HIGH SCHOOL EDITION
Journal of Student Research
Volume 12 Issue 1 (2023)

iNaturalist as a Tool to Study the Impact of Time of Day on Shorebird Observations

Siddharth Chidambaram[1] and Sree Ganesan[2#]

[1]Los Altos High School, USA
[2]Habana Labs, USA
[#]Advisor

ABSTRACT

As citizen science platforms, such as iNaturalist, become more popular and more data becomes available, they can be a useful tool for research purposes. In this paper we study the effects of the time of day on the amount of shorebird observations made by citizen scientists. "Research grade" data from *iNaturalist* was used, and the data was collected from the Don Edwards National Wildlife Refuge in Palo Alto, California, United States. We focused on the following shorebird species, namely American Avocet, Black-Necked Stilt, Greater and Lesser Yellowlegs, Sandpipers, Killdeer, and American Coot. We analyze the data collected at this refuge from the year 2000 and present our findings. Shorebird observations are made mostly during the day, and fairly uniform across days of the month, with more observations made during winter months and fewer made during the summer. In addition, the majority of observations were made during 2020 and 2021, coinciding with the COVID pandemic. We observed that citizen scientists were more likely to record observations of larger, more conspicuous shorebirds.

Introduction

This paper studies the impact of different time factors on the shorebird observation count using citizen science data from iNaturalist (n.d.). A common piece of advice for the best time of day to go birdwatching is around dawn or dusk. We were interested in studying the impact of the time of day on how many shorebirds are present at a given coastal location such as the Don Edwards National Wildlife Refuge (n.d). The Don Edwards refuge is a well-known and highly acclaimed site for birdwatching and is a wetland that is home to many species of shorebirds.

Data is not easy to obtain, and the collection is often a separate project completely. Large quantities of data must be collected in order to avoid outliers affecting averages. Additionally, some data may be collected be foreign, meaning that a trip must be organized. Transportation and accommodation could end up costing quite a bit and organization and planning potentially takes up time. This causes analysis and discoveries to take a long time, as first the data must be obtained before it can be dissected. Citizen science data is readily available and would require less time and money to organize. Local populations participate in the collection of data, rather than requiring scientists to go out and collect the data. As a result, more data can be collected quickly. This could greatly increase the speed of data collection. Cohn (2008) says "Collaborations between scientists and volunteers have the potential to broaden the scope of research and enhance the ability to collect scientific data." We decided to use citizen science data for the reasons listed above. For this study we selected iNaturalist (Boone et al, 2019).

The Research Question

Below are some questions that we sought to answer using the data we downloaded. Are more shorebirds recorded during dawn and dusk? What is the impact of time of day on the number of shorebirds observations? Are there seasonal variations and changes over the years?

Method

We downloaded data from the Don Edwards National Wildlife Refuge from the citizen science website iNaturalist. We used latlong.net to determine the latitude and longitude bounding box around the refuge in order to get data from that specific region. In addition, we selected only research grade data for birds (the class Aves). We used the following query:

quality_grade=research&identifications=most_agree&iconic_taxa[]=Aves&swlat=37.4176699326008&swlng=-122.246818711812&nelat=37.66087095987243&nelng=-121.9280700267499

The following fields were selected for download:
"id
observed_on_string
observed_on
time_observed_at
quality_grade
license
image_url
sound_url
tag_list
description
captive_cultivated
latitude
longitude
species_guess
scientific_name
common_name
iconic_taxon_name
taxon_id"

We processed the data further as follows:

(1) We filtered out all the data points where any of the columns were blank.
(2) We filtered the species down to a specific set of birds that we determined to be commonly visible shorebirds. These were decided by our experience in traveling to the refuge. Specifically we focused on the Black-Necked Stilt, Spotted Sandpiper, American Coot, American Avocet, Western Sandpiper, Semipalmated Sandpiper, Killdeer, Greater Yellowlegs, Least Sandpiper, Lesser Yellowlegs, Pectoral Sandpiper, Curlew Sandpiper, Baird's Sandpiper, Stilt Sandpiper and the Calidris Sandpiper.
(3) Since this was a study for the effect of time, we separated all the date and time data into year, month, date, and hour.

Results and Discussion

In this section we discuss the results and our analysis of the same.

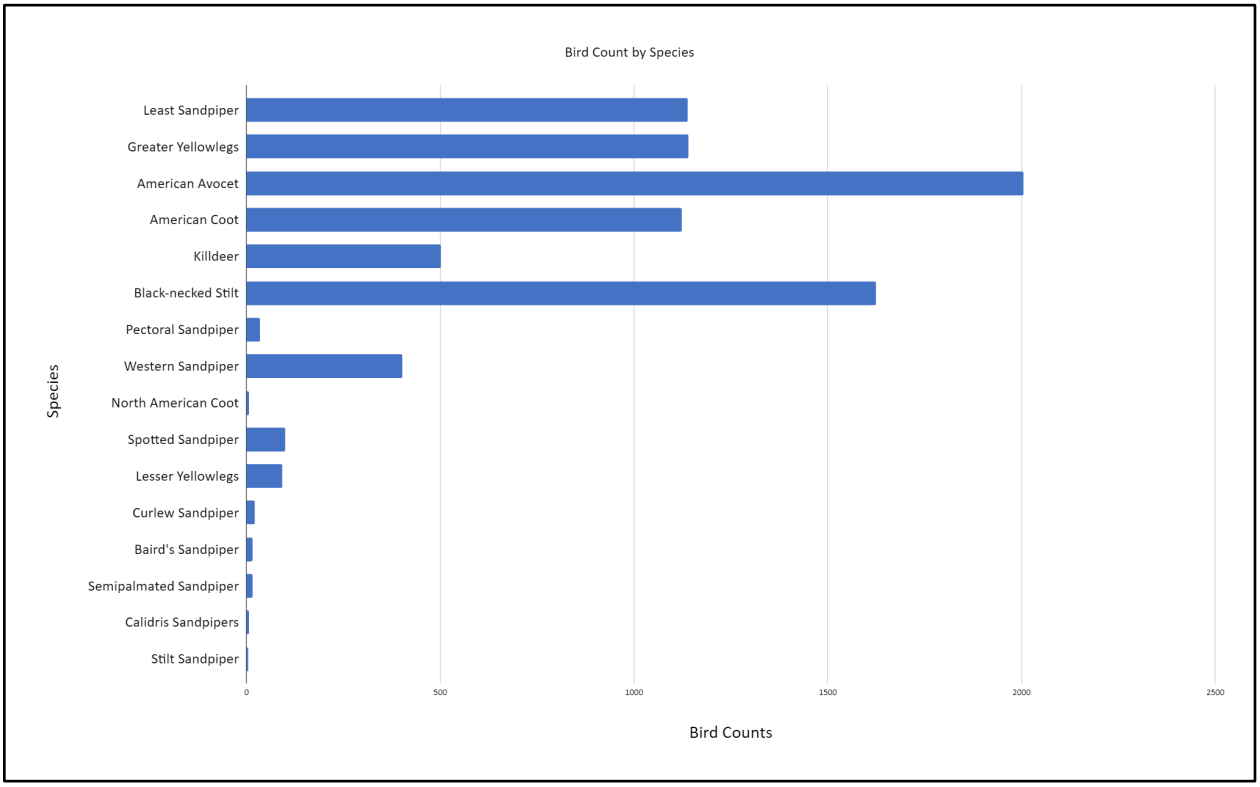

Figure 1. Bird Count by Species

In Figure 1, we show the count of observations of the species listed earlier. The y-axis represents the different species, while the x-axis represents the number of observations made of the particular species. We observe that larger, more common birds like Avocets and Stilts had more observations, while smaller, less distinguishable species such as the Curlew Sandpiper were not observed as often. This can be because of a bias towards larger birds (Callaghan et al, 2021). These specific species tend to live in large groups and may be overrepresented in the data. Also, counts may be exaggerated due to these large groups. In addition, more common birds will be counted multiple times, and this also leads to an exaggeration of population counts. Smaller, less common birds are missed by some people and similar species, like the Lesser and Greater Yellowlegs may be misidentified. This is where expertise becomes important. Experts would likely be able to distinguish between similar species. This validates the assumption that citizen scientists are more likely to record observations of larger, more common birds.

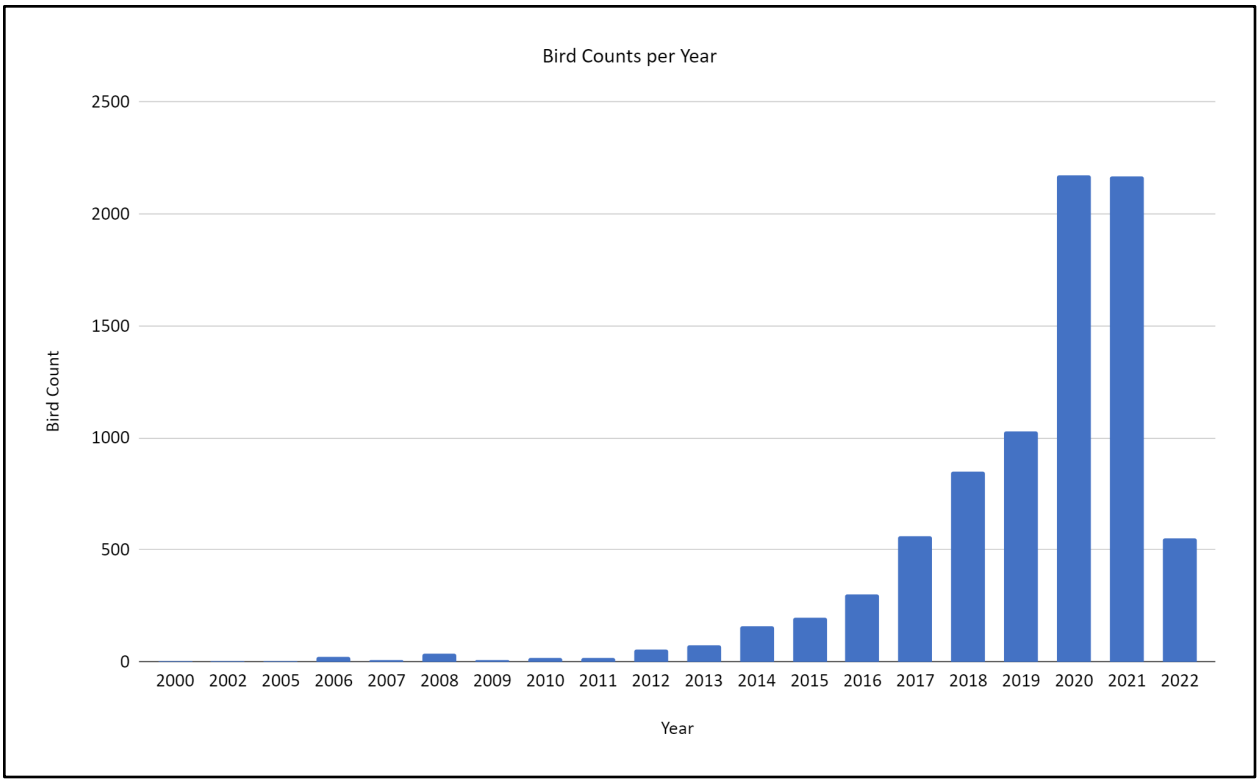

Figure 2. Bird Counts per Year

In Figure 2, we demonstrate the number of observations of the specified species per year. The x-axis corresponds to the year, while the y-axis is the total number of observations made. The data is only collected until April 2022, which is why the number of observations in 2022 is significantly lower than the number of observations in 2021. We discover that there is a significant spike in 2020 and 2021. From 2000 until 2014, there were less than 150 observations. After 2014, we see a steady increase until 2019. In 2020 and 2021, the number of observations is almost double the number of observations in 2019. This could be related to the beginning of the Covid-19 Pandemic. Our hypothesis is that more people went to recreational areas during the pandemic lockdown, which contributed to more recorded observations. However, this could also be related to when the iNaturalist began to grow in popularity. Regardless, this is an area for future investigation. It remains to be seen if this trend continues.

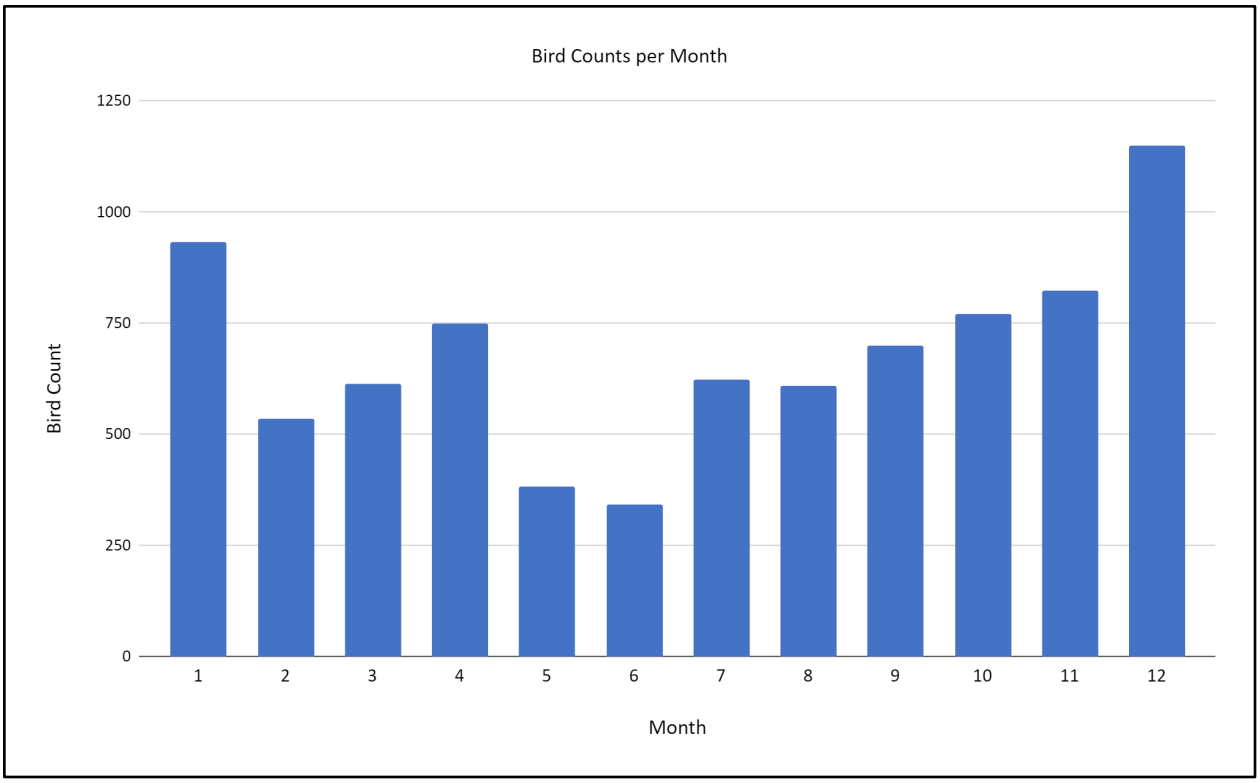

Figure 3. Bird Counts per Month

In Figure 3, we chart the number of observations in each month of the year. On the x-axis is the month, and on the y-axis is the number of observations made. It is relatively similar throughout the year. However, there is a clear decrease in May and July, and a clear increase in December and January. The increase could correlate to migration patterns of shorebirds or could also correlate to the annual Christmas Bird Count. The Christmas Bird Count is a likely cause for the spike in December as a lot of people participate by recording their observations. Additionally, in January, people making new year's resolutions may choose to go and make more observations during the month. In order to obtain accurate data on which months are best for birdwatching, we need to organize the citizen scientists in such a way observations are made for the same amount of time each month. This is because activities that incentivize people to make more observations during specific months (The Christmas Bird Count) can skew the data.

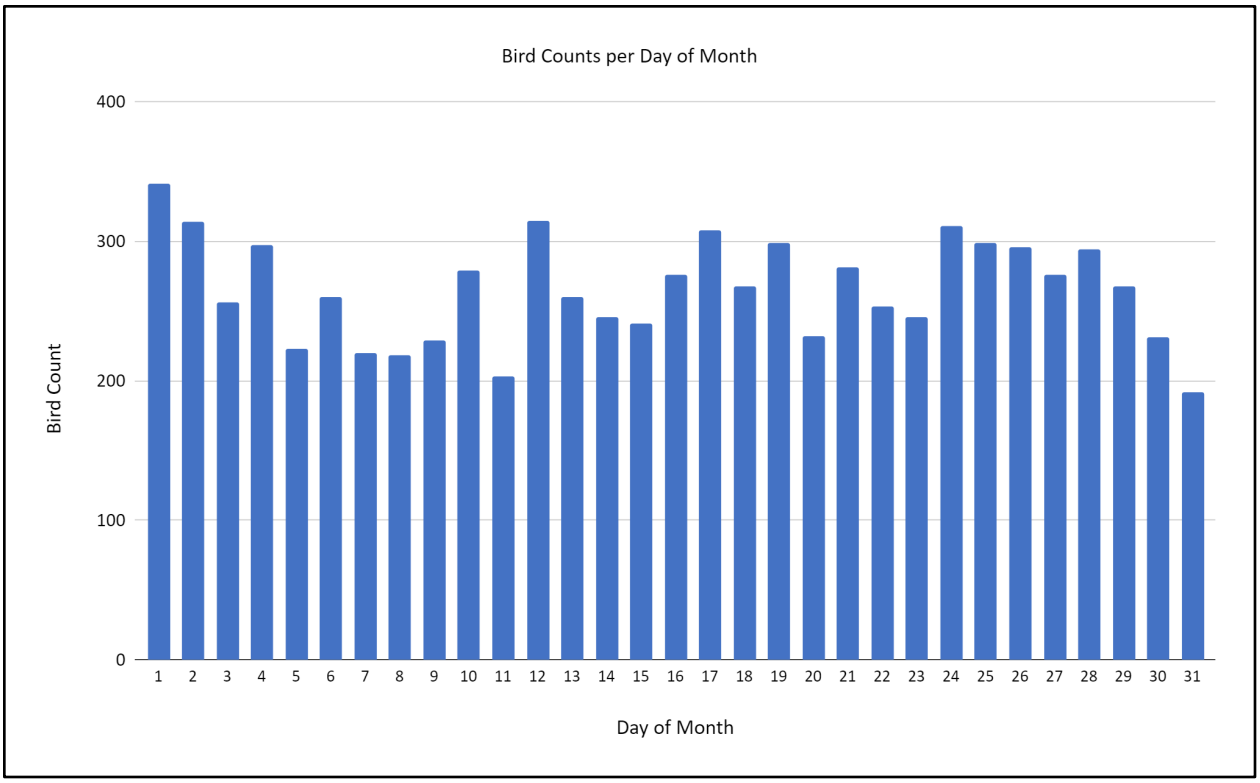

Figure 4. Bird Counts per Day of Month

In Figure 4, we investigate the number of observations per date number of a month. On the x-axis the day of the month, and on the y-axis is the observation count. We did not discover any patterns indicating that no particular days in a month are more popular for observation. However there seems to be a wave shape starting on the 1st of the month and fluctuating until the 30th/31st. The 31st having the lowest number of observations is most likely due to the fact that not every month has 31 days. The 1st of the month has the most observations, which could be due to goals set, similar to how January had more observations. Also, similar to how monthly distributions can be improved, we would want the citizen scientists to spend an equal amount of time making observations on each day of the month. This would eliminate bias towards specific dates. We believe that citizen scientists are more likely to make observations on weekends, but the data did not have the day of the week the observations were recorded.

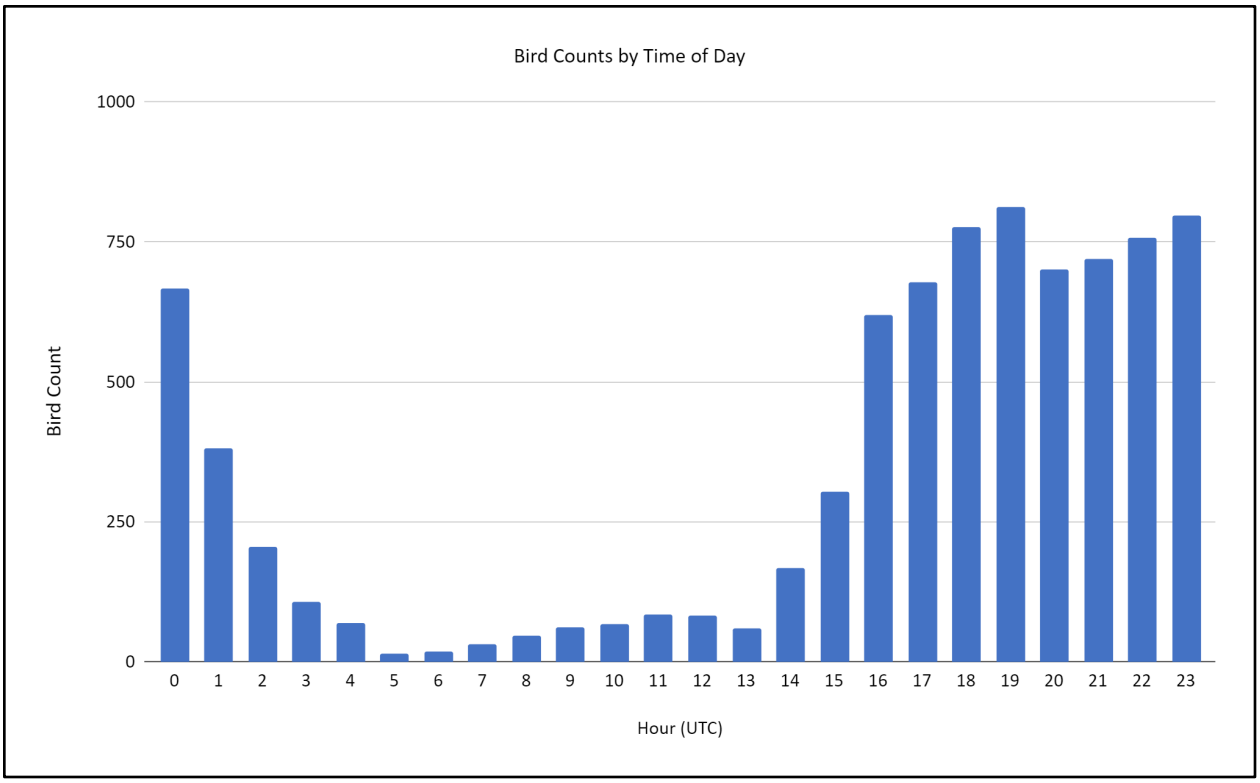

Figure 5. Bird Counts by Time of Day

In Figure 5, we illustrate the time of day that observations are made at. The x-axis depicts the time of day in UTC, and the observation count is on the y-axis. Importantly, the local time in Don Edwards Reserve is PST, while the data is recorded in UTC. This means that local time is 8 hours behind. According to this calculation, we can observe that most observations are made from 16:00 to 0:00 UTC, i.e., 08:00 to 16:00 PST. This goes against the hypothesis that the best time to view birds is during dawn and dusk, as more observations are made during the day, than dawn and dusk. One thing to consider is that most people do not go out to make observations at dawn and dusk, and they prefer the afternoons. In addition, it is much brighter during the afternoon, which makes it easier to observe and record the different birds present.

Future Work

Based on the observations and analysis, we hypothesize that shorebird feeding habits are more likely related to timing of tides than dawn or dusk. Shorebirds feed on mud creatures such as snails, clams, and oysters. These mudflats are exposed during low tides. This is an area we plan to investigate further.

Furthermore, Don Edwards Reserve is home to some of California's Species of Special Concern (California Department of Fish and Wildlife, n.d.) Future work includes tracking observations of these species through the years to support preservation efforts.

Lastly, we plan to compare the data we extracted from iNaturalist to our own personal observations and the US Department of Fish and Wildlife's surveys in order to understand how biases might have affected the data.

Conclusion

In this study, we analyzed how different factors such as, time of day, day of the month, month, and year affected the number of observations made on the popular citizen science data website, iNaturalist. We discussed the results of our investigation, as well as some of our plans for future work.

We concluded that the time of day, year, and month all had visible impacts on the amount of shorebird observations made. To summarize, more shorebirds were observed during the daytime hours, from 8 am to 4 pm. There are more observations in winter months, from November to January. And in 2020 and 2021, during the COVID pandemic, the majority of observations were made. It will be interesting to track if the number of observations in 2022 is more than or equal to the number of observations made in 2020 or 2021.

In continuation, there are a few areas where biases may affect the results. Pinson (2021) says "... users were most active on weekends during the spring and summer months, often in or around urban areas. This was reflected in the types of animals and plants they captured." In addition, for our study, we believe the Christmas Bird Count affects the number of observations in December, and New Year's resolutions likely affect the number of observations in January. It is also likely that there are fewer people making observations during the late evening and nighttime. In addition, larger birds, like the American Avocet and the Black-necked Stilt are easier to observe than smaller, less distinguishable birds like the many of the Sandpipers, causing them to have many more observations recorded.

Acknowledgements

The author would like to thank ___ for her advice and mentorship on this project. We are grateful to the citizen scientists on the iNaturalist platform, without whom this work would not have been possible.

References

iNaturalist (n.d) Retrieved April 2022, from https://www.inaturalist.org/

Don Edwards San Francisco Bay National Wildlife Refuge (n.d.) FWS.gov. Retrieved November 2022, from https://www.fws.gov/refuge/don-edwards-san-francisco-bay

Cohn, JP. (2008). Citizen science: Can observation contributors do real research? BioScience, 58(3): 192–197. DOI: https://doi.org/10.1641/B580303

Boone, M. E., & Basille, M. (2019). Using iNaturalist to Contribute Your Nature Observations to Science: WEC413/UW458, 6/2019. EDIS, 2019(4), 5. https://doi.org/10.32473/edis-uw458-2019

Callaghan, C.T., Poore, A.G.B., Hofmann, M. et al. Large-bodied birds are over-represented in unstructured citizen science data. Sci Rep 11, 19073 (2021). https://doi.org/10.1038/s41598-021-98584-7

California Department of Fish and Wildlife (n.d.) Species of Special Concern. Wildlife.ca.gov. Retrieved November 2022, from https://wildlife.ca.gov/Conservation/SSC

Pinson, J. (2021). Who observes the observers? Scientists conduct large-scale study of iNaturalist users. https://www.floridamuseum.ufl.edu/science/scientists-conduct-large-scale-study-of-inaturalist-users/