Cinnamon Teal Habitat Suitability Analysis

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Background

Cinnamon Teal is one of North America's studied dabbling duck species. Their breeding range is western North America, Mexico, and South America. Most of their breeding grounds reside in the Intermountain West and Central Valley California (Mackell, D. A. et al., 2021). According to the Cornell Lab in their the All About Birds online, these birds' habitats are wetlands and streams, reservoirs, stock ponds, baltic rush, cattails, sedges. When females nest, they usually nest amongst 2 feet high dead marsh grass, making them unnoticeable to the human eye. Due to the residing in and around wetlands, the dabbling duck is being monitored in association with the loss of wetlands, contaminants from agriculture, and human settlements (Cornell Lab, 2024). According to the IUCN Red List in 2020, this bird is not yet endangered but is coming near due to these reasons. In a recent study about bird habitat suitability by Ron Store and Jukka Jokimaki in Finland, habitat suitability was conducted with mature trees, roads, and streams. This project will be similar.

Objectives

The goal of this project is to develop a habitat suitability model for the Cinnamon Teal in California: Nevada County, Santa Clara County, and Orange County. It will be categorized based in the count on distance to highways, the slope of the DEM, and land use. Locations were determined by A) a study with data in Nevada County and B) iNaturalist most populous locations of Santa Clara County and Orange County.

Study Area, Data, and Methods

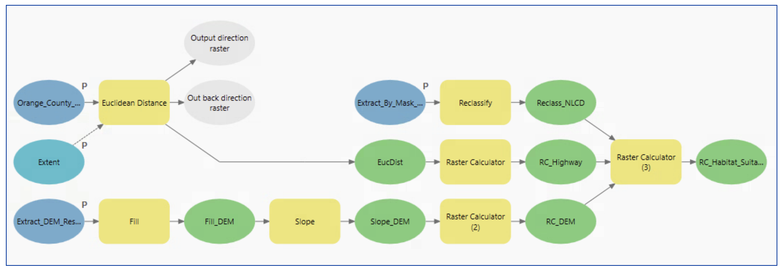
The study area is California: Orange County, Santa Clara County, and Nevada County.

Name	Source	Last Updated	Type	# of Layers
CA County Boundaries	CA Open Data Portal	05/03/2023	SHP	1
CA National Highway System	CA National Highway	10/25/2023	SHP	1
NLCD Land Cover Entire USA	National Landcover 2023	02/21/2023	TIFF	1
County DEMs	USGS TNM Downloader	n.d.	TIFF	SC County: 3 NV County: 2 OR County: 2

CA Counties: Deleted all counties except the three counties in focus → three individual shapefiles.
CA Highways: Clipped the highways by the county shapefile → Euclidean distance found for each county, extent being the map → Raster calculator with the following expression:
Con("County_Highways" < 500, 1, 0) → *(MDDNR, 2024)*
CA County DEMs: Imported each DEMs for the counties → Mosaic to new raster by 32bit float → Resample to get 30mx30m cell size → Fill → Slope → Raster calculator with the following expression:
Con("County_Slope" <= 3, 1, 0) → *(Walton, M. et al., 2014)*
NLCD: Extract by mask for USA raster by the county shapefile → change the symbology to match the description → Reclassified: *4 = wetlands (90/95), 3 = grassland/shrubs (52/71), 2 = pasture/hay (81), 1 = cultivated crops (82), and 0 = all others* → Saved as "NLCD_County"
Habitat Suitability Expression:
Con(("County_Slope" == 1) & ("County_Highways" == 1) & ("NLCD_County" > 0), "NLCD_County", 0)

Model Builder

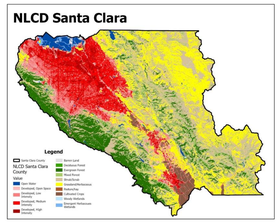
Model Builder was used in model for Habitat Suitability for reach of the three counties. Highways were chosen after the highways were clipped to the county. The DEM was chosen from the resampled data to a 30mx30m cell size. After extraction by the county mask, NLCD data was chosen and reclassified, changing the symbology to suitability levels to match other data was processed. It was then continued with the steps in the methods section for each parameter. The result is a raster calculator with numbers, not ranked. They were then ranked, as shown in the discussion and conclusions section. Each of the three counties resulted with the data. There were slight difference in the data "by hand" calculations to the model builder; shown in discussion and conclusion.

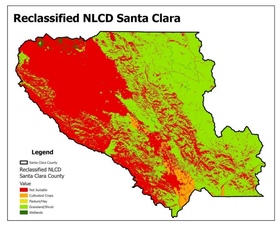


Maps – Pre-Processing

Representation of Santa Clara County. Data was processed in all three counties.

NLCD Data



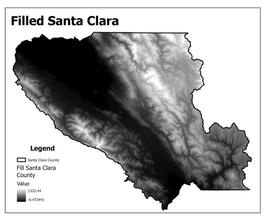


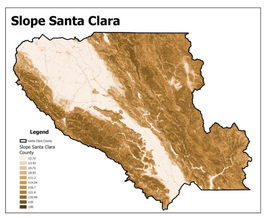
Rankings

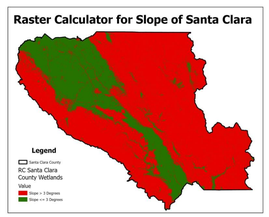
NLCD

0 = Not Suitable
1 = Cultivated crops
2 = Pasture/Hay
3 = Grassland/Shrub
4 = Wetlands

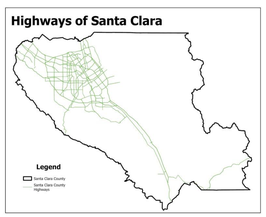
DEM Data

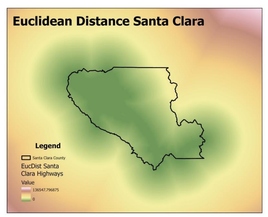


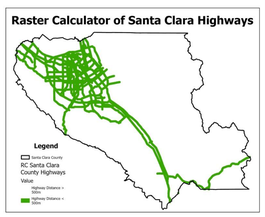




Highway Data

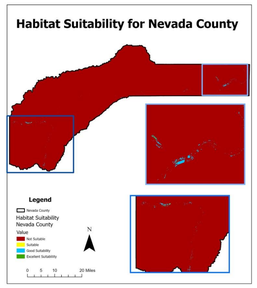




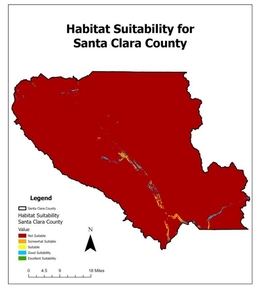


Results, Discussion, and Conclusions

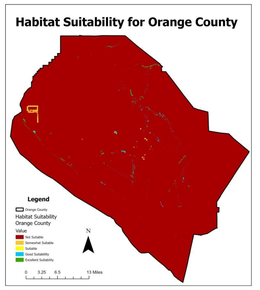
Below are the map results of Habitat Suitability *without* Model Builder: Santa Clara, Nevada County, and Orange County.



NEVADA COUNTY				
OBJECTID	VALUE	RANK	COUNT	PERCENTAGE
1	0	Not Suitable	4664314	99.83%
2	2	Suitable	57	0.00%
3	3	Good Suitability	6976	0.15%
4	4	Excellent Suitability	997	0.02%
		SUM	4672294	

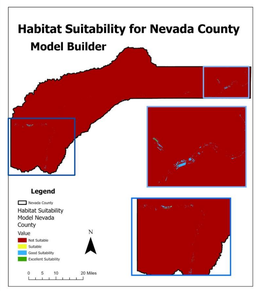


SANTA CLARA COUNTY				
OBJECTID	VALUE	RANK	COUNT	PERCENTAGE
1	0	Not Suitable	5855547	98.95%
2	1	Somewhat Suitable	33144	0.56%
3	2	Suitable	90	0.00%
4	3	Good Suitability	25996	0.44%
5	4	Excellent Suitability	3100	0.05%
		SUM	5917877	

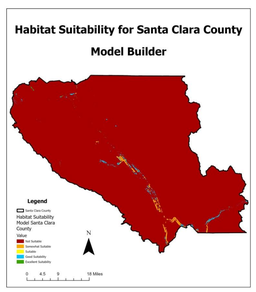


ORANGE COUNTY				
OBJECTID	VALUE	RANK	COUNT	PERCENTAGE
1	0	Not Suitable	3916598	99.37%
2	1	Somewhat Suitable	8502	0.22%
3	2	Suitable	290	0.01%
4	3	Good Suitability	7824	0.20%
5	4	Excellent Suitability	8392	0.21%
		SUM	3941606	

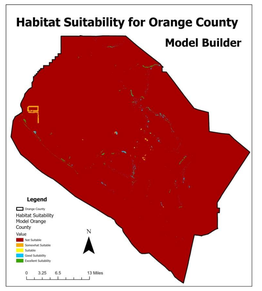
Below are the map results of Habitat Suitability *with* Model Builder: Santa Clara, Nevada County, and Orange County.



NEVADA COUNTY MODEL BUILDER				
OBJECTID	VALUE	RANK	COUNT	PERCENTAGE
1	0	Not Suitable	4664293	99.83%
2	2	Suitable	62	0.00%
3	3	Good Suitability	6930	0.15%
4	4	Excellent Suitability	1004	0.02%
		SUM	4672289	



SANTA CLARA COUNTY MODEL BUILDER				
OBJECTID	VALUE	RANK	COUNT	PERCENTAGE
1	0	Not Suitable	5855580	98.95%
2	1	Somewhat Suitable	33177	0.56%
3	2	Suitable	89	0.00%
4	3	Good Suitability	25961	0.44%
5	4	Excellent Suitability	3112	0.05%
		SUM	5917919	



ORANGE COUNTY MODEL BUILDER				
OBJECTID	VALUE	RANK	COUNT	PERCENTAGE
1	0	Not Suitable	3916708	99.37%
2	1	Somewhat Suitable	8477	0.22%
3	2	Suitable	289	0.01%
4	3	Good Suitability	7742	0.20%
5	4	Excellent Suitability	8432	0.21%
		SUM	3941648	

The approximate population of these birds is 380,000 (IUCN, 2020), in various populations through the west of North and South America. These are three counties consisting of approximately 8,400km^2 out of the total area of California, 424,000km^2. For the areas in which they inhabit – refer to background – this approximation seems to be accurate for the area in which they traverse and breed. Santa Clara County and Orange County, populated heavily by humans, are more suitable for the Cinnamon Teal to live with 0.41% for Orange County and 0.49% for Santa Clara County and 0.17% of Nevada County in the "Good/Excellent Suitability" category. Every time model builder ran for the counties, slight difference in the count portions occurred. This was more than likely due to a glitch of the extent parameter in the highway Euclidean Distances. Before running it, the parameters would change each time.

Rankings

Habitat Suitability Model

0 = Not Suitable
1= Somewhat Suitable
2 = Suitable
3 = Good Suitability
4 = Excellent Suitability

References

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