chicks during the El Niño, with 1.6 chicks in 2014, 2.4 chicks in 2015, and 1.9 chicks per nest in 2016. El Niño conditions affect both the breeding success and timing of seabirds in The Sea Ranch, but the effects vary by species. Also, top down forces (such as a peregrine falcon (*Falco peregrinus*) in 2016) impact reproductive success. (Poster)

## UNRAVELLING MORTALITY TRENDS IN TWO AT-RISK COASTAL DUNE BREEDING BIRDS IN SOUTHERN CALIFORNIA

Maggie Post<sup>1</sup> Rachel Smith<sup>1</sup> Megan Jones<sup>1</sup> Gabriela Ibarguchi<sup>1</sup> Katrina Murbock<sup>1</sup> Travis Wooten<sup>1</sup> Lisa Nordstrom<sup>1</sup> Ignacio Vilchis<sup>1</sup> Ron Swaisgood<sup>1</sup>

<sup>1</sup>San Diego Zoo Institute for Conservation Research, 15600 San Pasqual Valley Rd., Escondido, CA, 92027.

Seabird and shorebird populations have been experiencing global large-scale declines, often resulting from complex drivers stemming from anthropogenic disturbance and environmental change. Ecological studies can provide fundamental baselines on population health, survival and reproductive success. However, coupling site-based observations with analyses at larger geographical scales on potential environmental drivers, and including analyses at the individual and micro-scale level to assess body condition and general health, can provide invaluable insight into processes that may influence longer-term population trends. Here we examine population trends and causes of mortality for two coastal-dune nesting species, the endangered California Least Tern (*Sternula antillarum browni*), and the Western Snowy Plover (*Charadrius nivosus nivosus*) in Southern California. We combine data from detailed breeding monitoring, tracking of mortality from predation and environmental factors, and necropsy data from examination of eggs, chicks and adults of both species. In addition, we review general trends in the marine environment in California to examine possible factors influencing recovery in both species (e.g. foraging conditions and fisheries) over recent and longer time-scales. (Poster)

## MONITORING PIGEON GUILLEMOT COLONIES ON WHIDBEY ISLAND: 2008-2016

Emily Terao<sup>1</sup> GOVINDA ROSLING<sup>1</sup> ANN CASEY<sup>1</sup> PHYLLIS KIND<sup>1</sup> FRANCES WOOD<sup>1</sup><sup>1</sup>Guillemot Research Group, 1370 Seven Eagles Way, Greenbank, WA 98253.

Pigeon Guillemots are a good indicator species for the health of the Salish Sea because they nest throughout the area, they are found here all year, and they are near the top of the food chain. Since 2008, volunteers and paid researchers have monitored the 28 colonies of guillemots nesting on Whidbey Island. During the breeding season, 50-60 trained volunteers spend one hour per week at each colony observing the birds. They count the number of adults in the colony, the number of occupied burrows (defined as burrows an adult has entered), the number of burrows with chicks (defined as burrows to which an adult has delivered prey) and the type of prey delivered. In addition, paid interns monitor selected colonies for 15 hours of early morning observation time each week. They make the same observations as the volunteers, plus they document activities with photographs and videos. They are also able to estimate probable chick fledging, defined as burrows that receive prey for at least three consecutive weeks. Over this eight-year period, the population appears to be stable. The mean number of adults is 1032 ± 35, of occupied burrows is 244 ± 21, and of burrows with chicks is 160 ± 13. The fledging success was more variable, from a high of 81% of burrows with chicks to a low of 50% with a mean of 66% ± 12%. Identified prey includes gunnels, sculpins or other (including unidentified prey and other prey such as perch or cod). Over the eight-year observation period, we recorded 4852 gunnels, 2602 sculpin and 1466 other prey delivered. Gunnels are the predominant prey delivered each year. Prey deliveries begin in the middle of June, reach a peak in the middle of July and end by the last week of August. (Poster)

## A SUMMARY OF ALBATROSS BAND RECOVERY DATA IN THE HAWAII DEEP AND SHALLOW SET LONGLINE FISHERIES

John Peschon<sup>1</sup>

<sup>1</sup>National Marine Fisheries Service, Pacific Islands Regional Office Observer Program, 1845 Wasp Blvd., Honolulu, HI 96818.

This project is a summary of Hawaii Longline Fisheries observer program seabird band recovery data that has been accrued during the January 01, 2002 through December 31, 2015 period. The National Marine Fisheries Service Pacific Island Regional Office Fisheries Observer Program has been deploying observers on board Hawaii-permitted longline fishing vessels, as part of a mandatory requirement, since February of 1994. Seabirds, most commonly the black-footed and Laysan Albatross species, are known to occasionally interact with the observed longline fisheries. As a part of their regular responsibilities, observers deployed on longline fishing vessels record seabird sightings, document any observed fisheries interactions, assist with handling hooked or entangled seabirds, salvage dead seabirds, and report on compliance with all existing fisheries-related regulations (many of which are aimed at mitigating seabird interactions). Observers also opportunistically record seabird band recovery data. All banding-related data, is maintained in an 'in-house database, and is also submitted to the United States Geological Survey, Patuxent Bird Banding Laboratory (BBL) where it is joined with existing banding data provided by the United States Fish and Wildlife Service, and others, into a centralized bird banding laboratory database. The results presented here represent a cooperative effort between the NMFS, USFWS, USGS, as well as other governmental and non-governmental agencies. (Poster)

## PRELIMINARY AT-SEA TRIALS OF SEABIRD BYCATCH MITIGATION IN JAPANESE GILLNET FISHERIES

Mayumi Sato<sup>1</sup> Yutaka Yamamoto<sup>2</sup> Seiji Hayama<sup>2</sup> Rory Crawford<sup>3</sup>

<sup>1</sup>BirdLife International Tokyo, 2-14-6, Misakicho, Chiyodaku, Tokyo, Japan.

<sup>2</sup>Wild Bird Society of Japan, 3-9-23 Nishi-gotanda, Shinagawaku, Tokyo, Japan.

<sup>3</sup>The Royal Society for the Protection of Birds, The Lodge, Potton Road, Sandy, GB, SG19 2DL, UK.

Approximately 400,000 seabirds are being killed every year by gillnet fisheries. The North-west Pacific is the region that has the highest estimated bycatch with 140,000 seabird mortalities annually. Although very limited information on seabird mortality in gillnets is available, gillnets have been linked to major declines in some seabird populations around Hokkaido, Japan, particularly Common Murres and Tufted Puffins. In 2016, the Wild Bird Society of Japan and BirdLife International conducted preliminary trials of high visibility net panels that have been developed through a sensory ecology approach as a potential mitigation measure to reduce seabird bycatch. Working with gillnet fishermen from Teuri Island, home to the worlds largest colony of Rhinoceros Auklets and the last remaining Japanese colony of Common Murres, we examined the efficacy of these net panels in reducing seabird bycatch and whether there are any impacts on target fish catch. We present preliminary results from the at-sea trials, with an emphasis on the importance of engaging local fishermen and highlighting some of the operational issues encountered. (Poster)

MAIN HAWAIIAN ISLAND SEABIRD STUDIES TO ENABLE COMPREHENSIVE EVALUATION OF OWEI SITE SELECTION, SPECIES VULNERABILITY, AND CONSERVATION ACTION

Emma Kelsey<sup>1</sup> Jonathan Felis<sup>1</sup> Max Czapanskiy<sup>1</sup> David Pereksta<sup>2</sup> Josh Adams<sup>1</sup>

<sup>1</sup>USGS Western Ecological Research Center, 2885 Mission St. Santa Cruz CA 95060.

<sup>2</sup>BOEM Pacific Region, Camarillo, CA, USA.

Hawai'i state alternative energy policy mandates and federal interest in developing renewable energy resources have prompted three unsolicited lease requests for offshore wind energy infrastructure (OWEI): AW Hawai'i Winds O'ahu Northwest and South Projects and Progression Hawaii Offshore Winds South Coast of Oahu Project. Each project proposes an offshore wind power facility each with a capacity to generate approximately 400 megawatts (MW) of renewable energy by installing about 50 floating, 8-10 MW wind turbines. The industry's intent and capacity to develop these resources in the future, highlights the need for additional ocean- and island-based environmental assessments to inform planning. USGS and collaborators have been working since 2006 to collect information regarding the distribution and movements at sea among seabirds breeding throughout the Main Hawaiian Islands (MHI). Recent efforts to quantify relative vulnerability among seabirds to offshore wind energy infrastructure in the CCS provide a framework for a similar approach in Hawai'i. To enable this, and to generate requisite information for evaluating OWEI siting, additional threats to seabirds, and potential future mitigation strategies we describe several projects that will increase knowledge and capacity for better understanding seabird populations both on land and at sea: 1.) an evaluation of collision and displacement vulnerability for Hawaiian seabirds, 2.) revised assessments of colony distribution, abundance, and nesting habitat throughout the MHI, 3.) hi-resolution, sensor enabled measures of flight behavior, and 4.) enhanced, colony-based predicted-distributions of breeding seabirds at sea. (Poster)

## THE DISTRIBUTED BIOLOGICAL OBSERVATORY: A MEANS OF MEASURING CHANGE IN THE ARCTIC SEABIRD COMMUNITY.

Kathy Kuletz<sup>1</sup> Erik Osnas<sup>1</sup> Elizabeth Labunski<sup>1</sup> Daniel Cushing<sup>2</sup>

<sup>1</sup>U.S. Fish and Wildlife Service, 1011 E. Tudor Rd, Anchorage, AK, USA.

<sup>2</sup>Pole Star Ecological Research, Seattle, WA, USA.

The Pacific Arctic has been a focus of research, exploration, and development. In 2009, to monitor the effects of environmental changes, including anthropomorphic impacts, an international group of researchers proposed a Distributed Biological Observatory (DBO). The DBO consists of an array of sampling stations and polygons to serve as a 'change detection array; these currently extend from the northern Bering Sea (2 sites) through the eastern Chukchi Sea (3 sites) and the western Beaufort Sea (3 sites). The DBOs are scheduled through 2020, with collaborative efforts for multi-disciplinary studies from oceanography to whales. The DBO is part of the US National Ocean Policy Strategic Plan and is a framework for international research via the Arctic Council Circumpolar Biodiversity Monitoring Program. Using data from 2007-2015, we examined the efficacy of the DBO system to describe seabird species richness, diversity, abundance, and distribution in the eastern Pacific Arctic. The DBOs did well at detecting species richness, given their survey effort; they captured ~70% of potential species from an overall asymptote of ~45 species. The Arctic Basin and Beaufort Sea sites had low diversity and abundance. Although the Chukchi Sea had half the survey effort as the southern Bering Sea, it was equivalent in species richness, indicative of its importance to seabirds in late summer and fall. The DBOs were successful at reflecting the relative abundance and distribution of numerically dominant species, thus future analyses of seabirds with respect to environmental conditions and prey will focus on six abundant seabird species. (Poster)

## ESTIMATING POPULATION DENSITY OF MAGNIFICENT FRIGATEBIRD (*FREGATA MAGNIFICENS*) COLONY ON ST. GILES ISLANDS, TOBAGO USING PHOTOGRAPHIC SURVEYS

Robyn Bath-Rosenfeld<sup>1</sup> Darshan Narang<sup>1</sup>

<sup>1</sup>University of the West Indies, St. Augustine.

The St. Giles Islands Important Bird Area (IBA) off of Tobago, W.I. comprises of one main island (St. Giles, c.29 hectares of steeply-sloping land rising to just over 100 meters) and several outlying rocks. This IBA supports one of the most important seabird breeding colonies in the southern Caribbean. From October, 2014 to April, 2015, we circumnavigated St. Giles Islands and remotely photographed the seabird colonies using a handheld SLR camera with a telephoto lens. Photographs were analyzed using ImageJ software and counts of Magnificent Frigatebirds (*Fregata magnificens*) indicate that their numbers have increased at > 1000% from the last survey 15 years ago with an estimated population density of 10.91 individuals/100m<sup>2</sup> within the colony. This study introduces a novel approach to analyzing photographic surveys for inaccessible seabird colonies and acquiring data with low-impact and low-budget. (Poster)

## ACCURACY OF SEXING GALPAGOS AND MAGELLANIC PENGUINS BY MORPHOLOGY AND BEHAVIOR

Caroline Cappello<sup>1</sup> P. Dee Boersma<sup>1</sup><sup>1</sup>University of Washington, UW Biology, 24 Kincard Hall, Seattle, WA.

The ability to identify the sex of individuals is essential in studies of ecology, behavior, and conservation, but reliable methods of sexing seabirds that exhibit low sexual dimorphism are often time consuming or invasive. Previous studies have evaluated the usefulness of morphological measurements as easy and minimally invasive means of sexing penguins in the field, but few have included behavioral variables or within-pair comparisons of morphology in their analyses. Using a classification tree (CART) analysis, we determined the accuracy of sexing Galapagos (*Spheniscus mendiculus*) and Magellanic penguins (*Spheniscus magellanicus*) using four morphological measurements: bill depth, bill length, flipper length, and foot length. For Magellanic penguins, we also included a within-pair comparison of bill depth and observations of two breeding behaviors: 1) which member of a pair settled the nest at the beginning of the season and 2) which member of a pair took the first incubation stint. Bill depth and bill length were the best splitting variables in Galapagos penguins, correctly identifying the sex of 92% of study penguins. For Magellanic penguins, within-pair bill-depth comparison, bill depth, nest settlement, and first incubation were the strongest indicators, correctly classifying the sex of 100%, 97%, 97%, and 96% of study birds, respectively. These results suggest that penguins may be effectively sexed with minimally invasive procedures, including both morphological and behavioral indicators, thus allowing for greater flexibility in methodology. Though morphological measurements may differ between colonies, behavioral indicators and within-pair comparisons of morphology should be useful species wide. (Poster)

## MULTISPECTRAL PROCESSING OF HIGH RESOLUTION SATELLITE IMAGERY TO DETERMINE THE ABUNDANCE OF NESTING ALBATROSS

Jane Dolliver<sup>1</sup> Robert Suryan<sup>2</sup> Anne Nolin<sup>3</sup> Christopher Noyles<sup>4</sup> Ellen Lance<sup>5</sup> Erin Knoll<sup>6</sup>

<sup>1</sup>Department of Fisheries and Wildlife, Oregon State University, 104 Nash Hall, Corvallis, Oregon, 97330.

<sup>2</sup>Hatfield Marine Science Center, Oregon State University, 2030 SE Marine Science Drive, Newport, OR 97365.

<sup>3</sup>College of Earth, Ocean and Atmospheric Sciences, Oregon State University, 104 CEOAS Administrative Building, Corvallis, OR 97331.

<sup>4</sup>U.S. Bureau of Land Management, 222 West 7th Ave # 13, Anchorage, AK 99513.

<sup>5</sup>Bonneville Power Administration, 2715 Tepper Ln NE, Keizer, OR 97303.

<sup>6</sup>U.S. Fish and Wildlife Service, 4700 BLM Road, Anchorage, AK 99507.

All three species of North Pacific albatrosses (Laysan - *Phoebastria immutabilis*, black-footed-*P. nigripes*, short-tailed - *P. albatrus*) are listed as of conservation concern under the IUCN Red List. Counts of albatrosses on breeding colonies provide essential data on annual productivity, attendance, and population trends that supply key metrics to assess population status and effectiveness of management policies or actions. Due to constraints on wildlife monitoring budgets, logistics of accessing colonies, and sensitivities of some breeding areas, we explore the potential for using high resolution multispectral satellite imagery (DigitalGlobe WorldView-2 & 3) to enumerate albatrosses on breeding colonies. Advance image processing techniques include panchromatic-multispectral fusion and linear spectral unmixing. Spectral fusion techniques are designed to enhance identification and enumeration of individual albatrosses. In contrast, spectral unmixing techniques separate species-specific spectra from background spectra, identifying the percentage of a pixel that is albatross vs. vegetation or substrate. We use traditional, colony-based counts in designated plots identifiable by satellite to calibrate satellite-based counts. Preliminary results are promising with performance of either method differing by species and location. In cases where resolution, viewing angle or sun angle limit object-oriented classification of images, spectral unmixing produces a rapid means of detecting albatross in multi-species assemblages, without the knowledge of all spectral endmembers. For surface-nesting seabird colonies these methods could provide an efficient estimate of populations without disturbance to birds or habitats. (Poster)

## IDENTIFYING EFFECTIVE OUTREACH TOOLS FOR SEABIRD RECOVERY FROM ANTHROPOGENIC LIGHT DISTRACTION

Katsu Frausto<sup>1</sup> Jennifer Learned<sup>1</sup> Emily Severson<sup>1</sup> Jay Penniman<sup>1</sup>

<sup>1</sup>Maui Nui Seabird Recovery Project, PO Box 903, Makawao, HI, 96768.

Hawaii has more endangered species per square mile than anywhere else in the world. Hawaiian seabird populations, including the federally endangered endemic Hawaiian Pe-trel (*Pterodroma sandwichensis*) and the Wedge-tailed Shearwater (*Ardeanna pacifica*), have drastically decreased across the Hawaiian Islands due to habitat destruction, introduced predators, power lines, and light pollution. When the general public has accurate information and awareness to collect and report seabirds downed by electric light trespass to Maui Nui Seabird Recovery Project (MNSRP), seabird mortality is mitigated by timely recoveries of downed birds, getting them to rehabilitation or back out to sea. Collecting data on how the public finds out about Maui Nui Seabird Recovery Project allows us to invest in successful methods to get the most out of our outreach efforts. When picking up a bird from a responder, we use the data collecting app iForm, which includes a data field documenting how that individual discovered MNSRP. Using this information we can quantify and compare the influence of social media and other outreach campaigns with how the collectors were informed about seabird recovery efforts on Maui. Our analysis reveals that previously established contacts with hotels (common sources of downed seabirds) and Facebook were the most common reference for people reporting downed birds. This work reveals the potential of various outreach platforms, cost efficiency, and best methods in order to increase recovery of seabirds and establish a more visible presence in the Maui community. It will also facilitate working with properties which have repeated fallout due to light trespass to reduce or eliminate the sources of seabird distraction. (Poster)

## EFFICACY OF AUTOMATING PHOTOGRAPHIC COUNTS OF COMMON MURRE (*URIA AALGE*) AT COLONIES

Stephanie Schneider<sup>1</sup> Richard Golightly<sup>2</sup> Birgitte McDonald<sup>1</sup>

<sup>1</sup>Moss Landing Marine Laboratory, Moss Landing, CA 95039 USA.

<sup>2</sup>Humboldt State University, Arcata, CA 95521 USA.

Abundance is a basic ecological measure that is essential to assess whether populations are declining, stable, or increasing. For colonial surface-nesting seabirds, methods for estimating the size of breeding populations include aerial photographs of the colony from which each seabird is identified and manually counted by a trained biologist. This method is labor intensive and may be financially prohibitive. We conducted a pilot investigation to (1) assess an automated counting technique and (2) investigate the efficacy of this technique in terms of accuracy and expediency compared to traditional methodologies. Automated counting was accomplished using the Python computing language to develop image processing, edge-detection, segmentation, and particle analysis algorithms that could detect and tally individual murrelets in aerial photos. Because some particles generated by these algorithms contained more than one individual, a function that described the relationship between particle area and number of individuals was derived to estimate abundance. Ten additional photos were processed using the exact same suite of algorithms to assess accuracy and speed of automation relative to hand-derived counts. On average, automation produced estimates that were 3.51% less than manual counts and was considerably faster. Further refinement of automation algorithms will improve the efficacy of this method and facilitate more cost effective estimates of seabird abundance. (Poster)

## AMERICAN WHITE PELICANS FROM TWO COLONIES IN OREGON: NATAL PHILOPATRY TO COASTAL AND INTERIOR REGIONS?

Kirsten Bixler<sup>1</sup> Donald Lyons<sup>1</sup> Daniel Roby<sup>2</sup> Yasuko Suzuki<sup>1</sup> Michelle McDowell<sup>3</sup> Timothy Lawes<sup>1</sup>

<sup>1</sup>Oregon Cooperative Fish and Wildlife Research Unit, Department of Fisheries and Wildlife, 104 Nash Hall, Oregon State University, Corvallis, OR 97331 USA.

<sup>2</sup>U.S. Geological Survey-Oregon Cooperative Fish & Wildlife Research Unit, 104 Nash Hall, Oregon State University, Corvallis, OR 97331 USA.

<sup>3</sup>U.S. Fish and Wildlife Service, Migratory Birds and Habitat Program, 911 NE 11th Ave, Portland, OR 97232 USA.

American White Pelicans (*Pelecanus erythrorhynchos*) are considered a state/provincial endangered species in Washington and British Columbia, and a species of greatest conservation need in 6 other western states. Although the species is increasing range-wide, relatively little is known about their movements and demographics in western North America. We placed field-readable leg-bands on nearly-fledged pelicans at 2 breeding colonies in Oregon between 2011 and 2014. We banded 310 chicks in interior Oregon at Malheur Lake (430 km from coast) and 96 chicks at Miller Sands Island located in the Columbia River estuary (river km 37). Active since 2010, the Miller Sands colony is the only known coastal/estuarine nesting site for this species along the Pacific Coast. There have been 44 band encounters for 32 individuals (8% of banded birds), including 34 resights of live birds. The location of encounters suggests a divergence in movements by pelicans raised at the 2 colonies. North of California, pelicans from Miller Sands were observed 0-90 km from the coast. In contrast, pelicans banded at Malheur Lake were encountered 190-990 km from the coast, as far east as Montana. Birds from both colonies appear to travel through and/or winter in the Central Valley, San Francisco Bay, and Los Angeles Basin of California. Resight records indicate that the youngest age at first return to the vicinity of the natal colony is 2 years. During the breeding season, mature pelicans (> 3 years old) were resighted in the vicinity of colonies that were up to 660 km from their natal colony. Drought conditions in the interior West could increase philopatry to the coast and potentially lead to additional colony formation in that region. (Poster)

## SEABIRDS AT SEA – USING GPS TECHNOLOGY TO STUDY AUKLET HABITAT PREFERENCES

Alice Domalik<sup>1</sup> J Hipfner<sup>2</sup> David Green<sup>1</sup>

<sup>1</sup>Simon Fraser University, 8888 University Dr, Burnaby, BC, V5A 1S6.

<sup>2</sup>Environment and Climate Change Canada, 5421 Robertson Road, Delta, BC, V4K 3N2.

British Columbia, Canada supports globally significant breeding populations of both rhinoceros auklet (*Cerorhinca monocerata*) and Cassins auklet (*Ptychoramphus aleuticus*), but little is known about their individual movements and foraging behaviour. To address these knowledge gaps, we deployed Global Positioning System (GPS) loggers from 2014-2016 on chick-rearing auklets breeding at multiple colonies in British Columbia. GPS loggers recorded position every two to five minutes, providing fine-scale movement data for the duration of a single, approximately 19 hour, foraging trip. We will use these GPS tracks to assess the extent and stability of foraging areas between years. We will also compare foraging locations to sea-surface temperature (SST), chlorophyll a concentrations, and bathymetry to determine if foraging areas can be predicted by oceanographic features. Identification of auklet foraging areas will inform marine conservation planning, including the designation of the proposed Scott Islands Marine National Wildlife Area. Furthermore, knowledge of auklet habitat associations will help create predictive habitat-use models, which can be used to minimize potentially negative interactions between marine wildlife and human activities. (Poster)

MIGRATORY ROUTES AND WINTERING AREAS OF PINK-FOOTED SHEARWATERS (*ARDENNA CREATOPUS*)

Jonathan Felis<sup>1</sup> Josh Adams<sup>1</sup> Ryan Carle<sup>2</sup> Peter Hodum<sup>2</sup> Valentina Colodro<sup>2</sup> Seth Newsome<sup>3</sup>  
Yes<sup>1</sup>

<sup>1</sup>US Geological Survey, 2885 Mission St, Santa Cruz, CA 95060.

<sup>2</sup>Oikonos Ecosystem Knowledge, Yerbos Buenas 498, Valparaso, V Region, Chile.

<sup>3</sup>University of New Mexico, Albuquerque, NM.

The Pink-footed Shearwater (PFSH; *Ardenna creatopus*) is listed as in danger of extinction by Chile and under Annex 1 of ACAP. This species is an endemic breeder in Chile, but travels during migration as far north as the United States and Canada. We tracked PFSH post-breeding movements using satellite tags in order to identify important non-breeding areas at sea. We deployed satellite tags on breeding PFSH at colonies in Chile (n=30, 2006-2015) and at non-breeding areas at sea off southern California (n=12, 2009-2013). During the six month non-breeding period (May–October), post-breeding adults exhibited two winter migration strategies: 30% of tagged individuals traveled ~2500 km north from their colonies to winter off Peru and 70% traveled ~8000–11,000 km north to winter off western North America (Mexico to southernmost Canada). This division also was supported by stable iso-tope results from feathers grown during the non-breeding period. Individuals wintering in North America spent time off Peru on both legs of the migration (mean=16 days each way). Although only 30% of individuals wintered off Peru, the population overall spent almost half the non-breeding period there when accounting for post- and pre-breeding stopovers together with cumulative time off North America; therefore, Peruvian waters serve as a migratory bottleneck and are disproportionately important for the entire breeding population. High-use wintering areas included continental shelf and slope waters off Trujillo to Lima (Peru), central Baja California (Mexico), southern to central California (USA), and northern Oregon (USA) to southern Vancouver Island (Canada). (Poster)

## COMMUNITY-BASED MONITORING OF THE MARINE ECOSYSTEM IN KOTZEBUE SOUND, ALASKA

Adrian Gall<sup>1</sup> Tawna Morgan<sup>1</sup> Ashley Hovis<sup>1</sup> Robert Schaeffer<sup>2</sup> Julie Parrett<sup>1</sup> Noah Naylor<sup>3</sup>

<sup>1</sup>ABR, Inc. Environmental Research & Services , PO Box 80410, Fairbanks, AK 99708.

<sup>2</sup>Native Village of Kotzebue, PO Box 296, Kotzebue, AK 99752-0296.

<sup>3</sup>Northwest Arctic Borough, PO Box 1110, Kotzebue, AK 99752 .

Seabirds and marine mammals can serve as indicators of the productivity of, and changes in, the ocean, especially when studies of their at-sea distribution and abundance are paired with indigenous knowledge. Despite the reliance of residents on Kotzebue Sound, systematic boat-based surveys for seabirds and marine mammals have not been conducted there for > 30 years. We surveyed seabirds and oceanography in June and July 2016 and interviewed Kotzebue residents to explore seasonal changes in the upper-trophic-level predator community of Kotzebue Sound. Water temperature increased and salinity decreased from June to July, indicating a general freshening from the large rivers feeding the Sound. The density of marine birds was higher in July than in June; alcids were the most abundant species-group in both months. Species-composition differed between months, with murrens more abundant in June and auklets and Glaucous Gulls more abundant in July. Densities of marine mammals, especially bearded seals, were lower in July than June. Indigenous knowledge shared by four Kotzebue residents indicated that seabirds are more abundant in the summer and waterfowl are more abundant in the fall. The hunting season for bearded seals is occurring earlier as ice melts sooner in the spring, and beluga whale populations have not rebounded from a major die-off in the 1980s. Systematic surveys of seabirds and oceanography from small locally-hired vessels was feasible and successful and is a possible model for long-term, community-based monitoring of Kotzebue Sound. (Poster)

GEOLOCATORS REVEAL FORAGING MOVEMENTS OF BREEDING FORK-TAILED STORM-PETRELS *OCEANODROMA FURCATA* FROM THE GILLAM ISLANDS, BRITISH COLUMBIA

Luke Halpin<sup>1</sup> Ingrid Pollet<sup>2</sup> Harry Carter<sup>3</sup> Ken Morgan<sup>4</sup>

<sup>1</sup>Halpin Wildlife Research, Vancouver, British Columbia, V6G 1J3 Canada.

<sup>2</sup>Dalhousie University, Department of Biology, Dalhousie University, Halifax, Nova Scotia, B3H 4R2 Canada.

<sup>3</sup>Carter Biological Consulting, Victoria, British Columbia, V8S 4S8 Canada.

<sup>4</sup>Canadian Wildlife Service, Environment Canada, Institute of Ocean Sciences, British Columbia V8L 4B2 Canada.

Information about foraging movements during breeding is crucial for conserving seabirds, understanding the threats they face at sea and for pelagic marine protected area planning. Recent advancements and miniaturization of geolocation technology have greatly improved our ability to track movements of the smallest of seabirds and become an important tool for revealing information about seabird movements and identifying important foraging ar-eas. We used geolocators to track movements of fork-tailed storm-petrels *Oceanodroma furcata* breeding on the Gillam Islands, off the northwest coast of Vancouver Island, British Columbia, Canada. Our data demonstrate long-range foraging behavior in fork-tailed storm-petrels, that traveled a mean maximum distance from the colony of 1,002 578 SD km and with an average total trip distance of 1,604 2,664 SD km. All birds utilized a core area west of Vancouver Island beyond the continental shelf break, an area known to be used by other seabird species. Importantly, this region has elevated marine vessel traffic and associated threats, which underlines the importance of further study of this populations movements. (Poster)

## SHEDDING LIGHT ON THE WINTER MOVEMENTS OF CASSIN'S AUKLETS

Michael Johns<sup>1</sup> Pete Warzybok<sup>2</sup> Russell Bradley<sup>2</sup> Jaime Jahncke<sup>2</sup> Mark Lindberg<sup>1</sup> Greg Breed<sup>1</sup>

<sup>1</sup>University of Alaska Fairbanks, Fairbanks AK, 99775.

<sup>2</sup>Point Blue Conservation Science, Petaluma, CA 94954.

For many seabird populations, conditions experienced during the non-breeding winter season are most limiting. Understanding the distribution and habitat needs of individuals once they depart the breeding colony is therefore essential for effective management. Cassin's auklets breeding on Southeast Farallon Island (SEFI) exhibit a strong reproductive response to local environmental variability, yet little attention has been paid to the conditions that shape their non-breeding distribution. To quantify the winter range and habitat use of this population, 26 adults breeding in nest boxes on SEFI were outfitted with miniature archival global light sensing devices, or geolocators, in the summer of 2015; 16 of which were recovered during the 2016 season. An additional 33 geolocators were deployed in 2016, with recovery planned for the summer of 2017. Twilight events from raw light level data were identified in R with the package GeoLight, and position estimates were calculated using a hidden Markov chain model in the package FlightR. Preliminary results indicate these birds spend the majority of the non-breeding season in the productive California Current System off the continental shelf of California, with some movement north of Cape Mendocino and south of Point Conception. To characterize winter habitat use, remotely sensed oceanographic variables including sea surface temperature and chlorophyll a concentrations were overlaid with position estimates in R. These findings will help to better understand the stressors Cassin's auklets face while at sea, information that is particularly relevant for a population that uses resources within an increasingly unstable marine system. (Poster)

GPS TRACKING SURVEY FOR HABITAT USE OF BREEDING BLACK-TAILED GULLS:  
ASSESSING POTENTIAL RISKS TO MARINE AND COAST WIND FARM IN NORTH-  
ERN HOKKAIDO, JAPAN

Kentaro Kazama<sup>1</sup> Yutaka Watanuki<sup>1</sup>

<sup>1</sup>Hokkaido University, 3-1-1 Minato-cho, Hakodate, Hokkaido, 041-8611, Japan.

Many marine and coast wind farms (WF) has been planned in Hokkaido, northern Japan. Since there are many breeding colonies of seabirds in the area, large risks of the WF are concerned. We attached GPS data logger on 12 breeding Black-tailed Gulls at Rishiri Is-land, northern Hokkaido, to survey their habitat use, flight routes during incubation period. Flight heights were also assumed using GPS data. We detected two main foraging areas: 1) continental shelf slope between the island and Hokkaido mainland, about 15 km off the colony, and 2) oceanic front of the Sea of Okhotsk (mixed area with Soya warm current and eastern Sakhalin cold current) about 90 km apart from the colony. Gulls tended to flight at low altitude (<20 m) above the ocean during the foraging trip to the shelf slope. On the other hand, during the trip to the front in Okhotsk, they flew mainly along the coastline of Hokkaido mainland and sometimes over the land across the cape to move the shortest distance, and the flight height tended to reach > 80 m, which overlapped the height of turbine blade of the WF. Collision risks of the breeding gulls to WF seems to increase at near the coastline and cape shore of Hokkaido mainland.(Poster)

DISPERSAL OF COMMON MURRES (*URIA AALGE*) FROM YAQUINA HEAD,  
OREGON, DURING 2015-2016

Stephanie Loredó<sup>1</sup> Robert Suryan<sup>1</sup> Donald Lyons<sup>1</sup> Rachael Orben<sup>1</sup> Josh Adams<sup>2</sup>

<sup>1</sup>Oregon State University, 104 Nash Hall, Corvallis, OR 97331 .

<sup>2</sup>U.S Geological Survey, Santa Cruz Field Station 400 Natural Bridges Drive Santa Cruz, CA 95060.

The Common Murre (*Uria aalge*) is the most abundant colonial nesting seabird in the California Current Ecosystem (CCE), with at least half the population along the Oregon coast. However, little is known about their individual at-sea movement patterns and habitat associations during either the breeding or non-breeding periods. We are using satellite transmitters (Argos PTTs) integrated with either wet/dry or temperature sensors to investigate the spatial distribution and habitat associations of murres from a prominent Oregon colony. In 2015 and 2016, a total of 18 common murres were captured and tagged in the immediate vicinity of the Yaquina Head colony in Newport, Oregon. Fourteen of 18 provided 1-15 locations per day for 8-35 days in summer and 67-97 days in fall. Only a few birds maintained central-place foraging trips during the breeding season. Colony reproductive failure and effects of tag size are likely causes of non-central-place trips during the breeding season. However, birds that dispersed from the breeding colony frequented similar regions within the CCE in both years. Birds traveled as far north as Vancouver Island, British Columbia but only as far south as Yachats, Oregon (40 km south of the colony), spending significant time near bays and other inlets. The Columbia River mouth was used by 64% of all birds. Use of this area was more prominent during summer (73%, n=11) than in fall (33%, n=3). Preliminary results of this study show that birds associated with the Yaquina Head colony disperse primarily north using common foraging areas and habitats when unconstrained by central-place foraging. This study is ongoing and inclusion of winter tracking data will further examine seasonal variability in habitat-use. (Poster)

## LONG-TERM BAND TRACKING OF WEDGE-TAILED SHEARWATERS IN MAUI NUI

Rebecca Pederson<sup>1</sup> Jennifer Learned<sup>1</sup> Duvall Fern<sup>2</sup> Penniman Jay<sup>1</sup>

<sup>1</sup>Hawaii Division of Forestry and Wildlife, 1955 Main Street, #301, Wailuku, HI 96793.

<sup>2</sup>Hawaii Division of Forestry and Wildlife, 1151 Punchbowl Street, Room 325, Honolulu, HI 96813.

Wedge-tailed shearwaters (*Ardenna pacifica*, WTSH) are native to Hawaii. Population estimates are 67,000 breeding pairs on the main Islands and 230,000 pairs in the Northwestern Hawaiian Islands. Maui Nui is home to roughly 6,500 pairs. A mark and recapture study of WTSH started in 2002 to increase the understanding of the population dynamics in Maui Nui. Initially, WTSH chicks were banded annually in the fall. In 2008, banding became a biannual event with the addition of recapturing and banding of unbanded adults during spring.

WTSH colonies across Maui Nui suffer variable predation pressure due to differing predator populations and control. For example, offshore islets like Molokini have little predation, compared to islands that have predation from feral cats, mongoose, dogs and rats. Colonies with predator control are likely to increase in size. Therefore we predict that islets are source populations, while island colonies tend to be sink populations. We use 14 years of WTSH banding data to determine interpopulation dynamics among five colonies; Moomomi on Molokai; Kāmaole III, Hawea, and Hookipa on Maui; and Molokini islet. We have recaptured 1,400 out of 14,200 total bands distributed. Our initial analysis reveals that Molokini birds have been recaptured in island colonies, despite a reduced banding effort. This leads us to believe that Molokini is a source population. The data also suggest that colonies with predator control (Hawea and Moomomi) are increasing with respect to colonies with little predator control (Hookipa and Kāmaole III). Continued regular banding events will increase understanding of WTSH population biology. (Poster)

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