3rd Marine Spatial Planning Session
Thursday 11 February 2016 – Hawaii Room

CO-CHAIRS
David Pareksta (BOEM) and Joanna Smith (TNC Canada)

DESCRIPTION
Marine Spatial Planning (MSP) continues to be used to analyse existing and future human activities in the ocean and allocate space for multiple objectives – ecological, economic and socio-cultural. MSP is a public process specified through a political process, with decisions made by governments based on the best available science, expert and local knowledge, and stakeholder consultations. Globally, 10 countries have approved marine plans for waters under national jurisdiction, accounting for nearly 13 million square kilometres. By 2025, this number is likely to increase to more than 35 countries and 44.3 million square kilometres. In addition, MSP processes are underway to address planning needs at regional or local scales.

Building on the previous PSG Marine Spatial Planning Sessions in Turtle Bay, HI (2012) and Portland, OR (2013), the "3rd Marine Spatial Planning Special Paper Session" will highlight or share recent studies, techniques, tools and approaches that are contributing information about seabirds and their habitats to MSP processes and lessons learned, or that are developing spatial data layers in relation to a particular economic development. Contributed papers may focus on a particular sector (e.g., renewable energy or shipping), specific methodologies (e.g., Marxan, modeling), or innovative ideas for incorporating seabird population information into planning processes.

Updated: 4 February 2016

Time	Title & Authors
13:30	STATUS OF OFFSHORE RENEWABLE ENERGY DEVELOPMENT IN THE UNITED STATES AND NEEDS FOR COLLECTING AND ANALYZING AT-SEA AND COASTAL AVIAN DATA TO ASSESS POTENTIAL EFFECTS (Dave Pareksta) **[Co-Chair]**
13:45	GLOBAL PATTERNS OF SEABIRD BIODIVERSITY AND PRIORITIES FOR CONSERVATION (Kyle Van Houtan and Clinton Jenkins)
14:00	TAGGED, TRACKED, AND MODELED: HOW TECHNOLOGICAL ADVANCES CAN IMPROVE OUR UNDERSTANDING OF ARCTIC SEABIRD DISTRIBUTION ON MULTIPLE SPATIOTEMPORAL SCALES (Travis B. White*, Grant Gilchrist, Michael Janssen, Kyle Elliott, Graham Sorenson, Thomas Lazarus, Lenore Fahrig, & Mark Mallory)
14:15	CAN WE USE THE GLOBAL POSITIONING SYSTEM TO DETERMINE FLIGHT ALTITUDES OF SEABIRDS? A COMPARATIVE APPROACH (Rachael A. Orben*, Scott A. Shaffer, Josh Adams, & Robert M. Suryan)
14:30	USING HIGH-RESOLUTION DIGITAL VIDEO TO GATHER BROAD-SCALE BASELINE DATA ON THE DISTRIBUTION AND ABUNDANCE OF MARINE WILDLIFE (Iain J. Stenhouse*, Kathryn A. Williams, Andrew T Gilbert, Melissa Duron, Emily E. Connelly, & Wing Goodale)
14:45	MOVEMENTS AND HABITAT-USE OF BREEDING SEABIRDS IN THE KA‘IE‘IE WAHO CHANNEL SEPARATING THE ISLANDS OF KAUA‘I AND O‘AHU (Josh Adams*, Jonathan J. Felis, Bill Henry, Eric VanderWerf, Michelle Hester, & Lindsay Young)
15:00	COFFEE BREAK
15:30	ASSESSMENT OF THE AT-SEA DISTRIBUTIONS OF SEABIRDS IN THE MAIN HAWAIIAN ISLANDS TO INFORM SPATIAL PLANNING (Arliss J. Winship*, Brian P. Kinlan, Matthew Poti, Bryan M. Costa, Lisa T. Ballance, Trevor Joyce, Timothy White, Robert W. Rankin, Peter I. Miller, & Simon J. Pittman)
15:45	ASSESSING THE VULNERABILITY OF MARINE BIRDS TO WIND ENERGY INFRASTRUCTURE IN THE CALIFORNIA CURRENT (Emma Kelsey, Jonathan Felis, David Pereksta, & Josh Adams*)
16:00	DEVELOPING QUANTITATIVE MEASURES OF RISK USING SPATIAL AND TEMPORAL OVERLAP IN MARINE DATA SETS FROM NEARSHORE OREGON AND WASHINGTON – AN ECOLOGICAL EXAMPLE WITH SEABIRDS AND SALMON (Jeannette E. Zamon*, Brian Burke, Mary Hunsicker, David Teel, & Elizabeth M. Phillips)
16:15	MODELING SEABIRD DISTRIBUTIONS TO INFORM WASHINGTON'S MARINE SPATIAL PLAN (Jeffery Leirness*, Charles Menza, Timothy White, Arliss Winship, Brian Kinlan, John Pierce, Scott Pearson, Jeanette E. Zamon, Josh Adams, Karin Forney, Elizabeth Becker, David Pereksta, Liam Antrim, & Lisa Ballance)
16:30	USING BIRDLIFE MARINE IBAS TO INFORM ZONING IN SEYCHELLES (Jo Smith and Rick Tingey) **[Co-Chair]**
16:45	QUESTIONS AND DISCUSSION

ABSTRACTS

STATUS OF OFFSHORE RENEWABLE ENERGY DEVELOPMENT IN THE UNITED STATES AND NEEDS FOR COLLECTING AND ANALYZING AT-SEA AND COASTAL AVIAN DATA TO ASSESS POTENTIAL EFFECTS (Dave Pareksta) **[Co-Chair]**

At the time of the last PSG meeting on Oahu, there was one issued lease for an offshore wind energy project off the coast of the United States. Since then, additional leases have been issued on the Federal outer continental shelf, lease sales have been held in the Atlantic, and other projects are currently under development. In the Pacific, wind energy proposals include a demonstration project off Oregon, three commercial-scale projects off Hawaii, and a commercial-scale project off of Morro Bay, California. The increase in renewable energy development proposed off the coasts of the United States has led to a rush for data needs on potentially affected resources, particularly those related to avian species. The potential effects to avian species are complex and varied including collision, displacement, barrier effects, and attraction. With broad-scale assessments of suitable areas for wind, wave, and tidal energy production offshore, the challenge has been to collect and compile information quickly and at as large a scale as possible. Assessing what we know, what we can predict, and how can we assess risk has led to the development of a variety of studies including baseline data assessments, at-sea surveys, predictive modeling of seabird distribution and abundance, vulnerability and risk assessments, and technology testing for efficient ways to inventory birds on the OCS. These are being applied in both the Atlantic and Pacific, including the Main Hawaiian Islands, to provide for assessments of potential effects and data needs early in the planning process at regional and local scales with the goal of designing and implementing projects that will minimize effects to avian species to the greatest extent practicable.

GLOBAL PATTERNS OF SEABIRD BIODIVERSITY AND PRIORITIES FOR CONSERVATION (Kyle Van Houtan and Clinton Jenkins)

The oceans cover two-thirds of the planet and host more biodiversity than terrestrial ecosystems, yet the oceans are significantly less protected. Recent advances in modeling threats to marine life and in species range distribution data provide an unprecedented opportunity to design global marine conservation priorities. In this analysis, we assess the global and regional conservation priorities for seabirds within the context of nine major marine phylogenetic groups. Since marine protected areas (MPAs) are the principal means for conservation actions, we pay particular attention to their distribution and its overlap with marine life. We find that 96% of the oceans are unmanaged, with 4% set aside as general MPAs, yet with < 1% currently in no-take marine reserves (MRs) – the most effective type of MPA for conservation. As a group, seabirds are the most threatened group of marine biodiversity yet are also are among the least protected taxa. Almost 40% (82/220) of seabird species are listed as at least “vulnerable” by the IUCN, nearly twice the rate of marine mammals. However, out of nine taxonomic groups assessed, seabirds measure third worst in MPA coverage. For seabirds, the median case is that 99.5% of a species range lies outside a no-take MR. This metric is even more extreme for threatened, data deficient, and small ranged seabird species – categories specifically deserving conservation attention. We also discuss the biogeography of seabird diversity, and how global efforts based on all marine taxa may also fall short of protecting seabirds regionally and globally.

TAGGED, TRACKED, AND MODELED: HOW TECHNOLOGICAL ADVANCES CAN IMPROVE OUR UNDERSTANDING OF ARCTIC SEABIRD DISTRIBUTION ON MULTIPLE SPATIOTEMPORAL SCALES (Travis B. White*, Grant Gilchrist, Michael Janssen, Kyle Elliott, Graham Sorenson, Thomas Lazarus, Lenore Fahrig, & Mark Mallory)

Many marine spatial planning (MSP) initiatives are underway to protect wildlife resources while allowing sustainable development in the Canadian Arctic. Industrial interest in the Arctic is increasing, yet our knowledge of the spatiotemporal distribution of marine wildlife in this region is generally poor. Scientific survey data to inform credible habitat assessments are limited in number or outdated. Recent advancements in miniature telemetry technologies are providing new ways to derive data and help address this information gap. In this paper, we highlight three key areas of ongoing research. First, we present a comprehensive assessment of spatiotemporal marine habitat use by seabirds in the Canadian Arctic representing 12 species tracked between 1999-2013 allowing hotspot analyses on a foraging guild level (i.e. Pelagic Divers, Pelagic Surface-feeders, Seaducks). Second, we show an inter-colony comparison of foraging ranges of Thick-billed Murre (Uria lomvia) tracked (GPS) at four arctic colonies between 2012-2015. Lastly, we investigate space partitioning by subcolonies of Thick-billed Murre during chick-provisioning at Digges Island, Canada. Results to date have implications for MSP in the Canadian Arctic across varying spatiotemporal scales, principally, in relation to increased shipping traffic. We discuss the need for multi-year and multi-colony studies using large samples of telemetered individuals whenever conducting research on Arctic seabirds. Coupled with ever improving environmental data, movement and distribution data will collectively improve the capacity of scientists and marine planners to make informed decisions on how Arctic waters should be managed.

CAN WE USE THE GLOBAL POSITIONING SYSTEM TO DETERMINE FLIGHT ALTITUDES OF SEABIRDS? A COMPARATIVE APPROACH (Rachael A. Orben*, Scott A. Shaffer, Josh Adams, & Robert M. Suryan)

The Global Positioning System (GPS) is now widely used to track the two-dimensional movements of seabirds to understand foraging distributions and individual movements. However, to-date, little attention has been paid to the altitude data associated with the two dimensional locations. Seabirds use both the horizontal and vertical space while at-sea. Therefore a better understanding of when and where seabirds gain altitude is needed to describe fundamental aspects of foraging behavior as well as to inform marine spatial planning. A limiting factor in using altitude from GPS data is that manufacturer reported errors are roughly ± 20 m. Here we discuss the calculation and use of Dilution of Precision values (DOPs) in selecting the most accurate altitude estimates. We use altitude data from rhinoceros auklets (Cerorhinca monocerata) and western gulls (Larus occidentalis) carrying igotu GPS dataloggers, black-legged kittiwakes (Rissa tridactyla) and thick-billed murres (Uria lomvia) carrying Technosmart Gypsy-2 & 3 dataloggers and short-tailed albatrosses (Phoebastria albatrus) carrying Microwave Telemetry GPS/PTT transmitters to compare between species with different flight morphologies and behavior. Preliminary results indicate GPS derived altitudes can distinguish differences among species, over time, and flight height changes at the land-sea interface.

USING HIGH-RESOLUTION DIGITAL VIDEO TO GATHER BROAD-SCALE BASELINE DATA ON THE DISTRIBUTION AND ABUNDANCE OF MARINE WILDLIFE (Iain J. Stenhouse*, Kathryn A. Williams, Andrew T Gilbert, Melissa Duron, Emily E. Connelly, & Wing Goodale)

Marine spatial planning requires in-depth knowledge of baseline conditions at the regional scale, including information on the distribution and abundance of wildlife species and their use of marine habitats. Developed in Europe, aerial surveillance using high resolution digital video cameras has become an accepted, cost-effective method for broad-scale surveys of seabirds, marine mammals, and other taxa, and for detailed monitoring of the effects of development. An array of digital video cameras mounted on the underside of small aircraft capture extremely high resolution images (≤2 cm ground spatial distance per pixel), which are examined and reviewed onscreen by experienced biologists. Each video frame is georeferenced with GPS, and the flight heights of targets can be estimated. Compared with traditional observational aerial surveys, the advantages of this technique are many, including: safer flying at higher elevations, faster coverage, reduced disturbance, improved quality control, and auditable, archived data. This novel method also presents several challenges, however, which can be addressed through project management, technological advances, and analytical approaches. The first broad-scale use of this survey technique in North America examined the distribution and abundance of seabirds, marine mammals, and sea turtles in the offshore waters of the mid-Atlantic United States in 2012-2014, as part of a broader project to inform siting and permitting processes for offshore wind energy development. Here, we discuss the advantages and challenges of this innovative survey method, based on our experience in the mid-Atlantic, and provide recommendations on future application of this technique for marine spatial planning.

MOVEMENTS AND HABITAT-USE OF BREEDING SEABIRDS IN THE KA‘IE‘IE WAHO CHANNEL SEPARATING THE ISLANDS OF KAUA‘I AND O‘AHU (Josh Adams*, Jonathan J. Felis, Bill Henry, Eric VanderWerf, Michelle Hester, & Lindsay Young)

In 2015, the Bureau of Ocean Energy Management (BOEM) received two unsolicited lease requests to develop offshore wind energy facilities in the Ka‘ie‘ie Waho Channel separating the islands of Kaua‘i and O‘ahu. Each project proposes an offshore wind facility with a capacity of 408 megawatts (MW) of renewable energy generated by 51 floating 8 MW wind turbines. This region is frequented by a diverse seabird community that includes three Federal and Hawaiian State listed species and several important seabird colonies are located adjacent to the channel. To gather new information about the at-sea behaviors and marine habitat use, we deployed GPS loggers and satellite transmitters on six seabird species at multiple colonies on Kaua‘i and O‘ahu during 2013 – 15. We evaluate movements and area-use patterns among this assemblage of seabirds within and beyond BOEM lease blocks, proposed wind energy developments, and the near-island (< 100 km) areas surrounding Kaua‘i and O‘ahu.

ASSESSMENT OF THE AT-SEA DISTRIBUTIONS OF SEABIRDS IN THE MAIN HAWAIIAN ISLANDS TO INFORM SPATIAL PLANNING (Arliss J. Winship*, Brian P. Kinlan, Matthew Poti, Bryan M. Costa, Lisa T. Ballance, Trevor Joyce, Timothy White, Robert W. Rankin, Peter I. Miller, & Simon J. Pittman)

As part of a marine Biogeographic Assessment of the Main Hawaiian Islands (MHI) to inform spatial planning for renewable energy development, we characterized the at-sea spatial distributions of 24 species of seabirds around the MHI, including 19 breeding species and 5 non-breeding visitors. We analyzed visual sightings data from U.S. National Oceanic and Atmospheric Administration ship surveys conducted between 1989 and 2012. For 14 species with sufficient numbers of sightings we developed environmental-based spatial models of their at-sea distribution throughout the U.S. Exclusive Economic Zone surrounding the MHI. A range of geographic, bathymetric, oceanographic, atmospheric, and biological predictor variables were considered. For each model we evaluated its statistical performance, assigned it a quality class, and quantified uncertainty in its predictions. For the other 10 species we combined the at-sea sightings data with information about terrestrial site locations and foraging ranges to characterize their at-sea distribution. We will present results for example species and discuss how the information can be interpreted to help guide marine spatial planning and minimize potential conflict between human activities such as renewable energy development and seabirds. We will also discuss data gaps where future research effort could be focused.

ASSESSING THE VULNERABILITY OF MARINE BIRDS TO WIND ENERGY INFRASTRUCTURE IN THE CALIFORNIA CURRENT (Emma Kelsey, Jonathan Felis, David Pereksta, & Josh Adams*)

Offshore wind power is considered a viable renewable energy source for the United States west coast. With the development of floating, deep-water wind energy infrastructure, wind energy production in >50m waters off the coast of California, Oregon, Washington and Hawaii is now a possibility. The implementation of deep-water wind energy installations will affect marine birds, which risk collision with and displacement by offshore wind energy infrastructure. We used published data related to natural history, demography, and behavior (flight heights, flight styles, and avoidance behavior) to quantify collision and displacement vulnerabilities for 62 seabird and 17 marine water bird species. Our analysis was based on similar assessments quantifying marine bird vulnerability to offshore wind facilities in the North Sea, UK, and western Atlantic and is the first such assessment for the eastern North Pacific region. Pelicans, cormorants, gulls, terns, and jaegers have the greatest risk of collision with offshore wind energy infrastructure due to low avoidance and a greater percentage of time flying at the height of turbine blades. Alcids, terns, grebes, and loons have the greatest risk of displacement by offshore wind energy infrastructure due to relatively high sensitivity to disturbance and low habitat flexibility. To further address the range of factors that could influence a species' risk within the CCS and to provide a working example, we combine our vulnerability assessment results with recent marine bird at-sea distribution and abundance data to evaluate the risk of offshore renewable energy site locations in the northern CCS.

DEVELOPING QUANTITATIVE MEASURES OF RISK USING SPATIAL AND TEMPORAL OVERLAP IN MARINE DATA SETS FROM NEARSHORE OREGON AND WASHINGTON – AN ECOLOGICAL EXAMPLE WITH SEABIRDS AND SALMON (Jeannette E. Zamon*, Brian Burke, Mary Hunsicker, David Teel, & Elizabeth M. Phillips)

One common, practical objective of marine spatial planning analyses is to integrate multiple, spatially-explicit data sets to assess the probability that two or more potentially conflicting distributions or activities overlapping will space and time. Ideally, quantitative measures of risk from such analyses will inform management decisions so as to avoid or minimize undesirable effects of ocean energy development or fisheries activities. We present an example quantifying risk for an analysis investigating the degree to which seabird predators may pose predation risk to juvenile salmon. Although this work is motivated by a need to understand risk factors affecting early marine survival of fish, we wanted to share our approach because it focuses on seabird data and may well be useful for measuring other types of risk relevant to marine spatial planning. We applied two-stage, spatially-explicit models to measure overlap between seabirds and salmon and to assess environmental covariates (e.g. distance from shore, salinity, chlorophyll-a, distance to seabird colony) for association with spatial structure. Synoptic seabird and salmon surveys in May and June of 2003-2012 revealed that two species of seabirds (common murres Uria aalge and sooty shearwaters Puffinus griseus) accounted for ≥80% of birds counted between Newport, OR and the US-Canadian border in northern Washington. Model results provide a quantitative index of predation risk for the region of interest.

MODELING SEABIRD DISTRIBUTIONS TO INFORM WASHINGTON'S MARINE SPATIAL PLAN (Jeffery Leirness*, Charles Menza, Timothy White, Arliss Winship, Brian Kinlan, John Pierce, Scott Pearson, Jeanette E. Zamon, Josh Adams, Karin Forney, Elizabeth Becker, David Pereksta, Liam Antrim, & Lisa Ballance)

Marine birds are diverse, highly mobile species with high potential for interactions with human activities in coastal ecosystems. Habitat modeling can help to avoid and minimize adverse interactions with marine birds by facilitating spatial planning of human activities. We developed long-term seasonal distribution maps of seven seabird species off the Pacific Coast of Washington by integrating visual sightings data from ship-based and aerial surveys conducted between 2000 and 2013. An ensemble machine-learning technique was used to model counts of each species as a function of multiple spatial and temporal environmental covariates, while accounting for heterogeneous survey effort and the aggregated nature of sightings. In particular, we examined the ability of long-term climatologies of dynamic environmental variables (e.g., sea surface temperature and chlorophyll-a concentration) and static predictors (e.g., bathymetry) to explain spatial patterns of seabird densities. Quantitative methods developed by the Washington Department of Fish and Wildlife will be used to evaluate and combine species-specific estimates of relative density with a goal of identifying ecologically important areas in the state's offshore environment. This procedure provides a starting point for evaluating risk to marine bird populations in the region from human activities.

USING BIRDLIFE MARINE IBAS TO INFORM ZONING IN SEYCHELLES (Jo Smith and Rick Tingey) **[Co-Chair]**

The Republic of Seychelles is an archipelago of 115 islands within a rich tropical marine ecosystem in the Western Indian Ocean. The Exclusive Economic Zone is 1.37 million km2, with a land area of only 455 km2. The islands have high rates of species endemism and their global importance for biodiversity highlighted by two UNESCO World Heritage Sites. Seychelles contains important nesting habitat for 18 breeding seabirds and 42 other seabirds breed irregularly or are visitors or migrants. The government has committed to a 30% marine protection goal from the UN Convention of Biological Diversity Aichi target, up from 0.04% in marine protected areas. The Seychelles Marine Spatial Planning (MSP) Initiative began in 2014 to develop a draft zoning design and marine plan for the entire Exclusive Economic Zone that integrated the 30% goal with economic and other uses of the ocean. The Nature Conservancy is facilitating the process and developing a marine plan. To, date, we have gathered or created spatial data for the four main economic themes and partnered with UNDP to compile more than 100 biodiversity layers including the 2014 draft BirdLife Marine Important Bird Areas (IBAs) in Seychelles. The nine draft Marine IBAs in Seychelles (six nearshore and three pelagic) depict key foraging areas. These and other biodiversity data were used by UNDP to develop marine protected area expansion scenarios and we are using them to propose zones for high and medium biodiversity protection. In this presentation, we discuss our methodology for a zoning design and advantages and challenges of using coarse-scale spatial data such as Marine IBAs.