

# Road crossings of California tiger salamanders (*Ambystoma californiense*) near mitigation tunnels in Sonoma County, CA

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## Background

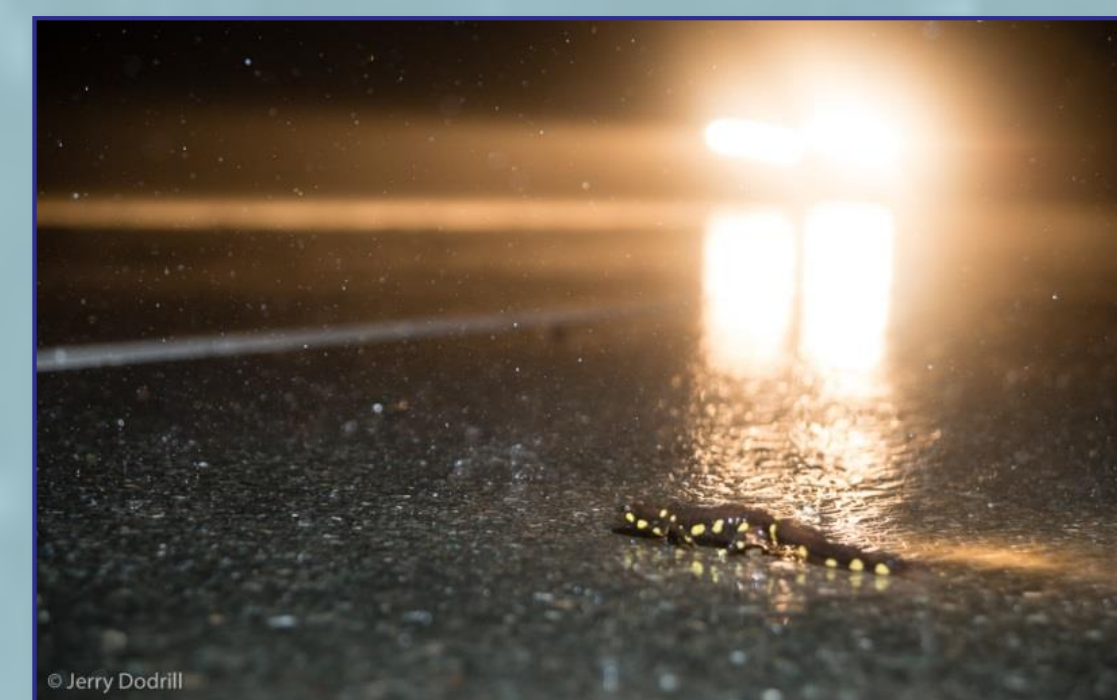
- The California tiger salamander (CTS) is an endangered species in the Sonoma County population (1), and depends upon unique, rapidly disappearing habitats
- A crucial event in the CTS life cycle is the annual migration of breeding adults from upland habitat to a vernal pool; this journey takes place on rainy nights from December to February (2)
- Human infrastructure development is continually encroaching upon CTS habitats (3); a significant example is Stony Point Road, a busy rural thoroughfare which cuts directly between the upland habitat and breeding pool of a population of Sonoma County CTS
- To mitigate this problem, Sonoma County constructed three tunnels under Stony Point Road within the migration corridor in 2011; additionally, fencing to funnel migrating salamanders into the tunnels was installed (4,5,6)
- Since construction of the mitigation project, a joint effort of Sonoma County Water Agency and Sonoma State University has monitored above- and below-ground CTS road crossings during the breeding season
- Following the 2016-2017 breeding season, we examined how the location of above-ground CTS road crossings has changed since the 2011-2012 breeding season



Sonoma County California tiger salamander  
Photo courtesy of www.CalHerps.com.



Vernal pool: CTS breeding habitat  
Photo courtesy of Tracy Bain



Salamander crossing road  
Photo courtesy of Tracy Bain

## Hypothesis

Observations of CTS migrating within the mitigation tunnel zone have decreased relative to observations outside the tunnel zone over time

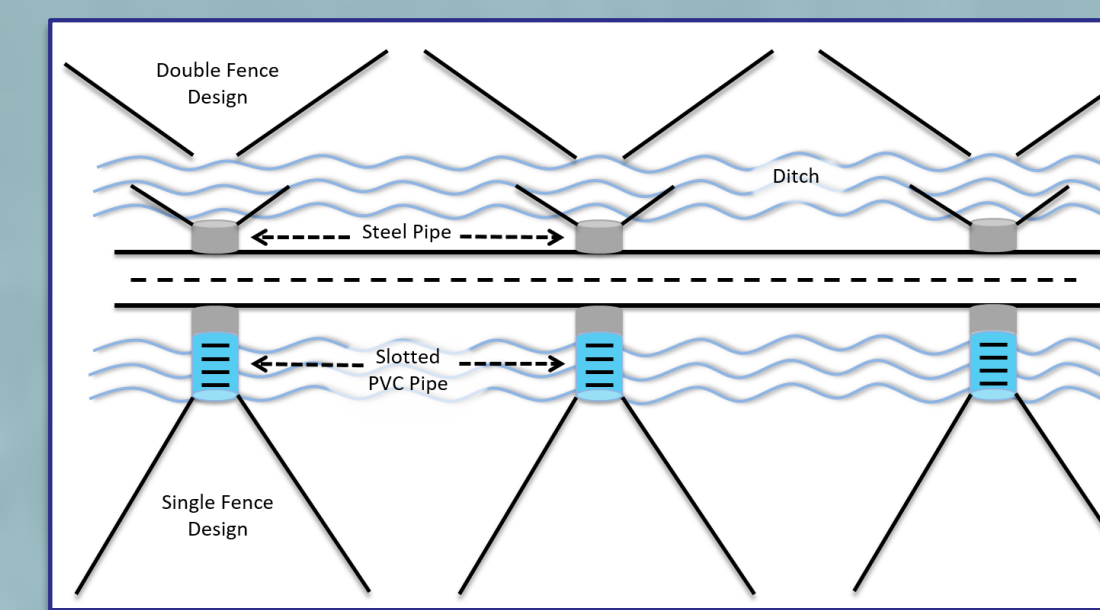


Photo courtesy of Tracy Bain

## Methods



Mitigation tunnel study site at Stony Point Road, Sonoma County, CA. Yellow field is migration corridor surveyed by observers, red triangles are funneling fencing, white rectangle is zone above tunnels.



Tunnel and fencing design at mitigation site.

- Pairs of observers walked along Stony Point Road within the migration corridor of the target CTS population, starting at dusk, on rainy evenings from December to February from 2011-2017
- Locations of sightings of migrating CTS adults were marked with pin flags; subsequently, an observer recorded the GPS location of each sighting using Garmin GPS unit
- Location data was downloaded and analyzed using Google Earth Pro and JMP Pro 13

## Discussion

- These data show an apparent change in the migration pattern across the road near the mitigation tunnel site; the likelihood of observing a CTS within the migration tunnel area has decreased since the years immediately following installation of the tunnels and fencing
- The overall number of observations per breeding season has decreased substantially; this trend coincides with a prolonged period of drought
- In order to determine whether the decrease in observations within the tunnel zone is due to use of the mitigation tunnels or avoidance of fencing by migrating CTS, it will be necessary to examine video footage from camera traps positioned at the entrance of the mitigation tunnels
- Observers noted that migrating CTS sometimes move parallel to the road during crossing; sighting locations may not always correspond to direct migration path from upland to pond
- The increase in observations during the 2016-2017 breeding season, following an increase in total precipitation in the 2015 water year, gives reason to hope that this population may rebound with improved abiotic conditions

## Acknowledgements

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- The Student SOURCE Award Fund
- The Sonoma County Water Agency
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Photo courtesy of U.S. Fish & Wildlife Service

## Results



Contingency analysis shows a significant difference between likelihood of CTS being observed inside the tunnel zone in the early years following tunnel construction, compared with more recent breeding seasons

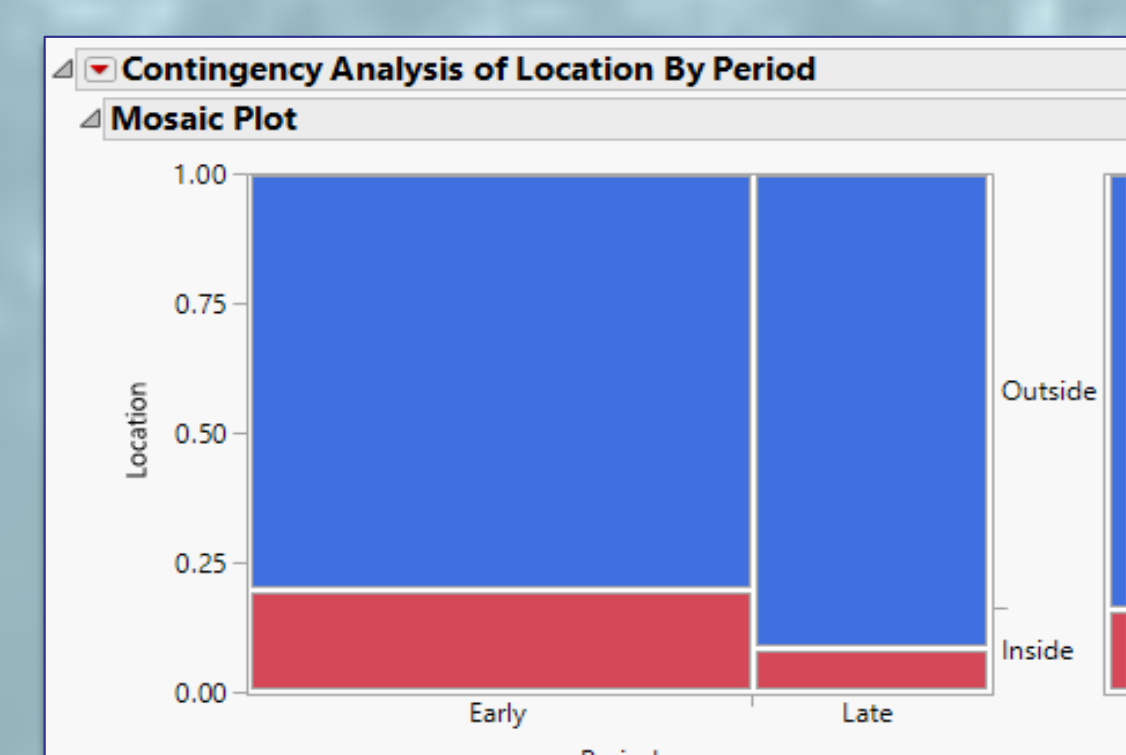


Chart 1. Contingency analysis of location of migrating CTS sightings by time period; Early is 2011-2013, late is 2013-2017; Time period does predict location of sighting (Likelihood ratio,  $\chi^2=5.015$ ,  $df=1$ ,  $p=0.0251$ )

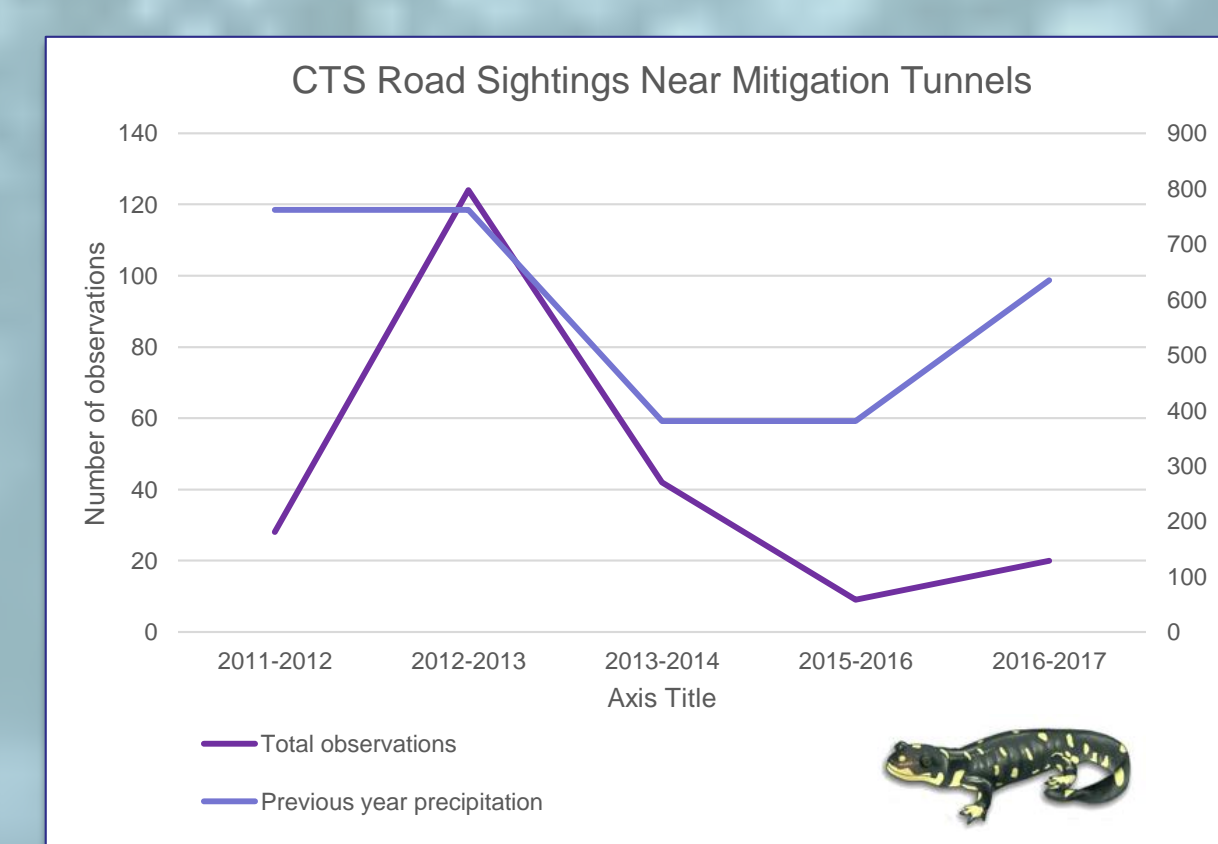


Chart 2. Progression of total number of CTS road sightings by year (purple) and total precipitation in previous year (blue) (7)

Total sightings increased substantially the year after tunnel installation, decreased from 2013-2016, then increased slightly in the 2016-2017 breeding season; this pattern is mirrored by total precipitation for the previous year (7)

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