



1ST WORLD SEABIRD CONFERENCE Seabirds: Linking the Global Oceans

Poster Session 2 Abstracts

The 1st World Seabird Conference has the distinct pleasure of presenting over 700 presentations during the conference September 7 to 11, 2010 in Victoria, Canada. These presentations include over 120 Invited Sessions, over 120 Contributed Sessions, and over 380 Posters. A series of Legacy Workshops, other Workshops and a Legacy Plenary round out the conference program. This document presents the full abstracts for the Poster Sessions.

Victoria Conference Centre
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Bycatch

P2-1 Kimberly Dietrich

Seabird bycatch in Alaska trawl fisheries: A comparison of observer sampling protocols

“Seabird bycatch in commercial fisheries, especially longline, trawl and gillnet fisheries, is recognized as a global conservation problem. In some southern hemisphere fisheries the bycatch of certain albatross species has been identified as the cause for serious population declines. North Pacific Groundfish Observers conduct species composition sampling on trawlers to support estimation of total removals for a variety of species. Sampling protocols work well in support of estimates of mortality for most fish species. Unfortunately, the estimates of seabird mortalities associated with trawl fishing operations are likely biased as seabird mortalities may also occur from encounters with rigging (trawl sonar and trawl door cables) or the net forward of the codend. Current sampling protocols are not able to account for either of these situations. Observers have been collecting data on seabird interactions with trawl warps, nets, and third wires over several years as part of a special project assigned to prior, experienced observers only. We compare seabird bycatch based on current observer protocols with the number of birds caught using the specialized observation protocols. Initial summaries reinforce the hypothesis that current estimates are low. We review changes incorporated into standard operating procedures for observers as a result of this work and recommend methods to improve seabird monitoring on trawlers in Alaska.”

Shannon Fitzgerald

WITHDRAWN P2-2 Ed Melvin

Reducing seabird strikes with trawl cables in the Pollock Catcher-Processor Fleet in the Eastern Bering Sea

“Little is known about threats posed to seabirds by cable strikes in northern hemisphere trawl fisheries or what mitigation measures might reduce those threats. We compared the rate of heavy seabird strikes with third-wire (scanning trawl sonar) cables and warps, using three mitigation measures, third-wire snatch block, streamer lines, and warp booms, compared to a control of no deterrent aboard two catcher-processor vessels targeting pollock in the eastern Bering Sea (EBS), one that rendered the majority of the offal and bycatch into fish meal and fish oil and one that discharged macerated offal. More birds attended the nonmeal-vessel, but the rate of seabird cable strikes was higher for the meal-vessel, due to the greater aerial extent of its cables. Streamer lines significantly reduced heavy seabird strikes with both cable types by at least an order of magnitude

regardless of the discharge type. Reducing the aerial extent of third-wires also reduced third-wire strike rates, but was less effective than streamer lines. Warp booms designed to divert seabirds from warps failed to significantly reduce seabird warp strikes, but this technique can be improved. Collectively these results show for the first time that seabird strikes with modern third-wire trawl sonar cable systems can be reduced through gear modification and that warp strikes can be mitigated with techniques similar those in place in southern hemisphere fisheries. However, because only small-winged birds classified as of least conservation concern were struck and appeared unharmed the need for mitigation in the EBS pollock fishery is questioned.”

Kimberley Dietrich; Shannon Fitzgerald; Tamre Cordoza

P2-3 Angel David Mac'as

Factors affecting Mediterranean Cory's Shearwater bycatch in Spanish longline fisheries from Mediterranean Sea

“Cory's shearwater *Calonectris diomedea* is currently listed like least concern in the UICN red-list. However, the subspecies *C. d. diomedea* is listed as Endangered. This subspecies is the principal Seabird caught by the Spanish Mediterranean longline (30.7% of total seabird by-catches). For this reason, understanding factors determining seabird by-catch, and how to control it, is a major goal in seabird conservation biology. We performed a binary logistic regression on the presence or absence of Cory's shearwater by-catch and the predictive variables to test if the probability of incidentally catching Cory's shearwater (1 or more) may be predicted by the combination of several phenological (27 variables), ecogeographical (5 variables) and technical factors (5 variables). Moreover we used the interaction with others fisheries. The interaction with others fisheries was estimate as the non-working days, because in function to Spanish normative the longline fleets is the only fisheries that can fisher in non-working days. A total of 2587 fishing operations were observed from January to December, during the years 2000 to 2009, which represent 5398297 hooks controlled directly, with 80 Cory's shearwater by-caught in 30 fishing operations. We obtained a statistically significant logistic model with the variables: number of hooks, sets over continental shelf, October, non-working days, and distance to the colony of Paloma Island. The model's goodness-of fit-was significant (Omnibus test= 96.644, df= 6, p= 0.001; Hosmer and Lemeshow test= 10.135, df= 8, p= 0.256), and its discrimination capacity was outstanding (AUC = 0.912).”

Salvador García-Barcelona; José Carlos B-ez; Raimundo Real; Enrique Alot



P2-4 Joan Browder

Modeling low rates of seabird bycatch in the U.S. Atlantic longline fishery

“Incidental capture of seabirds in commercial fisheries is a worldwide issue of concern for potential damage to vulnerable populations and their ecosystems. NMFS SEFSC initiated a project in 2004 to improve seabird bycatch estimation in the U.S. Atlantic pelagic longline fishery. The project’s first component was training in the Pelagic Observer Program to improve the specificity and accuracy of seabird identification. The most recent component is development of a new analytical approach to improve estimation of the total annual seabird bycatch of the fleet based on observer data. Catch, bycatch, effort, and other information are reported on observed longline trips. Estimates of total annual seabird bycatch are extrapolated from observed trips to the entire fleet based on total effort. The infrequency of seabird bycatch in observed longline sets (0 to 33 birds per year from 1992 to 2008 in ~5500-17300 observed sets) and low proportions of sets observed (2-7% from 1992 to 2005 and 10-14% from 2006 to 2008), raised concerns about reliability of estimates, leading to this work. We examined alternate methods of estimating seabird bycatch using generalized additive models (GAM), generalized linear models (GLM), and GLM with spatially auto-correlated parameters. Models were applied separately to probability of seabird bycatch (presence/absence) and numbers of seabirds per positive bycatch; then multiplied. AIC suggested best-fitting models included latitude, longitude, and quarter of year for presence/absence and numbers of hooks per set for positive bycatch. A composite model of GAM (presence/absence) and GLM (positive catch) gave best predictions of total seabird bycatch.”

Andreas Winter; Yan Jiao

P2-5 Edward Abraham

Seabird bycatch in New Zealand fisheries

“New Zealand has a rich seabird community, and supports extensive commercial fisheries. Core to understanding the impact of fishing on seabirds is estimation of the numbers of captures. We use the records of seabird bycatch incidents that are reported by fisheries observers to estimate the total number of seabird captures. Coverage by observers varies widely between different fisheries: some fisheries have observer coverage of over 30% coverage, and others having less than 1% coverage. The variable coverage makes the estimation more complicated, and Bayesian statistical methods are used to allow both point estimates and uncertainties to be calculated. Emphasis is placed on the species that are caught most frequently (white capped albatross, white chinned petrel, and sooty shearwater). In recent years the fishing industry and the New Zealand

government have implemented measures that have been aimed at reducing seabird bycatch. These include the compulsory use of streamer lines, or similar mitigation devices, on larger trawlers. While experimental work suggests that mitigation devices reduce seabird bycatch, the observer data allows the fisheries-wide effects of mitigation usage to be assessed. Time series of capture-rates and total captures are used to determine whether the introduction of mitigation has resulted in a decrease in the total captures.”

Finlay Thompson

WITHDRAWN P2-6 Cleo Small

Reducing seabird bycatch from the top: Progress in regional fisheries management organizations

“Regional Fisheries Management Organizations (RFMOs) have a central role in the sustainable management of the world’s oceans and the conservation of species vulnerable to bycatch. The Commission for the Conservation of Antarctic Marine Living Resources (CCAMLR) has demonstrated what can be achieved, having reduced seabird bycatch by over 99% in its regulated fisheries around South Georgia. However the world’s five tuna commissions overlap with more than 80% of the world’s albatross and petrel distribution. In 2004, only one tuna commission had requirements for seabird bycatch mitigation by its longline fleets. We review progress achieved between 2005-2010 through collaboration between member states, ACAP and other stakeholders, and identify future challenges.”

P2-7 Lewis Van Fossen

Seabird mitigation measures in Hawaiian longline fisheries

“The U.S. National Marine Fisheries Service’s Pacific Islands Regional Office (PIRO) annually issues reports detailing seabird interactions for its pelagic longline fisheries. These reports can be accessed on the PIRO web site at: <http://www.fpir.noaa.gov>. Seabirds, mostly albatrosses (*Phoebastria* spp.), are captured incidentally to fishing operations in both the deep-set and the shallow-set pelagic Hawaii longline fisheries. The deep-set fishery targets tunas (*Thunnus* spp.), while the shallow-set fishery targets swordfish (*Xiphias gladius*). Seabird mitigation measures (50 CFR 665.815) were originally implemented due to the possibility of interactions with the ESA-listed short-tailed albatross (*Phoebastria albatrus*). With the mitigation measures in place, overall seabird interactions were reduced by over 90% even after the re-opening of the shallow-set fishery in 2004. Gilman et al. (2008) demonstrated that albatross capture rates were reduced by 67% in the deep-set fishery. Seabird mitigation measures developed in Hawaii were used to help develop conservation management measures (CMMs) adopted internationally by the Western and Central Pacific Fisheries



Commission (WCPFC) in 2007. However, the WCPFC CMMs contain additional measures, such as tori lines, that are not required in Hawaii longline fisheries.”

P2-8 Susan Waugh

Using ecological risk assessment to reduce fisheries risk to seabird populations

“Seabird incidental mortality in fisheries is a key threat to the viability of populations. Over the last decade, Ecological Risk Assessment (ERA) methods have evolved to identify the species which may be most at risk, and the areas and seasons in which there is highest risk of interaction. Results can be used to target bycatch mitigation and monitoring. ERA methods range from qualitative such as those used in Antarctic fisheries to semi-quantitative, such as those applied in Australian fisheries management for shark and fish bycatch. Semi-quantitative methods, which take into account species distribution and productivity but allow for data paucity, have been applied in New Zealand domestic fisheries and Regional Fisheries Management Organisation contexts to define risk for seabirds across oceanic scales. We examine the outcomes of analyses along a continuum from qualitative to semi-quantitative, and discuss how they have been taken up in the management of fisheries bycatch of seabirds.”

Cleo Small; Nathan Walker; Richard Phillips

P2-9 Oliver Yates

The BirdLife Albatross Task Force – Making real change at the stern of the vessel

“The BirdLife Albatross Task Force – Making real change at the stern of the vessel The BirdLife International Albatross Task Force (ATF) is the world’s first international team of bycatch mitigation instructors. The ATF was established in 2006 as a collaborative initiative by BirdLife International and the Royal Society for the Protection of Birds (RSPB, UK) to bridge the gap between conservationists and the fishing industry, by providing skilled personnel to work with fishermen and fisheries managers both on-shore and at-sea. Currently, the ATF has 15 at-sea instructors working in seabird bycatch ‘hotspots’ in developing countries in South America and southern Africa (Argentina, Brazil, Chile, Ecuador, Namibia, South Africa and Uruguay). The ATF has the intimate ‘grass-roots’ knowledge of the local fishery that is required to take the action necessary to save seabirds and improve fisheries sustainability. Originally, the programme focused on establishing the industry and government contacts required to assess bycatch levels in target longline and trawl fisheries and to have existing mitigation measures adopted. We have achieved dramatic bycatch reduction in pelagic longline and trawl fleets in South Africa, and in the pelagic longline tuna fleet in Chile, and similar results are emerging from other ATF teams. In 2009, the teams embarked on an

ambitious mitigation research programme designed to refine existing mitigation measures and test emerging technologies to identify best practice mitigation for pelagic longline and trawl fleets. The results to date demonstrate that the ATF has the potential to make a significant contribution to halting the decline of many albatross and petrel populations.”

Esteban Frere; Ben Sullivan

P2-10 Yuri Artukhin

Seabird bycatch and ideas to make it reduced in the Russian Far Eastern fisheries

“In the Russian Far Eastern seas the mortality of seabirds can be in the high seas and bottom gillnet fisheries, in the demersal longlining, trawl and Danish seine fishing and in the coastal trap net fishing. The species composition and level of bycatch can vary extensively depending on the fishing gear, area, catch volume or season of fishing. The maximal accidental mortality is in the salmon driftnet fishery, providing by Russian and Japan fishermen in the Exclusive Economic Zone of Russia, and in the demersal longline fishery, operating generally in the waters adjacent Kamchatka. For today some practical measures to make seabird bycatch reduced can be introduced in the longline fishery. According to our experiments the most effective measure for the longline fishery is the paired streamer lines. Also some restrictive measures (including limitation and reduce of fishing fleet and catches allowed, changing boundaries of fishery areas and seasons, reduce of length of gillnet lines, application of other methods to fish salmon at sea) should be set in the driftnet fishery in the Russian EEZ. Making an accurate assessment of the effects of fisheries to the population state of seabirds requires concentrated monitoring studying. Quality monitoring can be provided just in the case of serious reorganization carried out in the system of observers and science representatives currently operating on the fishing vessels.”

P2-11 Liliana Ayala

Interactions between seabirds and Peruvian artisanal longline fishery: 2007 and 2009

The level of incidental catches of seabirds in artisanal fisheries was investigated in a questionnaire survey of 67 fishers from four villages in Peru, in 2007 and 2009 in the north and central coast off Peru. The first survey consisted of 23 and the second one of 63 questions that provided information about the interactions with seabirds and the fishing longline. In 2007 survey, 50% of longliners mentioned incidental bycatch of albatross (fishers known these birds as “pajarotes” or “pajaronas”). 25% of longliners describe “pajarotes” as Waved Albatross *Phoebastria irrorata*. Besides, a fisher from Chimbote (5%) admitted intentional catch of albatrosses for human consumption. In 2009 survey,



seventy-three percent (n=35) of these fishermen mentioned the bycatch of albatross and petrels, at least one in all 2008. The average of seabird bycatch was 2.3 (Max=10, Min= 0) by vessel for 2008 year. They mentioned Waved Albatross *Phoebastria irrorata* (40%), *Procellaria* sp. (42%), *Macronectes* sp. (16%) and *Thalasarche* sp (2%). According to our data 81 seabirds were captured in 1 619 279 hooks sets by 31 longliners in 2008. It means 5 seabirds/100 000 hooks and 3 of them are waved albatrosses. The seabird capture rate in Peru is the same of FAO recommendation, 0.05 birds/1000 hooks. The interview survey offers a means of obtaining a minimum estimate for bycatch frequency. Besides, this rate would be higher during ENSO periods. Also, we recommend evaluating the directed capture in the ports where it was mentioned.

Raul Sánchez-Scaglioni; Samuel Amorós; Luis Paz-Soldán

P2-12 Andres Baquero

Note: Poster being presented as a talk (C6-8)

First evaluation of seabird bycatch in Ecuador

“Here we present the first observations of the fisheries bycatch of Waved Albatross (*Phoebastria irrorata*), which is critically endangered according to the IUCN RedList. >99% of the population nests on Española Island Galapagos, Ecuador, with foraging trips along the coast of southern Ecuador and Peru. Because many species of albatross are vulnerable to fisheries bycatch, we evaluated the Waved Albatross interactions with small vessel fleets of southern Ecuador. In April 2008, we interviewed 155 fishermen in Santa Rosa de Salinas, the largest artisanal fishing port along the coast of Ecuador. Approximately 1000 9-meter fiberglass boats with outboard motors operate year-round in multi-species fisheries. More than 50% of the fishermen reported interaction with seabirds in their gear. Most (70%) occurred with artisanal longlines, with additional reports from gillnets. Between November 2008 and December 2009, we observed 147 fishing trips comprised of 359 fishing sets (104 driftnets and 255 longlines). Three Waved Albatross and a few other species, e.g. Blue-footed Booby (*Sula nebouxii*), Parkinson’s Petrel (*Procellaria parkinsoni*), were accidentally caught during the haul of artisanal longline fishing gear. Several individuals were released alive by the fishermen, in varying physical condition. We frequently observed more than 20 albatrosses following a boat. These preliminary findings are concerning given the size of the artisanal fleet, an estimated 30,000 boats. We are creating an educational campaign with fishermen to reduce bycatch and improve their ability to release live birds with minimal damage. This work is only possible thanks to active, interested participation by the fishermen themselves.”

Jessica Hardesty; Jodie Darquea ; Felipe Vallejo

P2-13 Sebastian Jiménez

Effectiveness of tori-line use to reduce seabird bycatch in the Uruguayan pelagic longline fleet

“Commercial longline fisheries cause the death of tens of thousands of seabirds annually, with consequent serious impacts on some populations. Various mitigation measures have been proposed, including the use of tori-lines. This measure has been successfully applied in demersal fisheries; however, the effectiveness of this measure has not been demonstrated in any pelagic longline fishery around the world. In this work the efficiency of a tori-line to reduce incidental seabird bycatch was tested in the Uruguayan pelagic longline fleet. Three trips were carried out on longline vessels in the area and season of high bycatch rates recorded in the SW Atlantic. Based on a randomized order we employed two different treatments during the longline sets: sets with a mix tori-line (with long and short streamers) and sets without tori-line (control treatment). The tori-line was set on the leeward side of the mainline and towed from a height of 6m from sea level and a horizontal distance of 5m (range 4-6m) from the setting station. Five birds were captured in the control treatment (0.46 birds/1,000 hooks, n=12 sets), while no captures were recorded in the tori-line treatment (n=11 sets). Results of the deviance analysis (GLM Binomial model) showed that the tori-line use was the single significant variable (P=0.026), explaining the higher proportion of the model deviance. This work suggests that tori-line use reduce seabird bycatch in pelagic longline fisheries; however, it will be extended to obtain a robust conclusion and sort some problems of entanglements between tori-line and fishing gear.”

Martin Abreu; Andrés Domingo

P2-14 Ebol Rojas

Effectiveness reducing seabird bycatch through the use of trotlines in the Patagonian toothfish fishery

“Seabird by catch is one of the most important concerns on longline fisheries management around the world; within Antarctic waters these negative interactions were estimated in 1355 petrels dead only in the toothfish (*Dissostichus eleginoides*) fishery within the Commission for the Conservation of Antarctic Marine Living Resources (CCAMLR) during the 2007/08 season, but the incidence on albatrosses in adjacent waters remains unclear. On the toothfish fishing season 2005-2006 in international waters of the Southern Oceans was introduced a new fishing gear called Trotline/ MBED/ Cachalotera, aimed mostly to reduce sperm whale (*Physeter macrocephalus*) depredation on the pieces caught, but also reduced to a zero the index of seabird mortality, throughout the assessment of this mitigation measure implemented for the fishing vessels on seabird by-catch arises that they were based on three different



approaches: sinking speed, physical barrier, and camouflage of the hooks, the same gear was used for different fleets in Uruguay, Chile and South Georgia; on the fishing boats, Fisheries Observers deployed for Uruguay, Chile and the United Kingdom recorded the configuration, and operative information of the devices. In some of those vessels initially with sets without mitigation measures were able to perform at sea sea bird by-catch comparisons against traditional fishing gear, without significant changes in the costs of implementation on the part of the owners. This poster shows a comparative study of the effectiveness of these devices in their different configurations: sea bird by-catch estimations, Catch per Unit of Effort (CPUE) of the target specie, and by-catch characteristics, focused in the same fishery in different operation area.”

P2-15 Leandro Tamini

Albatrosses and petrels mortality by interactions with freezer trawlers along the Patagonian Shelf

“Many seabirds are killed and injured by fishing trawl operations specially caused by impact with the cables and nets. Several fleets of trawlers works on the Argentine Sea and the one of the largest are freezer trawlers with ~40 vessels and 246 fishing days per year each. This study investigates the seabirds mortality in this fleet by three sources of data recorded during trawl operations: counting of seabirds killed by cables and get on board, direct observations of cables during discard and observations of nets during the hauling and setting. We cover 106 fishing days, 298 hauls and 83.5 hours of cables observations between October 2008 and February 2010 between 45° and 54°S. We confirmed the mortalities of 28 Black-browed Albatross (0.09 birds/haul, 3 juveniles, 25 adults) by cables impacts and 4 (0.013 birds/haul, 1 juveniles, 3 adults) by contact with the net. The estimation of mortality by cables observations was 1.04 birds/hour of trawl counting three categories: death, potentially death and injured. These observations included impacts of Black-browed Albatross, Southern and Northern Giant Petrel, White-chinned Petrel and Cape Petrel. At this fleet, the implementation of mitigation measures that reduce the number of seabird mortalities from collisions with warp cables is urgently needed, particularly for globally threatened albatrosses and petrels mortality along the Patagonian Shelf.”

Leandro Chavez; Fabián Rabuffetti

P2-16 Hans Jusseit

Development of a Smart Hook for the mitigation of incidental catch of seabirds and turtles in long-line fisheries using modern technology and innovation

“To date no effective methods have been successfully developed to provide a consistent practical solution to mitigate the incidental catch of seabirds in Tuna Longline

operations. No hook pattern or fishing method has been developed to prevent the capture of both seabirds and turtles at the same time. To fill this gap in bycatch mitigation of these species, a Smart Hook has been developed aimed at preventing the capture seabirds & turtles during the setting process. The key objective is to test the effectiveness on seabirds and determine operational performance of the Smart Hook System in a commercial fishing operation. Results were achieved by observing, documenting and recording seabird (Giant Petrels and large & small albatrosses) behavioral responses to the Smart Hook to confirm that seabirds are unable to immediately gain access to hooks protected by the Smart Hook shield when deployed from a vessel in a situation where birds have been attracted to a vessel. Research, development and testing showed the Smart Hook is highly effective in preventing the capture of seabirds by precluding the animals from ingesting the baited hook or becoming hooked. The performance of the Smart Hook was impressive in the presence of abundant and actively feeding seabirds. When deployed the baited hooks sank so quickly that many birds were barely aware that the baited hooks represented a food source. The Smart hook shield disarms the hook, prevents ingestion & hooking, increases the sink rate to 0.54 metres/sec and is released after a short period.”

P2-17 Bronwyn Maree

An improved tori line design reduced tori-warp entanglement rates in deep-sea trawl fisheries

“Tori lines are designed to scare seabirds away from zones around fishing gear that cause incidental mortality. The conventional tori line uses a towed object to tension the line, which generally pulls the line straight back. Although this is effective in some trawl fisheries, frequent entanglements with the warp (for example during strong cross-wind or cross-current conditions) can neutralize its efficacy and interfere with fishing operations. Albatross Task Force teams in Argentina (AR) and South Africa (SA) developed devices to offset the tori line (pulling it away from the trawl warp) while maintaining appropriate tension. We tested the effect of offsetting on the risk of entanglement and on seabird interaction rates. There was a significant difference in rate or risk of entanglement between the treatment (offsetting device) and the control (conventional design) ($\chi^2=286$ (AR), $\chi^2=455$ (SA), $P<0.001$ for both). There was no experimental effect on the rate of seabird interactions. However, a GLMz showed that seabird abundance ($P<0.001$) and seabird approach direction ($P=0.003$) had significant effects on seabird interaction rates. Reducing the risk of entanglement of the tori line is beneficial to the fishermen and their safety, and ultimately may result in increased use of tori lines. Moreover, the offsetting device did not affect seabird interaction rates per se. However, by improving practical utility and reducing entanglements with the warp, we expect that the offsetting



device will ultimately reduce seabird interactions with warps.”

**Leandro Tamini; Nahuel Chavez; Meidad Goren;
Lisa Mansfield; Fabi-n Rabuffetti; Ross Wanless**

P2-18 Flemming Merkel

Light induced birdstrikes on vessels operating in Southwest Greenland during winter

“Seabirds are highly visually oriented organisms and are known to become disorientated at night in the presence of artificial light, e.g., from lighthouses, oil platforms or vessels. Coastal and offshore waters of Southwest Greenland constitute internationally important winter areas for seabirds and birdstrikes are reported as a problem when vessels navigate in icy waters using powerful searchlight. In this study a selection of navy vessels, cargo vessels and trawlers reported on incidents of birdstrikes using pre-supplied forms. Among 30 vessels initially included in the study, 10 vessels reported a total of 41 incidents of birdstrikes over a period of three winters (Oct.-Mar., 2006-2009). Most birdstrikes took place less than 4 km from land (76% events, 93% birds), but in two cases as far offshore as 205 km and 422 km. The mean number of birds (\pm S.E.) reported killed per birdstrike was 11.5 ± 3.1 birds, with 88 birds reported as the highest number. All birdstrikes occurred between 5 p.m. and 6 a.m. and significantly more birds were killed when visibility was poor (snow) rather than moderate or good. The species reported were Common Eider (95%), King Eider (3%), Long-tailed Duck (1%), murre (<1%) and Black Guillemot (<1%). The study indicates that birdstrikes on vessels may constitute a substantial problem for Common Eiders in coastal wintering areas. More detailed information on vessel movements is needed to fully assess the magnitude of the problem.”

P2-19 Lisa Mansfield

New mortality source for seabirds in the trawl fishery: Potentially a global problem

“In 2009, during a routine voyage to observe interactions between seabirds and trawl warps, we recorded a previously undescribed and potentially significant threat to seabirds. The vessel had recently been fitted with a new set of trawl warps, which were covered in a thick, sticky, protective grease. Anything that came into contact with the grease, particularly feathers of seabirds, became soiled. When smaller species collided with the greased warps they frequently stuck fast, increasing the rate at which birds were dragged underwater and drowned. All birds that survived the warp collisions had soiled feathers. Birds are at risk from the effects of ingesting toxic petrochemical grease while attempting to clean themselves and from hypothermia from loss of insulation and waterproofing caused by soiled feathers; we speculate that many of the affected birds will have succumbed. The most

commonly affected species was pintado petrels *Daption capense*. Of those that became stuck to the trawl warps and were dragged underwater, 77% resurfaced. Nine birds died through being drowned in ~ six hours of observations. We estimate through linear extrapolation that 160 pintado petrels drowned and >500 were caught on the warps and became soiled. Other species affected included Cape gannet *Morus capensis* and Black-browed Albatrosses *Thalassarche melanophris*. Preliminary investigations suggest warps are replaced annually, and remain greasy for 3-4 weeks. With assistance from the Fishing Industry, we are investigating the nature and scope of the problem. Targeted research would confirm this issue elsewhere.”

Bronwyn Maree; Meidad Goren; Ross Wanless

P2-20 Nathan Walker

New Zealand, a seabird hotspot ñ diversity, abundance and bycatch

“New Zealand is host to around 80 species of seabirds and is referred by some as the ‘albatross capital of the world’ as around half of all species of albatross breed in New Zealand. New Zealand’s waters are productive, supporting a wide variety of fisheries. These fisheries overlap the distributions of the seabirds that use these waters for foraging and subsequently seabirds are caught as bycatch. Few of these 80 seabird species have been studied in enough detail that we understand each of the key factors critical to estimate the impact of fishing bycatch; population size and trend, at sea distribution, reproductive outputs, and survival. Independent data on the bycatch and fishing practices used vary significantly between fisheries; offshore fishing by large vessels has been relatively well covered by observer programmes while smaller vessels operating in inshore areas have been sparsely covered until recently. Increased attention on the development of mitigation and improving fishing practices has led to decreasing trends of bycatch of some seabirds species in some fisheries. Due to data deficiencies in other fisheries, we have been developing risk assessment approaches in order to better guide management in the future.”

Ed Abraham, Dominique Filippi, Ben Sharp, Finlay Thompson, Susan Waugh”



Climate/Ecosystem

P2-21 Jefferson Hinke

Rapid climate change and life history: How plastic is the Adélie Penguin?

“Climate change is having major impacts on physical and biological systems in the Antarctic. For Adélie penguins, different populations have been subject to different environmental conditions over space and time. To assess the ability of Adélie penguins to cope with rapid climate change, we compare survivorship, fecundity, age at first breeding, chick growth, and breeding success from long-term monitoring studies conducted within the last 5 decades throughout the latitudinal range of Adélie penguins. Results suggest that Adélie penguins retain inflexible life history traits associated with fecundity and chick rearing in all areas, but exhibit strong spatial variability in survival rates and the age of first breeding. These results demonstrate that Adélie populations do respond to local climate change in a manner consistent with life history theory, which predicts a trade-off between survival rate and the age of first breeding. However, the observed responses have been insufficient to maintain positive population growth rates in the Antarctic Peninsula region. Here, the rapid rate of climate change appears to have exhausted the ability of Adélie penguins to persist in natal habitats. “

Wayne Trivelpiece

P2-22 Claire Saraux

Can flipper-banded penguins be used to investigate the impact of climate on Southern Ocean resources?

“IPCC 2007 highlighted the need to assess responses of marine ecosystems to climate change. The highly productive Southern Ocean is a key actor in Earth’s climate regulation and is strongly affected by planetary climate change, making it an ideal model to study climate change and its impacts. Owing to short trophic chains, upper-level predators are rapidly affected by climate forcing on lower levels. There is therefore a growing interest in using marine top predators, such as penguins, as bio-indicators. Most available information on penguins is based on flipper banding. However its use has become controversial. Assuming deleterious effects are negligible, massive banding schemes are undergone and datasets from banded populations are used to predict climate impact on natural populations. We present a 10 year longitudinal study on free ranging king penguins (*Aptenodytes patagonicus*), monitored using Radio-Frequency-Identification in the Crozet archipelago. We show for the first time how climate and flipper banding interact to affect penguins. While in some years there are no differences

in breeding success of banded and non-banded king penguins, banded birds produced overall 39% fewer chicks and had an overall 16% lower survival. Banded birds were more affected by climate (i.e. longer foraging trips and delayed breeding cycles). Significance of data based on penguin banding to assess climate effects on marine ecosystems is therefore questionable and merits further consideration.”

Céline Le Bohec; Joël Durant; Michel Gauthier-Clerc; David Beaune; Young-Hyang Park; Nils Stenseth; Yvon Le Maho

P2-23 Katarzyna Zmudczynska

Trophic structure and organic matter circulation in the Arctic ornithogenic tundra ecosystem in the conditions of a changing climate on Spitsbergen

“Recent oceanographic studies indicate that increasing inflow of warmer Atlantic waters into the west Spitsbergen shelf carries zooplankton consisting of much smaller taxa, pushing out indigenous Arctic communities. This may cause long-term effects on the food abundance and availability to the consumers of higher trophic levels. Such trend in a longer perspective may facilitate plankton-eating fish populations and consequently, fish-eating seabirds. At the same time, feeding conditions for planktivorous seabirds will get worse. Large seabird colonies in the Arctic play very important role in creating and sustaining tundra. As a result, changes in avifauna composition related to climate fluctuations may generate changes in development and functioning of different types of ornithogenic tundra supplied by colonial seabirds of a different diet. We studied ornithogenic tundra in three Spitsbergen fjords representing distinct climatic and oceanographic regimes: Hornsund (SW Spitsbergen) strongly influenced by Arctic Sorkapp Current, Isfjorden (middle part of W Spitsbergen) with predominating warm Atlantic water and Magdalenefjorden (NW Spitsbergen) influenced by Atlantic West Spitsbergen Current but with short distance to favorable cold polar waters with abundant Arctic zooplankton. Using physicochemical analyses of soil and tundra plant communities we compared the impact of colonial plankton-eating Little Auks (*Alle alle*) and fish-eating Brunich’s Guillemots (*Uria lomvia*) and Black-legged Kittiwakes (*Rissa tridactyla*) on the terrestrial ecosystem. Thanks to ¹³C and ¹⁵N isotopic signals of successive food web links we studied the ecosystem trophic structure and organic matter circulation in the areas enriched by seabirds of a different diet, dependent on distinct local climatic conditions.”

Adrian Zwolicki; Mateusz Barcikowski; Pierre Richard; Lech Stempniewicz



P2-24 Christopher Barger

Mechanisms of ecological resilience of Common Murre populations to climate change in the Bering Sea

“We investigated how climate change might affect population processes in common murre (*Uria aalge*), one of the most abundant top-predators breeding in the south-eastern Bering Sea. Previous studies suggest that seabird responses to environmental changes are localized and might depend on the genetic and demographic structure of a specific colony. Here we used a novel integrative approach that combines molecular, physiological, and behavioral tools to examine causal factors determining persistence of murre breeding on St. Paul and St. George (Pribilofs) and Bogoslof (Eastern Aleutians) Islands. During past decades murre breeding on these colonies have shown contrasting numerical trends - declining on St. Paul, relative stability at St. George, and increasing on Bogoslof - providing an ideal framework for our study. We compared the frequencies of different mtDNA haplotypes (based on ND2 sequences) and foraging behavior (based on stable isotopes signatures and stress hormone titers) of individuals breeding on these colonies. We found an increased proportion of mutations in ND2 in birds at Bogoslof as compared to the Pribilof Islands. Stress levels were higher in carriers of mutated ND2 genes compared to carriers of the nominal haplotype. We also found that on St. George I. carriers of mutant and nominal haplotypes had distinct stable isotope signatures of their blood, suggesting that they were foraging on different prey species. Our preliminary results suggest that the genetic structure of focal colonies, dietary preferences, and physiological tolerance of different phenotypes to nutritional stress might be the basis of the observed differences in numerical trajectories.”

Alexander Kitaysky; Sergei Drovetski

P2-25 Fred Bunnell

Empirical consequences of climate change on birds in marine environments

“In British Columbia, 292 bird species breed regularly; of these only 19 are restricted to marine environments. Conversely, many more species overwinter in marine environments and move inland to breed, or rely on estuarine portions of the marine environment to meet a portion of their requirements. Climate change already has caused profound changes in avian use of marine environments. Species overwintering in marine environments (e.g., Common Loon, Surf Scoter) are spending less time there, moving inland earlier and arriving back from inland breeding areas later. Effort is too variable to compare at-sea distributions between el niño and la niña years, but inland most of these species have extended their ranges northward between the 1960s and 1990s. Comparing temperatures of occupied and unoccupied

areas during the 1960s and the 1990s permits extraction of apparent temperature thresholds for occupancy. These thresholds allow credible projection of future ranges using climate change models. Estuaries in British Columbia have a variety of forms, differentially susceptible to rises in sea level. To date there are few empirical consequences of sea level rise on avian use of estuaries. Projected consequences of available estuarine area and the use currently made of that area are presented.”

Michael Preston; André Breault

P2-26 Gary Kaiser

Specialization in a new habitat by three pre-adapted marine birds after the last global warming

“Continental glaciation dramatically altered the topography of the British Columbia coast. It may have looked much like adjacent Washington State but the ice carved many deep, steep-walled fiords. They connect to the sea but intense seasonal rains leave a surface layer of fresh water and poor circulation creates anoxic conditions at depth. Many marine organisms appear unable to exploit them. The California mussel, Pacific Herring, Pacific Sand Lance, and some anadromous fish are notable exceptions. The mussels form an intertidal bed that stretches along most of the coast. In the fiords, they have become critical resources for wintering populations of Barrow’s Goldeneye and Surf Scoter that greatly outnumber all other birds in the winter. Herring and sand lance are the main foods of the Marbled Murrelet that outnumbers all other water birds in the summer. Flight style may contribute to the success of these birds. They are powerful fliers capable of very high air speeds. The inlets’ turbulent winds may discourage soaring birds such as shearwaters and cormorants that have high wing loading. Both are abundant in adjacent waters. Other fish eating birds forage at the mouths of the inlets but otherwise prefer the shelter of estuaries at the heads. Colonial auks are also absent from the fiords even though they share flight styles with the murrelet. The impacts of future global warming may be significant for the fiord specialists.”

Gareth Dyke; Kyle Elliott

P2-27 Adriana Vallarino

“Eggs, contaminants and behaviour in a climate changing world”

“The effect of climate change on the distribution of pollutants in tropical species is little known. In the present work we aimed to study the relationship between levels of pollutants and incubation and parental behaviour on the Royal tern (*Sterna maxima*) breeding in the Terminos lagoon in the Gulf of Mexico. Two different colonies in terms of human disturbance and sea currents were compared. Data loggers



were used during the breeding period to record temperature during incubation from 20 nests from each colony. At the same time, behavioural observations of incubation and provisioning behaviour were carried out every other day for 3 hours at different times of the day (from the third day after laying the egg until chicks were 15 days old). Regurgitates and fish caught near by the colonies, as well as tern eggs were collected from both colonies to measure organic and inorganic pollutants (eg. pesticides, heavy metals). In order to integrate the contaminant levels found in eggs with the behavioural data, the temperatures recorded in the nest and the breeding success statistical models were compared between the colonies. It was predicted that individuals in colonies disturbed by human activities to have higher contaminant concentrations, unstable nest temperatures and low breeding success compared with those in colonies less disturbed by human activities. To our knowledge this is the first work carried out in the tropics to investigate the impact of pollutants on behaviour of parents and chicks and its relationship with reproductive success.”

P2-28 Azwianewi Benedict Makhado

Foraging grounds of African Penguins and Cape Gannets ñ The influences of colony location, oceanographic features and stage in the annual cycle

“The foraging areas of African Penguins *Spheniscus demersus* and Cape Gannets *Morus capensis* were investigated through deployment of satellite transmitters (PTTs) from 1995ñ2005 and examined in relation to the distribution of prey and oceanographic features, in order better to understand factors influencing large differences in regional trends in numbers for both species. Totals of 18 African Penguins and 10 Cape Gannets were fitted with PTTs. Oceanographic features were identified from satellite images of sea surface temperature and bathymetric maps. When breeding, the flightless African Penguin had a much shorter foraging range than the Cape Gannet and generally occurred near to the coastline. However, during pre-moult fattening African Penguins travelled considerable distances from colonies. Cape Gannets were able to forage farther offshore. Both species fed mainly on sardine *Sardinops sagax* and anchovy *Engraulis encrasicolus*. On the west coast, the diet of gannets exhibited a strong seasonal pattern. This resulted from a change in the position of an oceanic front. As the front moved inshore in summer, Saury *Scomberesox saurus* became available to gannets; as it moved offshore in winter saury moved offshore and gannets supplemented their diet with hakes *Merluccius* spp. discarded by fishing trawlers. On the south coast, both seabirds fed within bays and along the shelf break, where passage of the Agulhas Current creates a strong front. They also foraged in the vicinity of a quasi-permanent cold water ridge, where enhanced primary and secondary production is associated with aggregations of anchovy and sardine.”

P2-29 Yan Ropert-Coudert

Long-term, at-sea monitoring of Little Penguins foraging: What does it tell us about environmental change?”

“Seabirds use two different ecosystems: they breed on land but rely totally on the ocean for their food supply. However, there is disproportionately less information available on their marine life cycles. Only quite recently, thanks to new techniques, the marine life of seabirds has been revealed. Seabirds, penguins in particular, can be good indicators of the health of marine systems, so the need for long-term datasets on their foraging behaviour is growing, in particular to monitor or predict the impact of climatic changes in the oceans. Most studies on their foraging strategy are biased towards offshore seabirds with relatively less information on inshore species. Strategies used by offshore seabirds may not be the same than that of inshore species, which spend their lives in a much smaller area, may not migrate and may be more sensitive to changes at local rather than large scales. Here, I will summarise the results of a long-term collaborative study between Japan, France and Australia, of the foraging ecology of the smallest penguin *Eudyptula minor* through a bio-logging approach. One of the key point we’ve identified is that foraging success of birds decreases when thermoclines are absent in the foraging zone of the birds; an event that could become more frequent due to climate change.”

Andre Chiaradia; Akiko Kato

P2-30 Amanda Gladics

Seabirds, salmon and groundfish: Evaluating multi-predator proxies as ecosystem indicators on the central Oregon coast”

“During the past decade, the northern California Current has experienced dramatic inter-annual variability in ocean conditions, including both delayed and intensified upwelling, anomalous near-shore hypoxia, and decoupling of conditions between Northern and Southern regions. Managers require a better understanding of the impacts of such variability on marine ecosystems to adapt to increased climate variability and climate change, yet it is not possible to monitor all ecosystem components. Our long term goal is to develop a low-cost, multi-species index of forage fish populations, and the ecosystem in general, to aid coastal monitoring and management. As a preliminary step, we employed collaborative fisheries research techniques with synoptic observations of a major seabird colony to determine the diets of a suite of upper trophic level consumers on the central Oregon coast. Together, these species should reflect food web wide adjustments resulting from subtle biophysical changes in ocean dynamics. Focal predators included Common Murres (*Uria aalge*) Chinook and coho salmon (*Oncorhynchus tshawytscha* and *O. kisutch*), black rockfish (*Sebastes*



melanops), and Pacific halibut (*Hippoglossus stenolepis*). We report on 8 years of data for the Common Murre, as well as preliminary results from our first field season of intensive sampling of all predators. Inter-annual variation in prey species diversity in predator diets appears to be influenced by climate variability. Furthermore, several murre biometrics appear to vary in concert with annual ocean condition indices and, when studied with other ecosystem components, provide a mechanistic understanding of food web response to variation in physical forcing.”

Robert Suryan; Julia Parrish; William Peterson; Laurie Weitkamp

P2-31 William Sydeman

East Meets West: Macro-ecological patterns of plankton-seabird associations in the North Pacific

“In conjunction with the North Pacific Continuous Plankton Recorder program, we conducted surveys of seabirds across the North Pacific from Canada to Japan, June 2002 - June 2007. We test the hypotheses of (i) east-west longitudinal gradients in coupled plankton and seabird abundance, and (ii) that surface-feeding versus diving seabirds vary in their relationships to primary productivity and mesozooplankton species abundance and diversity. To test these hypotheses, we developed statistical models for 20 seabirds and 12 zooplankton taxonomic groups. We found associations at the bulk level (i.e., total zooplankton abundance and diversity were positively related to net primary productivity; total seabird density was positively related to zooplankton abundance, but not diversity), and many relationships at the individual species level, some of which reflect trophic relationships. Seabird species were consistently more abundant in the western than eastern North Pacific, but patterns of zooplankton abundance were not as defined. Surface feeding seabirds did not differ systematically from diving seabirds in zooplankton associations. Macro-ecological studies provides a framework for understanding and assessing basin-scale spatial variation in pelagic ecosystems as a focal point for marine spatial planning.”

SarahAnn Thompson; Jarrod Santora; Michael Henry; Sonia Batten

P2-32 Sarah Ann Thompson

Comparing pathways of response of seabirds, salmon and whales to upwelling in the north-central California Current

“Upwelling is an important driver of coastal productivity and an essential mechanism to predator-prey interactions in eastern boundary current systems worldwide. Along the west coast of North America, nutrients supplied by upwelling processes support abundant phytoplankton and zooplankton

communities that serve as the basis for trophic interactions leading to upper trophic level marine predators. We hypothesized that 1) predator productivity is indirectly affected by upwelling through intermediate trophic levels, and 2) different upper level predators would show different pathways of response. We tested these hypotheses using path analysis from upwelling through intermediate trophic levels to the relative abundance of two species of seabirds (common murre and Cassin’s auklet), chinook salmon and humpback whales. Intermediate levels included phytoplankton, proxied by chlorophyll-a concentrations, and mid-trophic level prey, indexed by measurements of copepod biomass and community structure and proxies of euphausiid and juvenile rockfish abundance based on seabird diets. Results confirmed indirect effects and variation in the pathways of response for different predators. Multiple intermediate trophic levels were important to include in the path models, and predators had specific key prey. Contrasting the differential pathways of response of predators to upwelling and intermediate trophic levels enhances understanding of fundamental ecosystem dynamics and mechanisms.”

William Sydeman; Jarrod Santora; Robert Suryan; William Peterson; John Calambokidis

P2-33 Jeannette Zamon

Spatial and temporal structure of marine predator-prey interactions in the Columbia River plume

“During 2003-2009, May and June oceanographic surveys on the Oregon and Washington coasts (USA) revealed anomalously high concentrations of fish-eating birds near the mouth of the Columbia River. Further ship- and land-based investigation demonstrated associations between marine birds and the tidally-driven convergence fronts separating low-salinity (< 20), recent river discharge from higher-salinity (27-31) coastal waters. Mixed-species aggregations include both surface-feeding and diving species (e.g. gulls, pelicans, alcids, shearwaters). Aggregations were evident and recurring at fine spatial and temporal scales of meters to kilometers and hours to days. Diet items from birds captured in these areas included planktivorous forage fishes such as northern anchovy, smelt, and herring as well as juvenile salmon. Preliminary evidence from hydroacoustic surveys shows fish schools primarily below the pycnocline, suggesting salinity structure has a strong effect on spatial distribution of forage fishes. We hypothesize the tidal dynamics of the Columbia River discharge create predictable aggregations of forage fishes in time and space, and fish aggregations then attract upper trophic level predators such as marine birds to river plume habitat. We propose the tidal dynamics of river plumes may be a general structural mechanism affecting predator-prey interactions in locations where river discharge affects coastal habitat.”

Elizabeth Phillips; Lauren Reinalda



P2-34 Christine Ribic

Water masses, ocean fronts, and the structure of Antarctic seabird communities: Putting the eastern Bellingshausen Sea in perspective

“We analyzed Antarctic-wide cruise data to determine seabird species assemblages and relationships to fronts providing context to at-sea studies done in the eastern Bellingshausen Sea. Antarctic-wide (summer and winter), seabird densities were highest in the High Antarctic water mass. In the eastern Bellingshausen, seabird density in the High Antarctic water mass was lower than in other Antarctic regions. During winter, Antarctic-wide, 2 species groups were found: one dominated by Adélie penguins and one by petrels and prions; in eastern Bellingshausen waters in winter, the only identifiable group was composed of species from both Antarctic-wide groups. In summer, Antarctic-wide, 3 groups were found: one dominated by Adélie penguins, one by petrels, one by albatrosses. In eastern Bellingshausen waters in summer, groups were inconsistent. Antarctic-wide in winter, distance to ice edge was an important explanatory factor for 9 of 14 species; Antarctic-wide models were not successful predicting relationships of winter seabird density in the eastern Bellingshausen. Antarctic-wide in summer, distance to land was important for 10 of 18 species and distance to the Shelf Break Front was important for 8 species. The summer models, compared to winter, were more successful in predicting eastern Bellingshausen species density. To understand seabird patterns found in this synthesis, multi-disciplinary at-sea investigations, including quantified prey fields, are needed.”

David Ainley; William Fraser; Eric Woehler; R. Glenn Ford; Cynthia Tynan

P2-35 Lesley Thorne

Evaluating the importance of biophysical interactions to Red-necked Phalarope (*Phalaropus lobatus*) foraging habitat in the Bay of Fundy, Canada

“Fine-scale oceanographic features, such as frontal zones and localized upwelling, can create important foraging areas for upper trophic level predators. In the Bay of Fundy, Canada, topographically-induced upwelling creates dynamic foraging areas for red-necked phalaropes (*Phalaropus lobatus*) during their southward migration from Arctic breeding grounds. These pelagic shorebirds recently abandoned an important foraging area in the Bay of Fundy, perhaps due to a reduction in the availability of prey. We require an improved understanding of biophysical coupling in upwelling regions used by phalaropes to determine the role of these features in creating foraging habitat and to better understand temporal variation in patterns of habitat use. In the summer of 2007, we conducted concurrent oceanographic and biological surveys at

the Brier Island ledges in the Bay of Fundy to investigate links between fine-scale oceanographic dynamics of phalarope foraging habitat and the distribution of prey and to examine the composition of prey items available to phalaropes relative to historical data. We used classification and regression trees to describe the relative importance of physical and biological variables to phalarope foraging habitat. Phalarope prey was aggregated in discrete, fine-scale (<500m) patches of upwelled water created by interactions between local tidal currents and benthic topography. Current speed, sea surface temperature, sea surface temperature gradient and distance to shallow bathymetric contours were important predictors of phalarope prey ($p < 0.001$, quasi-Poisson GLM). We discuss the spatial and temporal variability of these prey patches in relation to current and previous attempts to characterize the prey field of red-necked phalaropes.”

Andrew Read

P2-36 Kathy Kuletz

Northward movement of albatrosses in the Bering Sea - Indicators of ecosystem change

“Three albatross species frequent Alaska waters, the Laysan (*Phoebastria immutabilis*), the black-footed (*P. nigripes*), and the endangered short-tailed albatross (*P. albatrus*). Because these species do not breed in Alaska and are not tied to colonies during the summer, they can track prey without the limitations of being central place foragers. We examined at-sea survey data spanning four decades, in the North Pacific Pelagic Seabird Database, to determine if albatrosses show evidence of shifts in distribution in the Bering Sea, coincident with changes in water temperature and prey species. Maps of density anomalies showed that all three albatross species increased starting in the 1990s, and increased dramatically in the 2000s. Furthermore, in the 2000s they occurred farther north along the Bering Sea shelf edge. Nearly all of the albatross were observed near the shelf edge, with hotspots above undersea canyons, but the species also showed species-specific spatial and temporal distributions as well as habitat and sea surface temperature associations. The northward expansion of albatrosses coincides with an increase in squid in the Bering Sea since the 1980s, and distributions of albatross and squid were closely correlated. The predicted increases in ocean temperatures, and northward movement of many lower trophic species, could result in albatross and other marine apex predators foraging farther north along the Bering Sea shelf and staying later in fall. The observed change in albatross distribution is thus an early indicator of changes among upper trophic levels in response to ecosystem changes.”

Martin Renner; Elizabeth Labunski; John Piatt; George Hunt, Jr.”



P2-37 Lars Maltha Rasmussen

Evidence for strong trophic coupling between macrozoobenthos and wintering eiders (*Somateria* spp.) in a shallow sub-Arctic sound

“We monitored the number of wintering eiders (*Somateria* spp.) during the winters of 2008-10 in a shallow inlet, Nipisat Sound; a key wintering habitat in SW Greenland. Moreover, the macrobenthic species abundance and biomass were studied, and annual production was estimated by an empirical model including environmental characteristics, fauna composition and individual biomass. In the spring of 2008 the average macrozoobenthic abundance and biomass were 6912 individuals/m² and 28.4 g (AFDM) m², respectively. Annual production was estimated at 13.9 AFDM/yr. Converted to energy this corresponded to a biomass of 647 kJ m² and a production of 317 kJ m² yr⁻¹, respectively. We observed a distinct wintering season for eiders from late October through May. Eider abundance peaked at ~12-15000 individuals in mid-winter with an overall average of ~7800 individuals in the area covering 17 km². We estimated that wintering eiders required 16 to 30% of the expected autumn biomass and 50 to 90% of the total annual production of macrobenthos. Thus, eiders probably have a strong impact on the macrobenthic community structure. The diet of eiders wintering in Nipisat Sound a few years earlier did not directly reflect the macrobenthic species composition as observed in the spring of 2008. Hence, we suggest that eiders are likely to switch different feeding strategies or food sources during a wintering period and/or between years as adaptations to variations in macrobenthic community structure to cover the costs of living. The similar seasonal patterns and number of bird days in the period from 2008 to 2010 indicate that, the reliability of a certain level of harvestable and profitable food resources at arrival just before midwinter might be essential for the eiders.”

Martin Emil Blicher; Mikael Kristian Sejrr; Flemming Ravn Merkel; Søren Rysgaard

P2-38 Bethany Hawkins

Body condition links oceanographic change to the decline of North Sea Black-legged Kittiwakes

“Understanding recent declines in North Sea populations of black-legged kittiwakes (*Rissa tridactyla*) will reveal the factors impinging on the health of this marine ecosystem. Data on kittiwake body mass and breeding activity have been collected on the Isle of May, Scotland for over 20 years. This has allowed us to explore the relationships linking oceanographic factors, such as fisheries and temperature, to productivity and life history decisions. Breeding success was highly variable (between 0.02 and 1.38 chicks fledged per nest) and negatively related to the additive effect of previous winter sea surface temperature (SST) and fishery presence,

updating the findings of Frederiksen et al (2004). We observed a significant negative effect of previous winter SST and positive effect of North Atlantic Oscillation (NAO) index on body mass at egg laying. At the population level there was a significant, positive non-linear relationship between initial body mass and clutch size but clutch size was not a good predictor of overall breeding success. Seasonal changes in mass of breeding birds were associated with inter-annual patterns of reproductive failure with initial body mass significantly predicting parental effort over the breeding season. Our results suggest an early season state-dependence of North Sea kittiwake productivity. These will be compared with studies of Pacific populations that are characterised by contrasting life history strategies. Future work will assess whether or not the observed extrinsic factors affecting Atlantic colonies carry over as survival and fecundity costs, determining the future persistence of populations breeding in the North Sea.”

Francis Daunt; Pat Monaghan; Mark Newall; Sarah Wanless

P2-39 Javier Lenzi

Geographical distribution and colony sizes of New World Larus Gulls and their association to high productive areas at sea

“I present preliminary results about patterns of distribution and colony size of Larus colonies in the New World and their relation with the at-sea primary production. I revised 50 papers with information about colony sizes and geographical location. Analysis of chlorophyll concentration (mg/m³) at sea, was performed using an ocean color satellite image (SeaWiFS) data. The distribution of the gull colonies and the distribution of the high productive areas at sea were analyzed by means of a re-sampling method. I could observe that geographical positions of the colonies and the geographical positions of the nearest-maximum chlorophyll areas were not randomly distributed (overall mean observed=191 Km. S.D. = 154 < percentile 2.5 of the re-sample distribution: 3528 Km.). Neither seasonally random distributions between the colonies and high productive areas were observed. I found a negative association between the logarithm of the colony sizes and the logarithm of the nearest-chlorophyll maximum concentration area, principally in the period December-February (R² = 0.19, p < 0.001). A positive relationship between colony sizes and distance to nearest chlorophyll areas at sea was detected in April-June period (R² = 0.15 p < 0.01). The association between the distribution of the gull colonies and the distribution of the high productive areas at sea are very promising results to understand the actual distribution and colony sizes of seabirds. However, further investigation is required to disentangle the possible effect of the high productive areas on the colony sizes of this group of seabirds.”



P2-40 Chris Surman

Seabirds in Western Australia: El Niño Southern Oscillation impact upon the Leeuwin Current and its influence on seabird diet, timing of breeding and reproductive performance at the Houtman Abrolhos, Eastern Indian Ocean."

"Each spring/summer over a million pairs of seabirds breed at the Houtman Abrolhos, Western Australia, in the Eastern Indian Ocean. Seabirds at the Houtman Abrolhos are reliant wholly upon marine sources of food, predominately larval ichthyoplankton species, the availability of which has been found to play a pivotal role in their reproductive parameters. We conducted a comparative study of the timing of breeding, breeding participation and reproductive success of four tropical pelagic seabird species, in relation to the regional oceanographic conditions affecting the Leeuwin Current, over a 19 year period. Three tern species, the Lesser Noddy (*Anous tenuirostris*), Brown Noddy (*A.stolidus*), and Sooty Tern (*Onychoprion fuscata*), and the Wedge-tailed Shearwater (*Ardenna pacifica*) comprised our study species at the Houtman Abrolhos between 1991 and 2009. The diet of these species was also investigated between 1991-2000. During El Niño Southern Oscillation (ENSO) events reproductive effort and output were severely reduced in all species, which coincided with reduced volumes of key prey species in regurgitates. Between 1991 and 2000, ENSO driven changes in the Leeuwin Current resulted in lower participation rates and reduced breeding success for all four seabird species, and delayed timing of breeding for the tern species. Between 2000 and 2009, the relationship between each ENSO event and a subsequent poor reproductive season was not as strong. Increasing years of poor breeding performance were recorded outside El Niño periods. This was accompanied by a significant seasonal delay in the onset of breeding in the three tern species. The reasons for this are discussed. "

L.W. Nicholson

Colony Conservation and Restoration

P2-41 Jennifer Boyce

Montrose Settlements Restoration Program - restoring seabird populations on the Channel Islands of California, United States"

"From the late 1940s to the early 1970s, millions of pounds of DDTs and PCBs were discharged into ocean waters off the Southern California coast. Almost all of the DDTs originated from the Montrose Chemical Corporation's manufacturing plant in Torrance, California, and were discharged into the Los Angeles County Sanitation Districts' wastewater collection system. The DDT-contaminated wastewater was discharged into a submarine area known as the Palos Verdes Shelf. Additionally; large quantities of PCBs (polychlorinated biphenyls) from numerous sources throughout the Los Angeles basin were also released into ocean waters. As required by Superfund law, the Montrose Trustee Council must use settlement funds to restore natural resources harmed by the DDTs and PCBs. Seabird restoration is one four restoration categories the Trustee Council has identified for restoration within the Southern California Bight. The Trustees selected seabird restoration actions that benefit species with evidence of injuries from DDTs or with past evidence of elevated levels of DDTs in their eggs. Starting in 2006, the program has been implementing several seabird restoration projects to benefit seabird populations nesting on the Channel Islands. These projects include: Restoring Seabirds to Scorpion Rock and Orizaba Rocks off Santa Cruz Island, Restoring Alcids to Santa Barbara Island, and San Nicolas Island Seabird Restoration. The goal of these projects is to restore populations of Xantus's Murrelets, Ashy Storm-petrels, Cassin's Auklets, Brandt's Cormorants and Western Gulls using a combination of habitat improvement, social attraction, and introduced predator removal."

Laurie Harvey; Annie Little; Laird Henkel

P2-42 Laurie Harvey

Alcid breeding habitat restoration on Santa Barbara Island, California"

"At Santa Barbara Island, most breeding Cassin's Auklets (*Ptychoramphus aleuticus*) were extirpated by cat predation and other factors in the early 20th century; breeding Xantus's Murrelets (*Synthliboramphus hypoleucus*) have declined since the 1970s, with impacts from high depredation by deer mice (*Peromyscus maniculatus*) and barn owls (*Tyto alba*), as well as other factors. Extensive past grazing and introduced plants have limited natural vegetation to the island perimeter. As part of the Montrose Settlements Restoration Program, plant



habitat restoration has been underway since 2007 to provide additional breeding habitat and more natural breeding conditions for murrelets and auklets. Initial plant restoration was implemented in three sites along the northeastern portion of the island adjacent to murrelet nesting areas and later expanded to include areas on the western portion of the island adjacent to Elephant Seal Point where small numbers of auklets bred in 1977-94. A social attraction system for auklets was deployed near northeast plant restoration plots in January 2009. Nest monitoring, shoreline nest searches, and at-sea spotlight surveys and captures were used to assess population size, reproductive success, and distribution of murrelets and auklets. Murrelet hatching success in 2009 was relatively low, similar to 2007-08 breeding seasons. Extended spotlight surveys were conducted in 2009-10 to provide a baseline to identify future trends. While no evidence of nesting auklets was found during limited 2007-08 surveys, small numbers of nesting birds were found during more extensive surveys at past breeding areas at Elephant Seal Point and Sutil Island in 2009-10.”

Darrell Whitworth; Harry Carter

P2-43 Jennifer Boyce

Seabird restoration to compensate for oil spills in California

“In California, nine coastal oil spills and one DDT contamination site have impacted nearly 100,000 birds since 1990. Under state and federal laws, certain government agencies are designated as trustees for natural resources and may seek damages or restoration to compensate for injuries to wildlife and habitat in the event of an oil spill or other pollution event. These trustees have recovered over \$55 million to implement seabird restoration projects to compensate for injuries to seabirds. These projects have included murre colony restoration; rat eradication on Anacapa Island; cat removal on San Nicolas Island; habitat restoration on the Channel Islands, Ano Nuevo Island, and Southeast Farallon Island; raven management and land acquisition for Marbled Murrelets; pelican roost site protection; and grebe colony protection. While most of the projects have been in California, the trustees have also implemented projects in Mexico, Canada, Alaska, and New Zealand to benefit birds killed in oil spills off California’s coast. This poster describes the natural resource damage assessment (NRDA) process with respect to seabirds. It summarizes past oil spill impacts and describes the injury assessment and restoration scaling process, including mortality estimation and the use of Resource Equivalency Analysis (REA) to calculate the size of a bird restoration project necessary to compensate for a mortality event.”

Steve Hampton; Laird Henkel; Matthew Zafonte

P2-44 Russell Bradley

Challenges of island habitat restoration in the context of climate change

“Preemptive action is needed to modify tools currently used for seabird restoration in the context of climate change. Nest boxes are often used to create breeding habitat and facilitate research on seabirds. Since 1972, PRBO Conservation Science has used nest boxes for four species of cavity nesting seabirds at Southeast Farallon Island, California. Climate change predicts increased occurrence of heat-wave events with greater negative effects on birds, as we observed in June 2008. To assess the effects of extreme heat-wave events, we tested the hypothesis that Cassin’s Auklets (*Ptychoramphus aleuticus*) breeding in artificial surface nest boxes experience higher and more variable temperatures than those in natural burrows. In 2009 and 2010, we assessed nest micro-climate using temperature data loggers on uncovered nest boxes, shaded nest boxes, and natural burrows. In preliminary trials in 2009, we recorded extreme daytime temperatures 30% higher in uncovered nest boxes than in burrows. Maximum temperatures in shaded boxes were 10% greater than in burrows. Variability in maximum temperatures was 40% greater in uncovered boxes relative to burrows, and there were no differences between covered boxes and burrows. Differences in extreme temperatures are likely to have significant effects on auklet behavior, productivity and survival in nest boxes. Because artificial habitat creation is a key component in seabird restoration, the effects of extreme heat events in habitat design should be considered, particularly in the context of future climate change.”

Pete Warzybok; Gerard McChesney; Jaime Jahncke

P2-45 Mark Bellingham

Restoring Chatham Id Taiko and Chatham Is Petrel Colonies on Chatham Island

“In March 2006 the Chatham Island Taiko started restoring the Sweetwater taiko colony, a breeding site of taiko more than 50 years ago. They erected a 700m predator proof fence protecting 8ha of regenerating forest on southern Chatham Island. During the following 2007 and 2008 breeding seasons, all known taiko chicks produced at the Tuku Valley colony sites were moved to Sweetwater to fledge from the restored colony. This first cohort of chicks marked the beginning of the building up of a core population which can breed in a secure, predator free location. In spring 2009 a taiko was filmed exploring the burrows at Sweetwater, marking a major milestone for the conservation of Chatham Island taiko. Then the Chatham Island Taiko Trust transferred 47 Chatham Island petrel from South East/ Rangitira Island to artificial burrows at the Sweetwater colony. Chatham Island petrels once breed in huge numbers on Main Chatham, but became extinct over 400 years ago due to rat predation. Returning this locally



extinct species to the Chatham Island was an important step in re-installing a key eco-system species. The Taiko Trust secured funding for this project and the work was carried out by the Taiko Trust volunteers, local residents and Department of Conservation staff.”

P2-46 Jamie Newman

Pan-Pacific mitigation and international conservation of seabird-dominated ecosystems: The Rakiura Titi Islands Restoration Project

“In 2006, four New Zealand islands dominated by large Sooty Shearwater (*Puffinus griseus*) colonies were successfully cleared of introduced rats. Although eradication itself was straightforward, the event was noteworthy for three reasons: 1) the eradication was funded by the Command Oil Spill Trustee Council, a consortium of US natural resource management agencies charged with administering mitigation funds recovered after the California spill in 1998. Acquisition and transfer of funds for pan-Pacific conservation sets a new precedent by recognising that conservation for migratory seabirds can span geopolitical borders; 2) the islands are owned by Rakiura Māori and support culturally-important, annual, harvest of shearwater chicks. Restoration is community-led and involves local, governmental, and international stakeholders; 3) removal of rats is particularly poignant because Taukihepa/Big South Cape was made internationally famous by the eruptions of ship rats (*Rattus rattus*) in the 1960's which precipitated extinction of two land birds, a ground-dwelling bat, and a charismatic beetle-eating imperilled land bird was saved from extinction. It was a graphic demonstration of the damage inflicted by introduced predators on naïve flora and fauna. We describe the eradication, research and monitoring, and report ecological responses to date, including predictions of Sooty Shearwater increases and the greater ecological significance of restoring seabirds to damaged coastal island ecosystems.”

Hannah Nevins; Josh Adams; Henrik Moller; Michelle Hester; Penny Hutchins; Robert Coote; Morry Trow; Pete McClelland

P2-47 David Ringler

Rats, owls and seabirds: A case study of hyperpredation at Europa Island”

“Introduced rats are known for their direct detrimental effects as predators on seabirds. But rats can also become prey of native predators, and this may lead to some disequilibrium. By providing alternative prey to native predators, rat introduction may lead to a numerical increase in predator populations and this in turn may increase the impact of these predators on native prey (hyperpredation process). On the other hand native predators may at least theoretically limit rat populations. We investigated these processes at Europa Island

(Indian Ocean), where rats, seabirds and barn owls coexist. We analyzed 345 pellets of barn owls collected across the island. We also studied the diet and density of rats as well as the breeding success of seabirds. Although the major prey of owls was rats, we found important seasonal and spatial variations related to seabird ecology. Owls seasonally shifted from rats to seabirds when these prey became abundant. Almost all seabird species were found as prey of the owls. We also found spatial variation in owl diet, suggesting that some individuals became specialists of seabirds. Rats were also important predators of eggs and chicks. We did not find any evidence of owl-mediated regulation of rat density. Finally the breeding success of seabirds was very low and this was the result of rat and barn predation. Our results support the idea that a hyperpredation process provoked by rats is currently occurring at Europa, leading to seabird population decline. This is discussed in the light of island rehabilitation.”

Matthieu Le Corre

P2-48 Heather Major

The stability of a seabird population affected by introduced predators

“We hypothesized that although large populations may appear able to withstand predation and disturbance, added stochasticity in population growth rate (λ) increases the risk of dramatic population declines. Approximately half of the Aleutian Islands' population of Least Auklets breed at one large colony at Kiska Island in the presence of introduced Norway rats. We evaluated two management plans (do nothing or eradicate rats) for this colony and performed elasticity analysis to focus both future research and management. Our results indicated that compared with rat-free colonies at Buldir and Kasatochi islands, Least Auklets breeding at Kiska Island did not have significantly different mean λ 's during 2001-2008. However, the mean annual proportional negative change in population size was significantly greater (i.e., declining faster) at Kiska Island than any other island including Kiska under the proposed rat eradication model. Stochastic elasticity analysis revealed that λ was most sensitive to changes in adult annual survival. Vital rate estimates were not significantly different at Kiska Island than those measured during the same years at rat-free Buldir and Kasatochi islands. Thus, eradicating rats at Kiska Island is not likely to increase these vital rates but will decrease the amount of variation in λ , resulting in a significantly slower rate of population decline.”

Alexander Bond; Ian Jones; Cari Eggleston



WITHDRAWN P2-49 Annie Little

Restoration of seabirds on San Nicolas Island by removing feral cats

“Located off the coast of southern California, U.S. Navy-owned San Nicolas Island supports several threatened and endangered species and provides important nesting habitat for the western gull (*Larus occidentalis*) and Brandt’s cormorant (*Phalacrocorax penicillatus*). After five years of planning, the Montrose Settlements Restoration Program and U.S. Navy, in partnership with Island Conservation, Institute for Wildlife Studies, and The Humane Society of the United States (HSUS), initiated an intensive effort in 2009 to remove feral cats (*Felis silvestris catus*) from San Nicolas Island. The goal of this project is to restore seabird nesting habitat and protect native fauna by removing this non-native predator. As part of this comprehensive program, the U.S. Fish and Wildlife Service and U.S. Navy entered into a Memorandum of Agreement with HSUS. In 2009, 59 feral cats were trapped, removed from the island, and transferred to the HSUS for permanent care at an enclosed facility in Ramona, CA. An extensive mitigation program was also put in place to offset any injuries to the endemic island fox related to the trapping effort. It is our goal to successfully complete this restoration project in 2010.”

Grace Smith; Brad Keitt; David Garcelon; Chad Hanson

P2-50 Moira Lemon

Introduced mammals, vegetation changes, and seabird conservation on the Scott Islands, British Columbia, Canada

“The Scott Islands, British Columbia, Canada, support the largest aggregation of breeding seabirds in the eastern Pacific Ocean south of Alaska. However, large seabird populations were eradicated by American Mink (*Neovison vison*) and Raccoons (*Procyon lotor*) introduced to Lanz and Cox islands in the 1930s, while the ecological consequences of the introduction of European Rabbits (*Oryctolagus cuniculus*) to Triangle Island in the 1920s are unknown. We have seen dramatic changes in the vegetation on Triangle Island in recent decades, chiefly a decrease in Tufted Hairgrass (*Deschampsia cespitosa*) cover and a concomitant increase in Salmonberry (*Rubus spectabilis*) cover. We carried out vegetation surveys at Triangle Island (1989 and 2004) and its nearest neighbour, rabbit-free Sartine Island (1987 and 2006), to test the hypothesis that rabbits have caused these changes. We found, however, that similar changes have occurred at Sartine Island as at Triangle Island over the same time period. Because these two islands support the bulk of the world’s breeding population of Cassin’s Auklet (*Ptychoramphus aleuticus*), a small seabird that selects grass-covered habitat but avoids tall Salmonberry for nesting, the vegetation changes raise serious concerns for a species that has experienced dramatic population declines in recent years.

Restoration of seabird nesting habitat by removing American Mink and Raccoons from Lanz and Cox islands will be vital for long-term seabird conservation in the Scott Islands.”

J. Mark Hipfner; Michael Rodway

P2-51 Michael Langlois

Laughing Gull management on Tern Restoration Islands in Maine

“Within Maine, Laughing Gulls (*Larus atricilla*) only nest on four islands where predators are actively managed to enhance nesting of Arctic Terns (*Sterna paradisaea*), Common Terns (*S. hirundo*), and federally endangered Roseate Terns (*S. dougallii*). In the absence of predation, the Laughing Gull population has increased 343% during the past 15 years, resulting in direct competition for nesting habitat, predation on tern eggs and chicks, and kleptoparasitism. Initial efforts to minimize the competition and predation involved egg and nest destruction and limited shooting of the gulls. The four islands supporting Laughing Gulls support 59% of the Roseate, 65% of the Arctic, and 42% of the Common Terns breeding in Maine. Despite seven years of aggressive control efforts, the Maine population of Laughing Gulls increased by 55%. In 2008, Maine Coastal Islands National Wildlife Refuge and National Audubon Society implemented a state-wide reduction effort of Laughing Gulls. We utilized a Potential Biological Removal model (Wade 1998 and Runge et al. 2004) to determine an acceptable level of take for this population of gulls. Our goal is to eliminate productivity at all four colonies and to reduce the breeding population of gulls by 18%/year for the next five years. We believe that these drastic control measures are necessary to maintain the abundance, distribution, and productivity of Arctic, Common, and Roseate Terns in Maine.”

P2-52 Stacey Buckelew

Reclaiming Rat Island

“Invasive species on islands are a leading cause of extinctions, worldwide. The Aleutian Islands were invaded by Norway rats in the 1780s, when a boat went aground on what is now known as Rat Island. In the subsequent 230 years, seabird populations have been virtually extirpated, while rats have spread to at least 12 large islands in the archipelago, where they continue to threaten seabird populations. In October 2008, the U.S. Fish and Wildlife Service Alaska Maritime National Wildlife Refuge, Island Conservation, and The Nature Conservancy broadcast 50 tons of cereal-grain bait containing rodenticide (brodifacoum, 25 ppm) on Rat Island. This cooperative project was designed to restore seabird nesting habitat by removing introduced Norway rats. Two years of monitoring, with no sign of rats, are required before the island can be declared rat-free. The first year of monitoring was completed in September 2009; biologists found no signs of rats, and some preliminary signs of



ecosystem recovery, including nesting pigeon guillemots, black oystercatchers, and rock sandpipers. However, biologists also discovered a larger than expected number of glaucous-winged gull (230) and bald eagle (43) carcasses. Brodifacoum exposure has been confirmed for all sampled birds, and is the suspected cause of death. In June and August 2010, biologists will revisit Rat Island to complete the second year of monitoring for rats and to document ecosystem recovery. This paper presents the operational details of the Rat Island eradication program, and preliminary results of 2009 and 2010 monitoring.”

Stephen MacLean; Vernon Byrd

P2-53 Maria Felix

Seabird restoration using social attraction techniques on islands in the Pacific Ocean off the Baja California Peninsula, Mexico”

“In Mexico, invasive species are the main cause of the extinction and extirpation of seabirds. Particularly the islands have suffer these negative impacts. Asunción and San Roque are two small islands (43 and 37 ha, respectively) that are part of El Vizcaíno Biosphere Reserve. Until the introduction of cats and rats, these islands were nesting sites for the Black-vented Shearwater (*Puffinus ophistomelas*), Black Storm-Petrel (*Oceanodroma melania*), Least Storm-Petrel (*O. microsoma*), Leach’s Storm-Petrel (*O. leucorhoa*), Xantus’s Murrelet (*Synthliboramphus hypoleucus*), Cassin’s Auklet (*Prtychoramphus aleuticus*), Heermann’s Gull (*Larus heermanni*) and Elegant Tern (*Thalasseus elegans*). Decades’ predation over the seabirds caused the extirpation of most of the species. Cats and rats were eradicated more than 10 years ago. Therefore, both islands are now safe places for the seabirds to come back and nest again. To encourage recolonization of two seabird species, social attraction systems have been used for three years in a row. Decoys of Elegant Tern and Heermann’s Gull, were placed on the islands, as well as mirrors; calls are being playbaced by sound systems supported with solar panels. Also, a systematic monitoring of marine and terrestrial birds is being conducted. Interactions between Elegant Terns and Heermann’s Gulls with the decoys are observed. Furthermore, recolonization of Cassin’s Auklet and Brown Pelican was recorded. Social attraction techniques proves to be an excellent tool for active restoration in Asunción and San Roque islands. Other management techniques must be put into practice on these islands to assure their complete restoration. Results and data gathered set the basis for a long term program of seabird restoration.”

Alfonso Aguirre; Marlene Rodriguez; Araceli Samaniego; Antonio Ortiz; José Mar’a Barredo; Luciana Luna; Mariam Latofsky; Flor Torres; Ricardo Gonzalez; Julio Hernández; Federico Méndez; Edmundo Huerta; Blanca Roldán

P2-54 James Russell

Mesopredator release effect of introduced mammals on seabirds

“Theoretical models have suggested that on islands invaded by cats and rats, the removal of cats for bird conservation may generate an increase in rat numbers leading to an unanticipated increased threat to bird populations ñ termed the ‘mesopredator release effect’. This result counter-intuitively suggests that cats may in fact protect birds and eradication may not be desirable unless rats are simultaneously eradicated. Cats and rats however, have different impacts on life-stages of seabirds. Whereas cats can predate almost any life-stage, rats are restricted to preying upon smaller species or life-stages such as fledglings. We develop logistic differential equation models for long-lived species with complex life-histories, such as seabirds, in order to test if the mesopredator release effect does in fact pose a threat to seabird populations. The level of mesopredator release following cat removal depends on the strength of top-down or bottom-up controls in the island system, and even if mesopredator release occurs, the effect of released rats alone on fledglings does not outweigh the impact of cats on both fledglings and adults. This result supports the common observation that cat eradication, despite the presence of rats, will bring the greatest benefits to seabird conservation on islands.”

Vincent Lecomte; Yves Dumont; Matthieu Le Corre

P2-55 Donald Drake

Relationships among substrate, seabirds, and vegetation in a recovering Hawaiian ecosystem

“Ka’ena Point is a 16 ha coastal ecosystem at the northwest tip of Oahu, Hawaii. Along a gradient from land to sea, the substrate shifts from basalt boulders to volcanic soil to sand dunes, and exposure to salt-laden sea spray increases. The vegetation is a patchwork of shrubland and grassland communities composed of 47 plant species ranging from endangered endemics to invasive aliens. Since off-road vehicles were excluded in 1989 and predator control and vegetation management began in 1992, this ecosystem has recovered dramatically. The vegetation has regenerated and breeding populations of wedge-tailed shearwaters (*Puffinus pacificus*; ca. 3000 pairs) and Laysan albatross (*Phoebastria immutabilis*; ca. 55 pairs) have recolonized. To examine relationships among the physical environment, plants, and seabirds, we quantified substrate type, plant cover, and shearwater burrow density in 52 plots across the site. Plant community composition was strongly related to landward-seaward gradients in substrate and exposure, and dominance shifted from alien to native species as distance to the windward shore decreased. Shearwater burrows were concentrated in sand and soil substrates. Burrow density was



not correlated with relative abundance of alien plants overall, though it was positively correlated with abundance of some invasive alien species (e.g., *Atriplex semibaccata*). Planned construction of a mammal-proof fence and eradication of invasive mammals should further enhance recovery of the flora and fauna. Research on interactions among seabirds, plants, and other biota will help ensure that management maximizes recovery of all native components of the ecosystem.”

Lindsay Young; Eric VanderWerf; Clifford Morden

P2-56 Sara Williams

An adaptive approach for Seabird Island vegetation management

“Maine Coastal Islands National Wildlife Refuge conducted a three year Adaptive Management Study to determine the best management practices for enhancing Arctic and Common Tern nesting habitat. Refuge islands support more than 94% of breeding Arctic and Common Terns in Maine. The success and perpetuation of many of these colonies depends upon active predator control and annual habitat management using techniques such as mowing, prescribed fire, and sheep grazing. Habitat management techniques are applied to large portions of each island to create low vegetation communities that remain low during the tern breeding season. Island terrain, weather events, and bird breeding biology limit the practicality and timing of vegetation control techniques. Treated low meadow, high meadow, and raspberry vegetation communities were assessed using a stratified random sampling method during three sampling intervals correlated with tern nesting phenology. A rapid vegetation assessment approach limited disturbance to nesting seabirds. Field soil tests helped explain the persistence of habitats irrespective of treatments. We used multivariate analysis tools to examine the ecological relationships between soil conditions, habitat structure, and applied treatments. In addition to characterizing each community and documenting changes in structure over time, we developed a standardized method for rating the quality of habitats for nesting terns. This information will be used to create a predictive model for managing seabird habitats on Maine islands. Using soil, vegetation, technique efficacy, and costs, the model will help identify appropriate management prescriptions and guide the selection of future seabird restoration sites.”

P2-57 Kyung-Gyu Lee

Impacts of introduced plants on the breeding Swinhoe’s Storm Petrels (*Oceanodroma monorhis*) and restoration activities in Korea

“Impacts of introduced plants on the breeding Swinhoe’s Storm Petrels (*Oceanodroma monorhis*) were studied at Chilbaldo, Sokuguldo, Kuguldo, Gaerindo islet of Shinan,

Korea during the breeding seasons of 2008-2009. Usually, Swinhoe’s Storm Petrels make a nest burrow under the cluster of *Carex boottiana*, the dominant vegetation type of the four islets. However, invasion of introduced plants, such as *Achyranthes japonica*, *Artemisia princeps*, was detected. In the study plots (5m \times 5m, n=34 in total), the damage of Chilbaldo (13) and Sokuguldo (5) was about 36%, and it was more severe than those (about 10%) of Kuguldo (9) and Gaerindo (7). Tall and densely occupied introduced plants prevented the birds from reaching ground. Moreover dead Swinhoe’s Storm Petrels entangled by the utricles of *Achyranthes japonica* was observed at the study areas, except Kuguldo. Especially 386 dead bodies, including 47 juveniles, were observed at Chilbaldo in 2009. When the utricle of *Achyranthes japonica* ripens at fall, its hook-like shape becomes stiff and traps the birds. The damage of *Achyranthes japonica* on Swinhoe’s Storm Petrels were reported from 1980s, but current situation seems to be more severe than before. In 2008 introduced plants were removed in two experimental plots at Chilbaldo, and it increased the number of *Carex boottiana* and the ratio of laying burrows. In addition, there were no dead birds in three plots where *Achyranthes japonica* was removed before its maturity, but average 2 birds were dead in three control plots. Thus, removing introduced plants enhanced habitat quality and reduced mortality of the petrels. With the results, now we are trying to restore seabird colonies in Shinan.”

Jong-Gil Park; Chang-Yong Choi; Gyeong-Nam Ko; Gi-Chang Bing; Miran Kim; Hee-Young Chae; Gil-Myung Jegal

P2-58 Steven McGehee

Using stable isotopes to identify current and historical contributions of marine-derived nutrients from seabirds to island ecosystems in British Columbia

“Nitrogen is a limiting nutrient in temperate forests of British Columbia. Its availability can be a key factor in determining the abundance and distribution of plants and animals in the ecosystem. Many studies have demonstrated that seabirds contribute significant quantities of marine-derived nutrients to islands where they nest through deposition of guano, feathers, carcasses and dropped fish, with dramatic effects on biodiversity. We use stable isotope analysis to investigate the relative marine and terrestrial nutrient contributions of three species of colonial burrow-nesting seabirds, two non-burrowing bird species, and bats found on the coast of British Columbia. We will analyze the $\Delta 15N$ signature in tree core samples collected from colonies or roost trees and compare these with tree cores from areas without marine nutrient inputs to test the effect of nutrient inputs from different species on tree growth. We will also analyze soil and plant samples for the presence of marine-derived nutrients, and compare the distribution and abundance of plants in areas with and without nutrient input. This data will increase our



understanding of interactions between seabirds on the coast of British Columbia and the ecosystems on their nesting islands. It may also provide information on historical abundance and distribution of seabirds from tree rings dating back over one hundred years. Preliminary analysis indicates a strong $\delta^{15}\text{N}$ signature highlighting the presence of burrowing seabirds. This sets in motion the possibility of applying this technique to retrieve seabird colony histories.”

Thomas Reimchen; Barry Glickman

WITHDRAWN P2-59 Mel Durrett

Spatial variation in plant-available nutrients and soil processes on New Zealand seabird islands

“Many islands are subsidized by seabird nutrient inputs, but additions may be localized around the colony. Further, disturbance often increases soil heterogeneity, which affects plant nutrient status and soil processes. Invasive rats (*Rattus* sp.) alter spatial patterns by decreasing seabird populations and plant nutrient availability. On seabird islands in northeastern New Zealand, we expected spatial variance to be driven by seabird burrow density and rat invasion on individual islands, with extremely high burrow densities and rat presence both decreasing heterogeneity, while intermediate burrow density should increase it. Patterns of spatial variance (shown in variograms) behaved as predicted for some soil properties (e.g., pH), while other soil data were most variable on densely burrowed islands (e.g., inorganic N). Burrow density, though expected to drive spatial patterns at the within-island scale, was not consistently correlated with soil properties or processes on all islands. This could be a direct result of differing degrees of within-island spatial heterogeneity as well as legacy effects. Further modeling of these spatial patterns may predict the spatial extent of a seabird colony’s impacts on plants and soils.”

Christa Mulder; David Wardle; Ronald Barry

P2-60 Kelly Newton

Global distribution and conservation of threatened seabird breeding islands

“Seabirds are the most threatened group of marine animals with 28% of species at some risk of extinction. The most significant threats to seabirds occur on their breeding islands where, in many cases, effective conservation actions are feasible. We developed a database of current breeding islands for the 95 seabird species listed by the International Union for the Conservation of Nature as threatened (Critically Endangered, Endangered, and Vulnerable) and assessed anthropogenic threats and presence or absence of protective management for each island. We identified a total of 642 threatened seabird populations breeding on 429 islands (mean 1.49 ± 0.5 threatened breeding seabirds island⁻¹), with the

greatest number (9) on Campbell Island, New Zealand. Most of these islands (73%) are located in the Southern Hemisphere (particularly the Southwest Pacific). All of these colonies can be protected through conservation action in 32 countries. Critically Endangered seabirds ($n = 18$) breed on 40 islands, 80% of which contain introduced vertebrates, 62% have human population settlements, and approximately half have some form of habitat or species protection. At least one population of all Critically Endangered seabird species can be protected from extinction by conservation efforts on only 17 islands. This small number of islands make colony-based protection of threatened seabirds a unique conservation opportunity.”

Reina Heinz; Dena Spatz; Bernie Tershy; Don Croll

P2-61 Lisa Eggert

Conservation challenges and successes for seabirds in South Carolina, USA: Importance of longterm monitoring and research partnerships

“The proximity of seabird colonies in southeastern U.S. to coastal recreation, development, and nearshore fisheries presents numerous conservation challenges. The coast of South Carolina has 10 – 12 islands that annually support 16,000 – 30,000 breeding seabirds, and as many as 10 species. 35 years of nest count data suggest brown pelicans (*Pelecanus occidentalis*), royal terns (*Thalasseus maximus*), and black skimmers (*Rynchops niger*) have declined since the late 1980s. Since 2004 several ecological studies have been initiated to explore mechanisms that may have led to these trends. Analyses of sublethal levels of ectoparasites on growth and condition of pelican chicks revealed no strong negative effects. The relationship between foraging seabirds and shrimp trawlers was examined. Locally breeding gulls, terns and pelicans commonly attended trawlers and foraged readily on discarded bycatch which primarily was comprised of benthic fish. An assessment of intertidal habitat use by seabirds has revealed complex and annually variable habitat relationships that may create challenges for multi-use management. On the conservation front, a dredge island was created specifically for seabird nesting in 2005, and during 2009, over 12,000 pairs of 5 species nested there. Protection of all colonies was enhanced in 2006 by prohibiting human access at most nesting islands. This has resulted in increased nesting effort and reproductive success, particularly for black skimmers. Despite ongoing challenges, these results highlight the value of longterm monitoring and partnerships of state and federal wildlife management agencies with academic and federal research scientists.”

Patrick Jodice; Felicia Sanders



P2-62 Eric Woehler

Status and trends of seabirds of Heard Island, Indian Ocean

“A total of 19 species of seabirds breed on Heard Island and the McDonald Islands, in the southwest Indian Ocean. The islands are listed World Heritage sites. The seabirds of Heard Island and the McDonald Islands have received less attention than the avifaunas of most subantarctic islands, due largely to the infrequency of visits by scientific expeditions or private visits. Data collected between 1947 and 1955 on most aspects of the biology of all seabird species at Heard Island established valuable baselines for contemporary and future studies, in particular breeding localities and early estimates of breeding populations. A contemporary assessment of the distribution, abundance and conservation status of all the breeding and non-breeding seabird species at Heard Island is now possible derived from all data collected in the period 1947/48 – 2003/04, inclusive. Volcanic activity in the last decade has resulted in an approximate doubling of the surface area of the McDonald Islands, with a concomitant loss of vegetated and un-vegetated areas previously used for nesting by resident seabirds. All new data on distribution and abundance of breeding localities of seabirds at Heard Island have been compiled to facilitate a re-assessment of the conservation status of each species. Unpublished reports and narratives, field logs, other sources of information on the distribution and abundance of seabirds, such as aerial and ground photographs, have been examined, and all new data therein extracted. Breeding populations, population trends where known and the IUCN conservation status for species are detailed.”

P2-63 Gert de Jong

Pelecaniform seabird colonies in East Indonesia.

“Five species of Pelecaniformes breed in different compositions on six volcanic and coral islands in the Banda and Flores Seas. It was assumed that these species breed here in synchrony, loosely seasonal, following a monsoonal regime. In the 1980s breeding occurred synchronously around July-August, following a local upwelling period, during SE monsoon. This survey aims at establishing breeding status and studying threats, which probably diminished breeding numbers earlier. Together with local ornithologists, census methodology is developed for monitoring. In 2009, breeding peaks occurred in November-December, with species peaking at different times, on different islands. In December, great frigatebirds and red-footed boobies were breeding numerously on Pulau Manuk, a volcanic island invested with rats. On Gunung Api, the only colony without rats, brown boobies and red-tailed tropicbirds were mostly at the beginning of a breeding cycle, with eggs in most nests in December. On nearby Moromaho, only red-footed boobies were breeding at the end of a breeding period in November. On Suanggi red-

footed boobies were breeding, with similar numbers of active nests in July 2008 and December 2009. Total breeding numbers are in same order of magnitude as the numbers reported in the 1980s. Breeding is possibly non-annual, or temporary changes of wind patterns affected timing of breeding. Southeastern winds, normally ceasing in September, maintained strong into November in 2009, and this might have changed food availability. These colonies should be monitored throughout the year, to attain population estimates.”

P2-64 Gary Drew

Short-term effects of the 2008 Kasatochi Island eruption on Crested and Least Auklets

“Kasatochi Volcano, an island volcano located in the central-Aleutian chain, erupted on August 7th 2008. The resulting ash and pyroclastic flows blanketed the island, covering terrestrial habitats in 15-20 meters of material. The rarity of an eruption of this magnitude on a small island means there are few comparative studies creating a unique opportunity to investigate volcanic impacts on the terrestrial and marine environments used by marine birds. U.S. Geological Survey, in partnership with the Alaska Maritime Wildlife Refuge, began an integrated study to study the eruption and its biological impacts. We visited Kasatochi Island in June and July of 2009 to document marine bird occurrence on the island, and survey the local marine environment. Although it is unlikely that the eruption resulted in the immediate deaths of many adult birds, the burial of former colony sites must have seriously limited or eliminated annual reproduction. Crested Auklets (*Aethia cristatella*) and Least Auklets (*Aethia pusilla*), the two most common species on previous surveys, were present in large numbers, both on the island and at sea. The main Crested and Least Auklet colony was visited on foot, while at-sea distributions were mapped and compared with 1996 and 2003 surveys of the area. Preliminary results indicate at-sea distributions and abundances were similar to those prior to the eruption. Ongoing monitoring efforts will allow us to track the population trajectories of the two auklet species and quantify the roles of migration, predation, and reproduction in their future use of the island.”

John Piatt

P2-65 Gemma Jennings

Ecology of an urban Common Tern colony in Leith Docks, Scotland

“Leith Docks supports the largest common tern (*Sterna hirundo*) colony in Scotland, with approximately 5% of the UK population. In 2004 it was designated a Special Protection Area (SPA) for the species under EU legislation. The site is in the heart of a continually changing operational port, as a result the port owners are keen to understand more about the



ecology of the terns. The colony has grown from 50 pairs in 1971 to 732 pairs in 2009. Analysis of long-term count data suggests that colonisation of this urban environment occurred as a result of relocation from natural islands in the Firth of Forth over the past few decades. These islands were formerly a regional stronghold for the species but numbers of breeding gulls have increased. Field observations during 2009 showed that predators have an important influence on breeding success, with gulls taking 1 chick every 2 hours. Despite this, high numbers of chicks fledged from the colony. Tracking showed that terns fed primarily within 10 km of the site, in the nearby Firth of Forth; their diet consisted mostly of clupeids, but also sandeels and small gadoids. Observations and experiments on disturbance of terns at the colony indicated that the birds are tolerant of routine human activities in the area, and that they respond to approaching humans at shorter distances than have been recorded at more isolated colonies. The findings of this study will be important in the context of management of urban and industrial colonies.”

Bob Furness; Derek McGlashan

Conservation Genetics

P2-66 Cathryn Abbott

Are Rhinoceros Auklets from British Columbia, Alaska, and Japan genetically different and how is this relevant to conservation?

“The Rhinoceros Auklet is a widely distributed North Pacific seabird whose breeding range encompasses the coasts off California, British Columbia (BC), Alaska, Japan, and North Korea. About 50% of the global population breeds on colonies in BC, Canada, where data indicate a relatively constant annual adult survival rate of ~87%, but with extremely variable breeding success that is strongly linked to oceanographic conditions. Rhinoceros Auklets comprise a large proportion of seabird bycatch in salmon gillnet fisheries off Washington and British Columbia. While the magnitude of bycatch rates and its impact on populations is unknown, any factor that reduces the survival rate of breeding adults could have serious consequences for population trajectories. Genetic methods may help inform and facilitate the implementation of conservation management objectives, but an understanding of how populations are genetically structured is required. We used DNA microsatellite genotyping and mtDNA sequencing to assess levels of genetic divergence among Rhinoceros Auklets from BC, Alaska, and Japan. Populations from BC and Alaska were found to be genetically the same, but were together significantly different from the sampled population in Japan from Teuri Island. We discuss how this information can be used for conservation and attempt to address the question of whether genetic similarity among Rhinoceros Auklets in the Pacific Northwest is a vestige of historical associations (during the Pleistocene) or is reflective of contemporary processes.”

Rhonda Millikin; Mark Hipfner

P2-67 Frank Hailer

Magnificent Frigatebirds from the Galapagos: Genetic and morphological uniqueness despite extensive recent gene flow across most of the species' range

“Populations of tropical seabirds generally show pronounced geographic structuring, despite their capacity for long-distance flight. Magnificent frigatebirds (*Fregata magnificens*) are especially well-suited for a life in the air, even compared to other seabirds. We analyzed genetic variation at three marker systems (mitochondrial DNA, microsatellites and nuclear introns) in samples from Atlantic, Caribbean and Pacific populations. Across genetic methods, we consistently found signatures of extensive recent gene flow over most of the range. Even the Isthmus of Panama, a major barrier to gene flow in other tropical seabirds, does not



appear to significantly limit dispersal in this species. In contrast, we found that magnificent frigatebirds from the Galapagos are strongly differentiated from all conspecifics, consistent with isolation for several hundred thousand years. Phenotypic characteristics confirm the differentiation of Galapagos population and further stress the uniqueness of the Galapagos magnificent frigatebirds.”

**Elizabeth Schreiber; Joshua Miller; Iris Levin;
R Terry Chesser; Robert Fleischer**

P2-68 Sarah Trefry

Sexual size dimorphism and sex ratios in Magnificent Frigatebirds (*Fregata magnificens*)

“The distinctive morphological and behavioural characteristics that set frigatebirds apart from other seabirds raise interesting questions about their biology. For example, Magnificent Frigatebirds exhibit reversed sexual size dimorphism, and males are more ornate. This pattern is unusual in birds, especially seabirds, and the selection processes driving reversed sexual size dimorphism remain unclear. Using stable-isotope analysis, prey identification, and satellite transmitters, we will test two hypotheses for sexual size dimorphism in Magnificent Frigatebirds: 1) the resource division hypothesis, which suggests that sexual dimorphism decreases intra-pair food competition, and 2) the dimorphic niche hypothesis, which attributes dimorphism to differences in the reproductive roles of males and females. Frigatebirds lay a single egg and have the longest parental care of any bird, conditions conducive to adaptive manipulation of offspring sex. Therefore, we will also explore whether sex ratios of chicks vary from unity, as predicted by the energetic considerations of raising dimorphic offspring. Fieldwork is being conducted in a mangrove lagoon on Barbuda Island, Lesser Antilles. This project will contribute to our understanding of frigatebird breeding biology, and to the evolution of size dimorphism and unequal sex ratios in seabirds.”

Antony Diamond

WITHDRAWN P2-69 Matt Rayner

A century of trans-hemispheric separation in the migration of two genetically divergent Cook’s Petrel (*Pterodroma cookii*) populations

“Pelagic seabirds are highly mobile within and between breeding seasons. This mobility challenges allopatric speciation models involving the disruption of gene flow between breeding populations isolated by extrinsic barriers. Increasingly, theoretical and empirical studies indicate that non-breeding distribution may enforce genetic separation of seabird populations that occupy nearby regions during breeding. Cook’s petrel (*Pterodroma cookii*) exhibit genetic differentiation between breeding populations on Little Barrier Island (LBI) and Codfish Island (CDF) New Zealand, despite overlapping foraging distributions and interbreeding potential.

We used geolocator tracking and sequencing of mtDNA (Cytochrome Oxidase 1 gene) from skins collected at sea during the past 100 years to test the hypothesis that Cook’s petrel maintains long-term separation of population-specific non-breeding distributions. Cook’s petrel tracked during non-breeding displayed trans-hemispheric separation of their breeding populations. LBI Cook’s petrel migrated northeast to the California and North Pacific Currents, returning southwards in a circular migratory trajectory totalling $48,037 \pm 7953$ km. CDF Cook’s petrel migrated east then north wintering south of the equator in the Humboldt Current, returning southwest in a roundtrip of $38,051 \pm 7296$ km. The majority of haplotypes sequenced from Cook’s petrel skins collected in the non-breeding cores of birds tracked from LBI (North Pacific, $n = 8/8$) and CDF (Humboldt Current, $n = 8/10$) matched those of birds sampled from the modern colonies, confirming the long-term separation of these populations during non-breeding. Regional differences in oceanography and surface winds are likely mechanisms mediating the divergence of these populations.”

Mark Hauber; Todd Landers; Hayley Lawrence; Richard Phillips; Paul Sagar; David Thompson; Scott Shaffer

P2-70 Sarah Wallace

A species tree for the Hydrobatinae (Aves: Procellariiformes): Phylogenetic evidence for sympatric speciation

“The importance of sympatric speciation as a mechanism of species formation has been a controversial topic in evolutionary ecology as it describes a divergence process with ongoing gene flow between incipient species. The Hydrobatinae (Aves: Procellariiformes) is a diverse subfamily of mostly Northern Hemisphere seabirds. Populations of both *Oceanodroma castro* and *O. leucorhoa* have previously been found breeding in two different seasons (hot season and cool season) on the same island, often using the same burrows as nesting sites. Seasonal populations were found to be more closely related to each other than either was to other populations and appear to have originated in sympatry as a result of allochrony (separation by breeding time). We undertook a broader phylogenetic framework of the subfamily as a whole to investigate the importance of sympatric speciation in the history of the storm-petrels. Specifically, we used a multi-locus approach to estimate a species tree for the Hydrobatinae. Among other results, we found that two sympatric Northwest Pacific species, *O. matsudairae* (a winter breeder) and *O. monorhis* (a summer breeder) were sister species. These species appear to have diverged approximately 3.3 million years ago, and may be the result of sympatric speciation by allochrony. We also found evidence that parapatric speciation may have driven the origin of two or three sister species pairs in the Eastern Pacific Ocean.”

James Morris-Pocock; Jacob Gonz-alez-Solis; Vicki Friesen



P2-71 Hyun-Young Nam

No sexual size dimorphism in Swinhoe's Storm Petrels

“Sex determination is often of crucial importance in ecological and evolutionary studies, but it is difficult in seabirds which lack external, sex-related morphological characters. Although some sexual differences in vocalization and vent measurements have been reported in storm petrels (*Oceanodroma* spp.), those characteristics are available during short periods of breeding season only. To recognize sexual size dimorphism of Swinhoe's Storm Petrels (*Oceanodroma monohris*) and to find a clue for sex determination based on external measurements, we captured, banded, and measured two breeding populations of the storm petrels on Chilbaldo and Guguldo Islets, Korea. From 2008 to 2009, sex of 46 after-hatching-year birds was determined by molecular analyses using sampled bloods, and no difference between both sexes was detected in all measurements: total length, maximum wing, tail, tarsus, bill lengths at feather and at nostril, bill depth at nostril, head, and body mass. Discriminant function analysis (DFA) also indicated that only 65-70% of all birds were correctly sexed. This result suggests that the external measurements are not useful for reliable sex determination in Swinhoe's Storm Petrels as in other storm petrels, and that the other vocal, behavioral, or molecular clues are further required to identify sex in field conditions.”

Chang-Yong Choi; Jong-gil Park; Kyung-Gyu Lee; Hee-Young Chae

P2-72 Norine Yeung

Tales of a White Tern feather: A source of stable isotopes and DNA for ecological and evolutionary studies

“Historically, studying migration, dispersal and population structure of avian species has relied on banding and analyzing resights and recaptures. Utilizing non-invasive methods have been particularly useful for studies where they can supplement or replace more intrusive methods (i.e. collection of regurgitates and blood samples). Feathers are an ideal source of a diverse array of information on birds. A single molted feather can provide stable isotopes and DNA for feeding ecology and genetic studies, and an alternative to capturing individuals. In order to establish the utility of feathers in the study of the Pacific White Tern (*Gygis alba*) I analyzed carbon ($\delta^{13}C$) and nitrogen ($\delta^{15}N$) isotope ratios from populations in the Northwestern Hawaiian Islands and found no difference in isotopic signatures between and among feather types. This revealed that any type of feather could be used as an indicator of an individual's diet which was constant during feather growth. Isotopic values were similar to those of yellowfin tuna (*Thunnus albacares*) within the Hawaiian Archipelago confirming their status as iTuna birds.

I also examined phylogenetic relationships and population connectivity among Pacific White Terns, and mtDNA indicate that there are no phylogenetically distinct species or subspecies within the Pacific Ocean. Nuclear markers revealed significant differentiation among geographic populations, with the two main sources of migrants into all Pacific populations coming from the Northwestern Hawaiian Islands and Tuamotu Archipelago. This study shows that data collected from molted feathers may be a more efficient, effective, and conservation friendly way to analyze ecological and evolutionary patterns and the processes underlying compared with traditional methods alone.”

P2-73 Rebecca Young

Biological age as a link between climate change and population processes in a Bering Sea top-predator

“The effect of climate change on top-predators in dynamic environments is a topic that currently interests managers, ecologists, and population biologists alike. Demographic information is crucial to understanding population dynamics of top-predators, yet is difficult to assess. In addition to snapshots of current population states, longitudinal data provide depictions of long-term trends. Yet banded populations remain rare and expensive to develop. Furthermore, genetics, individual histories, and ecological factors all influence life expectancy in such a way that biological, rather than chronological, age gives pertinent information about future trends. In this study we characterize demographic structure (biological age) of three colonies of thick-billed murre (*Uria lomvia*) by measuring telomeres of individual birds. Telomeres are DNA fragments that degrade with cell damage and age, providing a reliable proxy for biological age. Previous work with this species has established a baseline relationship of chronological age to telomere quantity using known-age murre from a Canadian colony. Murre are one of the most abundant top predators in the Bering Sea, and they rely on the same food web as human harvesters and protected marine mammals. Here we define biological age for Bering Sea colonies experiencing different oceanographic conditions and population trajectories. Climate is likely to affect food availability, so to examine how age may influence foraging decisions in response to climate fluctuations, we compare individual stable isotope signatures and diving behavior in relation to their biological age. This study provides wildlife practitioners with a sophisticated new tool to measure effects of climate change on seabirds.”

Mark Haussmann; Christopher Barger; Alexander Kitaysky



P2-74 Gary Kaiser

Phylogenetic relationships and the inferred biology of fossil seabirds

“Morphology-based phylogenies for birds typically place marine and aquatic lineages among basal groups. Recent discoveries of Lower Cretaceous forms such as *Gansus* and *Jianchangornis* support that view, suggesting that waterbirds represent a very early radiation among ornithines. The congruence of these two lines of evidence implies a very early development for dense plumage, sustainable flight, and the production of large eggs. By the Mid-Cretaceous *Ichthyornis* and *Hesperornis* displayed a full suite of marine adaptations including supraorbital troughs over the eyes for large salt glands. None of those early forms can be tied to extant groups but fossils of *Vegavis*, *Tevionis*, *Presbyornis*, and *Polarornis* from later in the Cretaceous suggest some marine and aquatic lineages survived into the Paleogene. It can also be difficult to link more recent forms to extant groups and at least two significant marine lineages arose in the Paleogene but disappeared without descendants. The flightless pteropterids were divers, possibly related to penguins or petrels. The giant pelagornithids were oceanic soaring birds whose size challenges ideas about limits to the aerodynamics of much smaller albatrosses. The phylogenetic positions proposed for these giants may be at odds with their biology. Linking pelagornithids to anseriforms implies the independent evolution of parental care typical of mid-ranked oceanic birds but unknown in surviving representatives of basal anseriforms.”

Gareth Dyke

P2-75 Alice Martin

When morphology and genetics don't match: Evidence for cryptic speciation in Gentoo Penguins

“Developments of phylogenetics over the last decades highlighted the existence of complexes of sibling species in birds, i.e. closely related species occupying similar niches in different geographic locations. Gentoo penguin (*Pygoscelis papua*) is one of the most widespread penguin species and is highly plastic in many aspects of its ecology, morphology and behaviour (Bost & Jouventin 1990). There is a well-known subspecies distinction between sub-antarctic (*Pygoscelis papua papua*) and antarctic gentoos (*Pygoscelis papua ellsworthii*) based on the classical morphology taxonomy (Murphy 1947, Stonehouse 1970). Song analyses have shown 2 types of dialect according to the population (Atlantic or Indian Pacific, Jouventin 1982). The distinction may then rather be on vocal than morphological characteristics. In birds, song or call characteristics are indeed particularly involved in speciation processes because they are critical components in the selection of breeding partners, based on nuptial displays. In this context, we analysed the genetic

structure of gentoo penguins mitochondrial DNA. Our results demonstrate the existence of three genetically distinct clades of gentoo penguins that can be considered as three sibling phylogenetic species (the Indian Ocean population; the sub-Antarctic and Atlantic population; the Antarctic Atlantic population). Thus, the current morphology-based taxonomy of gentoo penguins does not fit with their phylogeographic structure. In conclusion, song differences reflect the genetic structure of the species complex and are more reliable indicators of phylogenetic distances than ecology and even morphology.”

M. De Dinechin; P. Zehindjiev; R. Metcheva; C. Couchoux; P. Quillfeldt; P. Jouventin

Demographics

P2-76 Naoki Tomita

The age composition of the Black-tailed Gull population on Kabu Island, Japan

“Long-term monitoring studies on the reproductive performance and population dynamics of seabirds have shown that these data can be used as indicators of marine environment. For long-lived seabirds, age composition of a population is important determinate factors of variation in the population growth rate. However, there are a few known-age populations of seabirds. This study was conducted a breeding population of the Black-tailed gull (*Larus crassirostris*) on Kabu Island (40°32' N, 141°33' E), Aomori prefecture, Japan. Chicks have been marked before fledging with a stainless steel band, and recapture of marked adults have been carried out every year since 1973 on the Island. In this study, we examined the return rate of each cohort to the island in 2007, 2008, and 2009. Ages of 451 recaptured adults were identified by reading the ring numbers for the three years. The ages of the returned adults ranged from 3 to 33 years old. The mean ages were 14.3±6.7SD years old in 2007, 13.2±6.4 in 2008, 12.9±6.4 in 2009, respectively. The return rates gradually increased until age 7-9 years and decreased with aging. The return rates of each cohort for the three years showed a similar trend. Variations of the return rates among cohorts were large, and the return rates in 1984, 1991, 1993, and 2000 were higher than those of the other cohorts. This study was the first record which showed the age composition of seabird populations in Japan.”

Kiichi Narita; Akira Narita; Yuichi Mizutani; Rina Sugiura; Hidenori Fujii; Yasuaki Niizuma



P2-77 Annie Schmidt

Contrasting demographic responses: Winners, losers, and climate change?

“Understanding the impacts of climate on communities requires studying sympatric species with different life-history strategies that are experiencing the same environmental conditions. Comparing and contrasting how climate influences survival, reproduction and population growth rates are crucial steps towards developing the ability to predict community level responses to climate change. Our focal species are Brandt’s cormorant (*Phalacrocorax penicillatus*) and Cassin’s auklet (*Ptychoramphus aleuticus*) on the Farallon Islands, California. These two species are particularly interesting since they have recently been exhibiting opposing trends in reproductive success. Our ultimate objectives are to (1) determine the physical and biological interactions associated with demographic variability, (2) evaluate the influence of demographic variability on population growth, and (3) compare demographic parameters and population models of these two species to assess differences in how climate impacts them. Here we describe the results from the first step in our analysis: relating reproductive success of Brandt’s cormorant to oceanographic conditions at both the local and basin scale. Local environmental factors examined include sea surface temperature, wind speed and sea surface height. Basin-scale indices include the Pacific Decadal Oscillation, North Pacific Gyre Oscillation, and the Northern Oscillation Index. Future analysis will examine relationships between survival and the same environmental variables as well as constructing population models to examine the impact of environment at the population level and comparing results to similar analysis with Cassin’s auklet.”

Louis Botsford; John Eadie; Russell Bradley;
Jaime Jahncke

P2-78 Luciana Pozzi

Population dynamics of Magellanic Penguins in North and Central Patagonia: A metapopulation approach

“Magellanic penguins (*Spheniscus magellanicus*) have 63 colonies distributed along 4000 km of coastline in Patagonia, Argentina, with 950,000 breeding pairs. No demographic studies have been conducted to evaluate trends under a regional perspective. We estimated population size and breeding success at large colonies scattered along Northern and Central Patagonia and assessed trends using population growth models. To evaluate dispersion we searched five colonies for penguins hatched and banded between 1983 and 2009 at Punta Tombo. In the North, colonies increased steadily after they started establishing in the late 1960’s. Río Negro, increased from 22 breeding pairs in 2002 to 3,751 in

2009 ($\lambda = 2.21$). In Península Valdés, larger colonies increased ($\lambda = 1.10$): San Lorenzo incremented from 93 breeding pairs in 1977 to around 100,000 in 2008. In Central Patagonia, the biggest colonies declined, including the largest colony in the world, Punta Tombo. Isla Leones decreased from 96,287 pairs in 1995 to 47,492 in 2009 ($\lambda = 0.95$). Islas Vernacci, an order of magnitude smaller, grew from 21,868 pairs in 1993 to 27,736 in 2008 ($\lambda = 1.02$). Breeding success was higher in northern colonies. Out of 82,695 birds checked for bands, the three banded penguins found breeding in the Península Valdés hatched at Punta Tombo in 1988 and 1991. Closed-population scenarios may not explain trends for particular locations hence dispersal might be an important driver on colonies that are expanding at the northern part of the Magellanic penguin’s breeding range and in the decline of penguins in the central part of their range.”

Pablo García Borboroglu; Dee Boersma; Miguel Pascual

P2-79 Gail Fraser

Apparent survivorship, population size and the projected persistence of a colony of Manx Shearwaters on Middle Lawn Island, Newfoundland, Canada

“Biogeography theory predicts that populations on the edge of their species’ distribution range will be smaller than those at the center of their range and will be less likely to persist. From 2000 to 2009, we studied a colony of Manx Shearwaters (*Puffinus puffinus*) established by a natural colonization event in 1977, at a site well outside the species’ previously recorded range. Each year we visited the colony during the incubation (and prospecting) period, from the end of June through to the first two weeks of July. We checked burrows (daytime) and marked and recaptured adults at night (average 3 banding nights per year; range 1-9). Using the Jolly-Seber model in Program MARK, we estimated an annual survivorship of 0.70 ± 0.04 (0.60-0.78); the population size to be 194 ± 43 (130-301) and a projected population decline $\lambda = 0.94 \pm 0.04$ (0.86 – 1.02). Our estimate suggests a historic population decline from an estimated 220-360 individuals during 1977-1981. As in the late 1970’s there continues to be low numbers of breeding adults. This site continues to attract prospecting birds, (26% of the growth rate is attributed to new birds), but recruitment to the breeding population appears limited. The relatively low tenacity (30% of captured individuals do not return) contributed to the projected decline of this colony, suggesting that one or more breeding habitat requirements are not being met at this site. Without continued immigration of prospecting birds it is unlikely that this colony will persist.”

Janet Russell; Gregory J. Robertson; Rachel Bryant;
Dave Fifield



P2-80 Craig Dockrill

Recent trends in penguin populations of the Falkland Islands

“Numerically and in terms of conservation status the Falkland Islands host several globally important seabird populations, including significant proportions of the world’s black-browed albatross *Diomedea melanophris* (~70%), gentoo penguin *Pygoscelis papua* (~21%), and southern rockhopper penguin *Eudyptes chrysocome chrysocome* (~29%). Fluctuations in local populations may impact the global conservation status of these species. In light of greater resource development, Falklands Conservation initiated the Falkland Islands Seabird Monitoring Programme (FISMP) in 1989/90. FISMP aims to monitor breeding pairs and breeding success of selected seabird species in order to understand their population dynamics and better inform conservation initiatives. Regular monitoring of population trends among seabirds in the Falkland Islands has contributed to the identification of regional and global conservation priorities and provided information necessary for IUCN listing of both rockhopper penguins (vulnerable) and black-browed albatross (endangered). We report on results of three (1995, 2000, 2005) archipelago-wide censuses of rockhopper and gentoo penguins at the Falkland Islands. We also present monitoring results from selected sites for gentoo penguins (1990-2009) and rockhopper penguins (1993-2009) and explore inter-annual variability in breeding pairs and success in relation to environmental indices, including the Southern Oscillation Index and fishery catch statistics as a proxy for environmental productivity. The Falkland Islands gentoo penguin population is currently estimated at 66 000 breeding pairs and appears healthy despite considerable inter-annual variation. Southern rockhopper penguins continue to decline, with a current population estimate of 211 000 breeding pairs.”

Alastair Baylis; Sarah Crofts; Pierre Pistorius

P2-81 Jessica Adkins

Too many or not enough? Recent population trends of Double-crested Cormorants in the western U.S. and Canada

“Current population trends for the Double-crested Cormorant (*Phalacrocorax auritus*) in North America apparently reflect recovery following protection of the species under the Migratory Bird Treaty Act, as amended in 1972, and the banning of DDT in the same year. This species, however, is now perceived as a pest across much of its range. Like cormorants in parts of Japan and Europe, the Double-crested Cormorant currently conflicts with fisheries and aquaculture interests in North America, including near the Columbia River mouth, where a large breeding colony overlaps spatially and temporally with out-migrating juvenile salmonids. Since the most recent status assessment for the entire Pacific Coast

population of Double-crested Cormorants was published in 1995 by Carter et al., the distribution of this population across its breeding range has changed dramatically. This is primarily due to the increase in the breeding population in the Columbia River estuary, which grew from ca. 3,300 pairs in 1991 to ca. 13,800 pairs in 2007. The current Pacific Region (British Columbia, Washington, Oregon, and California) breeding population of Double-crested Cormorants is ca. 27,000 breeding pairs, an increase of ca. 10,000 breeding pairs from Carter et al. (1995). Most of this increase can be attributed to the Columbia River estuary, which currently accounts for approximately 45% of Pacific Region breeding pairs. In contrast to this growth, numbers in coastal British Columbia, Washington, and parts of California have declined. Increasing Bald Eagle (*Haliaeetus leucocephalus*) populations and episodic human disturbance may be important factors causing declines in some regions.”

Daniel Roby; Donald Lyons; Karen Courtot; Timothy Marcella; Yasuko Suzuki; Peter Loschl; Daniel Battaglia

P2-82 Michelle Reynolds

Population trends of Hawaiian seabirds: Is there evidence of recovery and density dependence in breeding colonies?

“Throughout the first half of the 1900’s, seabirds in the Northwest Hawaiian Islands (NWHI) suffered from hunting, persecution, or introduced mammals. Since the second half of the 1900’s, there has been an extensive effort to restore seabirds and other NWHI species. These actions have included decreasing human disturbance, eradicating rats and invasive plants, and removing collision and entrapment hazards. We used long-term monitoring data collected by the National Wildlife Refuge at Tern Island to model seabird population dynamics. We compared density independent (exponential growth or decline) and density dependent models. Models suggested that the number of breeding seabirds had increased over the last 10-20 years. For many species, the density independent models were better supported suggesting increasing seabird populations that are not yet limited by density dependence. However, for some species, density dependent models were well supported. These models suggest that identifying the mechanism of density dependence (e.g., nest-site competition versus foraging competition) may aid in the conservation and management of these species. These models demonstrate the utility of long-term monitoring data for understanding population dynamics of breeding seabird populations in the NWHI.”

Nathaniel Seavy; Jeffery Hatfield



Diet & Foraging

P2-83 Javier Ciancio

Combining geographic information systems and stable isotope analysis to infer Magellanic Penguin diet in their austral distribution

“Magellanic penguin (*Spheniscus magellanicus*) is the most outstanding seabird in the Atlantic Patagonia. Around a million pairs breed along the coast, having a predominant role as top predator. Penguins breeding in Santa Cruz and Tierra del Fuego consume almost 30000 tons of fish and squid during the breeding season. Previous trophic studies in the region were based in direct stomach analysis, while these studies offer accurate data on diet, they are restricted in time, showing the diet of the available prey during the sampling period. Recently, stable isotope analysis provided a reliable and integrative tool for trophic studies. We created a geographic information system including the distribution patterns of prey and penguins collected from published articles. We selected prey from the spatio-temporal overlap analysis and from published data and included in a stable isotopes mixing model to estimated proportions of prey consumed. Four main prey species and pectoral muscle of dead chicks from five colonies (Latitude 47-52 S) were collected. We assumed that the SI signature of chicks represented de diet during the last months in the vicinity of the colony. SIA analysis showed similar patterns to previous published data in accordance to spatio-temporal overlap analysis, with a diet based mainly on sprats in the southern colonies and more diverse in the North. This analysis also revealed a higher proportion of squids, a prey item generally underestimated by direct methods.”

Esteban Frere

P2-84 Jennifer Doucette

What's for dinner? Stable isotopes reveal novel information about variations in adult and nestling diet

“Diet composition in many aquatic bird species is often analyzed using regurgitations and pellets. These methods have inherent assumptions and biases that may lead to false conclusions about diet and foraging. An example of this problem is the assumption that diet composition determined from nestling regurgitations or during chick-provisioning in colonial fish-eating birds is equally applicable to adult birds. However, this assumption has rarely been tested directly, and there is some evidence that this may not be the case. Using a combination of carbon and nitrogen stable isotopes and stomach content analyses, we investigated the diet of breeding double-crested cormorants (*Phalacrocorax auritus*) in Saskatchewan, Canada. Interestingly, mixing models used to

estimate the contributions of various prey in the diet of cormorants do not match % biomass estimates based on nestling regurgitations. These results suggest that the diet of adult cormorants differs from their offspring. This has major implications for ecology and management. For example, current biomass removal estimates for fisheries management decisions involving cormorants are often calculated using analyses of regurgitated boluses, with the assumption that adult and nestling birds have similar diets. Insight into differences in adult and offspring diet will further enhance our understanding of provisioning and optimal foraging, and our findings may not be limited to cormorants.”

Bjoern Wissel; Christopher Somers

P2-85 Andrea Raya Rey

Stable isotopes reveal variation by age, sex and locality in the diets and foraging habitats of Southern Giant Petrels breeding in Antarctica and southern Patagonia

“We examined the isotopic signatures (^{13}C , ^{15}N) of adult body feathers from southern giant petrels collected at two breeding colonies in Antarctica (Potter Peninsula and Cape Geddes) and one in southern Patagonia (Observatorio Island), as well as in whole blood collected from adults of both sexes at each Antarctic colonies and from chicks at Potter Peninsula. As body feather moult is a continuous process in giant petrels, feathers provide an integrated annual signal of an adult's diets and foraging habitats. In contrast, the stable isotope values of adult and chick blood are reflective of their diets during the breeding season. Feathers from the Antarctic colonies showed lower carbon and nitrogen values than those in Patagonia, suggesting that individuals from the Patagonia colony feed predominantly over the continental shelf, while Antarctic birds are likely feeding in Antarctic and Subantarctic waters throughout much of the year. When examining the breeding season (whole blood), males and females differed in their isotopic signature at both Antarctic colonies. This agrees with differences observed at other breeding locations, with females having high $\delta^{15}\text{N}$ value due to their reliance on marine prey which, in the Antarctic, have higher $\delta^{15}\text{N}$ values than penguin and seal carrion. Chicks had lower blood isotopic values than both males and females, indicating that adults provision their offspring with a relatively higher amount of carrion than what they consume. This finding confirms previous work that suggests that chicks are preferentially fed with prey of presumably of higher nutritional value such as carrion.”

Diego Archuby; Michael Polito; Néstor Coria



P2-86 Maelle Connan

Does sexual segregation exist in the feeding ecology of the Grey-headed Albatross breeding in the Prince Edward Islands?

“An important aspect of foraging ecology is the extent to which individuals, genders or age classes within a population exploit different food resources. We studied the feeding ecology of breeding males and females of the Grey-headed albatross, *Thalassarche chrysostoma*, during the chick rearing season and the moulting period, by sampling 11 females and 13 males at Marion Island (South Indian Ocean) in April and May 2009. We first investigated discrimination between the sexes using a combination of standard morphological measurements such as weight, tarsus and culmen length, and bill depth at the gonys. Birds were subsequently sexed using a molecular technique. On average, males were significantly heavier than females ($3.57 \pm 0.25 \text{ kg}$ vs $3.10 \pm 0.17 \text{ kg}$), and had greater bill depth at the gonys ($29.6 \pm 0.8 \text{ mm}$ vs $27.9 \pm 1.0 \text{ mm}$). When all measurements were included in a discriminant analysis, 96% of birds were correctly sexed when compared to the molecular results. During the chick-rearing period, male and female diets were assessed via three complementary methods: (i) stomach content analysis (food intended for nestlings), (ii) fatty acids of stomach oils and of plasma used as trophic markers, and (iii) stable isotope ratios of carbon and nitrogen of blood used as indicators of foraging areas and trophic level, respectively. During the moulting period, their diets were assessed using stable isotope ratios of carbon and nitrogen of feathers. Initial results from stable isotope analyses suggest no gender-based segregation of diet during either the chick rearing or moulting periods. This contrasts with findings at other breeding colonies.”

Christopher McQuaid; Bo Bonnevie; Christopher Kelly; Nigel Barker

P2-87 Vitor Paiva

Foraging ecology of Cory's Shearwaters in different oceanic environments of the North Atlantic

“The combined use of stable isotopes in animal tissues and conventional dietary analysis emerged as powerful tools to infer diet and habitat selection of marine top predators. This study combined information on where the individuals foraged (i.e. tracking data-loggers) with stable isotopes to study trophic and foraging ecology of Cory's shearwaters *Calonectris diomedea* over the vast North Atlantic. We deployed data-loggers to track foraging movements and feeding locations of six different populations foraging along a gradient of neritic to oceanic oceanographic conditions. After each foraging excursion, blood and diet samples were collected from each individual. We also measured the isotopic signatures in the main prey species for each population. The

birds $\delta^{13}\text{C}$ blood signatures matched those of their main prey items. Blood $\delta^{13}\text{C}$ signature was negatively correlated with latitude of main feeding locations and segregated individuals from different populations feeding over shelf systems or in oceanic seamount areas. The $\delta^{15}\text{N}$ signature discriminated the trophic level on which individuals mostly fed and was negatively correlated with the abundance of cephalopods in the diet. Results from a stable isotopic mixing model applied to our data estimated higher proportions of cephalopods in the birds' diet than those obtained by direct diet inferences, presumably due to the advanced digested stage of cephalopods in the regurgitations. Findings of this work may have a broader relevance for studying the foraging ecology of other upper trophic level predators in the north Atlantic region.”

José Xavier; Pedro Geraldes; Iván Ramírez; Ana Meirinho; Stefan Garthe; Jaime Ramos

WITHDRAWN P2-88 Claudia Stauss

The influence of reproductive status on sex-specific foraging behaviour in a monomorphic seabird

“Sexual segregation in seabirds can take place during both the breeding and interbreeding period. During the breeding season sex-specific differences range from choice in diet, foraging areas and chick provisioning behaviour, whereas detailed information from the interbreeding period is sparse. Sexual segregation as a behavioural strategy has been observed in both sexually size monomorphic and dimorphic seabird species; however, the ultimate causes remain unclear. Most hypotheses share the underlying idea that body-size, and thus competitive ability, is the driving element for the segregation of the sexes into different foraging niches. While this may be the case in some taxa, it does not account for sex-specific foraging behaviours of sexually size monomorphic species such as the Northern gannet (*Morus bassanus*). Previous analysis of stable isotope ratios of carbon and nitrogen in tissues of gannets revealed sex-specific differences during the breeding season, differences that do not persist during the interbreeding season. This suggests that conditions at the colony drive such differences, although it is unclear whether this relates to differential nutritional requirements of the sexes, or intraspecific competition. Here we analyse stable isotopes in the tissues of sexually immature gannets that gather at the third largest gannet colony (Grassholm Island, U.K.) to determine whether sex-specific differences exist during the same season in birds that are not reproductively active. This represents the first examination of sex-specific foraging in an immature seabird, which may have importance for understanding the causes and consequences of sexual segregation in birds in general and seabirds in particular.”

Stephen Votier; James Grecian; Mairi Knight



P2-89 Verónica Neves

Feeding ecology, movements and winter distribution of the Macaronesian Shearwater in the Azores, north-east Atlantic"

"Understanding seabirds trophic ecology and at-sea distribution is critical to design efficient conservation strategies. Here we present a panoptic study combining direct diet assessment, stable isotopes analysis, as well as above and under-water foraging behaviour to (1) investigate the diet and trophic niche of a small and poorly studied procellariiforme, the Macaronesian shearwater *Puffinus baroli baroli* (Bonaparte 1857), (2) characterize its foraging strategy, and (3) identify important areas for conservation at sea. We studied stomach contents, analysed $\delta^{13}\text{C}$ and $\delta^{15}\text{N}$ signatures both in winter and breeding feathers and tracked birds movements using geolocators and maximum depth gauges. Macaronesian shearwaters reached on average 14.8 m underwater, with dives ranging from 7.9 m to a maximum of 23.1 m. Squid was the most diverse prey (six families and at least 10 different taxa), but species composition varied considerably between years. The only fish prey identified was *Phycis* sp. which was present in high numbers (up to 27 individuals in a single stomach). Two squid families, Onychoteuthidae and Argonautidae, and the fish family Phycidae accounted for 82.3% of ingested prey. Feather nitrogen signatures suggested a switch to higher trophic levels during the non-breeding period. Both geocator data and carbon signatures indicated that birds spend the non-breeding period in offshore areas. No large-scale migrations were detected, the birds remained in the northeast Atlantic waters throughout the year. Our results indicate that the Macaronesian shearwater is a highly versatile predator feeding opportunistically on small, often schooling prey and highlight its usefulness for monitoring the squid community in the region."

Joël Bried; Jacob González-Solís; Jose Roscales; Malcolm Clarke

P2-90 Veronica Padula

Comparison of stable isotope readings in lipid extracted and non-lipid extracted tissue samples from Near Island seabirds

"Stable isotope analyses are often used to infer migration patterns, diet composition and trophic status of seabirds. However, a variety of techniques are used to analyze stable isotopes within certain tissues. Differences in techniques potentially affect the results and their interpretation and thus comparability of studies. One such difference is the processing of lipids in samples. Tissues contain variable amounts of lipids, which are depleted in the heavy carbon isotope (^{13}C). Consequently, lipids may introduce a bias in ^{13}C stable isotope analyses. While some studies extract lipids from tissues prior to stable isotope analysis, others do not.

Additionally, lipid extraction may affect other stable isotope analyses, such as for ^{15}N . Researchers have compared stable isotope readings from lipid extracted tissues to non-lipid extracted tissues, and have found that differences in ^{13}C and ^{15}N values depend on species and tissue type. Consequently, correction factors to appropriately interpret ^{13}C and ^{15}N values in tissues must be calculated for individual species. In this study, we collected seabirds representing seven species from the Near Islands, the western most group of islands in the Aleutian Island archipelago. We took samples of kidney, liver, heart and muscle from each bird. After freeze drying, individual tissue samples were divided into two subsamples. We left one subsample unaltered and extracted lipids from the other subsample. We will compare ^{13}C and ^{15}N of lipid extracted samples to unaltered samples overall, among tissue types, and among species. Ultimately we will be able to calculate new correction factors for these seabird species, contributing to the growing body of knowledge regarding the effects of lipids on stable isotope readings."

Naomi Bargmann; Douglas Causey; Trevor Haynes

P2-91 Michael Polito

The influence of diet on fatty acids in the yolk of Gentoo Penguins, *Pygoscelis papua*

"The use of intrinsic biomarkers, such as fatty acids (FA), to infer the diets of seabirds has helped researchers gain a better understanding of seabird foraging ecology. However, estimating seabird diets using these methods require an understanding of how FA signatures are modified from a consumer's diet to its tissues. In this study we examined the influence of diets on the FA signatures in yolk lipids using a captive population of Gentoo penguins (*Pygoscelis papua*) fed Atlantic herring (*Clupea harengus*). We quantified the FA signatures of both the captive penguins' diets and yolk lipids and calculated calibration coefficients to account for the metabolism of individual FA. Furthermore, we compared the FA signatures of yolk samples collected from a wild population of Gentoo penguins in the Antarctic Peninsula. We found that yolk lipids were composed primarily (70-71% of total) of three FA (16:0, 18:0, and 18:1n-9) which were found in similar amount in both captive (n=5) and wild (n=20) yolks and likely provide little or no indication of diet. In contrast, minor FA, such as 20:1n-11 (<1.5% of total) and 20:1n-9 (<3% of total), appear to be significantly influenced by diet. The yolks of captive penguins fed herring (high in 20:1n-11 and 20:1n-9) had significantly higher levels (p<0.001) of these two FA relative to wild penguins which consume krill that is low in both of these FA. This result suggests that FA analysis of yolk lipids can be used to help quantify the diets of seabirds prior to breeding."

Heather Koopman



P2-92 Viviane Barquete

Are toenails a good tissue for stable isotopes analysis? A study case in African Penguins

“Stable isotope ratios (mainly using ^{13}C and ^{15}N) increasingly are being used to infer information about the movements and trophic positions of birds. Feathers, blood, muscle, bone and other tissues frequently are sampled, allowing insights at a range of temporal scales, linked to tissue-specific turnover rates. Non-destructive sampling typically is limited to feathers and blood, but some studies have used toenails. We performed an experiment manipulating diet of captive African Penguins (*Spheniscus demersus*) to test the turnover rate and discrimination factor ($\Delta = \delta_{\text{diet}} - \delta_{\text{tissue}}$) of toenails, blood and its fractions. Eight penguins previously fed sardines (*Sardinops sagax*) were switched to a diet of small hakes (*Merluccius paradoxus/capensis*) for 49 days. The two fish differ in their nitrogen stable isotope signature but not carbon. Blood and its fractions had half-lives similar to those reported in other studies, with plasma showing a faster turnover rate (7.6 ± 0.7 days) than red cells (14.27 ± 1.58 days). Toenail growth averaged 0.11 ± 0.01 mm day⁻¹, suggesting that the visible portion of the average penguin nail takes 136.34 days to be replaced. However, no shift in the nitrogen isotope signature was detected, despite monitoring nails for 157 days after the diet switch. Discrimination factors varied among tissues, with toenails having the lowest factor: $\Delta^{15}\text{N}$ sardine-toenail = $1.45 \pm 0.64\%$. Although toenails can be sampled non-destructively, they need to be used with caution for isotope analyses because they appear to be relatively insensitive to short to medium-term diet shifts.”

Venessa Strauss; Peter Ryan

P2-93 Alexander Bond

Accurate estimates of discrimination factors are essential for stable-isotope mixing models

“Stable isotopes are now widely used in ecological studies, including diet reconstruction, where quantitative inferences about diet composition are derived from the use of mixing models. Recent Bayesian models (MixSIR, SIAR) allow users to incorporate variability in discrimination factors ($\Delta^{13}\text{C}$ or $\Delta^{15}\text{N}$), or the amount of change in either $\delta^{13}\text{C}$ or $\delta^{15}\text{N}$ between prey and consumer, but to date there has been no systematic assessment of the effect of variation in $\Delta^{13}\text{C}$ or $\Delta^{15}\text{N}$ on model outputs. We used whole blood from Common Terns (*Sterna hirundo*) and muscle from their common prey items (fish and euphausiids) to build a series of mixing models using various discrimination factors from the published literature for marine birds in both SIAR and MixSIR. While there was no difference between the modelling programs, the estimated proportion of each diet component was affected significantly by $\Delta^{13}\text{C}$ or $\Delta^{15}\text{N}$. It is therefore crucial for researchers wishing to use mixing models

to have an accurate estimate of $\Delta^{13}\text{C}$ and $\Delta^{15}\text{N}$, as quantitative diet estimates can direct future research, or prioritize conservation or management actions.”

Antony Diamond

WITHDRAWN P2-94 Leandro Bugoni

Feeding ecology of the Trindade Petrel *Pterodroma arminjoniana* in the Atlantic Ocean: Insights from geolocators, stable isotopes and stomach contents

“The feeding ecology of the tropical gadfly petrels (*Pterodroma* spp.) are probably the least studied among the Procellariiformes. In the Atlantic Ocean the Trindade Petrel (*Pterodroma arminjoniana*) breeds on the remote tropical Trindade Island in mid-Atlantic Ocean (c. $20^{\circ}30'S - 29^{\circ}19'W$), 1,200 km from the Brazilian coast, where there is a population estimated at 1,130 breeding pairs. We aimed to investigate its feeding ecology during the breeding season by collecting stomach contents of adults and chicks ($n=26$ samples, 17 adults, 6 chicks, 3 pellets), sampling adult and chick whole blood for N and C stable isotope analysis, and deploying geolocators, from December 2006 to April 2007. Overall, 17 food items and 303 individual prey were found. Cephalopods of 11 species predominated (%FO=100%; %N=57.8%), followed by fish (%FO=88.5%; %N=27.1%), with crustaceans and the insect *Halobates micans* occurring occasionally. Squid mantle length was 99.2 ± 83.3 mm (mean \pm 1 s.d.), and mass 40.6 ± 47.0 , both $n=39$. Stable isotope values in blood of adults ($\Delta\text{N } 11.3 \pm 0.2$; $\Delta\text{C } -17.5 \pm 0.1$, $n=18$) and chicks ($\Delta\text{N } 11.3 \pm 0.1$; $\Delta\text{C } -18.3 \pm 0.1$, $n=15$) were consistent with a diet composed by small squid ($\Delta\text{N } 7.8 \pm 2.0$; $\Delta\text{C } -17.0 \pm 0.1$, $n=4$, three squid species pooled). Data from eight geolocators were used to track breeding birds during foraging trips at sea, indicating that the species forages in a vast area of the tropical Atlantic Ocean, mainly to the south, reaching $\sim 35^{\circ}\text{S}$, feeding frequently at night, which agrees with data on bioluminescent squids being caught on the surface. Feeding ecology of Trindade petrels is similar to other tropical gadfly petrels elsewhere.”

Rona McGill; Roberta Santos; Robert Furness

P2-95 Lauren Reinalda

The use of digital imagery to improve training, accuracy, and efficiency in seabird diet analysis

“Seabird diet analysis frequently requires identification of bones and other hard parts to classify prey remains. Learning bone identification can be time consuming and overwhelming if one has no prior experience. The use of published keys and guides is helpful; however these resources are frequently limited to the identification of otoliths and large head bones. The use of a dissecting microscope with an attached digital camera allows observers to manipulate magnification and



lighting to highlight bone features which are otherwise difficult or impossible to see directly through an objective. As a result, in addition to any otoliths or head bones that are present, smaller, non-standard diagnostic bones can now be used to provide a more complete picture of diet composition. Digital imaging also speeds up training and quality control by allowing multiple observers to view the same image and observers can compare bones from multiple samples without physically mixing the specimens. Digital images also facilitate sharing of specimens with others who are not on site. Results show the combined use of digital imaging and non-standard diagnostic bones improves the accuracy of diet analysis (e.g. prey type, minimum prey number), especially for diet samples obtained with non-lethal methods such as regurgitation or lavage. Compilation of a digital image database for common prey types may be a useful research tool for seabird biologists.”

Jeannette Zamon; Elizabeth Phillips

P2-96 Jose Xavier

Advances in the feeding ecology methods on seabirds

“Dietary studies are essential understanding the role of seabirds in the marine ecosystem and therefore, form an integral component of most monitoring programmes worldwide. Collecting diet data can be a challenging and requires careful planning with respect field and analytical methodology and selection of study species. In this presentation, we will review the most recent advances in methods used to quantify diets of seabirds worldwide. Firstly, we will briefly outline conventional diet quantification methods (e.g. analysis of stomach contents, faeces or pellets or identification of prey carried in the bill) and discuss their advantages and limitations. We will then provide an overview of more recently developed alternatives for studying diet stable isotope analysis, fatty acid analysis, and DNA fingerprinting. Our commentary will include methods for collection and storage, a brief account of laboratory and statistical analytical procedures and a critical comparison of their application compared to one another and conventional methods. Finally, some recommendations for the suite of methods that could be used to describe year-round diet for a number of seabird species with differing feeding ecology will be presented.”

Norman Ratcliffe; Yves Chereil; Richard Phillips

P2-97 Alejandro Gatto

Adult South American Tern diet in relation to mate and chick prey requirements in Patagonia, Argentina

“Breeding seabirds may show changes in the use of prey resources as a result of constraints imposed by courtship feeding or chick provisioning, often resulting in differences

between self-feeding and prey provisioning. Deliveries during courtship feeding and the chick stage were quantified in South American Terns (*Sterna hirundinacea*) during the 2004 and 2005 breeding seasons at Punta Loma (42°S), Patagonia, Argentina, totaling 1840 prey items observed. Complementary stable isotope analysis was performed to assess isotopic niches and, using mixing models, evaluate the proportions of prey consumed by chicks and by adults during both the egg laying and chick rearing periods. South American terns at Punta Loma fed mainly on pelagic schooling fish, mostly Argentine anchovies *Engraulis anchoita* and silversides *Odontesthes* spp., but also included marine invertebrates and insects. Generalized linear models showed that adults delivered higher proportion of fish to their chicks than to their mates. Chicks were fed with a higher energy fish than mates (anchovies). Ordered Logistical Regression analysis showed that adults delivered larger fish to their mates than chicks. The diet of chicks was more diverse than that of mates, and showed higher amplitude in the use of fish sizes. Stable isotope analysis indicated that during the egg-laying and chick rearing periods, adults delivered higher energy and trophic level prey than that used for self-feeding.” **Pablo Yorio**

P2-98 Lindsay Adrean

Sitting on a dock of the bay, waiting for fish to swim my way: Foraging ecology and diet composition of Caspian Terns in San Francisco Bay, California

“The largest breeding colony of Caspian Terns (*Hydroprogne caspia*) currently resides in the Columbia River estuary and numbers approximately 10,000 pairs. The impact of this colony on survival of out-migrating, threatened and endangered juvenile salmonids has caused resource managers to attempt to relocate most of these terns to areas outside of the estuary. One proposed relocation site is Brooks Island in San Francisco Bay, which currently supports a Caspian Tern breeding colony of ca. 800 pairs. Based on studies conducted during 2003-2005, however, Sacramento River salmonids are a part of the diet at this colony, and fisheries managers are concerned that relocated terns could reduce survival of salmonids in the Bay Area that are listed under the United States Endangered Species Act. In 2008 and 2009 we collected diet composition information and used radio telemetry to investigate the foraging ecology of Caspian Terns nesting on Brooks Island. Diet composition data indicated that consumption of salmonid smolts increased from 3% of prey items in 2005 to 9% in 2008 and 2009. One popular foraging area was in close proximity to release sites for non-listed hatchery-raised Sacramento River fall-Chinook salmon. Coded wire tag recovery from the Brooks Island tern colony revealed that fall-Chinook from those releases comprised 98% of salmon in the Caspian Tern diet.”

Daniel Roby; Ken Collis; Allen Evans; Donald Lyons; Daniel Battaglia; S. Kim Nelson



P2-99 David Craig

Individual lateralization and the development of prey handling skills among terns

“Recent population level observations of diet and parental care revealed that Caspian terns demonstrate laterality, which is the different use of one or the other side of the body and is often reflective of hemispheric asymmetry and increased specialization of brain function. Because prey are held cross-wise and asymmetrically with the head to one-side and the tail another, bill-load holding birds like the terns are suitable for investigating lateralization. A hundred hours of video collected during chick-rearing were analyzed using The Observer XT 8.0 (Noldus, Inc) to determine the degree of individual laterality in prey handling and how prey lateralized prey handling related to on-colony survivorship. We believe we are among the first study to examine the orientation of prey within the bills of individual Caspian terns and are aware of no other comparable work focused on any of the other 45 species of tern or 100 bill-load handling species. Our research adds to a growing body of research of lateralization in the wild, but it may also be unique in considering lateralization as one piece of the much larger puzzle regarding the transition from parental dependence to independence. The ability to manipulate and consume prey items is intimately entwined with tern life and evolutionary history, as both chick and adult fitness depend on how well parents are able to deliver fish and chicks are able to consume prey items.”

Shealyn Friedrich ; Matthew Polzin

P2-100 Michael Horn

Review of food and feeding in the Crested Terns, a clade of coastal marine foragers

“The crested tern lineage comprises seven species of medium-sized terns: Royal Tern (*Thalasseus maximus*), Lesser Crested Tern (*T. bengalensis*), Chinese Crested Tern (*T. bernsteini*), Greater Crested Tern or Swift Tern (*T. bergii*), Sandwich Tern (*T. sandvicensis*), Cabot’s Tern, including Cayenne Tern (*T. acutiflavidus*), and Elegant Tern (*T. elegans*). Together they achieve a worldwide distribution in mostly tropical and warm-temperate latitudes, often nesting in dense colonies across expansive to restricted breeding ranges. Clade members are largely piscivorous, feeding mainly in productive ocean areas where populations of small pelagic fishes such as anchovies and sardines occur in fluctuating abundance. Even though some taxa are cited as dietary specialists, most species might be better regarded as habitat specialists, feeding in the ocean near the nesting colony and taking an array of small fishes that may reflect closely the availability of prey in the upper half-meter of coastal waters. As such, crested terns show promise as indicators of the composition and abundance of fish species that occur in the surface layers of the ocean. The Elegant Tern, for example, apparently evolved as a strict marine forager in the Gulf of California, and its continued

marine diet after expanding its range into southern California allows us to predict where the bird will feed at breeding sites undergoing restoration of potential foraging habitat.”

Jeanette Hendricks; Tyler Flisik

P2-101 Joseph Allen

Memory versus local enhancement: Different foraging strategies for different conditions

“High-density aggregations of forage species elicit an aggregative response in predators and, thus, influence the distribution patterns and foraging strategies of predators. This can result in the formation of ‘biological hotspots’, where energy transfer among trophic levels is maximized and where ecosystem processes are maintained. Capelin (*Mallotus villosus*) is the focal forage fish in the Northwest Atlantic. Our previous research on the northeast Newfoundland coast during the summer revealed that spatially and temporally persistent aggregations of spawning capelin resulted in the formation of biological hotspots. To explore the costs and benefits of foraging within hotspots, we repeated a fine-scale hydroacoustic survey (n=12) to quantify both avian and capelin density and distributional patterns during the capelin pre-spawning (no hotspots, low prey density) and spawning periods (hotspots, high prey density) and simultaneously conducted a decoy experiment outside of hotspot areas. The decoy experiment revealed that the response of murrelets *Uria aalge* and gannets *Morus bassanus* (e.g. landing within and circling decoys) was significantly greater during the pre-spawning relative to the spawning period, suggesting that seabirds switched from social (i.e. local enhancement) to memory-based foraging techniques when capelin became predictably located within hotspots. Larger tracking scales, or loose spatial associations of birds and capelin, were observed while using memory, suggesting that birds had an easier time locating and maintaining contact with capelin when they could be predictably located. Overall, this suggests that the benefits of group foraging within hotspots outweigh the costs.”

Gail Davoren

P2-102 Tatyana Obozova

Observational learning in the Glaucous-winged Gull colony

“Using standard laboratory method to investigate animal cognition it was shown that observational learning is one of the possible ways to transfer skills from one to another individual in the Glaucous-winged Gull colony. Experiments were carried out in the gull breeding colony on Toporkov Island (the Commander Island Nature Reserve, Russia). The territory-bound features of gull’s behavior in breeding period along with the fact that the birds have little fear of humans allowed us to work with individually recognized birds directly



in their nesting sites. Untrained gulls (observers) watched conditioned gulls (demonstrators) performance of two tasks which are not within the range of their natural capacities. Six demonstrators were trained to obtain a food placed into an opaque box. Observers started to obtain a food from the box in the first 3 trials whereas 15 - 41 trials were necessary for demonstrator to learn the task. Other two demonstrators were trained to choose one of four boxes that were different only in color. Observers performed the task correctly in the first trial whereas 12 - 15 trials were necessary for demonstrators to learn the task. We suppose that the ability to transfer skills from one individual to another may be one of the factors underlying behavioral flexibility of these birds.”

Anna Smirnova; Zoya Zorina

P2-103 Mikaela Davis

Spatial and historical comparisons of diet in the Glaucous-winged Gull on the West Coast of Canada: Context for interpretation of contaminant-monitoring data

“Environmental accumulation of persistent organic pollutants (POPs) is a growing concern to human health and ecological integrity, and there is an increasing need to establish monitoring programs to track contaminant levels in the environment. POPs in marine ecosystems have been shown to accumulate in the tissues of high trophic level predators which can be used as biological monitors to provide data on pollutant concentrations, means of exposure, and spatial and temporal contaminant trends. Environment Canada recently established a national monitoring program with gull species with the intention of tracking aquatic/marine contaminants. In order to ensure that the diet of glaucous-winged gull (*Larus glaucescens*) is informative of the local environment, and assess its feasibility as a monitoring species of marine contaminants on the Canadian West coast, initial studies on current diet structure and contaminant trends as they relate to diet, must be conducted. Objectives of this study include establishing a current baseline of this species’ diet structure across three historic breeding colonies off the coast of Vancouver Island, Canada, and comparing findings with those of similar studies conducted between 27-37 years ago. Using a combination of conventional diet analysis and stable isotope methods, we will determine a) if marine or terrestrial food items predominate in gull diets and b) whether diet and trophic level are reflective of a high level trophic predator foraging in the local marine environment. Results of this study will be used to interpret contaminant-monitoring data collected by Environment Canada.”

P2-104 Henriette Dries

Predation of swimming crabs by Lesser Black-backed Gulls in the south-eastern North Sea

“Swimming crabs (*Liocarcinus* spp.) are one of the most common Brachyurans (Crustacea) in the North Sea. Over the last century numbers have substantially increased. As revealed by diet analyses, swimming crabs are an important food, especially for lesser black-backed gulls (*Larus fuscus*). The aim of this study was to unravel interactions between swimming crabs and lesser black-backed gulls in the North Sea. We studied foraging behavior and distribution of lesser black-backed gulls in relation to swimming crab abundance during ship-based surveys. Our data show that swimming crabs were of significant importance as prey for lesser black-backed gulls. Gulls selected larger individuals than expected and took them only near the shore where they were most abundant, whereas they foraged on other prey further offshore. This indicates a possible energetic threshold at which gulls loose net energy gain from feeding on this prey type. Therefore, swimming crab abundance did not seem to have been the primary factor influencing overall gull distribution. Diet analyses of the largest German lesser black-backed gull colony on the island of Amrum in 2006 showed that up to 75% of all collected pellets consisted partly or exclusively of swimming crabs. However, a simple bioenergetic model showed that all gulls of the colony (11,000 breeding pairs) consumed only a small proportion of the total crab population (~5%) in its vicinity. Therefore it is rather likely that increasing numbers of swimming crabs may further support population increase of lesser black-backed gulls.”

Philipp Schwemmer; Stefan Garthe

P2-105 Nicolás Suárez

Diet composition and seasonal changes in prey selection in the threatened Olrog’s Gull *Larus atlanticus* breeding in Northern Patagonia, Argentina

“Knowledge of seasonal changes in resource use is important to adequately understand predator-prey relationships. We assessed seasonal changes in prey selection in the crab-eating Olrog’s gull. Diet was assessed through pellet analysis (n=360) during 2006 and 2007. Prey availability was assessed by sampling 1540 1m² quadrates distributed throughout potential feeding areas. Gulls fed almost exclusively on three crabs: *Neohelice granulata*, *Cyrtograpsus altimanus*, and *C. angulatus*. The relative importance (IRI%) of different crab species varied throughout the breeding cycle. During incubation, *N. granulata* showed the largest contribution (>95%) while *C. altimanus* contributed with less than 2%. This relative contribution was reversed during the early chick stage (<10% vs. >60%, respectively) and was between 40 and 50% for both species during the late chick stage. *C. angulatus*



showed relatively small %IRI values throughout the cycle. For each crab species, consumed sizes were similar among the three stages ($P > 0.05$). Percent occurrence, numerical abundance, and density of available crabs was similar between *N. granulata* and *C. altimanus*, and smaller in *C. angulatus* ($P < 0.05$). Sizes were larger in *N. granulata* and *C. angulatus* ($P < 0.05$). The Savage index showed that gulls selected *N. granulata* during incubation and largely *C. altimanus* during the chick stages. During incubation, gulls selected medium and large sized crabs, avoiding small available crabs. In contrast, small crabs were selected during both chick stages. Gulls chose crab species that were more available, switching from *N. granulata* to the smaller *C. altimanus* very likely as a result of constraints imposed by small chick prey requirements.”

Valeria Retana; Pablo Yorio

P2-106 Nathan Jones

Temporal and spatial differences in the at-sea diet and distribution of Thick-billed Murres and Black-legged Kittiwakes in the Bering Sea, July and August 2008, 2009”

“We studied the foraging ecology of two abundant seabirds of the Bering Sea, Black-Legged Kittiwakes (*Rissa tridactyla*), and Thick-Billed Murres (*Uria lomvia*), during the breeding seasons of July and August 2008 and 2009. We used strip transect surveys to assess bird distributions, and stable isotope signatures and stomach contents of birds collected at sea to assess diet. Significant spatial patterns in isotopic signatures and bird distributions indicated birds foraged consistently in distinct regions N-NW of St. Paul Island, S-SW of St. George Island, and N of Bogoslof Island. Based on collection times and wet biomass of stomach contents, we determined that most birds of both species foraged frequently during periods of darkness and crepuscular light. In 2008 total wet biomass in murre stomachs consisted primarily of euphasiids (89.3%; *Thysanoessa* spp), but in 2009 murre stomachs contained a more varied diet of: amphipods (36.2%; *Themisto* spp) squid (21.4%; Gonatidae family), Smoothtongue (18.1%; *Leuroglossus schmidti*) and Walleye Pollock (11.4%; *Theragra chalcogramma*). Kittiwake stomachs contained primarily myctophids (*Stenobrachius* spp) in both years (2008: 91.7%; 2009: 71.4%), but pollock became an important food item in 2009 (17.4%). Bird diets during the pre-breeding season (when foraging ranges were not constrained by breeding activity) were inferred by stable isotope signatures. Differences in $\delta^{15}N$ among feather, muscle and liver tissues in both species likely reflect seasonal shifts in prey consumption, and differences in $\delta^{13}C$ in kittiwake feathers likely reflect a pelagic signal.”

Brian Hoover; Kathy Kuletz

P2-107 Mark Bolton

Integration of multiple data-sources to model foraging areas of breeding Common Guillemots

“There is an increasingly urgent need to identify key foraging areas of priority assemblages of breeding seabirds. A variety of data sources, such as at-sea surveys and remote tracking data, are available to inform this process, but each has associated limitations. The objective of this study was to demonstrate whether foraging areas used by breeding Common Guillemots (*Uria aalge*) could be reliably predicted by integrating data from different sources into a single habitat association model. We used seasonally-stratified seabird distribution data from boat-based surveys; temporally coincident remotely sensed data on dynamic oceanographic variables (such as sea temperature) and physical oceanographic data (bathymetry, sediment type). These data were combined with information on the location and size of the breeding colonies and the time and energy costs associated with central-place foraging, to model the suitability of areas within range of the breeding colonies. We examined the change in distribution of seabirds at sea in relation to the occurrence and stage of the breeding season to assess the extent to which the constraints of breeding were reflected in the pattern of at-sea distribution at the population level. We discuss the utility of this approach and make suggestions for further developments. “

Maria Bogdanova; Francis Daunt

WITHDRAWN P2-108 Katherine Kauffman

Diet of Razorbill chicks at Matinicus Rock National Wildlife Refuge, Maine

“The breeding distribution of the Razorbill (*Alca torda*) extends across boreal and sub-arctic portions of the North Atlantic Ocean, extending south into the Gulf of Maine, USA. During 2006-2009, at Matinicus Rock, Maine, we observed breeding Razorbills return to their nests and identified the species and size of prey they delivered to their chicks. Prey included at least eight species of fish and one species of invertebrate. Atlantic herring (*Clupea harengus*) and hake (*Urophycis tenuis* or *Enchelyopus cimbrius*) were consistently among the three most common prey types by number, but their relative abundances varied significantly between years. In addition, prey species composition varied within seasons, sometimes changing dramatically within a few days. The high temporal variability in prey species composition of Razorbill meals suggests that prey availability rapidly changes in the marine environment and the birds are able to exploit this dynamic food resource. The ability to feed opportunistically may allow Razorbills to adjust to changing availability of prey species under global climate change scenarios.”

C. Scott Hall; Paul Sievert



P2-109 Motohiro Ito

Difference between single prey-loader and multiple prey-loader alscids in prey selection and foraging behaviour during self-feeding and chick-provisioning

“Parent birds are hypothesized to maximize both the provisioning rate for their chicks and the feeding rate for their own energy demand under species-specific ecological constraints. Here we compared the differences in prey selection and foraging behaviour during self-feeding and chick-provisioning between two alcid species that have contrasting chick-provisioning methods: the thick-billed murres, an obligate single prey-loader (on St. George Island, Bering Sea), and the rhinoceros auklets, a multiple prey-loader (on Teuri Island, Sea of Japan). Chick and adult diet (prey types and size) were examined by direct observation at the colony and by water offloading of adult stomach contents, respectively. Diving behaviour was recorded with a small (2.7g) depth-temperature data logger. Parent thick-billed murres delivered larger prey items (e.g. larger pollock) to their chicks while they fed on smaller prey items (e.g. smaller pollock and krill) for themselves. Parent murres dived deeper (>60m) during the last dive bout of foraging trip (presumably for chick-provisioning) compared to the rest of dive bouts (presumably for self-feeding). It may be necessary for murres to select larger prey sensitively to maximize provisioning rate, because they can carry only single item per load. In contrast, the prey items that rhinoceros auklet delivered to their chicks are the same as the adult birds fed during self-feeding. The main diet of the auklet shifted seasonally from 0 sand lance and juvenile greenling then to anchovy for both self-feeding and chick-provisioning, in response to the seasonal changes in food availability around the breeding colony. Diving behaviour of the auklets did not show any typical difference between self-feeding and chick-provisioning as murres did.”

Akinori Takahashi; Nobuo Kokubun; Sasha Kitaysky; Yutaka Watanuki

P2-110 Sigrid Engen

Warming effects on the diet and reproduction of the Little Auk (*Alle alle*) on Bear Island, Svalbard: A high-Arctic seabird relying on Arctic zooplankton

“Climate change is believed to affect seabirds through changes in food availability, and specialist foragers and populations at the limit of their species’ distribution range are thought to be the most vulnerable. Little auk, *Alle alle* is a high-Arctic planktivorous seabird that prefers to feed its chick lipid-rich Arctic zooplankton species like *Calanus glacialis* or *C. hyperboreus*. A substantial warming at the beginning of the 20th Century is suggested as the cause for the decline of little auk colonies on Iceland and West-Greenland. Bear Island (Svalbard) is the southern limit of the Barents Sea little auks.

In this area, the climate is largely affected by the variable influx of warm Atlantic water, which is occupied by smaller and lipid-poorer zooplankton species, such as *C. finmarchicus*. We hypothesize that a climatic warming with an increased Atlantic water influx will negatively affect little auks through the reduction in breeding success due to the lack of its preferred prey. We look at inter-annual variation in little auk chick diet, chick growth and breeding success in relation to zooplankton biomass during cold and warm years. The results show, contrary to our hypothesis that the diet in warm years contains a larger proportion of *C. glacialis* and *C. hyperboreus*. No inter-annual variation in breeding success was observed. The reproduction of the little auks is evidently not affected by a large influx of Atlantic water. A plausible explanation is that the topographically steered Polar Front stabilizes the supply of Arctic water to the foraging areas of little auk.”

Hallvard Strøm; Per Fauchald; Harald Steen; Tor Knutsen

P2-111 Carita Bergman

Black Oystercatchers as a sentinel species in the recovery of Northern Abalone

“Black oystercatchers (*Haematopus bachmani*) living along the Pacific coast of North America are known to consume a catholic diet of intertidal marine invertebrates, particularly mussels, limpets, snails and chitons. Despite the wide array of invertebrate prey consumed by oystercatchers, northern abalone (*Haliotis kamtschatkana*) has not been reported as a prey item, despite vulnerability to predation at low tide conditions. Moreover, populations of abalone have experienced precipitous declines in the past several decades, a factor that may contribute to a reduction in occurrence as a prey item for intertidal foragers. We document the diet of oystercatchers on Haida Gwaii, using 211 collections of prey remains found in close proximity to nest scrapes in Gwaii Haanas National Park Reserve and Haida Heritage Site and the adjacent Laskeek Bay, collected between 2004 and 2009. Using data gathered in the lower, mid and upper intertidal zones to estimate prey availability, we examine prey preference of oystercatchers using Ivlev’s electivity index. We further report the unique occurrence of and preference for abalone in these prey remains. To examine size selection of abalone by oystercatchers, we compare the size distribution of abalone found in prey remains with a sample of measurements taken from abalone found in situ at a nearby foraging sites. We speculate that the presence of abalone in oystercatcher prey remains may be indicative of locally abundant numbers of abalone. This result is unexpected because the status of northern abalone was uplisted to Endangered in 2009 after the population showed no recovery since 1990.”

Jake Pattison; Elin Price



P2-112 Phyllis Kind

Prey selection by Pigeon Guillemots nesting on Whidbey Island, WA

“Pigeon Guillemots (*Cephus columba*) are an important indicator species for the Puget Sound because they are one of the few seabirds that breed here and many remain through the winter. In spring, approximately 1000 birds gather at 21 breeding colonies around Whidbey Island where they nest in bluff burrows. Whidbey Audubon Society volunteers have monitored those colonies since 2004. Beginning in 2007, paid interns were charged with identifying the prey delivered to the chicks. Volunteers visit each colony weekly for two-months during the breeding season and observe the birds for one hour/visit. They count the birds, map the active burrows and identify prey. A burrow is deemed active if adults enter the burrow or if they deliver food to the burrow. In 2008, 225 active burrows were monitored and in 2009, 255 were monitored. About 45% of the birds attempted to breed. Prey deliveries begin in late June and reach a peak in late July. Prey are identified visually using binoculars and spotting scopes. Prey was delivered to 70% of the active burrows indicating at least one chick had hatched. In 2008 we observed 754 fish deliveries to 161 burrows and in 2009 we observed 1288 deliveries to 183 burrows. The fish delivered to the burrows were primarily gunnels (62%) or sculpins (22%). The other 16% of the deliveries were either unidentified or were prey other than gunnels or sculpins. The success of the Pigeon Guillemot population appears to be dependent upon the population of bottom fish.”

Kirsten Kremer; Houston Flores; Frances Wood

P2-113 Lauren Bessey

Foraging ahead in a changing environment: Influence of abiotic factors on Murre (*Uria lomvia*) foraging and diving behaviour

“Studies of seabird-prey interactions usually focus on biotic factors, such as prey abundance, seabird biomechanics and intra- or interspecific competition. In contrast, we examined the influence of abiotic factors, particularly tide, weather and light availability, on thick-billed murre (*Uria lomvia*) foraging. Tide can provide closer access to benthic prey, but can also drive movement of plankton and therefore schooling fish, potentially driving seabird behaviour. Nonetheless, tide had little impact on any parameters in our system. Inclement weather can increase flight and/or dive costs, making it more difficult to maintain energy budgets. We anticipated that weather would impact adult foraging behaviour more readily, and that adults might “buffer” reduced foraging opportunities, so that measures of at-sea behaviour might be more strongly correlated with weather than measures of chick growth or feeding rates. Indeed, foraging parameters were correlated with weather and energy costs increased when winds were >20 km/hr. As visual predators, light availability limits

foraging opportunities; however, prey often surface at night so there may be a trade-off between increased food availability and greater difficulty foraging during low light conditions. Our data supported both ideas, as dive depth increased with light availability and the proportion of invertebrates was highest during sunup and sundown. As climate change is expected to increase the severity of summer storms and to bring birds from areas of long nights to areas without nights, the paper would provide a background for investigating the impact of climate change on seabirds.”

Kyle Elliott; Joseph Allen; Tony Gaston

P2-114 Nathalie Hamel

Use of circular models to relate directional choices to diet in Common Murres

“Marine central place foragers must solve the conundrum of nesting on land while foraging at sea. One strategy is to exploit predictable features in the marine environment to more easily access prey. Because seabirds select fish prey that often occur in distinct pelagic habitats, their foraging locations may also coincide with particular prey or a suite of prey. Using circular distribution functions, we examined how directional choices of common murres (*Uria aalge*) from Tatoosh Island, WA (USA) related to their ensuing dietary choices, as measured by prey fed to chicks. We hypothesized that if murres showed directional bias, they would tend to aggregate towards meso-scale features known to concentrate plankton and fish prey, that aggregations would persist across years, and that prey choice would map onto directional bias. In all years, murres were distributed in a non-random, multimodal pattern. A mixture of von Mises distribution functions was always the most parsimonious model, indicating directional bias. Within and between years, a predominance of murres was always detected northeast of the colony. In contrast, murre distribution was diffuse west of the colony, an area encompassed by the Juan de Fuca Eddy. Prey were not associated with a specific direction. Tatoosh Island murres had access to a variety of dependable foraging sites near the island at which multiple, high-value fish species were taken. That a variety of fish were captured from a single hotspot further supports the idea that a stable feature acts to concentrate prey via direct physical or bottom-up mechanisms.”

Allan Hicks; Julia Parrish

P2-115 Juan Sala

Assessment of prey consumption by Magellanic Penguins in Patagonian colonies

“Following procedures outlined in Simeone & Wilson (2003), we used undulations in the dive profile of 15 logger-equipped Magellanic Penguin (*Spheniscus magellanicus*) foraging from three Patagonian colonies; Bahía Bustamante (BB), Puerto



Deseado (PD) and Puerto San Julián (PSJ), all located in Argentina between 45°54' S, to estimate the number of prey captured by the birds. We calculated the catch per unit time (CPUT) for foraging trips undertaken during the early chick-rearing period. Numbers of prey caught and CPUT were different between colonies. Birds from PD caught the highest number of prey per foraging trip (2325 ± 1401 vs. 1839 ± 944 and 460 ± 220 for PSJ and BB, respectively) with CPUT values of 130 ± 36 prey per hour (up to 2.5 times greater than BB). However, the number of dives performed by penguins from PSJ was two to five times higher than those made by birds from PD and BB, respectively. Consideration of other indirect measurements of the foraging effort (trip durations and foraging bout lengths) and success (the type of prey consumed), penguins from BB seem to be the least successful. Our results suggest that behavioral proxies for foraging success and effort may inform conservation initiatives for penguins and other top predator in a changing Patagonian Sea.”

Rory Wilson; Flavio Quintana

P2-116 Roberta Santos

Diet of Magellanic Penguin (*Spheniscus magellanicus*) stranded on Rio de Janeiro Coast, Brazil, with special reference to cephalopod prey

“The diet of magellanic penguins (*Spheniscus magellanicus*) was investigated from stomach contents of 78 individuals stranded on Rio de Janeiro beaches from Saquarema (22° 56' 14" S, 42° 28' 25" W) to Arraial do Cabo (22° 58' 15" S, 42° 01' 59" W), at the northern limit of the species' distribution along the Atlantic coast. The birds were found in regular beach monitoring conducted from July 2008 to November 2009. From 75 stomachs with some content, cephalopods represented the most frequent item, occurring in 97.3% of them, identified to specific level from lower and upper beaks. The pelagic octopod *Argonauta nodosa* was the main prey (84.0%), with numbers of specimens per stomach ranging from 1 to 608. The coastal squids *Loligo sanpaulensis* and *L. plei* were found in 58.7% and 49.3% of stomachs respectively, with 1 to 19 specimens per stomach. Oceanic squids as *Illex argentinus*, unidentified Ommastrephidae and one cranchid were also found with lower frequencies (less than 8%). Bottom living species as the octopod *Eledone* sp and the sepiolid *Semirossia tenera* contributed with 1.3% and 6.7% of occurrence. Besides cephalopods, other items found were fishes (80.0%) represented mainly by the presence of crystalline lenses, crustaceans (20.0%) and other molluscs (2.7%). Remains of vegetables (29.3%) and inorganic material as plastics (60.0%), nylon fishing line (29.3%), paper (20.0%) and stones (5.3%) were also found. Comparing with other feeding areas, the study emphasizes that magellanic penguins seems to be an opportunistic predator, and highlights the importance of *Argonauta nodosa* in the diet, when feeding

on Rio de Janeiro coast. The accidental ingestion of inorganic material, mainly plastics, could be considered a conservation concern, related to environmental pollution.”

Karen Rosa; Luciano Lima; Bruno RennÚ; Helio Secco; Salvatore Siciliano

P2-117 Andres Barbosa

Geographic variation in beak coloration in Gentoo Penguin along the Antarctic Peninsula: Environmental stress or resource limitation?

“We study the geographic variation of beak colour in a penguin species, the gentoo penguin, *Pygoscelis papua*, in different locations along a latitudinal gradient in the Antarctic Peninsula (from King George Island (62°15'S–58°37'W) to Ronge Island (64°40'S–62°40'W). Gentoo penguin shows a conspicuous red spot on both sides of the beak which is due to the presence of a carotenoid pigment, astaxanthin. Our results show that penguins in northern populations have the redder beaks. Two hypotheses have been proposed to explain geographical variation in colouration in animals, the 'condition hypothesis' and the 'environmental constraint hypothesis'. The former would predict that colour traits should be more intense in places where there is lower pressure of factors (i.e. contamination, parasite or disease pressure) affecting the use of carotenoids for other functions such as antioxidant or immune stimulation. The later would predict that colour traits should be more intense in places where there is higher availability of carotenoid sources, which in the case of penguins are the krill. Several informations seem to reject the condition hypothesis as redder beaks are present in the most polluted and parasitized areas in contrast with the prediction. Information based on the places where penguin forage from stable isotopes and the krill characteristics seem to support the environmental constraint hypothesis.”

Maria Jose Palacios; Francisco Valera; Ana Martinez

P2-118 Aileen Miller

Penguin foraging behavior and diet in relation to krill distribution from spatially and temporally synchronous studies, Livingston Island, Antarctica

“Seabirds can be effective indicators in the marine environment if the relationships with their prey are closely understood. To understand this relationship, studies of predator and prey need to be conducted at concurrent spatial and temporal scales. In this study we tracked penguin foraging locations, diving behavior and diet while conducting simultaneous krill acoustic and net surveys within the penguins' foraging range over 3 years. Krill abundance varied by several orders of magnitude during the study, yet there was



little evidence of changes in penguin foraging locations or diet. Diet samples of both species contained almost exclusively krill. The lengths of krill were similar to those caught in nets, though both penguin species exhibited a bias towards female krill. There was little spatial variability in either krill or penguin distributions, indicating that this location is predictable in terms of profitable foraging locations. Furthermore, chinstrap and gentoo penguins exhibited greater differences in foraging areas between the species than among years. This finding suggests that species specific foraging strategies and/or competition between the species play more important roles than krill biomass in determining behavior during the chick-rearing period. Surprisingly, there was little evidence of improvement in penguin chick-rearing success with increased krill availability.”

**Jarrod Santora; Anthony Cossio; Christian Reiss;
Wayne Trivelpiece; Joe Warren**

P2-119 Lisa Webb

Boom or bust: Low diet diversity in a nearshore avian predator, the Brandt’s Cormorant, in Central California

“Brandt’s Cormorants (*Phalacrocorax penicillatus*) are abundant, year-round predators in central California. They forage nearshore and become further constrained to forage near the colony during breeding, limiting available prey. Seabird diet studies are typically conducted at cessation of breeding; however, foraging and body condition during the non-breeding season may have a greater impact on breeding success. Therefore, our objective was to examine spatiotemporal variability of the diet during the non-breeding season. Regurgitated pellets (n=434) were collected from an outer coast site (Año Nuevo Island) and two bay sites (Moss Landing and Monterey) monthly or bi-monthly from September to the onset of breeding in March during the 2006-07 and 2007-08 non-breeding seasons. Pellets were sieved and all prey remains were enumerated and identified to the lowest taxonomic level possible. Twenty-two fish species occurred in the diet with a maximum of eight in a single sample, but on average only two fish species occurred in each sample. Brandt’s Cormorants relied mostly on northern anchovy (*Engraulis mordax*), on average comprising 52% of the diet by number, but dominating at Año Nuevo Island in 2007-08 with an average of 97%. At the two bay sites, speckled sanddab (*Citharichthys stigmaeus*) was the second most common prey averaging 20-30% of the diet by number. High adult mortality and poor reproductive output in central California in 2009 was likely the result of anchovies moving offshore. Boom or bust breeding success may be a consequence of low diet diversity in combination with major fluctuations in locally available prey.”

James Harvey

P2-120 Charlotte Boyd

Investigating the effects of changes in prey availability and distribution on seabird foraging success

“A number of seabird species face reduced breeding success attributed to changes in foraging conditions associated with climate variability and fisheries. Improved understanding of the attributes of foraging conditions that influence seabird breeding success is essential for the design of effective management and conservation strategies, such as marine protected areas and fisheries regulations. We will present an analysis of the effect of changes in prey availability on the foraging patterns of Peruvian Boobies (*Sula variegata*) in the northern Humboldt Current system, based on contemporaneous high-resolution seabird tracking data and acoustic surveys of their prey, Peruvian anchoveta (*Engraulis ringens*). The movement patterns of foraging seabirds can be partitioned into different movement modes associated with search/ foraging and travel behaviors. These data are then used to investigate the attributes of prey schools that correspond to search/ foraging habitat. Based on this analysis, an individual-based model is designed to explore the predictability of variation in the duration of foraging trips by Peruvian Boobies in response to changes in the availability and distribution of Peruvian anchoveta. This research will contribute to a mechanistic understanding of the relationship between foraging conditions and the foraging success of seabirds and other central place foragers in marine ecosystems.”

**Sophie Bertrand; Ramiro Castillo; Elisa Goya;
Henri Weimerskirch**

P2-121 Pete Warzybok

Working hard to get their krill: Cassin’s Auklets increase foraging effort when krill densities are low in the Gulf of the Farallones, California

“We assessed how Cassin’s auklet (*Ptychoramphus aleuticus*) foraging behavior responds to changes in prey availability and ocean conditions in the Gulf of the Farallones. During May and June 2008-2010, we tested the hypothesis that auklets work harder during periods of poor ocean conditions and decreased prey availability. We predicted that under these conditions, auklets would dive deeper, make more frequent dives, spend more time actively searching for prey and less time resting. Consequently, we expect that birds will need to work harder in 2010 due to major oceanographic changes resulting from El Niño. We used Time-Depth Recorders to evaluate foraging behavior while simultaneously conducting oceanographic cruises and diet sampling. In 2008-2009, ocean conditions were generally favorable, with cool sea surface temperatures, strong upwelling, and strong productivity, whereas 2010 is expected to be warmer and less productive. We observed both within and between year differences in



diving behavior. In June of each year, auklets spent less time diving, more time resting, and consumed more krill than during May of the same year. In 2009, when krill was abundant, auklets performed fewer shallow (exploratory) dives and spent more time at the bottom of the dive. The proportion of krill in chick diet varied in concordance with krill in Tucker Trawl samples from cruises. Auklet distribution at sea also varied between cruises. This study demonstrates how auklets foraging in the dynamic California Current respond to changing conditions by modifying their foraging efforts.”

**Nina Karnovsky; Russell Bradley; Eleanor Caves;
Meredith Elliott; Jaime Jahncke**

P2-122 Maryline Le Vaillant

Age and foraging in Thick-Billed Murres, *Uria lomvia*

“In several bird species, reproductive ability often increases with age until the individual reaches senescence. One main explanation for age-dependent reproductive performance is the capacity to find prey, i.e. foraging efficiency. In long-lived seabirds, a large part of reproductive success, and on a longer time scale survival, are linked to their foraging ability during feeding dives, making them useful models for foraging studies. Arctic seabirds are particularly relevant since, as top predators, their foraging activity is strongly influenced by any perturbation affecting the productivity of the sensitive, polar ecosystem. We investigated how age influences the foraging efficiency of breeding Thick-Billed Murres, at Coats Island (NU, Canada), separating birds into three groups: young (5-10years), middle-age (12-18years), and old birds (>20years). In 2009, individuals were equipped with accelerometers (Little Leonardo, Japan) to study foraging and resource utilization by measuring dive and biomechanics examination (i.e. dive shape and depth, underwater time allocation, buoyancy, wing beat activity, body angle, etc). Acceleration was recorded along the longitudinal and dorso-ventral axes at 16Hz, and temperature and pressure were measured every second. We estimate feeding efficiency during incubation and chick-rearing trips. We expect i) middle-age birds to be better foragers than young ones and ii) foraging efficiency to be lower in old birds than in middle-aged birds.”

**Kyle Elliott; Kerry Woo; Akiko Kato; Anthony Gaston;
Yan Ropert-Coudert**

P2-123 Amélie Lescroël

Mega-iceberg experiment: Forced variability in sea ice cover affects Adélie Penguin foraging efficiency

“The presence of the B15 and C16 mega-icebergs for 5 years in the southern Ross Sea brought anomalous sea-ice conditions that revealed how penguins cope with

environmental variability. In animal populations, a minority of individuals consistently achieves the highest breeding success and therefore contributes the most recruits to future generations. On average, foraging performance importantly determines breeding success at the population level, but evidence is scarce to show that best ‘long-time’ breeders (BB) forage differently than poorer breeders (PB). Here, using a ‘natural experiment’ brought by the icebergs, we tested the following hypotheses: 1) BB are more efficient foragers than PB and 2) the strength of the relationship is stronger under harsh environmental conditions and stronger resource competition (bigger colony size). We used a 10 year-3 colonies-individual-based longitudinal data set on breeding success and foraging parameters of Adélie penguins *Pygoscelis adeliae* on Ross Island. When the normal drift of pack ice was restricted, BB were significantly more efficient than PB at all 3 colonies. Birds that were breeding at the smallest colony gathered more food per unit of time (0.6 ± 0.2 g.min⁻¹) than birds from the medium-sized colony (0.4 ± 0.2 g.min⁻¹) and birds from the biggest colony (0.3 ± 0.2 g.min⁻¹). Under challenging conditions, BB exhibited higher foraging success for lower effort, therefore making higher net energy profit to be allocated to reproduction and survival. This study is the first to demonstrate the importance of ‘intrinsic’ conditions on the relationship between foraging strategy and individual quality.”

Grant Ballard; Kerry Barton; David Ainley

P2-124 Natalia Nikolaeva

Food composition and feeding habits of Common Eider (*Somateria mollissima*) in the Barents and White seas

“Excrement samples of Common Eider (*Somateria mollissima*) from different sites in the Barents and White seas are analysed. Food composition in winter and summer seasons, and in males and females are compared. Regional food habits differences between the Barents and White seas are revealed. Blue mussels (*Mytilus edulis*) dominated eider diet in the White Sea and southern Barents Sea, but its share greatly varied over the region. In some areas it is a principal food item. In other areas it is just of minor importance, and food composition is dominated by other clams, gastropods, crustaceans and echinoderms. Blue mussels are absent in Common Eider diet in the northern Barents Sea (Svalbard and Franz-Josef Land). Here, diets is diverse and consists of different species of gastropods, clams, crustaceans and echinoderms without clear preferences. Winter diet of Common Eider was found to be less diverse all over the study area. In the White Sea it is explained by limited foraging areas confined to polynyas, while in the Barents Sea changes in availability of mass aquatic organisms account for the restricted feeding spectrum. Feeding behavior of Common Eider is very flexible which allows effective foraging either on benthos or on moving objects such as fish. Under given



conditions, a bird feeds on the most numerous and accessible food items. Large-scale geographical variations in Common Eider diet composition prevail over the seasonal and sexual trophic relations differences.”

Yuri Krasnov; Galina Shklyarevich; Maria Gavrilov

P2-125 Monika Dorsch

Activity budgets of sympatric seaducks wintering in the Southern Baltic

“The Southern Baltic is an important wintering area for several seaduck and diving duck species which breed in the boreal zone of northern Europe. The objective of this study was to evaluate foraging activities of most common duck species in our study area aiming to use such information in the assessment of habitat use and species susceptibility to environmental perturbations. We measured the diving activity of three species of ducks: common eider, long-tailed duck and tufted duck in the waters of Fehmarn Belt, Denmark and Germany. We used radio telemetry in combination with an automatic datalogging system to document diurnal and nocturnal diving of tagged birds, and also to track individual duck movements. The results revealed substantial differences among investigated species in their diving effort, habitat preference and feeding activity allocation during day- and nighttime. Observed variation at least in part could be explained by different body size of investigated species, their habitat and diet preferences, and possibly predator avoiding behaviour.”

Ramunas Zydelsis; Jan Durinck; Marthe Otto; Georg Nehls

Migration & Tracking

P2-126 Chantelle Burke

Tracking and vessel studies reveal the post-breeding migrations of Murres in the Northwest Atlantic

“Post-breeding murres *Uria* spp. undergo a postnuptial molt after they leave the colony and are rendered flightless for ~ 4-6 weeks. At colony departure, females are released from parental care and males accompany the flightless offspring to sea and care for them until independence (~ 1 month). We investigate sex and colony differences (within species) in the post-breeding swimming migrations of Thick-billed Murres *Uria lomvia* and Common Murres *Uria aalge* from colonies in the Eastern Canadian Arctic and Newfoundland and Labrador. Differences in the timing and the range of movement away from colonies are assessed using satellite and geolocation tags, and observations from vessel surveys are used to assess concentrations of molting and immature birds (August-November). Four male Common Murres (attending offspring) equipped with satellite tags initiated southeasterly migrations away from Funk Island, closely following the trajectory of the Labrador Current. Preliminary information from geolocators indicates colony differences in the range of post-breeding movements of Thick-billed Murres from Arctic colonies. For example, murres from Coats Island (Hudson Bay) remained in the Bay until mid-November, coinciding with the usual period of sea ice formation in northern Hudson Bay, while murres from the Minarets (south Baffin Island) moved quickly away from the colony after departure. Sex and colony differences in post-breeding migration patterns will be discussed in relation to parenting constraints (single-parent males versus independent females), physical habitat features (surface currents, ice formation) and colony size (prey depletion).”

Laura McFarlane-Tranquilla; April Hedd; William Montevecchi; Dave Fifield; Paul Smith; Anthony Gaston; Richard Phillips

P2-127 Jerome Fort

Contrasted migratory strategies in a sympatric high-Arctic seabird duet

“The ecology of seabird species has been extensively studied during the breeding season. However, little is known about their behaviour and niche segregation during the winter period. Using miniaturized data loggers (LTD 2400; Lotek Wireless) and a thermodynamic model (Niche Mapper[®]) we determined the 2007-2008 wintering areas of the closely-related, sympatrically breeding Brønning’s guillemots (*Uria lomvia*, n=10) and common guillemots (*Uria aalge*, n=5) from Svalbard, and investigated their activity levels and their energy expenditure. We found that birds adopt contrasted strategies in winter since the former species migrates to south



Greenland, while the latter remains resident to the Barents and the Norwegian Seas. Furthermore, we highlighted that both species displayed significant behavioural plasticity, with important differences between the winter period and the rest of the inter-breeding season. For example, we showed that maximum dive depths are multiplied by 3 in winter to reach approx. 140-160 m. Overall, we showed that Brønning's guillemots have lower flying activity, equal diving activity, and 18% lower total energy expenditure than common guillemots during the inter-breeding period. Such a result could highlight important differences in the ability of these two species to respond to environmental constraints and rapid variations of resource availability. Brønning's guillemots therefore apparently face better wintering conditions. However, their population is declining in Svalbard, whereas the common guillemot population is currently increasing by 6% per annum. We propose that this difference is due to substantial anthropogenic pressure on Brønning's guillemots wintering off Greenland."

Harald Steen; Hallvard Strøm; Yann Tremblay; Emeline Pettex; Geir Gabrielsen; Yvon Le Maho; Warren Porter; Eirik Grønningseter; David Grémillet

P2-128 Rachael Orben

Flight performance limits winter migration? A comparison of two species breeding at three colonies in the Bering Sea, AK"

"The non-breeding season is a time when seabirds are freed from the constraint of central-place foraging; however, differences in flight performance likely influence the size of wintering ranges. Hence, species with higher wing loading and greater flight costs, such as the Thick-Billed Murre (*Uria lomvia*), should have smaller wintering distributions, and should show more overlap in range amongst birds from nearby colonies than species with lower wing loads and lower flight costs, such as the Black-legged Kittiwake (*Rissa tridactyla*). Here we compare the winter ranges of Black-legged Kittiwakes and Thick-billed Murres from three breeding colonies in the Bering Sea: St. Paul and St. George, in the Pribilof Islands, and Bogoslof Island, 350 km to the south. Seventy-four geolocators were deployed on chick-rearing kittiwakes in 2008, and 36 were retrieved in 2009. Forty-seven geolocators were deployed on murres in 2008, and 29 were retrieved in 2009. Both species wintered south of their breeding sites, and exhibited a high degree of overlap in range among birds from the three different colonies. As expected, Thick-billed Murres remained closer to their breeding colonies, and utilized cooler water. In contrast, Kittiwakes from all three colonies utilized warmer waters by concentrating in large areas within the subarctic domain of the North Pacific, south of the Bering Sea. However, a number of birds dispersed over the entire North Pacific Basin."

Rosana Parades; Daniel Roby; David Irons; Richard Phillips; Scott Shaffer

P2-129 Shona Lawson

Delineating wintering populations of White-winged Scoters and Long-tailed Ducks: A stable isotope approach

"Seaduck, species White-winged Scoters (*Melanitta fusca deglandi*) and Long-tailed Ducks (*Clangula hyemalis*), are known to winter on both the Atlantic and Pacific coasts of Canada. Some birds, of both species, are known to use Lake Ontario for migration stop-over and wintering. These species may have distinct geographic populations separated by breeding and wintering distributions. Naturally occurring stable isotopes ($\delta^{15}\text{N}$ and $\delta^{13}\text{C}$) have been used successfully to investigate migratory connectivity between geographic (breeding and wintering) locations and years in several avian species. We developed a methodology based on nitrogen ($\delta^{15}\text{N}$) and carbon ($\delta^{13}\text{C}$) ratios in White-winged Scoter and Long-tailed Duck feathers to delineate wintering populations of these two species. We used isotopic evidence in combination with banding data from breeding locations in Nunavut and Saskatchewan, Canada to connect breeding and wintering areas of individuals. Isotopic evidence and banding data suggested a separation of geographic populations of White-winged Scoters. Although banding data suggested separate populations of wintering Long-tailed Ducks, isotopic results were not as evident. Isotopic results of Long-tailed Duck feathers showed overlap of nitrogen ($\delta^{15}\text{N}$) and carbon ($\delta^{13}\text{C}$) marine signatures between Pacific and Atlantic Coasts and Lake Ontario. In addition, isotopic evidence suggested Long-tailed Ducks on wintering grounds move between freshwater and marine biomes during molt, making a geographic separation of Long-tailed Duck wintering populations undistinguishable. Results suggest behavior during molt is as important as molt location for delineating geographic winter populations of White-winged Scoters and Long-tailed Ducks."

Cindy Wood; Ray Alisauskas

P2-130 Joel Schmutz

Cross-continent migration strategies: Linking tundra breeding Yellow-billed Loons (*Gavia adamsii*) to coastal marine wintering habitats

"Yellow-billed Loons (*Gavia adamsii*) winter along the north Pacific coast in a broad arc from southern British Columbia in the eastern Pacific, across the south coast of Alaska, along the Aleutian Islands and down the Asian coast to southern Japan. Although wintering distribution is well defined based on observations, there has been no direct linkage of known marked individuals between breeding and wintering areas for this rare Gaviforme. Since 2003, we have deployed 39 satellite transmitters (PTT; Argos Systems Inc.) on Yellow-billed Loon's breeding on Alaska's arctic coastal plain (n=27), Alaska's Seward Peninsula (n=10) and in north-central Canada (n=2). All loons breeding on the North Slope wintered



exclusively off the Asian coast, from northeast Japan to China's Yellow Sea. Multiple migrations by individuals demonstrated fidelity to transitory stops along migration pathways. Frequent layover near St. Lawrence Island and reported harvest are conservation concerns for the species. Yearly variation was observed in the pathway of migration between continents. Some years all loons used an entirely marine route through the Bering Strait, whereas other years most loons used a more direct, but overland route, that crossed the Chukotka Peninsula. Of those loons marked on the Seward Peninsula, half followed this Asian migration pathway and the other half wintered in the Aleutian Islands and Alaska Peninsula. Loons wintering in Asia migrated substantially farther (~6,000 km) and further south (to 35°N) than those wintering in North America (to 49°N)."

Kenneth Wright; Daniel Rizzolo; Jeff Fair

P2-131 Corey VanStratt

Alaska or Mexico for winter vacation? Factors affecting Surf Scoter winter distributions

"Distributions of seabirds are influenced by many factors. Understanding these underlying influences is complicated when considering migratory animals, as different mechanisms may be acting at different annual cycle stages. One factor that may be driving winter distribution of Surf Scoters (*Melanitta perspicillata*) along their Pacific range is foraging opportunity. We affixed 69 Surf Scoters with VHF radio transmitters during 2006 and 2007 in Baja California, Mexico, and 110 Surf Scoters during 2008 and 2009 in Juneau, Alaska. We monitored their dives and measured foraging effort at the southern and northern peripheries of their winter distribution (Baja California, Mexico, and Juneau, Alaska, respectively). We compared this effort to published findings of effort at high quality foraging habitats at the core of their winter range (Strait of Georgia, British Columbia, Canada). We predicted that if foraging opportunity limited their winter distribution, foraging effort would be higher at the peripheries of the distribution. Results indicate that foraging effort is highest at the southern periphery, but lowest at the northern periphery. We suggest that foraging opportunity may be limiting the southern distribution, but that other factors such as climate or predation may be limiting the northern distribution. Population dynamics of seabirds are influenced by events and conditions on nonbreeding areas. By understanding factors influencing winter distribution, we may gain insights into features that influence population change."

Dan Esler; David Ward; Jerry Hupp; Kathy Brodhead

P2-132 Klemens Puetz

Post-moult dispersal of sympatrically breeding Humboldt and Magellanic Penguins in south-central Chile

"Ten Humboldt (*Spheniscus humboldti*) and eight Magellanic Penguins (*S. magellanicus*) were successfully equipped with satellite transmitters in March 2009 at Puñihuil Islets, Chile, to follow their post-moult dispersal. There were no significant differences in the migration patterns observed between species and sexes. Overall, the migration of Humboldt and Magellanic Penguins could be followed for a mean period of 49 ± 18 days (range: 25 – 93) and 57 ± 12 days (range 35 ñ 68), respectively. Maximum distance to the colony ranged between 6 and 1036 km in Humboldt and between 17 and 927 km in Magellanic Penguins. The total minimum distance covered (= sum of all distances between consecutive positions) was 8014 km in Humboldt and 9247 km in Magellanic Penguins, the mean daily distance covered was 21.9 ± 12 km (Maximum 106 km) and 22.0 ± 8 km (Maximum 115 km), respectively. Irrespective of species and sex, two different migration patterns were apparent. Birds either remained at the breeding site, presumably performing daily foraging trips, or migrated north. However, most of the latter turned south again during the course of their migration and, in some instances, returned to the breeding site. Overall, the post-moult dispersal was restricted to a coastal area stretching 1000 km from the breeding site at 42°S to about 33°S. The observed migratory patterns are discussed with respect oceanographic parameters and artisanal fishing activities."

Lucinao Hiriart-Bertrand; Andrea Raya Rey; Alejandro Simeone; Ronnie Reyes-Arriagada; Victoria Riquelme; Benno Luethi

P2-133 Elizabeth Skewgar

Spatial ecology of migrating Magellanic Penguins in southern Chile

"Migration plays a critical role in the persistence of many species facing seasonally variable environmental conditions, enabling them to find adequate food or space to reproduce. Magellanic Penguins (*Spheniscus magellanicus*) nesting on the Atlantic coast and Falkland/Malvinas Islands are the most migratory in their genus, but almost nothing is known about migration from colonies on the Pacific coast. We used satellite telemetry to determine the migration patterns of six male Magellanic Penguins that had finished their molt at Puñihuil, Chile, in 2006. We divided each track into outbound and wintering phases, and found that birds had slower speeds and less directed travel during the wintering phase. Five birds went north, stopping at foraging areas 200-400 and 600-800 km from the colony. The most commonly used wintering area was near the Gulf of Arauco, where bathymetric features cause persistent eddies that lead to upwelling and high levels



of primary productivity. This area is also used by Pink-footed Shearwaters from the Juan Fernandez Islands and Isla Mocha and Black-browed Albatrosses from the Diego Ramirez Islands and Islas Ildefonso. One bird went south 300 km, inland of the island of Chiloé, within 100 km of a Magellanic Penguin tracked from Tierra del Fuego in the same time interval that year. In their migration and wintering areas, Magellanic Penguins may compete with industrial fisheries for key prey species including anchoveta, sardine, and silverside, and also may become entangled and drown in gillnets used in artisanal fisheries for corvina.”

P. Dee Boersma; Alejandro Simeone; Daniel Grünbaum

P2-134 Mark Carey

Post-breeding migration of Short-tailed Shearwaters ñ Testing old theories with new technology

“Although Short-tailed Shearwaters (*Puffinus tenuirostris*) have been studied extensively during their breeding season, our understanding of their movements outside this period remains largely unknown. Early results from banding studies and museum collections implied a broad ‘figure-of-eight’ movement across the Pacific Ocean. Recent oceanic transects suggested birds migrated in broad fronts in the western and central Pacific. Here, we present the first tracks of the trans-equatorial migration of Short-tailed Shearwaters from a colony on Great Dog Island, Tasmania, Australia. Data were obtained from global location sensors (GLS loggers), which enable the estimation of bird location twice per day based on ambient light levels. We deployed 27 GLS devices in 2007 and retrieved 20 in December 2008. Tracks revealed that after breeding, shearwaters fly south to the Antarctic convergence for a brief period before flying rapidly north through the western Pacific to the coastal waters off Japan. Short-tailed shearwaters spent the bulk of the winter either in this region or further north in the Bering Sea, before returning south through the central Pacific to their breeding grounds in Australia. Birds used local waters around the colony before the commencement of egg laying. For the first time, our results show the complete migration of this long-lived seabird and reveal individual variation in their wintering distribution. Our results, in part, confirm previous assumptions as well as present new knowledge of their movements in the Pacific Ocean.”

Richard Phillips; Janet Silk

P2-135 Patrick Jodice

Movement patterns of Bahmaian Audubon’s Shearwaters and White-tailed Tropicbirds determined from geolocators

“The foraging behavior and movement patterns of Audubon’s Shearwater (*Puffinus lherminieri*) and White-tailed Tropicbirds (*Phaethon lepturus*) in the North Atlantic have

not been studied directly. We attached geolocators equipped with a wet/dry sensor to 11 shearwaters and 13 tropicbirds with young chicks in June 2008 at the colonies in the Exumas, Bahamas. We retrieved two of the devices from shearwaters in July 2008 after a deployment period of ca. 5 weeks, 4 devices from shearwaters and 3 from tropicbirds in June 2009. During the breeding season both species frequented the northern Bahamas but shearwaters also were located south of Cuba. During winter shearwaters dispersed along the coast as far north as the northeastern U.S. Tropicbirds dispersed north but also were frequently located east of Bermuda and in waters towards the mid-Atlantic ridge. Additional devices will be deployed in 2010 and efforts to recover devices still at-large will continue. These locations represent the first annual movement data collected from seabirds in the Bahamas and broaden our view of their foraging range in the breeding and nonbreeding seasons.”

William Mackin; Jennifer Arnold; Richard Philips

P2-136 Teresa Militao

Migration of Balearic and Yelkouan Shearwaters inferred by stable isotopes and geolocation analysis

“Understanding the migratory movements of endangered seabirds, such as the Balearic (*Puffinus mauretanicus*) and Mediterranean (*P. yelkouan*) shearwaters, is crucial to evaluate risks faced at sea by emerging anthropogenic threats, particularly when confined in highly exploited seas, such as the Mediterranean. The analysis of stable isotope (SI) of C and N in feathers can help us to understand these movements, if we gather sufficient information about SI baseline signatures and moulting patterns in relation to the timing of migration. To link these factors, we (1) analysed a set of primary, secondary and rectrice feathers of 10 Balearic and 10 Mediterranean shearwaters accidentally caught by Catalan longliners from 2003 to 2009; (2) analysed 1st primary and the 6th rectrice feathers from 40 Mediterranean and 58 Balearic shearwaters from the same source, (3) tracked five Mediterranean shearwaters from Hyeres (France) with light level geolocators over one or two year, and analysed SI in their 1st primary and the 6th rectrice feathers at their return. Stable isotope and geolocation analyses both showed that some Mediterranean shearwaters remain on the Western Mediterranean all year-round, while others migrate to the Black and Aegean seas. According to the SI analyses, the majority of Balearic shearwaters wintered and moulted most feathers in the Atlantic Ocean, but some remained all year-round in the Western Mediterranean. This study shows stable isotope analysis in feathers can provide important insights into migratory and assignment studies of endangered seabirds, particularly when combined with tracking methodologies.”

José Roscales; Karen Bourgeois; Jacob Gonz-lez-Solí



P2-137 Nariko Oka

Autumn migratory movements of Streaked Shearwaters (*Calonectris leucomelas*)

“Seabirds have refined migratory movements between breeding and wintering areas to increase degrees of adaptation. Recent advance of devices effectively documents the behavior of migrants en route, such as transit behavior and time budget in different marine environments. We tracked streaked shearwaters (*Calonectris leucomelas*), a Western Pacific migrant, to know their migratory behavior in relation to marine environments, deploying satellite transmitters. Birds showed the two striking movements consisting of ‘rapid flight’ and ‘slow cruise’ until they reached the wintering waters. They commenced southward movement at top speed for the first four days in average from the breeding area of Japan, covering 2,200km in average. This ‘rapid flight’ played the role to shorten their stay in the lowest productive region (i.e. low CHL). They, afterwards, geared down to low speed and sustained the southward slow cruising for four weeks, covering another 3,000km until reaching the specific wintering waters in equatorial region with significantly higher CHL than those of the transit waters. During the slow cruise they moved three times faster in day than at night, which were similar to the daily flight performance foraging in the wintering waters.”

Aya Fujinaga

P2-138 Ian Nisbet

Migrations and winter quarters of five Common Terns tracked using geolocators

“We attached ten geolocators (light-level data loggers) to Common Terns (*Sterna hirundo*) at a breeding site in the northeastern USA in 2007 and 2008, and retrieved six (five with useful data) in 2008 and 2009. The results show wide variability in migratory behavior among individual birds. The five birds wintered in four discrete areas on the north and east coasts of South America, from Guyana (6–7° N) to northeastern Argentina (36–42° S); three birds remained within restricted areas for most or all of the winter, whereas two ranged more widely. They left the breeding area at various dates between 1 August and 14 September; three migrated directly from the breeding area, while two first moved southwest to stage near Cape Hatteras, one staying there for 49 d before leaving North America on 27 September. All five birds flew directly to the vicinity of Puerto Rico, then moved at varying speeds along the north and east coasts of South America, staging at scattered locations for periods of 3–11 d, before reaching their winter quarters at various dates from 6 September to 26 October. The two birds for which we had spring data left their winter quarters on 2 March and 4 April, staged at the same site in northern Brazil for 47 and 6 d, then traveled via the Bahamas to reach the breeding site on 1 May. During the breeding and post-breeding periods, the

birds spent a mean of 10 min each day and virtually no time at night resting on the water, but during the rest of the year they often rested on the water for up to 6 h by day and up to 11 h at night. This suggests that they spent substantial periods at sea, unlike their behavior in the breeding and post-breeding seasons.”

Carolyn Mostello; Richard Veit; James Fox; Vsevolod Afanasyev

Species Conservation

P2-139 Alan Burger

What limits populations of Marbled Murrelets?

“I review evidence that populations of the Marbled Murrelet (*Brachyramphus marmoratus*) can be limited by either availability of forest nesting habitat or prey availability at sea. The murrelet is unique among temperate seabirds in nesting in large old-growth trees. Major historical population declines are linked to loss of nesting habitat due to logging, and consequently the species is listed as threatened in British Columbia (BC), Washington, Oregon and California. In addition, current murrelet numbers show linear correlations with accessible areas of suitable forest, at a range of spatial scales. Radar studies show that when nesting habitat is lost due to logging murrelets do not pack into remaining forest stands in higher densities and watershed populations decline. Although these results indicate limiting effects of nesting habitat other studies show population impacts due to marine conditions affecting availability of murrelets’ prey (small schooling fish). Murrelet numbers have declined across much of Alaska despite relatively little loss of forest nesting habitat and in accordance with similar declines in other piscivorous birds and mammals. Isotope studies suggest historical and current impacts of prey changes on murrelet populations in BC and California. Murrelet numbers and juvenile recruitment are affected by prey availability off Vancouver Island. Better information on the limiting effects of terrestrial (nesting) and marine (foraging) factors is needed to facilitate integration of these factors into conservation planning for murrelets.”

P2-140 Gary Falxa

Status of the Marbled Murrelet in the Pacific Northwest of the U.S.: Ten years of population monitoring

“The Northwest Forest Plan is an ecosystem management plan for federal forest lands in the Pacific Northwest of the United States. To evaluate the Plan’s effectiveness in conserving species associated with forests, we monitored Marbled Murrelet (*Brachyramphus marmoratus*) populations annually from 2000 to 2009 in near-shore marine waters



associated with the Plan Area. We sampled murrelets from boats in coastal waters off Washington, Oregon, and northern California south to San Francisco Bay, using line transects and distance estimation. We divided the sample area of about 8,800 km² into five geographic subareas (conservation zones). Annual population estimates for the area ranged from 17,400 to 23,700 birds, with a 2009 estimate of 17,800 (95% confidence interval: 14,200 to 21,300). We evaluated population trends at the Plan-wide (all 5 zones) and single-zone scales. We excluded data from Washington for 2000, because of potential biases associated with logistical problems that year. We found a population decline over the Plan area, with an estimated average rate of annual decline of 3.8% (95% CLs: -4.8 to -2.8%) for 2001-2009. This annual rate suggests a total decline of about 27% during this period. Trend analyses at finer spatial scales are preliminary due to low power, but we documented a downward trend for northern Washington (Conservation Zone 1), which includes the Puget Sound, San Juan Islands and Straits of Juan de Fuca. Trend analyses also provided preliminary evidence of declines in northern Oregon and the outer coast of Washington, but were not statistically significant.”

Jim Baldwin; Thomas Bloxton, Jr.; Monique Lance; Sherri Miller; Scott Pearson; Martin Raphael; Craig Strong

P2-141 Paul Jones

Distance tolerance and proximity index of breeding Marbled Murrelets to human presence

“Most avian species exhibit stress responses to the presence of human and other predator species, especially in the vicinity of active nests. In recent research into breeding Marbled Murrelets in British Columbia, when three separate nestings were studied (in 1993, 1994 and 1997), behavioural changes were observed in response to human presence where MAMU were able to see individuals in exposed locations, as opposed to sheltered locations, during fly-ins to nests or when individuals approached too close to nests. In his paper the author describes the distance tolerances of MAMU as a Proximity Index (PI), based on actual measurements, which attempts to define distance limits inside which MAMU will alter their normal behaviour in the vicinity of nests. He also describes a PI for at-sea behaviours of breeding and non-breeding MAMU.”

P2-142 Monica Mather

Marbled Murrelet nesting habitat suitability model for the British Columbia coast

“The Marbled Murrelet is a Threatened species in Canada primarily due to loss of nesting habitat. The Marbled Murrelet nesting habitat suitability model for the British Columbia (BC) coast was developed to estimate the amount and distribution of Marbled Murrelet nesting habitat, throughout BC including protected areas. This information will be used

to monitor progress towards meeting the Canadian Marbled Murrelet Recovery Team goal of maintaining 70% of the suitable nesting habitat that existed in 2002. The habitat algorithm for the model incorporates mapped forest cover attributes of tree height and age that are important for nesting habitat. The model identified approximately 2 million hectares of potential Marbled Murrelet nesting habitat. Twenty-six percent of the total area of habitat is in existing protected areas, which is equivalent to 37% of the habitat required to meet the recovery goal. The amount of nesting habitat from the model was compared to aerial survey habitat estimates on Vancouver Island. There was no significant difference between the amounts predicted from the two methods of identifying potential nesting habitat. The Suitability Model is recommended for broad-scale accounting of habitat, status assessments, and to aid in recovery and action planning.”

Trudy Chatwin

P2-143 Gerry McChesney

Recovery of the Common Murre in central California

“The central California, USA population of Common Murres (*Uria aalge*) is the southernmost extant breeding population of the species. This population experienced severe declines in the early 19th to mid-20th centuries due to commercial eggging, disturbance and oil spill mortality. Following partial recovery in the mid-20th century, the central California murre population again declined rapidly (about 50%) in the mid-1980s mainly because of large-scale set gill-net fishery and oil spill mortality as well as impacts of the strong 1982-83 El Niño event. These declines also resulted in the extirpation of one murre colony at Devil’s Slide Rock (DSR). Efforts by California and U.S. agencies led to a series of restrictions to the gill-net fishery beginning in the 1980s that substantially reduced murre mortality. In the early 1990s, most colonies began to reverse the declining trend. Beginning in 1996, funds from the 1986 Apex Houston oil spill settlement were used to restore the DSR colony using social attraction techniques and to assess other colonies. In the late 1990s, the discovery of continued gill-net mortality in the Monterey Bay area led to broader-scale restrictions that essentially eliminated this fishery. Reduced anthropogenic mortality combined with favorable ocean and prey conditions in the 1999-2007 period resulted in further increases at most colonies. By 2007, most colonies had recovered to or exceeded the early 1980s levels although some colonies, such as at DSR, are still below pre-decline sizes. A recently established program to reduce aircraft and boat disturbance at colonies will assist further recovery.”

Harry Carter; Michael Parker; Richard Golightly; Phillip Capitolo; Russell Bradley; Lisa Eigner; Pete Warzybok; Sandra Rhoades; Stephen Kress; Karen Reyna



P2-144 Mark Hipfner

How a single pair of Peregrine Falcons changed the lives of thousands for colonial seabirds

“Protective nesting associations are a common form of facilitation in birds, but rarely involve pelagic seabirds. At Triangle Island, British Columbia, Common Murres (*Uria aalge*) and Pelagic Cormorants (*Phalacrocorax pelagicus*) generally bred successfully from 2003 to 2006, four years in which a single pair of Peregrine Falcons (*Falco peregrinus*) nested among them. However, the falcon eyrie was inactive from 2007 to 2009. In these three years, unlike in any of the four earlier years, we saw Bald Eagles (*Haliaeetus leucocephalus*) depredate adult murres on the breeding colony, and by causing the murres to flush, facilitate the depredation of murre eggs by Glaucous-winged Gulls (*Larus glaucescens*). With no falcons present and predatory eagles and gulls active on the colony, the seabirds’ breeding success was low in 2007, then in 2008 and 2009 no murres bred successfully and no cormorants built nests in previously occupied areas. The nesting association that we describe is noteworthy both for the number of individuals involved (just a single pair of falcons protected thousands of seabirds, including ~90% of British Columbia’s breeding Common Murres), and for the starkness of its fitness consequences for the two seabirds. Studies of the mechanisms by which seabird populations are regulated focus overwhelmingly on bottom-up control. We suggest that greater attention should be paid to mechanisms of top-down control as a result of both direct (consumptive) and indirect (non-consumptive) effects of predators.”

Kyle Morrison

P2-145 Kirsten Bixler

Is the recovery of Pigeon Guillemots from the Exxon Valdez oil spill in Prince William Sound, Alaska limited by food availability or nest predation?

“More than 21 years after the Exxon Valdez oil spill (EVOS), which directly killed 2,000-3,000 Pigeon Guillemots (*Cepphus columba*), the population in Prince William Sound (PWS), Alaska has continued to decline. This decline now exceeds 85%, from ~15,500 individuals in the 1970’s to ~2,100 in 2007. Sub-lethal effects from EVOS may have limited recovery for up to 15 years, but recovery is now likely limited by either indirect, long-term EVOS effects or unrelated factors. We investigated forage fish availability and nest predation at the Naked Island Group (NIG), which formerly supported 1/3 of the Sound-wide guillemot population. Although beach seine samples and guillemot diet composition provided no support for the food limitation hypothesis, the NIG guillemot population declined by >90% since the 1990’s. The guillemot population at the nearby Smith Islands, however, remained stable, despite lower

abundance of preferred forage fish than at NIG. On the NIG, the prevalence of cliff-nesting increased, while ground-nesting decreased compared to pre-spill. An apparent invasion of NIG by mink (*Neovison vison*) within the last 15-25 years may be the cause. Nest predation by mink increased at NIG throughout the 1990’s and by 1998 at least 60% of nests were depredated by mink. By 2008, only 17 guillemot nests remained on NIG, but nest depredation by mink still occurred. We conclude that population recovery of guillemots nesting at NIG is primarily limited by mink predation, not food supply. Restoration of guillemots in PWS to pre-spill levels will likely require mink eradication at the NIG.”

Daniel Roby; David Irons

P2-146 Darrell Whitworth

Evidence for recovery of the Xantus’s Murrelet seven years after the eradication of Black Rats from Anacapa Island, California

“Black Rats (*Rattus rattus*) were eradicated from Anacapa Island in 2002, benefitting Xantus’s Murrelets (*Synthliboramphus hypoleucus*) and other breeding seabirds. In 2000, nest searches were initiated in 10 sea caves (the only areas with evidence of nesting in 1994-97 surveys), and standardized monitoring began in 2001 to measure changes in hatching success and numbers of clutches laid after rat eradication. Hatching success increased considerably post-eradication (30% in 2001-02 versus 87% in 2003-09) and contributed to strong population growth in sea caves. The number of clutches increased from an annual maximum of 11 clutches pre-eradication to 30 clutches in 2009. Murrelets also began breeding outside sea caves post-eradication, with 22 nest sites found in cliff and shoreline habitats where none were known before 2003. Recent nest site competition between murrelets, Pigeon Guillemots (*Cepphus columba*) and Cassin’s Auklets (*Ptychoramphus aleuticus*) suggests that suitable crevice nest sites may be limited in some sea caves and other habitats. To date, colony growth has been limited to certain sea caves and shoreline habitats, as extensive surveys in 2009 found no evidence of murrelets nesting in apparently suitable upper island habitats. Full colony recovery may require several decades, but habitat enhancement and social attraction may speed re-use of upper island habitats where murrelets have been absent for about a century and evidence of former occupation by rats persists. Continued annual nest monitoring and periodic reassessments of colony size with spotlight and radar surveys (with comparison to pre-eradication baseline data) are desirable to best document colony recovery.”

Harry Carter; Laurie Harvey; Franklin Gress



P2-147 Pablo Garcia-Borboroglu

Penguin status in troubled oceans

“Marine and coastal ecosystems are undergoing unprecedented alterations in their processes and structure. Penguins are sensitive species impacted by these phenomena. As top predators, they are key constituents of marine ecosystems, and are indicators of the oceanic and coastal ecosystem health. We integrated the most updated information on distribution, abundance and trends for all penguin species. IUCN listed 60% of the 18 penguin species as vulnerable or endangered. Some threatened species are at their lowest recorded populations: Galapagos, Yellow-eyed and Fiordland, with their restricted ranges, have less than 3,000 pairs; Humboldt, Snares and African, have less than 30,000 pairs. Even abundant species like the Macaroni, and Rockhopper penguins are in steep decline. Around 80% of the threatened species occur on islands, increasing their vulnerability to threats such as introduced predators. Threatened penguins are mainly concentrated in New Zealand, East-Pacific Coast (Galapagos and Peru-Chile), and South-Africa. The status of penguin species is not improving. Anthropogenic sources of mortality are likely to increase and are drivers of the decline of penguins. Oceanic threats include climate change, marine pollution, and fisheries mismanagement. Prey availability potentially linked to climate variation is one of the most commonly suggested causes of population decline. Human activities, including irresponsible tourism, coastal development, and introduced predators, can have a major impact on penguin populations. As ocean samplers, penguins provide insight into the magnitude and location of marine conservation problems. Larger scale ecosystem-based conservation planning and more focused local efforts are needed for the successful conservation of many penguin species.”

P. Dee Boersma; Phil Trathan; Klemens Putz; Barbara Wienecke; Yvon Le Maho; Gerald Kooyman; Thomas Mattern; Robert Crawford; Underhill Les; Jessica Kemper; Peter Dann; Ursula Ellenberg; Phil Seddon; Yolanda Van Heezik; Antje Steinfurth; F. Hernan Vargas; G. Jimenez-Uzcategui; S. Naranjo; Charles Bost; Karine Delord; Heather Lynch; Lloyd Davis; M. Cerdena; Patricia Majluf; Richard Cuthbert; Wayne Trivelpiece; Mark Hindel

P2-148 Esteban Frere

High predation rates by pumas on Magellanic Penguin adults: New conflicts in coastal protected areas in Argentina

“Avian predation on Magellanic penguin along the Argentinean coast was historically reported. However, carnivore predators never represented an important mortality factor. Monte Leon National Park was created in 2004, where ovine cattle were excluded. Since 2004 we monitored its colony and from 2007 we are evaluating carnivore predation impact on adult penguins on six 2500 m² plots along the

colony, where number of breeding pairs, adults predated, sex, timing, and location of carcasses were recorded. Predator species was identified by carcass necropsy. We have also installed four camera traps to identify and quantify responsible individuals. High levels of mortality were detected from 2006; over 95% of the adults were predated by pumas. Most penguin carcasses were actually not consumed. At the studied plots, between 2007 and 2008 nest density decreased by 47% ($F=10.42$; $p<.0017$). The highest predation rates were observed in two plots ($X_{22007}=435$, $X_{22008}=445$, $p<0.001$) located at the periphery and near to ravines. During 2007, 15% and 5% of the breeding adults were predated at those plots and the same figures, during 2008, were 36% and 19%. Our preliminary estimation showed that more than 1500 adults are killed each year. Preliminary camera analyses identified an adult puma with three young as the former predators. Removal of those individuals seems the better option as a management tool, in order to stop the decrease (16%) of the penguin colony observed during the last years.”

Ana Millones; Annick Morgenthaler; Travaini Alejandro; Gandini Patricia

P2-149 Antje Steinfurth

Predatory impact of cats (*Felis catus*) on the Galapagos Penguin (*Spheniscus mendiculus*) at its main breeding site, Caleta Iguana, Isabela Island, Galápagos

“Insular breeding seabirds are extremely vulnerable to introduced mammalian predators as they have not evolved behavioural, morphological or life-history responses against them. We undertook the first study on in situ predation of Galápagos penguins (*Spheniscus mendiculus*) by feral cats (*Felis catus*) at the penguin’s main breeding site to investigate whether cats pose a threat to this species. We examined five cat digestive tracts and eight scats and identified the occurrence of prey remains. Feathers and the tarsal bones of adult Galápagos penguins were identified in a total of two digestive tracts and four scat samples. Additionally, seven adult penguin carcasses were recovered within one month, six of which showed distinctive signs of predation by cats. One observation of a feral cat feeding on a penguin carcass was also recorded. These data importantly demonstrate that Galápagos penguins are actively predated by feral cats. We used VORTEX population viability software to investigate how this previously unaccounted source of penguin mortality influences the risk of penguin population extinction. The simulations revealed that cat predation, in addition to known sources of mortality, can significantly increase population extinction rates. These results have profound implications as our current understanding of the stability of the Galápagos penguin population fails to consider this source of mortality. Further work is urgently needed to assess the wider impact of feral cat predation on the endangered Galápagos penguin.”

Dan Forman; Victor Carrion; Felix Hernan Vargas



P2-150 Amy Van Buren

Avian predation patterns in a Falkland Islands mixed seabird colony

“Steeple Jason, Falkland Islands, is one of the world’s most important breeding sites for Southern Rockhopper Penguins (*Eudyptes chrysocome chrysocome*, ROCP) and Black-browed Albatross (*Thalassarche melanophrys*, BBAL). Both species are IUCN-listed (ROCP vulnerable, BBAL endangered) due to long-term and recent population declines. Predation may have a disproportional impact as breeding populations decline, functionally increasing predation rates. In 2005-2006, we examined predation at Steeple Jason, where two locally abundant bird species--Falkland Skuas (*Catharacta antarctica*) and Striated Caracaras (*Phalacrocorax australis*)--are important predators on ROCP and BBAL eggs/chicks. In the mixed-species ROCP/BBAL subcolony, predators engaged primarily in scavenging. During ROCP hatching, ejected eggs/chicks supplied surplus food for both predators. When BBAL began hatching a few weeks later, both predators scavenged extensively on starved/abandoned albatross chicks. In late crÉche, starved ROCP chicks provided a further food source. In five single-species ROCP subcolonies, predation caused complete reproductive failure in the two smallest, and dramatically reduced fledging success in the remaining three. Colony size, colony species composition, adult non-breeder presence, and predator territorial behavior may affect a colony’s vulnerability to predation.”

P. Dee Boersma

P2-151 Allison Patterson

Restoration of Caspian Terns to the Upper Klamath Basin, California

“Since the early 1900s, Caspian Terns (*Hydroprogne caspia*) in western North America have shifted their breeding from colonies in interior lakes and marshes to coastal colonies, dominated by a single large colony in the Columbia River estuary. This poster examines the potential for creating nesting habitat at historical nesting sites in the Upper Klamath Basin of northeast California, thereby restoring interior breeding populations of this species. Caspian Tern colonies on Lower Klamath Lake and Tule Lake, California, were regionally significant for the species prior to the draining of these wetland complexes in 1905. This history of nesting and contemporary use of the region by non-breeding Caspian Terns suggests that breeding may be limited by a shortage of suitable nesting habitat. Between the 2009 and 2010 breeding seasons the US Army Corps of Engineers built three new islands in the Upper Klamath Basin to compensate for reductions in Caspian Tern nesting habitat in the Columbia River estuary. Constructed islands have previously been used to restore nearby colonies to the north in interior Oregon at Crump Lake, where over 430 and 690 pairs nested in 2008

and 2009, respectively, and Summer Lake, where 15 pairs nested in 2009. In 2010, we used social attraction techniques to encourage nesting at new islands in Tule Lake and Sheepy Lake, California, and monitored each island using direct observation and video recordings to detect nesting activity by Caspian Terns and other colonial waterbirds.”

Daniel Roby; Ken Collis; Donald Lyons; Daniel Battaglia

P2-152 Kathy Keane

Status of the endangered California Least Tern: Population trends and indicators for the future

“Following listing under the federal and state endangered species acts, the California least tern increased from an estimated 664 nesting pairs in 1976 to over 7,000 in 2008. However, the majority of the increase occurred during the 1990’s. Although nesting site protection efforts have continued at similar levels in recent years, productivity has declined over the past 10 years, resulting in reduced recruitment into the population. Higher levels of predation at some nesting sites, as well as fluctuations in numbers and timing of appearance of preferred prey, are implicated in higher levels of mortality. Thus, although the least tern population has increased substantially from its pre-listing numbers, continued management will be required to ensure continued reproductive success and long-term survival.”

WITHDRAWN

P2-153 Sandra Beatriz Giner Ferrara

Least Tern nesting on the coast of Venezuela

“Nesting sites of seabirds residents are not well known on the coast of Venezuela. Most of the information are occasional records of these birds. In this study we report the nesting of Least Terns (*Sterna antillarum*) in two coastal wetlands of the state of Falcon in the years 2007, 2008 and 2009. In May 2007, in Chichiriviche, Falcon state, there was a Least tern’s nest with two eggs and a group of 50 adult terns displaying courtship behavior. Terns nesting at Chichiriviche occurred again in May 2008 with a total of 50 active nests, and an average of 1.89 eggs / nest, and in May 2009 with a total of 62 active nests, and 1.59 eggs / nest. In Wildlife Refuge iBoca de Cañoi, located in the Paraguana Peninsula, a group of Least tern nesting with a total of 7 active nests was recorded in May 2008. Least tern nesting on the Venezuelan coast was unknown until now, these records show the relevance of some coastal wetlands at Falcon state to resident terns nesting. It is important to increase the sampling effort along the coast in order to know the nesting sites of species of seabirds and develop monitoring to determine population status of these species on the coast of Venezuela.”



P2-154 Borut Rubinic

Nesting distribution, numbers and nesting ecology of Audouin's and Yellow-legged Gulls on the islands of south Dalmatia, Croatia

“The main goal of this work focuses on gulls in the area of South and partially Middle Dalmatia, Croatia. Special focus was put on the two species that breed in that area, Audouin's Gull and Yellow-legged Gull, their distribution, numbers and nesting ecology. The area of research is limited to the islands of 0,1 to 526 ha of surface area. The majority of the area is not protected. The whole of the area lies in the eumediterranean zoogeographic region. 239 islands have been censused between 1997 and 2002. A combination of the direct count and flushing count bird counting methods was used. Censuses were conducted once a year, over five seasons. In 2001 the nesting population of Audouin's Gull in the whole of area studied was 67 pairs, and that of Yellow-legged Gull, 12,535 pairs. Nesting densities of Yellow-legged Gull are among highest in the world, while nesting densities of Audouin's Gull are comparable to those in the E. Mediterranean. The number of nesting pairs of Audouin's Gull varies positively with the distance of islands from larger land masses. This allows Audouin's Gull to be closer to its main food, pelagic fishes from the Clupeidae family. Smaller, more distant islands, where human disturbance is less extensive and terrestrial predators are absent, are preferred. The number of nesting Yellow-legged Gulls depends positively on larger land-mass distance, as well as on the distance from the continent, and on the extent of garigue and rocky coverage.”

P2-155 Aili Labansen

Status of the Black-legged Kittiwake breeding population in Greenland, 2008”

“Based on intensified survey efforts (since 2003) of Greenlandic breeding colonies of black-legged kittiwake *Rissa tridactyla*, the total Greenland breeding population was estimated at roughly 110,000 breeding pairs constituting about 4% of the total North Atlantic breeding population. This population estimate of black-legged kittiwake is the most reliable and updated estimate hitherto reported for Greenland. The results confirm considerable population declines in many areas of West Greenland. The breeding population of black-legged kittiwakes in the Qaanaaq area appears healthy, whereas the rest of the west coast has experienced declines, especially the Northwest region (Upernavik to Kangaatsiaq area). Exactly when these reductions have occurred is uncertain due to a limited survey effort in the past, but some colonies declined as far back as the mid 1900ies, whereas declines of other colonies have occurred since the 1970-80ies. East Greenland data from the past are few, but recent aerial surveys confirm that the abundance of breeding kittiwakes on this inaccessible coast is low. The reasons for the West

Greenland declines are not documented; however, poor feeding conditions and a high hunting pressure, particularly prior to 2002 when the open season was shortened considerably, are possible explanations.”

Flemming Merkel; David Boertmann; Jens Nyeland

P2-156 Katrin Ludynia

Foraging and diet of endangered Bank Cormorants at Mercury Island, Namibia

“The Bank Cormorant (*Phalacrocorax neglectus*), endemic to the Benguela Region, is declining throughout its range. In Namibia the population crashed between 1993 and 1998 and has not recovered. Mercury Island is the only breeding site where the local breeding population has recovered from the crash. It represents today more than 80% of the Namibian subpopulation and more than 70% of the world's population, making Mercury Island the largest breeding site for this endangered species. We studied the foraging behaviour of breeding Bank Cormorants from Mercury Island during the breeding season 2007-08 using data logger technology to identify foraging areas and diving behaviour. Additionally, we investigated the diet of breeding Bank Cormorants from pellet analysis. The area frequently used for foraging by breeding cormorants was located within close vicinity to the island (maximum distance 5km). Birds were mostly feeding at the sea bottom, diving to an average depth of 25m. The birds' diet consisted almost entirely of large Pelagic Goby (*Sufflogobius bibarbatus*), a demersal fish species. Increasing numbers of breeding pairs and good breeding success of Bank Cormorants at Mercury Island seem to be due, in part, to good prey availability in the vicinity of the island. The protection of the identified feeding grounds, which lay within Namibia's Islands' Marine Protected Area (MPA) along the southern Namibian coast, will be vital to ensure the future of this endangered species.”

Rian Jones; Joan James; Kathleen Peard; Jean-Paul Roux; Les Underhill

P2-157 Raja Sekhar Penmetcha

Breeding biology and conservation of White-bellied Sea Eagle (*Haliaeetus leucogaster*) at Visakhapatnam coast, Andhra Pradesh, India

“Studies were conducted on breeding biology of White-bellied Sea eagle (*Haliaeetus leucogaster*) as part of status survey in Visakhapatnam Coast, Andhra Pradesh, India. The White-bellied Sea eagle is distributed along the sea board from Mumbai on the West coast to Calcutta in the East coast. As per Indian Red Data Book it is in vulnerable status and listed in Schedule-I of the Indian Wildlife (Protection) Act, 1972. The Visakhapatnam Coast on the East Coast of India is a rocky shoreline of diversified habitats from Eastern ghats ridges to saline marshes and interior coastal wetlands harbour



diversity of avifauna. For studying the breeding biology of White-bellied Sea eagle two nest sites were selected in the vicinity of Visakhapatnam Coast with an ariel distance of 60 meters from the shoreline. Observations were made on two nesting eagles from construction of nest to incubation of eggs, rearing of chicks and fledgelings. prey composition, feeding intervals and behavioural attitudes of the nesting eagles were documented. The nests were located from the “Goose-like” honking calls and from soaring flights of the courtship eagles. The eagle laid two eggs for each nest and incubation was completed between 38 and 42 days. Prey composition consists of marine fish and snakes account for 80.0% and remaining 20.0% food comprises terrestrial fauna of garden lizards, birds and small mammals. Conservation measures were suggested for protection and management of White-bellied Sea eagle population in Visakhapatnam Coast. The Video-documentation on breeding biology of Sea eagle is to be presented in the Sea Bird world Conference.”

P2-158 Valéria Moraes-Ornellas

Types of colonies occupied by the Magnificent Frigatebird in Brazil and aspects of conservation

“Several islands are home to colonies of breeding seabirds in the Brazilian coast and has been the subject of some studies. The Magnificent Frigatebird (*Fregata magnificens*) occurs in eleven of these colonies, with a limit of occurrence in the southern Moleques do Sul island (27° 51’ S, 48° 26’ W) and in the northern Sela Ginete island (3° 54’ S, 32° 25’ W). Nineteen articles focusing on the islands were reviewed, together with data obtained by the authors, between 1992-99 and 2009-2010. We develop an analysis of parameters that characterize the islands and present a discussion on the Magnificent Frigatebird population status in Brazil. The islands where their colonies occur had different origins, such as volcanism, changes in the relative level of the sea and weathering. The ground cover used by frigatebirds is predominantly shrubs, but the species also uses the tree layer in some islands. Species often associated with *F. magnificens* in the colonies are: *Sula leucogaster*, *Larus dominicanus*, *Sterna hirundinacea* and *Thalasseus sandvicensis*. Estimates indicate that a number between 16.000 and 20.000 individuals make use of 1.184 km in the southern coast. Part of their colonies are integrated into protected areas, but some of them are still very vulnerable to human disturbances. Nesting of frigatebirds is relatively restricted to a few islands in Brazil and some of their colonies have not even been properly studied. It is important to make an effort to fill this gap, better monitoring their colonies in order to produce benefits for their conservation in the country.”

Ricardo Ornellas

P2-159 Karen Bourgeois

The Yelkouan project: Towards an international collaborative program for the study and the conservation of an endangered Mediterranean endemic seabird

“The Yelkouan shearwater *Puffinus yelkouan* is a medium-sized Procellariiforme endemic to the Mediterranean Basin. Few studies have dealt with the Yelkouan shearwater despite its recent categorization as Near Threatened on the IUCN Red List. Consequently, this species remains the poorest known seabird in the Mediterranean, with little documentation of its distribution, population size and trends. We reviewed available data on range, population size and trends, and of threats to the species’ existence in order to (1) provide an exhaustive compilation of available data concerning the species, (2) identify the main gaps in this data, and (3) discuss priorities for its study and conservation. Breeding sites range from the Marseille islands (France) to Bulgarian islands in the Black Sea but many are not confirmed. The estimated global population is 12,622-57,737 pairs but most censuses are probably overestimates and the global population could be only a few thousand breeding pairs. There is evidence of a population decline and susceptibility to introduced mammals, particularly feral cats *Felis catus* and ship rats *Rattus rattus*, and to accidental bycatch in fishing gear. We highlight the lack of accurate and regular censuses of the species, and the alarming situation suggested by the little data available. We encourage collaborative work to clarify Yelkouan shearwater status, and make a plea for more data on the species’ demography and ecology, and for the evaluation of terrestrial and marine threats.”

Eric Vidal

P2-160 Michael Brooke

The potential for rat predation to cause decline of the globally threatened Henderson Petrel *Pterodroma atrata*: Evidence from the field, population modelling and stable isotopes”

“Henderson Island in Central South Pacific is one of the world’s most important breeding sites for gadfly petrels *Pterodroma* spp. Fieldwork on four species suggests that breeding success is routinely very low (< 10%) because of predation by Pacific rats *Rattus exulans* on newly-hatched petrel chicks. This is particularly significant for the Endangered Henderson petrel *P. atrata*, for which Henderson is the only confirmed breeding site. In the light of probable low annual breeding success, we draw on vital rate information for the cahow *P. cahow*, a similar sub-tropical species, to model changes in the Henderson petrel population, and find a negative growth rate ($\lambda = 0.9918$) under current conditions. Growth rate becomes positive if annual adult survival rises above 0.95 or breeding success above 0.25, the latter unlikely while rats remain on Henderson. That



conclusion of continuing decline would be weakened if there was an expectation of rat decline as petrel populations declined. However stable isotope analysis indicated that petrels constitute well under half of the rats' diet. Rat populations and rat predation on petrels may not diminish even as petrels decline further. Rat eradication is the only solution."

**Tamsin O'Connell; Norman Ratcliffe; Geoff Hilton;
Jeremy Madeiros; David Wingate**

P2-161 Chang-Yong Choi

Population viability analysis for Swinhoe's Storm Petrels on Chilbaldo Islet, Korea

"Approximately 12,000 breeding pairs of Swinhoe's Storm Petrels (*Oceanodroma monohris*) breed on Chilbaldo Islet, Korea. The population was stable for past 20 years, but rapid expansion of introduced plants severely threatens the breeding colony; introduced tall shrubs replace the available nesting areas, and *Achyranthes japonica* entangled and killed storm petrels. To identify the effects of each threat, the population viability analysis was performed by Vortex 9.98 software based on field data in 1987-1988 and in 2008-2009. In 2009, we estimated that 424 adults and 59 fledged juveniles killed by *A. japonica* and that the total area of native vegetation decreased by 0.3% annually. Because control of introduced plants may affect two different ways in harvest and carrying capacity, we tested four scenarios: 1) no management, 2) tall shrub controls, 3) *A. japonica* controls, and 4) intensive managements for both. When the intensive managements are adapted, 21,474±1,190 storm petrels may survive after 100 years later. Control of tall shrubs also may secure 14,590±1,443 birds in 2110. However, unless urgent control of direct mortality by *A. japonica* is taken, total population will be extirpated within 35.5±4.1 years (scenario 2) and 33.2±4.0 years (scenario 1). Although many variables were rough estimation due to insufficient information on life history of this species, this result indicates that control of introduced *A. japonica* is most required on Chilbaldo Island. Considering occurrence and rapid expansion of *A. japonica* in all known breeding colonies of the storm petrels in Korea, this study suggests that urgent development of action plan and its implementation to control *A. japonica* in breeding colonies are essential to long-term survival of Swinhoe's Storm Petrels in Korea."

**Kyung-Gyu Lee; Jong-Gil Park; Hyun-Young Nam;
Hee-Young Chae**

P2-162 Craig Harrison

Crying wolf? Are Black-footed Albatross really endangered?

"Birdlife International listed black-footed albatrosses (*Phoebastria nigripes*) as 'endangered' in 2003, stating that its population is declining. Birdlife may be reconsidering this classification. The Center for Biological Diversity has petitioned the Fish & Wildlife Service to list black-footed albatrosses under the federal Endangered Species Act. Conservation concerns include by-catch in longline fisheries and the ingestion of contaminants. Standard statistical techniques analyzing 19 years of publicly-available nesting data in Hawaii (1992-2010) from colonies accounting for about 80% of the world population indicate the aggregate population is probably increasing slightly and is surely stable. Black-footed albatrosses have greatly recovered from the feather hunting era a century ago. The population may be reaching an asymptote in Hawaii, raising the possibility that its population is near carrying capacity. The Japanese population is increasing. During 1961-1973 Harvey Fisher found oceanic conditions can cause temporary declines in albatross nesting effort, and such fluctuations continue today. DDE and PCB levels do not threaten albatross existence. Recent DDE egg levels (1.80 mg/kg) are 2.6 times the levels in wedge-tailed shearwaters (*Puffinus pacificus*) and 5% of the levels that caused complete reproductive failures in brown pelicans (*Pelecanus occidentalis*). If reproductive failures from eggshell thinning occur at all, they are rare. Virtually all seabirds encounter conservation challenges. Classifying any seabird as 'endangered' when its management problems do not include the threat of extinction endangers the credibility of the conservation community."

P2-163 Jeremy Madeiros

Population increase of the critically endangered Bermuda Petrel

"The Bermuda petrel *Pterodroma cahow* is one the world's rarest birds. It was thought to have gone extinct early in the 17th Century, but a small population was rediscovered in 1951. Recovery actions began in 1961 when the population numbered just 18 pairs, dispersed among five small islets. Since that time rats have extirpated the colony on one of these islets. Despite this setback, the breeding population has been increasing exponentially, doubling about every 22 years. The population now numbers around 85 breeding pairs. The birds arrive in Bermuda around mid-October. They depart on a pre-breeding exodus in late November, returning again to lay in early January. Eggs hatch in early March after a mean incubation period of 52 days, and young fledge in early June after a mean nestling period of 91 days. Between 2000-01 and 2007-08, fledgling production ranged from 29 to 40 individuals per annum. Mean annual breeding success was reasonably high relative to other Procellariiformes, but was



lowest during the 2003–04 breeding season, after all four nesting islets sustained extensive hurricane damage. The vulnerability of the current nesting sites to accelerating storm damage and erosion is now the greatest threat to the Bermuda petrel.”

Nicholas Carlile; David Priddel

P2-164 William McIver

Restoration of Ashy Storm-Petrels (*Oceanodroma homochroa*) at Santa Cruz Island, California, in 2008-10”

“Through the Montrose Settlements Restoration Program, Ashy Storm-Petrel (*Oceanodroma homochroa*) colonies on Santa Cruz Island, California, are being restored by addressing problems related to reduced colony sizes and reproductive success noted during studies in 1995-2007. Although impacted by organochlorine pollutants in 1995-97 and earlier, lower levels of pollutants were found in eggs in 2008, associated with higher reproductive success and low egg breakage at colonies in 2006-09. To assist recovery from light pollution and to develop a larger more protected colony, vocalizations were broadcast at night on Orizaba Rock in 2008-09 to attract birds to visit artificial nest sites deployed in small caverns. In 2008 and 2009, eggs were laid at 4 and 6 artificial sites, with hatching success similar to natural crevices. Use of natural crevices also increased; by 2009, overall colony size approached highest former levels in 1995-97 and likely will continue to grow as more artificial sites are occupied. Although not noted in 1995-2004, predation by native island spotted skunks (*Spilogale gracilis amphiala*) resulted in 40% and 85% reductions at Bat Cave in 2005 and Cavern Point Cove Caves in 2008; a trapping program has been developed but no skunks were noted in 2009. In 2009, signs were deployed at sea caves to protect nesting areas by reducing unauthorized human visitations. In addition to reduced pollutants and restoration actions, restoration has been conducted during a period of reduced impacts from light pollution and reduced avian predation, although skunk predation and human use of colony areas have increased.”

Laurie Harvey; Harry Carter; Luke Halpin

P2-165 Jay Penniman

Hawaiian Petrel (*Pterodroma sandwichensis*) endangered seabird management on the Island of Lānaʻi

“The presence of a significant breeding colony of Hawaiian petrel (*Pterodroma sandwichensis*, ʻĕuaʻĕu) in the upper reaches of the Lānaʻi watershed has only recently been documented. The colony is the second largest known breeding assemblage of this endangered species. Project staff has worked to delineate the colony boundaries, understand the breeding phenology of ʻĕuaʻĕu on Lānaʻi and mitigate threats to

the birds. Feral cats and barn owls predate ʻĕuaʻĕu ʻn these animals are now trapped and removed from the colony area. Fences in the colony area presented collision threats – they have been made visible with white fence ribbon. Invasive weeds have become established in the watershed threatening, not only the habitat the birds require, but the ability of the land to capture rain and fog moisture to recharge the island’s aquifer. Habitat restoration is being undertaken – clearing the habitat-altering weed, strawberry guava (*Psidium cattleianum*, waiawi), and rebuilding the native plant community. 95% of the island of Lānaʻi is owned by a private corporation which plans a wind generated electrical energy development on the island’s north quarter. We review program progress to date and present findings on colony habitat description, ʻĕuaʻĕu breeding phenology on the island of Lānaʻi, predator control results and the importance of working with island residents and Hawaiian cultural practitioners. The critical roles of agency and organizational cooperation and coordination to achieve conservation objectives on a privately owned island are highlighted.”

Fern Duvall; Samuel Aruch; Christine Costales; David Duffy

P2-166 Vikash Tatayah

The Round Island Petrel - Unravelling the species, nest site selection and breeding success

“The Round Island Petrel *Pterodroma arminjoniana* (Vulnerable) only breeds on Round Island, Mauritius. It is hybridizing with *P. neglecta* and *P. heraldica*. Chicks or adults were ringed and all recaptures recorded; the breeding status of adults, plumage phase and morphometric data were collected. Between 1970 and 2007, 2348 birds had been ringed, 95% of which since 1993. 4083 recaptures were made. In 2009 above 95% of the adults had been ringed. The population is c. 1,500-2,000 birds and growing. The polymorphic Round Island Petrel is composed of 60% darks, and the remaining is light or intermediate, and breeds assortatively. Breeding occurs all year round, ranging from c.140 pairs in October to 20 nests between May (the austral winter). 150-200 pairs breed annually and 93% re-nest within three years. About 55% of the eggs laid hatch successfully. In each of the annual cohorts, 35%-71% of ringed chicks returned and attempted breeding at least once. Inter-seasonal and inter-annual differences in hatching success have been found; austral winter eggs had greater hatching success than those laid in other seasons. The Round Island Petrel lays under overhangs, among boulder piles or in open nests or among grass. High nest site philopatry has been demonstrated. Some nest sites are successful annually and at may be used successively during a year. Others have no fledging record. Aspect is a strong determinant of nest site selection. Wing length growth curve was found to be the best predictor of age, and can be used exclusively for ageing chicks.”



P2-167 Graeme Taylor

Establishment of a new colony of Pycroft's Petrels through chick translocations and acoustic attraction

“Pycroft's petrel (*Pterodroma pycrofti*) is a small (150 g) seabird breeding on only 11 small islands off the north-eastern coast of New Zealand. As a technique development project for the critically endangered Chatham petrel (*Pterodroma axillaris*) we transferred 232 Pycroft's petrel chicks over three consecutive years (2001-03) from the large Red Mercury Island colony to Cuvier Island, 23 km distant. This site had been cleared of introduced rats and cats by 1993 and surveys had not found any Pycroft's petrels on Cuvier before the transfer. The chicks were shifted before they began emerging from their burrows, and were placed in artificial burrows (plastic and wooden chambers) under forest on Cuvier Island. They were hand-fed a diet of canned sardines blended with vegetable oil and fresh water, fed directly to the stomach by crop-tube. All but 5 of the transferred chicks fledged successfully. New techniques developed on this remote and uninhabited offshore island included the use of inverters to power electrical appliances (food blenders) using solar panel charged 12-volt batteries. An automated solar powered acoustic attraction system was installed at the site in 2001 and broadcasts petrel calls nightly. The project has been successful with 37 Pycroft's petrels lured back to the site including 22 transferred chick returns and 15 immigrants. By 2009/10, 14 breeding pairs had established in the new colony. Transferred chick returns have been male-biased whereas immigrants are mostly females. The sex ratio of the 25 chicks reared at the new colony from 2007 - 2010 has been even.”

WITHDRAWN P2-168 Anton Wolfaardt

Conservation of albatrosses and petrels in the UK South Atlantic Overseas Territories

“The United Kingdom Overseas Territories of the Falkland Islands, South Georgia and the South Sandwich Islands, the British Antarctic Territory and Tristan da Cunha have all been included in the UK ratification of the Agreement on the Conservation of Albatrosses and Petrels (ACAP). These sites host significant proportions of the global populations of many ACAP-listed species, including three species endemic as breeders to the Tristan da Cunha islands. Albatrosses and petrels of the South Atlantic face a range of threats, both on land and at sea. Chief among these is fisheries-related mortality. In most cases, this is exacerbated by a suite of other threats, the most critical of which is the impact of introduced predators. A number of initiatives have been undertaken to address these threats. Much effort has been directed towards the design, testing and implementation of a range of seabird bycatch mitigation measures, which have significantly reduced the level of seabird mortality associated with local fisheries. However, in spite of these successes, the populations of many of the albatross and petrel populations

continue to decline, likely due to the vast foraging movements of these birds which take them onto the High Seas and the jurisdictional waters of other nations. We report on what is being done to manage these threats, and highlight the importance of a collaborative approach, including international coordination, in the conservation of South Atlantic seabirds, which minimises the gap between conservation science and real-world action.”

Paul Brickley; Darren Christie; James Glass; Trevor Glass; Nick Rendell; Mark Tasker

Techniques and Tools

P2-169 Buddy Goatcher

The use of helicopters to capture free-flying seabirds

“Our ability to capture specific individual seabirds for contaminants and disease monitoring, satellite tracking, and oil spill rehabilitation has been limited to non-specific live-traps, toe-snares, rocket nets and hand capture. Our ability to capture the exact bird we want, when we want, is lacking. Hurricane Gustav triggered an oil spill in 2008 that oiled threatened brown pelicans in Breton Sound off the coast of Louisiana. We used a helicopter to put down onto the water surface for capture by net boat any bird we located in full flight, regardless of how strong the bird was flying or its altitude. We found the angles of approach, timing of changes in those angles and altitude at key moments, ambient winds of less than 10 knots and being able to read plus understand bird body language in flight to all be critical technical components to successful and safe captures. This capture technique has applications beyond the rescue of oiled birds, such as contaminants investigations, disease studies and satellite tracking equipment installation and recovery.”

P2-170 Brian Cooper

Use of radar to monitor Leach's Storm-petrel colonies

“We conducted a two-year study examining the utility of mainland marine radar techniques for obtaining indices of abundance of Leach's Storm-petrels (*Oceanodroma leucorhoa*) at five off-shore breeding colonies on islands of the Oregon Islands National Wildlife Refuge. We used a standard, X-band marine radar to conduct a total of 32 survey nights during summer in 2008 and 2009. All surveys were completed within one week of a new moon phase and were conducted from one hour after sunset to one hour before sunrise. The specific objectives of the study were to determine the feasibility of using radar as a non-intrusive (off-site) technique to: 1) derive an index of colony population sizes for



long-term monitoring; 2) compare radar population indices to breeding population estimates calculated by on-island burrow sampling and colony area estimation; and 3) determine nightly and seasonal activity patterns. We present abundance indices for five storm-petrel colonies and provide measures of variation in those counts. Nightly activity patterns consisted of a buildup in radar counts of storm-petrels one hour after sunset to a peak in activity near midnight. The nightly peak activity at the colonies lasted for several hours until flying bird numbers dropped to zero at dawn. In summary, it was determined that mainland based use of marine radar can be a powerful, non-intrusive tool for obtaining indices of off-shore storm-petrel abundance when limitations of colony distance, access, and marine and weather clutter issues are eliminated or controlled.”

Peter Sanzenbacher; Christopher Swingley; Shawn Stephensen; Roy Lowe; David Ledig

P2-171 Marco Zenatello

Breeding shearwaters of Sardinia (Italy): Testing a novel census method

“Sardinia (Italy, 24,000 km²) is the second largest island of the Mediterranean Sea. Its rim of about 100 satellite islands hosts at least 18% (possibly 61%) of the world population of Yelkouan Shearwater (*Puffinus yelkouan*) and about 5% of Scopoli’s Shearwater (*Calonectris diomedea diomedea*), with most breeding sites lying within a narrow belt along the coastline. This peculiar geographic situation suggested that land-based counts of birds moving daily to their breeding sites might allow a census of the breeding population and the identification of the main coastal feeding areas. Two coordinated counts were organised around Sardinia, at the start of incubation and in dates close to the last moon quarter (16-17/6/2006 for SS and 14-15/4/2007 for YS). Birds were counted since mid afternoon to dark at 20 stations in 2006, and 11 in 2007. Census points were located far from known breeding areas, to count as much as possible birds in active flight rather than evening rafts. 5310 SS and 7974 YS were observed, and non-random movements were found at most census points. The largest flows of individuals headed towards the main known colonies (Capo Caccia for SS, Tavolara for YS). The results give a reliable description of colony distribution and size, even though they can be markedly affected by weather conditions. Movements suggested the existence of some unknown breeding areas, which will be investigated with ad-hoc searches.”

Giovanna Spano; Nicola Baccetti; Carla Zucca; Massimo Putzu; Caterina Azara; Egidio Trainito; Mirko Ugo

P2-172 Matthew McKown

Improving automated acoustic devices for seabird monitoring

“Monitoring seabird population changes on remote breeding colonies can be prohibitively expensive, dangerous for field biologists and have negative impacts on seabirds due to disturbance or increased probability of invasive species introduction. Automated recordings of seabird vocalizations can be used to measure relative seabird abundance and chick production. However, available equipment is expensive, needs regular on-site maintenance to download data or change recording parameters and is vulnerable to data loss when units are stolen or destroyed. Here we describe: 1) components of an ideal automated acoustic seabird monitoring device (low coast, long-operating units that transmit their to servers and can be programmed remotely); and, 2) our efforts to design and field test such a device using a cell phone platform. This device could provide real-time monitoring of the world’s threatened seabird breeding colonies.”

Abe Borker; Don Croll; Bernie Tershy

P2-173 Mark Rauzon

Vocal repertoire of Tahiti Petrels in American Samoa

“Relatively few studies have been made of Procellariid vocalizations, but where comparisons are available, Tahiti Petrel (*Pseudobulweria rostrata*) calls are much more complex and idiosyncratic than any species described by Warham (1992). Tahiti petrels calls were recorded with a sound-collecting parabola, in the montane rainforest of Mount Lata, a unit of the American Samoa National Park, in December 2001 and 2002, and are presented in sonagrams created by using the Kay Elemetrics DSP Sonagraph- Model 5500. There are two basic call types: the ground call and the in-flight call. Each call starts with the ‘hiccup’ note separated by a gap (inhalation?) then the variable center portion of three harmonics, a buzzy whistle portion, and the moaning end. The in-flight call is the ground call condensed into a swift ascending whistle. The individualist ground-calls take on the quality of ‘voice’ that may be seen during dueting. This quality may be critical to finding mates in burrows in the thick montane rainforest, while the piercing flight call may be used by birds approaching the nesting area in dense fog and darkness and may have echo-location qualities. More research is needed into the basic communications of these petrels, i.e., determining the sexual dimorphism in the calls. Unfortunately, Norway rats have invaded the colony so time is of the essence if more is to be learned here.”



P2-174 Jonas Hentati Sundberg

Innovative research lab in the middle of a guillemot colony

“In order to enable detailed studies of common guillemots *Uria aalge* while limiting disturbance and achieving a high data resolution, an artificial system of breeding ledges has been built in the middle of an existing colony at the island of Stora Karlsö, Baltic Sea, Sweden. The construction is nine meters high and four meters wide, with a steel frame covered with oak boards and lime stone shelves. The interior is up 1.5 meter deep with room for equipment and researchers. The flexible construction, built autumn 2008, has space for up to 600 breeding pairs and is prepared for usage of automatic balances, video surveillance and antennas that reads PIT-tags (Passive Integrated Transponder tags). A majority of the chicks in the subcolony surrounding the artificial ledge have been ringed, weighed and sampled for DNA during recent years, in total nearly 17,000 since year 2000. Since 2002, studies have been conducted to resight these birds when prospecting for breeding sites with a special focus on the natural ledges next to the artificial one. Thus, the birds recruiting to the artificial ledge will to a large extent have known history making it possible to study or control for differences in behaviour and performance related to age, sex, experience or life-stage. This fact will increase the value of the data obtained in the studies. A range of life-history parameters are also continuously collected from the surrounding breeding colony, which will facilitate interpretation of data obtained from individuals breeding on the artificial ledge.”

Martina Kadin; Olof Olsson; Henrik Österblom

P2-175 Dominique Filippi

A handheld wireless burrowscope for seabird studies

“Burrowscope is a common and valuable tool to inspect burrows and check the nest content. We present here a wireless burrowscope specially developed for sub-antarctic conditions which can be operated by a single person. This instrument has been used with success on many sub-antarctic petrels and little blue penguin.”

Susan Waugh

P2-176 Stefanie Collar

A non-invasive technique of colony mapping for colonially nesting seabirds

“The Caspian tern (*Hydroprogne caspia*) colony on East Sand Island, Oregon, in the Columbia River estuary, is the largest in the world for this species, supporting ca.10,000 breeding pairs. As part of a study on nest site fidelity of terns on East Sand Island, we have developed a technique to create a spatially accurate map of the nests of uniquely marked

individuals (and their neighbors) using a Leica TPS1200 total station. Beginning from a known point this rangefinder can be used to measure the distance and direction to each nest. The rangefinder emits a small (2 cm/50 m) red laser beam that bounces off the target and uses the return time to calculate distance. The Leica 1200 requires no reflector and corrects for height differences between the unit and target. It also emits a visible red laser beam so that targets can be positively identified and is accurate to ± 2 mm with a non-reflective target. This distance and direction information can then be converted into GPS coordinates for each nest, and maps can be generated using standard GIS software. These data will provide detailed information on nest site fidelity, nest density, and preservation of nesting groups of Caspian terns, but the mapping technique could be used for a variety of other spatial analyses and is applicable to any easily observed colonially nesting seabird. This non-invasive technique of colony mapping – no colony entries required – is particularly suitable for species that are sensitive to disturbance and beset by aggressive nest predators.”

Dan Roby; Don Lyons

P2-177 Lorraine Chivers

Time depth recorders and GPS loggers provide detailed behavioural repertoires for breeding Black-legged Kittiwakes

“Black-legged kittiwakes *Rissa tridactyla* are generally considered good indicators within marine systems because of their sensitivity to food abundance. Nevertheless, because of their small size, it has only been possible to study their behaviours at-sea with logging devices in recent years. As a consequence of this logistical bottleneck there are comparatively few empirical studies of kittiwake behaviour away from the nesting site; knowledge that is crucial to the production of comprehensive activity budgets and the kittiwake’s development as an indicator species. To address this gap in our knowledge, activity loggers have been used to derive activity budgets for kittiwakes under the general headings of foraging, resting at sea, nest attendance and travelling but not to distinguish between different at-sea foraging behaviours. To complement these existing efforts we report on the use of time depth recorders and GPS loggers to detail kittiwake behavioural repertoires, with specific reference to at-sea foraging. Devices were attached to eight breeding kittiwakes at two sites around the island of Ireland. Here we report how this combined approach can be potentially used to: (1) distinguish ‘at-sea’ behaviours (loafing, dipping and pattering, plunge diving, pursuit diving and surface seizing) using temperature and depth traces alone; (2) differentiate periods of chick brooding from terrestrial loafing; (3) assign different foraging behaviours to exact locations; (4) yield activity budgets that are broadly compliant with defined estimates based upon more established techniques.”

Hansjoerg Kunc; Jon Houghton



P2-178 Timothée Cook

Progress in bio-logging science helps reveal fine-scale four-dimensional foraging behaviour in small flighted diving seabirds

“The technological revolution of the compass sensor, GLS, ARGOS-PTT, and GPS tags has produced exciting discoveries in the spatial monitoring of breeding seabirds, and become a key asset to conservation. However, to date, many studies have focused on large bodied species, like albatrosses, penguins, or gannets, which move over large distances and are thought to respond to rather large-scale oceanographic physical processes. Tracking of smaller species has been delayed, not only due to the size of data-loggers, but also because of their resolution and/or sampling interval. Indeed, many small seabirds have short foraging ranges and should therefore respond to small-scale oceanographic cues. Fine-scale temporal (<10s) and spatial (<10m) resolution is therefore essential when studying these species. In addition, fine-scale spatial positioning has proved difficult to obtain in divers, because animals’ surface periods when communication with satellites is possible are sometimes very short, and waterproofing loggers is decisive. We used state-of-the-art GPS and time-depth recorders for studying the fine-scale four-dimensional (space and time) foraging behaviour of an inshore small (~1000g) flighted diving seabird: the Cape Cormorant (*Phalacrocorax capensis*). By intersecting our results with precise inshore bathymetric data, we show how these birds, which feed on shoaling fish, explore and exploit the coastal zone horizontally and vertically, and how differences in dive category (benthic or pelagic) can relate to dive shape and foraging strategy. We discuss the limitations of the methods and what technological boundaries need to be abolished to progress even further in the study of fine-scale at sea foraging behaviour.”

Maike Hamann; Lorien Pichegru; Francesco Bonadonna; David Grémillet; Yan Ropert-Coudert; Peter Ryan

P2-179 Klemens Puetz

New miniaturised and solar-powered GPS-Logger

“Thanks to miniaturisation and technological innovation, biologging could be applied to increasingly smaller animals over the past decades. This has led to substantial growth in our knowledge of animal behaviour and physiological constraints in remote environments. Here, we present a newly developed, solar-powered GPS-datalogger for applications in medium-sized flying and diving animals.”

Peter Kühne

P2-180 Lucy Quinn

Combining light-based geolocation and metal contaminant analysis to identify winter foraging areas of Northern Fulmars

“Light-based geolocators are being increasingly employed to identify areas used by seabirds during the non-breeding period. However, this requires recovery in subsequent years, limiting sample sizes and meaning that only certain colonies have suitable conditions for such tagging studies. By developing a chemical signature technique that allows the identification of broad-scale foraging areas, birds need only be caught once to obtain tissue samples. Hence, considerably larger sample sizes are possible using such techniques. We used light-based geolocators to track 25 northern fulmars from a Scottish colony during the non-breeding period. A suite of 21 elements were analyzed in feathers, oil and eggshells collected from both tagged individuals and non-tagged birds from this colony. Marked individual, sexual and inter-annual differences in the extent to which birds used discrete sectors of the eastern and western North Atlantic were recorded. Comparing known locations from geocator data with contaminant loading values (in particular of Se, Pb, As, Cd, Fe, Mn, Rb and V) we were able to classify large-scale wintering areas and therefore compare with values obtained from non-tagged individuals. Wintering foraging areas are seldom included in analyses of a colony’s population dynamics. This study provides new opportunities to characterize foraging areas of specific birds and use these data as co-variables in individual-based demographic studies. We suggest that understanding individual foraging patterns may be an important and underestimated parameter when considering the impact of large-scale climate change on breeding success and population change.”

Andy Meharg; Paul Thompson



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