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# **Species overview**

Name of Species: *Rana sierrae* (Sierra Nevada Yellow-Legged Frog)

The Sierra Nevada Yellow-Legged Frog (*Rana sierrae*) was formerly recognized as part of the same species as the Mountain Yellow-legged Frog (*Rana muscosa*). Research into separate populations of *R. muscosa* has indicated significant genetic differences, indicating that these populations comprised of two distinct species rather than distinct populations of the same species (Vredenburg, et al., 2007).

Morphology

The Sierra Nevada Yellow-Legged Frog is approximately 1.5 to 3.25 inches on average, and is classified as a medium-sized amphibian. Similar to most anurans, the female Yellow-Legged Frog is typically larger than the males (U.S. Fish & Wildlife Service, 2017).

Coloration of the frogs can vary, though adults tend to have a mix of brown and yellow coloration on the dorsal side of the body. The common-name for Rana sierrae comes from the coloration of the underside of the back legs which are a distinctive yellow or light orange. Tadpoles grow up to 2 inches long and are brown with flecks of gold (Nafis, 2018).

Species Status

The Sierra Nevada Yellow-Legged Frog is considered endangered by the IUCN. The species was federally protected under the Endangered Species Act as of 4/25/14 (Nafis, 2018). Approximately two years after the listing, the U.S. Fish and Wildlife Service designated 1.8 million acres of protected critical habitat for the Sierra Nevada Yellow-Legged Frog. This protected habitat was also designated to help other threatened and endangered amphibians including the Southern Mountain Yellow-Legged Frog (*Rana muscosa*) and the Yosemite Toad (*Anaxyrus canorus*) (Miller, 2016).

Ecology and Life Cycle

The Yellow-Legged Frog is mostly found near persistent pools of water and does not forage far from their initial breeding lakes. It eats a variety of terrestrial and aquatic invertebrates and tadpoles and may also consume dead frogs and its own eggs (Nafis, 2018).

Unlike other species of frogs found in California, the Yellow-Legged Frog is active mostly during the day. During the height of winter, the species is assumed to live at the bottom of frozen lakes and will not reemerge until shortly after the beginning of snowmelt. It rarely occurs where predatory fishes have been introduced (U.S. Fish & Wildlife Service, 2017).

Reproduction is aquatic and follows a reproductive cycle similar to most other frogs and toads in California. The Yellow-legged frog comes into maturity after approximately 4 years, though food availability can alter the length of the juvenile life-stage. Adult males will produce a mating call after at the beginning of breeding season, which typically occur after April, to attract females.

Fertilization is external, and is done in amplexus, with the male grasping the back of the female and releasing sperm as the female lays her eggs. Females lay eggs in large clusters and are often attached to underwater vegetation. Entire egg clusters have the approximate mass of a tennis ball (Stebbins, 2003).

The eggs hatch into tadpoles which feed in the water and eventually grow four legs, lose their tails and emerge onto land where they disperse into the surrounding territory (Nafis, 2018). Yellow-legged frog tadpoles often overwinter 2-3 times before metamorphosing into juveniles (Vrendenburg, Fellers, & Davidson, 2005).

Juvenile and adult Yellow-legged frogs are considered highly aquatic, rarely found more than a few meters from a source of water (Vrendenburg, Fellers, & Davidson, 2005). These frogs are opportunistic feeders and consume both aquatic and terrestrial invertebrates. Adult Yellow-Legged frogs are expected to live up to 20 years old (Matthews & Miaud, 2007).

Yellow-legged frogs have no natural aquatic predators, other than an occasional cannibalism. Introduced trout species to naturally fish-free lakes and streams in high elevation regions of California are considered the main reason of the species decline (U.S. Fish & Wildlife Service, 2017), followed by the subsequent introduction of a fungal pathogen, *Batrachochytrium dendrobatis*, that has been linked to global declines in amphibian populations (Skerratt, et al., 2007).

Range Description

The historical range of the Sierra Nevada Yellow-Legged Frog (R. sierra) extended throughout California and parts of Nevada. The historical range is bounded by the Diamond Mountains in Plumas County at the Northwest; Mount Rose, located in Washoe County, Nevada, to the Northeast; the Middle and South Fork of the Kings River, located in Fresno County, California, to the Southwest; and the Glass Mountains, located in Mono County, California, to the Southeast. Rana sierrae is now extirpated from Nevada and from large portions of the historical range in the Sierra Nevada of California (Hammerson, 2008).

The population of this species that we will be looking at is located within Yosemite National Park and includes studies of species across several geographically distinct lakes found within that park (Knapp, et al., 2016).

Conservation Problem

The primary cause of population declines of the Sierra Nevada Yellow-legged Frog has been attributed to non-native trout introductions to high elevation lakes and streams in the Sierra Nevada. Fish introductions have stopped in some areas, such as within the National Parks, but they continue in others. Extensive surveys within the Sierra Nevada region has clearly demonstrate the strong detrimental impact of introduced trout on *R. muscosa/R. sierrae* populations. Removal of non-native fishes is expected to reverse the decline.

Data

We have acquired a dataset of 20 years across multiple Yosemite lakes with population counts broken down by life stages. The data comes from Roland Knapp, a researcher associated with the Sierra Nevada Aquatic Research Laboratory (SNARL), University of California.

Surveys were conducted by Roland Knapp across 2154 water bodies within Yosemite National Park between the years of 1993 and 2012, inclusive. Not all water bodies were surveyed every year, though bodies with persistent Yellow Legged Frog populations were surveyed most frequently. In some cases, bodies of water were surveyed multiple times within a same year, as such the date of each survey is included in our dataset.

A quick example population data was created using excel. These two graphs show the population counts for the Sierra Nevada Yellow-legged Frog at one of the surveyed lakes. Population counts included counts for adults, juveniles, and tadpoles. In total we have data from 7678 individual surveys. We will likely being doing this project on a subset of this data, perhaps looking at one particular lake or a cluster of lakes that are located near each other. Information on where the lakes are located is also included in the dataset that we have obtained from Roland Knapp’s research.

Beyond your basic life history information above, is there information about average fecundity, annual survival rates of juveniles and adults, and the fraction of eggs that survive to one year old?

What management questions do you hope to address? On the previous page you talk about fish removal, but the example data you show seems to be a fish-free lake?

Do you know what caused the increase from earlier parts of the time series to later parts? Is the environment changing in some way, or was the population recovering from an initial low density?

It is likely that you will need to incorporate density dependence into a model of this species, at least in fish-free lakes. Do you know anything about the relative importance of cannibalism, food limitation on survival and/or growth, and food limitation on fecundity?

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