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Honors Thesis
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The effects of human approach on sanderling foraging behavior

Abstract

During low tide, sanderlings (*Calidris alba*) forage on small invertebrates in the sand of the intertidal zone. As a result, these common shorebirds frequently come into contact with humans who visit the beaches for a variety of activities, such as fishing or jogging. Here, the effects of three different approach types (undisturbed, passive, and aggressive) on sanderling foraging behavior were examined to help understand how human activities may be affecting their ability to search for food. At two local beaches, locomotory rate was recorded in addition to obvious changes in initial behavior. Treatments were defined as follows: 1) Undisturbed – sanderlings observed from a distance that does not influence their behavior 2) Passive - a human approached by walking at a steady walking pace from a predetermined distance 3) Aggressive - a more assertive approach at a noticeably faster speed from a closer distance. In general, sanderlings exposed to an aggressive approach moved at the highest rate, while the rates of birds approached passively or not at all did not differ significantly from each other. This was true for birds found at both locations. These results show a correlation between intensity of human approach and sanderling response, potentially impeding their ability to forage. The similarities between sites suggest that sanderling populations move frequently between local beaches and are therefore likely to show similar responses to the presence of humans regardless of beach location.

Introduction

Sanderlings, *Calidris alba*, are extremely common shorebirds found on almost all sandy beaches throughout the temperate and tropical regions. Sanderlings are foragers who feed on aquatic invertebrates in the damp sand of the intertidal zone. They are typically seen running back and forth with the waves, probing the sand with their bills. The prevalence of the species means they often come into contact with humans, who also frequent these areas. Just as in any other interspecies interaction involving humans, this contact between sanderlings and beachgoers has the potential to affect the behavior of the small wading birds who depend on the swash zone to provide the food they need to survive.

Previous studies have been conducted exploring the effects of human activity on other sanderling foraging behaviors. Burger and Gochfield (1991) studied the temporal differences in sanderling foraging behavior as they compared to the presence of humans at Delray Beach, Florida. The study found that as the beach became more crowded, the sanderlings attempted to feed in areas with less people. An increase in people led to more time spent running or flying. At night, when less humans were present, both flock size and active feeding time increased. These results supported the hypothesis that an increased presence of humans leads to a decrease in sanderling foraging behavior. The study also suggested that sanderlings may use nocturnal foraging in response to this relationship as an attempt to avoid disturbance.

Roberts and Evans (1993) also studied the impact of human disturbance on sanderling foraging behavior in Coatham Sands, England, focusing primarily on the response of flight. It was hypothesized that sanderlings adjust their behavior according to the costs and benefits of certain actions--they do not necessarily take flight as soon as they see a potential threat. In the study, an individual approached a flock of sanderlings at a constant pace, observing the dominant behavior of sanderlings in 5 10-meter zones in front of the approacher. The results showed that

the average approach distance for a sanderling in this location was 12 meters. Probability of flight decreased with increased distance from the approacher. The most significant finding was that sanderlings changed their behaviors in such a way as to maximize foraging time, minimizing flights and distance flown without allowing close approaches. To do this, birds nearest to the approacher were found to fly in behind the approacher, while those farther away most commonly flew farther ahead along the beach.

Finally, a recent study by Trulio and White (2017) investigated the response of waterfowl wintering near San Francisco, California to introduced trail use at foraging sites. Researchers found that birds at existing trail sites, who were regularly exposed to (non-threatening) human disturbance habituated to the stimuli and exhibited less avoidance behaviors than those at non-trail sites, who were not used to being disturbed. This behavioral difference was interpreted as the birds' adaptation to avoid wasting energy.

This study continues the investigation of sanderlings' behavioral responses to humans, focusing on locomotory rate along the beach as well as observable changes in behavior (active foraging vs. avoidance). The purpose was to better understand the impact of human presence and level of disturbance on the foraging behavior of sanderlings. An experiment was carried out which measured individual sanderlings' responses to a casual walking approach and a second, more assertive approach. These results were then compared to undisturbed trials, which measured the locomotory rates of sanderlings who were not being approached.

Methods

The study was conducted on two sandy beaches near Myrtle Beach, South Carolina, USA. Each beach represented a different level of human activity. Waties Island is a private, undeveloped barrier island located just north of North Myrtle Beach, SC. Human activity tends to be low and is limited to a few researchers each day. The beaches at HBSP receive far more

visitors than Waities, approximately 300,000 (L. Kowalski, HBSP Admin., personal communication). This made the site a good model for a high level of human activity.

The study was carried out in Spring (February-April) and Fall (September-November) of 2018. Surveys were performed every 1-2 weeks during these periods, generally in the mornings. Time, weather conditions, and tidal cycle were recorded for each survey. At the onset each field excursion, flocks of sanderlings were located using 10x x 42 binoculars. The number of birds in the flock was recorded prior to the test and individuals were assigned numbers. The presence of other species (other birds, dogs, humans) was also noted.

An experiment consisting of three treatments of varying levels of interaction intensity (“Undisturbed,” “Passive,” and “Aggressive”) was used to assess behavioral responses in each flock. After an individual bird from the flock was randomly selected, it was observed from a determined safe distance (at least 25 paces, or 19 m) for a period of 60 seconds. The distance traveled as the sanderling foraged along the beach during this time period was used to calculate locomotory rate. For the purposes of this study, the term locomotory rate refers to the speed of the bird along the beach measured in human paces per minute. The behavior of the bird and any changes were also noted throughout the sampling period. This first test was a control representing normal sanderling behavior without the effects of human approach (Undisturbed).

The next two treatments introduced increasing degrees of human approach intensity as an independent variable. These results were compared to those of the Undisturbed treatment in order to note changes in rate and foraging behavior due to approach and/or approach method. In the Passive treatment, the sanderling was approached at steady walking pace (approximately 0.8 m/s) from a distance of approximately 10 paces (7.6 m) away. Locomotory rate and behavior were noted using the previous method for a duration of 60 seconds or until the bird flew away. If

flight occurred, the elapsed time to this behavior was recorded. In the Aggressive treatment, the sanderling was approached at a faster pace (approximately 1.4 m/s) from a shorter distance (approximately 5 paces, or 3.8 m away). Behavior was observed once again and locomotory rate determined for a 60-second period or until the bird flew away. These methods were repeated for different sanderlings within the same flock and in different flocks, if any were present.

Results

At Waties, average locomotory rate of sanderlings increased with approach intensity by humans (Figure 1). Average foraging rate for a undisturbed sanderling was 31.1 ± 6.37 paces/min. Foraging rate increased to 49.0 ± 5.97 paces/min when the sanderling was exposed to the Passive human approach. Under the Aggressive treatment, foraging rate increased dramatically to 81.4 ± 6.04 paces/min.

One-way ANOVA showed there was significant difference both between the groups of treatments and within the groups at Waties Island (One-way ANOVA: $df = 2, 36$ $F = 16.027$, $p < 0.001$). The rate under the Aggressive approach treatment was significantly different from both the rates under the Passive approach and Undisturbed treatments. Sanderlings exposed to the Aggressive approach moved the most rapidly. The Passive rate was significantly slower than the Aggressive rate, but not significantly faster than the Undisturbed rate.

Huntington Beach State Park showed the same general trend of increasing locomotory rate with degree of human interaction (Figure 2). Undisturbed sanderlings foraged at a rate of 37.1 ± 4.81 paces/min. When approached passively, sanderlings traveled at a faster rate of approximately 48.0 ± 12.4 paces/min. Finally, sanderlings under the aggressive treatment moved at a rate of 104.6 ± 17.7 paces/min.

One-way ANOVA showed there was significant difference both between the groups of treatments and within the groups at HBSP (One-way ANOVA: $df = 2, 19$ $F = 10.131$, $p = 0.001$).

Like at Waties, the rate under the Aggressive approach treatment was significantly different from both the rates under the Passive approach and Undisturbed treatments. Sanderlings exposed to the Aggressive approach moved the most rapidly. The Passive rate was significantly slower than the Aggressive rate, but not significantly faster than the Undisturbed rate.

Foraging rates observed under the different treatments were then compared between the two locations (Figure 3). Undisturbed sanderlings in Waties Island foraged at a slower rate than undisturbed sanderlings at Huntington Beach State Park. Sanderlings exposed to a walking, passive approach had similar foraging rates at both locations (49.0 paces/min Waties, 48.0 paces/min HBSP), but increased their previous rates by different amounts. Birds from Waties increased their rate from undisturbed levels by 17.9 paces/min, and those from HBSP showed an increase of only 10.9 paces/min. Sanderlings exposed to a more targeted, aggressive approach at HBSP moved at a faster rate than those at Waties. The HBSP rate was 66.9 paces/min faster than the undisturbed average, and the Waties rate was 50.3 paces/min faster than the undisturbed average. The differences between sites, however, were insignificant (two-tailed t-test).

Finally, flock sizes were compared between sites in order to gain a greater understanding of the populations at each of the study sites (Figure 4). The average flock size at Waties was 10.4 ± 4.8 birds. This was larger than the average flock size at HBSP, which was 7.0 ± 2.0 birds. This difference was not statistically significant, however (t-test: $t = -0.727$, $df = 9$, $p > 0.05$).

Discussion/Conclusions

Overall, sanderling locomotory rate increases with increased levels of human activity, including intensity of approach.. Undisturbed birds moved the slowest, while birds exposed to the Aggressive approach treatment had the highest rates. This behavior makes sense, as the birds

would move more rapidly in response to an approach that seemed more threatening. With no humans present, they would be free to forage at their own pace without disturbance.

Undisturbed sanderlings foraged at a slower rate at Waties Island than those at HBSP. Rates were similar for the Passive approach. The birds found at HBSP increased their rates more drastically when approached using the Aggressive method than those at Waties. These differences across sites were slight and insignificant, however. There was not sufficient evidence to show that sanderlings in areas with higher levels of human activity respond less to approaches (are desensitized) than sanderlings in less active areas. Rather, the similarities in flock size and in response to approach type between Waties and HBSP could suggest that sanderlings move between local beaches instead of staying in one location.

In conclusion, the responses of sanderlings to human approach could potentially affect their ability to find food through foraging as they increase their avoidance behavior. As sanderlings are common on most sandy beaches, it is not realistic to expect to reduce their regular contact with humans. The results of this study, however, could be used to educate members of the public that their method of approaching sanderlings does have an impact on the sanderlings' responses. Instead of pursuing sanderlings, visitors to beaches should give them space and allow them to forage relatively undisturbed. This should help to minimize the potentially negative impacts of human presence and activity in the sanderlings' natural habitat.

Figures

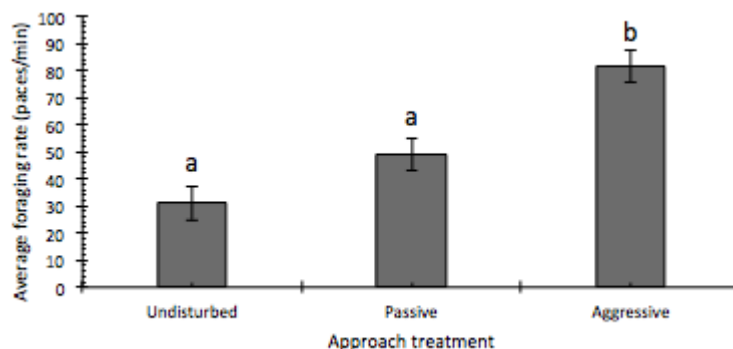


Figure 1. Average foraging rate of *Calidris alba* in response to different human approaches at Waties Island, South Carolina. Error bars represent ± 1 S.E. There was a significant difference between the rates under the different treatments (One-way ANOVA: $df = 2,36$ $F = 16.027$, $p < 0.001$). Letters above the bars indicate significant differences among treatments (post-hoc Tukey Test, $p < 0.05$).

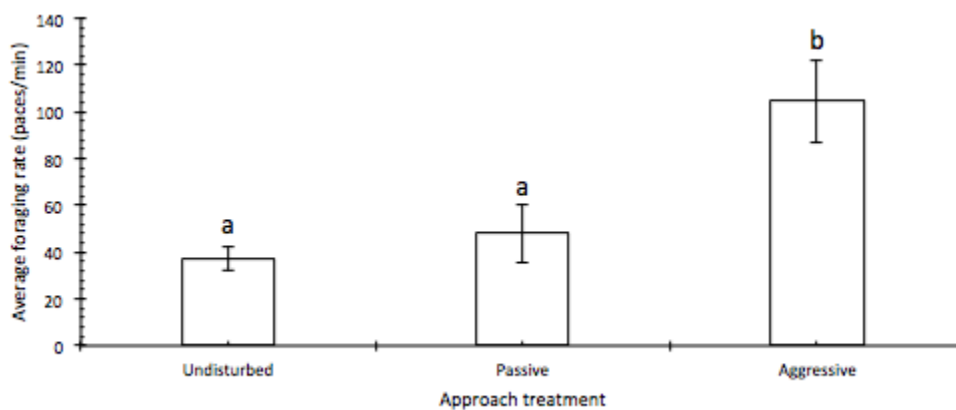


Figure 2. Average foraging rate of *Calidris alba* in response to different human approaches at Huntington Beach State Park, South Carolina. Error bars represent ± 1 S.E. There was a significant difference between the rates under the different treatments (One-way ANOVA: $df = 2,19$ $F = 10.131$, $p = 0.001$). Letters above the bars indicate significant differences among treatments (post-hoc Tukey Test, $p < 0.05$).

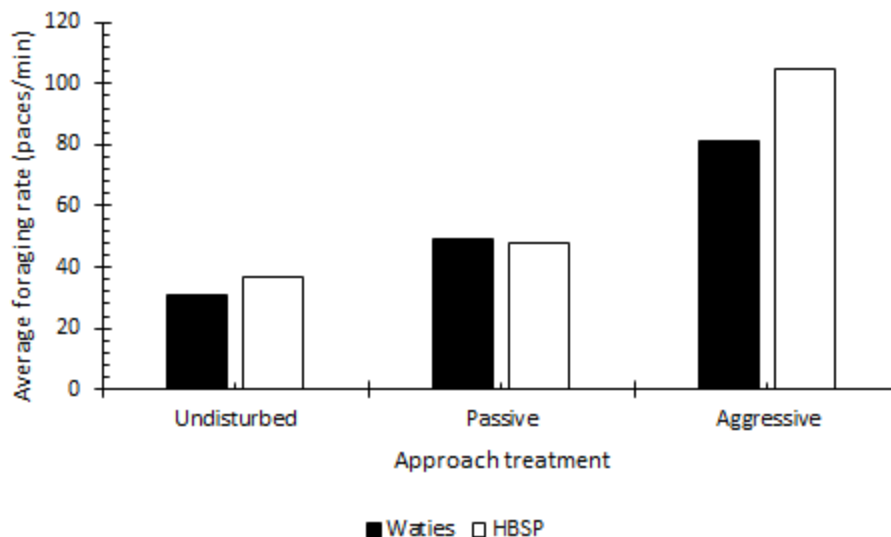


Figure 3. Comparison of foraging rates observed in Waties Island and in Huntington Beach State Park, SC for sanderlings exposed to different levels of human approach. Birds at HBSP moved at a faster rate under both Undisturbed and Aggressive treatments. There was no significant difference between sites (Two-tailed t-test, Und: $df = 26$, $t = 0.677$, $p\text{-value} = 0.50$; Passive: $df = 16$, $t = -0.09$, $p\text{-value} = 0.93$; Aggressive: $df = 13$, $t = 1.63$, $p\text{-value} = 0.13$).

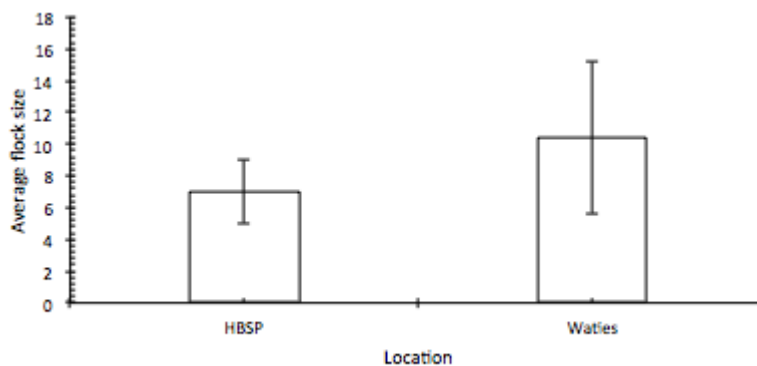


Figure 4. Average flock size of sanderlings at Huntington Beach State Park and Waties Island. Error bars represent ± 1 S.E. The average flock size at Waties was larger than at HBSP, but this was not statistically significant (t-test: $t = -0.727$, $df = 9$, $p > 0.05$).

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