Abundance and Community Composition of Marine Birds in the San Juan Archipelago, WA
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Abstract

The San Juan Archipelago is ecologically important to numerous marine bird species. The Pelagic Ecosystem Function Apprenticeship has conducted Fall surveys in this area since 2006. This study took place in the San Juan Channel. It evaluates the abundance and community composition of marine bird populations in October and November of 2011. The most dominant families, Alcids and Gulls, were assessed. Species with the highest abundance were ranked over the last six years. Overall, the data does not display evidence of decline; stable abundance and community composition have been established. This is in opposition to other studies, which show general declines across marine bird populations over the last 40 years. However, long-term relationships have yet to be established in the San Juan Channel.

Introduction

The Salish Sea, located on North America's west coast, is shared by Washington state and British Columbia. The San Juan Archipelago (SJA) lies within the Salish Sea and is an important ecosystem for local flora and fauna. These islands provide habitat to a wide variety of marine birds throughout the year. It is a known nesting and migratory site for these birds (Bower, 2009). It is an especially important wintering site due to the protection it provides against adverse weather and winter storms, as well as an abundance of prey for marine birds.

Marine birds are abundant and diverse and act as indicators of ecosystem change (Gaydos, 2011). They are important indicators of environmental health and have been widely used as such (Bower, 2009). They are susceptible to contamination and are vulnerable to disease and emerging pathogens; therefore, monitoring density fluctuations of marine birds can be used as an indicator of changing health (Gaydos, 2011). Many studies conclude that marine bird populations are rapidly declining to dangerous levels in the Salish Sea. For example, declines of 47 percent since the 1970s have been established in this area (Gaydos, 2005). The effects of climate change, as well as habitat exploitation, contaminants, and human interaction are possible causes of decline (Bower, 2009). Though trends have been established, there are relatively few studies in the Salish Sea when compared worldwide (Bower 2009).

Though long-term surveys of marine bird populations have been conducted in the past, they have largely been observed during the summer or winter seasons. The fall transitional season has not specifically been looked at, except by the Pelagic Ecosystem Function (PEF) Apprenticeship at the Friday Harbor Laboratories. To assess this, the PEF

Apprenticeship began conducting surveys in 2006, characterizing marine bird abundance and community composition in the SJA within the Fall season. Building the data set from 2006 to 2011 will begin to help understand long-term trends.

In this study, I assessed marine bird populations in the San Juan Channel during the Fall of 2011. I evaluated abundance and community composition, and described predominant species. Further, I assessed density variation and seasonal change during the Fall of 2011. I compared this data to trends from previous PEF surveys from 2006 to 2010 to determine the status of the marine bird community in the San Juan Channel.

Methods

Pelagic Ecosystem Function Apprentices from the Friday Harbor Laboratories surveyed marine birds in the San Juan Archipelago, WA, in the Fall of 2011. The San Juan Channel is used as a proxy in this study, representing the San Juan Archipelago.

Study Site

The survey site commenced at a location parallel to Yellow Island (48 35.00; N, 123^{o} 02.50' W) and proceeded south to an end point located just beyond Cattle Pass at the mouth of the Juan de Fuca Strait (48° 25.20' N, 122° 56.60' W) (Figure 1). A northern transect was performed along the same route, following the southern transect. We surveyed marine birds on six days from 7 October through 15 November, 2011. Each transect was 21.5 km in length and 0.3 km wide, creating a total area of 6.45km^2. Together, the transects are 12.9km^2. In the fall of 2011 we surveyed a total of 77.4km^2.

Sampling Method

I conducted surveys using a strip transect method on the bow of the *R/V Centennial*. Birds were observed and recorded in a 150-meter corridor off port and starboard sides, measuring 300 total meters, as the boat progressed on its route through the channel (Figure 2). Using binoculars, three or more observers identified birds down to the species level when possible; otherwise, they were identified at the family level. The vessel traveled at a constant speed at a mean of 8 knots (Stombaugh 2009).

Analyses

I determined the mean density for all marine bird species in 2011, as well as the total seabird density for 2010. In addition, I ranked the ten most abundant species for 2010 and 2011, and compared it to those from 2006 – 2009 (Stombaugh 2009). One modification I made to the data was to distribute unidentified cormorants as either Brandt's or Pelagic, depending on species percentages each year, in 2010 and 2011. This was in line with Stombaugh (2009) (W. B. Tyler Pers. Comm. 2011).

Results

Abundance, Community Composition, and within-season variation: Fall 2011

During the 2011 Fall season, 9,386 marine birds were observed in San Juan Channel on transect, with a mean density of 121 birds per km^2. These birds consisted of twenty-five species that fell into eight families. Of the eight families, six had significant densities that contributed to the overall abundance. The Alcid and Gull families were the two predominant families. Together they account for 80% of observed birds (Figure 3). The largest family, Alcidae, comprised 46% of total birds, and had a mean density of 56

birds/km^2. The Gull (Laridae) family had an abundance of 42 birds/km^2 and comprised 34% of the total birds. Less abundant were the Cormorant (Phalacrocoracidae) (9%), Loon (Gaviidae) (7%), Duck (Anatidae) (3%) and Grebe (Podicepedidae) (1%) families. The total mean abundance of marine birds varied weekly in this Fall study and resulted in a net gain of 53 birds/km^2 over the course of this study period. Density ranged from a low of 85/km^2 to a high of 170/km^2 (Figure 4).

The alcid family showed a net gain of 57 birds/km^2 over the study period with a low abundance of 41 alcids/km^2 on 24 October and a high of 108/km^2 on 15 November (Figure 5). The Alcids were broken down by species abundance. Common Murre had an abundance of 30.5/km^2, which is more than triple the density of any other alcid (Figure 6). This species increased steadily into the study and experienced a net gain of 21 birds/km^2 over the study (Figure 7). The Rhinoceros Auklet (7.9/km^2), Ancient Murrelet (8.7/km^2), and Marbled Murrelet (6.0/km^2) all had mid-level densities. The Rhinoceros Auklet displayed decline over the study and had a net decrease of 9 birds/km^2. The Ancient Murrelet appeared on 24 October had a net gain of 42 birds/km^2 by 15 November as it flooded the area. Marbled Murrelet numbers ranged from 5 to 8 birds/km^2 but only experienced a net gain of 1 bird/km^2 over the study. The least abundant alcid, the Pigeon Guillemot showed low numbers throughout the study with a density below one bird/km^2.

The Gull family demonstrated seasonal variation on the family level, as well as at the species level. Gulls showed a net loss of 12 birds/km^2 over the study from 47 gulls/km^2 on 7 October to 35 gulls/km^2 on 15 November, with a range between 19 gulls/km^2 on 7 November and a high of 60 gulls/km^2 on 24 October (Figure 5). The gulls

were broken down by species according to abundance. The most abundant gulls, the Glaucous-winged and Bonaparte's Gulls, had a density of 14.4/km^2 (Figure 8). The Glaucous-winged Gull experienced a modest net gain of 3 birds/km^2 (Figure 9). The density ranged from 10 to 18 birds/km^2 over the six survey dates. Bonaparte's Gulls showed dramatic fluctuation in abundance over the season. They had a net decrease of 3 birds/km^2, with a low of 3 birds/km^2 on 7 November and a high of 39 birds/km^2 on 24 October. Less abundant were the Mew and Heermann's Gulls. The Mew Gull showed variation throughout October and November with densities ranging from 1 to 15 birds/km^2. This gull had a density of 7 birds/km^2 at the beginning and end of the study. The Heermann's Gull showed steady decrease over the study; starting with a density of 11 birds/km^2 they left the area before 7 November. Least abundant were the California (0.5/km^2) and Thayer's Gulls (0.2/km^2).

Patterns among the other four families varied within the study as well but on a smaller scale. The Cormorant family showed a net gain of 15 birds/km^2 over the study. The duck family ranged from 1 to 5 birds/km^2 over the study and had a net loss of 2 birds/km^2. The grebe family showed the lowest numbers, remaining at or below 1 bird/km^2 over the October and November months. The loon family showed a small net gain of 2 birds/km^2, while ranging between from 6 and 17 birds/km^2.

The ten most abundant species during Fall 2011 included: four alcids, four gulls, one loon, and one cormorant (Table 1). Duck and grebe species had densities too low to be one of the ten most abundant species. Common Murre was the most abundant species overall, with a density twice that of other birds. Glaucous-winged and Mew Gulls were

the second and third most abundant species, and had densities over 10 birds/km^2. The other seven species had abundances that varied between 4 and 9 birds/km^2 roughly.

Interannual Variation

Marine bird total densities varied yearly with a slight net gain between 2006 and 2011 (Figure 10). A density of 121 birds/km^2 occurred in 2011. The abundance of marine birds varied from 42 to 79 birds/km^2 between 2006 and 2009. During the last six years, the highest density, 178 birds/km2, occurred in 2010.

From 2006 to 2011, the top ten most abundant marine birds has been comprised of 12 species (Table 2). Yearly, the two most abundant species were Common Murre and Glaucous-winged Gull from 2006 to 2011; the exception was 2010, when they were still the three most abundant species. During every year, six species repeated among the ten most abundant species. These six species included: Common Murre, Ancient Murrelet, Glaucous-winged Gull, Mew Gull, Heermann's Gull, and Pacific Loon. Three other species appeared five out of the six years; they were: Bonaparte's Gull, Brandt's Cormorant, and Surf Scoter. Two more species appeared four out of the six years: Rhinoceros Auklet and Marbled Murrelet.

Discussion

Abundance, Community Composition, and within-season variation: Fall 2011

Overall, the abundance of marine birds stayed generally stable over the study with a slight net gain from 117 to 170 birds/km^2. This could be due to birds migrating into the area to over-winter in the SJA or due to birds passing through the area to a more

northward migration destination. Overall, more birds migrated into the area than out. Variation among the cruise dates could have been a result of seasonal migration patterns of birds entering and leaving the area, or short-term variation in prey availability or environmental conditions, in which birds may have been feeding outside of San Juan Channel.

Seasonal patterns can be understood when looking at family level trends, specifically when considering patterns displayed by the alcid family. Alcid average density remained constant from 7 October through 7 November with a drastic increase on the last survey date, 15 November. My findings could be attributed to the combined affects of alcid migration patterns. Patterns of bird families are best explained by looking at species level trends. The Common Murre, the largest alcid in the area, increased in abundance over the study period as they migrated into the SJA. This is typical Common Murre's Fall pattern as their numbers increase in the SJA during the Fall and winter months. Over the study there was a net increase of 21 birds/km^2. Similarly, the Ancient Murrelet migrated into the area, but arrived later in the season, at the end of October. By 15 November, Ancient Murrelet populations had increased to 42 birds/km^2 with no clear peak in abundance at that time. The Rhinoceros Auklet followed an opposite pattern and decreased over the season. This smaller alcid does not over-winter in the SJA and leaves the area as the Fall season approaches. Rhinoceros Auklets declined 9 birds/km^2 over the study. These alcids demonstrate patterns of seasonal migration.

Gulls also demonstrate seasonal migration trends. At the start of the study, the gull family had a density 47 birds/km^2 and hit a peak mid-study of 60 birds/km^2; they decreased by the end of the study to 35 birds/km^2. This is most likely due to species level

fluctuations of the gull population. Throughout the study, the resident Glaucous-winged gull displayed steady numbers with a slight elevation in November; this is possibly due to coastal gulls flying inward to protected waters to avoid winter storms. My findings of Bonaparte's Gull mid-study peak might be attributed to passing through the area in Fall but not overwintering in the SJA; leading to high numbers that drop as the fall season progresses. During the study period their density started at 11 birds/km^2, increased to 39 birds/km^2 mid-study, to return to lower densities once more. The Heermann's gull's abundance decreased over the study period as the gulls traveled south to Mexico to over-winter, this is demonstrated by their numbers which dropped to zero birds/km^2 at the end of October. The Mew gull, which is a winter visitor in this area, showed variation in density between survey dates. This may be due to flocks of birds migrating as prey migrates in and out of San Juan Channel. When combining these different patterns, in the Fall of 2011, we saw a mid-study peak, followed by a decrease in gull abundance.

Loons followed a similar pattern to gulls over the study, but on a smaller scale. They began on 7 October at 6 birds/km^2, had a mid-study peak, and decreased to 8 birds/km^2 on 15 November. These findings contradict the expected pattern. Loons migrate into the area over the season, an increase in loon abundances is expected. My findings of decreasing duck abundances in mid-November contradict the expected trend. Duck numbers typically rise as the season progresses and ducks migrate into the area for the winter months. The grebe numbers were too low to see any obvious pattern and would take lots of observation over many weeks, possibly on waters closer to shore, to see any obvious patterns as Fall progresses.

Interannual Variation

The absence of decline in marine bird abundance over the last six years opposes the expected trend found in other studies. It is possible that declines since the 1970s have shifted base levels of marine bird populations in the SJA. Decadal oscillations are another explanation of increasing populations. Increasing this study length is the best way to clearly understand the long-term direction of marine bird populations and determine patterns in the future. Exceptionally large numbers seen in 2010 might be comparable to densities in future years.

Community structure is strengthened by the tendency for species to appear yearly as a most abundant species between 2006 and 2011. Only twelve species have ever been one of the ten most abundance species over the last six years. Eleven out of the twelve species appear most years. Differences in species density may vary yearly, but their stable position in species structure indicates that community composition is extremely stable. The Rhinoceros Auklet appears four out of the six years from 2006 to 2011. The species is one of the four most abundant species, two years and one of the ten most abundant species two other years. The Rhinoceros Auklet was not one of the ten most abundant species two more years. The Fall transition in which indicators such as the upwelling index, change, signaling the transition from summer into the Fall season. This transition was early in 2007 and 2009. These were the two years Rhinoceros Auklet was not one of the ten most abundant species. These findings are consistent with Alcid migration patterns, which leave the area as Fall progresses; the earlier the Fall transition takes place, the earlier the species begins to leave. This results in lower abundances compared to years with later Fall transitions.

Conclusions

In conclusion, the Pelagic Ecosystem Function data does not show evidence of decline in marine bird populations from 2006 to 2011. The abundance over the last six years has increased or at the very least, remained stable. The community structure as well is very stable. The data is contrary to other studies. It is possible that decline happened prior to the study, but there is no evidence that this is currently the case. This is encouraging, but more years of PEF data collection are needed to see and understand long-term trends, which is true of all top predators.

Future Direction

We cannot be sure what causes yearly density variation; we can be certain it is important to continue data collection to see future marine bird population trends in the SJA. Future PEF apprentices should also observe more sheltered waters in the SJA via small crafts, in addition to continuing the original study site in the San Juan Channel. This will help to identify duck, grebe and possibly loon trends within the Fall season. This will help make composition of family populations that typically appear in lower numbers more obvious. A long-term data set will also help show variation in marine bird populations as a long-term pattern or rather a result of decadal oscillations.

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References

Bower, J. 2009. Changes in Marine Bird Abundance in the Salish Sea: 1975 to 2007. Marine Ornithology 37: 9-17.

Gaydos, J. K. 2005. 2005 Puget Sound Seabird and Seaduck Research meeting: Summary Meeting Notes.

Gaydos, J. K., Pearson, S. F. 2011. Birds and Mammals that depend on the Salish Sea: A Compilation. Society for Northwestern Vertebrate Biology. Northwestern Naturalist, 92(2):79-94.

Stombaugh, R. 2009. Marine Bird and Mammal Composition in the San Juan Channel (WA) during Fall 2009. Pelagic Ecosystem Function in the San Juan Archipelago Research Apprenticeship. Friday Harbor Laboratories, University of Washington.