Steelhead Trout of Humboldt County:

An Analysis of Critical Habitat for Steelhead Trout

By

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Abstract

Steelhead trout, *Oncorhynchus mykiss*, is a species of fish that can grow to up to 55 pounds and up to 45 inches long. They are distinctive due to their olive color and heavily speckled bodies with, a red-pink stripe along the side of their bodies. This species has adapted to survive in a wide range of temperatures, but do best in areas where dissolved oxygen concentrations are at least 7 parts per million (ppm). Steelhead trout have been listed as endangered and threatened under the Endangered Species Act. In this analysis, we are looking to see the total amount of precipitation affects the available habitat of Steelhead trout. In addition, we analyze the relationship between Steelhead abundance and annual precipitation. The results of the following analyses have important implications for real-world applications, such as proper management of critical habitat based on individual need.

Introduction

Steelhead trout, *Oncorhynchus mykiss*, is a species of fish that can grow to up to 55 pounds and up to 45 inches long. They are distinctive due to their olive color and heavily speckled bodies with, a red-pink stripe along the side of their bodies. This species has adapted to survive in a wide range of temperatures, but do best in areas where dissolved oxygen concentrations are at least 7 parts per million (ppm). Adults migrate from marine environments into freshwater streams and rivers to mate about every 2-3 years after leaving their parent steam. Males maturing at two years and females at three years but may spend up to seven years in freshwater before migrating to estuarine areas. When in streams, deep pool with low velocity are important for overwintering. In order to spawn, Steelhead require a habitat that consists of gravel substrates free of silt.

Steelhead trout have been listed as endangered and threatened under the Endangered Species Act. It is believed that the dramatic decline in population is due to both human and natural factors (NOAA, 2016). The diversion of water for agriculture, hydropower and domestic uses has reduced the quality and quantity of habitat. Problems such as alteration of streambanks and channel morphology, increased water temperatures, and fragmentation of available habitats have further reduced the suitable habitats of the Steelhead trout. Some of the most crucial habitats for Steelhead are their migratory, rearing, estuarine, spawning, and rearing habitats.

We are looking to see how the total amount of precipitation affects the available habitat of steelhead trout. We will be focusing our analysis to Steelhead populations within Humboldt County (see Figure 1 for details of the study area). In

this analysis, we analyze how precipitation levels affect available habitats. In addition, we look at the quality of critical habitat to see which habitats have the most impact on Steelhead populations.

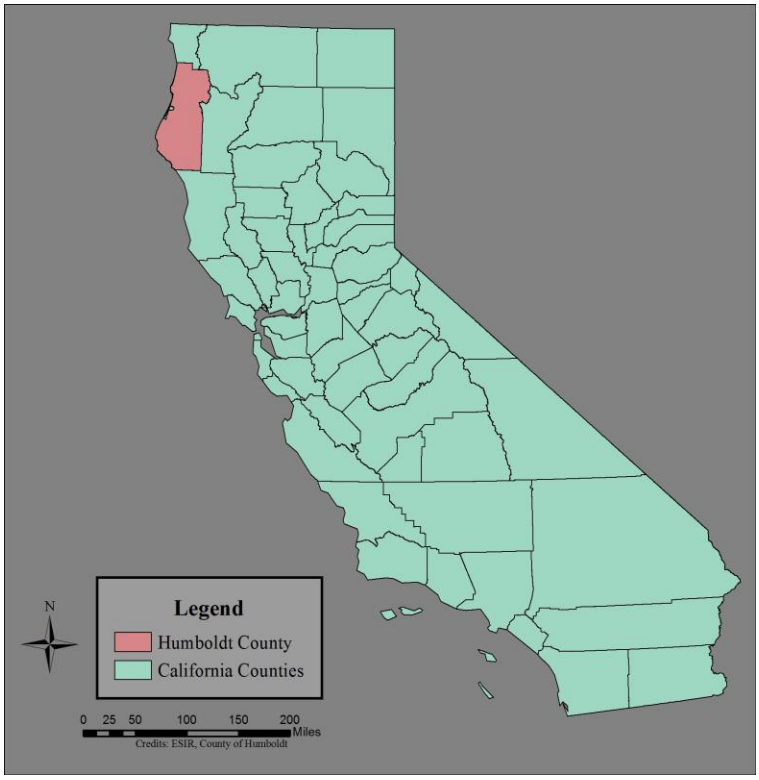

Figure 1: Location of Humboldt County in relation to California

Methods

The datasets used for this analysis were collected from ESRI, County of Humboldt, NOAA, and CalFish.

Analysis of Precipitation and Abundance

For the first analysis, we used precipitation data collected from NOAA and Steelhead abundance data from CalFish. Since the latest year for abundance from CalFish was 2005, the year for precipitation was also from 2005, to show a better relationship. The data from NOAA was originally a unison distributed polypoint shapefile. Because of this, the first step we took was to run an interpolation (IDW) to get a raster image of annual precipitation. The new dataset was then extracted by mask to Humboldt County (provided by County of Humboldt) in order to have the image fit to only Humboldt County. Next, the abundance layer was symbolized based on average fish found in a run by year. The resulting map can be found in Figure 2.

Analysis of Critical Habitats

The datasets used for the critical habitat analysis were primarily collected from CalFish. A series of select by attribute analyses were run on the critical habitat layer (provided by CalFish) to collect data on Steelhead found in the habitats. This data can be found in Table 1 and Figures 6-7. It is noted that estuary habitat was insignificant for the study. There were only 4 estuary habitats with a presence, as shown depicted in Figure 7. Next, the critical habitat layer was symbolized based on quality of habitat (Migratory: Figure 3, Rearing: Figure 4, and Spawning: Figure 5).

Results

The results of the select by attributes in within the critical habitat layer show that the rearing habitats are the most important for Steelhead sustainability (Table 1, Figure 6). While only having one year of abundance and precipitation, it is clear there is a direct relationship between these two factors (Figure 2). Figures 3-5 depict the quality of various critical habitat for Steelhead and their locations within Humboldt County.

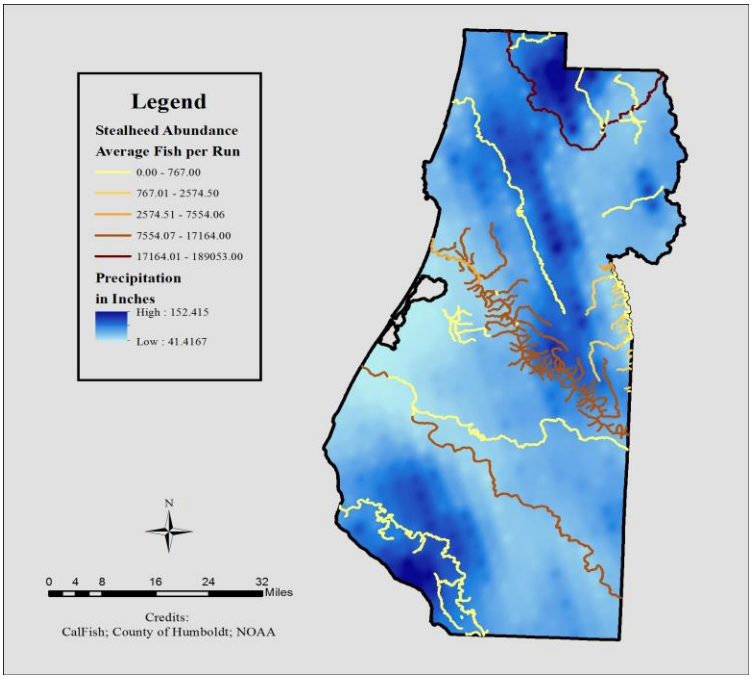

Figure 2: A map depicting the relationship between amount of precipitation and steelhead abundance in runs.

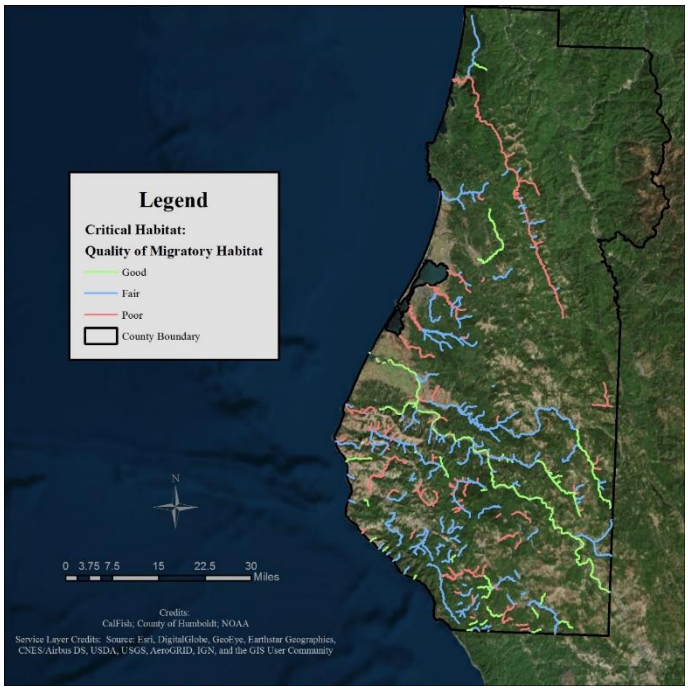

Figure 3: A map depicting the locations of different qualities of migratory habitat for Steelhead populations throughout Humboldt County.

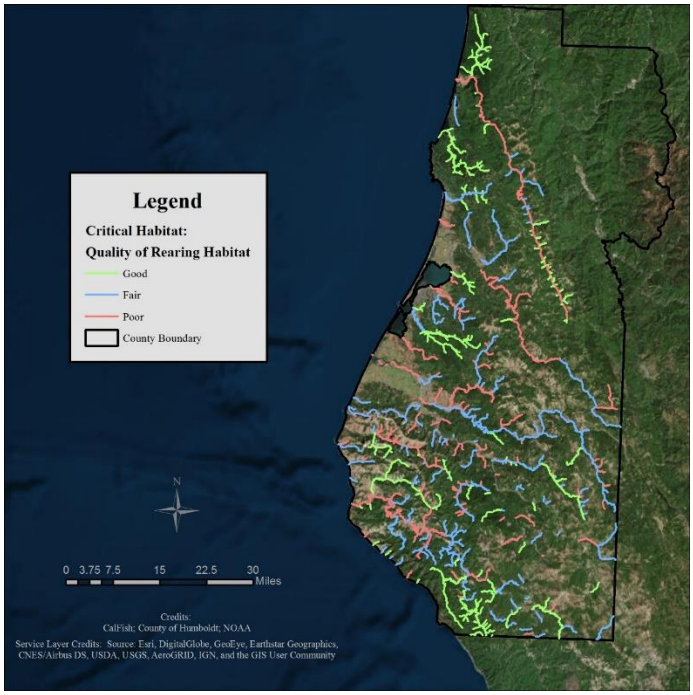

Figure 4: A map depicting the locations of different qualities of rearing habitat for Steelhead populations throughout Humboldt County.

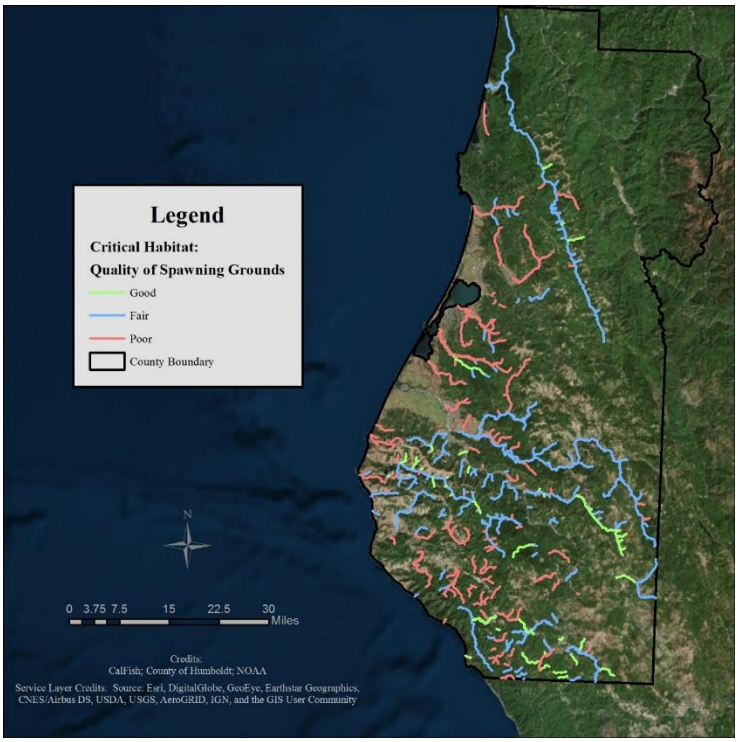

Figure 5: A map depicting the locations of different qualities of rearing habitat for Steelhead populations throughout Humboldt County.

Table 1: Table showing the relationship between quality of habitat and the amount of Steelhead found in each habitat quality. Note that the quality of rearing habitat is the most important aspect for steelhead population sustainability.

Amount of Steelhead found in various habitats based on quality of each habitat			
Type of Habitat	**Quality of Habitat**		
	Good	Fair	Poor
Spawning	40	114	100
Rearing	125	111	81
Migratory	35	126	72

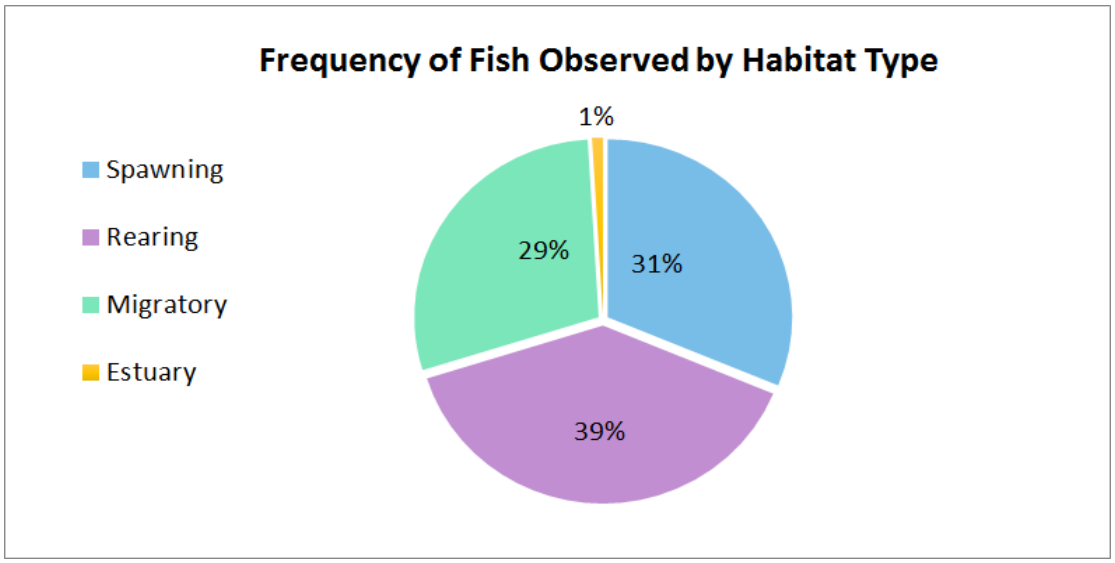

Figure 6: The above graph shows the frequency that fish have been observed in each of the habitat types

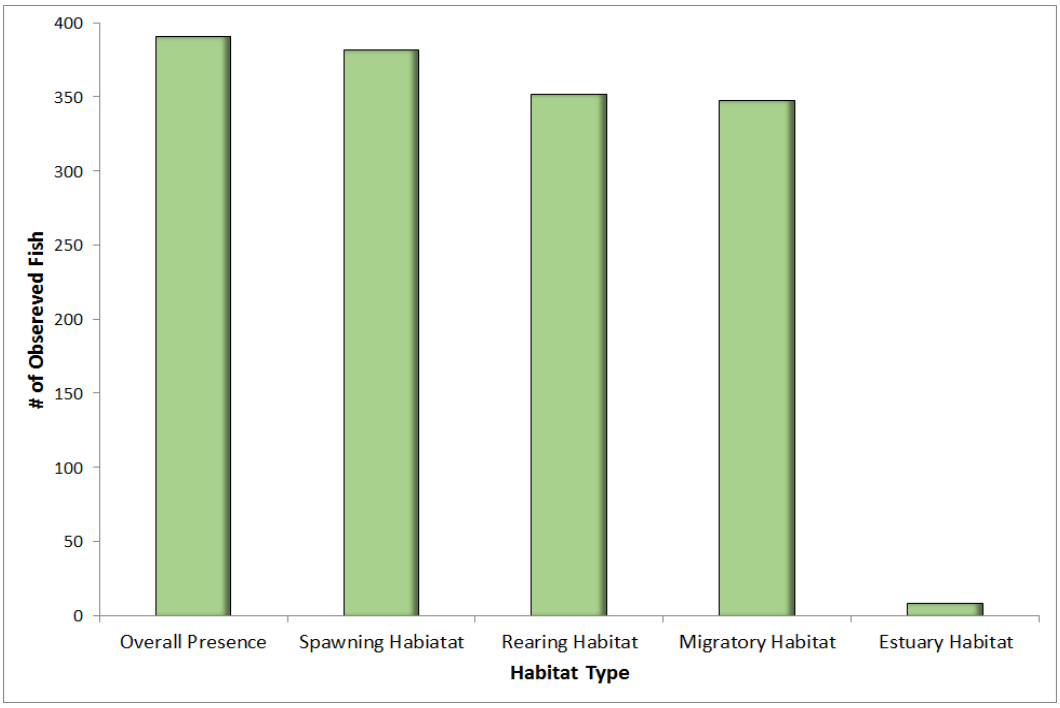

Figure 7: The graph above shows the number of observed fish in each of the habitat types.

Discussion

The results of this analysis have important implications for real-world applications. While the precipitation analysis was rather small, it allows understanding of a relationship between overall annual precipitation and abundance of Steelhead populations throughout Humboldt County. Because of this direct relationship, the implications of climate change on Steelhead populations are made real, and allow for a call to action on preserving these populations, as necessary. In addition, understanding the locations of centralized populations is vital. While this was not an analysis we ran, it could be a future project to analyze the abundance in relation to critical habitat by using buffers and/or a select by location.

While there is no map or chart showing the relationship between precipitation and critical habitat, it is well known that precipitation is vital for fish habitat. With the growing issues of climate change and sea level rise, there is more demand in understanding the importance of habitats for all species that may be affected by these changes we are just beginning to experience.

As shown in the data, rearing habitat is the most crucial habitat for Steelhead sustainability. Knowing this, we can focus most restoration efforts on rearing habitats. Current management plans throughout California are focused on estuarine, rearing and spawning habitats, along with lagoons (McEwan & Jackson, 1996). However, with this detailed information, we can focus more on rearing habitats than other habitats that may not be as crucial to Steelhead survival. As shown in examples such as the Humboldt Bay Estuary, there is a lot of money spent on creating estuary habitat in many different coastal areas. However, the results of this study show that there should be a greater emphasis put on rearing habitats, followed closely by spawning and migratory habitats. There is little evidence from this study that supports estuary habitats being a critical focus for Steelhead. Being such a large part of the culture, Steelhead need proper management.

Acknowledgements

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Bibliography

"CalFish Data Explorer." *CalFish Data Explorer*. N.p., n.d. Web. 16 Oct. 2016.

"CalFish Programs & Data Species Anadromous Fish Distribution Steelhead." *CalFish Programs & Data Species Anadromous Fish Distribution Steelhead.* N.p., Feb. 2011. Web. 16 Oct. 2016.

Dennis McEwan & Terry Jackson. “Steelhead Restoration and Management Plan for California.” Feb. 1996. Web. 5 Dec. 2016.

"Pacific Salmonids Major Threats and Impacts: NOAA Fisheries." *NOAA Fisheries*. N.p., May 2014. Web. 20 Nov. 2016.

"Steelhead Trout (Oncorhynchus Mykiss): NOAA Fisheries." *NOAA Fisheries*. N.p., 24 Feb. 2016. Web. 02 Dec. 2016.