Rufous (*Selasphorus rufus*) and Anna's Hummingbirds (*Calypte anna*) population changes in Western Washington

by

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Abstract

Western Washington is home to a large variety of bird species including Rufous Hummingbirds (*Selasphorus rufus*) and Anna's Hummingbirds (*Calypte anna*). Hummingbirds' diets largely consist of nectar from blooming flowers or from human provided hummingbird feeders. Rufous Hummingbirds are long-distance migrants and travel to Washington to breed and their arrival date in Washington State has been earlier due to climate changes (Courter 2017). In Washington, Rufous Hummingbirds are in decline (Sauer, et al., 2017). Anna's Hummingbirds have undergone a large range expansion and now are present in Washington year round. One large reason Anna's Hummingbirds have been able to expand northward is by the use of exotic flowering plants in gardens and hummingbird feeders providing an additional food source (Birds of North America, 2017). This study will utilize data acquired from a survey sent out to Audubon Society members in western Washington about their hummingbird feeders, what species they see, and if there has been a change in Rufous or Anna's Hummingbirds sightings over the years to try to answer questions related to the population changes of both of these species in the past several years.

Introduction

Rufous Hummingbirds (*Selasphorus rufus)* and Anna's Hummingbirds (*Calypte anna*) can both be found in western Washington State. Both of these charismatic species can be found in natural areas and suburban areas utilizing hummingbird feeders and exotic plants that provide nectar high in sucrose. Hummingbirds are attracted and follow food sources, whether they are blooming flowers or feeders put out by people. Feeders have provided a constant food source for these birds, which has contributed to their survival, especially during the winter. Both of these species are widespread, but sightings of Rufous Hummingbirds in Washington, especially Seattle and Tacoma have been decreasing, whereas Anna's Hummingbirds are now present year round (Birds of North America, 2017).

Rufous Hummingbirds are small hummingbirds known for their aggressive behavior, incredibly long migration to Mexico, and beautiful rufous color. They have a rather wide range

and breed in Washington (Figure 6). They can usually be seen in western Washington as early as late February to mid-March since their migration towards their wintering grounds is centered on floral phenology. These birds have high breeding site fidelity, so they often return to the same area year after year to breed (Birds of North America, 2017). However, due to climate change there has been a noticeable advancement of their arrivals to breeding grounds in recent years. In areas in Washington, they are arriving 15-17 days earlier than the historical average (Courter, 2017). They generally leave the breeding grounds in July or August. The habitat in their breeding grounds, such as Washington, include a wide range of habitat types such as secondary succession forests, mature forests, parks, suburban areas, and farmland. As most hummingbirds do, both Anna's and Rufous hummingbirds primarily subsist on floral nectar and small insects. Rufous hummingbirds are well adapted for their lifestyle with short wings and high wing loading that allows them to have successful long distance migration. They are well known for their extremely aggressive behavior to protect their territories, especially their feeding territories (Birds of North America, 2017). Unfortunately, according to Breeding Bird Survey data, there have been significant declines in the populations in British Columbia, Oregon, and Washington. In Washington from 1966 to 2015 they have declined on average 2.30% per year (Sauer, et al. 2017). Despite this local decline, the global population is about 6.5 million and they are part of IUCN's least concern (Birds of North America, 2017).

Anna's Hummingbirds can be found on the west coast of North America (Figure 8). They have been able to expand their range substantially since the 1930s because of hummingbird feeders and exotic plants in gardens and yards. These also allow them to stay in many areas year-round. They are medium sized and stocky hummingbirds that have greenish bodies and broad tails. Adult males have beautiful iridescent magenta gorgets and crowns with dark tails. Females

and juvenile males can have some magenta on their gorgets, but no rufous color on their tails. Their breeding range in Washington includes Tacoma and Seattle and most likely Bellingham and Federal Way. They typically nest from December to May and can be found regularly nesting in Seattle and Eastern Puget Sound. However, it is difficult to tell resident and wintering birds apart. Anna's hummingbirds do not migrate in the way that many hummingbirds do and instead they move upward towards the mountains and to the southeast after breeding. However, this post-breeding movement is different among populations and it is very possible that it is simply driven by food availability. The habitat in their historical range is chaparral, but outside of chaparral habitats they heavily utilize urban and suburban areas with gardens, parks, and feeders. Breeding range used to be in the chaparral habitat in Southern California, heavily relying on currant and gooseberry, but by 1964 they were able to expand their range all the way to Washington State. This was made possible by the use of exotic plants in gardens and parks and the use of hummingbird feeders in both suburban and urban areas offering alternate food sources (Birds of North America, 2017).

Their diet consists of the nectar from primarily currants and gooseberries, also utilizing other flowering plants for their nectar and gnats and small flies for protein. Anna's hummingbirds of both sexes are also known to be highly aggressive, especially during the breeding season and of feeding territories. Anna's populations are increasing as they do extremely well in human-modified areas and are able to use feeders to raise their numbers in both suburban and urban areas. Their use of humanized areas and ability to adjust to live, breed, and nest in human-dense areas are one of the reasons for range expansion. Although feeders are highly beneficial to their population numbers, they do prefer flowers when available. Although it

is not thoroughly documented, they most likely have breeding-site fidelity (Birds of North America, 2017).

Feeding birds for educational purposes began to become popular in the United States during the twentieth century. Bird feeding later grew to become both a hobby and fun activity. It gained popularity as ornithologists and bird enthusiasts shed light on how human actions were hurting bird populations, especially from the feather trade. Bird feeding became viewed as a fun activity that were "simple acts of kindness" (Baicich, et al. 2015) in order to help birds that have been harmed by humans. It also helps encourage creating sympathy and bonds between wild birds and humans. Carolyn B. Soule first mentioned feeding hummingbirds in the 1900 issue of *Bird-Lore*. This publication quickly popularized hummingbird feeders. Feeders began being sold in the 1930s and since then has continued to gain recognition (Baicich, et al. 2015).

People now put up hummingbird feeders to help hummingbirds with their high-energy intake needs, especially during times of drought or other natural disasters. They often use feeders to help the hummingbirds in their areas, especially during their long migrations. Since they are an extremely charismatic species people also like to attract them to their yards and windows for viewing pleasure and for photographic opportunities (Baicich, et al. 2015). Having this additional food source provided by humans can be extremely helpful for hummingbirds, especially when natural food availability is scarce and during times of lower temperatures. Some hummingbird species, including the Anna's Hummingbird, utilize these human resources extensively and as a result have expanded their range northward out of their historic chaparral habitat in Southern California. Washington State now has Anna's Hummingbird populations that stay year round, using feeders to supplement their diet when flowering plants are not as abundant. The hummingbird feeders in colder climates, such as Washington, may be an essential

part of their survival and one of the reasons Anna's Hummingbirds are now present in western Washington year round (Birds of North America, 2017).

In 2016 John Marzluff sent The Hummingbird Feeder Study (attached in the Appendix) to members of the Audubon Society in Seattle and surrounding areas in Western Washington. The survey responses asked what years and seasons people fed hummingbirds, if at all. It also asked what initially drew people to start putting out the feeders- to attract hummingbirds, or because they saw them in the area. The surveys also included a section for them to give a response about which species of hummingbird species they see (Anna's and/or Rufous) and if it has changed throughout the years. Comparing the responses of which species seen at people's feeders over the years to the results from the North American Breeding Bird Survey, Christmas Bird Count, and Seattle Audubon's Neighborhood Bird Project can give us an idea of population changes for Rufous and Anna's Hummingbirds in suburban and urban areas of Western Washington.

I hypothesized that the data from the Hummingbird Feeder Study would represent the trends shown in the Breeding Bird Survey and Christmas Bird Count- that Anna's Hummingbirds are increasing in Western Washington and that there would be a slight decline in the Rufous Hummingbird populations. I thought that half of the participants would have started to feed hummingbirds because they wanted to attract them and half of them because they noticed them in their neighborhoods.

Methods

Study Area

John Marzluff's 2016 Hummingbird Feeder Study was sent to birders in western Washington. The study was sent to members of the Audubon Society in areas in western Washington. The Audubon Society has many chapters encompassing this area including the Seattle Audubon, Eastside Audubon, Pilchuck Audubon, Skagit Audubon, Whidbey Audubon, Kitsap Audubon, Tahoma Audubon, Olympic Peninsula Audubon, North Cascades Audubon, San Juan Islands Audubon, Rainier Audubon, Black Hills Audubon, Grays Harbor Audubon, Vancouver Audubon, and Willapa Hills Audubon. The different chapters of western Washington are shown in a map from the Audubon Society's website (Figure 9).

Data Collection

The Hummingbird Feeder Study was sent out by John Marzluff in early February 2016 and responses were collected via email and letter throughout February and March. The Audubon Society members in western Washington were asked to participate in the study by answering the questionnaire shown in the Appendix. Overall, there were 242 responses sent in to be included in the study.

The Neighborhood Bird Project is a citizen science program through The Audubon Society that has volunteers perform bird censuses in parks in their neighborhoods. The surveyed parks included in the project are Carkeek Park, Genesee Park, Discovery Park, Lake Forest Park, Golden Gardens, Seward Park, Magnuson Park, Lincoln Park, and the Arboretum (Seattle Audubon). Data from this project was sent to me from Toby Ross of the Seattle Audubon Society. Toby Ross also emailed me the data from the Christmas Bird Count to use for Anna's Hummingbirds. Results and data from the North American Breeding Bird Survey were acquired from the USGS Patuxent Wildlife Research Center website and downloaded directly. They also

have summaries of annual efforts and analyzed results that were used for the purpose of my research. I used this data for Rufous Hummingbirds.

Data Analysis

The data from the Hummingbird Feeder Study, Christmas Bird Count, Breeding Bird Survey, and Neighborhood Bird Project were all organized and analyzed using Excel. Each data set was analyzed separately and then compared to the results from the Hummingbird Feeder Study to see if the trends were similar. I used the analysis that USGS provided for the Breeding Bird Survey data to acquire the annual indices for Rufous Hummingbirds from 1968 until 2015.

Regression analyses were performed using Excel for the data from the Breeding Bird Survey, Christmas Bird Count, and Neighborhood Bird Project. Using linear regression I was able to find the coefficient of determination (R^2) value to see how strong the relationship between the year and the hummingbird population variable were. The probability of detecting Anna's and Rufous Hummingbirds were determined from the Neighborhood Bird Project and from the Hummingbird Feeder Study responses.

Results

Of the 191 people who answered the question of why they started feeding hummingbirds, it was pretty close to being half because they noticed them in the neighborhood and half because they wanted to attract them. Of the people responses 43%of people wanted to attract hummingbirds to their yard, 47% put up a feeder in response to seeing hummingbirds in their neighborhood, 8% put up feeders because they both noticed them and wanted to attract them, and 2% started for other reasons (Figure 1). Other reasons included a hummingbird feeder being left

behind by the house's previous tenants and wanting to help hummingbirds in the winter and/or during migration.

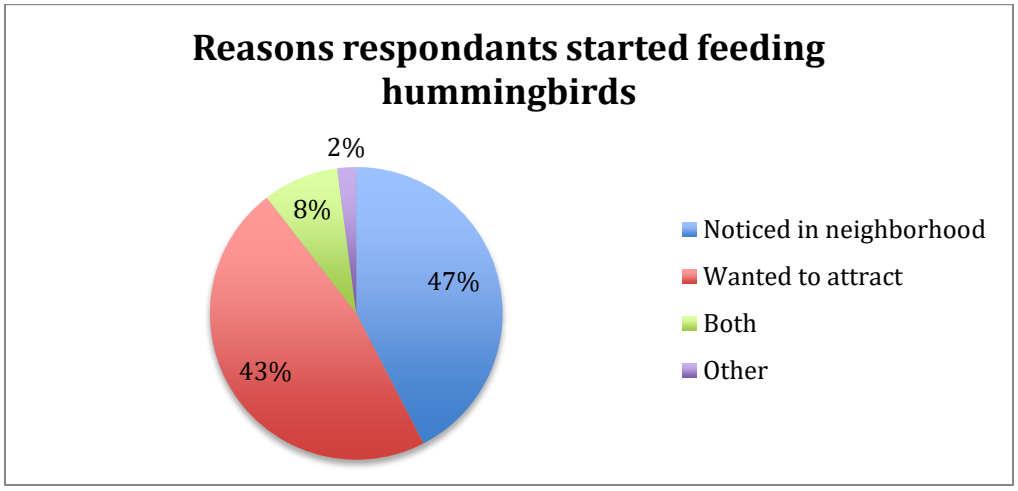

Figure 1

An increase of Anna's Hummingbirds is shown with the data from the Christmas Bird Count (Figure 2), Neighborhood Bird Project (Figure 5), and Hummingbird Feeder Study (Figure 6). Sightings of Anna's Hummingbirds for the Neighborhood Bird Project have gone up substantially as shown in Figure 5. There is a high correlation between year and number of sightings of Anna's Hummingbirds (R^2=0.78713) and on average there has been an increase of about 40 detections for the project each year. This is extremely important because it shows how Anna's Hummingbirds have been increasing dramatically in the urban and suburban areas of Seattle. This increase of Anna's Hummingbird sightings in Western Washington is also shown in the results from the data from The Hummingbird Feeder Study (Figure 6). The probability of seeing an Anna's Hummingbird at one's feeder in Western Washington has increased since 1970. Anna's Hummingbird populations in Washington State are also increasing each year shown with the data from the Christmas Bird Count (Figure 2). There is a relatively high correlation between year and number of Anna's Hummingbirds detections per party hour (R^2=0.65769).

A decrease in Rufous Hummingbird sightings is shown from the annual index of Rufous Hummingbirds from the Breeding Bird Survey (Figure 3), probability of detecting a Rufous Hummingbird for the Neighborhood Bird Project (Figure 4), and probability of having a Rufous Hummingbird at one's feeder in Western Washington from the Hummingbird Feeder Study (Figure 6). The annual index of Rufous Hummingbirds for the North America Breeding Bird Survey shows a slight decline each year. From 1968 until 2015 there has been an average decrease in annual index of 0.0609 for each year (R^2= 0.97617). It is also important to note that many Hummingbird Feeder Study participants who have been feeding for several years made the switch from feeding only in spring/summer to feeding year round in the past 5-10 years.

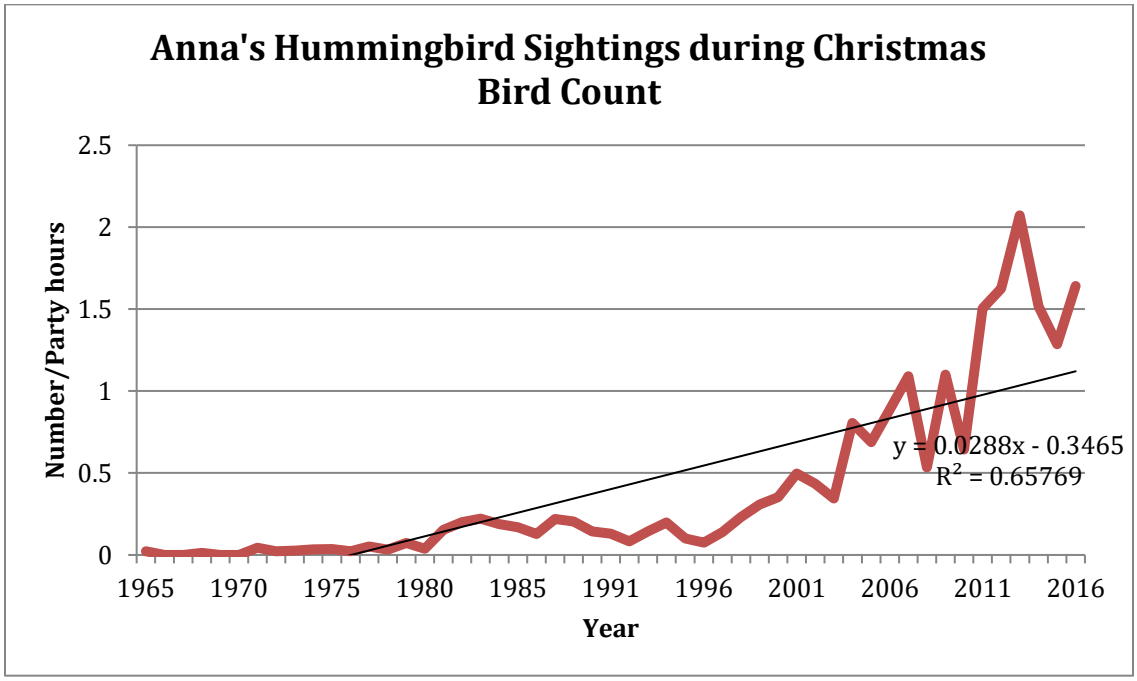

Figure 2: Data for Washington State

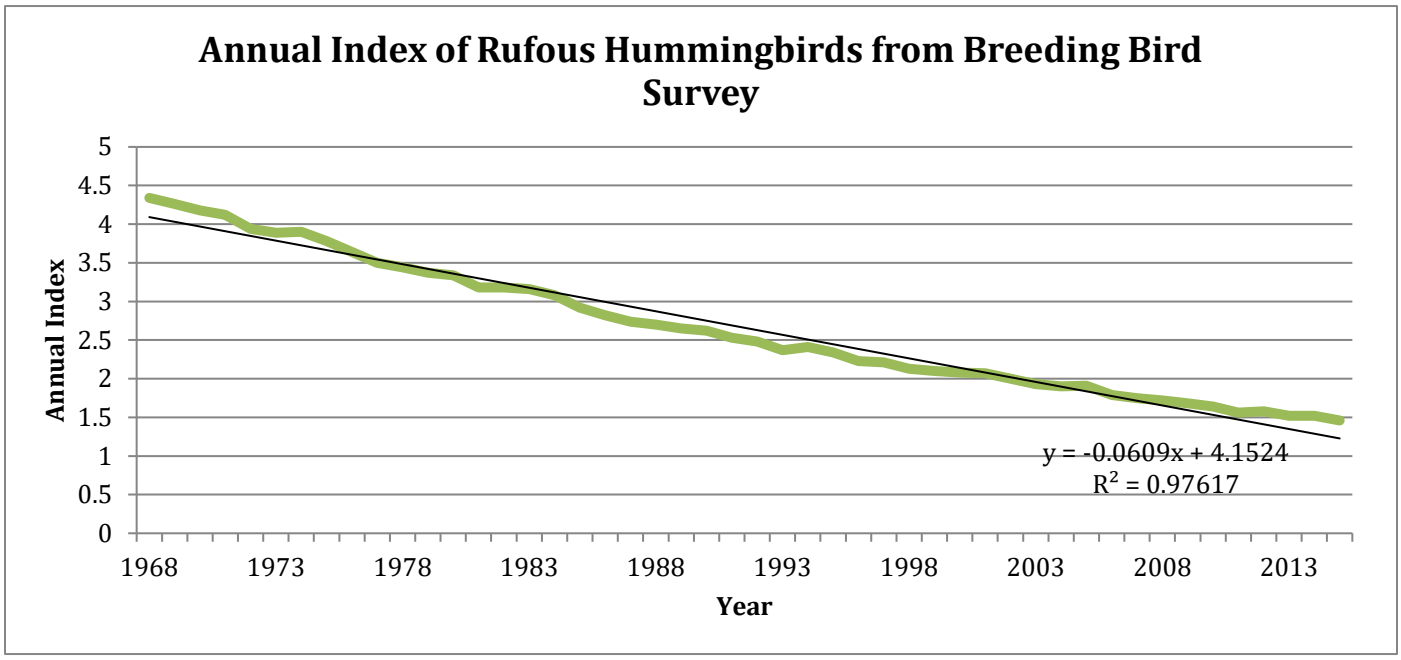

Figure 3: Data for Washington State

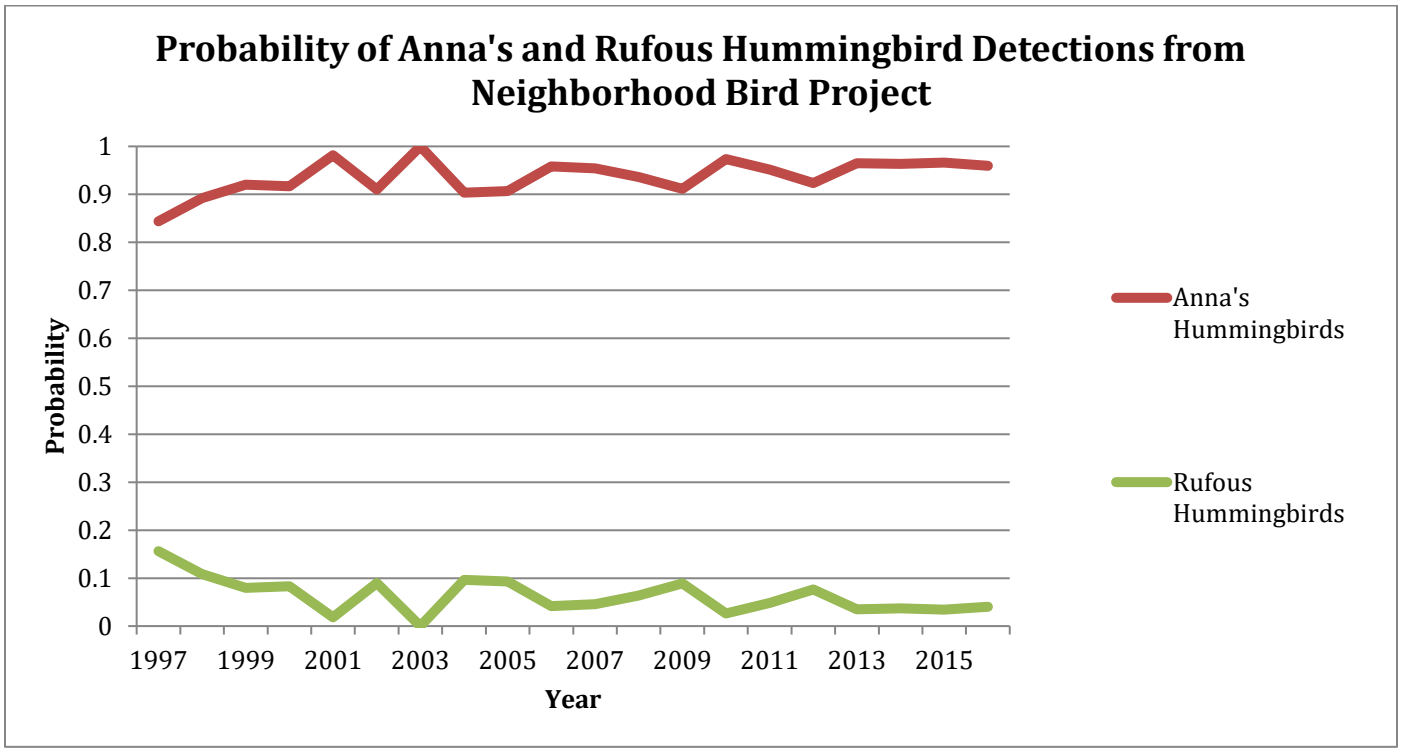

Figure 4: Data for Seattle, Washington

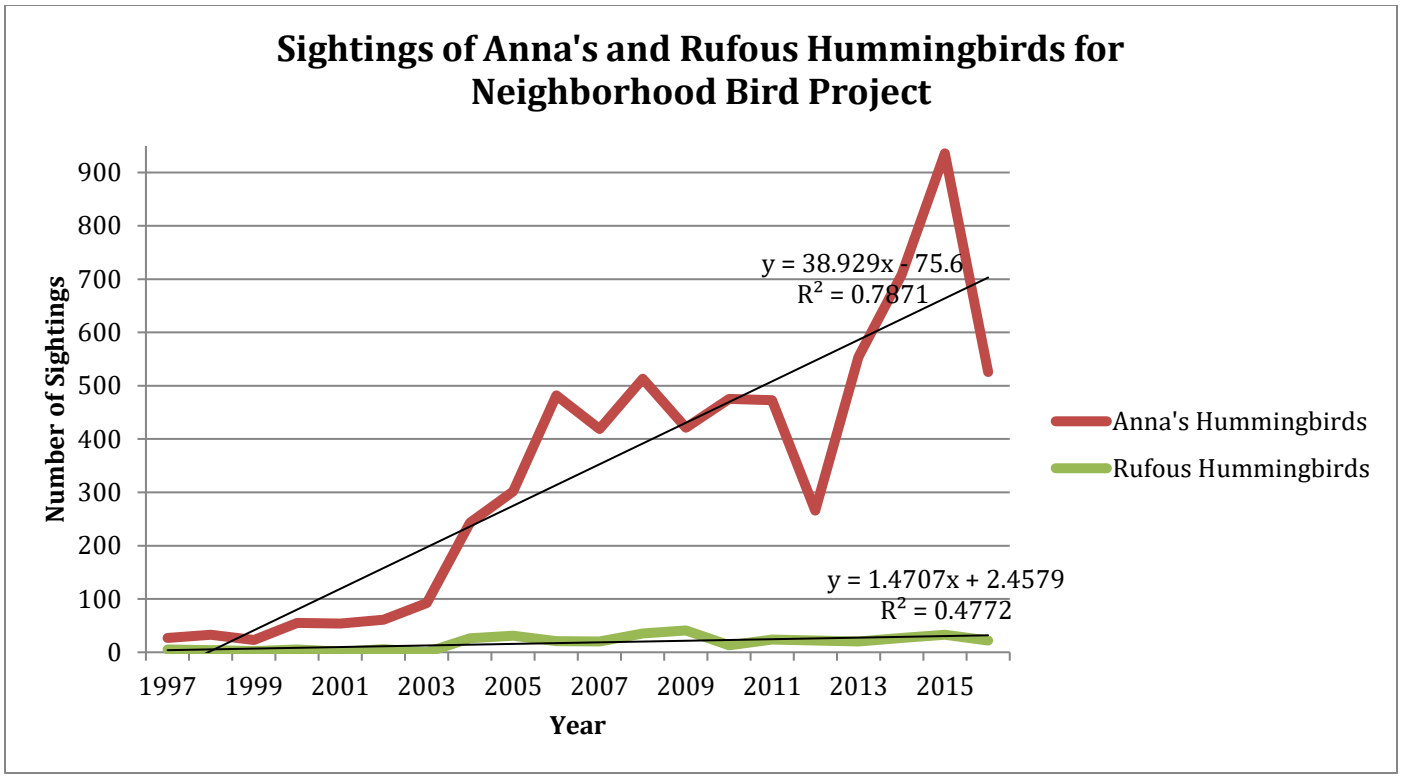

Figure 5: Data for Seattle, Washington

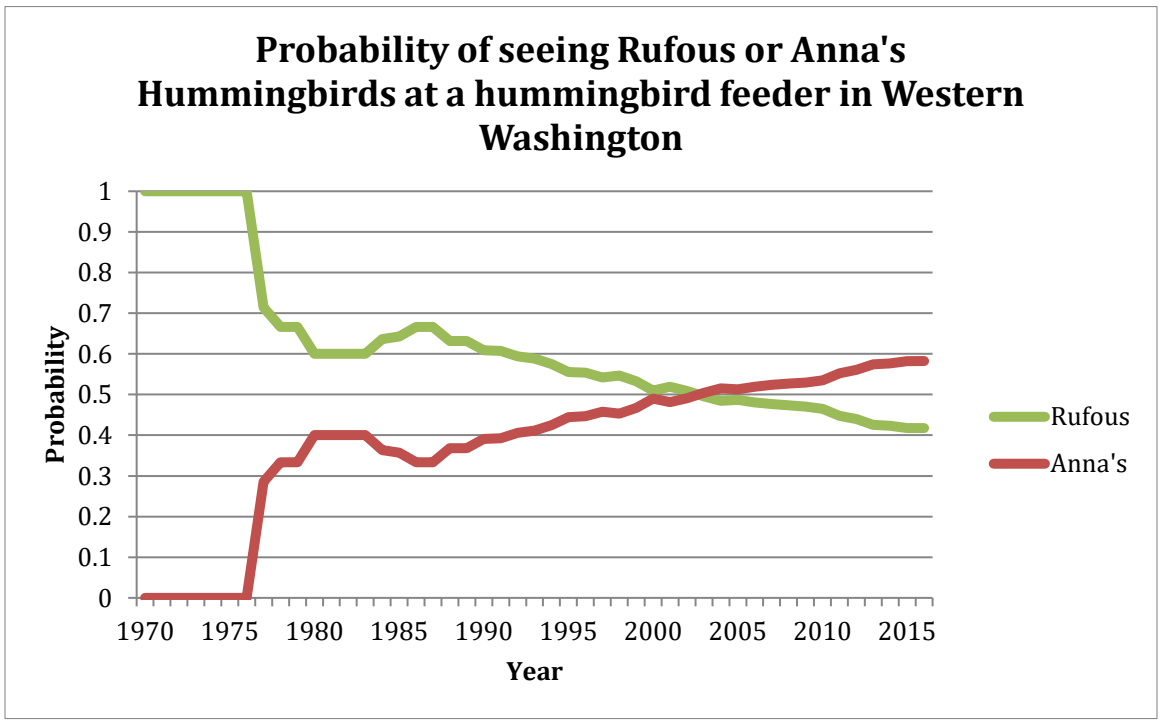

Figure 6: Using data from the Hummingbird Feeder Study

Discussion

People's motivations to feed hummingbirds are relatively evenly split between wanting to attract them and seeing them in their neighborhoods. Seeing bird species in one's neighborhood can spark conservation interest and enthusiasm. People want to attract charismatic species to their homes, providing new food sources to do so. This can inspire people to have a more active individual role in helping conserve species by providing habitat and food sources for certain species. Increasing awareness of what bird species are present in one's neighborhood could greatly help with conservation efforts.

Feeders and exotic plants in gardens are helping Anna's Hummingbirds overwinter in Western Washington, especially in urban and suburban areas. They are able to utilize these urban areas to their advantage (National Audubon Society, 2010). Their populations have already and are likely to continue to increase based on the Christmas Bird Count, Hummingbird Feeder Study, and Neighborhood Bird Project data.

People with hummingbird feeders have noticed an increase in sightings of Anna's Hummingbirds, especially year round. They have also noticed a decrease in sightings of Rufous Hummingbirds. In recent years many people have made the switch from only feeding in the spring and summer to feeding year-round. This year round reliable food source encourages Anna's Hummingbirds to overwinter in Western Washington and helps their population increase. Although there has been a noticeable decrease in sightings of Rufous Hummingbirds at feeders according to the data from the Hummingbird Study, statewide there is only a slight decrease in their population. This suggests that they are not as common at feeders in urban areas because they are choosing to utilize food sources in rural areas that have less competition from Anna's Hummingbirds. As Anna's Hummingbirds are now present year-round they can establish a

territory including a feeder before the arrival of Rufous Hummingbirds. This increased competition makes it difficult for Rufous Hummingbird to use feeders in the urban areas that Anna's Hummingbirds are so well adapted to exploit.

Moving forward it is important for Rufous Hummingbirds to continue having areas without high densities of Anna's Hummingbirds. As Anna's Hummingbirds have used urban feeders and exotic plants to expand their wintering range and increase their population it is unlikely that Rufous Hummingbirds will be able to outcompete Anna's in the urban areas of Western Washington. A possible way to do this is to encourage people in more rural settings to bring their feeders in during the fall and winter months after the Rufous Hummingbirds have left for their migration south. This could possibly hinder Anna's Hummingbirds from overwintering in these areas, so there will be less interspecific competition.

Acknowledgements

I would like to thank John Marzluff for being my advisor and letting me use his data from the Hummingbird Study. I would also like to thank him for being so patient with me and for instilling a love for birds that I am sure will only continue to grow. He is such an incredible teacher and his passion is contagious. Thank you to Toby Ross and the Audubon Society for letting me use their data for the Neighborhood Bird Project and the Christmas Bird Count. Thank you to my roommate Kiana Young for her continued encouragement throughout this entire process.

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Appendix

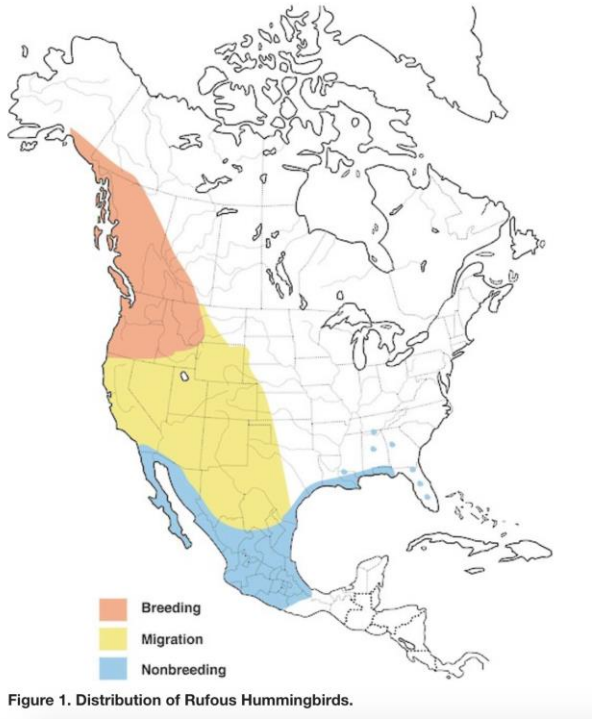

Figure 7: Distribution of Rufous Hummingbirds (Birds of North America, 2017.)

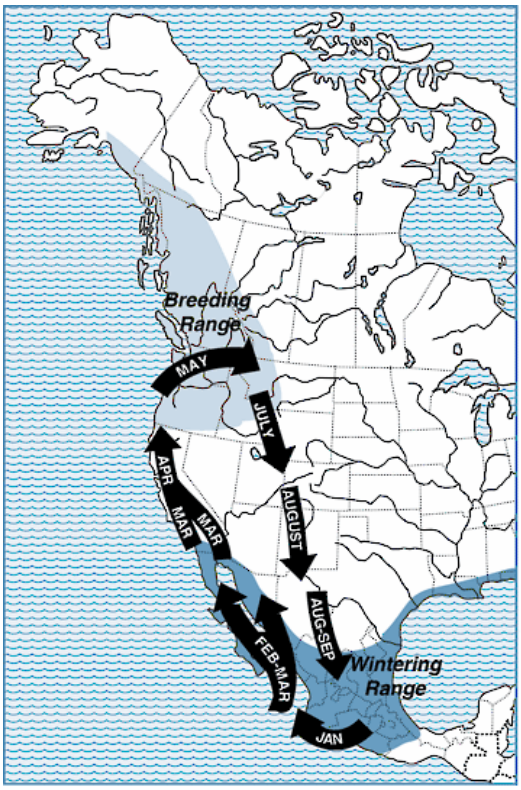

Figure 8: Breeding route of Rufous Hummingbirds (Birds of North America, 2017.)

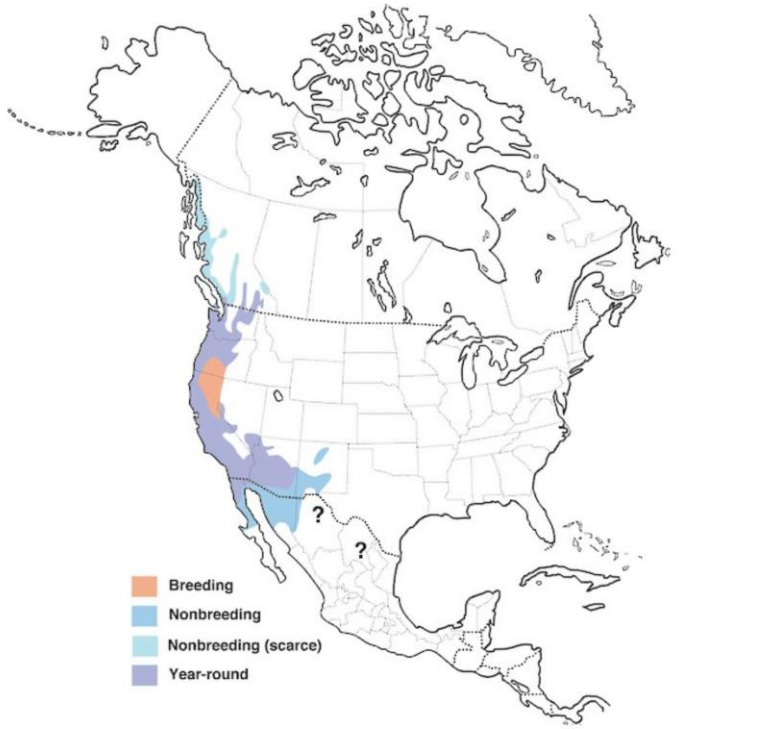

Figure 1. Range of Anna's Hummingbird. + Enlarge

Anna's Hummingbird breeds from December through May and occupies its non-breeding range from July through December.

Figure 9: Anna's Hummingbird range (Birds of North America, 2017.)

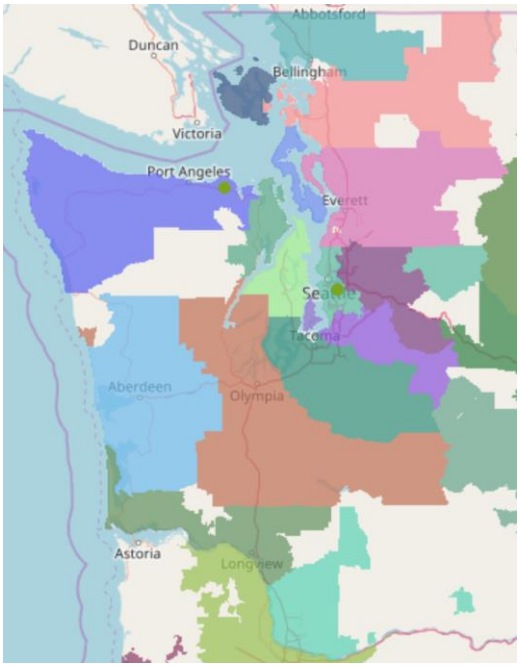

Figure 9: Map of Western Washington Audubon Society chapters (The Audubon Society, 2017.)

Hummingbird Feeder Study

A new study by UW professor John Marzluff is trying to quantify the annual number of people feeding hummingbirds in our region. If you'd like to get involved in the study please complete the short survey below.

Good Day and thanks for considering my request to complete the following survey. The purpose of these questions is to learn a bit more about hummingbird feeding in western Washington. I'm especially interested in the timing (through the years and seasons) of feeding. Even if you don't feed hummingbirds, your answer to the first question is very important. Have fun thinking about the birds and your feeders! And please send your responses directly to John Marzluff (simply forward this email with your answers to me (corvid@uw.edu) or if you wish, mail to John Marzluff, Box 352100, University of Washington, Seattle, WA 98195). I'd appreciate getting your responses by the end of March!
Thanks, John Marzluff

SURVEY

1. Do you feed hummingbirds (check your answer below)?
   YES / NO

If your answer is "no, I don't feed hummingbirds", then you're survey is complete! Please send to the address above
If your answer is "yes, I feed hummingbirds", can you please provide more details in the table below (expand the table as needed; an example is given at the start of the table in italics)

What year did you start feeding?
What year did you end feeding (list 2016 if you continue)?
For each year that you fed hummingbirds, can you please indicate if you fed year round, in the summer only, or in the winter only.

YEAR	**Feed?** (Y or N)	**Season Fed?** (A = year round, S = summer only, W = winter only)
e.g. Started: 1991	*Y*	*S*
1992-2005	*Y*	*S*
2006-2016	*Y*	*A*

2. If you are comfortable identifying the two species of hummingbirds we routinely have west of the Cascades, could you please indicate, as best as possible by ranges of years, whether you have:
   1) Rufous hummingbirds only
   2) Both Rufous and Anna's hummingbirds
   3) Only Anna's hummingbirds

   For example, you might have noticed only Rufous hummingbirds from 1992 until about 2000, then a mix until about 2010, and then only Anna's form 2010 to present.

3. Finally, if you feed hummingbirds, would you say that you started placing feeders because you noticed a lot of hummingbirds in the area or because you were hoping to attract hummingbirds that were not yet evident (check answer below, add any comments you wish)?

   Answer option 1. I started feeding because I noticed hummingbirds.
   Might add comment here that you started feeding in winter for this reason, etc.

   Answer option 2. I started feeding because I wanted to attract hummingbirds.