

# Influence of Pesticides on Bird Abundance in Santa Barbara, CA

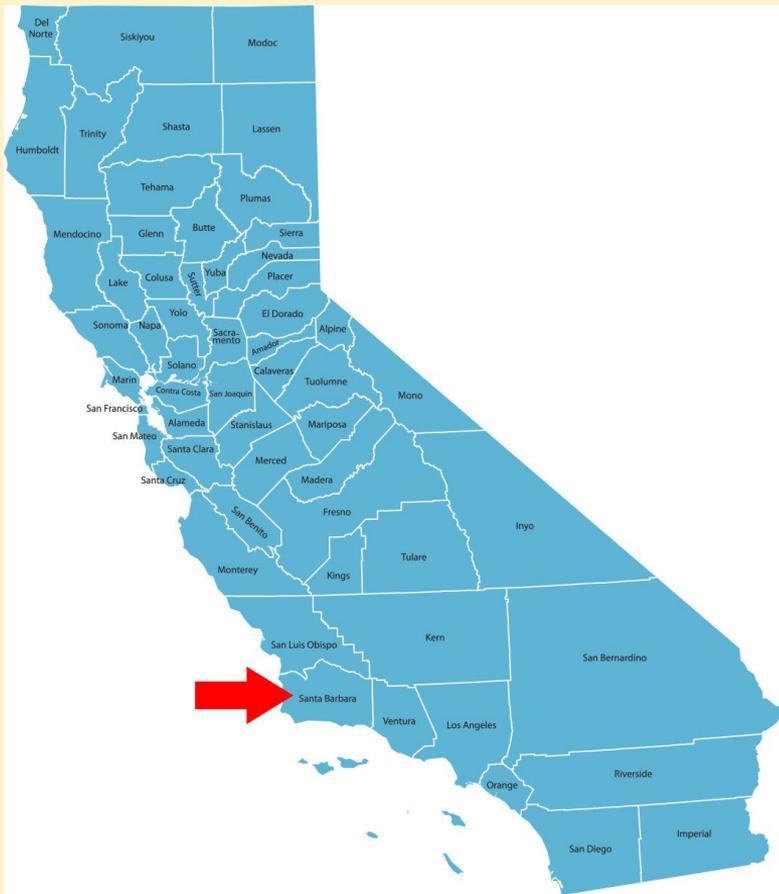
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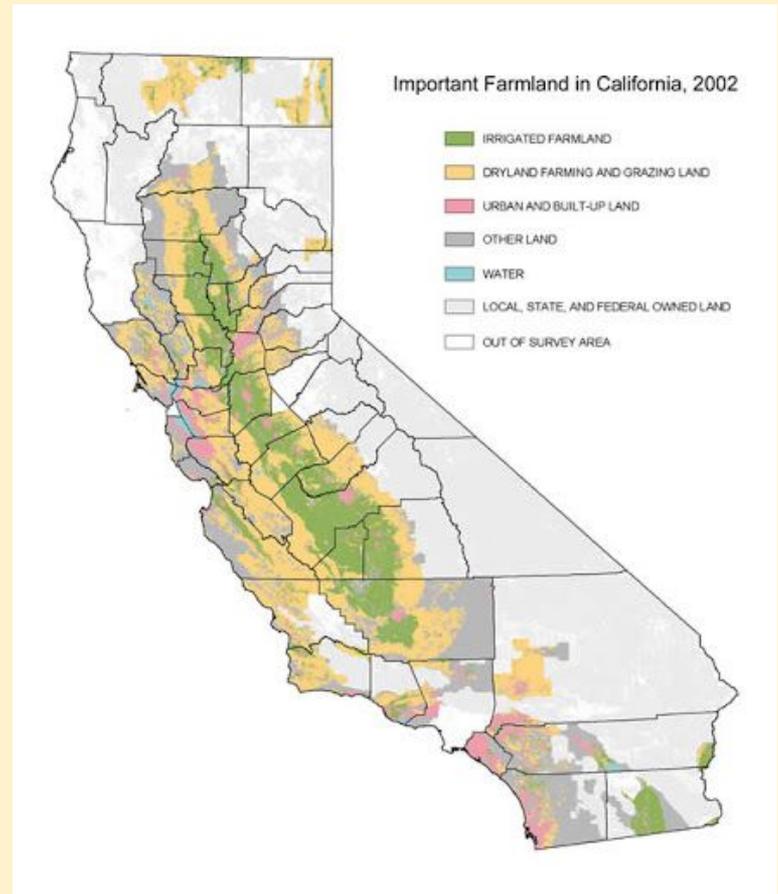
# Background information

- **Pesticides** are used to control pests that are harmful to cultivated plants or to animals; there are many different types
- **Studies** on the effects of pesticides on bird abundance can lead to pesticide restrictions that help prevent a decline in bird abundance
- **Restrictions** on pesticide use are occurring in cities around the world
- **Santa Barbara, CA:** No synthetic fertilizers, rodenticides, or insecticides since 1997





**Figure 1: Santa Barbara, CA.**



**Figure 2: Types of land use in California.** Santa Barbara is mostly dryland farming and grazing land and local, state, and federal owned land.

# Background information

## Song Sparrow

### Habitat:

Habitat Generalist  
(Grasslands)

### Diet:

Insects and seeds



## Red-Winged Blackbird

### Habitat:

Habitat Generalist  
(Grasslands)

### Diet:

Insects and seeds



## Townsend's Warbler

### Habitat:

Western Forests  
(Forests)

### Diet:

Insects



## Turkey Vulture

### Habitat:

Habitat Generalist  
(Open Woodlands)

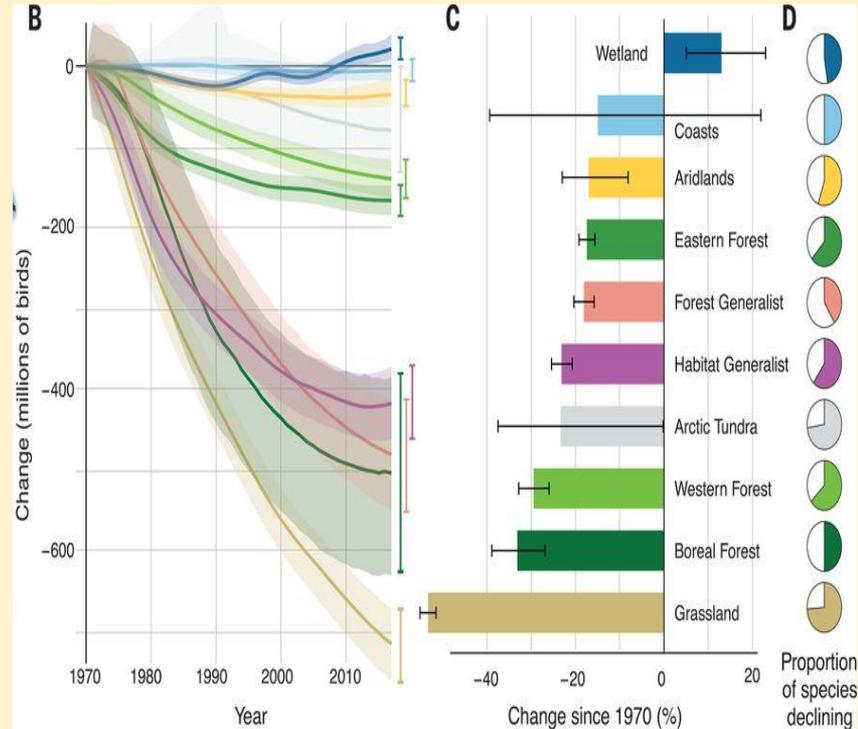
### Diet:

Carrion and human garbage



# Bird population decline

- Bird populations across the country are quickly **declining** in all biomes, specifically grasslands. (Rosenburg et al., 2019).
- Bird population **decline** has been linked to the **increased** use of pesticides around the world (American Bird Conservatory, 2020).



**Figure 3. Average bird population in different biomes.** Bird populations decline in every biome except wetlands.

# Pesticides on birds

- Pesticides effect **almost all** species of birds in heavily agricultural areas (Thompson, 2014).
- Birds can **ingest pesticides** by directly feeding on vegetation, insects and rodents affected by pesticides (Royte, 2017).

Red-winged blackbird



Song sparrow

# Questions and hypothesis

- **Questions:** Does pesticide use affect the abundance of bird species? Will areas with decreased pesticide use have a higher bird abundance?
- **Hypothesis:** The bird biodiversity and abundance in Santa Barbara, CA will increase post 1997 due to pesticide regulations.

Turkey vulture



# Data needs

1. Data that encompassed years pre and post ban of pesticides
  - a. Santa Barbara banned pesticide use in 1997
  - b. 1990-2019
2. Bird species in both Virginia and California
  - a. Compare no pesticide regulations vs pesticide regulations
3. Bird species count
  - a. Know the approximate number of each species there was each year



# Data sources

- Christmas Bird Count
  - used to find specific counts for each species
  - Santa Barbara (examining pre and post 1997)
  - Waynesboro, VA (used as control; no pesticide laws)
- eBird
  - Where each species is present

Townsend's warbler



Song sparrow



Red-winged blackbird



Turkey vulture

# Christmas bird count

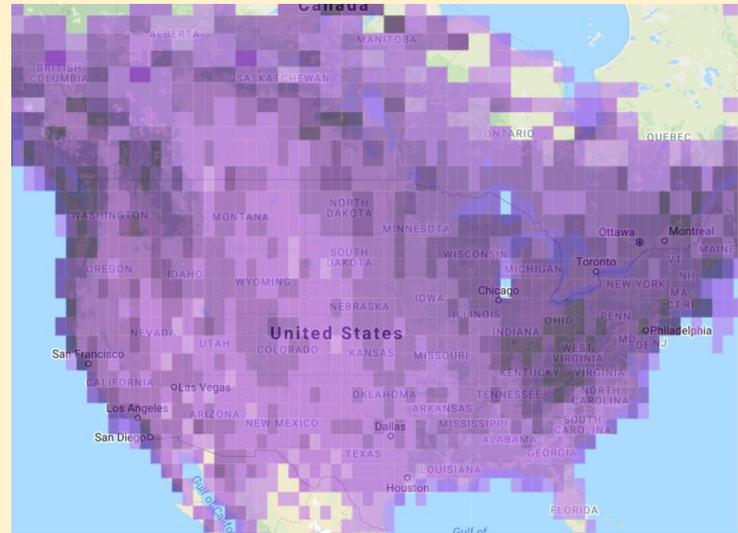
- Observational study
- Data has counted bird species in various locations over 20+ years
  - Used to see the rise or decline in bird populations
- Strengths: Covers many locations and species
- Weaknesses:
  - Flexible format for volunteers to contribute means less standardized protocols
  - Varying efforts each year

Song Sparrow Count

Species	Year	1990 [91]	1992 [93]
		Count Date: 12/31/1990 # Participants: # Species Reported: 75 Total Hrs.: 97.00	Count Date: 12/30/1992 # Participants: # Species Reported: 75 Total Hrs.: 118.00
Song Sparrow [Melospiza melodia]	Number:	134	458
	Num/Party Hrs.:	1.3814	3.8814

# eBird

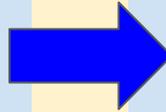
- Documents bird distribution, abundance, habitat use, and trends
- Strengths:
  - Data quality is of critical importance
  - Checklist filters are developed by some of the most knowledgeable bird distribution experts in the world



Song Sparrow Distribution

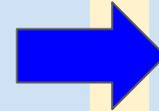
# Methods

#1. Bird species were gathered from eBird to ensure both were present in Santa Barbara, CA and Waynesboro, VA



#2. Species count data was collected from the Christmas Bird Count.

- Taken from each year for each species

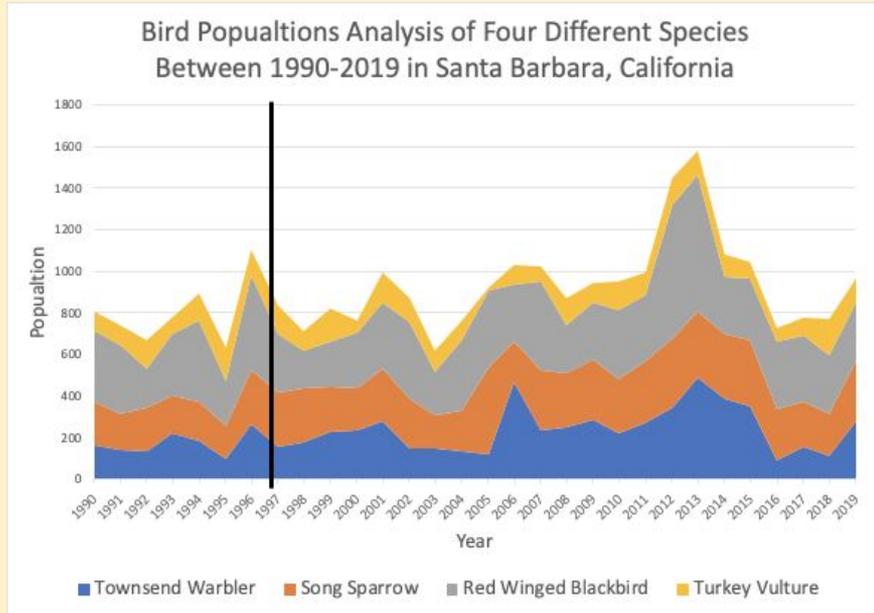


#3. A t-test was used to find significance and graphs were constructed in excel to compare Santa Barbara to Waynesboro.

The eBird logo, featuring the word "eBird" in a green and black serif font.

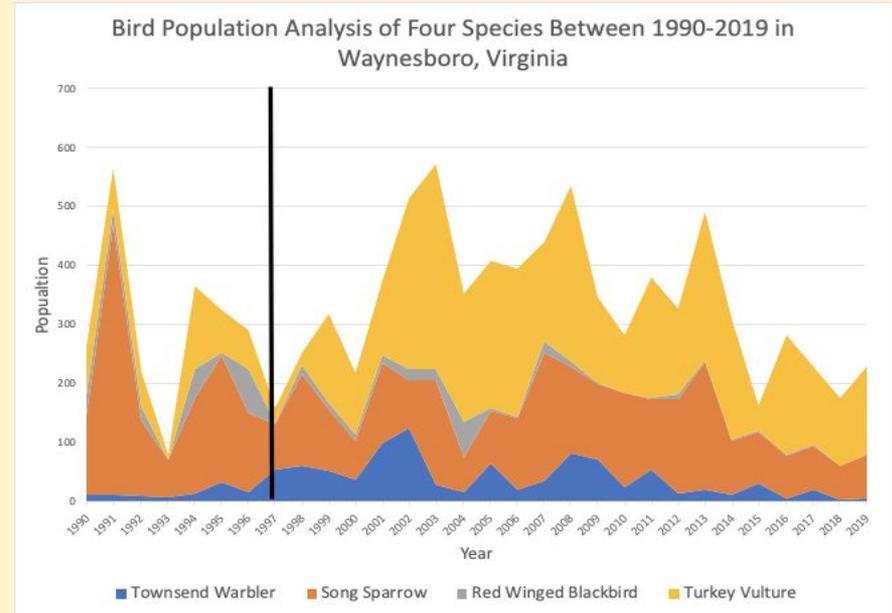


# 1990-2019 Bird abundance data



**Figure 4. Bird Abundance Analysis of Four Species Over 30 Years in Santa Barbara, California.**

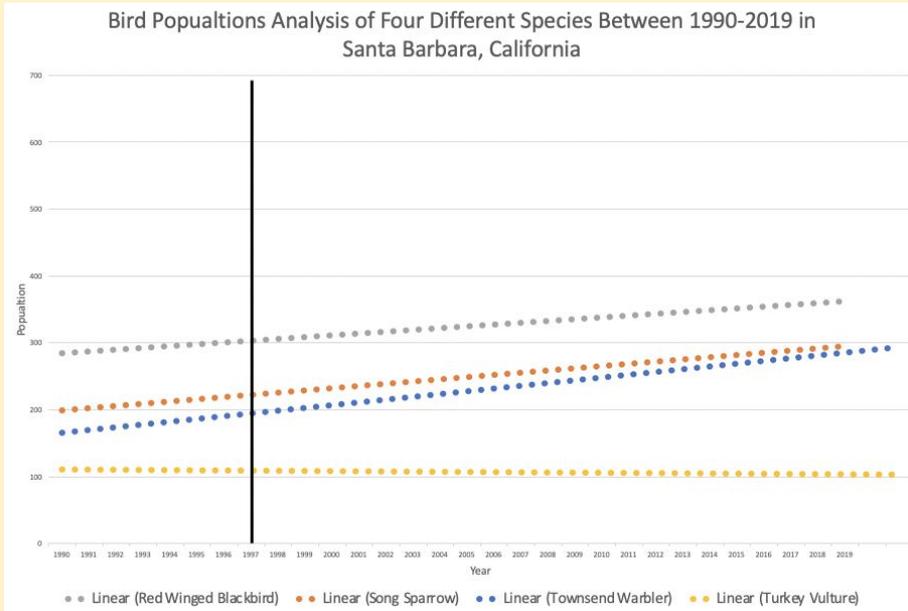
The black line at 1997 represents when pesticides were banned in Santa Barbara, California. Data was collected from Christmas Bird Count database from the 1990-2019.



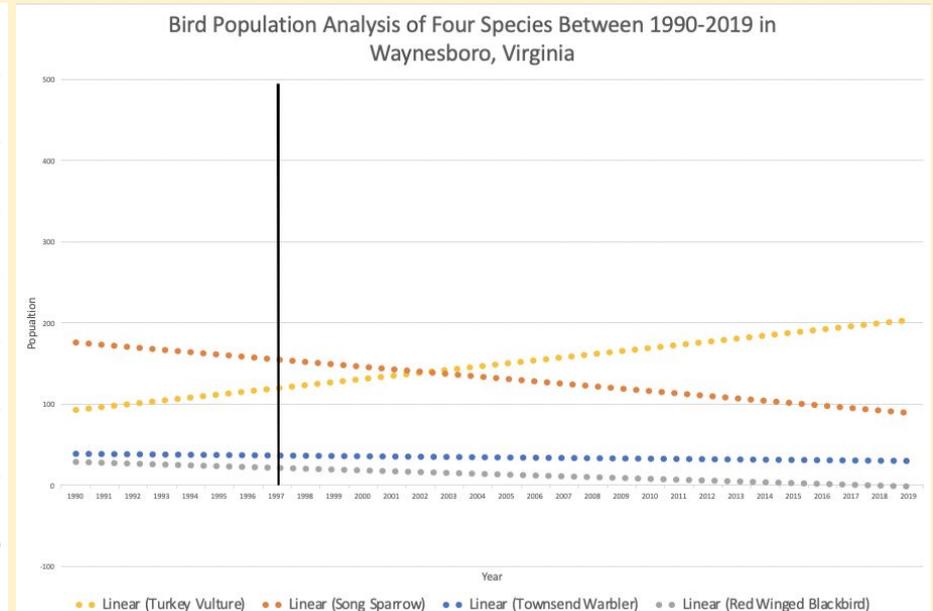
**Figure 5. Bird Abundance Analysis of Four Species Over 30 Years in Waynesboro, Virginia..**

The black line at 1997 represents when pesticides were banned in Santa Barbara, California. Data was collected from Christmas Bird Count database from the 1990-2019.

# Trendlines of Bird Abundance

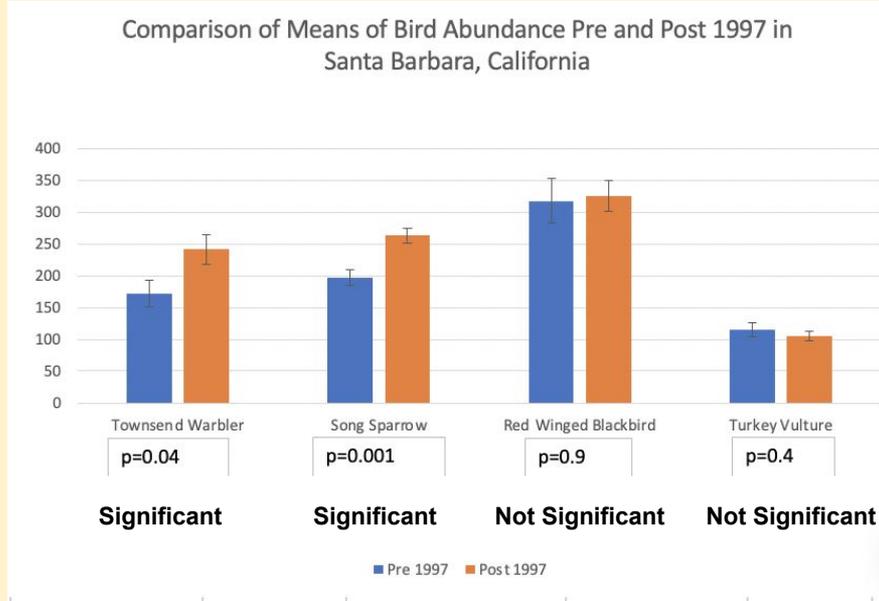


**Figure 6. Trendline of Bird Abundance in Santa Barbara, California.** The black line at 1997 represents when pesticides were banned in Santa Barbara, California. Data was collected from Christmas Bird Count database from the 1990-2019.



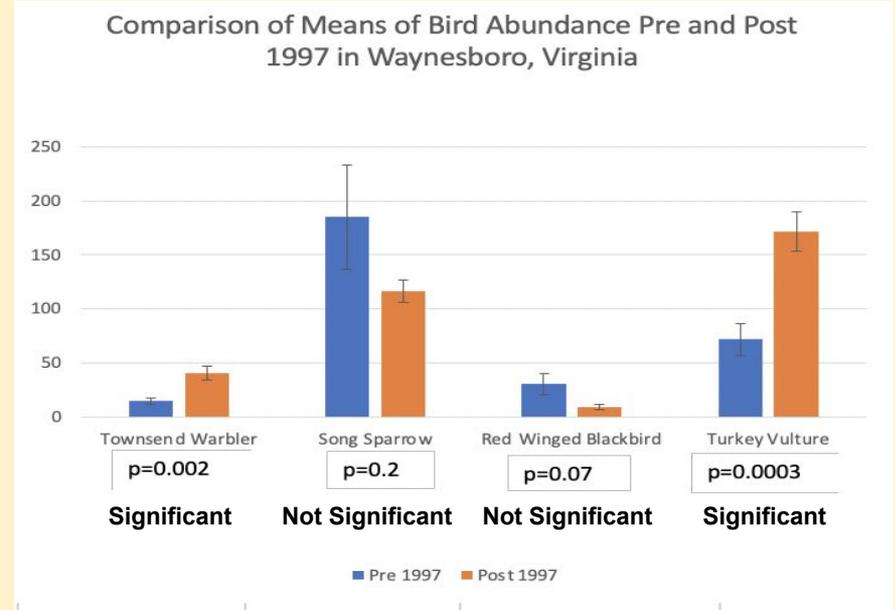
**Figure 7. Trendline of Bird Abundance in Waynesboro, Virginia.** The black line at 1997 represents when pesticides were banned in Santa Barbara, California. Data was collected from Christmas Bird Count database from the 1990-2019.

# Pre and Post 1997 Data



**Figure 8. Bird Abundance Pre and Post 1997 in Santa Barbara, California.**

Data was retrieved from Christmas Bird Count Database to determine the abundance of each bird species pre and post 1997. The p-values less than 0.05 are highly significant.

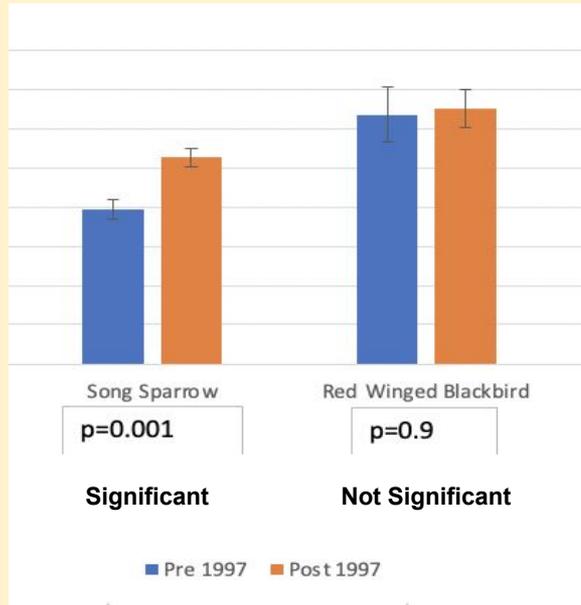


**Figure 9. Bird Abundance Pre and Post 1997 in Waynesboro, Virginia.**

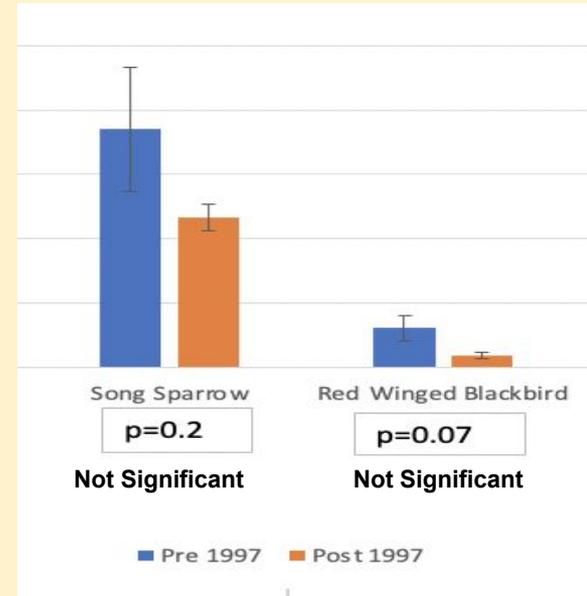
Data was retrieved from Christmas Bird Count Database to determine the abundance of each bird species pre and post 1997. The p-values less than 0.05 are highly significant.

# Figures 8 & 9 continued...

Santa Barbara, California

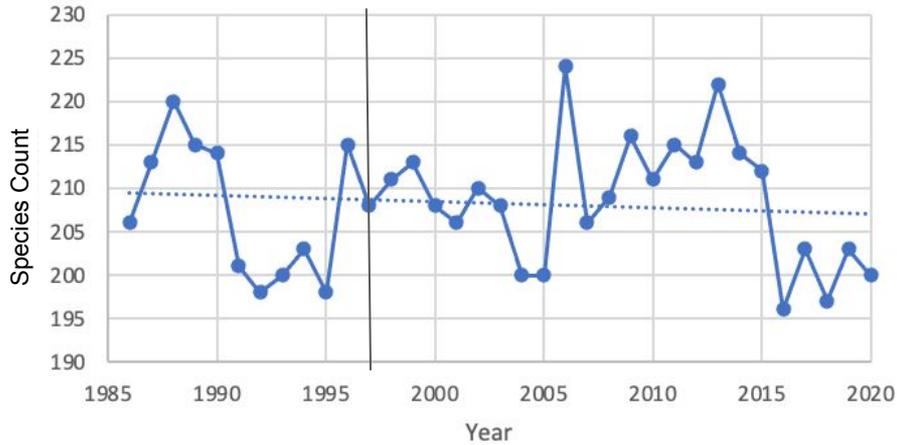


Waynesboro, Virginia



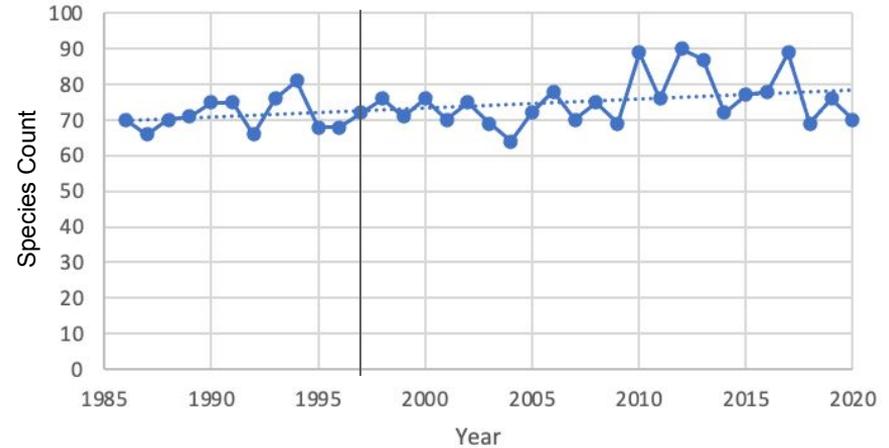
# Bird Biodiversity

Santa Barbara, California Bird Diversity



**Figure 10.** Bird species biodiversity from 1986 to 2020 in Santa Barbara, CA.

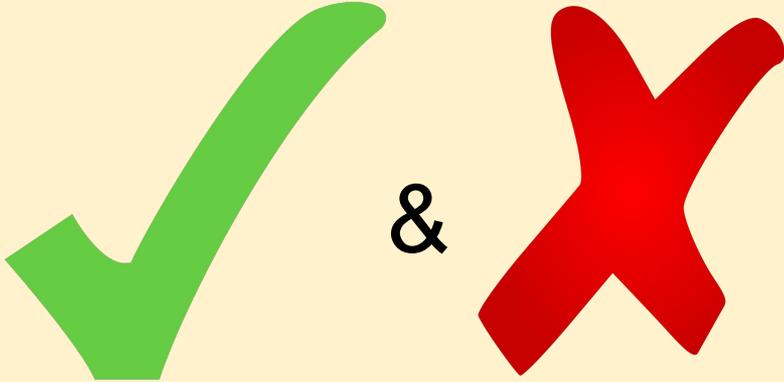
Waynesboro, VA Bird Diversity



**Figure 11.** Bird species biodiversity from 1986 to 2020 in Waynesboro, VA.

# Discussion

- Hypothesis = Partially supported



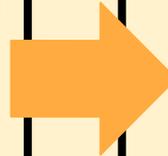
- All studied bird species in CA saw an **increase** in abundance after 1997, except vultures
  - **Grassland species** experienced a decrease in VA, although not significant

# Discussion

- Bird biodiversity is **decreasing** in Santa Barbara



Pesticides **only** affect a proportion of bird species, which could appear not to be an important factor in bird biodiversity decreasing



**Biodiversity:**

Santa Barbara:  
**Overall decline**

Virginia:  
**Increasing slightly**

# Discussion



- **Grassland Species:** Song sparrow = most significant p-value, results not conclusive, studying more grassland species could clear that up
  - Grasslands are replaced by agricultural lands, meaning the remaining grasslands are adjacent to the agricultural lands therefore the pesticides have direct effect on the birds.
- **Past Studies:** “Decline of North American Avifauna” conclude how pesticides play a role in the bird population declines. Birds consume insects **decline** and use of insecticides on land reduce prey for the birds (Mitra 2011).

# Future Studies

- Emphasize grassland species to study why they are more affected than other species
- Use a control area closer to the focus area for less confounding variables



# Works Cited

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- American Bird Conservatory. Pesticides. 2020.
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- Rosenburg, KE., Dokter, AM., Blancher, PJ., Sauer, JR., Smith, AC., Stanton, JC., Panjabi, A., Helft, L., Parr, M., Marra, PP. 2019. Decline of North American Avifauna. *Science*.
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