



SF Zoo Conservation Head-starting and Behavioral Research Updates

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Conservation Team



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Head-starting Threatened Species



We are head-starting:	IUCN Status	US Status
Sierra Nevada Yellow-legged Frog	Extinct: EX, EW; Threatened: CR, EN, VU; Least Concern: NT, LC	Endangered
California Red-legged Frog	Extinct: EX, EW; Threatened: CR, EN, VU; Least Concern: NT, LC	Threatened
Yosemite Toad	Extinct: EX, EW; Threatened: CR, EN, VU; Least Concern: NT, LC	Threatened
Western Pond Turtle	Extinct: EX, EW; Threatened: CR, EN, VU; Least Concern: NT, LC	Petitioned
San Francisco Forktail Damselfly	Extinct: EX, EW; Threatened: CR, EN, VU; Least Concern: NT, LC	Rare



A Decade+ of Conservation

Species	Project Years	Released pre-2022
Sierra Nevada Yellow-legged Frog	2014–2023 (10 years)	1,876



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Western Pond Turtle	2008–2023 (16 years)	445



A Decade+ of Conservation

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Western Pond Turtle	2008–2023 (16 years)	445
Yosemite Toad	2017–2023 (7 years)	—



Released in Summer 2022 (Year 9)

Species	Population	2022
Sierra Nevada YLF	Yosemite Summit Meadow	350
	Yosemite South Lyell Lake	94
	Plumas National Forest	164
	Sequoia-Kings Canyon	224
CRLF	Yosemite Valley	100

Total of
832



Released to Date

Species	Years	Released pre-2022	2022	Total pre-2023
Sierra Nevada YLF	10	1,876	832	2,708
California Red-legged Frog	8	1,073	100	1,173
Western Pond Turtle	16	445	—	445
Yosemite Toad	7	—	—	—



Proposed Releases

Species	Population	Cohort	Total
Sierra Nevada YLF	All 745 will be released in 2023		
CRLF	700+ will be released in 2023 ~250 will be released in 2024		
Yosemite Toad	All 153 will be released in 2024		



Dedicated Quarantine Space

Recovery Facility
1155 sq ft



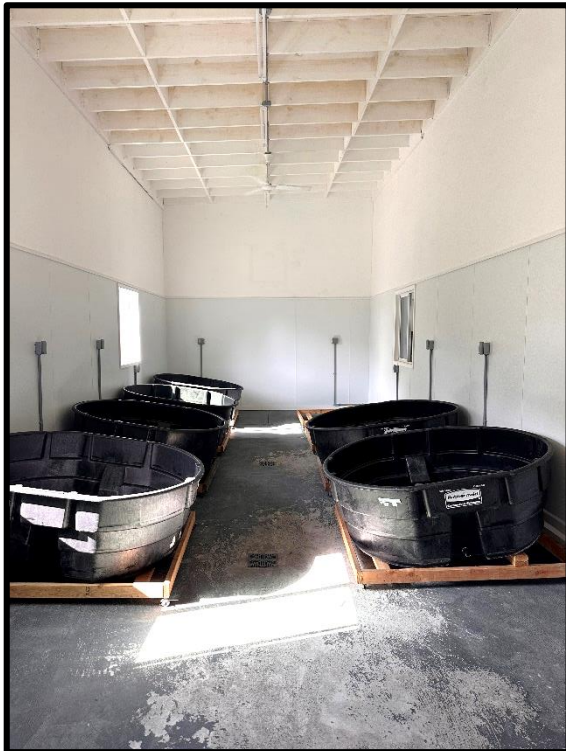
“Yellows Building”
400 sq ft





Dedicated Quarantine Space

Renovated Space
1170 sq ft



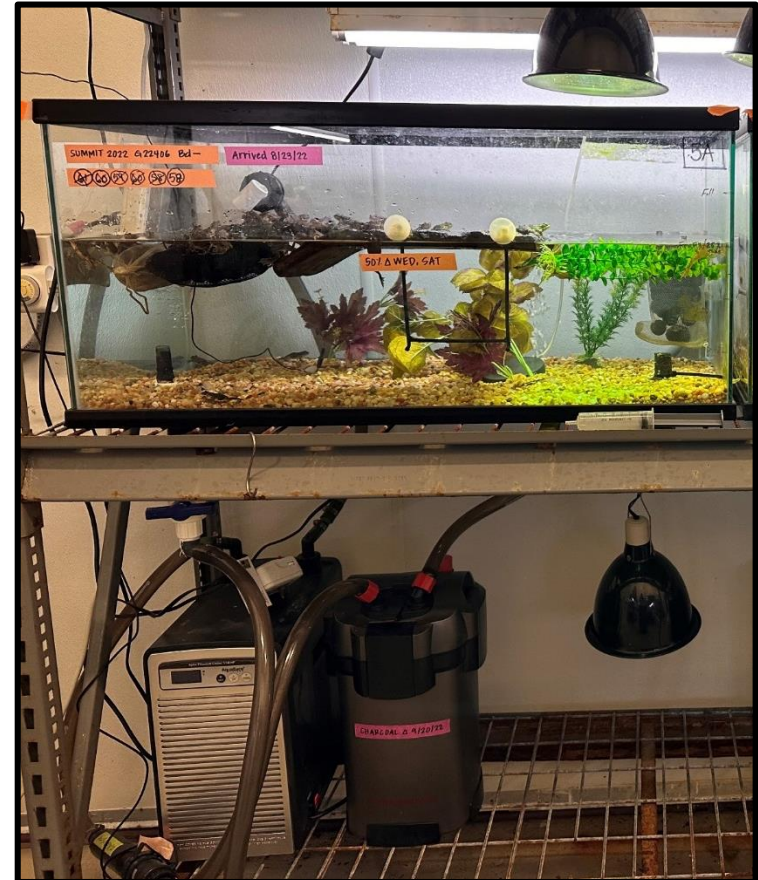


Rearing – Glass aquaria



Tadpoles ~ 35 gal

Frogs ~ 30 gal



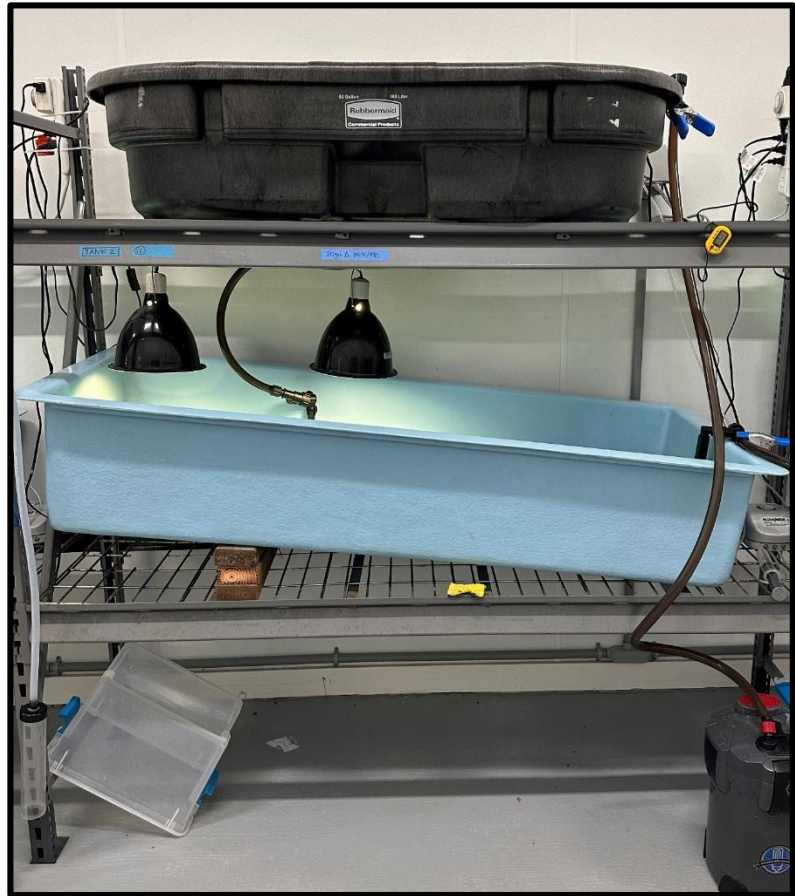


Rearing – tadpole/toad troughs

~ 125 gal



~ 60 gal





Rearing – troughs for YoToad





Rearing – *aquatic* stock tanks



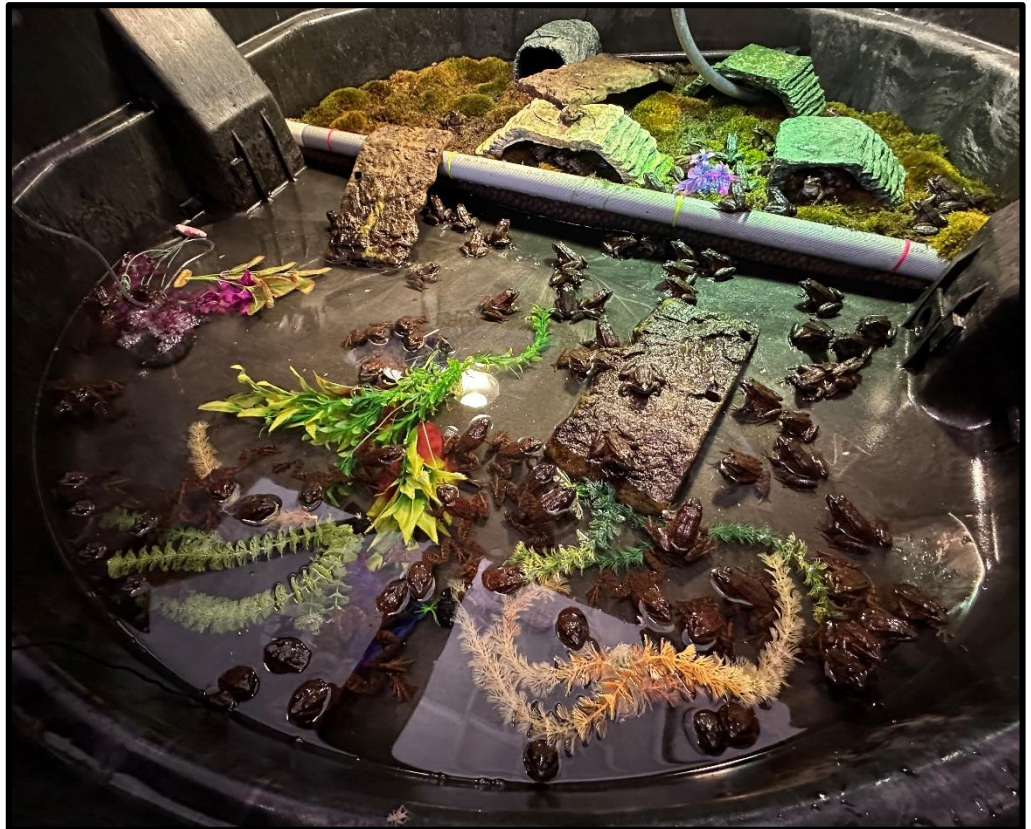
Rearing – *aquatic* stock tanks



Isaac Chellman



Rearing – *aquatic/terrestrial*





Suitability for the wild

Behavior



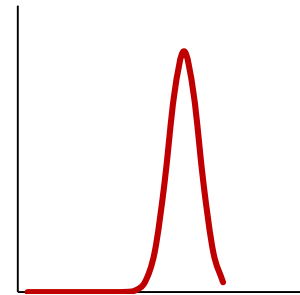
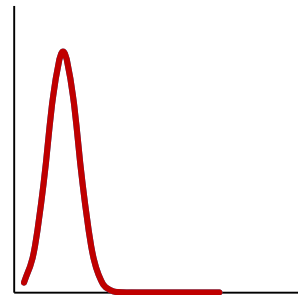
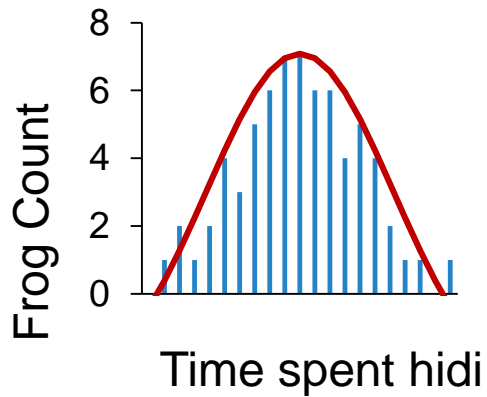
Disease





Behavior

Behavioral types: Individual behavioral differences that are consistent over time and multiple contexts.
~ **Personalities**



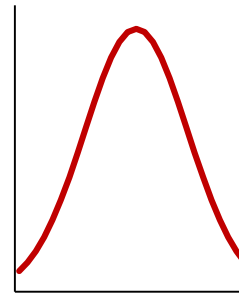


Behavior

Behavioral types: Individual behavioral differences that are consistent over time and multiple contexts.
~ ***Personalities***

Determined by:

- ✎ Genetics
- ✎ Environment

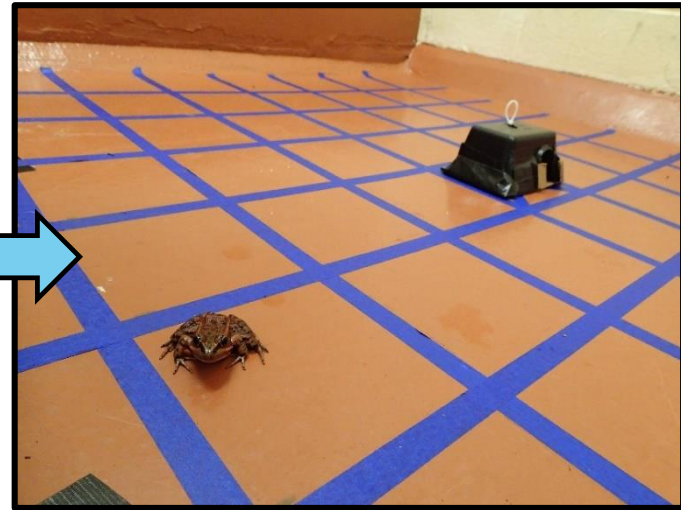


**Wide range =
Best given
uncertainty**



Behavioral types

Novel setting





Behavior in a **novel** setting?

38 frogs per enclosure, 5-min trials, **x 2 years**
3 trials total (5 weeks in between)





Behavior in a **novel** setting?

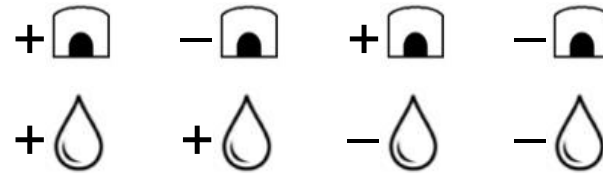


Measured (time spent):

- ✎ Hiding = **HIDE**
- ✎ Sitting in hide entrance = **ENTRANCE**
- ✎ Moving outside the hide = **MOVE**



How do individuals behave?



HIDERS	41 %	45 %	63 %	37 %
VIGILANT-ES	22 %	11 %	13 %	26 %
MOVERS	14 %	29 %	11 %	26 %
AVERAGE JOES	23 %	15 %	13 %	11 %



Suitability for the wild

Behavior



Main Findings

- ✚ Frogs do have consistent behaviors, ~ personality
- ✚ Wider range of behavioral types in enclosures with fewer hides
- ✚ Frogs have behavioral plasticity in a novel setting



Suitability for the wild

Behavior

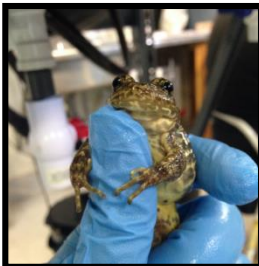
Disease





Disease susceptibility

Joel Sartore



Chytrid (*Bd*) fungus

- Deadly, global disease
- Driven extinction of > 200 species
- > 90% Yellow-legged Frogs have disappeared from Sierra Nevada Mts
- Mary Toothman (UCSB), created immunization protocol
- Infect frogs with chytrid, let infection develop, treat with antifungal, reinfect, infection intensity lower, nonlethal

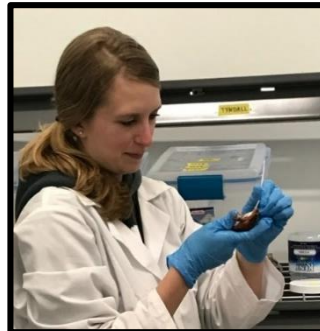


Disease susceptibility



California Red-legged Frogs

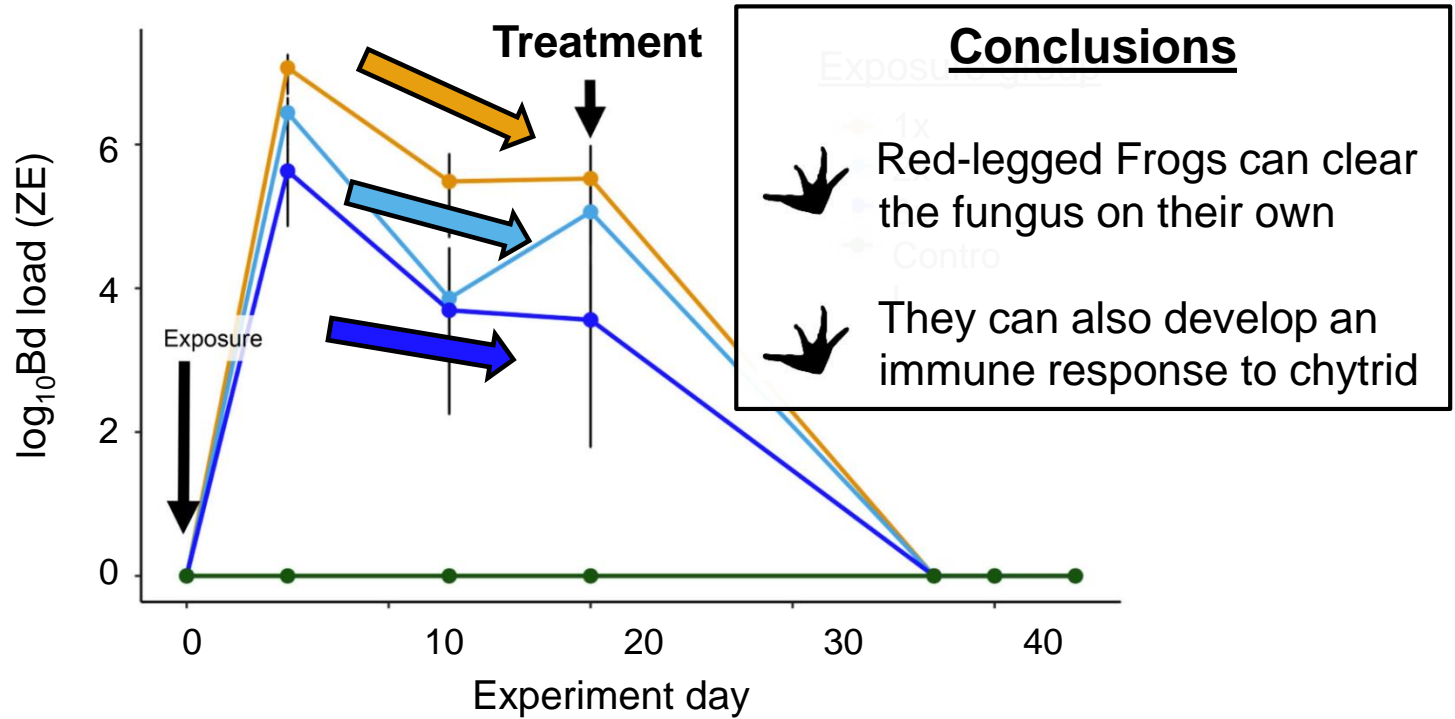
- Have chytrid, but not causing declines
- Do these frogs have innate immunity?
- Two-year infection study and release





Disease susceptibility at SF Zoo

Infection 3





Suitability for the wild

Main Findings

- ✎ Can clear chytrid fungus without treatment
- ✎ They can also develop an immune response
- ✎ Their infection intensities are much lower than the threshold for mortality
- ✎ Hold the key to understanding innate/adaptive immunity





Head-starts' survival in the wild?

Highly Ambitious

- ✎ Nearest donor site = 100 km south and 800 m lower in elevation
- ✎ Yosemite Valley has endured floods (2017, 2019), drought (2018, 2020, 2021, 2022), and wildfire since we released frogs...



NPS / ABC NEWS



Head-starts' survival in the wild?



Milestones

- 1) First release group survived the winter
- 2) Frogs bred (2019–2022) at 8 of 16 release sites
- 3) Tadpoles metamorphosed (2019–2022)
- 4) The offspring of head-starts are now breeding
- 5) Frogs are finding new habitats (non-release sites)
- 6) Frogs are breeding in those new habitats (2022)



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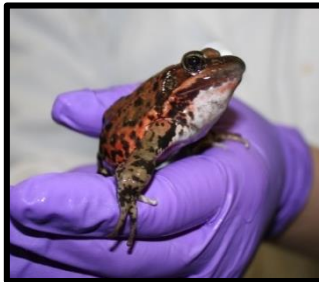


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Questions?

