# 2023 PACIFIC SEABIRD GROUP 50<sup>TH</sup> ANNUAL MEETING 15 – 17 February 2023



# PREDICTED DISTRIBUTION OF 'UA'U (HAWAIIAN PETREL*, PTERODROMA* SANDWICHENSIS) NEST SITES ON HALEAKALĀ, MAUI

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## Abstract

Haleakalā National Park and surrounding high-elevation montane areas on east Maui in the Hawaiian Islands supports critical remaining nesting habitat for Endangered 'Ua'u (Hawaiian Petrel, Pterodroma sandwichensis). Accurate predictions of suitable nesting habitat are integral for understanding abundance and can inform conservation strategies and outcomes for the species throughout the Hawaiian Islands. We provide the first landscape-scale predictive model describing the most likely habitat available for nesting petrels throughout upper elevations of Haleakalā. We used 2,453 unique nest site locations and evaluated thirteen spatial landscape and climate predictor variables associated with these sites and the landscape. Random Forest (RF) modeling indicated nest sites occurred in higher, drier, and windier areas with scale-specific topography compared with a random selection of locations. Our final model predicted Hawaiian Petrel nest sites to occur nonrandomly throughout much of the central part of the summit and crater with the greatest concentrations of nest sites predicted along the crater rim and along a ridgeline extending to the southwest from the crater rim. Other areas with moderately high predicted density included the northeastern and northern parts of the Haleakalā crater. Although we focused on predicting nest site habitat at higher elevations on Haleakalā, there is no reason to suspect that conservation efforts would not be successful at lower elevations provided nesting petrels were protected from invasive predators, grazing ungulates, and significant land alteration. Our results inform current fencing of habitat and offer new information to conserve additional areas that likely support suitable nesting habitat for petrels.

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# FORAGING IN A PLASTIC OCEAN: CHARACTERIZATION OF NATURAL AND NON-NATURAL DIET ITEMS INGESTED BY LAYSAN ALBATROSS

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### Abstract

The purpose of this study was to assess non-natural diet items found in Laysan Albatross (*Phoebastria immutabillis*) boluses. We sorted and weighed and categorized the contents of individual boluses found at Ka'ena Point and Kuaokala in O'ahu, Hawaii collected in 2020 and 2021. We classified non-natural diet items by color, size, and type (fibrous vs fragment) and quantified the weight and volume of the contents of each bolus. We found that each bolus had between 4 and 90 pieces of plastic. The majority of plastic pieces were less than 2.79 cm in length. Most of the plastic was white or brown/tan; identifiable objects included bottle caps, toothbrushes, pieces of fishing line and nets, glass, and a plastic mailing envelope. The main natural prey item found in boluses were squid beaks, which we sorted into upper beaks, lower beaks, and beak fragments to assess the total number of squid ingested. In addition, we identified some items within the bolus to be nesting material such as grass, sticks, and rocks (pumice). These data will be used to assess trends in plastic ingestion by Laysan Albatross foraging in the Pacific. Future directions include multi-year comparison and multi-colony comparison of trends in ingestion of nonnatural objects.

## "FIELD OF DREAMS": THE MYTHOLOGY OF SEABIRD NATAL PHILOPATRY

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### Abstract

"If you build it, they will come," spoke Kevin Costner arguing that despite building a ball field in a Kansas corn field, players and fans will show up. In a way, the same is true of seabirds. Regardless of species or family, seabirds rapidly occupy new breeding habitat despite high natal philopatry being a central tenet of marine ornithology. It is incorporated unquestioningly in the analysis of population dynamics, damage assessments and restoration strategies. However, we could not build nest boxes fast enough to accommodate the population increase of Black Guillemots at Cooper Island, Alaska, and Newell's Shearwaters at Makamaka'ole, Maui. From where did these recruits suddenly appear? Another example: a volcanic eruption at MacDonald Island in 1997 formed a cinder beach providing access to breeding habitat for King Penguins, before which there was no access. By 2003 "several thousand" penguins bred there. Terns are famous for shifting their colonies as their frequently ephemeral nesting habitat comes and goes, e.g., Columbia River saga. To understand what is going on in these and other examples, we will consider: 1) the definition of a seabird colony; 2) source vs sink demographic dynamics; 3) 'floating' populations (individuals not breeding for want of nesting habitat); and 4) trophic competition vs colony size (Furness & Birkhead phenomenon). We will discuss how natal philopatry happens only if seabirds are willing to exhibit the behavior, but otherwise are easily dissuaded. Demonstration often requires research at more than one "breeding site" in a region, a rare phenomenon.

# USING ORNITHOLOGICAL RADAR AND ACOUSTIC SURVEYS TO DETERMINE POPULATION TRENDS OF HAWAIIAN PETRELS ON THE ISLAND OF MAUI

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### Abstract

Hawaiian Petrels (Pterodroma sandwichensis; 'ua'u) are an endemic and endangered seabird species of the Hawaiian Islands. The island of Maui holds a significant proportion of the breeding population of 'ua'u, the majority nesting on Haleakalā in eastern Maui. Their nocturnal habits and remote breeding grounds makes this species population trends particularly difficult to study. It is critical to find robust and accurate methods to measure population stability and thus, understand the conservation needs of 'ua'u on Maui. The objective of this study is to combine radar and passive acoustic survey data from eastern Maui to determine how, and if populations of 'ua'u are changing. Using an ornithological radar at 8 sites in eastern Maui in 2001, 2021 and 2022, we found 'ua'u passage rates among sites were highly variable (20-656 targets per sample night); with the mean number of targets lowest in 2001 and highest in 2021. Acoustic surveys in a managed area of leeward Haleakalā in 2014, 2017 and 2020, found a dramatic increase in 'ua'u calls over time. Together, radar and acoustic survey results suggest that conservation efforts are having a positive effect and they support that 'ua'u populations in eastern Maui are at least stable, if not increasing. Consistent, long-term survey data will identify population trends and help better focus our search for unknown seabird breeding areas and target conservation efforts. In this study, the combined ongoing use of both survey methods will increase our toolkit, giving us a more robust population assessment of 'ua'u on Maui.

## CHARACTERIZING ARCTIC SEABIRD BYCATCH IN EASTERN CANADA

### Allison Anholt

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## Abstract

The global Arctic is an emerging area of study for fishery impacts on seabird populations. Opportunities for fishing in the Arctic have increased and are expected to continue to grow as a result of retraction of summer sea ice, shifts northward of targeted fish species, and increased fishing infrastructure. With this increase, the risk to Arctic-breeding seabirds from fisheries bycatch is likely to increase as well. In the eastern Canadian Arctic, one of the fisheries operating in Baffin Bay and Davis Strait targets Greenland Halibut (Reinhardtius hippoglossoides) utilizing trawlers and gillnets. This study characterizes seabird bycatch data obtained from onboard fisheries observer programs between 2010-2019 in the Baffin Bay and Davis Strait region (NAFO fishery regions 0A and 0B). Observer coverage was nearly 100% across all years in 0A, and averaging 10% in 0B. 0A During the observation timeframe, Northern Fulmars (Fulmarus glacialis) constituted the majority of the individuals caught (76% of recorded observations, n=620 individuals). Four other species were recorded, including three shearwater species and Iceland gull (Larus glacoides), with 815 individuals bycaught across all avian species. An additional 19% of observed individuals were not recorded to the species level. 81% of seabird bycatch occurred between August 15-October 15 across years, with substantial annual variability. While this effort represents the most comprehensive characterization of seabird bycatch in this region, inconsistent data reporting, lack of species-level identifications, and difficulties obtaining spatially-explicit corresponding fisheries effort data all hinder efforts to comprehensively assess risk to seabirds through fishery operations in the region.

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## INTERACTIONS OF PREY ABUNDANCE, PREY QUALITY, AND PREDATOR DISTURBANCE FOLLOWING AN ECOSYSTEM RESET IN THE GULF OF ALASKA

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### Abstract

The 2014-2016 Pacific marine heatwave precipitated an unprecedented Common Murre die-off signaling a collapse of the forage community in the northern Gulf of Alaska. To document immediate and lingering impacts on seabirds and forage fish in the region, we repeated at-sea and colony-based surveys in lower Cook Inlet, Alaska during 2016-2022. We found that the impacts of the heatwave on seabirds and their forage base were severe and extended several years beyond the heatwave. Compared to baseline data (1995–1999), we observed declines and increased variability of colony attendance and productivity across bird species and colonies. We also documented frequent and prolonged disturbance by avian predators as a significant factor contributing to murre breeding failures. Although fish biomass indices were relatively high during the peak heatwave year (2016), the forage community was largely dominated by low-quality age-0 fish. During 2019 we documented a moderate improvement in abundance and quality of forage fish in the system, however, a second severe heatwave occurred that year and high disturbance levels were still impeding breeding success at the colony. After a return to relatively cooler conditions, during 2022 there were signs of improvements in forage abundance and quality in the system along with greater at-sea densities of birds, increased hatching success, productivity, and resilience to disturbance. Continued monitoring of seabird, forage fish, and marine habitat in lower Cook Inlet will facilitate better understanding of complex predator-prey interactions in response to rapidly changing conditions in the northern Gulf of Alaska.

# ECTOPARASITE COMMUNITY ASSEMBLAGES OF LARIDS FROM AN OUTBREAK OF AVIAN BOTULISM

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#### Abstract

Feathers provide niches that support diverse communities of ectoparasites including feather mites, feather quill mites, feather lice, ticks, and sticktight fleas. As ectoparasites interact with their host's skin, feathers, and blood, they are exposed to the host's microbial infracommunities. Clostridium botulinum is a ubiquitous bacterium that, in some conditions, produces a lethal neurotoxin (BotN/C) with pathogenic consequences. Avian Botulism is considered the causative agent for an avian die-off event that impacted larid seabirds on Middleton Island, Alaska in 2021. Here, we compare the ectoparasite communities on those birds to conspecific hosts collected under non-die-off conditions in 2016 from other colonies. To evaluate the ectoparasites, we washed individual bird carcasses with soap and strained the "ectowash" water through a 50-micrometer sieve into 90% ethanol. We inspected samples under a stereoscope and sorted arthropod ectoparasites into morphospecies, which we then counted. Our analysis for Blacklegged Kittiwakes (Rissa tridactyla, BLKI) indicate healthy BLKI carried larger abundances of ectoparasites (p-value=0.027, t-test), but 2021 birds contained more diverse communities (pvalue=0.018, t-test), exhibiting higher evenness. Further, we could discriminate among the ectoparasite communities of diseased vs. healthy birds with 93% accuracy. Three of the seven feather mite species contributed to the successful differentiation among the two groups of BLKI. Results of other larid species in our samples, and ectoparasite taxonomic group identifications will be explored further. This research presents prospects of Avian Botulism testing using ectoparasites, a novel and non-invasive method for collecting samples from seabird colonies.

## COMPETITIVE INTERACTIONS BETWEEN NESTING SEABIRD SPECIES MEDIATE THE POPULATION IMPACTS OF RAPID CONTEMPORARY SEA LEVEL RISE

#### Daniel Barton

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#### Abstract

Observing and predicting impacts of contemporary climate change on populations is a focus of contemporary ecological research. Single-species models of population response to shifting abiotic factors, including temperature, precipitation, and sea-level, have been widely and quickly adopted to attempt to predict the effects of climate change. The extent to which ecological interactions between species may mediate the effects of climate change has remained less explored, perhaps with the exception of climate-driven phenological mismatches and declines in resource bases for consumers. Here I show that competition for nest sites between Double-crested Cormorant (*Phalacrocorax auritus*) and Caspian Tern (Sterna caspia) mediates the effects of rapid contemporary sea level rise on nesting success. I monitored a mixed seabird colony in Humboldt Bay, California, from 2019-2022 using a combination of drone surveys and remote cameras, and created a <3 cm absolute accuracy digital elevation model of the colony relative to the local tidal datum. Humboldt Bay is experiencing very rapid local sea level rise (>4 mm/yr), partly due to plate subsidence. Due to asymmetric interference competition and increasing numbers of cormorants, displaced terns nested lower at Sand Island, in Humboldt Bay, California, resulting in complete reproductive failure via flooding for this species in both 2021 and 2022, while cormorants, nesting higher on the island, enjoyed substantial reproductive success. I demonstrate that competitive interactions can play a major role in mediating the impacts of contemporary sea level rise, and suggest this may be a more general phenomenon.

# THE IMPACTS AND INTERACTIONS OF HUMAN DISTURBANCE ON REPRODUCTIVE SUCCESS IN WESTERN GULLS

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#### Abstract

Human disturbances can negatively affect wildlife by causing stress, altering behavior, or even impacting populations through changes in survival or productivity. Colonial-nesting seabirds are of particular concern due to population declines and their gregarious and conspicuous nature, which may attract human visitors. However, the effects of nearby human activities, though frequently negative, could be neutral or even positive through phenomena like habituation to human activities or subsidization by human-supplied food sources. I tested for anthropogenic disturbance impacts by comparing reproductive success at two colonies of Western Gulls with different exposure to human activity and proximity to food subsidies. I estimated nest success and fledging success and observed parental care behaviors at 110 nests from May – September 2022. Differences between colonies may indicate that Western Gulls' reproductive success is impacted by proximity to human activity, with potential longterm implications. Preliminary results of proportionate nest success suggest that the colony with lower exposure to human activity had higher success (0.816) than the more frequently exposed colony (0.583). I will present results from logistic exposure models testing whether observed differences can be explained by colony, parental attendance, or other variables. These findings can support managers charged with the protection of marine wildlife in creating reasonable and effective guidelines for visitors.

# A REVIEW OF CALIFORNIA NATURAL RESOURCE DAMAGE ASSESSMENT SEABIRD RESTORATION PROJECTS OVER THE DECADES

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## Abstract

The California coast has been impacted by a series of oils spills and hazardous releases for decades. These anthropogenic events resulted in wide-spread impacts to seabird populations both in California and beyond including other Countries. Through innovative thinking and dedication-Natural Resource Damage Assessment professionals from both State and Federal agencies were able to achieve groundbreaking settlements with companies responsible for the damages and implement a suite of widereaching and diverse restoration projects that have resulted in significant benefits for seabird populations breeding along the California coast. This talk will highlight the approaches used to achieve the settlements and review the diverse array of restoration projects implemented.

# TURNING OFF LIGHTS SIGNIFICANTLY REDUCES LEACH'S STORM-PETREL (HYDROBATES LEUCORHOUS) STRANDINGS

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### Abstract

Leach's Storm-Petrels (*Hydrobates leucorhous*) are small, threatened seabirds whose population is declining sharply. Anthropogenic light likely contributes to this decline, as many nocturnal procellariiforms are attracted to coastal lighting. Light attraction can result in stranding on land, leading to injury and mortality. Conservation methods such as reducing artificial light at night (ALAN) have been proposed to reduce Leach's Storm-Petrel strandings, but few studies have examined the effectiveness of this tactic. Thousands of Leach's Storm-Petrels reportedly strand each year at a brilliantly-illuminated fish processing plant adjacent to the species' largest colony on Baccalieu Island, Newfoundland and Labrador, Canada. Throughout the breeding season, we tested the effects of broad-spectrum LED lights and environmental factors on the number of stranded individuals. Turning off the lights significantly reduced Leach's Storm-Petrel strandings, breeding adults frequently stranded throughout the entire breeding season. These results emphasize the need for widespread reduction of anthropogenic light.

# AVIAN INFLUENZA (H5N1) AND A MARINE HEATWAVE SPELL REPRODUCTIVE DISASTER FOR NORTHERN GANNETS AT THEIR SOUTHERNMOST COLONY

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### Abstract

During 2022, Highly Pathogenic Avian Influenza A (H5N1) devastated seabird colonies throughout the North Atlantic Ocean. Sick and dying seabirds infected with H5N1 began showing up on the west coast of Newfoundland in May 2022. The virus was thought to have been transmitted by Northern Gannets (*Morus bassanus*) from the Magdalen Islands and radiated across the south coast of Newfoundland. H5N1 reached Cape St. Mary's, the gannets' largest colony in Newfoundland in July. Then in early August, a marine heatwave hit, similar to a previous ocean warming event that impacted the gannets' reproductive success. We investigated the effects of avian influenza coupled with added stress of a marine heatwave on gannet breeding success in the species' southernmost breeding colony. We found that breeding success was the lowest on record since the 1970s, which at 17% is unsustainable for population resilience. Reproductive failure and mortality peaked in August, coinciding with the onset of the marine heatwave, which likely exacerbated the effects of the H5N1 epidemic. In the face of ocean climate change, we anticipate continued severe interactive effects between H5N1 and predicted extreme weather events.

# GENETIC POPULATION STRUCTURE OF ATLANTIC PUFFIN (*FRATERCULA ARCTICA*) BREEDING COLONIES IN ATLANTIC CANADA

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#### Abstract

The Gulf of Maine (GOM) is warming faster than most of the global oceans and is home to the southernmost breeding sites of Atlantic Puffins (Fratercula arctica; "puffins"). Dispersal is one mechanism of responding to changing environmental conditions. Dispersal among GOM breeding colonies, which are substantially smaller than colonies to the north, has been documented using markrecapture. However, connectivity between GOM colonies and larger, northern colonies in Atlantic Canada is unknown. We used ddRAD sequencing to characterize genetic diversity within puffin breeding colonies and genetic differentiation between colonies. Puffin blood samples were collected from Machias Seal Island (MSI), the largest GOM colony, Witless Bay, Newfoundland (WB), James Island, Newfoundland (JI), Île de la Maison, Quebec (QC), and Betchouane, Quebec (QC). We found that puffins within each colony were genetically diverse and there was no evidence of inbreeding. MSI puffins formed a distinct genetic cluster from WB, JI, and QC using PCA. Pairwise-F<sub>sT</sub> values showed small but significant differentiation between colonies (0.001 - 0.011), with the greatest differentiation observed between MSI and all other colonies. These results suggest puffins nesting in the GOM are genetically differentiated from northern colonies, with F<sub>st</sub> values consistent with differentiation seen in other marine species. This genetic differentiation could result from drift; MSI is a smaller colony that grew rapidly since the 1800s. GOM birds experience warmer waters and feed on different prey than northern colonies; future research should examine if genetic patterns are associated with environmental gradients or if GOM birds are locally adapted.

# SEABIRD COLONY REGISTRY FOR EAST ASIA

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## Abstract

After the World Seabird Conference in 2021, the Seabird Working Group of the East Asian Australasian Flyway Partnership (EAAFP) started to compile a simple inventory of seabird breeding sites (and some important staging sites) from Japan to Indonesia. The first draft was completed and the results launched at the Year of the Tern webinar on 1 July 2022. A total of 762 sites were listed, with input from 41 ornithologists and conservationists from 12 countries and regions. The number of sites in this first draft is expected to increase in future revisions: new sites will likely be added and some existing sites possibly subdivided into smaller units. The registry will serve as a baseline for the identification of potential future seabird protected areas, for mapping areas unsuited for such developments as ocean wind farming, and for monitoring of seabird populations in eastern Asia. The species recorded at the greatest number of sites in Northeast Asia was the Black-tailed Gull, and in South East Asia Black-naped Tern and Bridled Tern.

# SOUTHWESTERN BORDER? THE THREATENED BREEDING COLONY OF STREAKED SHEARWATER IN COTTON ISLET, TAIWAN

#### Han-Po Chang, Chung-Hang Hung, Hsiao-Wei Yuan

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#### Abstract

Seabirds around the world, especially Procellariiformes, facing survival crisis, including habitat degradation, invasive predators, and human disturbance. Hence, conservation acts should be involved to pinpoint main threats of target population and cease the declining trend. In 2010, a small breeding population (4.91±3.06 pairs/year, n=11, 2018-2019 data unknown) of Streaked shearwater (Calonectris leucomelas) were first recorded on Cotton islet, to the northeast of Taiwan. However, there were no further attention and conservation action on Streaked shearwater in Taiwan. Since the obvious decline of breeding population in the West Pacific and being rated as Near Threatened (NT) in IUCN red list, proper conservation strategies are crucial for sustainability of Streaked shearwaters on Cotton islet in Taiwan. Previous observation showed that low breeding success (1.00±0.22 chicks/year, n=11, 2018-2019 data unknown) of Streaked Shearwater was likely due to Norwegian Rat (Rattus norvegicus) predation on Cotton Islet. The main actions of conserving Streaked Shearwater on Cotton Islet will focus on the following topics: (1) rodent eradication, (2) breeding ecology, (3) population dynamics. As the only species of Procellariiformes breeding in Taiwan recent years, we started to eradicate rats on Cotton Islet, and prepared to reevaluate the protected species level of Streaked Shearwaters. Additionally, we look forward to not only saving the population on Cotton Islet, but also to benefit other seabird relatives that used to breed on islets near Taiwan in the future.

# THE CRESTED MURRELET POPULATION THREATENED BY DOMESTIC CATS ON MARA ISLAND, KOREA

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### Abstract

The Crested Murrelet (Synthliboramphus wumizusume) is one of the rarest and most threatened Alcid seabirds only breeding on uninhabited islands in Korea and Japan. However, the murrelets on Mara Island, one of four known breeding sites in Korea, have been threatened by introduced cats (*Felis catus*) but detailed information on their population size and predation risk by cats and other predators are unknown. Based on nocturnal at-sea counts in 2018, the breeding population size was estimated to be 225 pairs (95% CI: 70-410 pairs). This result indicates that the island hosts the second largest colonies in Korea, occupying 5-8% of the global population. There were a total of 20 free-ranging and reproductive adult cats in 2017, and telemetry data and trail cameras indicated that at least five cats, as well as Brown Rats (*Rattus norvegicus*), were active at the murrelet colonies. Carcass surveys suggested that the murrelet mortality by cats was 24 adults (16-48 birds) per breeding season. We simulated various scenarios with the known predation rate in the population viability analysis (PVA) for domestic cats and Crested Murrelets. PVA results indicated that the murrelets would decrease in all scenarios and probably extinct in 20 years if the cat population size would be greater than 80. However, as of 2022, the number of cats on the island seems to be more than 120, and the cat population must be actively controlled immediately for the long-term conservation of the unique and threatened murrelets on Mara Island, Korea.

# HEARING THE SIGN OF RECOVERY: PASSIVE ACOUSTIC MONITORING OF STREAKED SHEARWATER ON COTTON ISLAND, TAIWAN

#### An Chou, Chung-Hang Hung, Hsiao-Wei Yuan

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#### Abstract

On the northeast side of Taiwan, Cotton Island has a historical record of large seabird colonies (Brown Booby, Bridled Tern) in 19 A.D. However, the island was occupied by fishermen and livestock in 1986, and habitat loss and invasive rodents eliminated the seabird colonies quickly. In 2010, a small breeding population of Streaked Shearwater (Calonectris leucomelas) was rediscovered, and the rodent control project was conducted in 2021. However, their population size and life history remain unknown. Compared to traditional methods such as point count surveys, passive acoustic monitoring (PAM) is suitable for nocturnal, burrow-nesting seabirds which live on remote islands. Many studies show that there are a lot of applications of PAM in seabirds, such as rare species detection, population trend estimation, and outcomes monitoring. In this study, we use five autonomous recording units (ARUs) to determine the calls of Streaked shearwater on Cotton Island, Taiwan, in March 2022. The objective is to find their daily, seasonal activity patterns and breeding population by temporal calls. We used a pythonbased audio source separation tool, the soundscape\_IR (Sun et al., 2022), to extract our target sound from the soundscape using a decomposition algorithm. We collected over 8100 audio files and recorded more than 1300 hours of valuable data. The massive data was still waiting to be analyzed. We expected that the ARUs and acoustic identification technique would help clarify and track the colony changes of Streaked Shearwater over time.

# BREEDING POPULATION STATUS, DISTRIBUTION, AND TRENDS OF THE DOUBLE-CRESTED CORMORANT IN NORTHWEST MEXICO

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## Abstract

The Pacific Coast population of the Double-crested Cormorant (Nannopterum auritum albociliatus) covers a large geographic range and spans political boundaries from Canada to Mexico. Many cormorant populations suffered heavy pressure from European colonization in the early 20th century, but those in Mexico were less impacted. Since then, cormorant populations in northwest Mexico have undergone significant declines due to threats including contaminants, human disturbance, invasive species, and forage fisheries collapse. In 1995, researchers completed the first status assessment on the Pacific Coast of North America for cormorants, but data from Mexico were outdated and incomplete. Recent population assessments omit Mexico from their estimates due to a lack of readily available data. To fill this knowledge gap and better understand the status and trends of cormorant populations, we compiled historic and current data from unpublished and published sources. We created a catalog of the breeding distribution and abundance of cormorants in northwest Mexico. We calculated population trends for sites with long-term monitoring data by estimating annual population growth rates, fitting a power law to the number of breeding pairs at each colony. Results indicate a mix of colonies that are increasing, decreasing, or stable. Overall, cormorant populations in the region have not recovered to historic levels as threats continue. To ensure the long-term health of cormorant populations across their range, managers must consider the status of the Mexican portion of the population when undertaking lethal management actions as they may have impacts at the Pacific Coast population scale.

# INTEGRATION OF ANIMAL PERSONALITY IN SEABIRD CONSERVATION: A BIBLIOMETRIC INVESTIGATION

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### Abstract

Consistent individual differences in behaviour, termed animal personality, are a widespread phenomenon with important consequences for fitness, natural selection, and trophic interactions. Animal personality research may prove useful in several conservation contexts, but which contexts remains to be determined. We conducted a structured literature review combining search terms for animal personality and various conservation subfields. We scored the relevance of both personality and conservation issues for the 654 studies found by the search to identify which studies meaningfully integrated the two fields as opposed to surface-level connections or vague allusions. Across taxa, invasive species and climate change were by far the most abundant conservation subfields that occurred in our search, though a substantial proportion of these papers weakly integrated conservation and animal personality. Of the 243 papers that were relevant to both animal personality and the conservation subfield, 11 studied seabirds (4.5%). The conservation topics covered in these papers included climate change, overexploitation, invasive species, nuisance disturbances, and pollution, suggesting a wide range of applications for personality to seabird conservation. Based on our results, we first recommend that researchers strive for consistent and broadly applicable terminology when describing consistent behavioural differences to minimize confusion and to improve the searchability of research. Second, we identify several gaps in the reviewed literature for personality traits and conservation subfields that appear to be promising avenues for future seabird research. Finally, we recommend ways that practitioners can begin informing future seabird conservation efforts with knowledge gained from animal personality research.

# INVESTIGATING ALEUTIAN TERN BREEDING SEASON MOVEMENTS USING SATELLITE TELEMETRY

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### Abstract

The number of Aleutian Terns (Onychoprion aleuticus) at known breeding colonies in Alaska have declined dramatically over the last several decades. Unfortunately, conservation planning is limited by the lack of information on nesting site fidelity, new colony formation, and within breeding season dispersal. At two sites in Nome, Alaska, we fitted eight Aleutian Terns with 2g satellite telemetry tags during the 2022 breeding season. Five tagged terns displayed site fidelity to their capture location, remaining in the Norton Sound region south of Nome, with the maximum distance from their respective capture sites ranging from 130 to 170 km. Two tagged terns moved further south to the mouth of the Yukon River, covering distances ranging from 230-340 km. One tagged individual moved north approximately 200 km through the Bering Strait, and spent most of the breeding season near Shishmaref Inlet. Three terns spent considerable time onshore (7-43 days) in the vicinity of previously documented colonies suggesting that they may have attempted renesting after nest failure at their tagging site. This project was a continuation of a study in which 37 Aleutian terns were satellite tagged at colonies around Dillingham, Yakutat, and Kodiak Island in 2017-2019. Combined, these results will help us determine the extent to which the spatial or temporal scale of breeding season movements might differ among geographic regions, and inform the development and interpretation of the regionally based, multi-year statewide survey plan in Alaska that is currently underway.

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## FRAMEWORK FOR ASSESSING AND MITIGATING THE IMPACTS OF OFFSHORE WIND ENERGY DEVELOPMENT ON MARINE BIRDS

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## Abstract

Offshore wind energy development (OWED) is rapidly expanding globally and has the potential to contribute significantly to renewable energy portfolios. However, development of infrastructure in the marine environment presents risks to wildlife. Marine birds in particular have life history traits that amplify population impacts from displacement and collision with offshore wind infrastructure. Here, we present a broadly applicable framework to assess and mitigate the impacts of OWED on marine birds. We outline existing techniques to quantify impact via monitoring and modeling (e.g., collision risk models, population viability analysis), and present a robust mitigation framework to avoid, minimize, or compensate for OWED impacts. Our framework addresses impacts within the context of multiple stressors across multiple wind energy developments. We also present technological and methodological approaches that can improve impact estimation and mitigation. We highlight compensatory mitigation as a tool that can be incorporated into regulatory frameworks to mitigate impacts that cannot be avoided or minimized via siting decisions or alterations to OWED infrastructure or operation. Our framework is intended as a globally-relevant approach for assessing and mitigating OWED impacts on marine birds that may be adapted to existing regulatory frameworks in regions with existing or planned OWED.

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# DIFFERENTIAL RESPONSE OF SEABIRD SPECIES TO WARM- AND COLD-WATER EVENTS ALONG THE SEWARD LINE IN THE NORTHERN GULF OF ALASKA

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## Abstract

We surveyed seabirds at sea as a component of multidisciplinary oceanographic studies during spring 1998–2019 along the Seward Line, a 220-km transect across the shelf and slope in the northern Gulf of Alaska. To evaluate how seabirds responded to temperature fluctuations, including a protracted marine heatwave, we examined temporally-changing distributions of seabirds across the shelf and slope and evaluated relationships between water-mass properties and seabird abundance. Environmental factors associated with abundance include depth, water-column temperature and salinity, and surface-current velocities. Environmental responses of alcids and gulls contrast with those of tubenoses, suggesting a possible shift in community composition under future climate warming. Changes in seabird distribution and abundance associated with a shift from cool to warm conditions were especially pronounced over the middle- and outer-shelf domains, which are transitional between coastal and oceanic water masses. Tubenoses increased over the middle and outer continental shelf during and after the heatwave, whereas alcids and gulls redistributed to inshore habitats. These spring at-sea observations were concurrent with, or preceded, reproductive failures of murres and kittiwakes and the mass-mortality of murres during the heatwave. Tubenoses appear well-adapted to periods of lower productivity during warming events because of their flight efficiency, allowing them to search widely to locate prey patches. In contrast, alcids, which forage by diving and have energetically-expensive flight, appear sensitive to such conditions. Consequentially, continued warming in the northern Gulf of Alaska may result in more surface-feeding tubenoses such as fulmars and storm-petrels and fewer diving-feeders such as murres and puffins.

# CONSERVATIVE OR BOLD, WHICH FEMALE BREEDING STRATEGY IS ADVANTAGEOUS UNDER NORMAL AND WARM OCEANOGRAPHIC CONDITIONS?

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## Abstract

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Because seabirds occupy marine environments with highly variable productivity, low reproductive effort, and longevity play an important role in their reproductive success. Rasa Island, in the Gulf of California, is the nesting site of 95% of the world's Heermann's Gull (Larus heermanni) breeding population. During years with anomalously warm sea surface temperature (SST), the reproductive strategy in the population is to avoid breeding until normal conditions (favorable food availability) exist. In this study we asses this pattern at the individual level. We used data of females banded between 1984 and 1993, and recaptured between 1989 and 2013 and data of SST from remote sensors. We identified two different strategies; females who laid eggs and raised chicks during normal and anomalously warm years (15% of the individuals in the sample: bold females), and females who laid no or very few eggs, and raised no chicks in anomalous years (85% of the sample individuals: conservative females). Bold females live significantly shorter lives, and lay significantly fewer eggs in their lifespan than conservative females. Conservative females live significantly longer, and produce significantly more eggs throughout their lifespan. Nevertheless, there was no significant difference in the total number of chicks fledged between females of both strategies. These strategies are adaptive and our results suggest that they are maintaining a balance in the population. Questions about the future, if these warm anomalies become more frequent, are open. Perhaps bold females may have a selective advantage over the conservative ones.

# A PRELIMINARY REVIEW OF PREDATOR ACTIVITY ON LEEWARD HALEAKALĀ, MAUI, HAWAI'I USING GAME CAMERAS AT LEGHOLD TRAP LOCATIONS

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### Abstract

Haleakalā towers over the island of Maui at 10,023 feet in elevation, with five different climate zones. The upper elevations are home to a marvel of nature, the federally endangered 'ua'u, Hawaiian Petrel (*Pterodroma sandwichensis*). Maui Nui Seabird Recovery Project (MNSRP) monitors and protects 'ua'u in the Nakula Natural Area Reserve and Kahikinui Forest Reserve, which are located in the sub-alpine climate zone with lava rocks, cinder, native shrubs, and trees blanketing the terrain. This area provides great habitat for breeding 'ua'u, however, feral cats (*Felis catus*) and other invasive mammal predators that harm the native ecosystem have also made this place their home. MNSRP and project partners Auwahi Wind, a joint venture of AEP Renewables and BP Wind Energy, collaborate on predator trapping, including but not limited to padded leg hold traps, often accompanied with game cameras. We have previously reported on the limitations of conventional predator control. Here we present preliminary data and important anecdotes on our trapping and game camera methods. In 2023, MNSRP will scale up predator control efforts, and begin standardized monitoring of traps, as suggested by Kelsey et al. (2019). Maui Nui Seabird Recovery Project aims to protect, restore, and preserve the seabirds of Hawai'i and their habitats. We give thanks to these seabirds, as they helped with the navigation of native Hawaiians to this land, and contributed to the formation of nutrient rich soils in the Hawaiian Islands.

# MONITORING MARINE BIRD DISTRIBUTION AND ABUNDANCE IN RESPONSE TO LNG TANKER TRAFFIC

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### Abstract

In 2021, Gitga'at LGL Environmental Services Ltd. commenced a multi-year program to conduct vesselbased surveys for marine birds and marine mammals within the Gitga'at Marine Use Planning Area (MUPA) on the north coast of British Columbia. The overall purpose of the program is to assess the potential effects of tanker traffic during shipping operations for the LNG Canada Project. This project is proposing between 170 and 350 LNG carrier visits per year, resulting in approximately 1-2 large vessel transits each day. Assessing the effects of vessel traffic on marine species is challenging given the inherent natural variability in marine bird and mammal distribution and abundance. This is further compounded by other potential sources of anthropogenic disturbance including other large vessels (i.e., cruise ships, ferries, and cargo vessels), recreational boats, and fishing vessels. To address these challenges, a pilot program was completed in the latter half of 2021 to establish a robust study design that maximized the accuracy and precision of data on the distribution and abundance of marine species in the MUPA. In April 2022, monthly surveys commenced as part of the baseline data collection for the program. Future monitoring will be completed over a 30-year time period with vessel-based surveys occurring monthly for the first three years, and then monthly every five years thereafter. This paper presents the marine bird monitoring results for the first year of baseline data collection as well as the methods and challenges faced.

# THE INFLUENCE OF WESTERN GULL PERSONALITY ON NEST SITE LOCATION AND REPRODUCTIVE SUCCESS

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### Abstract

Personality studies (i.e., spectrum of bold vs. shy) are essential for understanding individual and grouplevel processes like foraging behavior and habitat use while foraging in seabirds, where specific traits may confer a greater level of fitness than others. The present study uses a novel object test to measure the boldness of western gulls (*Larus occidentalis*) with known breeding histories at multiple sub-colonies on the Farallon Islands in central California. Here, we measured gull boldness by presenting 41 birds (24 nests) with a novel object and recording responses. Overall, 73 novel object tests were conducted with some birds tested one to four times. We used GPS loggers to get the nest locations for our 24 focal nests and the locations of neighboring nests within 5 and 3m. Our results suggest that western gulls mate assortatively where both partners of a pair share the same level of boldness. The long-term average (3year) of chicks fledged per pair was positively correlated with the shyness of the shyest mate of a pair. Similarly, boldness also varied across sub-colonies on the island, and the degree of which boldness influenced long and short-term breeding success of pairs within these plots. Overall, our results expand the current knowledge of mechanisms that putatively influence mate choice, habitat selection for nesting, and how these factors may contribute to changes in the population of a colonial seabird species.

# TEMPORAL TRENDS OF BROWN PELICAN ATTENDANCE AT INLAND LAKES IN SOUTHERN CALIFORNIA IN RELATION TO OCEANOGRAPHIC CONDITIONS

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### Abstract

Brown Pelicans within California (Pelecanus occidentalis californicus) are a familiar sight to see along the coast and beaches of southern California year-round. Other than the Salton Sea, it is uncommon for Brown Pelicans to roost or forage at inland, freshwater lakes. Through data collection from local bird enthusiasts, we detected that there are some years where Brown Pelicans are found in high numbers at inland lakes. As Brown Pelicans rely on marine resources, this flux inland may be driven by oceanographic conditions that affect prey availability, such as El Nino Southern Oscillation (ENSO) and increases in sea surface temperature (SST) due to anthropogenic climate change. We used data collected through the eBird mobile application and analyzed Brown Pelican observations at lakes within Southern California to test whether inland lake occurrence has increased over time. To investigate the potential drivers of years when Brown Pelicans move inland, we used eBird observation data, along with BeachCOMBERS mortality data, compared with Multivariate ENSO Index (MEI) and SST. Our results indicate that Brown Pelican attendance at inland lakes varies over years, but may have increased over time (2000-2022). The research aims to quantify temporal trends in Brown Pelican occupancy at lakes and the relationship between oceanographic conditions. The trend and potential drivers of Brown Pelicans traveling to inland lakes may reflect conditions in their associated food web and could be used as an indicator of Brown Pelican population health in this region.

# COMPARING THREE HIGH RESOLUTION SATELLITE IMAGERY PLATFORMS TO CENSUS NESTING PACIFIC ALBATROSS.

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### Abstract

The conservation status of all species is highly dependent on abundance data which are often limited in geographic or temporal scope. Very high-resolution satellite imagery provides a means to address geographic limitations and count large colonial species. We used previously validated WorldView-2 (0.46 m), WorldView-3 (0.31m) satellite imagery and tested the utility of Pléiades Neo (0.30m) satellite imagery to count three species of nesting albatrosses (*Phoebastria immutabilis, P. nigripes, P. albatrus*) at multiple sites in the Northwest Hawaiian Islands and Japan. In particular, annual colony counts from the *P. albatrus* colony on the Senkaku Islands are needed to inform the Endangered Species Act downlisting process. Obtaining images of the Senkaku Islands has been challenging due to geopolitical competition for satellite resources in the region, however new high-resolution satellites make this more feasible. Here, we present whole island censuses of the near- globally threatened *P. nigripes* and the endangered *P. albatrus*. We compare the counts between two observers and estimate intra-observer error. Our next step is to incorporate new data and satellite platforms (Pléiades Neo) into an existing model of paired ground and satellite images to account for image and habitat covariates. With sufficient calibration, we demonstrate that very high-resolution satellite imagery can be used to satisfy monitoring objectives constrained by time, funds, and accessibility.

# DOCUMENTING THE UNIMAGINABLE: LONG-TERM SEABIRD MONITORING IN AN AGE OF EXTINCTION

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### Abstract

At the 1972 Western Society of Naturalists meeting, where the Pacific Seabird Group was first proposed, there was a talk on the recent discovery of a small colony of Mandt's Black Guillemots on Cooper Island, Alaska. The species is one of the few seabirds dependent on the cryopelagic ecosystem associated with Arctic sea ice. No one at the 1972 meeting could have imagined that rather trivial observation would lead to an ongoing 47-year study, or that at the 50th annual meeting of PSG there would be a talk on the extinction of that colony. This is that talk.

Provision of nesting cavities in the 1970s and 1980s saw the colony increase from ten pairs in 1972 to >200 pairs in the late 1980s, with high immigration rates indicating a large and healthy regional metapopulation. Beginning in 1990, however, a series of atmospheric and oceanographic shifts and trends caused a steady decline in the guillemot's sea ice habitat resulting in decreased immigration, breeding productivity and adult survival. In 2022, the colony had <30 breeding pairs, none successful, and adult overwinter mortality was three times the long-term mean. Importantly, a complete lack of immigration in 2022 indicates source colonies are also now greatly reduced in numbers and productivity. The continuing reduction of sea ice due to fossil fuel emissions melting the Arctic over the last half century has caused the quasi-extinction of the Cooper Island colony and is threatening the entire Western Arctic metapopulation of Mandt's Black Guillemot.

## SEABIRDS MONITOR A MULTI-DECADAL DECLINE IN ARCTIC COD, THE PRIMARY FORAGE FISH IN THE ARCTIC BASIN

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#### Abstract

Arctic Cod (*Boreogadus saida*) is the primary prey of Arctic piscivorous marine predators and especially important to birds dependent on the cryopelagic ecosystem associated with Arctic sea ice. Since 1979, the Western Arctic has lost 1.9 million km<sup>2</sup> of summer sea ice but the effect of this habitat loss on Arctic Cod has gone largely unnoticed; because there is no commercial fishery, there have been only minor survey attempts. With alternative prey species in the Western Arctic being few and uncommon, a 47-year study of an Arctic cod specialist, Mandt's Black Guillemot, provides a good proxy for Arctic Cod availability in the last half century. Arctic Cod were abundant in the region in the 1970s and 1980s as tens of thousands of Mandt's Black Guillemot bred at Russian colonies in the Chukchi, and provided immigrants allowing our study colony to grow from 10 to >200 pairs. A decrease in the colony began in 1990 coinciding with the start of a long-term decrease in regional sea ice. By 2022, the colony was reduced to <30 pairs, in large part due to decreased immigration—evidence of decreased size and productivity of source colonies. Changes in sea ice and SST at the study colony, also occurring at other colonies, have decreased the frequency of Arctic Cod in nestling diet with the lower quality less abundant alternative prey decreasing nestling survival and quality. Decreased guillemot overwinter survival since 2017 is correlated with reductions of Arctic Cod in the Bering Sea wintering area.

# A DEADLY ATTRACTION: BRIGHT BOATS CAUSE COLLISIONS AND PREDATION FOR LEACH'S STORM-PETRELS

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#### Abstract

Various nocturnally active seabird species are attracted to anthropogenic lights. This behavior can lead to collisions with vessels, structures, and oil platform flares. Leach's Storm-Petrels (Hydrobates *leucorhous*) are small, nocturnal, pelagic seabirds that experience the most light-related mortality in the North-West Atlantic. This threatened species has undergone an alarming decrease in their Atlantic population since the 1980s, which overlaps with an increased prevalence of nocturnally active crab fisheries and the adoption of broad-spectrum white LEDs. We investigated the impact of light pollution from fishing vessels near storm-petrel breeding colonies. Specifically, during breeding (July) and fledging (October) periods we quantified and compared collision events on commercial fishing vessels circumnavigating Baccalieu Island, the world's largest Leach's Storm-Petrel colony. For each circumnavigation we alternated the lighting on the vessel between illuminated and dark conditions. All collisions occurred during illuminated conditions when on-wing predation from Great Black-Backed and Herring Gulls was observed. The cumulative effects of collisions and predation around brightly illuminated fishing vessels is likely to be a significant source of mortality, owing to large-scale overlap in vessel and storm-petrel distributions. Our ongoing work will measure exposure to vessels and the number of storm-petrels following vessels to gauge risk and to develop realistic protocols that reduce bird-vessel collisions.

# ANNUAL HABITAT USAGE AND DISTRIBUTION PATTERNS OF THE WESTERN GULLS (*LARUS OCCIDENTALIS*) IN CENTRAL CALIFORNIA

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### Abstract

Central place foraging is a fundamental constraint in breeding seabirds, but their range and habitat use outside the breeding period is expected to change as seabirds are no longer tied to a colony. However, for coastal breeding gulls (Larus sp.) that use both marine and terrestrial habitats, their flexible foraging may reduce the need for extended migrations to more productive habitats. Here, we studied the yearround movement patterns of coastal breeding Western Gulls (Larus occidentalis) to examine how for aging range and habitat use varied throughout the year. In May 2021, breeding adult gulls (n = 17) from an island colony in central California were equipped with solar GPS tracking devices. When breeding (April-August) gulls primarily foraged in marine habitats within 52.42 ± SE 5.26 km of the colony (n = 12). Conversely, most gulls (n = 7) occupied localized areas (108.84 ± SE 41.56 km) in coastal and urban habitats around the San Francisco Bay Area region when not breeding (September – March). Overall, estimated home-ranges did not change significantly between the breeding and non-breeding phases, although three individual gulls conducted more far-ranging excursions north along the coastline during the non-breeding period. Finally, there were marked differences in habitat use throughout the year, where gulls had higher occupation of terrestrial habitats during the non-breeding period. Unlike other gull species that exhibit various forms of post-breeding migration, our results suggest that Western Gulls in central California remain in the same habitats that they exploit while breeding, without the need for expanding foraging distribution.

# LESS THAN PERFECT ATTENDANCE: AN ATTEMPT TO FILL SOME GAPS IN LEDGE-NESTER BREEDING SUCCESS MONITORING

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#### Abstract

Alaska Maritime National Wildlife Refuge has been monitoring seabird reproductive success at numerous colonies across Alaska for decades. This entails following a subsample of nests from nest initiation/egg laying to chick fledging; success is calculated as a ratio based on a prescribed sample size of monitored nests. However, the inferences we can make from these data have some limitations. The current methodology provides information on conditions during incubation and chick-rearing periods, but (for most species) rarely documents nest failures earlier in the breeding season. It also does not account for variation in the number of birds attending the colony or attempting to breed in a given year: success rate itself may be high even if only a small proportion of birds actually breed and fledge chicks. In the years following a recent marine heat wave in Alaska, we observed poor colony attendance and low numbers of nesting attempts for some species of ledge-nesting seabirds, yet relatively high breeding success ratios in the few that did breed. This led us to explore additional monitoring methods that enhance our current datasets. We began following breeding birds prior to nest initiation and egg laying to estimate success during early stages in the breeding cycle, and conducted early-season counts on fixed plots to quantify the magnitude of nesting effort. We present successes and challenges from the first three years of implementing these new methodologies for ledge-nesting kittiwakes and murres at six of our long-term monitoring sites.

# CALIFORNIA BROWN PELICAN MASS STRANDING EVENT, MAY-JUNE 2022: TIMELINE, OUTCOMES, AND RESIGHTING EVENTS

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### Abstract

Beginning May 12, 2022, unusual numbers of California Brown Pelicans (Pelecanus occidentalis) stranded along the southern California coast, and north to Monterey Bay. Stranded birds flooded wildlife rehabilitation centers, with International Bird Rescue (IBR) receiving 247 new pelicans May 12-31, plus 102 in June. To identify potential causes, testing for domoic acid (DA) toxicity and highlypathogenic avian influenza (HPAI) was completed, with negative results for both. Most birds examined via necropsy were second-year (SY) and third-year (TY) birds, and exhibited emaciation with depleted adipose tissue and atrophied skeletal muscle, others had signs of trauma. By plumage, birds received by IBR in May were 13.0% Hatch Year (HY), 37.6% SY, 23.5% TY, and 22.7% after third-year (ATY). June admissions showed a larger proportion of HY birds, with 56.9% HY, 17.6% SY, 6.9% TY, and 11.8% ATY. Arriving birds were hypothermic, emaciated, and anemic and ~25% had traumatic injuries due to fishing gear or unknown causes; 66.4% responded well to care and were released with federal leg bands and blue auxiliary leg bands. Resightings of banded BRPE from this event showed that many birds rapidly moved north after release. This event was an excellent example of coordination between California Department of Fish and Wildlife (CDFW), U.S. Fish and Wildlife Service (USFWS), and non-profit wildlife rehabilitation centers statewide. Cooperative efforts included identification that an event was occurring, rapid diagnostics to determine possible causes, and collaboration to identify support needed to provide care to the birds. Data consolidation from the event is ongoing.

# CREATING A BEHAVIOR CHANGE CAMPAIGN TO ENGAGE RECREATIONAL FISHERMEN TO PROTECT SEABIRD COLONIES ON THE CALIFORNIA COAST

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### Abstract

During the COVID-19 pandemic boat-based recreational fishermen flocked to California's Central Coast, presenting an increased risk for disturbing significant seabird colonies.

Seabird Protection Network, which seeks to reduce human disturbances to seabird colonies, is currently developing a behavior change campaign. It seeks to develop effective outreach strategies to encourage fishermen to keep at least 1,000 feet away from seabird colonies. Here, we discuss lessons learned on recreational fishermen's attitudes and practices regarding seabird colonies, and progress towards creating a campaign to engage them in conservation efforts.

Broadly applicable environmental behavior change design methods and lessons learned from extensive field surveys will also be discussed.
# AN INTERCONNECTED WORLD: TROPICAL ISLAND RESTORATION FOR SEABIRDS AND CORAL REEF ECOLOGY

#### Ruth Dunn

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#### Abstract

Natural nutrient flows have been interrupted by the decimation of island ecosystems via invasive species introductions and land-use changes. Island restoration provides opportunities for the re-establishment of seabird populations which then transfer nutrients between their pelagic foraging areas, terrestrial breeding colonies, and adjacent nearshore marine habitats. Currently, we lack knowledge of whether the prey base to support restored seabird populations exists, in addition to predictive models of the conservation gains that these techniques could provide. Here, we demonstrate that successful rat eradications and habitat restoration across an archipelago of tropical atoll islands in the central Indian Ocean could lead to 255% increases in seabird abundances (increases of over 400,000 pairs of breeding birds) and that there is ample prey to support the energetic requirements of these populations. Furthermore, the restoration of island habitats and seabird communities throughout the entire tropical Indo-Pacific region could boost nutrient fluxes, generating 419 tonnes of seabird-derived nitrogen annually. An influx of nutrients to the coral reefs encircling seabird islands could result in increased coral growth rates, reef fish biomass, and coral reef functioning (both bioerosion and grazing). Given the cross-ecosystem benefits, the restoration of tropical island ecosystems for seabirds should be a conservation priority.

# EFFECT OF OCEANOGRAPHIC VARIABILITY ON DEMOGRAPHY OF CASSIN'S AUKLET IN THE CALIFORNIA CHANNEL ISLANDS

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### Abstract

The Cassin's auklet (Pytchoramphus aleuticus) is an ecological indicator of ocean climate change for the California Current Ecosystem, a dynamic coastal ecosystem with seasonal wind-driven upwelling. Auklets are zooplanktivores and thus are more directly linked to productivity in the marine environment than predators that feed at higher trophic levels. Demographic rates and abundance have been linked to oceanographic conditions across the auklet's breeding range; however, the strength of this relationship appears to vary by latitude. The Channel Islands in the Southern California Bight, USA are a unique location to examine auklet demography due to the spatial gradient of oceanographic conditions at the transition zone of two marine biogeographic provinces. We developed an integrated population model in a Bayesian framework to evaluate oceanographic drivers of demography over a 23-year period (2000-2022) at two breeding colonies subject to different conditions within the transition zone. Monitoring data included band-recapturing data, nest-box occupancy data, and reproductive data. We analyzed survival data using an open robust design model in an individual state-space formulation, and reproductive data using a multistate daily nest survival model. Preliminary results suggest auklet populations in proximity to predictable upwelling zones are more viable. Our results underscore the utility of tracking auklet responses to ocean climate change and anthropogenically changing seascapes off southern California, and ultimately allow us to better understand auklet ecology and promote conservation efforts.

# INFLUENCE OF SEA ICE DYNAMICS ON THE MOVEMENT ECOLOGY OF AN ARCTIC SEABIRD

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## Abstract

Climate change results in sea ice loss in Arctic regions, directly impacting ice obligate or ice-associated species, including marine mammals and seabirds. Thick-billed Murres (Uria lomvia), an Arctic seabird, are considered an ice-associated species that targets sympagic Arctic Cod (Boreogadus saida). Recent findings from Iceland found Thick-billed Murres to be cold-water specialists, selectively foraging in cooler waters in fjords and along the Marginal Ice Zone and are therefore likely to be impacted by changing sea ice conditions. Additionally, as loss of sea ice in Arctic regions can influence the breeding success of murres it is important to determine how murres respond to changes in sea ice dynamics. This study aims to use high-resolution sea ice data to determine the extent murres forage near sea ice in the Canadian Arctic. To examine the movement, type, and concentration of sea ice throughout the murre breeding season (June – August), I will use the Lagrangian Ice Tracking System with satellite-derived sea ice data. To examine murre foraging behaviour, I will use previously collected murre movement data from the breeding season at one high Arctic site – Cape Graham Moore, Nunavut and two low Arctic sites - Coats Island, Nunavut and Digges Island, Nunavut. Sea ice data will be overlaid with movement data to calculate ice concentration at foraging locations. I will then use a habitat selection function to determine whether murres preferentially select to forage in areas of higher sea ice concentration and determine the proximity that murres forage to sea ice floes.

# OFFSETTING TO ACHIEVE NET POSITIVE IMPACTS OF OFFSHORE WIND ENERGY DEVELOPMENT TO SEABIRDS: TWO PACIFIC CASE STUDIES

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## Abstract

Offshore wind energy development is rapidly expanding globally, including facilities planned for development on the U.S. West Coast. Offshore wind can provide lots of zero carbon electricity but will also negatively impact some seabirds. Seabird populations are impacted by habitat displacement and collisions, but empirical quantification of these impacts is not yet possible. To facilitate the rapid development of offshore wind energy, we need to estimate and mitigate the resulting impacts to seabird populations. Impact offsetting (also known as compensatory mitigation) is a promising approach to produce net positive impacts of offshore wind energy development, but it has not yet been implemented on a broad scale. This approach is particularly promising for seabird applications because there is already a suite of proven tools to estimate population-level impacts, identify effective mitigation options, and implement them using well-established and effective seabird conservation tools. Here, we use two areas designated for offshore wind development on the Pacific Outer Continental Shelf, the Morro Bay and Humboldt call areas, as case studies to demonstrate an application of impact offsetting. We demonstrate that modeling can be used both to estimate population-level impacts and identify effective conservation actions for mitigation to achieve net positive seabird impacts in the face of offshore wind energy development.

# NEW BREEDING COLONY OF ELEGANT TERNS (*THALASSEUS ELEGANS*) IN NORTHERN CALIFORNIA

#### Susan Euing

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#### Abstract

Elegant Terns (*Thalasseus elegans*) are known to breed in a limited number of locations in Mexico and southern California. In late summer through early fall, Elegant Terns generally migrate up through N. CA, with some reaching the coast lines of Oregon, Washington and British Columbia before heading southward for the winter. A Caspian Tern colony that had been abandoned in 1999 was re-initiated in 2014 in NW Alameda Island after a 15-year hiatus. For a day or two in August of 2016 and 2017, we noted that six to ten Elegant Terns had dropped by the Caspian Tern colony during their annual northward migration. However, over 1,000 Elegant Terns showed up at this spot, and roosted with the remaining Caspian Terns and over 1,500 brown pelicans for several days in early August 2018.

The following spring, on the morning of May 9, 2019, we observed the first wave of several hundred Elegant Terns in breeding plumage arrive at the Caspian Tern nesting site in NW Alameda Island. The cacophony of vocals was fantastic, between the low raspy screech of the Caspian Tern combined with the high- pitched shriek of the Elegant Terns. The new arrivals frantically began their courtship rituals to catch up with the Caspian Terns, which were further advanced into their breeding season, and laid their first eggs shortly thereafter. Since 2019, the Elegant Terns have returned in spring to this colony site off San Francisco Bay, and successfully produced and raised offspring.

# MONITORING AND CONSERVATION ACTIONS FOR THE ASHY STORM-PETREL (HYDROBATES HOMOCHROA) ON THE TODOS SANTOS ARCHIPELAGO, MEXICO

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#### Abstract

The Todos Santos Archipelago (TSA) in Mexico has been recently confirmed as the southernmost breeding site for the endangered Ashy Storm-Petrel (*Hydrobates homochroa* - ASSP). This warranted the need to establish a baseline to evaluate its population trends. Here we present progress in monitoring and conservation actions carried out on the TSA during 2021-2022 breeding seasons. We conducted nest searches in potential habitat and selected active nests to evaluate reproductive success. To estimate CPUE as population index, we conducted mist-netting sessions to capture and band ASSP individuals. Additionally, we carried out workshops with stakeholders to formulate an ad hoc biosecurity protocol for the TSA. We recorded 53 nests in 2021 and a higher number in 2022 (75 nests). The overall reproductive success was similar in both years (68%-72%). In total, we captured 319 ASSP individuals in both years— one banded on the Channel Islands National Park—and CPUE peaked in April 2021 (3.4 individuals per hour) whereas in 2022 was in May (8.85 individuals per hour). A draft of the biosecurity protocol is now ready to share with stakeholders. This information contributes to generate insights about the population trends of the ASSP in Mexican colonies and to the global breeding population based on an established US-MX monitoring protocol. On the other hand, we are attending conservation actions established in the action plan of the ASSP.

# STATUS AND TREND OF MARBLED MURRELET AT-SEA ABUNDANCE AND REPRODUCTIVE OUTPUT OFF CENTRAL CALIFORNIA, 1999–2022

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#### Abstract

Marbled Murrelets (Brachyramphus marmoratus) have been listed as "threatened" by USFWS since 1992 in California, Oregon, and Washington. Information regarding murrelet abundance and distribution is critical for effective management, evaluation of conservation efficacy, and ultimately to meet Federalmandated recovery efforts. From 1999–present, line-transect surveys have been conducted to estimate at-sea abundance and reproductive output of Marbled Murrelets in USFWS Conservation Zone 6 (San Francisco to Point Sur, central California). Using this long-term annual time series, we developed a comprehensive analytical framework to estimate annual murrelet abundance and trend, evaluated the effectiveness of the monitoring study design, and assessed two measures of annual murrelet reproductive output (annual juvenile abundance and juvenile-to-adult ratios). We estimated an adult abundance for 2022 of 397 murrelets, similar to the long-term (1999-present) average of 379 murrelets (range 163–585 annually), and we did not detect any significant long-term trend. The long-term average juvenile abundance estimate was 13 murrelets (range: 0–31 annually), and the long-term average juvenile-to-adult ratio was 0.052. Both reproductive output metrics showed similar interannual patterns and we found no evidence of significant trends in either; however, large uncertainty in estimates made evaluation of interannual differences difficult. The CZU wildfire burned a large portion of remaining murrelet nesting habitat in Zone 6 in 2020. Despite the apparent stability in murrelet abundance at sea in this region from 1999–present, future long-term annual monitoring will be critical to determine the effects of this nesting habitat loss to murrelet at-sea abundance.

# CHANGES IN GENTOO PENGUIN NEST FORMATION DURING THE COVID-19 PANDEMIC

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#### Abstract

While most Gentoo Penguin (*Pygoscelis papua*) colonies on the Antarctic Peninsula are rapidly increasing, the population on Port Lockroy has been steadily declining in recent decades. Port Lockroy is one of the most frequently visited sites by tourists in Antarctica, but tourism ceased in the 2020 season due to the COVID-19 pandemic and resumed at a lower level than pre-pandemic in 2021. We gathered aerial drone imagery of the colony during the incubation stages of the 2018, 2020, and 2021 seasons and discovered that the population has rapidly increased from 605 to 1,024 nesting pairs during that time period. We appended spatial points to every nest, and observed that the number increased more on the portion of the island that historically experienced tourist traffic than on the side of the island where foot traffic was prohibited. In order to quantify how nest formation changed on the island at a finer scale, we plan to implement a point matching algorithm to assess the proportion of nests that remained in the same location across survey years, and quantify the distance that the matching nests shifted from year to year. We will explore how the nest patterns may have changed differently between the heavily trafficked side of the site and the off-limit side. This analysis may allow us unique insights into the effects of tourism and its subsequent decline from COVID-19 on Gentoo Penguin population dynamics.

# ASSESSING DRIVERS OF ROUTE FIDELITY IN TWO CLOSELY RELATED GULL SPECIES

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### Abstract

Urbanization has rapidly expanded in coastal areas, and understanding drivers of seabird movement foraging patterns in urban environments is key to anticipating further impacts of human development. Herring Gulls (Larus argentatus) and Great Black-backed Gulls (L. marinus) are generalist species that forage in both urban and natural habitats. Urban habitats provide reliable foraging habitats for these species, and tidal patterns can also create predictable foraging areas in estuarine habitats. Recent studies have examined the foraging site fidelity and foraging ecology of these species, but route fidelity, or the repeated use of the same flight path by an individual, has not been examined to date. We examined whether the use of predictable foraging habitats associated with urban habits or tidal patterns influenced the extent to which Great Black-backed Gulls and Herring Gulls show route fidelity. We collected tracking data from incubating Herring and Great Black-backed Gulls at four nesting colonies along an urban gradient in New York and Massachusetts from 2016 to 2022 and quantified route fidelity using Fréchet distance. We found that birds whose proportion of time spent foraging in urban habitats was greater than 0.50 showed a significant difference in route fidelity than those whose proportion of time spent foraging in estuarine habitats was greater than 0.50 after running a Wilcoxon rank test (p-value = 0.02). Foraging trip timing in estuarine habitats was closely linked with tidal patterns and higher route fidelity. Our findings highlight the importance of predictable features to seabird movement and foraging behavior.

# MERCURY CONTAMINATION OF ARCTIC MARINE SEABIRDS: PAN-ARCTIC AND REGIONAL APPROACHES

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## Abstract

Mercury (Hg) is a global pollutant, yet the Arctic harbors among the most exposed biota. Hg emitted by mid-latitude countries undergoes long-range transport to polar regions through oceanic, atmospheric, and riverine pathways. As a consequence, Hg is found in high concentrations in Arctic marine food webs and, being highly toxic, raises important environmental concerns. Seabirds, with a long lifespan and a high trophic position are among the Arctic organisms most exposed to Hg. Understanding the spatio-temporal dynamics and potential toxic effects of Hg in Arctic breeding seabirds is thus a major objective for the conservation of these vulnerable species.

In that context, the international network ARCTOX established in 2014, coordinates the collection of samples from 25 seabird species at more than 60 breeding sites around the Arctic in order to monitor their contamination by Hg at the pan-Arctic scale.

During this presentation, we will: 1) show new results from ARCTOX regarding the pan-Arctic distribution of Hg in seabirds, both during the breeding and non-breeding seasons, identifying hotspots of Hg and highlighting sensitive populations and species in which Hg concentrations exceed toxicity thresholds, requiring particular attention and protection. 2) Provide new information on selenium (Se) concentrations in Arctic seabirds. Se has a protective role against Hg toxicity, and further understand its interspecific and spatial variations is thus essential to a more complete understanding of Hg impacts on individuals and populations. 3) Focus on seabirds breeding on Saint George Island (Pribilofs, Alaska), to investigate inter-species and seasonal variations at the local scale.

# DISTRIBUTION OF WHITE-EYED GULL (*ICHTHYAETUS LEUCOPHTHALMUS*) NESTS IN THE AL WAJH ARCHIPELAGO, NORTHERN RED SEA, SAUDI ARABIA

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#### Abstract

Island nesting seabirds are the most threatened group of avian fauna and are particularly vulnerable to habitat disturbance. The White-eyed Gull nests exclusively on islands in the Red Sea and Gulf of Aden, many of which are facing anthropogenic pressure. The Al Wajh archipelago in the northern Red Sea hosts the largest population of the White-eyed Gulls in Saudi Arabia and is currently undergoing tourism development for one of the country's largest ongoing "Gigaprojects". The habitat preferences and movement ecology of the White-eyed Gull are understudied, and the species' ability to respond to rapid habitat modification is unknown. In 2021 and 2022, a ground census was conducted on all 92 islands of the Al Wajh lagoon to determine the distribution of White-eyed Gull nests. In total, 55% of the White-eyed Gull metapopulation were found on islands where development is either ongoing or upcoming, with the one of the largest and densest colonies occurring on an island already undergoing development. The baseline census presented here should be viewed as a first step in understanding the population dynamics of the White-eyed Gull and predicting their response to enhanced anthropogenic change in the Al Wajh lagoon.

# PRELIMINARY ANALYSIS OF MARINE BIRD VESSEL-BASED SURVEY DATA ON BRITISH COLUMBIA'S SOUTH COAST

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## Abstract

There is a pressing conservation need to quantify marine bird distributions and abundances in order to establish current baselines, particularly in areas of elevated importance to marine birds. In the Salish Sea and waters off the west coast of Vancouver Island, current marine bird distributions and abundances are relatively poorly known. In 2020, vessel-based marine bird surveys were initiated on British Columbia's south coast. Survey objectives include: (1) providing a quantitative baseline of marine bird distribution and abundance; (2) supporting the generation of predictive models of marine bird distribution and abundance, and; (3) informing a spatial assessment of risk with anthropogenic activities, with an emphasis on vessel traffic. To date, and acknowledging several survey cancellations due to Covid-19, over 15,000 km have been surveyed, with over 50,000 sightings collected. A preliminary Conventional Distance Sampling analysis has been completed to provide abundance estimates of four marine bird species or groups of species, including Common Murre (Uria aalge), Dark Shearwater (group made up of Sooty Shearwater [Ardenna grisea], Flesh-footed Shearwater [A. carneipes], and Short-tailed Shearwater [A. tenuirostris]), Marbled Murrelet (Brachyramphus marmoratus), and Surf Scoter (Melanitta perspicillata). For species with high sightings numbers, robust, lower uncertainty abundance estimates were generated. For certain species and seasons with low sightings numbers, abundance estimates generated tended to have very high coefficients of variation. These interim results offer insight on the future robustness of abundance estimates, variability between species, and provide new information regarding marine bird distributions and abundances in a region of conservation importance.

# FROM COLONY TO FALLOUT: IMPACTS OF ARTIFICIAL LIGHTS ON SEABIRDS ALONG COASTLINES AND WITHIN ISLAND CHAINS

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## Abstract

Seabirds are at a heightened risk of decline from multiple threats, including artificial light that results in their grounding ("fallout"). Wedge-tailed Shearwaters (*Ardenna pacifica*, 'Ua'u Kani), an abundant native seabird in the Hawaiian Islands, have experienced fallout among fledglings. Identification bands were affixed to 3,120 chicks from 2018-2020 at several O'ahu natal colonies prior to fledging to assess fallout locations in relation to natal colonies. Distances between fallout location and colony were mapped and fallout location variables (radiance, elevation, distance to coastline, road, and nearest colony) were analyzed after banded fledglings were discovered post-fallout (n = 21). Greater and more varied distances between natal colonies and fallout locations than those expected ( $\overline{x} = 24.7$  km) were observed. Additionally, fallout occurred frequently on opposite coastlines from natal colonies, with one recorded on a separate island. None of the fallout individuals came from the colony nearest to their fallout location. Modeling results indicate that fallout locations were associated with close proximity to coastlines and roads. Our results demonstrate the impact of anthropogenic lighting on fallout, and that the threat from artificial lights can extend broad distances and fallout in relation to natal colony can occur in complex patterns. Collaborative, large-scale, and multi-island light management for the duration of the fledging season is critical in recovering Pacific Island seabird populations.

# POPULATION DYNAMICS AND TRENDS OF AN ENDANGERED SEABIRD: TUFTED PUFFINS (*FRATERCULA CIRRHATA*) IN WASHINGTON

#### Olivia Fross

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#### Abstract

The Tufted Puffin (Fratercula cirrhata) is a seabird species of imminent conservation concern, currently listed as Endangered by Washington State and declining throughout the California Current Large Marine Ecosystem. Tufted Puffins in Washington have undergone widespread colony abandonment and have declined by an order of magnitude which fits into a larger observed pattern of regional range contraction. Tufted Puffin populations are predicted to continue declining in Washington due to ongoing threats from multiple anthropogenic factors and may become functionally extinct within 40 years if the current rate of decline continues. We assessed Tufted Puffin breeding population dynamics and trends from 2016 to 2022 on three active breeding sites in Washington: Destruction, Smith, and Protection islands. On Destruction Island, we conducted land-based surveys to determine colony attendance patterns, total number of burrows, burrow occupancy rates, and breeding success. We also conducted land- and boat-based surveys on Smith (boat surveys only) and Protection Islands to determine burrow locations, total number of burrows, and burrow occupancy for both populations. We are now conducting inter-annual comparisons of colony attendance, breeding population size (Destruction and Smith Islands) and breeding success (Destruction Island only). We are also analyzing burrow distribution and breeding population size on Protection Island. Of the 14 historic Tufted Puffin breeding colony sites in the Salish Sea, only Protection and Smith Islands remain active today. Tufted Puffin population size and dynamics on these critically important islands will inform future conservation planning.

# PILOT STUDY DEMONSTRATES POWERLINE COLLISION RISKS FOR ENDANGERED SEABIRDS IN MAUI COUNTY, HAWAI'I

<u>Martin Frye</u><sup>1,2</sup>, Brad Keitt<sup>3</sup>, Jennifer Learned<sup>1,2</sup>, Skye Anderson<sup>1,2</sup>, Cheryl King<sup>1,2</sup>, Mariah Rivera<sup>1,4</sup>, Joshua DeCambra<sup>1,4</sup>, Katelynn Gulley<sup>1,4</sup>, Jay Penniman<sup>1,2</sup>

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### Abstract

Endangered seabird populations on Kaua'i have declined since the early 1990s (Raine et al. 2017). Mortalities attributed to powerline collisions are likely a contributing factor in these declines for the federally listed 'ua'u (Hawaiian Petrel, Pterodroma sandwichensis) and 'a'o (Newell's Shearwater, Puffinus newelli), and the scale of the problem on Kaua'i is being revealed by novel methods and modeling (Travers et al. 2021). In 2021 and 2022, Maui Nui Seabird Recovery Project undertook a pilot study designed to provide evidence of powerline collision risks to endangered seabirds on Maui, following the methodology established on Kaua'i. We conducted visual observations along powerlines with a near infrared illuminator and night vision goggles while simultaneously using ornithological radar to determine if birds were transiting the survey area out of view of observers. We selected 20 sites, deploying automated acoustic recording units at the base of powerline poles to remotely detect strikes. Finally, we surveyed a highly searchable powerline situated in an area with potentially high risk for collisions, and documented 'ua'u carcasses under and near the wires. This pilot study demonstrates there is collision risk for seabirds on Maui; additional survey of the electrical transmission and distribution infrastructure is required to fully document the level of take. The power utility on Maui, Hawaiian Electric, has indicated willingness to perform minimization actions and to develop a Habitat Conservation Plan to mitigate mortalities caused by powerline collisions.

# DIET INSIGHTS OF A BURROW-NESTING SEABIRD USING DNA METABARCODING OF FECES AND SOIL

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## Abstract

Understanding trophic relationships can be critical for managing marine predator and prey species. DNA analysis of feces is increasingly used as a non-invasive method to uncover seabird dietary patterns across space and time. Tufted Puffins (Fratercula cirrhata) are listed as endangered in Washington, and reduced prey availability is thought to be key to its decline. However, recent information on tufted puffin diet is lacking, and opportunities for direct diet observation is limited. We conducted a pilot study to characterize tufted puffin diet on Destruction Island in 2019 using DNA metabarcoding of feces from burrow entrances and soil from burrow nesting chambers. Primers detected smelt and rockfish in all fecal samples as well as other fish taxa, squid, crab, and shrimp. Primers detected smelt in most soil samples as well as other fish, crustaceans, and terrestrial insects. DNA metabarcoding detected several taxa also identified in tufted puffin bill-loads in 2019; however, multiple taxa not identified in bill-loads were detected in fecal and soil samples. This study suggests tufted puffin diet can be characterized using DNA metabarcoding, provided fecal samples are high quality and contamination is minimized. Amplifying prey DNA from soil samples opens opportunities for sampling burrows on other islands and after breeding, minimizing colony disruptions. Future strategies to characterize tufted puffin diet may combine direct observation and eDNA methods where possible and focus on eDNA methods where observation is difficult. These non-destructive and non-disruptive methods hold promise for characterizing diet for tufted puffin and other burrow-nesting species of conservation concern.

# IS THERE HETEROZYGOSITY-FITNESS CORRELATION IN A COLONIAL SEABIRD, THE THICK-BILLED MURRE?

<u>Marianne Gousy-Leblanc</u><sup>1</sup>, Thomas Merkling<sup>1</sup>, Lila Colston-Nepali<sup>2</sup>, Emma Lachance Linklater<sup>2</sup>, Anthony J Gaston<sup>3</sup>, Grant Gilchrist<sup>4</sup>, Kyle Elliott<sup>5</sup>, Vicki L. Friesen<sup>6</sup>

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## Abstract

Understanding the genetic basis of fitness variation in a population is an important objective for ecologists. Immune-related genes, such as Toll-like Receptors (TLRs), can be important genes for individual fitness as they are central components of the vertebrate immune system and they play an essential role in parasites and disease resistance. TLRs, thus, have a direct effect on the survival and reproductive success of an individual. Heterozygosity at these genes is often correlated with high pathogen resistance, and some studies reported associations between immune genetic diversity and reproductive success. This will be particularly important in species with high parasite load, such as murres at Coats Island (Nunavut, Canada), where many birds fail breeding in years of high mosquito prevalence. Parental genetic similarity could also negatively impact reproductive success in monogamous species with long-term pair-bonds, as mate choice may strongly affect reproductive success throughout an individual's lifetime. Using seven TLRs genes and multiple years of reproduction over 169 breeding individuals, we present how individual genetic diversity and partner genetic similarity affect reproductive success in an Arctic seabird, the Thick-billed Murre (*Uria lomvia*). This project will help to understand variation in breeding success but also how individuals may select their partner in long-lived species.

# DRIVERS OF INTRASPECIFIC TROPHIC DIVERSITY IN TWO SPECIES OF TERN

Natasha Gownaris<sup>1</sup>, Jill Tengeres<sup>2</sup>, Linda Welch<sup>2</sup>

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## Abstract

Individuals within a population often differ in their responses to declining food availability. In the Gulf of Maine, breeding seabirds are experiencing climate shifts and extremes that lead to reductions in preferred prey. We used chick provisioning data and stable isotope data from five islands across three years to examine drivers of trophic diversity in Common Tern (*Sterna hirundo*) and Arctic Tern (*Sterna paradisaea*). We hypothesized that: 1) diet diversity calculated using provisioning watch data (Shannon-Wiener Index and diet evenness) would be correlated with isotopic diversity (isotopic dispersion, divergence, and uniqueness in  $\delta^{13}$ C,  $\delta^{15}$ N space); and 2) trophic diversity would be highest under conditions of low food availability (lower provisioning rates, proportion hake/herring, and prey size) and breeding success (lower chick growth rates and productivity).

Surprisingly, measures of isotopic and diet diversity were not correlated in Arctic Terns (H1). In common terns, diet evenness was positively correlated with some isotopic diversity metrics (dispersion and uniqueness) and negatively correlated with others (divergence); the Shannon-Wiener Index was not correlated with any isotopic diversity metrics. Our results highlight differences in the information provided by these two common approaches in trophic ecology. Productivity was positively correlated with isotopic dispersion and uniqueness in Arctic Terns, opposite the pattern we expected (H2). In common terns, chick growth rates were negatively correlated with isotopic dispersion and uniqueness, in support of our prediction (H2). These findings suggest complex links between seabird trophic diversity, food availability, and breeding success across space and time.

# A NOVEL TRAIL CAMERA DIET MONITORING METHODOLOGY AND ITS CAPACITY TO REFLECT ROSEATE AND COMMON TERN CHICK PROVISIONING

#### Sarah Guitart<sup>1</sup>, Michelle Staudinger<sup>1,2</sup>

<sup>1</sup>University of Massachusetts Amherst, Amherst, Massachusetts, USA. <sup>2</sup>U.S. Geological Survey, Department of the Interior, Northeast Climate Adaptation Science Center, Amherst, Massachusetts, USA

#### Abstract

Diet monitoring is critical to understanding shifts in prey availability and the subsequent impacts on seabird populations. However, current methodology for in-person monitoring by field technicians is resource-burdensome, resulting in many colonies having intermittent diet data collected depending on island staff capacity across years. Based on the success of recent pilot studies, we aimed to develop a trail camera-based monitoring methodology for chick provisioning on two tern colonies in Buzzards Bay, Massachusetts, a region that supports a significant percentage of the Federally Endangered Roseate Tern (Sterna dougallii) and Common Tern (Sterna hirundo) populations. On each island, three productivity plots were selected. Multiple cameras were set-up to cover potential landing sites, create multiple viewing angles, and reduce blind spots. Additionally, in-situ and video-based monitoring stints were conducted to compare the overall effectiveness of trail cameras to standard monitoring techniques. Cameras were deployed from late May to mid-July, for a total of 15,585 camera hours. Sixteen monitoring stints were conducted from June 21 to July 13, totaling 47.25 monitoring hours, with Sandlance (Ammodytes spp.) and Herring (Culpea spp.) identified as the two most frequent prey items overall. Trail cameras were successful in collecting an abundance of provisioning data and were particularly adept at capturing prey items of Roseate terns nesting in artificial structures. Machinelearning techniques are being explored for media-based data processing efforts, the scripts and workflows will be delivered to interested colony managers.

# INTEGRATING MULTI-STATE MOVEMENT MODELS AND MARINE BIRD BEHAVIOR INTO ASSESSING RISK FROM PLANNED OFFSHORE WIND DEVELOPMENTS

<u>Julia Gulka</u><sup>1</sup>, Evan Adams<sup>1</sup>, Alicia Berlin<sup>2</sup>, Kevin Friedland<sup>3</sup>, Andrew Gilbert<sup>1</sup>, Chandra Goetsch<sup>1</sup>, Pam Loring<sup>4</sup>, William Montevecchi<sup>5</sup>, Matthew Perry<sup>2</sup>, Iain Stenhouse<sup>1</sup>, Kate Williams<sup>1</sup>

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## Abstract

Movement modeling of marine bird tracking data is an important tool to improve understanding of impacts from anthropogenic stressors, including offshore wind energy development (OSW). Hidden Markov Models (HMMs) can provide insight into factors influencing movement behavior, and we have incorporated HMMs into multiple analyses to understand avian exposure and vulnerability from OWED. Using satellite, GPS, and automated radio telemetry data, we employed HMMs to 1) examine behaviorally explicit use of planned Wind Energy Areas by Northern Gannet (Morus bassanus), Redthroated Loon (Gavia stellata), and Long-tailed Duck (Clangula hyemalis) in relation to forage fish availability and environmental covariates, and 2) assess exposure of Roseate Tern (Sterna dougallii), Red Knot (Calidris canutus) and Piping Plover (Charadrius melodus) to collision risk with offshore wind turbines in newly developed movement-based stochastic collision risk models. Of the species examined in the first analysis, Northern Gannets exhibited the highest overlap with OSW in the area-restricted movement state (i.e., a proxy for foraging), indicating Gannets may have higher exposure to potential effects, such as displacement and collision risk. In collision risk modeling, HMMs proved to be useful for informing exposure, flight height, and movement speed parameters; estimated collision risk for the three species varied by location, turbine model, time of year, and other factors. Incorporating movement modeling into these risk estimation processes is critical to understanding the mechanisms driving marine bird behavior and space use in the context of rapidly changing ecosystems due to anthropogenic stressors.

# ASSESSING PUBLIC ATTITUDES ON A WEDGE-TAILED SHEARWATER COLONY WITHIN A PUBLIC PARK

<u>Katelynn Gulley</u><sup>1,2</sup>, Jennifer Learned<sup>1,3</sup>, Martin Frye<sup>1,3</sup>, Skye Anderson<sup>1,3</sup>, Mariah Rivera<sup>1,2</sup>, Joshua DeCambra<sup>1,2</sup>, Cheryl King<sup>1,3</sup>, Mike Ing<sup>1</sup>, Jay Penniman<sup>1,3</sup>

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### Abstract

Native ecosystems across the globe are reliant on ecosystem engineers such as seabirds. Seabird populations face existential threats from anthropogenic stressors. The general public should have an awareness of local seabirds and seabird conservation efforts. Maui Nui Seabird Recovery Project, in collaboration with state and county organizations manages several seabird colonies around Maui, Hawai'i. An 'ua'u kani (Wedge-tailed Shearwater, *Ardenna pacifica*) colony located in the popular Kama'ole III Beach Park, has been under reinvigorated management since 2018. Initiatives include invasive plant removal, trapping mammalian predators, and establishing roped boundaries to keep foot traffic away from the nesting area. Since starting these efforts, reproductive success has risen from 9.68% (2018) to 50% (2022). This study gauges public attitudes, awareness, and knowledge around the 'ua'u kani colony and other wildlife at Kama'ole III. Random park visitors and volunteers were asked to complete a 20 question survey about their use of the park and knowledge of the 'ua'u kani. Initial data from these surveys indicate that restoration efforts enhance park experience and do not negatively impact the public's activities. In addition, respondents correctly answered two out of three questions about 'ua'u kani biology on average. Future work at Kama'ole III could include more aspects focusing on public education such as increased signage, volunteer events, and active outreach in the park.

# IMPACTS OF INVASIVE RATS ON BROWN BOOBY (*SULA LEUCOGASTER*) NESTSUCCESS ON TETIAROA ATOLL, FRENCH POLYNESIA

Eve Hallock, Beth Gardner, Jayna DeVore, Amelia Duvall, Sarah Converse

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#### Abstract

Introduced mammals are a well-documented and persistent threat to seabirds globally. Two non-native rat species, the Polynesian Rat (*Rattus exulans*) and Black Rat (*R. rattus*), are present on a subset of the twelve low-lying islets (motus) composing Tetiaroa Atoll, a small (3,366 ha) coral atoll in the Society Islands. A large-scale rat eradication effort is currently in progress there. During the breeding season prior to the 2022 eradication, we monitored all Brown Booby (*Sula leucogaster*) nests (n = 452) that could be located on the atoll weekly to determine nest success and cause of nest failure. We deployed time-lapse game cameras on a subset of nests until nest failure or until chicks reached 3-4 weeks of age. Causes of nest failure included rat predation, crab predation, infertility or embryo death, and wave inundation. To evaluate the impact of invasive rats, we compared pre-eradication Brown Booby hatching success between motus with rat infestation and those believed to be rat-free. In future years, we plan to collect post-eradication data on Brown Booby nests across the atoll to compare pre- and post-eradication nest success. These efforts will allow us to better understand the effects of rat eradication on a ground-nesting sulid.

# NOAA FISHERIES NATIONAL SEABIRD PROGRAM: 5-YEAR STRATEGIC PLAN UPDATE

<u>Annette Henry</u><sup>1</sup>, Lee Benaka<sup>2</sup>, Joan Browder<sup>3</sup>, Shannon Fitzgerald<sup>4</sup>, Tom Good<sup>4</sup>, Trevor Joyce<sup>1</sup>, Mi Ae Kim<sup>2</sup>, Ryan Silva<sup>5</sup>

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## Abstract

NOAA Fisheries National Seabird Program (NSP) is a cross-cutting group of managers and scientists who work domestically and internationally to protect and conserve seabirds. Our activities are guided by statutes and emerging agency priorities and form the basis for NSP's two overarching goals: 1) Monitor and Mitigate Bycatch, and 2) Promote Seabirds as Ecosystem Indicators. The NSP produced a 5-year Strategic Plan (Plan) covering years 2020-2024 based on input from NSP representatives, as well as NOAA's National Ocean Service, U.S. Fish and Wildlife Service, Bureau of Ocean Energy Management, and regional fishery management councils. The Plan has five strategic goals:

- 1) monitor and estimate seabird bycatch;
- 2) mitigate seabird bycatch;
- 3) strengthen key partnerships;
- 4) promote seabirds in advancing ecosystem-based fisheries management; and
- 5) elevate awareness of and support for the NSP.

A steering committee formed in 2020 to implement the Plan has made significant progress toward defining and implementing actions toward the Plan's goals and milestones. This includes following up on new ideas, tracking current projects, collaborating with Federal and State agencies and NGO groups, and maintaining a strong leadership role in international seabird conservation, especially with bycatch. As we complete the third year of the Plan, the steering committee continues to Identify issues pertaining to the conservation of seabirds and advancing best practices to minimize seabird bycatch. We are also looking ahead to a new 5-year strategic plan to guide the work of the NSP beyond 2024.

# FOLLOW THE EATER: A LOOK AT WESTERN GULLS' FORAGING RELATIONSHIP WITH SEA OTTERS

#### Katherine Herrmann, Gerick Bergsma

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#### Abstract

Gulls are feeding generalists that engage in a wide variety of foraging strategies, ranging from scavenging to kleptoparasitism. In order to find and acquire food, they often interact with other species, including marine mammals feeding near the surface. In Central California, for example, Western Gulls (Larus occidentalis) commonly trail after feeding Sea Otters (Enhydra lutris). Many researchers assume these interactions with otters to be kleptoparasitic, though it appears to be a complex relationship that more frequently involves commensalistic interactions (gulls eating scraps discarded by otters). Our project aims to classify and understand this relationship and discover factors that affect this behavior. We recorded interactions between Western Gulls and Sea Otters off the Monterey Peninsula between August 2022 and January 2023. These videos were then analyzed to determine behavioral aspects that classify the relationship, such as the distance between the gulls and otters, the direction of pecking (distinguishing between pecking at the otter or near the otter), and the reaction of the otters. We confirmed that the relationship is most commonly commensalistic, with only the occasional opportunistic kleptoparasitic interaction. Additionally, we found that this behavior can be impacted by gull age, time of year, and the presence of other feeding marine mammals. This study is important for furthering our understanding of the complex ecological dynamics and foraging behaviors of Western Gulls.

# DOES PLASTIC LOOK LIKE PETREL AND SHEARWATER PREY? A SENSORY ECOLOGY APPROACH

<u>Ariel-Micaiah Heswall</u><sup>1</sup>, Aidan Sarginson<sup>1</sup>, Matt Rayner<sup>2</sup>, Brian Wijaya<sup>1</sup>, Agustina Dominguez<sup>3</sup>, Lynn Miller<sup>3</sup>, Kristal Cain<sup>1</sup>, Megan Friesen<sup>4</sup>, Anne Gaskett<sup>1</sup>

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### Abstract

Plastic is an environmental issue affecting a diverse array of animal groups including seabirds. Previous studies show that the smell of plastic could be a sensory trap, with odours that encourage foraging. Little research focuses on colour and whether the colours of plastic also act like a sensory trap, resembling the colour of the seabird's prey. This study aims to explore the colours of plastic ingested by seabirds. We checked for plastics in the guts of 7 species of New Zealand (NZ) procellariformes (n = 72 birds). Using a spectrometer, we measured the spectral reflectances of the plastics ingested by seabirds and representative prey items (e.g., fish and squid). We also performed a literature review to analyse the colours of plastics available on coastlines. However, NZ seabirds did not. The spectra of plastics ingested by NZ seabirds resembled the prey's colour, suggesting it may act as a visual sensory trap. Sensory ecology is a useful tool to analyse plastic ingestion from the seabird's perspective. This technique can be applied globally and could inform consumer and commercial choices about plastic colours.

## GULLS AS INDICATORS OF THE HEALTH OF THE SALISH SEA ECOSYSTEM

Mark Hipfner<sup>1</sup>, <u>Alice Domalik</u><sup>1</sup>, Hannah Hall<sup>2</sup>, Theresa Burg<sup>3</sup>, Tony Williams<sup>2</sup>

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## Abstract

The Salish Sea is a biologically-rich inland sea surrounded by urban development and a burgeoning human population. It is also an important wintering area for several species of gulls. As part of a larger program to assess the ecological health of the Salish Sea, and to establish ecological baselines against which future changes can be assessed, Environment and Climate Change Canada in 2020 initiated a multi-faceted, collaborative study of the behaviour and ecology of gulls, chiefly Glaucous-winged Gulls, in the BC portion of the Salish Sea. Some key components of the research program include genomics (population structure, provenance, hybridization), quantifying indices of physiological health and contaminant exposure, GPS tagging to quantify habitat selection, and banding to measure age-specific survival rates. In this talk, we will provide greater detail on the objectives of the research program, present some key early findings, and outline how we see the program evolving in future years.

# THREATS TO AND CONSERVATION STATUS OF DE FILIPPI'S PETREL, A THREATENED CHILEAN ENDEMIC

<u>Peter Hodum</u><sup>1,2</sup>, Paola Gonzalez<sup>1</sup>, Guillermo De Rodt<sup>1</sup>, Cabila Manriquez<sup>1</sup>, Ryan Carle<sup>1</sup>, Hector Gutierrez<sup>1</sup>, Valentina Colodro<sup>1</sup>

<sup>1</sup>Oikonos Ecosystem Knowledge, Frutillar, Chile. <sup>2</sup>University of Puget Sound, Tacoma, WA, USA

### Abstract

Gadfly petrels of the genera Pterodroma and Pseudobulweria are the second most threatened group of seabirds globally. Despite this worrying conservation status, many *Pterodroma* species lack assessments of threats to their populations. One such species, De Filippi's Petrel (Pterodroma defilippiana), is a Chilean endemic with a breeding distribution restricted to two island groups, the Juan Fernández and Desventuradas. The species is listed as Vulnerable by both BirdLife/IUCN and Chile. Previous work by Oikonos produced population estimates of approximately 3000 breeding pairs of petrels. Our objectives in this study were to assess on-colony threats and use annual breeding season monitoring to evaluate breeding population trends on Isla Santa Clara, Juan Fernández Islands. Principal threats on Isla Santa Clara include rock/mudslides and encroachment of Juan Fernández Fur Seals (Arctocephalus philippii) in the scree slope breeding habitat of the petrels. The presence of introduced mammalian predators, including rats (Rattus spp.), feral cats (Felis catus), Coatimundis (Nasua nasua) and dogs (Canis lupus familiaris), prevents the species from nesting successfully on the main island of Robinson Crusoe. The percentage of nests occupied by breeding pairs on Santa Clara varied between years but has remained stable between 2010-2022. Priority conservation actions include determining marine habitat use and migration patterns, collaborating with artisanal fishers to improve our understanding of the population status of the species in the Desventuradas, installing artificial ceramic nests to help stabilize nest sites on Isla Santa Clara, and installing conservation fences to exclude fur seals from critical petrel breeding habitat.

# THE STAMP EGG COLLECTION AT THE NIST BIOREPOSITORY

Jennifer Hoguet, Debra Ellisor, Amanda Moors, Jennifer Ness, Rebecca Pugh

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### Abstract

Seabirds have demonstrated a valuable role in environmental monitoring. As such, in 1999, the Seabird Tissue Archival and Monitoring Project (STAMP) was established as a long-term collaboration between the National Institute of Standards and Technology (NIST) and a multitude of local, state, and federal agencies to monitor trends in Alaskan marine environmental quality. To do so, standardized protocols were implemented for the systematic collection and processing of eggs and the cryogenic archival of resultant egg tissues. The expressed goals were to minimize contamination and ensure long-term tissue stability, both key factors for optimal environmental monitoring. Since STAMP's inception, ~ 1850 eggs from target Alaskan species spanning 45 colonies have been collected, the majority of which have been utilized for environmental monitoring studies.

In 2010, the U.S. Congress provided funding to NIST in an effort to expand its capabilities into the Pacific region. In response, NIST, again in partnership with local, state, and federal agencies, expanded STAMP to the Pacific Islands. Target species have included Laysan Albatross (*Phoebastria immutabilis*) and Black-footed Albatross (*P. nigripes*). To date, ~ 750 eggs spanning 28 Pacific Island colonies have been collected, processed, and archived. In contrast to the Alaskan collection, the Pacific Island collection has been underutilized yet remains a valuable resource for environmental monitoring. Potential avenues include temporal, spatial and species comparative studies. Use of these tissues is highly encouraged and may be requested through STAMP's tissue access policy.

# DETERMINING ARTHROPOD CONSUMPTION BY LAYSAN DUCKS TO INFORM NON-TARGET MITIGATION EFFORTS DURING RODENT ERADICATION

Wieteke Holthuijzen<sup>1</sup>, Carmen Antaky<sup>2</sup>, Beth Flint<sup>3</sup>, Jonathan Plissner<sup>4</sup>, Coral Wolf<sup>5</sup>, Holly Jones<sup>6</sup>

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## Abstract

The critically endangered koloa pohaka (Laysan Duck, Anas laysanensis) in the Northwestern Hawaiian Islands has wild populations on Kamole (Laysan Island), Kuaihelani (Midway Atoll NWR), and Holanikū (Kure Atoll). Although its population and distribution have increased since its listing in 1967, the koloa pohaka faces a new risk on Kuaihelani: non-target poisoning via a pending House Mouse (*Mus musculus*) eradication. After mice were observed attacking and depredating molī (Laysan Albatross, Phoebastria immutabilis) on Sand Island of Kuaihelani in 2015, plans to eradicate mice with rodenticide were quickly developed. To reduce exposure to rodenticide, ducks will be captured and translocated to Eastern Island (mouse-free) during eradication activities. Even so, ducks may risk secondary poisoning by ingesting arthropods that feed on brodifacoum bait. Therefore, it is crucial to monitor rodenticide residue in arthropods to determine when koloa pohaka can be safely released post-eradication. Because duck diet is unknown on Kuaihelani, we used next-generation sequencing (NGS) to identify which arthropods ducks consume. We found that Sand Island's ducks most frequently consume cockroaches (Blattodea), freshwater ostracods (Cyprididae), midges (Chironomidae), and isopods (Porcellionidae). Notably, Sand Island's ducks consume entirely different arthropods from ducks on Kamole, which mainly eat flies (Diptera) and brine shrimp (Anostraca, Artemia sp.). Our study adds to the literature on the biology and ecology of translocated koloa pohaka populations by using advanced techniques to uncover their diet with a high degree of taxonomic precision. In addition, our study serves as a model for risk mitigation during invasive rodent eradications.

# CALCOFI SEABIRD SURVEYS IN THE CALIFORNIA CURRENT: NEW SPATIOTEMPORAL MODELS TO ACCOMMODATE DETECTION AND COMMUNITY EFFECTS

Brian Hoover, Sarah Ann Thompson, William Sydeman

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#### Abstract

In the California Current ecosystem, the distribution, abundance, and behavior of seabirds observed via at-sea surveys provide valuable insights into ecosystem health and function. The analysis of long-term survey data remains difficult, however, as these data often include substantial variability across weather conditions, observers, and vessel platforms. Furthermore, at-sea data can have inconsistent spatial and temporal survey coverage, are typically zero-inflated, and may exhibit strong autocorrelation trends. These challenges require new analytical approaches that robustly incorporate the full range of seabird community data while accommodating the biases in the data. One such approach are Vector Autoregressive Spatio-Temporal (VAST) models, which use a delta-generalized framework to model encounter probabilities and positive count densities to generate population estimates. This approach can be further extended to create joint dynamic species distribution models (JDSDMs) that model spatial and temporal correlations simultaneously across multiple species and thus help identify community assemblage trends in addition to optimizing single-species estimates. Here, we used seabird data collected from California Cooperative Oceanic Fisheries Investigations (CalCOFI) cruises from 1987 to 2022 to calculate annual abundance trends for key species. The CalCOFI seabird data provides comprehensive and long-term coverage of the southern California Current (>60,000 3km2 survey transect bins), and we apply the VAST framework to incorporate random detection effects and investigate data trends in seasonality and within species assemblages. Refining our ability to accurately quantify shifts in California Current seabirds over time improves our understanding of how seabirds respond to climate-linked shifts in food availability and habitat conditions.

# NORTHERN BREEDING RANGE EXPANSION OF TWO SULA SPECIES AT SUTIL ISLAND, SANTA BARBARA ISLAND, CALIFORNIA

<u>Jim Howard</u><sup>1</sup>, Amelia DuVall<sup>2</sup>, David Pereksta<sup>3</sup>, David Mazurkiewicz<sup>4</sup>, Adam Searcy<sup>5</sup>, Phillip Capitolo<sup>6</sup>, Tamara Russell<sup>7</sup>

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## Abstract

We report a northern expansion of the breeding ranges of the Brown Booby (*Sula leucogaster*) and Bluefooted Booby (*Sula nebouxii*), with successful breeding of the two species at Sutil Island off Santa Barbara Island, California, USA. We documented the arrival, colonization, and successful breeding of both species through opportunistic monitoring using land, boat, and aerial-based surveys 2013-2022. Brown Booby attendance on the island was first noted in October 2013, with breeding confirmed in October 2017 with the observation of four active nests and a chick fledged in 2019. The northernmost known breeding colony for this species was previously Middle Rock at the Coronado Islands, Mexico, indicating a 200km range expansion. Blue-footed Boobies were first observed in August 2018, with breeding confirmed in 2021 with the observation of one active nest and a chick fledged in 2022. The northernmost known breeding colony for this species was previously Isla San Jeronimo, Mexico, indicating a 500-km range expansion. These are the first confirmed breeding records for a *Sula* species in the continental USA and represents a northward shift of both species' breeding ranges.

# CANADA'S OCEANS PROTECTION PLAN: WHAT HAVE WE DONE FOR SEABIRDS, AND WHAT COMES NEXT?

<u>Sarah Hudson</u>, Mark Hipfner, Doug Bertram, Mark Drever, John Elliott, Sandi Lee, Vivian Pattison, Alice Domalik, Nik Clyde, Elsie Krebs

Environment and Climate Change Canada, Delta, BC, Canada

### Abstract

Since 2017, the Government of Canada has invested in the Oceans Protection Plan to keep our oceans and coasts healthy and improve shipping safety. Under this funding and building on previous research, Environment and Climate Change Canada has conducted five years of research primarily in British Columbia to improve our understanding of threats to marine birds from shipping. Using tracking technology, at-sea surveys, and contaminant studies, our marine team within the Wildlife and Landscape Science Directorate is working to identify high use areas for marine birds year-round, and conduct risk assessments to prioritize threats from shipping. This information informs management action and mitigation of impacts on marine birds during individual marine incidents such as an oil spill, and can inform conservation and management decisions broadly. With renewal and national expansion of the Oceans Protection Plan in 2022, we would like to communicate the work done thus far and invite feedback on future research and collaborations.

# FISHING ACTIVITY AS THE CAUSE OF NIGHT DESERTION OF CHINESE CRESTED TERNS' COLONY IN MATSU, TAIWAN

Chung-Hang Hung<sup>1</sup>, Kung-Kuo Chiang<sup>2</sup>, An Choui<sup>1</sup>, Hsiao-Wei Yuan<sup>1</sup>

<sup>1</sup>National Taiwan University, Taipei, Taiwan. <sup>2</sup>Wild Bird Society of Taipei, Taiwan

#### Abstract

The critically endangered Chinese Crested Tern *Thalasseus bernsteini* (CCT) nests sympatrically with the Great Crested Tern (*T. bergii*, GCT) among seven protected islands within the Matsu Island Tern Refuge (MITR), Taiwan. To minimize disturbances during breeding season, we used real-time surveillance system to observe the numbers and location of CCT and GCTs' nests, and autonomous acoustic recorders (Song meter 4, Wildlife Acoustics, Inc.) were also used to monitor the activity of CCTs and GCTs on the protected islands of MITR. Based on the records from 2015 to 2022, we found that the average sound pressure level between 1.5-8 kHz was associated changes in the number and status of the tern colony. And we also notice that the noises and light pollution from fishing boat at night occurs frequently (every 2-3 days), which might be the main factor that caused the night desertion of GCTs and CCTs in recently year. Therefore, it can be considered as an important information for terns' protection in MITR. Overall, the real-time surveillance system could help to identify the threat to the terns' colonies. However, the system also indicated that twenty-four-hour warden near the tern breeding colonies were truly needed during May to July in MITR, especially at nighttime. We will take the actions to rescue the current significant decline of CCT nesting success rates within the MITR.

# AERIAL AND GROUND SURVEYS TO ESTIMATE THE BREEDING POPULATION OF PERUVIAN DIVING-PETRELS ON TWO MAJOR COLONIES IN PERU

<u>Cinthia Irigoin-Lovera</u><sup>1</sup>, Sebastian Lozano<sup>1</sup>, Diego Gonzasles-DelCarpio<sup>1</sup>, Isabella Diaz<sup>1</sup>, Dayana Alva<sup>2</sup>, Carlos Zavalaga<sup>2</sup>

<sup>1</sup>Universidad Cientifica del Sur, Lima, Lima, Peru. <sup>2</sup>Universidad Cientifica del Sur, Lima, Lima, Peru

## Abstract

The Peruvian Diving Petrel (PDPE) is an endemic seabird of the Humboldt Current. The bulk of its population is restricted to Isla La Vieja and isla San Gallan in Peru. In the last PDPE count (2009) on both islands a total of ~ 36 000 active nests were estimated by direct inspection of burrow contents. They breed year-round and build their nests in sand or guano burrows, an in holes in salt crusts clustered in sub-colonies of 100s and 1000s of nests. In 2021, a combination of aerial (drones) and ground (burrow-scopes) surveys was used on both islands to assess the number of active nests and breeding phenology. The occupation rate of nests was 0.313 (n = 6,051 prospected nests). Based on the counts of nests (n = 324,853) in all clusters (n = 389), the occupation rate and correction factors (true vs faked burrows), a total of 99,077 active nests (with eggs, chicks or adults) were estimated, of which 96.2% and 3.8% were counted on Isla La Vieja and Isla San Gallán, respectively. The PDPE population in Peru has tripled since 2009 despite the presence of House Mice (*Mus musculus*) on Isla la Vieja. However, the ban of guano harvesting on the island since 1996 (less disturbance) and a better regulation of anchovy fisheries (more food) seems to counteract any possible effect of mice predation so far.

## METABOLITE LEVELS REFLECT NUTRITIONAL STATE IN A FREE-LIVING SEABIRD

Lauren Jackson<sup>1</sup>, Don-Jean Léandri-Breton<sup>1</sup>, Shannon Whelan<sup>1,2</sup>, Alexandre Turmaine<sup>1</sup>, Scott Hatch<sup>2</sup>, Kyle Elliott<sup>1,2</sup>

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#### Abstract

Identifying sensitive periods of an animal's life cycle is important for wildlife conservation and management. Indeed, the ability to efficiently measure the health and nutrition of wild populations is a valuable tool, as most traditional methods of evaluating animal physiology are complex and time consuming. This study investigates the use of blood plasma metabolite concentrations as indicators of nutritional state for free-living seabirds. We measured the blood plasma concentrations of glucose, cholesterol, B-hydroxybutyrate, and triglycerides in a population of breeding Black-Legged Kittiwakes (Rissa tridactyla) on Middleton Island, Alaska. We manipulated the energy expenditure of individuals to assess consequences on metabolite levels and thereby nutritional state in two treatments: 1) food supplementation (unlimited food provisioning) to decrease energetic demands; and 2) a flight handicap (by clipping primary and tail feathers) to increase energetic demands. We collected blood samples of fed, control, and wing-clipped birds throughout the breeding season. Metabolite concentrations were measured using point-of-care devices that provide rapid results from very small quantities of blood. Supplemental feeding improved the nutritional state of kittiwakes while wing-clipping caused slight nutritional decline. Additionally, we found measurable differences in metabolite concentrations of individuals across three stages of the breeding period (pre-laying, incubation, and chick-rearing), suggesting that pre-laying is the most nutritionally challenging stage. These results show potential for the use of blood plasma metabolites as proxies for evaluating individual or population health and environmental food availability. We conclude that point-of-care devices, used in the field, can determine when individuals are nutritionally-challenged in the wild.

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# OFFSHORE WIND ENERGY DEVELOPMENT AND SEABIRDS: INFORMING DECISION MAKING WITH SUBJECT MATTER EXPERTISE

<u>Edward Jenkins</u><sup>1</sup>, Julia Gulka<sup>1</sup>, Kate Williams<sup>1</sup>, Mark Severy<sup>2</sup>, Rebecca Green<sup>3</sup>, Caleb Spiegel<sup>4</sup>, Tim White<sup>5</sup>, Kate McClellan Press<sup>6</sup>

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## Abstract

Offshore wind energy development (OWED) is a rapidly growing industry in the United States. While lessons can be learned from Europe, effects on seabirds, such as collision risk and displacement, must be understood within the American ecological, technological, and regulatory context. Through regional, science-based collaboration, the state of New York has convened multiple efforts to develop frameworks, methodologies, and research priorities to guide research on the impacts to seabirds from OWED. These subcommittees of the Offshore Wind Environmental Technical Working Group (E-TWG) have brought together a broad suite of subject matter and quantitative experts, developers, and other stakeholders. One of these committees recently developed a public database of regionally-focused research needs and data gaps related to wildlife and OWED such that potential researchers and funders can easily access, sort, and prioritize research needs. A second committee, in collaboration with the U.S. Fish and Wildlife Service and Bureau of Ocean Energy Management, is developing guidance for pre- and post-construction monitoring to detect macro- to meso-scale changes in seabird distributions and habitat use in relation to OWED. These effective stakeholder engagement processes serve as successful examples of collaboration for other geographies, ensuring that research priorities are developed transparently and in consultation with the scientific community, and that research and monitoring studies are scientifically robust in order to improve understanding of impacts to seabirds from OWED. Lessons learned include the need for adequate technical expertise and facilitation support, as well as the importance of collaboration among state and federal agencies to ensure efficiency.
# ALTERED PREDATOR DIET UNDER VARYING PREY AVAILABILITY SUGGEST SHIFTS IN A COASTAL FOOD WEB

<u>Edward Jenkins</u>, Julia Gulka, Kelsey Johnson, Paloma Carvalho, Marissa Berard, Laurie. D Maynard, Lauren Lescure, Gail Davoren

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#### Abstract

Shifts in prey availability can lead to altered predator dietary niche and species interactions, ultimately leading to changes in food web dynamics. On the northeastern Newfoundland coast, availability of the dominant forage fish species, Capelin (Mallotus villosus), has become highly variable, potentially altering species-specific diet, species interactions and energy flow pathways. We aimed to investigate intra- and inter-annual food web dynamics, with a focus on diets of breeding and non-breeding seabirds and other top marine predators, under varying capelin availability. We constructed a simplified coastal food web by reconstructing species-specific dietary composition using stable isotope ratios ( $\delta^{15}$ N,  $\delta^{13}$ C) from predator and prey tissues sampled under varying capelin availability. We found evidence of intra-annual dietary shifts, with breeding seabird species relying more on alternative prey species (e.g., amphipods, sand lance Ammodytes spp.) under low capelin biomass, but shifting to primarily capelin once they migrated into coastal waters to spawn. Interannually, variation in capelin biomass influenced the proportion of capelin in predator diets, more so for breeding relative to non-breeding seabirds, exemplifying the consequences of being spatially constrained nearby colonies. Findings iterate the importance of capelin for breeding and non-breeding seabirds, but also the importance of alternate prey types when capelin biomass is low. Findings also highlight potential for changing species interactions as diets of multiple predators converge on potentially limited prey (e.g., low biomass of capelin or alternative prey types), suggesting a need for ecosystem-based management of the capelin fishery and additional studies focused on non-commercial forage fish species.

## NORTHWARD MIGRATION AND WINTER RESIDENCY OF CALIFORNIA BREEDING PIGEON GUILLEMOTS (CEPPHUS COLUMBA)

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#### Abstract

Pigeon Guillemots (*Cepphus columba*) are ubiquitous along the coasts of the eastern North Pacific, yet little is known about their winter migration patterns, habitat needs, and potential threats faced during the non-breeding period. We used three seasons of year-long light level data from tagged individuals to estimate the migration timing and winter residency of Pigeon Guillemots breeding on Southeast Farallon Island in California. Light level data were combined with a movement model to estimate positions of tagged animals, revealing that individuals from this population undertook a coordinated coastal migration north in the fall, stopping at sites near Haida Gwaii in British Columbia presumably during a flightless prebasic molt, before continuing north to stationary overwintering sites in coastal British Columbia and Southeast Alaska. Birds then made an uninterrupted migration south in the spring, returning to waters around Southeast Farallon in late March and early April. Wet/dry data indicated nocturnal resting on land during the breeding season and likely on the water throughout the nonbreeding months. This is the first study to confirm the migratory patterns of Pigeon Guillemots from California, and highlights the importance of the waters of British Columbia and Southeast Alaska for this and possibly other major populations of this species.

# MARINE BIRD MASS MORTALITY EVENTS AS AN INDICATOR OF THE IMPACTS OF OCEAN HEATING

<u>Timothy Jones</u><sup>1</sup>, Julia Parrish<sup>1</sup>, Jacqueline Lindsey<sup>1</sup>, Charlie Wright<sup>1</sup>, Hillary Burgess<sup>1</sup>, Lauren Divine<sup>2</sup>, Robert Kaler<sup>3</sup>, David Bradley<sup>4</sup>, Graham Sorenson<sup>4</sup>, Rémi Torrenta<sup>4</sup>, Stacia Backensto<sup>5</sup>, Heather Coletti<sup>5</sup>, James Harvey<sup>6</sup>, Hannah Nevins<sup>6</sup>, Erica Donnelly-Greenan<sup>6</sup>, David Sherer<sup>7</sup>, Jan Roletto<sup>8</sup>, Kirsten Lindquist<sup>9</sup>

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#### Abstract

An emergent property of global heating, the frequency and severity of marine heatwaves (MHW) has led to large-scale disruptions to marine ecosystems. As upper trophic species, seabirds reflect shifts in trophic structure and stability; therefore, a sharp increase in beached bird deposition rate is a signal of ecosystem change. In this presentation we describe results stemming from the analysis of 29 years (1993-2021) of citizen-science beached bird monitoring data (~90,000 surveys), with the aim of identifying unusual mortality events of seabirds, or wrecks, throughout the Northeast Pacific and Alaska, and linkages to ocean-climate variability. Wrecks were documented throughout the study period, but massive events (>500 km in extent, >10 carcasses km<sup>-1</sup>) occurred infrequently (n = 4), with an unprecedented sequence from 2014-2019. Event characteristics, including encounter rate (carcasses/km), duration and spatial extent, were positively related to prior-year averaged sea-surfacetemperature anomaly, with event magnitude (product of encounter rate, extent, and duration) displaying a step-like transition, increasing five-fold between +0°C and +1°C above baseline (1981-2010) temperatures. We will present comparisons of beached bird encounter rates in the California Current large marine ecosystem following three prolonged MHW events, which were suggestive of a common sequence of wreck occurrence (1-6 months and 10-16 months after heatwave onset), followed by a consistent 16-month period of depressed carcass encounter rates. We will discuss how these signals may be indicative of a recurrent systemic response to extreme perturbations in sea-surfacetemperatures, as well as a potential lowering of system carrying capacity under warmer conditions.

## AN UNCREWED AERIAL SYSTEM PHOTOGRAMMETRIC CENSUS OF BRUSH-TAILED PENGUIN CHICKS AT KING GEORGE ISLAND, ANTARCTICA

#### Trevor Joyce<sup>1</sup>, Tamara Russell<sup>2</sup>, Jefferson Hinke<sup>3</sup>

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#### Abstract

A key objective of U.S. Antarctic Marine Living Resources (AMLR) Program is the collection of census counts of nesting brush-tailed penguins to inform the management of an international krill fishery operating in Antarctic waters. Counts of Adelie (Pygocelis adeliae), Gentoo (Pygocelis papua), and Chinstrap (Pygocelis antarcticus) penguin nests and chicks have been monitored over a period of more than 30 years at the Copacabana Field Camp on King George Island, Antarctica (62.178°S, 58.446°W). In this study we conducted a series of flights using a fixed-wing vertical take-off and landing Uncrewed Aerial System (UAS, FireFly6 Pro) to collect very high-resolution aerial images of penguin colonies in conjunction with a traditional manual ground census. Aerial images and flight telemetry data were combined using the photogrammetry software Agisoft MetaShape to produce seamlessly stitched orthomosaic surfaces with overall ground sampling resolutions of 0.7-1.2 cm. Counts of penguin chicks based on these orthomosaic surfaces allowed considerably greater precision in counts of penguin chicks by minimizing skipping and double-counting errors that are unavoidable when manually counting large aggregations of moving animals. Spatially-referenced orthomosaics also allowed high-precision threedimensional mapping of colony boundaries as a baseline for measuring future changes in colony size and distribution as breeding conditions change in the rapidly warming Antarctic Peninsula region. Finally, large orthomosaic surfaces can also be subdivided into tiles to facilitate partially automated detection and classification using machine learning computer vision algorithms.

# UPDATING THE MARINE BIRD VULNERABILITY INDEX ON RISKS OF OFFSHORE WIND ENERGY PROJECTS ON THE PACIFIC OUTER CONTINENTAL SHELF

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

<sup>1</sup>USGS Western Ecological Research Center, Santa Cruz, CA, USA. <sup>2</sup>BOEM Pacific Region, Camarillo, CA, USA

#### Abstract

Minimizing negative interactions of offshore wind energy infrastructure with marine bird species is an important step towards a sustainable offshore energy future. From 2012–2016, BOEM and USGS collaborated to develop the first comprehensive database to quantify marine bird vulnerability to potential wind energy development offshore of California, Oregon, and Washington on the Pacific Outer Continental Shelf. These data were used to quantify marine bird vulnerabilities, at the population level, to collision with and displacement by offshore wind energy infrastructure, as well as associated uncertainties. In the 6 years since this work was completed, abundant new research and data have been published that better inform data inputs (e.g., flight height, habitat flexibility, and population estimates) and structure of the vulnerability index. Herein we present an update to the marine bird vulnerability index with up-to-date information in order to better inform current offshore wind energy development needs on the Pacific Outer Continental Shelf. This updated vulnerability index can inform site selection for offshore wind energy projects as well as efforts to minimizes adverse effects to marine birds.

## **CLIMATE CHANGE AND SEABIRD PRODUCTIVITY**

#### <u>Pat Baird</u>

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#### Abstract

High or low reproductive success in seabirds is often explained with the terms having a "good" or "poor" food year. What does this mean? Poor food is a code for energy-poor prey, that is, prey with lower fat. The frequency of poor reproduction and "poor prey years" seems to be increasing and we need to understand the underlying cause. The quality of prey, not the quantity of fat is at play here and the explanation is actually revealed by what is happening at lower trophic levels. Microphytoplankton, at the bottom of the food web, are one of the few life forms that can produce *de novo* long chain polyunsaturated fatty acids, especially EPA and DHA, and these molecules are essential for successful reproduction at all trophic levels: copepods to euphausiids and macroinvertebrates to forage fish, thus affecting every group of seabirds. Microphytoplankton output of EPA and DHA is highly susceptible to chemical and physical shifts in oceanic parameters such as pH, temperature, salinity, and turbulence that come with climate change. Thus, the usual explanation of poor reproduction needs to pivot away from good or poor prey to examining the entire trophic web where these seabirds breed. We need to document proportions of long chain fatty acids not only in seabirds but also throughout the seabird food web, and to understand what is happening to the microphytoplankton which are the crux to seabird success.

# THE FORAGING BEHAVIOR OF ATLANTIC PUFFINS (*FRATERCULA ARCTICA*) IN THE GULF OF MAINE DURING MARINE HEATWAVE CONDITIONS

#### William Kennerley<sup>1</sup>, Rachael Orben<sup>1,2</sup>, Donald Lyons<sup>1,3</sup>

<sup>1</sup>Department of Fisheries, Wildlife, and Conservation Sciences, Oregon State University, Corvallis, OR, USA. <sup>2</sup>Hatfield Marine Science Center, Oregon State University, Newport, OR, USA. <sup>3</sup>National Audubon Society's Seabird Institute, Bremen, ME, USA

#### Abstract

The Gulf of Maine experienced marine heatwave (MHW) conditions for much of 2021 and 2022, the fourth significant such event in the last decade. During this prolonged period of anomalously warm ocean conditions, the monitored seabird colony at Matinicus Rock, Maine reported Atlantic puffin adults provisioning chicks at low rates and with poor-quality prey. As a result, puffin productivity in these years was below the long-term average (0.34 [2021], 0.56 [2022], 0.62 [2004-2022 mean]), part of an ongoing regional decline in puffin productivity and chick body condition. In this context, we monitored the foraging behavior of 25 breeding puffins through the use of either GPS units (Pathtrack Nanofix-GEO and GEO+RF, n=10) or TDRs (CEFAS G5, n=15). These devices captured more than 115 foraging trips and 36,000 dives over two breeding periods, representing the largest such dataset for this species within the Gulf of Maine. This work aims to quantify relevant foraging metrics and determine the environmental factors influencing puffin foraging effort. These data will also serve as a baseline for future studies in the region as the Gulf of Maine continues to warm rapidly and to experience increasingly frequent and prolonged MHWs.

# MONITORING TUFTED PUFFIN POPULATION TREND WITH TIME-LAPSE PHOTOGRAPHY

#### Arthur Kettle

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#### Abstract

Since Tufted Puffins spend most of their time away from or inside their burrows, their availability for counts at the surface is sporadic and highly variable. Therefore, a common method used for monitoring population trend is to count burrows rather than birds. Burrow counts are usually performed by researchers traversing plots of nesting habitat. However, at many colonies the substrate is fragile and burrows occasionally collapse with human weight. Once collapsed, in at least some colonies, burrows are not rebuilt because insufficient soil remains. Long-term population monitoring with this method can cause artificial decline in population trend estimates and reduction of nesting habitat. Alternative methods for sampling population trend for Tufted Puffins are necessary. We have tested the use of time-lapse photography for increasing the sampling of surface counts. Images of plots are recorded hourly through the nesting season, and puffins outside their burrows are counted on the images. Counts focus on the nestling period, when most surface activity occurs. The large sample of counts strengthens statistical analyses within, between, and among years. Further analysis of the images may allow inferences about breeding effort and productivity. Improvements in image resolution may allow automated computer counts. This poster presents results from the project's test-phase years through 2022.

### MAUI COUNTY'S ADOPTION OF A NEW OUTDOOR LIGHTING ORDINANCE TO PROTECT NATIVE WILDLIFE AND PRESERVE DARK SKIES

<u>Cheryl King</u><sup>1,2</sup>, Jennifer Learned<sup>1,2</sup>, Martin Frye<sup>1,2</sup>, Skye Anderson<sup>1,2</sup>, Emily Severson<sup>1,2</sup>, Mariah Rivera<sup>1,3</sup>, Josh DeCambra<sup>1,3</sup>, Katelynn Gulley<sup>1,3</sup>, Jay Penniman<sup>1,2</sup>

<sup>1</sup>Maui Nui Seabird Recovery Project, Makawao, HI, USA. <sup>2</sup>Pacific Cooperative Studies Unit, Honolulu, HI, USA. <sup>3</sup>KUPU, Honolulu, HI, USA

#### Abstract

Seabird colonies in the Main Hawaiian Islands have struggled to persist due to, among other threats, habitat loss and degradation with the continuing statewide human population surge. In an attempt to minimize the negative impacts of artificial lighting on native wildlife populations, to preserve dark skies that are critical to Hawaiian cultural practices, astronomy, and community health, as well as to decrease energy consumption, Maui County adopted a new lighting ordinance in October 2022: Bill 21, Ordinance 5434 (effective July 1, 2023, with a three-year implementation timeline). All outdoor lighting fixtures, except for neon, must limit short wavelength content to no more than 2% of blue light content. These fixtures must also be down-directed, shielded, and with no light shining above the horizontal or over the ocean (and if the light hits a wall surface, the surface must be non-reflective). Non-oceanfront residential properties, along with additional situations brought up during the multiple council meetings concerning public safety, sports, and special events, have triggered exemptions. This is still a notable improvement upon the previous lighting code (Chapter 20.35), which has not been adequately enforced. The total number of Maui and Lana'i seabird fallout reports from 2009-2022, an under-representation of the amount of cases that actually occurred, was 1,187. With the new legal lighting implementations and improved enforcement, fallout numbers will ideally decline significantly in the future. This legislative action also raises community awareness of light pollution, the plight of native seabirds, and most importantly, how to help.

## ALIGNING STATISTICAL AND BIOLOGICAL POPULATIONS FOR ABUNDANCE ESTIMATION OF *BRACHYRAMPHUS* MURRELETS

Michelle Kissling<sup>1</sup>, Paul Lukacs<sup>1</sup>, Kelly Nesvacil<sup>2</sup>, Scott Gende<sup>3</sup>, Grey Pendleton<sup>4</sup>

<sup>1</sup>University of Montana, Missoula, Montana, USA. <sup>2</sup>National Park Service, Corpus Christi, Texas, USA. <sup>3</sup>National Park Service, Juneau, Alaska, USA. <sup>4</sup>Alaska Department of Fish and Game, Juneau, Alaska, USA

#### Abstract

Ideally, a statistical population is the same as or accurately represents its corresponding biological population, yet in practice, they do not always align in space and time, which can lead to biased inference. We developed a hierarchical Bayesian integrated model for the Kittlitz's Murrelet (Brachyramphus brevirostris), a highly mobile, non-colonial, ice-associated seabird. Our model combines datasets from boat-based surveys and telemetry flights to estimate abundance of the biological population by accounting for all components of overall detection: probability of presence  $(p_o)$ , probability of availability ( $p_a$ ), and probability of detection ( $p_d$ ). By estimating  $p_p$  directly, we were able to account for temporary emigration from the sampled area, which changed with shifting icefloes between sampling occasions. Across a 6-year period,  $p_{\rho}$  explained most (83%) of the variation in overall detection probability, averaging 0.50 (SD=0.02; range=0.35-0.65), but was not predictable using five environmental covariates. In years when two boat surveys were conducted, our model reduced coefficients of variation (CV) of annual abundance estimates by 13–35%; in the year with only one boat survey, the CV increased by 270%, underscoring the importance of within-year replication when  $p_{\rho}$  is highly variable. By explicitly accounting for all components of overall detection probability, especially  $p_{\rho}$ , we reduced variation of the across-year trend estimate by 38%. Although temporary emigration of murrelets from our study area appears to be random, its high variability, if ignored, reduces power to detect and diagnose population changes of this ice-associated species and could introduce confusion in integrated population models.

# SPATIAL ANALYSIS OF TRENDS IN TUFTED PUFFIN BREEDING HABITAT ON THE OREGON COAST

Carina Kusaka<sup>1</sup>, Melanie Davis<sup>1,2</sup>, James Peterson<sup>1,2</sup>

<sup>1</sup>Oregon State University, Corvallis, OR, USA. <sup>2</sup>Oregon Cooperative Fish and Wildlife Research Unit, Corvallis, OR, USA

#### Abstract

Tufted Puffins (Fratercula cirrhata) are an iconic species in the Pacific Northwest that provide a wide range of ecological, economic, and historically important services such as ecotourism for local communities and bringing marine derived nutrients to terrestrial habitats. Further, Tufted Puffins are sensitive to changes in prey availability and as such, are good indicators of overfishing and ecosystem disturbance. Tufted Puffin populations on the Oregon Coast have declined dramatically over the past few decades from over 5,000 birds in 1989 to only 500 birds in 2021. In 2018, the Tufted Puffin Species Status Assessment determined that factors related to breeding site conditions are one of the most probable causes of puffin decline; however, little is known about the specific characteristics of breeding habitat in Oregon. To address this knowledge gap, I conducted a spatial analysis to examine the distribution of suitable breeding habitat for Tufted Puffins on the Oregon Islands National Wildlife Refuge, OR, USA. Specifically, I compared the percent cover of vegetation at tufted puffin breeding sites from 1979 to 2021 using a combination of ground-truth data, aerial photo from a helicopter, National Agriculture Imagery Program (NAIP) imagery, and other remote sensing data sets. Preliminary analyses suggest a decrease in the percent cover of live vegetation at critical breeding habitat. I will then relate vegetation loss to site-specific, climatic, and environmental variables. Assessing how suitable puffin breeding habitat characteristics have changed over time will provide necessary information to guide refuge managers in habitat restoration and support adaptive management decisions.

# USING NETWORK ANALYSES OF INDIVIDUAL MOVEMENT DATA TO EVALUATE POPULATION STRUCTURE AND DEFINE MANAGEMENT UNITS

#### Juliet Lamb

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#### Abstract

Conserving migratory wildlife requires understanding how groups of individuals interact across seasons and landscapes. Telemetry reveals individual movements at large spatiotemporal scales; however, using movement data to define conservation units requires scaling up from individuals to species-and community-level patterns. We developed a framework to define flyways and identify important sites from telemetry data and applied it to two case studies: a long-term, range-wide tracking dataset from three species (640 individuals) of North American scoters (*Melanitta* spp.), and a focused telemetry effort for Brown pelicans breeding in the southeastern United States (280 individuals). Tracking data from scoters revealed limited spatial overlap between scoters wintering on the Atlantic and Pacific coasts of North America, with differing connectivity patterns between coasts, and showed mismatches between multi-species conservation units and traditional management flyways. Meanwhile, Brown Pelican data showed distinct groups of interconnected breeding and non-breeding sites in the western and central Gulf of Mexico, Florida Pandhandle, southern Gulf coast of Florida north to the South Atlantic Bight, and mid-Atlantic coast, which do not correspond to any of the management structures typically used for this species. These case studies provide examples of how network analysis of individual movement data can be used to quantify range-wide connectivity of migratory species and identify gaps in conservation strategies.

### EFFECTS OF URBANIZATION ON TROPHIC NICHE WIDTH AND OVERLAP BETWEEN SYMPATRIC SEABIRD SPECIES

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#### Abstract

Urbanization can alter the trophic niches of foraging animals, with consequent impacts on resource partitioning. In terrestrial environments, urbanization has been found to increase niche overlap and competition between species, though it is unclear if these effects are the same for coastal species. As abundant generalists in coastal ecosystems, gulls offer a unique vantage point for studying the effects of urbanization and urban foraging on trophic ecology and interactions. We combined GPS tracking with stable isotope ( $\delta^{13}$ C,  $\delta^{15}$ N,  $\delta^{34}$ S) analyses to assess whether trophic niche size, trophic niche overlap, and overlap in foraging space of two sympatric gull species (Larus argentatus, L. marinus) differed between urban and remote colonies. We found that gulls at the urban colony had significantly wider trophic niches than gulls at the more remote colony (Kruskal-Wallis  $p = 1.0 \times 10-3$ ). Furthermore, we found higher spatial overlap between species across 95% of their foraging range at the remote colony in comparison to the urban colony (Utilization Distribution Overlap Index = 1.18 vs 0.660, respectively). Gulls showed considerably more overlap in trophic niche space at the more remote colony than at the urban colony (59.84% vs 9.24% overlap, respectively). Our findings demonstrate that by providing abundant alternative dietary resources, coastal urban areas can allow generalist seabird species to expand their trophic niches and increase resource partitioning between species. We posit that urbanization may have different impacts in coastal regions than in terrestrial environments, particularly for mobile generalist consumers that can access both natural marine and urban foods.

### ISLAND COMMUNITY LEADERS AS CHAMPIONS FOR SEABIRDS

<u>Mariam Latofski Robles</u><sup>1</sup>, Yuliana Bedolla Guzman<sup>1</sup>, Alicia Aztorga Ornelas<sup>2</sup>, Alejandra Fabila Blanco<sup>1</sup>, María Félix Lizárraga<sup>1</sup>, Gabriela Fernandez Ham<sup>1</sup>, Marimar Garciadiego San Juan<sup>1</sup>, Cynthia Jauregui García<sup>1</sup>, Karina Salizzoni Chavez<sup>1</sup>, Federico Méndez Sánchez<sup>1</sup>

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#### Abstract

After over twenty years of implementing a comprehensive ecological restoration program which has included the removal of invasive mammals, social attraction techniques, reducing human disturbance, island biosecurity and environmental education, 85% of all extirpated seabird colonies have returned to nest in the Mexican islands off the Baja California Peninsula. To ensure that conservation gains will be long lasting, the island biosecurity and environmental education chapter of the program has been implemented in two fronts: 1) with federal authorities to formulate island specific biosecurity protocols and institutionalize their implementation; 2) with local communities to build capacities and promote the adoption of new habits to protect the islands. Since 2021, a group of community leaders came together as advocates for island conservation with the aim to co-create projects and activities on topics they considered to be most impactful for their own communities and that at the same time served to protect the nesting sites of 129 seabird breeding populations of 23 species in this seabird hotspot.

## BROADCAST PLAYBACK ATTRACTS A FEMALE-BIASED POPULATION OF NEWELL'S SHEARWATERS WITHIN PREDATOR-PROOF EXCLOSURES ON MAUI

Jenni Learned<sup>1</sup>, Kenneth Hayes<sup>2</sup>, Skye Anderson<sup>1</sup>, Joshua DeCambra<sup>1</sup>, Martin Frye<sup>1</sup>, Mariah Rivera<sup>1</sup>, Jay Penniman<sup>1</sup>

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#### Abstract

Social attraction of colony nesting seabirds can foster populations of threatened species within protected habitats. Typical social attraction methods include cues such as decoys and broadcast calls. These methods are used to attract endangered 'a'o (Newell's Shearwater, Puffinus newelli) into predator-proof exclosures at Makamaka'ole in Mauna Kahalawai, West Maui. The exclosures and 100 artificial nest boxes were completed by 2015, and we assumed site management in 2020. 'A'o attendance continues to increase annually; however, only one pair at one nest box has successfully fledged chicks. While it is possible that the majority are young, inexperienced breeders, the number of nonviable eggs produced each season also continues to increase (2020 n=7, 2021 n=16, 2022 n=18). In order to better understand the small yet growing population, we took blood samples from 14 adults captured within the artificial nest boxes during the 2022 breeding season. Genetic analysis revealed that all sampled individuals are female. The low proportion of males present in this group explains the high rate of nonviable egg production. Based on these findings, we question some assumptions about our social attraction methods. Are the particular calls used in the playback at Makamaka'ole selecting for females? Following diversification of the playback calls for the 2023 breeding season, we will monitor 'a'o for changes in attendance, behavior, and sex ratio. Refining these methods is crucial for the management of endangered Hawaiian seabirds, as the number of protected sites and planned social attraction projects is projected to increase.

## VULNERABILITY TO OFFSHORE WIND FARM COLLISION THROUGH THE YEAR BY USING BLACK-TAILED GULLS' TRACKING

#### Who-Seung Lee, Seungyeon Lee

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#### Abstract

It is well known that energy generation by wind power has become an important means to reduce reliance on fossil fuels and mitigate against climate change induced by human. So, it is true that human-wildlife conflict has significantly raised and many relative conflicts was revealed. Non-surprisingly airborne taxa such as birds may be particularly sensitive to collision mortality with wind turbines. Although there are few studies to show the relative vulnerability of populations in seabirds across their annual life cycles, many evaluations have not been taken. I studied that impact of offshore wind farms on the distribution of Black-tailed Gulls (*Larus crassirostris*) in the Korean peninsula. Distributions were derived from GPS tracking of breeding adults from six different colonies through their annual cycle during 2021-2022. I analyzed their movement and behavior in relation to offshore wind sites. Sensitivity was combined with turbines density to evaluate spatio-temporal vulnerability. Sensitivity was higher near to colonies and major foraging area during the breeding season, whereas the pattern of sensitivity was slightly different post-breeding season. Consequently, vulnerability was high near to colonies and relative major foraging sites.

### MARINE LITTER POLLUTION OF BREEDING COLONY AND HABITAT USE PATTERNS OF BLACK-TAILED GULLS IN SOUTH KOREA

#### Who-Seung Lee

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#### Abstract

Marine litter can affect the survival of the breeding population in seabird colonies. In this study, five 5m × 5m quadrats were installed at a Black-tailed Gull (*Larus crassirostris*) breeding colony on Nan Island to collect marine litter and regurgitated pellets, from which the types, sizes, and quantities of marine litter were identified. Global positioning system (GPS) devices were attached to five adult gulls to investigate their major foraging habitats during the breeding period. Eighty-two pieces of marine litter. Over half of the foraging habitats included fishing areas (ports and fish farms). This study is the first to quantitatively demonstrate the exposure of breeding period; the birds forage predominantly in fishing areas close to their breeding colonies during this period.

# HOW DOES BREEDING-FORAGING BEHAVIOR AND POST-BREEDING DISPERSAL PLASTICITY DEPEND ON HABITAT CHARACTERISTICS?

#### Seungyeon Lee, Who-Seung Lee

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#### Abstract

Pattern and tempo of the food consumption could depend on environmental variation in different lifehistory stages. Since most seabirds breed colonially, it is important in behavior ecology to know where/when they move for foraging or resting, etc. Recently, behavior tracking by using the GPS revealed new era for foraging ecology, but necessity for long-term survey has been issued. So, by using long-term GPS tracks, we investigate to understand how breeding-foraging pattern and relative postbreeding dispersal variation in seabirds depend on habitat characteristics on breeding colonies.

Black-tailed Gulls (*Larus crassirostris*) is the most dominant species in the Korean peninsula, showing that high fidelity to breeding island and dispersion to near countries (e.g., China, Japan, or Russia, etc.) after breeding. We tracked 65 adults in six breeding islands around the peninsula for 2021-2022. We reviewed and built the dataset of habitat's geological and ecological property in each colony by using GIS data and previous reports.

Foraging behavior during breeding season (June to July) was quantified as four variables (Frequency, Duration, Maximum Distance, Total Distance). Also, Maximum Distance disperse and time of leaving island for non-breeding season were analyzed to compare with breeding season behaviors.

Although each colony has unique feature, all habitats were categorized in to three parts of the peninsula: West (i.e., Yellow Sea), South, and East. Western Colonies of the peninsula where clustered islands with overpopulated seabirds showed highest foraging activity. After breeding, birds in the East traveled earlier and further than the West.

### HABITAT USE OF URBAN GULLS IN CHILE

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#### Abstract

Humans are causing impacts on the environment through numerous activities, including urbanization. While some wildlife species cannot cope with the consequences of urbanization, it might be advantageous for others. Many species of gulls are opportunistic feeders and their numbers are increasing in urban areas worldwide. Kelp Gulls (*Larus dominicanus*) are not the exception, and their increase in numbers has been associated with predictable and abundant anthropogenic food. However, accurate knowledge about their habitat use is still scarce. Here, using GSM-GPS devices we study the movement patterns of incubating Kelp Gulls (n=5) breeding in an artificial site (on top of a building) in the city of Coquimbo (29°96609S, 71°35316W), Chile. We found that Kelp Gulls were using natural and anthropogenic habitats. The most frequent areas visited were the landfill, the port, and the wetland. We confirm that urban areas are highly used by breeding gulls at Coquimbo City. Kelp Gulls using anthropogenic areas are in accordance with studies in other regions, indicating that the species has the plasticity to use human-derived food resources throughout their range. In Chile, increasing numbers of Kelp Gulls due to abundant anthropogenic food might cause conflicts with humans or other bird populations, therefore the results from this study are relevant for planning management decisions.

# DIGITAL AND OBSERVER-BASED AERIAL SURVEYS FOR MONITORING BIRDS AT SEA: METHOD COMPARISONS

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#### Abstract

Monitoring of seabirds at sea in German waters has been an ongoing project for more than 30 years. By monitoring seabirds at sea, we can detect changes in species composition, abundance, and distribution. Monitoring is made by observers on ships or planes, or by cameras on planes. Digital methods using cameras allow surveying from greater heights than observer-based methods and are becoming particularly important in the North Sea, where the average wind turbine height interferes with the observer-base aerial surveys. However, due to the novelty of digital survey methods, scarce information exists on how comparable the estimates are with observer-based surveys. To explore the difference between methods, digital and observer-based aerial surveys were carried out in parallel during the spring period between 2017 and 2019 at the German North Sea. Here, we present results from density estimates and spatial distributions generated by each method. Our results suggest that estimations are comparable between methods. However, ongoing studies are currently being made to understand under which conditions each method might perform best. Understanding the differences between digital and observer-based aerial surveys is critical for comparability of time series data, future survey planning, and for obtaining adequate estimates for species of concern in the future.

## HAKE, HERRING, OR SAURY? COMMON TERNS USE DISTINCT FORAGING AREAS FOR DIFFERENT FISH IN THE GULF OF MAINE

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#### Abstract

The purpose of this study was to identify foraging hotspots of Common Terns (*Sterna hirundo*) and investigate the use of this marine predator in the development of preyscapes in the Gulf of Maine. We hypothesized that Common Terns forage in separate areas for different species of fish. We used GPS devices to track the flights of nine individuals raising chicks on Seal Island National Wildlife Refuge during the summer of 2022. At the same time, we collected chick diet data from these same individuals over 10 days. We paired the foraging location and prey data to elucidate where birds were foraging prior to provisioning their chicks with identified prey items. We examined 74 distinct foraging trips, consisting of 28 trips for hake (*Urophycis* spp.), 27 trips for Atlantic Herring (*Clupea harengus*), and 19 trips for Atlantic Saury (*Scomberesox saurus*). Six of the nine birds provided their young with all three prey types in our study. We found that common terns forage in three separate areas for hake, herring, and saury. Our results provide insight into the foraging strategy of breeding terns and highlights marine areas that are important to provisioning seabirds in the Gulf of Maine, which is home to multiple restored seabird colonies.

# MYSTERY OF AHOUDORI: A REVIEW OF THE LOCAL EXTINCTION HISTORY OF SHORT-TAILED ALBATROSS IN THE WESTERN PACIFIC REGION

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#### Abstract

The population of Short-tailed Albatrosses (Phoebastria albatrus) dramatically declined due to the feather trade in the late 19th century and early 20th century. Although the current population is increasing according to Hasegawa's team, since there are just a few breeding colonies in Japan, they are still facing threats such as bycatch and volcanic eruption (Birdlife, 2018). We reviewed several historical papers (1899-1994) describing the short-tailed albatross colony in the Western Pacific, Northern Islets, Taiwan. It had almost the same latitude as the Diaoyutai/Senkaku Islands, one of the current breeding sites. The first formal record was published in 1899 by Tabei, which estimated that there were about 52,800 albatrosses on Pengija and Cotton Islets. We speculated that this colony formed after 1884 when Pengjia Islet became uninhabited after the Sino-French War. Meanwhile, the rapid growth in the global market of feathers encouraged Japanese hunters to catch Short-tailed Albatrosses on Torishima and Diaoyutai/Senkaku Islands. No official document recorded how or why Short-tailed Albatrosses on Northern Islets were gone, however, the population gradually decreased after 1920, plummeted after 1930, and was extinct in 1935. The massive harvests might mainly cause the extinction of the colony on Pengjia and Cotton Islets, which Japan occupied from 1895 to 1945. Based on the successful conservation action of short-tailed albatross in Japan and the rise of marine conservation awareness in Taiwan, Northern Islets and other surrounding islets might be a potential base for Procellariiformes conservation and rewilding in the Western Pacific Ocean.

### USE OF DETECTION DOGS TO FIND RARE AND ELUSIVE SEABIRDS ON SOCORRO AND GUADALUPE ISLANDS, MEXICO

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#### Abstract

The use of detection dogs is recognized as a valuable tool for conservation purposes. Dogs can be trained to locate species that are difficult to detect because they are threatened or declining. The Revillagigedo Archipelago is home to 12 breeding seabird species, including the endemic Townsend's Shearwater (*Puffinus auricularis*, TOSH), one of the most threatened seabirds worldwide (CR: critically endangered in the IUCN Red List). This species was either extirpated or its populations reduced by invasive alien species. To date, invasive mammals are being removed from Socorro Island (sheep eradicated in 2010 and cat eradication is ongoing) and we have in place a long-term monitoring program to assess and update TOSH population. Finding TOSH burrows has been challenging due to a combination of complex topography, dense vegetation and a very low density of individuals. On Guadalupe Island, feral cats extirpated breeding colonies of native and endemic seabirds from the main island, remaining only at the nearby islets. The species are recolonizing as feral cats are being removed from the island. However, their densities are very low and very difficult to detect. Therefore, detection dogs have been used to find breeding sites for Guadalupe Murrelet (Synthliboramphus hypoleucus), Ainley's (Hydrobates cheimomnestes) and Townsend's (H. socorroensis) Storm-Petrels and Black-vented Shearwater (Puffinus opisthomelas) on Guadalupe, and TOSH on Socorro. We will describe the methods we are following with detection dogs and provide some insights about the potential of this valuable tool for seabird conservation.

# PHENOTYPIC PLASTICITY IN A RAPIDLY WARMING OCEAN: CHANGES IN ATLANTIC PUFFIN BILL SIZE AND SIZE AT FLEDGING

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#### Abstract

Bergmann's and Allen's rules suggest that body size and the size of thermoregulatory structures differ between warm and cold locations, where body size decreases with temperature but thermoregulatory structures will increase proportionally in size. The Gulf of Maine (GOM) is located at the southern end of the Labrador current and many of the marine species that occupy these waters exist at the southern edge of their distributions, including Atlantic Puffins (*Fratercula arctica*; hereafter "puffin"). Monitoring of puffins at Machias Seal Island (MSI) has continued since 1995. We asked whether puffins nesting at MSI follow Bergmann's and Allen's rules, specifically whether changes in fledger body size and the proportional size of bill to body size in adults have changed with observed rapid ocean warming. We found that the size of fledgling puffins is negatively related to sea surface temperature (SST) anomalies and that adult puffin size is related to fledgling size. We found an increase in the proportional size of bill to wing chord in adults, supporting Allen's rule. Using fledger measurements, we projected adult wing chord for fledgers from 2009 – 2021 and predicted a decrease in size of adults; if supported by future measurements these data support Bergmann's rule. Our results suggest that puffins nesting in the GOM have morphological plasticity that may help them acclimate to ocean warming.

# TRADE-OFFS BETWEEN SURVIVAL AND REPRODUCTION IN TWO SPECIES OF NORTH PACIFIC ALBATROSSES

<u>Christopher Malachowski</u><sup>1</sup>, William Kendall<sup>2</sup>, Roberta Swift<sup>3</sup>, Elizabeth Flint<sup>4</sup>, Jennifer McKay<sup>5</sup>, Matthew Rogosky<sup>5</sup>, Maura Naughton<sup>6</sup>, Marc Romano<sup>7</sup>, Jun Yoshizaki<sup>1</sup>, Paul Doherty Jr.<sup>8</sup>

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#### Abstract

Understanding the trade-offs between life-history traits, such as survival and reproduction, is important for addressing numerous questions in theoretical and applied ecology. Albatrosses are wide-ranging seabirds characterized by high adult survival, delayed recruitment, and intermittent breeding. Albatrosses are also among the most threatened families of birds, and estimating demographic parameters needed to monitor population health can be challenging due to their life-history characteristics and the long time-series of data required. Further, birds are often detected off nests leading to uncertainty in state assignment (pre-breeder, breeder, skipped breeder). We developed multistate hidden Markov models that accounted for state uncertainty and used capture-markrecapture data (1980-2012) to evaluate survival, recruitment, and transition probabilities between breeding and skipped breeding states for two species of near threatened albatrosses, the Laysan Albatross (LAAL; Phoebastria immutabilis) and the Black-footed Albatross (BFAL; P. nigripes), on Tern Island, French Frigate Shoals. Our modeling framework accounted for dynamic monitoring protocols, which are common in long-term studies. LAAL had higher apparent annual survival (0.934 vs. 0.916) but greater delay in recruitment compared to BFAL. Recruitment probability had a quadratic relationship with age, and cumulative recruitment surpassed 0.9 by 11 years of age in LAAL and 9 years in BFAL. Further, LAAL had a higher probability of skipped breeding (0.115 vs. 0.036), but lower probability of remaining a skipped breeder (0.104 vs. 0.704) than BFAL. These results provide insight on albatross lifehistory strategies and demonstrate the utility of multistate hidden Markov models and capture-markrecapture data for monitoring population health of long-lived seabirds.

# PREDATION IMPACTS OF TWO CORMORANT SPECIES ON SALMONID SMOLTS AS IT RELATES TO NESTING LOCATION IN THE COLUMBIA RIVER ESTUARY

Joelle Marchiani<sup>1</sup>, Nathan Banet<sup>2</sup>, Allen Evans<sup>2</sup>, Quinn Payton<sup>2</sup>, Ken Collis<sup>2</sup>, Daniel Roby<sup>3</sup>, Timothy Lawes<sup>3</sup>

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#### Abstract

East Sand Island (ESI), located in the marine zone of the Columbia River Estuary (CRE), once supported the largest Double-crested Cormorant (Phalacrocorax auratus; DCCO) colony in the Pacific Flyway, and a large colony of Brandt's Cormorants (Phalacrocorax penicillatus; BRAC). During 2012–2015, ESI colonies averaged 13,248 DCCO and 1,727 BRAC breeding pairs. Recently, both species relocated their primary breeding colony in the CRE to the Astoria-Megler Bridge (AMB), ~8.5 km upstream of ESI and in the freshwater mixing zone. In 2021–2022, AMB colonies averaged 4,104 DCCO and 945 BRAC breeding pairs. Both species are central place foragers. Previous findings have shown greater consumption of outmigrating salmonid (Oncorhynchus spp.) smolts by DCCO nesting in the freshwater zone than of those nesting in the marine zone of the CRE. Predation impacts and foraging ecology of DCCO and BRAC nesting in the mixing zone are less documented. This study investigates differences in per-capita (per breeding pair) predation rates on juvenile salmonids by nesting cormorants as it relates to colony location in the CRE. Per-capita predation rates for DCCO were 2.2 to 5.3 times higher at the AMB (2021-2022) compared to ESI (2012–2015). Per-capita predation rates for BRAC were 1.7 to 4.1 times higher at the AMB (2022) compared to ESI (2012–2015). Results indicate a larger dietary shift toward salmonid smolts for DCCO and BRAC nesting in the freshwater mixing zone compared to the marine zone of the CRE.

# INVESTIGATING THE USES OF AUTOMATIC PIT TAG RESIGHTING IN A BURROWING SUBARCTIC SEABIRD

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#### Abstract

Investigator disturbance while monitoring seabirds often results in lower survival rates and breeding success, leaving lasting negative impacts on the population. For these reasons, researchers must seek to decrease their disturbance and time spent on breeding seabird colonies. Radio-Frequency Identification (RFID) Passive Integrated Transponder (PIT) tagging is an inexpensive and reliable way to identify individuals. However, PIT tagging has not yet been thoroughly explored as a monitoring method for seabirds. PIT tags can either be implanted subcutaneously or attached externally. Reliable automated detectors can then detect the unique PIT tag ID. This technology opens possibilities for remote monitoring of tagged individuals by collecting large amounts of data with limited disturbance. We PIT tagged Rhinoceros Auklets (Cerorhinca monocerata) nesting in artificial burrows on Middleton Island, Alaska, during the 2022 breeding season and monitored burrow entrances with RFID readers to collect resighting and nest attendance data. PIT tagged and control birds had similar breeding success and chick growth rates. Birds tagged with leg bands arrived later at the colony than subcutaneously tagged birds. Our results highlight that subcutaneous PIT tagging on the Rhinoceros Auklet is a reliable, and relatively non-invasive method for seabird monitoring compared to conventional methods. We suggest that PIT tagging has potential for monitoring of other sensitive seabird species as well. The automated detectors also provided unique insight into the natural history of the mysterious Rhinoceros Auklet and opened the door for enhanced behavioural and demographic studies.

# COMPARATIVE ANALYSES OF DIVE DURATIONS IN BIRDS WITH DIFFERENT SWIMMING MODES

#### Hiroya Matsushita<sup>1</sup>, Yuuki Watanabe<sup>2</sup>

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#### Abstract

Factors affecting dive durations of air-breathing animals remain unclear despite their importance for better understanding the foraging ecology and strategy of these animals. In this study, we tested whether the swimming modes of diving birds affect their energetic cost and, therefore, dive durations. We predicted that wing-propelled birds dive for longer durations than foot-propelled birds due to lower energetic costs of wing-propelled swimming. We compiled data on diving behavior for 72 species of diving birds and analyzed them using phylogenetically informed statistics. We found that dive durations of wing-propelled birds are 2.6 times longer than those of foot-propelled birds for a given body mass. However, several species of blue-eyed shags had unusually long dive duration despite their foot-propelled swimming style. Our results indicate that swimming mode is an important factor determining dive duration in birds, and that physiological and biochemical analyses of blue-eyed shags regarding oxygen utilization are needed in future studies.

### USING ARCHIVED GEOLOCATOR DATASETS TO EXAMINE PRE-LAYING BEHAVIOUR IN ATLANTIC PUFFINS AND RAZORBILLS

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#### Abstract

Seabirds that are sensitive to human disturbance are challenging to monitor during the pre-laying period, defined as the period after arrival at the breeding colony but prior to egg-laying. Examining archived datasets from geolocators that were deployed on multiple species year-round to examine nonbreeding movements can provide insights into pre-laying behaviour and species interactions. We investigated geolocator (MigrateTech C65+ and C330, and Lotek LAT2800) datasets for Atlantic Puffins (Fratercula arctica) and Razorbills (Alca torda) during the pre-laying period of 2020 (6,7), 2021 (13, 14), and 2022 (6,18) nearby a breeding colony (James Island), on the northeast Newfoundland coast. These light level and immersion sensor data were first used to define the pre-laying period by combining light level (i.e., duration of dark periods during the day), movement, and location estimates (i.e., near the colony). Within this period, we investigated fine-scale behaviour based on a combination of the light and wet/dry data, estimating time in the burrow or crevice (defined by a combination of dry and dark) and time spent at sea (light and wet). Analyzing these data will allow us to characterize how these species behave and potentially interact during this pre-laying period. This study supports the feasibility of gaining new insights into bird behaviour with archived geolocator datasets, allowing researchers to add to the body of knowledge without additional stress to the study species, especially during a highly sensitive period of the breeding season.

# AVIAN FLU WREAKS HAVOC IN NEWFOUNDLAND: GEOGRAPHIC AND TEMPORAL RADIATION OF SEABIRD MORTALITY

<u>Gretchen McPhail</u><sup>1</sup>, Sydney Collins<sup>1</sup>, Tori Burt<sup>1</sup>, Stephanie Avery-Gomm<sup>2</sup>, William Montevecchi<sup>1</sup>

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#### Abstract

Highly pathogenic avian influenza (HPAI) A is a group of viruses causing mass mortality among both domesticated and wild bird populations. HPAI H5 was first detected among poultry in Asia in 1996 and has since circulated through Asia to Russia, Europe, Africa, and North America. HPAI A (H5N1) was found in Newfoundland and Labrador (NL), Canada, in December 2021. We collected observations of stranded, sick, and dying birds throughout NL to document the spatial and temporal distribution of H5N1. Starting in May 2022, dead seabirds appeared on the west coast of the island, moving progressively eastward along the southern coast then northward along the eastern coast. Observations of infected birds peaked in August. The greatest mortality from H5N1 occurred, in decreasing order, in Common Murre, Northern Gannet, Atlantic Puffin, and Black-legged Kittiwake. These results support the hypothesis that mortality was positively associated with nesting density, though population effects remain to be seen. Unexpectedly, there was no evidence of high mortality among scavenger species including gulls and eagles. Though uncommon, observations of infected trans-equatorial migrants raise concern about their potential as vectors for further virus circulation to the Southern Ocean. We expect ongoing effects of H5N1 over an expanding global scale.

# POPULATION TRENDS OF SEABIRDS IN MEXICAN ISLANDS AT THE CALIFORNIA CURRENT SYSTEM

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#### Abstract

The Baja California Pacific Islands (BCPI) is a seabird hotspot in the southern California Current System supporting 129 seabird breeding populations of 23 species. It had a history of environmental degradation because of invasive alien species, human disturbance, and contaminants that caused the extirpation of 27 seabird populations. Most of the invasive mammals have been eradicated and colonies restored with social attraction techniques. We have recorded the number of breeding pairs annually for most of the colonies since 2008. The maximum number of breeding pairs for each nesting season was used to estimate the population growth rate ( $\lambda$ ) for each species at every island colony. We performed a moving block bootstrap analysis to assess whether seabird breeding populations are increasing or decreasing. San Benito, Natividad, and San Jerónimo are the top three islands in terms of abundance of breeding pairs. The most widespread species is Cassin's Auklet with 14 colonies. Thirty-one populations of 14 species are significantly increasing while eleven populations of seven species are decreasing. We did not find statistical significance for 19 populations, however, 15 have  $\lambda$ >1 which suggest they are growing. Twelve of the 18 species for which we estimated a regional population trend are significantly increasing. The BCPI support between 400,000 and 1.4 million breeding individuals annually. Our results suggest that these islands support resilient and growing populations of seabirds, and that such resilience has been strengthen from conservation and restoration actions such as the eradication of invasive mammals, social attraction techniques and island biosecurity.

## CHARACTERIZING MARINE FORAGING HABITAT FOR THE ENDANGERED MARBLED MURRELET IN THE SOUTHERN PUGET SOUND

#### Max Merrill

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#### Abstract

Marbled Murrelets (*Brachyramphus marmoratus*), a small seabird from the Alcidae family, are currently listed as endangered in Washington, Oregon and California. In the Pacific Northwest, their population dropped by 30% between 2000 and 2010 and is still declining. These murrelets rely on both marine habitat for foraging and terrestrial old growth forests for breeding, which makes them highly vulnerable to anthropogenic disturbances. Marbled murrelet marine habitat use in the South Puget Sound is under researched. Understanding the regional habitat use of marbled murrelets will be essential when informing conservation specific to the South Puget Sound. I conducted shore-based surveys from early June through early August at Browns Point Lighthouse (BPLH) in Tacoma, WA. During instantaneous counts, the number of Marbled Murrelets present, their foraging behavior and location were recorded along with boat traffic close to the foraging habitat and Marbled Murrelet responses to boats, if any. Dive intensity (number of dives in a 10-minute period) and dive duration were collected opportunistically. At BPLH, the foraging locations of the marbled murrelets were consistent between the summer of 2021 and 2022. The average dive duration and dive intensity were also found to be comparable between the two summers. BPLH has been found to be an annually consistent foraging area for marbled murrelets. This consistency suggests BPLH is an important marine habitat for the endangered Marbled Murrelet.

## SPECIALISTS, GENERALISTS, AND THE FUTURE: LINKING DIET AND PHENOLOGICAL FLEXIBILITY THROUGH META-ANALYSIS

<u>Amy Miles</u><sup>1</sup>, Thomas Hahn<sup>1</sup>, Marcel Holyoak<sup>1</sup>, John Wingfield<sup>1</sup>, Mike Johns<sup>2</sup>, Heather Major<sup>3</sup>, Joshua Hull<sup>1</sup>

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#### Abstract

As the timing of biological events shift with the progression of climate change, the threat of mistiming life history stages is becoming increasingly acute. A theoretical understanding of why certain seabird species may or may not have the flexibility to shift their phenology is vital as we work to protect threatened species. A commonly discussed threat to species the world over is trophic mismatch, where the timing of breeding (an extremely energetically demanding life history stage) does not overlap with the peak availability of prey resources. The diversity of prey a seabird parent is behaviorally and physiologically capable of using may be key in whether they shift breeding timing to match shifts in prey phenology or not. In this study, we used a global dataset of 49 seabird species from 68 colonies worldwide to investigate how diet diversity and the capacity for prey-switching relates to phenological flexibility and how a species' capacity for prey-switching affects whether they show changes in breeding phenology over time, using a combination of generalized linear mixed models, structural equation modeling, and meta-analysis. While we found evidence that greater diet diversity is associated with greater year-to-year phenological variability, this does not seem to translate to differences in directional phenological shifts over the course of long-term monitoring data.

## A REVIEW OF SEABIRD BYCATCH AND MITIGATION EFFORTS IN ALASKA FISHERIES FROM 2012 THROUGH 2022

Joshua Moffi, Cathy Tide

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#### Abstract

Alaska has some of the most productive marine ecosystems in the world. Over 90% of U.S. breeding seabird populations, approximately 50 million birds from 39 species, use waters off Alaska during their life cycle. In waters off Alaska, hook-and-line fishing vessels use seabird avoidance measures to minimize seabird bycatch. However, despite these avoidance measures, seabirds are caught unintentionally as bycatch in certain commercial fisheries off Alaska. NOAA's 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. 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 seabird bycatch and mitigation efforts off Alaska in the federal commercial groundfish (2012-2022) and halibut fisheries (2013-2022) will be presented.

## POSITIVE ASSOCIATIONS AMONG SEABIRDS AND MARINE MAMMALS IN THE CALIFORNIA CURRENT

#### Samantha Monier<sup>1,2</sup>, Richard Veit<sup>1,2</sup>, Lisa Manne<sup>1,2</sup>, Jarrod Santora<sup>3,4</sup>

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#### Abstract

Social interactions are a ubiquitous and critical component of seabird foraging behavior. We studied atsea interspecific associations among foraging seabirds and marine mammals in the California Current between 1996 and 2018. Recurrent Group Analysis was used to identify pairs of species with a "strong affinity" for one another, that were a "nearly constant part of each other's biological environment" (i.e., species associating in both time and space). Although only 26% of species were found to significantly associate with at least one other species, these species accounted for >97% of all individuals sighted during the survey. These 18 seabirds and 4 marine mammals formed 97 unique significant pairings. We tested for interannual variations in the number of pairings that form in a given year; most pairings were low fidelity, with the majority occurring in only 1 of the 20 survey years, however, some species paired repeatedly, such as Common Murre and Western Gull which were associated every year. Utilizing others for foraging success (e.g., via local enhancement) may place these species disproportionately at risk to declines in biodiversity. Thus, it may be important to conserve groups of species that facilitate one another as units of biodiversity. Of immediate concern is that anthropogenic changes may be altering the quantity and quality of these associations, with potential fitness consequences for the species involved. Knowledge gained from this study will lead to a better understanding of the structural components of ecological networks.

### IF NOT FOR BAD NEWS THERE WOULD BE NO NEWS AT ALL: CURRENT RISKS AND DEVELOPMENTS FOR SEABIRDS IN THE NORTHWEST ATLANTIC

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### Abstract

Unprecedented changes are ongoing throughout the world's oceans. In the Northwest Atlantic, seabirds are experiencing incrementing risks associated with climate change, avian influenza (H5N1), extreme heatwaves, light pollution, and their interactions. Anthropogenic risks (e.g., light pollution) afford more direct options for mitigation. We overview major seabird events in Newfoundland and Labrador (NL), Canada that occurred during 2022. In late April, strong offshore winds pushed sea ice offshore from the southern Labrador coast where Thick-billed Murres were aggregating for movement to Arctic colonies. Rapid temperature declines and high winds induced irreversible hypothermic stress in the icedependent murres; tens of thousands likely perished. From spring through fall, Leach's Storm-Petrels experienced multiple wrecks associated with anthropogenic light and onshore gales. Strandings peaked in October when fledglings were departing colonies. Throughout summer, the H5N1 virus radiated eastwards along the south, east and northeast Newfoundland coasts, leaving swaths of dying and dead Common Murres, Northern Gannets, Black-legged Kittiwakes, Razorbills, Atlantic Puffins, and others. Many tens of thousands likely died, with the densest nesting species (murres, gannets) exhibiting the greatest losses. Mortality at the Cape St. Mary's gannet colony coincided with a sharp rise in sea surface temperature in early August. While 2022 saw unprecedented seabird mortality in Newfoundland, new research initiatives including analyses of personality and social media reports of stranded seabirds and ongoing conservation efforts provide some hope for better understanding and survival.
## CLIMATE VARIABILITY AND REPRODUCTIVE SUCCESS OF LAYSAN ALBATROSS

<u>Amanda Munro</u><sup>1</sup>, Rob Suryan<sup>2</sup>, Annette Henry<sup>3</sup>, David Kacev<sup>4</sup>, Jonathan Plissner<sup>5</sup>, Roberta Swift<sup>6</sup>, Trevor Joyce<sup>3</sup>

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### Abstract

Reproductive responses to environmental extremes associated with short-term climate events may provide important clues to the potential responses of species to long-term changes in global climate. This study examined reproductive success of Molī or Laysan Albatross (*Phoebastria immutabilis*) in association with large scale oceanographic and local environmental variability at Sand Island, within Midway Atoll, which is the largest breeding colony in the world. Productivity of Laysan Albatross showed declines in association with high local air temperatures, negative North Pacific Gyre Oscillation index, and greater distance from Midway Atoll to the Transition Zone Chlorophyll Front. Further study of the impact of these variables is necessary to fully understand how future climate change may impact reproductive success at different locations within the Laysan Albatross' North Pacific subtropical range.

## UNDERSTANDING BIODIVERSITY ACROSS SPACE AND TIME TO INFORM POLICY: A CASE STUDY ON THE PACIFIC COAST

#### Rossy Natale

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#### Abstract

Quantifying how biodiversity is spread across space aids in conservation, policy, and land management planning. Migratory species, such as many seabirds, complicate our understanding of spatial biodiversity patterns given that their presence and abundance at any given location changes dramatically over annual cycles. Here, I will present an analytical framework that utilizes freely available spatial data in combination with phylogenetic and trait data to quantify both spatial and temporal biodiversity. While this presentation focuses on an order of seabirds and shorebirds (Charadriiformes) across the Pacific coast as a case study, these methods can be readily applied to other locations and species. I use this case study to demonstrate two major outcomes of analyzing biodiversity in this framework: 1) the identification of spatial and temporal mismatch between various facets of biodiversity (taxonomic, phylogenetic, and functional biodiversity); and 2) the identification of biotic and abiotic factors that may be contributing to differences in biodiversity across space and time. Given the relatively efficient workflow and ability to provide an understanding of patterns at any given spatial scale, this method has strong potential utility for applied researchers and land managers who focus on migratory species and/or on locations with pronounced changes in species composition during annual migration cycles.

## OBSERVATION OF FEEDING AND FIGHTING BEHAVIOR OF SURFACE-FEEDING ALBATROSSES IN THE WESTERN NORTH PACIFIC

#### Daisuke Ochi<sup>1</sup>, Shintaro Ueno<sup>1</sup>, Tsukasa Kondo<sup>2</sup>

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#### Abstract

Albatross species, which have low diving ability, often utilize floating dead carcasses, fishery discards and fishing bait on the ocean surface as food. Many individuals are attracted to such a limited food source in the pelagic ocean, causing them to fight for. Although this feeding and fighting behavior can provide important insight for understanding the bycatch process of surface feeding albatrosses, there are few examples of ethological analysis of this behavior. Therefore, video footage was taken of the feeding and fighting behavior of albatross species off Northeast Honshu in May 2022. An action camera with adjusted buoyancy was attached to a shark liver that mimicked a fishery discard and deployed. The floating camera was released from the research vessel and video footage was taken of attracted albatrosses to the bait. The trial was conducted 14 times, capturing the successfully foraging and fighting behaviors of albatross of these albatrosses was described and it was found that Laysan albatrosses engaged in more direct feeding behavior, while Black-footed and Short-tailed Albatross more frequently displayed threatening behavior. Although there were some disadvantages to the floating camera, it was expected to be a useful tool for observing the foraging and fighting behavior of albatrosses and other surface feeding seabirds.

# PARTNERING FOR ALEUTIAN TERN CONSERVATION IN ALASKA: IMPLEMENTING A STATEWIDE COLONY CENSUS PROTOCOL

Susan Oehlers<sup>1</sup>, Robert Kaler<sup>2</sup>, Robin Corcoran<sup>3</sup>, Trent McDonald<sup>4</sup>, Michael Goldstein<sup>5</sup>, Heather Renner<sup>6</sup>, Donald Lyons<sup>7</sup>, Megan Boldenow<sup>2</sup>, Nathaniel Catterson<sup>1</sup>, Daniel Pepin<sup>8</sup>, Alison Williams<sup>9</sup>

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### Abstract

The Aleutian Tern (Onychoprion aleuticus; ALTE) is one of Alaska's most imperiled seabirds, having undergone population declines of more than 80% at known colonies in recent decades. The Pacific Seabird Group's Aleutian Tern Technical Committee (ATTC) has created a diverse and collaborative partnership to develop and implement a list of prioritized projects that benefits ALTE conservation in Alaska. An updated population estimate, and a complete understanding of statewide distribution, are necessary to confirm documented trends and assess species status. To that end, detecting breeding activity in previously un-surveyed areas is a high priority. A subset of ATTC members with support from National Fish and Wildlife Foundation, developed and pilot tested a colony survey framework in the Bristol Bay Region of Alaska in 2021 and 2022. The two-phase methodology included aerial surveys of potential habitat, documenting colony presence, size, and species composition (ALTE and Arctic Terns). We used double-observer line transects integrated with distance sampling to estimate abundance and detectability. We conducted direct ground counts at a sample of colonies. In 2022, after adjusting for detectability, we estimated a total of 51 tern colonies in the 3,978 km2 study area (density of 0.01 colonies/km<sup>2</sup>), and we detected 87 colonies over two seasons. Some of these colonies were mixed and some single species. The 2021 and 2022 pilot work has informed the final statewide survey protocol that we will implement from 2023-2025, beginning in eastern coastal Alaska. Here, we will present survey methodology, pilot results, and lessons learned.

# UNVEILING RECIPROCAL CONTRIBUTIONS BETWEEN FISHERS AND SEABIRDS IN THE PATAGONIAN HAKE FISHERY

#### Jaime Ojeda<sup>1,2</sup>, Flavia Morello<sup>2</sup>, Cristán G. Suazo<sup>3</sup>, Natalie C. Ban<sup>1</sup>

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#### Abstract

Fishing activities are often characterized by how marine life benefits people (ecosystem services between fishers and commercial species). Alternatively, Indigenous scholars and ethical thinkers emphasize the need to encompass other ways of relationship, such as reciprocity and reciprocal contributions between people and nature. This work explores the reciprocal contributions between artisanal hake fishers and seabirds in Patagonia, Chile. Using an ethnographical approach, we conducted semi-structured interviews with hake fishers and performed participant observations of fishing operations to understand fishers' relationships with seabirds. From a seabird's ecological perspective, we evaluated food provision from fishers to seabirds by consumption offal based on stomach, liver, and gonad items. We randomly offered offal items to understand feeding preferences. From fisher perceptions, we found four common attributes: seabirds are indicators of productive areas, seabirds provide companionship in fishing activities, albatrosses are part of the scenic beauty, and seabirds help to clean the sea. From a seabird perspective, we found that seabirds consumed the liver 99% of the time, while they consumed less stomach (31.8%). Both Southern Giant Petrels (61.4%) and Black-browed Albatrosses (28.6%) consumed more liver, while kelp gulls (60.6%) were the most common in the stomach item. The liver is composed of 51.6% fat, essential for top-level marine predators such as southern giant petrels. In conclusion, the characterization of reciprocal contributions between fishers and seabirds helps unveil the cultural, social, and ecological connections that management assessments can ignore in fisheries.

## DIVING TO THE BOTTOM: MAPPING COASTAL AND ESTUARINE BATHYMETRY USING BENTHIC DIVES OF TAGGED CORMORANTS

<u>Rachael Orben</u><sup>1</sup>, Adam Peck-Richardson<sup>2</sup>, Alexa Piggott<sup>2</sup>, Dylan Winters<sup>3</sup>, Sabir Bin Muzaffar<sup>4</sup>, Alexa Foster<sup>5</sup>, Greg Wilson<sup>6</sup>, James Lerczak<sup>6</sup>

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### Abstract

The coastal oceans sustain high human use, yet the spatial resolution of bathymetric measurements can be lacking due to the complexity of coastal habitats. Furthermore, bathymetry can change due to surf and current action. The ability to measure bathymetry from benthic diving marine megafauna is an overlooked opportunity to integrate animal-borne instruments into ocean observing systems. Herein, we describe the use of biologging to measure the bathymetry within the foraging ranges of three species of cormorant. We use customized biologging tags (Ornitela, ~26 g) to take GPS fixes when birds resurface to georeference each dive. We identified bottom dives from the vertical component of dive velocity using a threshold approach. We demonstrate that Brandt's Cormorants (Urile penicillatus) foraging in the Columbia River estuary map changes in the navigational channel over time. Pelagic Cormorants (Urile pelagicus) forging in the Gulf of Alaska provide valuable nearshore depth soundings around Middleton Island where bathymetry is outdated. Socotra Cormorants (Phalacrocorax nigrogularis) foraging in the Arabian Gulf offer a broad scale cormorant derived bathymetry. Using these datasets, we also compare the cormorant derived bathymetry to the current GEBCO and ETOPO 2022 global bathymetry datasets (both at 450 m resolution) to look at the congruence of depth values and, from GEBCO, the associated data sources (e.g., multibeam, sounding, seismic, satellite-derived). Our goal is to contribute cormorant depth soundings to these databases to allow for multi-purpose use of seabird biologging data and contribute to global ocean observing systems of the littoral zone.

# EFFECT OF OIL SPILL DISPERSANT USE ON MARINE BIRDS: A REVIEW OF SCIENTIFIC LITERATURE AND IDENTIFICATION OF INFORMATION GAPS

#### Orla Osborne<sup>1</sup>, Megan Willie<sup>2</sup>, Patrick O'Hara<sup>3</sup>

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#### Abstract

Dispersants are a class of chemical treating agents commonly used globally as an alternative response measure to mitigate impacts from oil spills. Applying dispersants on an oil slick can enhance natural dispersion, transferring oil from the surface to the water column. Enhanced dispersion largely reduces impacts on sea surface-dwelling animals and reduces the likelihood that spilled oil reaches the shore potentially impacting sensitive coastal habitats. However, this benefit comes with the cost of increasing oil exposure risk to marine biota in the water column, including diving marine birds.

In Canada, dispersants are being proposed for expanded use beyond treating spills from an offshore oil and gas facilities. The use of dispersants would be considered in a formal decision-making framework such as NEBA (Net Environmental Benefits Analysis) for determining their use in any oil spill scenario. For this reason, it is necessary to assess and document the potential impacts from dispersant use on marine birds comprehensively. Here we present the results from an exhaustive literature review to identify both the direct and indirect effects of their use. We used a Pathway of Effects (POE) conceptual model as a tool for understanding the interactions between dispersants, marine birds, and their environment in order to support an ecosystem-based level input into the NEBA process determining the appropriateness of dispersant use in an oil spill response. We also identify important information gaps that need to be addressed to effectively inform a NEBA when considering the use of dispersants.

# PRODUCTIVITY BASELINE TRENDS OF THE THREE CORMORANT SPECIES WITHIN THE CAPE PERPETUA MARINE PROTECTED AREA

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<sup>1</sup>U.S Fish and Wildlife Service, Newport, Oregon, USA. <sup>2</sup>Portland Audubon, Portland, Oregon, USA

#### Abstract

The statewide planning goal Oregon's Marine Protected Areas is to conserve renewable marine resources, promote biological diversity of marine life, and protect key habitat types. Seabirds act as sentinels of ocean conditions. Health of the marine environment can be monitored and suggested through seabird population health, reproductive success, and recruitment. Portland Audubon, U.S Fish and Wildlife Service, community scientists, and Sealion Caves, a private business in Florence, Oregon has allowed monitored reproductive success of three cormorant species at Heceta Head and Oregon Island National Wildlife Refuge within the Cape Perpetua Marine Protected Area. Productivity monitoring of Brandt's (Phalacrocorax penicillatus), Pelagic (Phalacrocorax pelagicus), and Double-crested (Phalacrocorax auratus) Cormorant has been an observational study. Established nests from three different sites were randomly selected and monitored until fledging or the nest was deemed unsuccessful with failure to produce an egg or mortality of young. This monitoring effort has been in effect since 2014 in order to suggest the changes in resource variability and oceanic conditions since the establishment of Cape Perpetua marine protected area in 2010. Trends over the last eight years resulted in interannual variability across species, nesting sites, and years; likely due to annual variable oceanic conditions. Brandt's Cormorants were the only species that showed a net positive increase in productivity, however the little change in productivity in Pelagic and Double-crested may leave the success and productivity of the marine protected area up for debate and further studies.

# BROWN PELICAN BREEDING EFFORT AND FLEDGLING PRODUCTION IN SOUTHERN CALIFORNIA IS HIGHEST IN MORE THAN 50 YEARS

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### Abstract

The California Brown Pelicans' Southern California Bight (SCB) sub-population experienced multi-year breeding failures (particularly 2012-2015) soon after federal and state de-listing in 2009. As a result, monitoring efforts were increased from 2016-2021 to investigate reasons for the breeding failures and, if needed, to take action to ensure that pelican populations remained secure at this sub-population's only active nesting colonies—Santa Barbara and Anacapa islands. During this study, SCB pelicans experienced some of the highest breeding performance (nest attempts and fledged young) recorded for this sub-population since monitoring began in 1969, and likely for a much longer period, especially in breeding population size. The number of nests increased during the study with over 13,000 nests documented in 2021, an increase of 235% since 2016. The number of fledged chicks peaked at over 13,500 in 2019 and breeding seasons were protracted with breeding activity occasionally occurring yearround, but still peaking in the spring season. This sub-population increase has occurred concomitant with a severe decrease in the major breeding colonies in the Gulf of California. We discuss potential reasons for this meta-population phenomenon and place these results into perspective with over 50 years of historical insight.

# COMMON RAVEN IMPACTS ON ASHY STORM-PETRELS WITHIN CHANNEL ISLANDS NATIONAL PARK

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## Abstract

Ashy Storm-petrels (*Hydrobates homochroa*; ASSP) are a rare seabird endemic to California and northern Baja California. ASSP are listed as endangered by IUCN, and considered extremely vulnerable due to a small population size, limited range, and vulnerability to depredation. Reproductive monitoring for this species at Channel Islands National Park has been ongoing since the mid-1990s. Since 2010, monitoring of Santa Cruz Island colonies has documented substantial depredation by Common Ravens (*Corvus corax*) on offshore rocks and sea caves. In order to provide safe nesting habitat, various iterations of artificial nesting modules have been deployed over the last decade. In 2019, a Common Raven study was initiated to better understand raven predation through GPS tracking of individuals and camera monitoring in key colonies. Between 2019 and 2021, this study demonstrated that one mated raven pair was responsible for a majority of predation events on adult ASSP (n=50 carcasses/feather piles collected) in Bat Cave where approximately 100 ASSP pairs nest. The Park and its partners are now pursuing the following activities: 1) targeted removal of the responsible raven pair; 2) understanding the impact of removal0; 3) identifying corvid impacts on other rare seabird species/colonies; and 4) development of a corvid management plan. Lessons learned from the monitoring and conservation measures will inform future management of ASSP across its range.

# THE EFFECT OF URBANIZATION ON THE MICROBIOMES OF CALIFORNIA GULLS (LARUS CALIFORNICUS)

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#### Abstract

Recent studies using biologging devices and measures of stable isotope analysis confirm that landfills and urban centers are important foraging habitats for both Western (Larus occidentalis) and California (L. californicus) Gulls in the San Francisco Bay. These adaptations in foraging behavior can result in exposures to and alterations in, the microbial communities found on gulls that influence physiological functions, growth, and immune response to pathogens. Here, we collected swabs from the feet, mouth, and cloaca of 66 breeding California Gulls from two distinct environments: an urban population in San Francisco Bay (n=39) and a rural population in Mono Lake (n=27), Sierra Nevada Range. We hypothesized that microbial diversity would be higher in urban nesting California Gulls due to exposure to foreign microbes while feeding at landfills. DNA extractions of biomaterial on each swab (average of 614.0 ng/ $\mu$ l per swab) were performed using molecular methods. The 16S rRNA V4 region was sequenced using the pair-end reads approach on the Illumina MiSeq platform to yield 250 bp contigs. A bioinformatics pipeline was used to analyze and identify microbial taxa. By applying similar methods to previous studies on gulls, we were able to test whether California Gulls nesting in San Francisco Bay have similar microbial diversity and composition to Western Gulls nesting in the same region. Results from this study can elucidate which microorganisms are common to California Gulls, which unique microbes are associated with each population, and how foraging in different habitats can facilitate exposure to potentially beneficial or harmful microbes.

## DO MURRELETS PREFER FISH OR TREES: MARINE HABITAT SUITABILITY FOR MARBLED MURRELETS ON THE SALISH SEA

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### Abstract

The Marbled Murrelet (*Brachyramphus marmoratus*) is listed as Threatened in Canada primarily due to the loss of old-growth nesting habitat and risks from oiling, gillnet entanglement, and ocean climate change impacts on prey populations. Due to the highest rates of population decline in southern conservation regions of British Columbia, attention has been focused on birds inhabiting the Salish Sea. Using at-sea surveys and marine point counts from 1990 onwards, we explore and describe spatial trends over decades with a time series of Kernel Density Estimation plots. Using a generalized additive model framework, we use relevant environmental factors, including a new Pacific Sand Lance (*Ammodytes hexapterus*) habitat prediction layer, and an updated suitable nesting habitat layer, to explore associations between environmental attributes and at-sea counts. These predictive models are used to identify potential areas of importance, as well as update first-generation models of candidate marine Critical Habitats part of the species' Recovery Strategy.

# PLASTIC INGESTION – A SENSORY ECOLOGY APPROACH

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#### Abstract

Plastic ingestion is a global threat to many marine animals including seabirds. Currently, there is a research gap connecting the relationship between sensory ecology and plastic ingestion. My master's project looked at how plastic in the ocean changes over time and viewed seabird plastic ingestion from a sensory ecological perspective. My main study species are the albatrosses, gannets and shags which have different foraging strategies. For the first part of my research, I placed contained samples of hard and soft plastics in the ocean and measured changes in colour and odour at monthly intervals using mass spectra gas chromatography and spectrometry. The reflectance spectra of these plastics were modelled into the previously developed vision systems of two seabird species. For the next part of my research, I collected and compared the sensory morphological features of birds as well as types of plastics found in faecal samples, and gut contents of albatrosses, shags and gannets around New Zealand. From the plastic deployment study, I found that sulphur compounds associated with feeding in top marine predators increased as plastics spent longer in the ocean. Seabirds are more easily able to distinguish between plastics reflecting at a shorter wavelength that have spent different amounts of time in the ocean compared to plastics that reflect longer wavelengths. Morphological comparisons also revealed different amounts of investment in vision and olfaction according to species and feeding behaviour.

## A 31-YEAR TIME SERIES REVEALS A WEAK NEGATIVE TREND IN MARBLED MURRELET AT-SEA COUNTS IN LASKEEK BAY, HAIDA GWAII

Vivian Pattison<sup>1</sup>, Mark Drever<sup>2</sup>, Doug Bertram<sup>1</sup>, Sonya Pastran<sup>1</sup>, Anthony Gaston<sup>3,4</sup>, Rian Dickson<sup>3</sup>

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### Abstract

The Marbled Murrelet (Brachyramphus marmoratus) breeds and overwinters along the British Columbia (BC) coast, and is listed as threatened under the Canadian Species at Risk Act. Understanding population trends for this seabird species is critical for management and recovery, and long-term time series of murrelet abundance are rare. At-sea counts provide important information on the marine distribution of murrelets. In this study, we report on the long-term trends and annual fluctuations of Marbled Murrelets as observed during at-sea counts in Laskeek Bay, Haida Gwaii, on the northern Pacific coast of Canada, from 1990 to 2020. We found a weak, non-significant, negative trend (1.55 % decline per year), and found that counts varied throughout the season with peaks occurring in early June. The abundance of murrelets varied spatially, and highest abundances of murrelets occurred within 1km of shore. Importantly, a change in survey protocol that reduced the transect width from 400 m to 100 m resulted in lower counts after 1996. Inter-annual fluctuations in counts were high, although we found no significant relationships between murrelet counts and large-scale oceanographic cycles or more localized indicators of ocean productivity. The weak negative trend in at-sea counts reflects trends derived from systematic radar counts for the Haida Gwaii Conservation Region (-2.8 % per year) over a similar period. This study emphasizes the need to investigate fluctuations in at-sea murrelet counts more closely to understand movement of birds between regions.

## EVALUATING REPRODUCTION OF WEDGE-TAILED SHEARWATERS AT KĪLAUEA POINT N.W.R. PRIOR TO PREDATOR EXCLUSION FENCE CONSTRUCTION

Lauren Pederson<sup>1</sup>, <u>Dylan Blanchard</u><sup>1</sup>, Lindsay Young<sup>1</sup>, Eric VanderWerf<sup>1</sup>, Tristan Luxner<sup>2</sup>, Brooke Burrows<sup>2</sup>, Heather Tonneson<sup>2</sup>

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### Abstract

Predator-exclusion fences, capable of excluding all mammalian predators, have been highly effective tools for protecting island bird species across Hawai'i and New Zealand. In 2022 construction began on a predator-exclusion fence to replace an existing ungulate fence to protect more than 160 acres of native bird habitat at Kīlauea Point National Wildlife Refuge (KPNWR) on the island of Kaua'i, Hawai'i. The purpose of the fence is to protect the eight breeding species of seabirds and waterbirds that reside on the refuge against predation by non-native mammals (pigs, cats, and rats). Upon completion this will be the longest predator-exclusion fence in Hawai'i. Baseline biomonitoring was conducted from April-October 2022 to assess the nesting success of five native seabird species. Approximately 21,000 Wedge-tailed Shearwater (*Ardenna pacifica*) pairs nest on the refuge, making predation by feral cats and pigs particularly noticeable and thus an ideal indicator species for eradication outcomes. We monitored more than 500 active nests to determine Wedge-tailed Shearwater reproductive success. This dataset provides a pre-eradication baseline of Wedge-tailed Shearwater reproductive success in different habitat types across KPNWR, resulting in an overall nest success rate of 58.1%. Following the eradication of invasive mammalian predators inside the fence, the biomonitoring will be repeated to determine the fence's effectiveness.

# NIGHT LIGHTS AND SEABIRD BEHAVIOR – WHAT WE OBSERVE, UNRESOLVED QUESTIONS AND A NEED TO BE PROACTIVE

#### Jay Penniman

Maui Nui Seabird Recovery Project, Makawao, Hawai'i, USA. Pacific Cooperative Studies Unit, Honolulu, Hawai'i, USA

#### Abstract

Seabird distraction, misorientation and grounding is often attributed to artificial light at night (ALAN). While there is ample anecdotal evidence for this hypothesis, there are numerous potential contributing causal factors which remain to be tested. For example, the role of other potential distractions such as olfactory or auditory stimuli, and environmental factors such as moon phase, wind direction and speed, and visibility. These, and other considerations, have been clearly discussed in a recent paper by Brown, et al. The research needs they identify are valid and deserve addressing. Meanwhile there is a growing body of research documenting the increase of light pollution across the planet and its ecologically disruptive impacts on a large array of taxa. Short wavelength light spectra in ALAN have been shown to be particularly disruptive of astronomical observations, due to their propensity for Rayleigh scattering, and of circadian rhythms of many organisms. This may also disrupt magnetoreception in seabirds or confuse instinctual knowledge of bioluminescent prey that young birds have yet to fully develop. A review of evidence of reduced seabird distraction and fallout when short wavelength spectral content in ALAN is minimized provides support for efforts to address light pollution and seabird fallout by following National Park guidelines to use long wavelength light, keep lights as low as possible and fully shield all lights.

# MULTIDIMENSIONAL NICHE DIFFERENTIATION IN SYMPATRIC CHICK-REARING AUKS

#### Christina Petalas<sup>1</sup>, Kyle Elliott<sup>1</sup>, Raphael Lavoie<sup>2</sup>

<sup>1</sup>McGill University, Montreal, Quebec, Canada. <sup>2</sup>Environment Climate Change Canada, Quebec, Quebec, Canada

### Abstract

Ecological niche theory predicts that similar coexisting species cannot coexist in the same space when resources are limiting. Sympatric seabirds are ideal systems to investigate mechanisms of niche differentiation, as seabirds often share life history traits and form dense mutli-species breeding colonies that forage on common prey. Differentiation among species may be driven by variation in wing-loading, aerobic dive limit, and visual acuity leading each species to forage at different distances around the colony, optimum dive depths, or times of day, respectively. We tested this theory at the Mingan Archipelago National Park Reserve (Gulf of St. Lawrence) using GPS-TDR devices and satelliteenvironmental data on similar chick-rearing sympatric species: Atlantic Puffins (Fratercula arctica), Razorbills (Alca torda), and Common Murres (Uria aalge). We show high niche overlap in geographical foraging areas. Rather, partitioning was greatest in vertical depth, followed by time, than horizontal location. Razorbills and puffins both exploited the same shallow foraging areas. However, puffin foraging activity occurred at different times of day and in deeper water columns than Razorbills. Murres foraged in the deepest benthic areas, and were the only species to forage at night. These foraging differences reveal niche partitioning across multiple dimensions. Ultimately, investigating niche differentiation along multiple dimensions can provide insight into the mechanisms allowing for coexistence that are not apparent when only few are considered.

## THE PARADOX OF TUFTED PUFFIN POPULATION DECLINES IN NORTH AMERICA

John Piatt, Mayumi Arimitsu

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#### Abstract

The Tufted Puffin (Fratercula cirrhata) is an iconic and abundant seabird that breeds widely throughout subarctic and arctic regions of the North Pacific. Despite their ecological success, and fewer anthropogenic factors (e.g., net-bycatch, invasive predators) impacting populations today than in the past, West Coast (WC) and some Gulf of Alaska (GOA) populations have declined markedly in recent decades, while some colonies in the Aleutians may be stable. Whereas 65% of colonies on the WC have been surveyed, only 0.9% of colonies in Alaska (AK) have been monitored, using plots sampling <5% of island habitat, and so our power to detect population change in Alaska is limited. We examined Tufted Puffin population trends using a completely different method, i.e., we used Vector Autoregressive Spatio-Temporal (VAST) modeling of at-sea densities recorded on >500K transects archived in the North Pacific Pelagic Seabird Database. We binned data collected from 1974-2021 into stanzas (7-11 yr) separated by significant oceanic climate shifts and estimated average puffin population size over the entire U.S. continental shelf from California to the Arctic during each stanza. Analysis suggests that the NA puffin population declined by about half from 3.5-4.0 M birds in decades prior to 1999, to about 2.0M birds in following decades (2000-2021). We also analyzed trends in 10 mesoscale areas distinguished by regional variation in puffin diet composition and found different rates of decline among these areas. We hypothesize that population changes at that spatial scale reflect the changing status of regional food webs and discuss supporting evidence.

## **CORMORANT OCEANOGRAPHY PROJECT**

<u>Alexa Piggott</u><sup>1</sup>, Adam Peck-Richardson<sup>1</sup>, Dylan Winters<sup>2,1</sup>, Dorukhan Ardağ<sup>3,1</sup>, Greg Wilson<sup>1</sup>, Rachael Orben<sup>4</sup>, James Lerczak<sup>1</sup>

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#### Abstract

The Cormorant Oceanography Project is an interdisciplinary collaboration between physical oceanographers, oceanographic numerical modelers, and seabird ecologists. We are developing and deploying solar-powered, network-connected (GSM) biologging tags to measure in situ oceanographic data along the daily foraging paths of cormorants. Here we present an overview of our biologging tag developments, collaborations, field deployments, analytical methods, and data processing and publishing pipeline. To date we have built international collaborations with partners from 20 countries, across 6 continents and plan to deploy biologging tags on 15 different cormorant species. These deployments provide opportunities to field trial GPS tags with integrated conductivity, temperature, depth (pressure) sensors (CTDs), external thermistors, and inertial motion sensors (IMUs) while simultaneously collecting movement ecology data on cormorant species. We also refined tag sampling and analytical methods to estimate surface current speeds from drifting birds (GPS), salinity, temperature profiles and bottom soundings from dives (CTD), and surface gravity wave statistics from between-dive surface intervals (IMU). We are working with the Animal Telemetry Network to automate data pipelines to deliver oceanographic data in near real-time. Additionally, these cormorant-derived datasets can be assimilated into coastal ocean models to reduce uncertainty in model inputs, such as bathymetry and boundary conditions. Assimilation improves model fidelity, and model outputs also aid in interpretation of the spatiotemporally distributed data. Furthermore, this work highlights the value of interdisciplinary seabird research projects; biologging projects are collecting animal movement data that can simultaneously advance oceanographic research as well as our understanding of seabird ecology.

## THE TROPHIC NICHE OF INVASIVE HOUSE MICE AT THE LARGEST BREEDING COLONY OF PERUVIAN DIVING PETRELS, ISLA LA VIEJA, PERU

<u>Michael Polito</u><sup>1</sup>, Sara Wang<sup>1</sup>, Diego Gonzales-DelCarpio<sup>2</sup>, Isabella Diaz<sup>2</sup>, Dayana Alva<sup>2</sup>, Sebastián Lozano-Sanllehi<sup>2</sup>, Cinthia Irigoin-Lovera<sup>2</sup>, Carlos Zavalaga<sup>2</sup>

<sup>1</sup>Louisiana State University, Baton Rouge, LA, USA. <sup>2</sup>Universidad Científica del Sur, Lima, Peru

#### Abstract

The Peruvian Diving Petrel (*Pelecanoides garnotii*) is a small, endangered seabird that is locally extinct in much of its former breeding range and restricted to only a handful of offshore islands in Peru and Chile. Peruvian diving petrels are especially vulnerable to invasive species due to their burrow nesting life history, high breeding site fidelity, low dispersal, and low connectivity between island populations. Invasive House Mice (*Mus musculus*) have been recently found on Isla La Vieja, Peru which is the largest single breeding colony of Peruvian diving petrels in the world. We used carbon, nitrogen, and sulfur stable isotope analysis to quantitatively assess the diets and foraging niches of house mice on Isla La Vieja to better understand their potential trophic interactions with native flora and fauna. We found that mouse liver, muscle, and hair stable isotope values did not differ by age or sex, and all tissues suggest a strong contribution of marine-derived resources. In addition, carbon, nitrogen, and sulfur stable isotope values were strongly correlated among liver, muscle, and hair samples from the same individuals. These positive correlations among tissues that reflect short (liver) and longer-term (muscle and hair) diets suggests a high degree of individual trophic consistency in mouse diets. Analysis of mouse prey items is ongoing and will allow us to present the results of mixing model analyses to quantify the consumptive impacts of mice to Peruvian Diving Petrels and other native species on Isla La Vieja.

## COMBINING DIFFERENT WAYS OF KNOWING TO UNDERSTAND CLIMATE CHANGE EFFECTS ON SEABIRDS AND THE ECOSYSTEMS THEY RELY ON

#### Delbert Pungowiyi<sup>1</sup>, Alexis Will<sup>2</sup>

<sup>1</sup>Native Village of Savoonga, Savoonga, Alaska, USA. <sup>2</sup>US Arctic Program, World Wildlife Fund, Anchorage, Alaska, USA

#### Abstract

When Delbert Pungowiyi was growing up, he would watch millions of birds, all species of birds that thrive in the Arctic, flying East past his home in Savoonga, Alaska. Now his friends and him reminisce about the huge flocks of birds they would see swirling among giant waves, flocks that no longer exist. Alexis Will only started studying the responses of Sivuqaq (St. Lawrence Is.) seabirds to changes in the environment in 2016, but in the short time since has also witnessed dramatic changes in the number of birds attending colonies. In this talk, Delbert and Alexis will discuss Indigenous and western science ways of knowing in the context of climate change impacts on seabirds. Delbert will share the connection his people have with the ocean, and the changes they have witnessed. Delbert will illustrate how Indigenous people's understanding of the world is holistic, is made up of relationships, and occurs across time. Alexis will share how she is learning to formally combine local ecological knowledge and western science to arrive at a more comprehensive understanding of seabird responses to changes in the northern Bering Sea's ecosystem. Delbert and Alexis hope to provide an opportunity to reflect on different ways of knowing and how to incorporate different lines of evidence in seabird-focused research.

### **BREAKING UP IN THE BERING SEA**

Delbert Pungowiyi<sup>1</sup>, <u>Alexis Will</u><sup>2</sup>, Mark Rauzon<sup>3</sup>

<sup>1</sup>AK Coaltion on Toxics, Savoonga, AK, USA. <sup>2</sup>World Wildlife Fund, Fairbanks, AK, USA. <sup>3</sup>Laney College, Oakland, CA, USA

#### Abstract

Extreme stress in the Bering Sea climate and geopolitical systems threatens the stability of the region, including the people and wildlife that depend on it. Ecologically, sea ice loss depletes winter algae formation, delays spring plankton blooms, and diminishes the associated bottom cold pool that acts as a thermal barrier. The removal of this "ice curtain" has opened the Arctic to pollock and Pacific cod, predatory fishes exerting top-down pressures that may compound changes in primary production and bottom-up forces, scrambling trophic pathways for seabirds, marine mammals, fish, and people in the Bering Sea. People and wildlife are also caught between international geopolitics and economic aspirations. Russian fishing vessels and nuclear icebreakers keep shipping lanes open year-round and jeopardize Siberian Yup'ik subsistence hunting. The War in Ukraine heightens growing militarization of the region, and has intensified Russia's efforts to exploit its natural gas development and protect shipping interests, made possible by the disappearing winter sea ice. The Bering Sea faces increasing risks of oil spills, shifts in commercial fish stocks across international borders and potential border trespass. U.S. military build-up in the Bering Strait region echoes legacy pollution from the cold war, particularly on St. Lawrence Island where the development of a new Navy Seal training station reminds residents of the battles they fought to clean up their island after the previous base was dismantled. A panel discussion will explore the ecological and geopolitical stressors acting on the region and how people and wildlife are responding.

## USING TRACKING TECHNOLOGY TO LOCATE ENDANGERED 'UA'U (HAWAIIAN PETREL *PTERODROMA SANDWICHENSIS*) BURROWS

#### Andre Raine<sup>1</sup>, Alex Wang<sup>2</sup>, Brett Mossman<sup>2,3</sup>, Scott Driskill<sup>1</sup>

<sup>1</sup>Archipelago Research & Conservation, Hanapepe, HI, USA. <sup>2</sup>Hawaii Division of Forestry and Wildlife, Hilo, HI, USA. <sup>3</sup>Pacific Cooperative Studies Unit of the Research Corporation of the University of Hawai'i, Honolulu, HI, USA

### Abstract

The 'ua'u, or Hawaiian Petrel Pterodroma sandwichensis, is an endangered seabird endemic to the Hawaiian Islands. While its distribution on some of the islands is well documented, on larger islands such as Hawai'i there are significant distribution gaps. Previous work within the Pu'u O 'Umi Natural Area Reserve (NAR) on Hawai'i strongly suggested that a breeding colony of the species was present, but active burrows had not been located making it difficult to focus management actions. Searching for burrows of this nocturnal burrow-nesting seabird had been particularly challenging in the NAR, as the birds are very rare, widely dispersed and breeding in remote areas with dense vegetation and challenging topography. To locate active burrows, we employed the use of tracking devices to track breeding adults back to their burrows. 6 eObs data loggers were attached to transiting birds caught using lights in 2018 and 2019. Overland locational data was then interrogated for concentrated areas of circling and ground activity. This resulted in several areas of concentrated activity and two different locations where tracked birds ended up transmitting from the ground. Burrow searching teams were then deployed to these areas and an active Hawaiian Petrel burrow was located. This represents the first active burrow ever documented in the NAR and the entirety of Kohala Mountain. Management actions have since been initiated to protect birds breeding within the areas defined by our tracking data. Logistical and methodological considerations inherent in the use of telemetry for locating endangered seabird colonies are discussed.

# BEYOND RESTORATION; THE NEEDS AND CHALLENGES OF INDUSTRIAL SCALE HABITAT CREATION

Mark Rauzon<sup>1</sup>, Alex Wegmann<sup>2</sup>

<sup>1</sup>Laney College, Oakland, CA, USA. <sup>2</sup>The Nature Conservancy, Sacramento, CA, USA

#### Abstract

The past fifty years have seen fantastic gains in island habitat recovery via a suite of techniques, including predator and weed eradications, species restoration through social attraction and translocations, and increased policy and funding focus on island ecosystems. The price of success is rising as the techniques are upscaled with aerial bait delivery over larger areas in invasive species eradication campaigns, since the low-tech islands have largely been cleared of predators in easy-toaccess areas. Seabird habitat restoration costs on islands are approaching that of human-created habitat for seabirds, so-called industrial habitat creation, which is nascent. We describe early examples focusing on California that demonstrate the potential for, and the inherent problems of industrial scale design. Bridges and decommissioned oil platforms offer the best examples of success, but opportunities exist to expand habitat creation to other marine situations, justified by sea-level rise, human encroachment of water edge habitat, and the complexity of restoring seabird habitat to large, complex island systems. Yet costs, permissions, maintenance and political will limit the potential. Case studies of stainless-steel platforms on the San Francisco Oakland New Bay Bridge that took six years for cormorants to adopt and anywhere from US\$700,000 to 10,000,000 to develop; construction of funded platforms on Berkeley pier delayed due to ferry construction; oil platform conversion constrained by concerns for greenwashing by the fossil fuel industry and complexity of structure access and maintenance, are presented. Suggestions to overcome these surmountable concerns are made and new ideas are solicited.

# IT WAS WORSE THAN WE THOUGHT: HALF OF ALASKA'S COMMON MURRES KILLED IN A HEAT WAVE

#### Heather Renner<sup>1</sup>, John Piatt<sup>2</sup>, Brie Drummond<sup>1</sup>

<sup>1</sup>Alaska Maritime National Wildlife Refuge, Homer, Alaska, USA. <sup>2</sup>USGS Alaska Science Center, Anchorage, Alaska, USA

#### Abstract

During the prolonged (2014-2016) marine heatwave in the northeast Pacific, about 62,000 dead Common Murres washed ashore on beaches from California to the Bering Sea, from which total murre mortality in Alaska was estimated at 0.5 to 1 million birds. Several years of widespread breeding failures in Alaskan colonies followed the die-off, accompanied by a crash in numbers attending long-term study plots. However, because seabirds may defer ("skip") breeding under food-poor conditions, we were reluctant to infer from the initial crash the extent to which true population declines had occurred. Now 7 breeding seasons after the main die-off event, we analyzed time-series of murre counts at 17 colonies in the Gulf of Alaska, Bering Sea, and Arctic. We averaged counts in 5-year blocks from most recent preand post-heatwave time periods possible, excluding 2015-2016 data because low attendance was likely confounded by skipped breeding. We conclude that the decline in Common Murre population was actually much greater than the toll reported earlier from beach-cast birds, and comprised -47% to -53% of pre-heatwave counts at Gulf of Alaska colonies, and -72% to -78% at Bering Sea colonies. Weighted by colony size, this corresponds to a catastrophic loss of ~2 million Common Murres, more than half the Alaskan population. In contrast, Thick-billed Murres did not decline at colonies where they co-occur with Common Murres, a difference in response of these two remarkably similar species that begs the question of which adaptations bridge the gap between success and catastrophe in a warming world.

# PREVALENCE OF HIPPOBOSCIDAE PARASITISM ON WEDGE-TAILED SHEARWATER (ARDENNA PACIFICA) HATCH-YEARS ON MOLOKINI ISLET

<u>Mariah Rivera</u><sup>1,2</sup>, Jennifer Learned<sup>1</sup>, Martin Frye<sup>1</sup>, Skye Anderson<sup>1</sup>, Cheryl King<sup>1</sup>, Joshua De Cambra<sup>1</sup>, Katelynn Gulley<sup>1</sup>, Jay Penniman<sup>1</sup>

<sup>1</sup>Maui Nui Seabird Recovery Project, Makawao, HI, USA. <sup>2</sup>KUPU, Honolulu, HI, USA

### Abstract

The Wedge-tailed Shearwater (Ardenna pacifica, 'ua'u kani) is a seabird species indigenous to the Hawaiian Islands. Since 1999, Maui Nui Seabird Recovery Project has banded adult and hatch-year wedge-tailed shearwaters throughout Maui Nui. This data set of biological information for banded and recaptured individuals is used to answer long-term demographic questions about 'ua'u kani populations. During banding operations, we check for the presence of avian pox and hippoboscid flies on processed seabirds. Flies belonging to the family Hippoboscidae are the most common parasitic flies found on birds. The impact of hippoboscid flies on seabirds is not fully understood. To determine the prevalence of hippoboscid parasitism among our managed 'ua'u kani colonies we analyzed our three most recent years of banding data. Across our banding sites (Kama'ole III, Hawea, Ho'okipa, Mo'omomi, and Molokini), we have detected the most hippoboscid presence among hatch-year 'ua'u kani on Molokini Islet. In 2022, we observed hippoboscid flies on 21.33% of hatch-years banded on Molokini, a 9.3% increase from the previous year (2021 = 12.03%, 2020 = 9.97%). The parasite incidence on Molokini is high in comparison to the main island colonies that have percentages ranging from 0.56% to 1.22% for the year 2022. We calculated occupancy rates and density for the colonies. Molokini had quantitative values similar or lesser than values for the main island colonies. Continuing to monitor disease transmission and parasitism in these colonies is crucial for future 'ua'u kani conservation efforts in Maui Nui.

## TROPHIC PATHWAYS DRIVE DIFFERENTIAL RESPONSES OF NEARSHORE MARINE BIRD FORAGING GUILDS TO THE PACIFIC MARINE HEATWAVE

<u>Brian Robinson</u><sup>1</sup>, Heather Coletti<sup>2</sup>, Brenda Ballachey<sup>1</sup>, James Bodkin<sup>1</sup>, Kimberly Kloecker<sup>1</sup>, Sarah Traiger<sup>1</sup>, Daniel Esler<sup>1</sup>

<sup>1</sup>U.S. Geological Survey, Anchorage, AK, USA. <sup>2</sup>National Park Service, Anchorage, AK, USA

#### Abstract

The Pacific marine heatwave (PMH) of 2014-2016 was an intense, long-lasting environmental disturbance expressed throughout the north Pacific. While dramatic consequences of the PMH on pelagic food webs have been well documented, effects on top-level predators in nearshore food webs, i.e., those based on macroalgae primary productivity and benthic invertebrate intermediate consumers, are not well understood. Using data from coastline surveys in the northern Gulf of Alaska from 2006 – 2022, we quantified changes in abundance of marine birds from nearshore and pelagic food webs after the onset of the PMH. We also evaluated changes in abundance of nearshore benthic invertebrate prey to allow specific consideration of a prey-based mechanism for effects of the PMH across food webs. We found that piscivorous and planktivorous foraging guilds, which are associated with pelagic food webs, showed negative effects, while benthivorous foraging guilds, which are part of nearshore food webs and consist of sea ducks and shorebirds, were positively impacted or not affected. Unlike extreme reductions in quantity and quality of forage fish, we found that common benthic invertebrate prey abundance remained stable or increased in association with the PMH. Our results support the hypothesis that food has a strong mediating effect of the PMH on upper trophic levels across food webs. These findings show how a large-scale environmental perturbation affects biological communities through trophic pathways, provide insight into ecosystem resiliency, and can inform management strategies in the face of persistent climate change.

# PRELIMINARY RESULTS OF TRACKING THE NON-BREEDING DISTRIBUTION OF TUFTED PUFFINS FROM AIKTAK ISLAND, EASTERN ALEUTIANS

Nora Rojek, Heather Renner

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#### Abstract

Tufted Puffin (Fratercula cirrhata) is a Bird of Conservation Concern in the North Pacific that has dramatically declined in the southern portion of its range. While breeding biology has been monitored at multiple colonies, limited information exists on post-breeding dispersal, migratory movements, and the extent that individuals from geographically disparate breeding colonies intermix. Non-breeding distribution information is critical for identifying and assessing threats and to implement effective conservation measures, particularly as the portion of the annual cycle in which limiting factors occur for declining colonies has not been identified. Aiktak Island, located at the center of the species' range in the eastern Aleutians, is one of the largest tufted puffin colonies in Alaska. Long-term monitoring at this site since 1995 indicates the population is increasing at this colony and others in the Aleutians, compared to declining trends in other parts of the range, including the Gulf of Alaska. In 2021, 19 geolocation loggers (Intigeo-C65 SUPER, Migrate Technology) were deployed on breeding adult Tufted Puffins on Aiktak and 15 loggers (79% recovery rate) were recovered in 2022. An additional 28 geolocators were deployed in 2022, with plans for retrievals in 2023. We present a preliminary analysis of migration and wintering areas used by Tufted Puffins from Aiktak over the winter of 2021/2022, and discuss methodology used for successful tag deployments and retrievals. Results will ultimately be compared to tracking efforts, both recently conducted and concurrently conducted, by other researchers at puffin colonies in the Gulf of Alaska.

# BIOGEOGRAPHIC PATTERNS OF SEABIRDS IN THE CALIFORNIA CURRENT ECOSYSTEM

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#### Abstract

The spatial patterns of marine predators, such as seabirds, often highlight areas of persistent ecological importance and reveal associated food web characteristics. Owing to high productivity, the California Current Ecosystem (CCE) harbors an avifauna composed of resident and migratory species. Toward protecting that habitat, the three distinct biogeographic regions — North, Central, and South CCE host five National Marine Sanctuaries (NMS). Seabird distribution within the CCE is the best studied anywhere, but only recently, has a new, comprehensive dataset been compiled (1980 to 2017). Using that data set, we characterized spatial patterns of seabirds, and compared relative abundance, diversity, and community composition both within and outside of the NMSs. We found that CCE seabird abundance and diversity change in a linear relationship, increasing from south to north and decreasing with distance from the coast. The avifauna of the North and South regions are the most distinct, with the Central region being transitional between the two. The CCE avifauna showed limited diversity, with the 10 most abundant species contributing > 93% of abundance totals. Similarly, certain foraging guilds and prey preference groups exhibited patterns of dominance: pursuit-feeding and piscivorous species dominate in the North and surface feeding generalists dominate in the South. Overall, seabird relative abundance and diversity are higher within compared to outside NMS boundaries and are broadly reprehensive of their corresponding biogeographic regions. The analysis of this extensive dataset provides a better understanding of seabird spatial patterns and their ecological roles within different regions, thus facilitating effective management.

## SOCIAL ATTRACTION AS A TOOL TO BRING SEABIRDS BACK TO KAUA'I ISLETS

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### Abstract

Lehua and Moku'ae'ae Islets are State Seabird Sanctuaries off the island of Kauai, hosting 17 and seven seabird species respectively. Lehua has been free of rabbits and rats since 2021 whereas rodents have not been recorded on Moku'ae'ae. Relatively high elevation, pest-free status, and absence of human population on both islets provide a great opportunity for recovery and reintroduction of native seabirds. We aim to establish colonies of Band-rumped Storm-petrel, Bulwer's Petrel, Hawaiian Petrel, Sooty Tern, and Gray-backed Tern on two islets using social attraction. A call playback system is planned along with artificial burrows and decoys in suitable but unoccupied locations. The deployment will be completed in early 2023 and monitored regularly. We expect to establish new colonies of the target species on both islands. An established Band-rumped Storm-petrel colony will be one of the first accessible colonies of the species on Kaua'i. Besides enhancing distribution and providing accessible study populations, these colonies are expected to attract other individuals or species, increasing the value of Seabird Sanctuaries. These trials will also inform future social attraction project designs for similar species and habitats. Finally, attracting seabirds to higher elevation islets will contribute to climate change adaptation as NW Hawaiian Island seabird populations are becoming more vulnerable to sea level rise. Reintroduction efforts should follow pest eradication for complete island restoration. Instead of passive recovery of the seabird populations using well-established and efficient tools like social attraction can facilitate conservation and climate change adaptation of seabirds.

# SAN DIEGO AUDUBON SOCIETY'S COLLABORATIVE EFFORTS TO CONSERVE AND MONITOR CALIFORNIA LEAST TERNS IN MISSION BAY, SAN DIEGO

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#### Abstract

The federally- and state-endangered California Least Tern (Sternula antillarum browni) breeds from mid-April to mid-September in California and Baja California. San Diego Audubon Society has been organizing conservation work for this species since 1993, and we present a summary of conservation and monitoring efforts in Mission Bay, San Diego. Conservation efforts include coastal dune habitat restoration, colony monitoring during breeding, outreach events, and volunteer predator monitoring programs. Since 2012, our volunteers have been monitoring vegetation at the nesting preserves. We have done coastal dune habitat restoration since 2013, including the preservation of rare sand dune plants such as Nuttall's Lotus (Acmispon prostratus) and Coast Wooly Head (Nemacaulis denudata) along with hand pulling and targeted spraying management for invasive vegetation removal. Since 2014, the community science predator monitoring Ternwatchers program continues to provide an opportunity for the public to work with the California Least Tern and support predator management efforts. We have also advocated at Pacific Marine Fisheries Council meetings to improve the monitoring of forage fish and improve stock quotas for the forage fish species important to California Least Tern, venturing beyond the local nesting preserves and beginning to look at this species' needs holistically. This multi-pronged conservation program has been successful in helping the community understand and support this species and has, at least in part, been responsible for the success of these nesting preserves.

## COMBINING GPS, VIDEO, AND ACCELEROMETRY DATA TO IDENTIFY PREDATOR-FACILITATED FORAGING BEHAVIORS IN PELAGIC SEABIRDS

Abigail Schiffmiller<sup>1</sup>, Sara Maxwell<sup>2</sup>, Scott Shaffer<sup>3</sup>, Hillary Young<sup>4</sup>, Michael Johns<sup>5</sup>, Greg Breed<sup>1</sup>

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#### Abstract

Many seabirds engage in "facilitated foraging" whereby marine predators (like tuna) trap aggregations of small fish against the ocean's surface, increasing their accessibility to foraging birds. Understanding the importance of this foraging strategy to seabird populations is key to understanding how changes in marine predator populations may be linked to seabird population outcomes. However direct observation is often not possible, and wide ranging, free-living species are often only observable via biotelemetry, making detecting and understanding foraging strategies difficult. To address this, we are deploying a suite of biologging devices, including GPS, animal borne cameras, accelerometers, and heart rate loggers. Biologger data, along with oceanographic covariates related to ocean productivity and weather, will be analyzed with dynamic-parameter behavior discriminating correlated random walk models. Camera data, matched with GPS and accelerometers, will be used to develop and validate models that can identify movement and kinematic patterns associated with predator-facilitated foraging in members of the Sulidae. Ultimately, models will identify behaviors from GPS tracks alone, and will be used in delineating behavior time budgets, with particular attention to time spent in facilitated foraging relative to ordinary foraging. Though the modeling work is in early stages, we have had good success in deploying multi-instrument packages on Red-footed (Sula sula, RFBO) and Masked Boobies (Sula dactylatra, MABO) in the tropical Pacific. Thus far, 57 RFBOs have been deployed, 18 with camera+GPS, 19 with accelerometer+GPS, and 20 with camera+accelerometer+GPS packages. We have also deployed 4 camera+accelerometry+GPS packages on MABOs.

# ABUNDANCE IN 3D: ASSESSING COLLISION VULNERABILITY OF SEABIRDS AND FLOATING OFFSHORE WIND IN THE CALIFORNIA CURRENT

<u>Stephanie Schneider</u><sup>1</sup>, Sophie Bernstein<sup>1</sup>, Glenn Ford<sup>2</sup>, Janet Casey<sup>2</sup>, Jarrod Santora<sup>3</sup>, Lisa Ballance<sup>4</sup>, Sharon Kramer<sup>1</sup>, Scott Terrill<sup>1</sup>, David Ainley<sup>1</sup>

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### Abstract

The California Current System (CCS) is the most intensely surveyed marine region in the world, with decades of ship and aerial surveys targeting seabirds that have supported the development of twodimensional (2D) "hotspot" maps relevant to the management of trophic resources. However, current proposals regarding another resource, wind, to construct floating offshore wind facilities (FOSW) necessitate more explicit consideration of vertical (3D) use of space by seabirds, particularly the extent of overlap with rotor-swept zones, to better assess collision vulnerability in offshore environments. This is especially true for the outer continental shelf of the CCS, which supports a diversity and abundance of gliding and dynamically soaring seabird species during spring and summer months as they migrate into the area from elsewhere in the Pacific (e.g., Hawaii, New Zealand); flight heights for these seabirds increase rapidly as wind speeds increase. Here, we present a 3D view of seabird abundance as a function of location, season, and wind speed. This demonstrates how, in areas of the CCS with a rich wind resource capable of supporting FOSW, seabird composition and abundance, as depicted by traditional 2D analyses, is distinct from what is predicted to occur at the height of rotor-swept zones when accounting for species-specific flight styles and heights achieved in relation to prevailing winds. Improving understanding of how the seabird community varies as a function of height above the ocean is essential for assessing seabird vulnerability to collision with future FOSW facilities across the CCS and elsewhere in the Pacific.

# TRACKING SEABIRD USE OF THE AIRSPACE AT OFFSHORE WIND ENERGY AREAS USING THE THERMAL TRACKER-3D: A CASE STUDY

Stephanie Schneider<sup>1</sup>, Sophie Bernstein<sup>1</sup>, Sharon Kramer<sup>1</sup>, Scott Terrill<sup>1</sup>, Shari Matzner<sup>2</sup>

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#### Abstract

As the development of floating offshore wind facilities (FOWFs) advances along the west coast of the United States and other areas in the Pacific, there is an increasing need to understand the potential for seabird collisions with turbine rotors before FOWF construction and to autonomously monitor seabirdturbine interactions in harsh and remote offshore environments following FOWF construction. Precise and robust understanding of vertical airspace use by seabirds offshore is currently lacking because technologies capable of autonomously monitoring the vertical airspace use of seabirds around-the-clock in such environments are still being developed and tested. One such technology, Pacific Northwest National Laboratory's Thermal Tracker-3D (TT3D), was deployed between May 2021 and May 2022 at the Humboldt Wind Energy Area, one of the sites leased for FOWF development off California. During this deployment, the system successfully collected data for 80 consecutive days and a total of 1707 targets were tracked flying through the TT3D's field of view. Spatiotemporal information was assigned to each target, including flight height and timing relative to ambient light; the maximum target height was 342 meters above sea level and detections at rotor-swept heights occurred throughout the 24-hour cycle (i.e., day, night, and crepuscular periods). Additional efforts to identify targets were also undertaken. Because the TT3D operated for extended periods of time in the offshore environment without human intervention and precisely documented vertical space use by seabirds, this technology represents a promising mechanism to address critical knowledge gaps about the potential for interactions between seabirds and FOWFs.

# NORTH PACIFIC PELAGIC SEABIRD DATABASE (NPPSD) UPDATE: WHY YOU SHOULD USE IT AND CONTRIBUTE DATA TOO

<u>Sarah Schoen</u><sup>1</sup>, Gary Drew<sup>1</sup>, John Piatt<sup>1</sup>, Mayumi Arimitsu<sup>2</sup>, Heather Coletti<sup>3</sup>, Marla Hood<sup>1</sup>, Robert Kaler<sup>4</sup>, Kathy Kuletz<sup>4</sup>, Elizabeth Labunski<sup>4</sup>, Samuel Stark<sup>1</sup>, Christopher Swingley<sup>5</sup>

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### Abstract

Data on the abundance and distribution of seabirds have long been used to assess ecosystem function, measure population status and trends, and assess threats and critical habitat to species. The North Pacific Pelagic Seabird Database (NPPSD) is one of the largest data sources on seabird distribution at sea in the North Pacific Ocean and is the result of contributions from numerous collaborators. The newly released NPPSD version 4 contains 50 years (1973-2022) of at-sea survey data for seabirds and marine mammals across >489,000 transect segments, from the Arctic to Hawaii and from California to South Korea. It includes observations of nearly 21,000,000 birds from 249 species and >390,000 mammals from 40 species. These data are used by a variety of users with numerous applications, including mapping the seasonal abundance and distribution of birds, understanding the status and trends of species, identifying important bird areas, and identifying marine regions where seabirds may be at risk due to human activities. The large spatial and temporal coverage of the NPPSD is well-suited for addressing large-scale management issues, and data can be used to model density, distribution, and abundance across space and time. In support of the NPPSD, we developed a pair of applications that facilitate the efficient collection and integration of at-sea data into the NPPSD: SeaLog, a robust datalogging application, and QA/QSea, a data proofing and formatting tool. The USGS and its partners are committed to maintaining and updating the NPPSD as a resource for investigating seabird populations amidst changing ecosystems.

# PLANES, BOATS, AND BIRDS: INFLUENCE OF THE COVID-19 PANDEMIC ON SEABIRD COLONY DISTURBANCE IN CENTRAL CALIFORNIA

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#### Abstract

Since 1996, the Common Murre Restoration Project has worked to restore and monitor populations of breeding seabirds annually at multiple seabird colonies in central California. Since 2005, in partnership with the Seabird Protection Network (SPN), we have focused on the reduction of anthropogenic disturbance at these colonies. We recorded hourly rates of activity ("detections") of aircraft, watercraft, and other human-derived sources, including disturbances to seabirds. Detection and disturbance rates declined significantly after 2012, following several years of concerted outreach by the SPN to pilots, boat operators, and the general public. However, with the onset of the COVID-19 pandemic, we observed major changes to the patterns of disturbance at our monitored colonies; we detected ten times as many watercraft in 2020 relative to long-term means, followed by >60% increases in aircraft detection and disturbance rates in 2022. These increases were most marked at the restored colony at Devil's Slide Rock & Mainland, where disturbance rates in 2022 were similar to levels pre-outreach. Our observations reflected increases in outdoor recreation activities during the pandemic that were recorded elsewhere in the region. Despite increasing anthropogenic disturbances and fairly high avian disturbance and predation, productivity of our monitored birds is still relatively high. We discuss potential reasons for and consequences of increased anthropogenic disturbances to seabird populations in the Pacific.
# SEABIRDS AS BIOVECTORS IN THE TRANSPORT OF ANTHROPOGENIC DEBRIS SUCH AS PLASTIC

### Mylene E. Seguel<sup>1</sup>, Claudia E. Fernández<sup>1</sup>, Guillermo Luna-Jorquera<sup>1,2,3</sup>

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## Abstract

Plastic debris has spread worldwide having serious effects on natural ecosystems. Among wildlife communities, seabirds are identified as potential biovectors of plastic debris by transporting it to their colonies while consuming it or using it for nest construction. However, knowledge about the amount and type of plastic being transported by seabirds to colonies is still scarce. In this study, we used a feeding generalist species, the Kelp Gull Larus dominicanus, as a study model due to their ability to use artificial food sources resulting from anthropogenic activities. We analyzed 391 gull's pellets in breeding and roosting sites. Also, we examined 40 gulls' nests in the urban zone and coastal islands in the III and IV Region of Chile, between 29°-33° S. We found plastic in pellets from urban areas and islands. We observed more plastic in pellets collected on the island (64%) than those from the urban zone (36%). The analysis of nests showed that nests in urban areas contain more plastic items (70%) than those nests on islands (30%). Moreover, we found that the type of plastic between urban areas and islands differ. In urban areas, ropes are more common, while in the islands, laminates predominate. The results from this study confirm that seabirds are important biovectors of plastic and these are transporting plastic to their reproductive colonies, which may also affect other species that live on islands far from urbanization. The results presented here are relevant for authorities and communities to plan and manage waste deposition.

# WHEN YOU LAND IN THE WRONG PLACE: SEABIRD PARASITE INFECTION DYNAMICS IN OTHER WATERBIRD HOSTS

#### Kate Lyn Sheehan

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#### Abstract

Ecosystem processes tend to exhibit entropy; however, in some cases, energy can be conserved and even maximized. For parasites, the host often serves as an entire ecosystem and, unless energy loss is minimized by the parasite community, the host can exhibit poor condition. Thus, host-parasite dynamics in definitive hosts like seabirds, tend to promote the co-evolution of conservative energy-losses and minimal host-responses. Further, many parasites have evolved to infect only particular species of hosts. When infecting a non-ideal host, helminthic parasites can cause disease and secondary infection. Alternatively, in a non-ideal host, a parasite could exhibit alterations in its life history characteristics, such as the timing, location, or abundance of eggs produced. Here, we discuss a recent and unique observation of the cestode Schistocephalus solidus (Platyhelminthes) infecting a non-ideal host: Mallards (Anas platyrhynchos), in Cheney Lake, Anchorage, Alaska. S. solidus exhibits a nearly semelparous strategy in ducks, where the parasite remains for only a few days before being lost through defecation. This parasite is likely to persist for longer periods, promoting a higher reproductive output, when infecting the species with which it has co-evolved—like loons and grebes. Despite having few ideal hosts at our study site, the high predation rates of the Mallards on the second intermediate host fish (Threespined Stickleback, Gasterosteus aculeatus) and the duration of peristaltic movement through the GI tract at an appropriate temperature for sexual maturation supports a highly abundant population of S. solidus in Cheney Lake.

# PARASITE INFECTIONS AND MICROPLASTIC CONSUMPTION OF SEABIRDS FROM THE PACIFIC AND ATLANTIC OCEANS

#### Kate Lyn Sheehan<sup>1</sup>, Douglas Causey<sup>2</sup>

<sup>1</sup>Frostburg State University, Frostburg, Maryland, USA. <sup>2</sup>University of Alaska, Anchorage, Anchorage, Alaska, USA

### Abstract

Seabirds acquire helminthic parasitic infections primarily through foraging activities. Likewise, birds consume microplastic contaminants, either intentionally or accidentally while feeding, drinking, or preening. Here, we document the frequencies of both endohelminthic parasites and microplastics from the digestive tracts of 17 species of seabirds. We collected numerous samples were collected from the Aleutian archipelago, while others were donated to our collection from the NOAA Ocean Observers Offices in Seattle, WA and Woods Hole, MA. While microplatic fibers were found in every species, there was a gradient in microplastic frequency across species, where some contained more plastic debris than others. Similarly, some species harbored diverse and abundant parasite communities, while others had few infections. Interestingly, we find that the species that tend to consume more plastics had fewer parasites, thus, we document a negative relationship between parasites and plastics frequencies. However, there was a positive relationship between parasite species richness and plastics consumption, suggesting that seabirds with a higher dietary breadth might be more likely to also consumer plastics. Within individual species, these trends were not consistent, and only a few species exhibited detectable patterns between parasites and plastics. This finding is likely contributed to the relatively low sample sizes (n = 2-33) and we expect that as we process more individuals of the species in our collection will confirm the variety of these relationships.

## **ELEGANT TERN COLONY RESCUE 2021**

#### Julie Skoglund

International Bird Rescue, San Pedro, CA, USA

### Abstract

The Elegant Tern (ELTE), Thalasseus elegans, is listed as near threatened due to its small breeding range. Up to 95% of the population breeds on Isla Rasa in the Gulf of California, east of the Baja California peninsula. Small populations breed in Southern California at Bolsa Chica, San Diego Bay, and Los Angeles Harbor. In 2021, the breeding colony at Bolsa Chica, which has the largest breeding population of Elegant Terns in Southern California, experienced a disturbance so significant that it led the colony to abandon several thousand nests and settle on barges in the Long Beach Harbor in California. These barges proved to be unsuitable for the colony to raise their chicks as they began falling off in large numbers. Without aid the majority of the fallen chicks would have ultimately drown. To address the problem, International Bird Rescue, a wildlife rehabilitation organization, teamed up with various local and state organizations, scientists, and veterinarians and launched an emergency response to protect and aid the breeding colony of Elegant Terns nesting on the Long Beach Harbor barges. Ultimately over 3,000 chicks were rescued, 1,000 of which received auxiliary bands for continued monitoring. Additionally, a committee has been created to share expertise and knowledge that can help identify and combat the continued threats the species faces today and in the future. This talk explores the challenges, innovations, and partnerships during this wildlife emergency response and hopes to show how collaboration with wildlife rehabilitators can be an important contribution to species conservation.

# ENVIRONMENTAL INFLUENCES ON CALIFORNIA LEAST TERN NEST ATTENDANCE

Rachel Smith<sup>1</sup>, Justin Schuetz<sup>2</sup>, Kristina Wolf<sup>1</sup>, Elena Oey<sup>1</sup>, Travis Wooten<sup>1</sup>, Nacho Vilchis<sup>1</sup>

<sup>1</sup>Conservation Science, San Diego Zoo Wildlife Alliance, Escondido, CA, USA. <sup>2</sup>JGS Projects, Bath, ME, USA

## Abstract

Nest attendance is important in determining hatching success mainly because consistent incubation drives embryo health by regulating humidity, temperature, and egg turning. Human or predator disturbance and food availability, however, can also alter nest attendance and incubation behavior. In colony nesting seabirds for example, food proximity and availability are likely factors that affect nest neglect and consequent egg outcomes. To measure nest attendance rates of California Least Terns (Sternula antillarum browni) we used time-lapse nest camera traps taking one picture per minute during incubation at two Southern California colonies over three nesting seasons (2019-2021). We digitally classified the resulting pictures (2,480,608) as having parents on or off the nest. We then used Bayesian structural time series models of each nest to gauge what environmental factors influence nest attendance. We found that nest attendance increases at night, decreases with tide height, and decreases with rapidly rising tides. This supports hypotheses explaining absences of both parents during incubation and daylight being driven by foraging bouts. Also, linking how tidal height affects prey availability in nearshore shoals, inlets, and bays. Additionally, we found that nest attendance variability affected nest outcome. Abandoned nests had lower nest attendance rates than depredated or successful nests, which did not differ. Our results stress the importance of holistic approaches to habitat management of endangered seabirds. Being central place foragers, nesting seabirds need optimal habitat not only where they nest, but also in adjacent oceans and bays where they forage.

# EFFECTS OF DOUBLE BROODING ON NESTLING CASSIN'S AUKLET (PTYCHORAMPHUS ALEUTICUS)

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### Abstract

Characterizing differences in the reproductive performance of individuals in a population is crucial for understanding patterns of life history evolution in organisms. Although Cassin's Auklets (Ptychoramphus aleuticus) are the only known northern hemisphere seabird species to commonly attempt raising two broods in a single season, there are population-level differences that have been attributed to fitness consequences of adults. However, little has been done to describe the effects of this strategy on the fate of nestlings from double broods. Here, we examined the impact of double brooding on Cassin's Auklet nestlings by modeling data of breeding histories for a population monitored for 35 years at Southeast Farallon Island in central California. Specifically, we examined relationships between double brooding and egg volume (cm<sup>3</sup>), growth rate, days to fledge, asymptotic and fledgling masses, recruitment probability, and age at first breeding. Estimates from generalized linear mixed models suggest that lifetime reproductive success and parents' age positively influenced egg volume, chick growth parameters, and recruitment probability. Whether a nestling was hatched as a single brood, first clutch, and second clutch had little effect on egg volume, chick growth parameters, and recruitment. Environmental covariates showed little influence on any response variables tested, suggesting that individual quality rather than nesting state may play a more critical role in predicting nestling health and recruitment probability. Taken together, we show that double brooding has little influence on chick health, further supporting why this life history strategy is advantageous for this seabird species.

# ESTIMATING THE POPULATION NUMBER AND TREND OF TOWNSEND'S SHEARWATER (*PUFFINUS AURICULARIS*) IN SOCORRO ISLAND, MÉXICO

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### Abstract

Townsend's Shearwater (*Puffinus auricularis*) is one of the most critically endangered seabird species from North America. It is an endemic species from the Revillagigedo Archipelago, Mexico. The largest breeding colony is located on Socorro island. Also, a small population recently returned to nest on Clarion Island after conducting restoration actions. Socorro's population decreased dramatically from 1980 to 2008 because of the impact of invasive mammals. The last surveys suggest that the breeding population could be lower than 100 breeding pairs, but there is a lack of data that accurately supports the population status and its trend. Here we present a current estimate of the population structure and its tendency. We collected four years of acoustic data recorded by automatic recorders placed systematically all over the historic nesting area on Socorro island. Then we analyzed the acoustic activity of the shearwaters to get the potential distribution of breeding colonies. We estimate the breeding population through a linear model based on shearwaters vocalizations, the number of known active burrows, and breeding probability. Then we predict population trends by the simulation of different demographic parameters under management actions. While current known breeding colonies are located at the highest point of the island, the highest number of calls have been recorded in the east. The estimated breeding population is 175 pairs, a more optimistic scenario than the last estimate. Our results show how management actions impact population trend.

# TRACKING RESTORATION OUTCOMES OF GLOBAL ACTIVE SEABIRD RESTORATION

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## Abstract

Seabirds are globally threatened and management actions, such as social attraction and translocation, are known active restoration techniques that can improve seabird populations, particularly where threat removal alone does not result in recovery. However, there is a lack of guidance on how to select and apply active restoration methods with the greatest chances of success. We developed the Seabird Restoration Database to assist in knowledge transfer among practitioners seeking to use restoration tools to recover seabird populations. The database is available online at seabirddatabase.org, and serves as a public compendium of over 800 translocation and social attraction efforts targeting 138 seabird species in over 500 locations, which was synthesized from 1400 resources and 300 expert contributions. Here we present on the global application and justification of these interventions and include a novel assessment of restoration outcomes measured via seabird visitation and breeding responses post-implementation. Visitation occurred in 80% of assessed projects, and breeding occurred in 76%, on average 2 years after implementation began. The primary determinant of these outcomes was taxonomy, with highly successful social attraction projects for gulls and terns driving results. The Seabird Restoration Database can be used for a variety of planning and implementation purposes and serves as a model for tracking and evaluating conservation actions, including management for non-seabird taxa.

# MULTI-EVENT MODELING SHOWS VARIABLE NEST SUCCESS FOR THE AT-RISK DOUBLE-CRESTED CORMORANT POPULATION IN THE STRAIT OF GEORGIA

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## Abstract

The Double-crested Cormorant (Phalacrocorax auratus; DCCO) experienced a loss of 68% of its population within the Strait of Georgia between the years 1987 and 2009, and is a species of 'special concern' within British Columbia. The reason for their decline is unknown as there has been a lack of monitoring in the region for the often-disparaged species. To study the DCCO, advances in remote, timelapse photography captured the entire nesting season at three locations within the Strait of Georgia during the years 2020, 2021, and 2022. These locations include two sea cliff breeding colonies, and one colony under a Vancouver highway bridge. With the collected data, a multi-event capture-recapture model compared differences in breeding success between locations and years. This model estimates probabilities of egg and chick survival, detection, and state transitions. From these, we estimate overall nest success, an important indicator of colony health. Results showed that the small, rounded cliff colony had high nest failures, while the steep cliff colony experienced success in half the nests present. The Vancouver bridge colony, the largest DCCO nesting colony in the province, experienced the highest nest success. Although the bridge is the most productive nesting site for the DCCO, there is consideration by local and provincial governments to exclude the cormorants due to the potential impact their acidic guano has on the structure. This management action could further threaten population declines as natural cliff nesting sites may struggle to support the DCCO population under the era of rapid environmental change.

# FORAGING BEHAVIOR OF BLACK-LEGGED KITTIWAKES AND COMMON MURRES IN RELATION TO PREY DISTRIBUTION AND DENSITY

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### Abstract

Seabird distribution, abundance, and reproductive success is regulated in large part by the distribution and density of their prey. In the Gulf of Alaska, this relationship is best understood in Black-legged Kittiwakes (Rissa tridactyla) and Common Murres (Uria aalge) which have been the focus of long-term monitoring and intensive investigation for decades. Previous work in lower Cook Inlet identified speciesspecific differences in their non-linear responses to food supply, but both species exhibited a negative relationship between foraging trip duration and prey density. To further examine behavioral mechanisms linking seabird behavior to fine-scale variation in foraging habitat, we deployed GPS loggers outfitted with diving sensors on Common Murres and Black-legged Kittiwakes at two colonies with contrasting prey distribution and density in lower Cook Inlet, Alaska during the summer of 2022. We use detailed location and dive information to quantify metrics that drive energy expenditures in these two species including foraging trip duration, maximum (foraging) distance from colony, dive depth, size of foraging area, and time spent on colony. We then compared foraging distribution and dive characteristics between species and colonies. Differences in foraging behavior between colonies illustrates the direct links between prey availability and seabird energy expenditure, which has further consequences for individual fitness and reproductive success. These results are important for improving our understanding of plasticity in foraging behavior of these two species and will provide insight into potential impact of future variation in prey abundance.

# AN INTEGRATED APPROACH TO INCORPORATING MARINE BIRD HABITAT USE TO SUPPORT OFFSHORE WIND SITING IN THE GULF OF MAINE

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### Abstract

As offshore wind energy development (OWED) accelerates in the U.S., it is important to incorporate existing seabird data into marine spatial planning, yet it can be challenging to integrate across data types. To support the Maine Department of Inland Fisheries and Wildlife as they inform siting of renewable energy leases in the Gulf of Maine (GOM), we conducted a multi-faceted analysis to determine regions of relative risk for marine birds. We used three primary approaches: a spatial buffer analysis that integrated known maximum foraging distances and colony counts at marine bird nesting islands; a combined exposure/vulnerability assessment using regional marine bird models; and movement models for three diving bird species. Findings based on known colonies and foraging distances suggested that key foraging habitat for nesting marine birds are focused on Midcoast and Downeast Maine, and Cape Cod, primarily within 64 km of the coast. Species vulnerability to OWED was highest inshore and around bathymetric features including Jeffreys Ledge, Cashes Ledge, and George's Bank, and was lowest in the Central GOM, an area associated with deeper water and muddy benthos. Movement modeling of birds captured in the mid-Atlantic indicated broad migratory movements throughout the GOM, but that core use areas are concentrated inshore and near shoals. Combining colony-level information, regional distributions, and tracking data provides greater understanding of potential habitat use of both breeding and non-breeding marine birds and exemplifies the need to incorporate all available data to minimize potential impacts to marine birds from anthropogenic stressors, including OWED.

# COMPARING SURVEY METHODS FOR *FRATERCULA* PUFFINS IN THE KODIAK ARCHIPELAGO

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## Abstract

There has been little consensus on the best methods for monitoring Tufted (*Fratercula cirrhata*) and Horned puffin (*F. corniculata*) populations in Alaska. A patchwork of approaches, including boat-based surveys and land- and boat-based colony counts, is currently used to assess population trends across each species' range. Anecdotal declines suggest an urgent need to evaluate and compare methods, to enhance comprehensive and rigorous range-wide trend analyses for both species. Kodiak National Wildlife Refuge (NWR) has collected significant abundance data on Tufted and Horned puffins as part of 1) a broadly scoped project of designated seabird colony surveys to monitor breeding populations within the Kodiak Archipelago, and; 2) transect-based nearshore marine bird surveys to determine population estimates and trends for the most abundant coastal birds present in the Kodiak Archipelago. We present preliminary results comparing estimates of puffin abundance and evaluating trends derived from these two survey methodologies. By comparing abundance assessments obtained via designated colony surveys and at-sea transect surveys we enhance the potential to work collaboratively across regions to produce comprehensive, accurate range-wide population estimates, despite varying survey methods.

# INDIVIDUAL-LEVEL RESPONSES TO RAPID CLIMATE CHANGE IN COMMON TERNS (STERNA HIRUNDO) AND ARCTIC TERNS (STERNA PARADISAEA)

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### Abstract

Behavioral plasticity may help long-lived species to persist in rapidly changing environments. The Gulf of Maine is one of the fastest-warming regions of the ocean. As the water warms, seabirds' preferred prey (hake and herring) follow cooler waters deeper and farther offshore. It is unlikely that all individuals respond to changing food availability in the same way. For Common Terns (*Sterna hirundo*) and Arctic Terns (*Sterna paradisaea*) breeding on Petit Manan Island, we hypothesized that: H1: preferred prey decline in the diet as sea surface temperature (SST) increases; H2: individuals vary in their response to increasing SST; H3: ondividual-level diet influences fitness.

In June and July of 2022, we conducted daily chick provisioning watches and recorded prey size and species. Average SST (MUR Satellite) increased as the season progressed. While SST did not influence average feeding rate, increased SST drove declines in the average prey size (b = -0.091, p <0.001) and the proportion of hake and herring in the diet (b = -0.068, p <0.001) at the colony level (H1 supported). Slopes were similar across nests, suggesting no individual variation in diet plasticity with increasing SST (H2 not supported). At the nest level, a lower average feeding rate, a higher average proportion of herring and hake, and a larger average prey size were all associated with higher chick mortality and lower chick growth rates (H3 supported). Our findings suggest that individuals that try to maintain a diet of preferred prey may have lower fitness in a changing climate.

# THE BLOB RUINED MY RELATIONSHIP: A STORY OF MURRE CHICKS, ISOTOPES, AND PHYSICS

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#### Abstract

For over a decade on the central Oregon coast, dietary stable isotopes of Common Murre chicks (*Uria aalge*) had remarkably strong relationships with physical processes during the upwelling season. Trophic level ( $\delta^{15}$ N) had a strong connection with the upwelling index, whereas nutrient source ( $\delta^{13}$ C) had a strong connection with the Pacific Decadal Oscillation. And then came..."The Blob". The Blob, or the northeast Pacific marine heatwave, peaked in 2015 and was the longest recorded heatwave in recent decades, lasting two full years. This event was responsible for major species distribution shifts, declines in some populations with dramatic increases in others, malnourished fish and whales, and seabird mass mortality events. As if that was not enough, The Blob ruined a near perfect, negative linear relationship between murre trophic level and upwelling index—before I published it! Fortunately, one relationship, a positive one, still remained. Nutrient source stayed positively linked to basin scale processes despite attempts by The Blob to disrupt it. Will the nitrogen-upwelling relationship be repaired after The Blob subsides? Stay tuned, there is more to be revealed at the Pacific Seabird Group's 50th Annual Meeting.

# WHAT FACTORS INFLUENCE THE DAILY NEST SURVIVAL RATES OF ALEUTIAN TERN NESTS ON KODIAK ISLAND, ALASKA?

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### Abstract

The Aleutian Tern (*Onychoprion aleuticus*) is a species of high conservation concern in Alaska due to large declines at known breeding colonies since the 1960s. We monitored Aleutian Tern nests at five colonies on Kodiak Island from 2017-2020. A total of 148 nests were incorporated into our analysis. We used the nest survival model in program MARK to estimate daily nest survival rates (DNS) as a function of colony location, year, within-season time trends, vegetation cover and height, and weather covariates. The best model structure for year indicated that daily nest survival was similar in 2017-2018, and 2019-2020 (2017-2018 DNS estimate = 0.82; 2019-2020 DNS = 0.92; 95% CI 0.77, 0.86 and 95% CI 0.89, 0.93 respectively). We modeled the potential influence of camera monitoring but did not find support for an effect ( $\Delta$ AlCc > 2;  $\beta$  = 0.00, 95% CI -0.48, 0.49). Our final competitive model set suggested that the interaction between year and colony was most important but average vegetation height at nests also appeared in all competitive models ( $\beta$  = 0.03, 95% CI 0.00, 0.05). There was weak support for a decline in DNS as the nesting season progressed ( $\beta$  = -0.02, 95% CI -0.4, -0.01), and daily low temperatures increased ( $\beta$  = -0.10, 95% CI -0.19, -0.01), and DNS increased with increased precipitation ( $\beta$  = 1.27, 95% CI -0.10, 2.65). The importance of the year effect suggests food availability in 2019-2020 was higher than in 2017-2018, likely with episodic predation modulating that influence at some colonies.

# SHIFTS IN DIET NICHE SPACE OF PRE-LAYING ALEUTIAN TERNS THROUGH TIME USING MUSEUM SPECIMENS

#### Jill Tengeres<sup>1</sup>, Robin Corcoran<sup>2</sup>, Donald Lyons<sup>3</sup>

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### Abstract

The Alaska breeding population of Aleutian Terns (Onychoprion aleuticus) has experienced significant declines since the 1960s. The drivers of this decline are unknown, but recent impacts of climate change on important forage fish species may be contributing factors. We used carbon ( $\delta^{13}$ C) and nitrogen ( $\delta^{15}$ N) compound-specific stable isotope analysis in amino acids (CSIA-AA) of eggshells from 23 modern samples and six pre-1960s museum specimens to compare foraging ecology of pre-laying Aleutian Terns. CSIA-AA can account for shifts in the baseline ratios of isotopes in primary producers through time, which makes it useful when baseline isotopes are unknown. We used CSIA-AA in  $\delta^{15}$ N to estimate trophic position across years and  $\delta^{13}$ C isotope fingerprinting of essential amino acids to examine shifts in foraging habitat between modern and historic samples. Modern samples were collected from 2017 – 2020 at colonies in the Kodiak Archipelago. Historic museum samples were collected between 1868 -1934 from colonies across Alaska. In the Gulf of the Alaska, our results suggest that the trophic position of pre-laying female Aleutian Terns has not changed with time. Our sample size limited interpretation, but there is some evidence that trophic position is variable depending on colony location. Carbon values in amino acids indicated that food webs based on microalgae were the predicted source of carbon in all samples, though historic and modern samples clustered separately in the linear discriminant model. These results highlight the need for more information about the diet of Aleutian Terns, especially in regions outside of the Kodiak Archipelago.

# EXPANDED GLOBAL SEABIRD BREEDING SUCCESS DATASET ENABLES LARGE SPATIAL AND TEMPORAL ANALYSES

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### Abstract

Time series of seabird demographic and dietary responses to climate change are of tremendous value for examining shifts in food webs and ecosystems. As part of a new project to examine the effects of increasing ocean thermal stratification on the oceans, we have collated an expansive dataset of seabird breeding success from researchers around the world. Here we present information on the updated dataset (the original was published in Sydeman et al. 2021 *Science*) that now includes over 5,200 annual measurements of breeding success based on >180 time series representing >70 seabird species across >70 colonies. Most data come from temperate and polar latitudes, and there are far fewer tropical time series. The longest time series in the dataset extend back to the 1960s, but most begin in the 1980s or 1990s. Alcid species comprise much of the data, but penguins, procellariids, terns, and gulls/kittiwakes are also well represented. We are still compiling data, but in the forthcoming data analysis phase we will integrate this breeding success dataset with high-resolution data on stratification, primary productivity, and prey use and availability (where possible) to assess how environmental change is affecting seabird productivity and the probability of breeding failure across the globe.

# SEABIRD COLLISIONS WITH HUMAN INFRASTRUCTURE ARE DRIVEN BY VISITATION RATES TO BREEDING COLONIES & DETECTABILITY OF HAZARDS

### Marc Travers<sup>1,2</sup>, Karim Hana<sup>3</sup>, Scott Driskill<sup>4</sup>, Andre Raine<sup>4</sup>

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## Abstract

On the island of Kaua'i, powerline collisions have been documented as the greatest anthropogenic threat faced by the Newell's Shearwater (*Puffinus newelli*) and Hawaiian Petrel (*Pterodroma sandwichensis*). Here we document that three additional seabirds collide with powerlines; the Wedge-tailed Shearwater (*Ardenna pacifica*), White-tailed Tropicbird (*Phaethon lepturus*), and the Red-footed Booby (*Sula sula*). We report the frequency of seabirds flying directly at powerlines and the ratio of collisions to avoidances. We compare species-specific avoidance capability and factors that predict collisions and avoidances. Overall, the frequency of crossing powerlines and detectability of the powerlines played a larger role in collisions than did species-specific maneuverability. These data are critical in ensuring the success of powerline minimization methods, such as the attachment of bird diverters to powerlines, removal of static wire, and lowering or consolidating wires. By matching the type of minimization to the species and conditions where seabird powerline collisions are occurring, we aim to maximize the efficacy of possible collision reduction strategies.

# MIDWAY SEABIRD PROTECTION PROJECT- THE FINAL COUNTDOWN...AGAIN

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### Abstract

After COVID related delays over the past several years, the U.S. Fish and Wildlife Service (Service) will be implementing a plan to remove invasive mice from Sand Island, Midway Atoll National Wildlife Refuge. This removal is necessary to protect the largest colony of albatross in the world as well as 29 other species of birds that rely on Midway Atoll. On more than 500 other islands worldwide, similar invasive rodent removal campaigns successfully resulted in long-term benefits to native species and outweighed the limited, short-lived negative impacts from an eradication operation. The effort on Midway has many challenges including endangered non-target species, extensive infrastructure, and a community of 50 people that live on the island. This presentation will provide updates on scientific data collected, lessons learned from trialing methodologies, and how monitoring and data collection are interwoven throughout the project. The lessons learned from these research and monitoring projects can be applied to rodent eradication efforts across the world.

# NEGATIVE EFFECTS OF ONGOING HABITAT FRAGMENTATION ON MARBLED MURRELETS ARE AMPLIFIED NEAR ITS RANGE EDGE

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## Abstract

Habitat fragmentation can negatively affect biodiversity but understanding how it affects any particular species is complicated by idiosyncratic habitat requirements and spatial variability in fragmentation effects within a species' range. We aggregated 29 years of Marbled Murrelet (Brachyramphus marmoratus) breeding surveys from >42,000 forest sites throughout the Pacific Northwest, USA. We built species distribution models linking occupied sites with Landsat imagery to quantify murreletspecific habitat, then used occupancy models to test the hypotheses that: (1) fragmentation negatively affects murrelet breeding distribution; and (2) these effects are amplified with distance from the marine foraging habitat towards the edge of the species' nesting range. Murrelet habitat declined in the Pacific Northwest by 20% since 1988 while the proportion of habitat comprising edges increased by 17%, indicating increased fragmentation. Furthermore, fragmentation of murrelet habitat at landscape scales (within 2 km of survey stations) negatively affected occupancy of potential breeding sites, and these effects were amplified near the range edge. On the coast, the odds of occupancy decreased by 37% (95% CI: -54% to 12%) for each 10% increase in edge habitat (i.e., fragmentation), but at the range edge (88 km inland) these odds decreased by 99% (95% CI: 98% to 99%). Conversely, odds of murrelet occupancy increased by 31% (95% CI: 14% to 52%) for each 10% increase in local edge habitat (within 100 m of survey stations). Avoidance of increasingly fragmented landscapes and attraction to locally fragmented sites with reduced quality may help explain the lack of murrelet population recovery.

# PRECISION MONITORING OF COLONIAL NESTING ISLANDS USING UAVS AND MACHINE LEARNING

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### Abstract

Monitoring colonial waterbirds at nesting sites is a common technique for tracking population trends, informing conservation decisions, and understanding ecosystem health. Censusing these nesting sites has considerable effort and risk. Traditional colonial waterbird monitoring includes traversing the colony on foot, surveying via boat, or surveying aerially using small, manned aircraft. Each of these methods has challenges and consequences. Small Unmanned Aerial Vehicles (UAVs) are widely available and have become a useful wildlife management and research tool. Where this technology has been applied in waterbird studies, the use of UAVs was found to result in more precise count estimates than traditional, ground surveys. Manually counting and digitizing the very large sets of photos or videos, however, is a time-consuming task. To reduce the time needed to generate accurate counts from waterbird colony imagery, we developed guidelines for acquiring UAV footage of colonial waterbird nesting islands and a deep-learning tool that can be applied to precisely, accurately, and efficiently count and digitize multispecies waterbird colonies. We developed and trained these machine-learning algorithms to identify 16 classes of waterbirds nesting together on islands along the Texas coast using convolutional neural network-based object detectors. These algorithms can also be trained to detect and identify other species and be applied to monitoring efforts in a variety of habitats. We found the use of UAV-collected aerial imagery and deep learning can significantly improve the accuracy of monitoring events, while reducing staff processing time and colony disturbance.

# THE IMPACT OF DIGESTION ON THE RELEASE OF TOXICANTS FROM PLASTICS USING AN *IN VITRO* SEABIRD GASTRIC DIGESTIVE SYSTEM MODEL

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## Abstract

Seabirds, specifically Procellariiforms, are particularly exposed to plastic ingestion. In addition to mechanical injury, ingested plastics are suspected to release toxicants (plastic additives present inside the matrix and POPs adsorbed on the surface) in their digestive system which could in long term, impair their reproductive success. We hypothesized that plastic type, digestive conditions (presence and type of food, pH and enzymes) and contact time influence the bio-accessibility of plastic-associated chemicals in the digestive tract of seabirds. We developed an in vitro Procellariiform gastric digestive system model to which we exposed two polymers-HDPE and PVC-commonly ingested by seabirds. These polymers were manufactured with two additives of different physico-chemical properties–PBDE-209 and BPS. Plastics added with PBDE-209 were subsequently incubated in saltwater containing environmental concentrations of two POPs–PCB-28 and -138–to stimulate a relevant sorption of PCBs on plastic particles, as known to occur in the ocean. The digestive process stimulated the release of additives and adsorbed PCBs from the plastic particles in a polymer-dependent way. Higher concentrations of PBDE-209 and PCBs were released in the lipidic phase of the digestive fluids, while BPS was more present in the aqueous phase. Regarding the impact of diet composition, higher concentrations of chemicals were found in wax ester-rich marine oil compared to triacylglycerol-rich oil. Finally, around 100% of PCBs adsorbed at the plastic surface were released in the digestive fluids within a week of treatment as compared to only  $\leq$ 5% for the additives distributed within the plastic matrix.

# MANAGED RELOCATION OF ALBATROSS TO THE CALIFORNIA CHANNEL ISLANDS: CONSERVATION BASIS AND PRELIMINARY SUITABILITY ASSESSMENT

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### Abstract

Laysan (Phoebastria immutabilis) and Black-footed Albatrosses (P. nigripes) primarily nest on atolls in the Northwestern Hawaiian Islands threatened by inundation from sea level rise and increasing storm surge associated with climate change. Restoration or creation of breeding colonies on higher islands are among the highest priority conservation actions to enhance viability of these species. A previous US Fish and Wildlife Service structured decision-making exercise identified the California Channel Islands as a possible restoration site for Black-footed Albatross. The California Current is part of the natural foraging range of Laysan and Black-footed albatrosses and archaeological evidence indicates albatrosses were present in the California Channel Islands prehistorically, yet neither species nests in the Channel Islands. We assessed the suitability of managed relocation of Laysan and Black-footed albatrosses to the Channel Islands using social attraction and/or translocation. We also used a new risk analysis framework developed for the National Park Service to evaluate the potential ecological risks of this action. Creating an albatross colony in the Channel Islands is logistically feasible using available methods, and several islands would be suitable. The risks associated with albatross relocation were deemed low, but the risk of no action is high for these albatrosses. Remaining steps include evaluating policy alignment with landowners and other agencies and jurisdictions. This exercise can be a useful managed relocation case study that can inform future decisions by land managers and agencies regarding North Pacific albatross conservation.

# COMPOUND EFFECTS OF WARM OCEANOGRAPHIC ANOMALIES AND FISHING PRESSURE ON ELEGANT TERN COLONY SIZE AND NESTING DISTRIBUTION

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## Abstract

Parallel studies of nesting colonies in Mexico and the United States show that Elegant Terns (*Thalasseus elegans*) have expanded from the Gulf of California Midriff Island Region into Southern California, but the expansion fluctuates from year to year. A strong inverse relationship between nesting pairs in three Southern California nesting areas: San Diego saltworks, Bolsa Chica Ecological Reserve, and Los Angeles Harbor (1991 to 2022) and Isla Rasa in the Midriff (1980 to 2022) shows that terns migrate northward when confronting warm oceanographic anomalies (>1.0°C), which may decrease fish availability and hamper nesting success. Migration pulses are triggered by sea surface temperature anomalies localized in the Midriff and also, by reductions in the sardine population as a result of intensive fishing. This behavior is new; before year 2000, the terns stayed in the Midriff even when oceanographic conditions were adverse. Our results show that terns are responding dynamically to rapidly changing oceanographic conditions and fish availability by migrating 600 km northwest in search of more productive waters. Our results also show there is a need to re-think fisheries management strategies by radically integrating the precautionary approach and ecosystem-based management into decision making.

# IMPACTS OF RISING SEA SURFACE TEMPERATURE ON NESTING BEHAVIOR OF ATLANTIC PUFFINS IN THE GULF OF MAINE

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### Abstract

Between 2017 – 2022, we followed chick provisioning and burrow guarding behavior of an Atlantic Puffin (*Fratercula arctica*) pair occupying a burrow equipped with a high-definition web cam on Seal Island NWR in the Gulf of Maine, USA. The 20-year-old male reared chicks in 2017-2018 with one partner, and with another since 2019. The years 2017, 2019, 2020, and 2022 were fair to good food provisioning years, during which we observed that the female provided twice as many feeds as the male, while the male spent twice as much time guarding the chick and burrow as the female. We assessed the impact of rising SST in the Gulf of Maine on provisioning and burrow guarding for 160 days (n). Daily SST anomaly was determined from a 30-year mean SST baseline. Multivariate regression analyses showed significant decreases in daily feeds (p=0.03), and burrow guarding time (p =.002), with increasing SST anomaly. Together, these results suggest that as the Gulf of Maine warms, puffin parents provide fewer feeds for their chick and spend less time at the burrow. These results were amplified in 2018, a poor food year driven by the onset of a marine heat wave mid-season. While provisioning and burrow guarding the heatwave. When conditions improved, male and female feeds/day were comparable, suggesting that male Atlantic Puffins may trade burrow guarding time for additional provisioning in adverse conditions.

# SEASONAL SHIFTS AND INDIVIDUAL CONSISTENCY IN THE DIET AND FORAGING OF PERUVIAN BOOBIES (*SULA VARIEGATA*)

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### Abstract

Past stomach content analysis of Peruvian Boobies (Sula variegata) indicates that they are specialist foragers, primarily feeding on Anchoveta (Engraulis ringens). However, longer-term diet may not be reflected in stomach contents; stable isotope analysis of tissues can offer insight into diet consistency over a longer timeframe. We analyzed  $\delta^{15}$ N and  $\delta^{13}$ C from blood and feathers of boobies sampled across three years and oceanographic conditions at Isla Guañape Norte, Peru. To test whether population-level diets shift between seasons, we compared population means of breeding season (blood)  $\delta^{15}$ N and  $\delta^{13}$ C values to the standardized non-breeding (feather)  $\delta^{15}$ N and  $\delta^{13}$ C values using Wilcoxon signed-rank tests. To test whether individual diets are consistent between seasons and/or relative to one another, we regressed individual breeding and non-breeding  $\delta^{15}$ N and  $\delta^{13}$ C values using Kendall rank correlations. Preliminary results indicate that both  $\delta^{15}$ N (Wilcoxon signed-ranks test, T<sup>+</sup> = 174.5, n = 40, P = 0.02) and  $\delta^{13}$ C (Wilcoxon signed-ranks test, T<sup>+</sup> = 154.5, n = 40, P = 0.01) values were higher in non-breeding versus breeding seasons. There was a significant correlation in  $\delta^{15}$ N between seasons (Kendall rank correlation,  $r_t = 0.53$ , n = 40, P < 0.001), but none in  $\delta^{13}C$  (Kendall rank correlation,  $r_t = 0.16$ , n = 40, P = 0.166). This may indicate a consistent seasonal population-level diet shift, and individual consistency of shifts in trophic position. This analysis will add to ongoing research into the degree of flexibility and consistency in the diet and foraging of Peruvian Boobies.

# FINE-SCALE BIOLOGGING REVEALS PENGUIN-KRILL INTERACTIONS UNDER ANTARCTIC FAST-SEA ICE

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### Abstract

Linking marine predator movements with prey distribution may contribute to understanding predatorprey interactions in 3-D marine environments. Recent developments in biologging have enabled us to simultaneously record 3-D dive paths and feeding activities of marine predators. In this study, we monitored the underwater 3-D diving behaviour of Adélie Penguins Pygoscelis adeliae to examine how they adjust their fine-scale foraging behaviours to variable prey distribution. In the summer of 2018/2019, we conducted fieldwork at Hukuro Cove colony, Lützow-Holm Bay, where fast sea-ice remained. We attached three types of data loggers to 13 chick-rearing penguins: GPS loggers to examine movements on sea ice during foraging trips, multi-channel data loggers to reconstruct their 3-D dive paths, and head-mounted accelerometers to examine their feeding events. During the foraging trips, penguins walked on fast sea-ice after leaving the breeding colony, and they conducted repeated dives (dive bouts) to feed on Antarctic Krill Euphausia superba in small open waters along tidal cracks and leads. According to reconstructed 3-D dive paths, penguins swam horizontally for 60-160 m during a dive, fed on prey around the maximum horizontal distances they reached, and mostly returned toward the starting point of dives. The horizontal travel distances and the mean feeding locations in a dive tended to increase during a dive bout. This suggests that penguins gradually expanded the range of prey search during a dive bout in response to prey distribution changes (depletion or dispersion). These results contribute to a better understanding of dynamic penguin-krill interactions under Antarctic fast sea-ice.

# SEABIRD TRANSFER OF MICROPLASTIC FIBERS TO OCEANIC ISLANDS VIA GUANO DEPOSITION AT PALMYRA ATOLL, NORTHERN LINE ISLANDS

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### Abstract

Plastic pollution affects nearly every marine and freshwater ecosystem. In the Pacific Ocean, plastic debris accumulates at high concentrations near population centers and in gyre-controlled oceanic "garbage patches." Away from the oceanic garbage patches, concentrations of microplastic particles ("MPs"; <5mm) in surface waters of the Pacific Ocean are low; however, bioaccumulation through the oceanic food chain occurs. This study investigates seabird accumulation and transfer of MPs from the ocean to islands at Palmyra Atoll, a U.S. territory in the Northern Line Islands Archipelago (5.88°, -162.08°). We document ocean-to-land transfer of MP fibers through an analysis of the excrement (guano) collected beneath roosting and nesting sites inhabited by Palmyra's resident Sula sula (Redfooted Booby) population. S. sula is a tree-nesting marine predator of pelagic fish and squid. To our knowledge, this is the first study documenting transfer of marine microplastic particles to tropical islands following a two-vector (minimum) process involving marine prey and predatory seabirds. S. sula guano was collected from stems and leaves below six nesting sites across the atoll. Samples were dried, weighed (0.72 kg total), and prepared via wet oxidation. Guano from all six sampling locations averaged 0.2 (0.04 – 0.61) MP fibers/g of dry guano. S. sula adds ~140 dry tons of guano to Palmyra's islands annually, likely containing 26-30 x 106 microplastic fibers. Our results indicate remote terrestrial oceanic island ecosystems are not immune from the accumulation of long-lived synthetic fibers, despite their remoteness from hotspots of plastic waste injection and accumulation.

# DEEP LEARNING OF ORTHOMOSAIC IMAGES IS AN EFFICIENT TOOL FOR MONITORING URBAN SEABIRD COLONIES

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## Abstract

The largest Double-crested Cormorant nesting colony in British Columbia lies under the Ironworkers' Memorial Bridge, a six-lane stretch of the Trans-Canada Highway connecting communities of Metro Vancouver bordering Burrard Inlet. To monitor breeding success of this provincially-listed species, we captured high-resolution orthomosaic images of the bridge colony using the robotic camera system developed by GigaPan EPIC Pro. The non-invasive and inexpensive nature of these methods allowed us to monitor nests and birds in the colony more frequently (3x weekly). While monitoring frequently provides greater insight into the colony, there is significant effort and expense required to manually perform population counts from images. To remove the burden and associated bias of manual counting and to standardize the count, we developed a deep-learning pipeline to detect and count cormorants and their nests. We used semi-automated annotation to generate datasets used to train and evaluate multiple CNN algorithms. We chose to use CenterNet meta-architecture with a ResNet-101 model as the backbone network based on its performance on our validation set. The resulting pipeline was applied to dozens of panoramic photos and thousands of close-up photos of cormorants and their nests collected to reduce the image processing burden across the season. We compared automated counts with manual bridge counts and found high agreement between counting methods. These automated counts allowed us to compare nest success between monitoring years, and suggests deep learning models could be more broadly applied to monitoring large seabird colonies when paired with high-resolution orthomosaics.

# THE 2015-16 COMMON MURRE DIE-OFF IN ALASKA WAS PRIMARILY DUE TO ACUTE STARVATION OF FEMALES FROM THE NORTHERN BERING SEA

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## Abstract

In the winter of 2015-2016, an estimated one million Common Murres (Uria aalge) died in a massive mortality event, the majority of which were in Alaska. The cause of death was broadly identified as starvation and the event is estimated to have removed one quarter of the birds belonging to colonies in the Bering Sea and Gulf of Alaska. We collected feathers from dead birds throughout the Gulf of Alaska during the die-off and from live breeding birds at various Alaskan colonies following the die-off to determine whether starvation was chronic or acute. We also investigated how the die-off was distributed across breeding regions and between sexes to characterize impact on Alaska's common murre population. We analyzed feathers for corticosterone concentration (indicative of nutritional stress), stable isotope signatures (indicative of molt region) and bird sex (genetically determined). Feathers collected from dead birds grown two months prior to the die-off had low concentrations of corticosterone, indicating that the starvation event was acute. A random forest analysis of  $\delta^{15}$ N,  $\delta^{13}$ C,  $\delta^{18}$ O, and  $\delta^{2}$ H values assigned 78% of dead birds to northern Bering Sea colonies, and the rest to the Gulf of Alaska (18%) and Cook Inlet (4%). The majority of dead birds were female (77%) in contrast to relatively even sex ratios amongst live birds at breeding colonies (49% female). We discuss the potential demographic consequences for Alaska murre populations, the linkages across the Bering Sea and Gulf of Alaska marine ecosystems, and implications for conservation focused research.

# SEEING UNDERWATER: WHAT WE HAVE LEARNED FROM 185 HOURS OF ADÉLIE PENGUIN FORAGING VIDEO PAIRED WITH ACCELEROMETRY DATA

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## Abstract

Animal-borne video loggers are an increasingly important tool in the investigation of animal behavior. Their utility is limited by time-consuming post processing. Video loggers deployed on Adélie Penguins (Pygoscelis adeliae) at Cape Crozier, Antarctica, captured 185 hours of foraging video over two breeding seasons. Video loggers were deployed on 51 breeding adults along with an accelerometer that recorded time, depth, temperature, tri-axial acceleration and GPS location (second season) during their 1–3 day foraging trips. Approximately 400 hours of video were manually annotated to produce a dataset of habitat and behavioral observations. Device-equipped birds spent 53.4% of the video period actively diving, with 40.0% of dives reaching depths greater than 50 meters where light levels were frequently insufficient to identify behaviors. A total of 8,844 individual prey capture events were observed during the lighted portions of dives and 3,098 prey captures were identifiable by type of prey. Krill (n=2,574) was the most frequently identified prey type, followed by fish (n=229), and squid (n=60). Fewer than 50 prey captures were identified as either pteropods, gelatinous prey or amphipods. Foraging dives occurred primarily in open water habitat, however some individuals were observed making repeated benthic dives or dives associated with the underside of sea ice, at times in extremely shallow water, which was unexpected in this population. This dataset of visually confirmed prey capture events will be further compared to commonly used time-depth recorder (TDR) based metrics of foraging behavior to investigate how often dives classified as non-foraging contain video-confirmed prey captures.

# FITTING A SMALL PLUNGING SEABIRD WITH TELEMETRY TRANSMITTERS

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## Abstract

Fitting small seabirds with telemetry devices is notoriously difficult. This is due to a lack of lightweight transmitters and appropriate fitting techniques for small plunging seabirds. Here we test an attachment of miniaturized VHF transmitters to get a better handle of what type of transmitters and fitting techniques best work with California Least Terns (Sternula antillarum browni; CLT). Back-mounted telemetry is an established method of transmitter attachment on large sea birds. With the advancement of miniaturized VHF transmitters, we wanted to test this approach with CLT and gauge impacts transmitters and their attachment may have on breeding behavior. To do so, we fitted six CLT with Lotek NTQB2-1 VHF transmitters (weighing 0.26g) by gluing transmitters to the birds' dorsal inter-scapular region with fast acting cyanoacrylate adhesive. We found that glued back-mounted transmitters had little impact on CLT behavior. Compared to non-fitted adults, copulation, incubation, and foraging were not impacted by the placement of the transmitters or antennae length. We also found evidence showing that glued transmitters can stay in place and pinging for more than 30 days. Average time our transmitters pinged was 14 days. This average, however, was influenced by heavy predator pressures during the breeding season, leading to early site abandonment by all but one telemetry fitted adult. Testing attachment of miniaturized VHF transmitters not only allowed us to understand if back-mounted methods can be successful on small plunging seabirds, but also gives us a way to gather valuable data on factors effecting CLT foraging budgets.

# NOVEL KNOTLESS LEG-LOOP HARNESS PROVIDES FIRST YEAR-ROUND GPS TRACKS OF AN ARCTIC TERN (*STERNA PARADISAEA*)

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### Abstract

With rapid technological advancement in the development of miniaturized global positioning system (GPS) tracking technology, devices for deployment on small avian species (40–200g) are now widely available. With this technology comes the need for a variety of new, or adapted, attachment techniques for both short and long-term deployments. It is essential that these techniques minimize impacts to tagged individuals while ensuring a secure fit that will optimize data collection. Leg-loop harnesses have long been used to attach tracking devices to passerines, shorebirds, and seabirds. As this technique does not impact the mobility of the birds' wings in any way, it is ideal for use on small and highly mobile avian species. Here we introduce a modified leg-loop harness design for seabirds that was successfully used to deploy small ~3g GPS tags on Arctic Terns *Sterna paradisaea* (average body mass =105g) in the Gulf of Maine, USA. We provide a detailed description on how to build a harness along with an illustrated step-by-step guide to the process. In addition, we provide some of the first GPS tracking results following the remarkable migration of Arctic Terns from Maine to the Weddell Sea in Antarctica.

# FORAGING ECOLOGY OF BREEDING LEACH'S STORM-PETRELS (*HYDROBATES LEUCORHOUS*) IN THE GULF OF MAINE, USA

### Keenan Yakola<sup>1,2</sup>, Gemma Clucas<sup>3</sup>, Don Lyons<sup>2,1</sup>

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### Abstract

As part of the Biden-Harris administration's plans to deploy 30 gigawatts of offshore wind energy by 2030, the Bureau of Ocean Energy Management is rapidly moving forward with plans to designate commercial lease areas in the Gulf of Maine, USA. Unfortunately, relatively little is known about the movement ecology of seabirds in the region, making it difficult for managers to provide data on the locations of critical foraging areas relative to forthcoming development. Among the most common breeding species in the Gulf of Maine is the Leach's Storm-petrel (*Hydrobates leucorhous*), which was recently up listed to vulnerable by the IUCN following significant population declines of >30% in some regions, including the nearby Canadian Maritimes. To better understand storm-petrel foraging movements, we deployed miniaturized GPS tags on both incubating and chick rearing adults during the summer of 2022 (total n=67). We explored differences in foraging locations by breeding stage and sex, and compared areas of high transit and foraging use with planning areas for offshore wind development. In order to examine the diet of this species, we collected both fecal and regurgitate samples from breeding adults and analyzed them using DNA metabarcoding. As Leach's Storm-petrels are among the widest-ranging breeding seabird species in the region, our results highlight their use as efficient indicators of regionally important foraging areas utilized by a variety of marine taxa.

# THE POTENTIAL FOR ANTHROPOGENIC NOISE TO SERVE AS AN INADVERTANT ATTRACTANT FOR SEABIRDS

#### Lindsay Young

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#### Abstract

Many seabird species are highly colonial and use a complex series of vocalizations for communication, courtship and colony locating. As a result of these behaviors, acoustic attraction is frequently employed as a mechanism for restoring and augmenting seabird colonies by using their calls to attract birds to a specific location. From 2016-2022, searches were conducted for Hawaiian Petrels on the island of Oahu, Hawaii where the petrels were assumed to have been extinct for 300+ years. Surprisingly, birds were detected during the first year of surveys. The area where birds were detected was immediately below a large communications tower that emitted a hum that matched the tonal frequency of the first note of their call. During the same period, several Hawaiian Petrels and a Cook's Petrel were killed by nearby wind turbines. The findings raised the question of whether the birds found were a remnant population, or whether they had been inadvertently attracted to the hum of the tower and/or wind turbines. Similar examples exist on Midway Atoll where Bonin Petrels are attracted by the hundreds to the hum of a generator. Despite the importance of acoustic communication to seabirds and the potential for it to alter their behavior and even breeding location, little research has been done to determine the impacts of human generated noise on them. This paper will review the sound spectrum of wind turbines, and several other human structures to determine the potential for overlap with seabird vocalizations and the implications of anthropogenic noise attraction.

# DOES ECOSYSTEM-BASED FISHERY MANAGEMENT WORK FOR SEABIRDS IN ALASKA?

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### Abstract

Ecosystem-based fisheries management (EBFM) is a way to manage fisheries that takes all components of marine ecosystems into account, including seabirds. In the USA, NOAA Fisheries is committed to progressing and implementing EBFM for federally-managed species. But how does EBFM benefit seabirds? In this talk we present a review of evidence whether EBFM has in fact benefitted seabirds in Alaska and discuss areas where this is not so clear. For example, the use of bird deterrents has been shown to decrease fishing-induced bird mortality rates with positive impacts on seabird populations. Also, there is a ban on forage fish fishing in Alaska. However, the evidence of EBFM positively impacting seabirds through managing fisheries on fish species that feed on the same prey as seabirds is not so straightforward. We use the case study of the 2014-2016 marine heatwave in the NE Pacific to show how the severe decline in the Gulf of Alaska Pacific Cod (*Gadus macrocephalus*) stock could be impacting the recovery of common murres in the region, and how EBFM plays a role in that interaction.
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# WHY INTERACTIONS AMONG SEABIRDS, FORAGE FISH, AND THE COLUMBIA RIVER PLUME MATTER TO THE SURVIVAL OF ENDANGERED SALMON

#### Jeannette Zamon<sup>1</sup>, Elizabeth Phillips<sup>2</sup>, Josh Adams<sup>3</sup>, John Horne<sup>4</sup>

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#### Abstract

Understanding ecological processes that affect early marine survival of endangered Pacific Salmon in the United States is considered a key component to successful population recovery plans for salmon. However, while predation is a known key factor affecting juvenile salmon survival, mechanisms of ocean predation remain poorly understood. Therefore, in 2003, NOAA Fisheries initiated a program to investigate the potential for fish-eating birds to impact salmon survival. Results of our work so far show Common Murres and Sooty Shearwaters are the numerically dominant predators that overlap in space and time with a variety of listed stocks of juvenile salmon during their early marine residence. These avian predators preferentially use an oceanographic habitat feature called the Columbia River Plume, where both salmon and forage fishes consumed by seabirds are abundant. Real-world data used to construct models of seabird foraging suggest predation risk to salmon can be as much as 70% lower when non-salmon forage fish are available, supporting the hypothesis that healthy forage fish populations are key to buffering salmon against ocean avian predation. Further understanding of the nature of seabird-fish interactions in the plume will advance our knowledge of the effects of ocean avian predation on salmon recovery. The next steps for research include quantifying seabird diet, examining stock-specific salmon mortality caused by seabirds, and expanding forage fish responses to plume dynamics.

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# INTERACTIONS BETWEEN ANCHOVY FISHERIES AND PERUVIAN BOOBIES REVEALED BY BIRD-BORNE CAMERAS AND MOVEMENT LOGGERS

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### Abstract

Fisheries threaten marine predator populations through bycatch and competition for the same resources, but may also provide feeding opportunities. Understanding benefits and mitigating impacts, therefore, requires a detailed understanding of fishery interactions. The Humboldt Current system supports the world's largest single-species fishery (Peruvian Anchoveta Engraulis ringens), along with abundant marine predators dependent on these forage fish, including seabirds. We combined birdborne video cameras and GPS-acceleration-dive loggers to quantify the foraging behavior of chickrearing Peruvian Boobies Sula variegata around Isla Macabi, Peru, in December 2020 and May 2021. Videos revealed that 18% of 77 Peruvian Booby foraging trips included feeding at actively fishing purse seine vessels, diving in and around the nets. Most vessel interactions were close to the colony, and we found no difference in foraging effort between trips with and without vessel interactions. We recorded fishing effort in the foraging range of the colony using remotely sensed data from the vessel monitoring system accessed via Global Fishing Watch, finding more frequent interactions and catch depredation when fishing effort was high near the colony. We found no evidence that birds expended additional energy (e.g., dynamic body acceleration) or travelled to different locations to reach vessels. We emphasize the value of combining high-resolution movement and video loggers with remotely sensed fisheries data to monitor seabird-fishery interactions in detail, rather than just spatio-temporal overlap, and assess the potential for competition and bycatch. Threatened seabird populations may benefit from no-take zones or reduced fishing effort in core foraging areas of colonies.