National Park Service

Proposed Restoration of Native Species in High Elevation Aquatic Ecosystems

Sequoia and Kings Canyon National Parks

November 19, 2013

Public Meeting

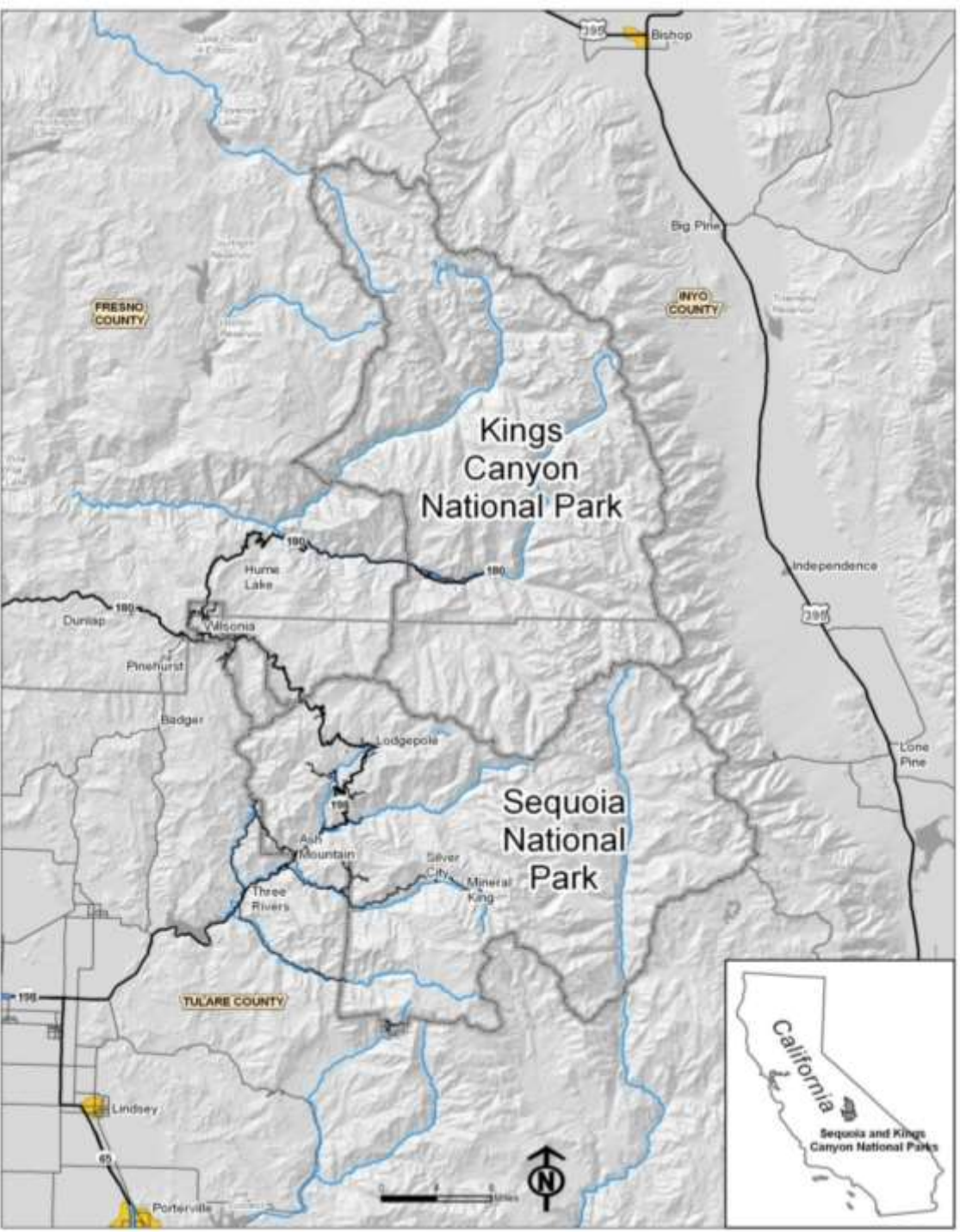
UC Merced Fresno Center, Fresno, CA

The Purpose of the Presentation

- **WHY** - is restoration necessary?
- **WHAT** - has occurred so far?
  - are the main issues?
  - are we proposing for the future?
- **HOW** - you can be involved and provide input?

Regional Map

Sequoia and Kings Canyon National Parks



Several fish species native to low and mid-elevation *streams*

Sequoia and Kings Canyon National Parks

- All high elevation waters were naturally fishless: (~8,000 – 13,000 ft)
- ~1,000 lakes (≥ 2.5 acres)
  ~1,500 ponds (0.25 – 2.5 ac)
  ~1,000 very small (< 0.25 ac)
- Typically occur in basins – groups of lakes, ponds, marshes and connecting streams

Photo by Isaac Chellman, 2012

High Elevation Aquatic Ecosystems: Zooplankton

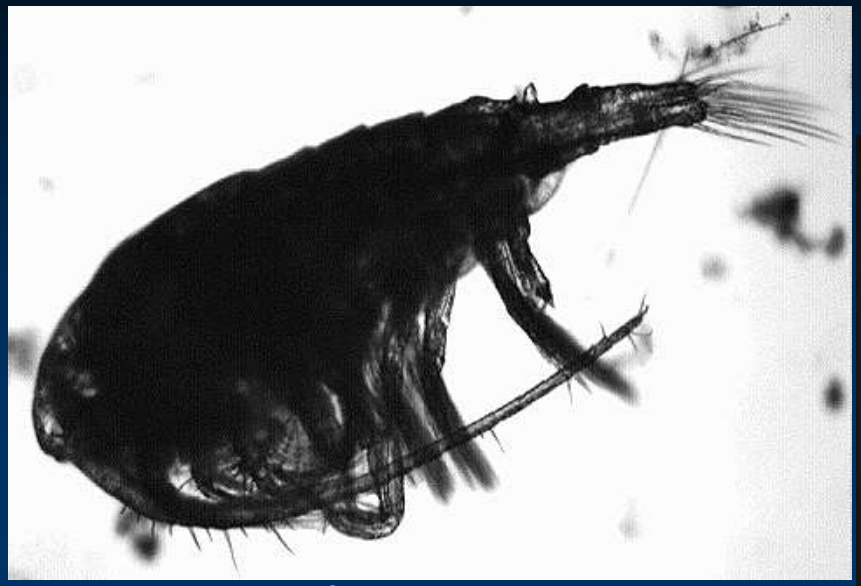


Image above provided from Dr. Roland Knapp, Sierra Nevada Aquatic Research Lab, CA

Photos from Wikipedia Commons

Aquatic Invertebrates

Photos from Wikipedia Commons

Amphibians

Pacific Treefrog

Mountain Yellow-legged Frogs

Photos by Erik Meyer and Isaac Chellman

High Elevation Lake

Photo by Isaac Chellman, 2012

Other Vertebrates

Photo by Isaac Chellman

Photo by Jamie Chavez, 2008

Photos from Wikipedia Commons

Photo by Stephanie Serson

Photo by Dr. Vance Vredenburg (from CalPhotos)

FOCUS - Mountain Yellow-legged Frogs (MYLF)

- Endemic to high elevation waters in Sierra Nevada and So. CA
- Formerly one of most abundant vertebrates in high Sierra
- Predator, prey, and large recycler of nutrients
- Key species in these ecosystems

Photos by Isaac Chellman, 2012 and Harold Werner, 2006

Two Species of MYLFs – Both in Severe Decline

Rana muscosa
(southern species):
mountain yellow-legged frog
86 – 92% decline

Rana sierrae
(northern species):
Sierra Nevada yellow-legged frog
69 – 92% decline

- Both have much smaller populations today v. historic sizes
- Primary causes of decline shown to be nonnative fish and disease

Photos by Isaac Chellman, 2012 and 2013

Fish Stocking

1870 - 1988: nonnative trout were introduced to majority of lakes

Photo from www.mylfrog.com

Photo from Johnston, H. 1995. Yosemite trout

Photo from www.mylfrog.com

Stocked Trout

Eastern Brook Trout

Rainbow Trout

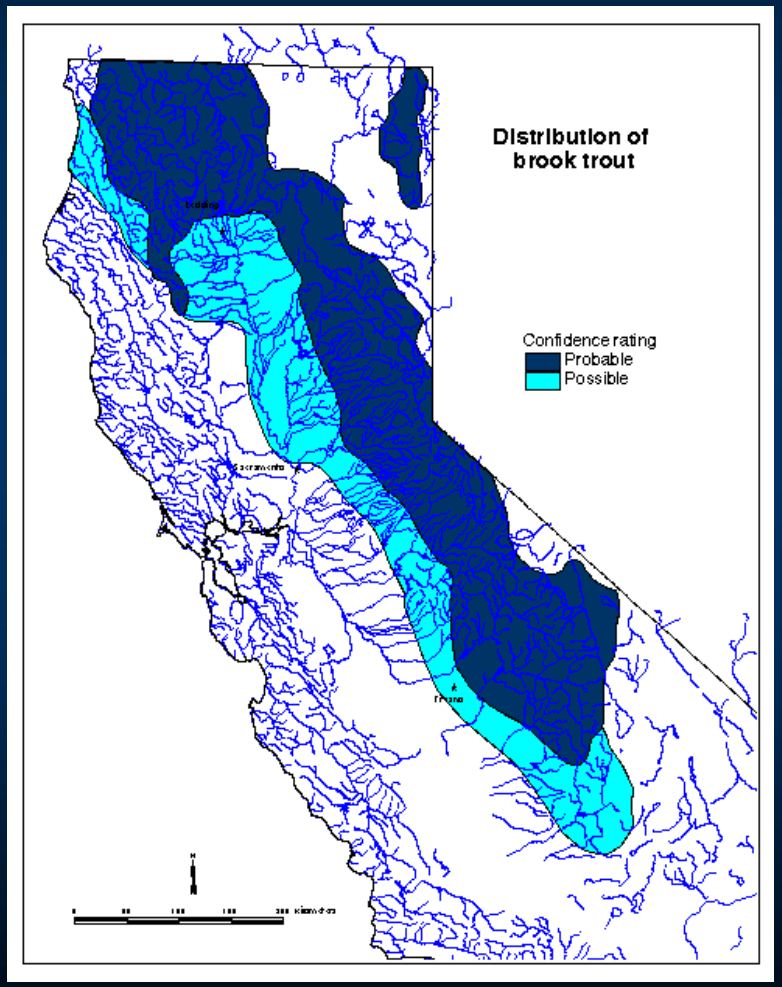
Golden x Rainbow Hybrids

1970s - present: dozens of studies have shown long-term negative effects to native species from nonnative trout

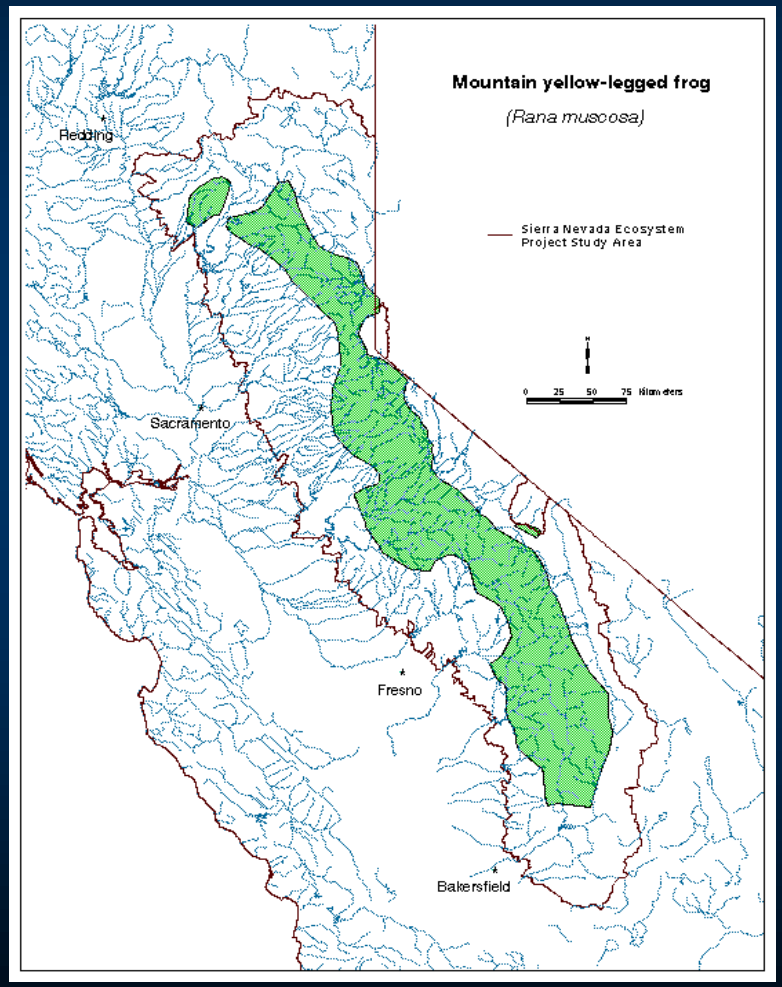
Photos by Danny Boiano

Distributions of Nonnative Trout and Mountain Yellow-legged Frogs

TROUT

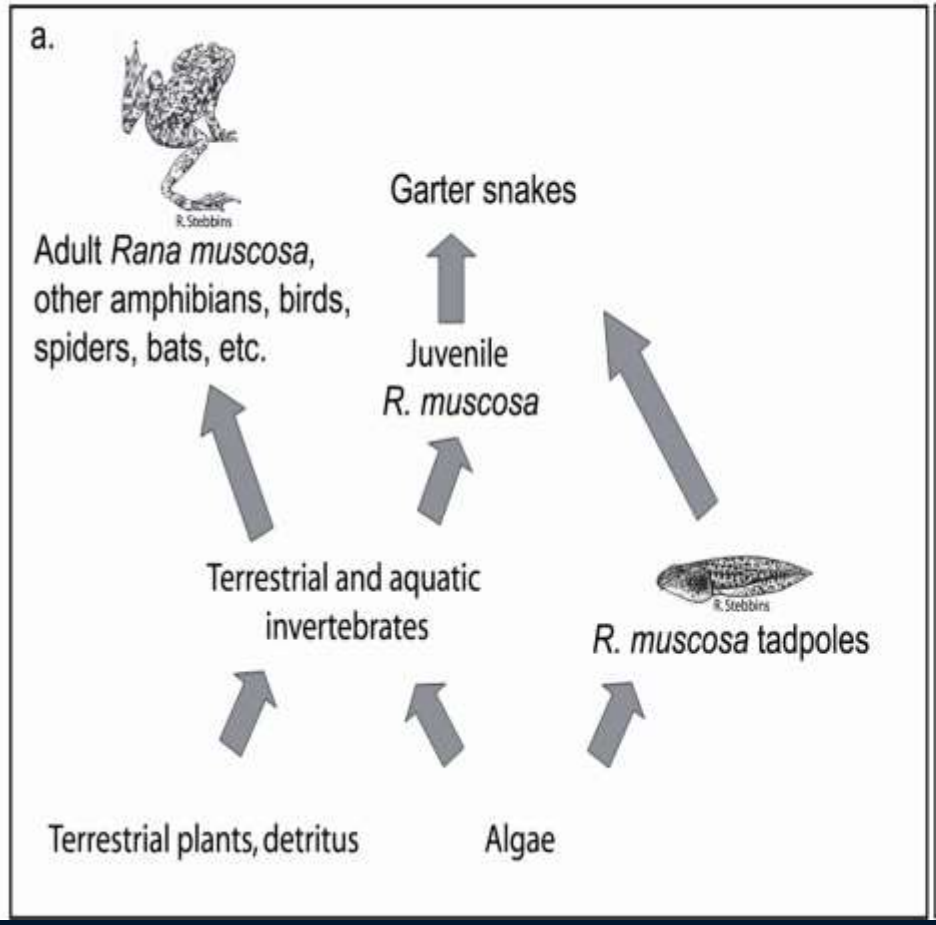


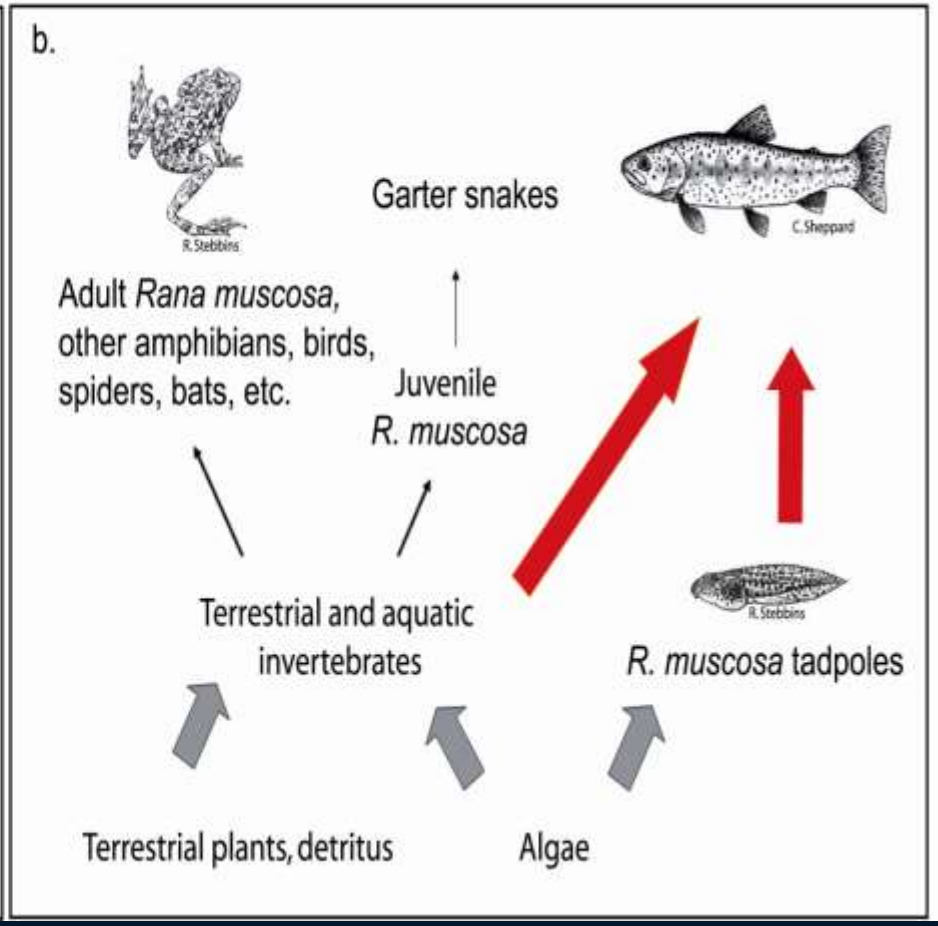
MYLFs



Maps from University of California Davis, Information Center for the Environment

Nonnative Trout Sever Food Webs





Data from Finlay and Vredenburg. 2007. Ecology 88:2187-2198

The Purpose of the National Park Service (NPS)

"…to conserve the scenery, the natural and historic objects, and wild life therein, and to provide for the enjoyment of those resources in such a manner as to leave them unimpaired for future generations."

- Organic Act 1916

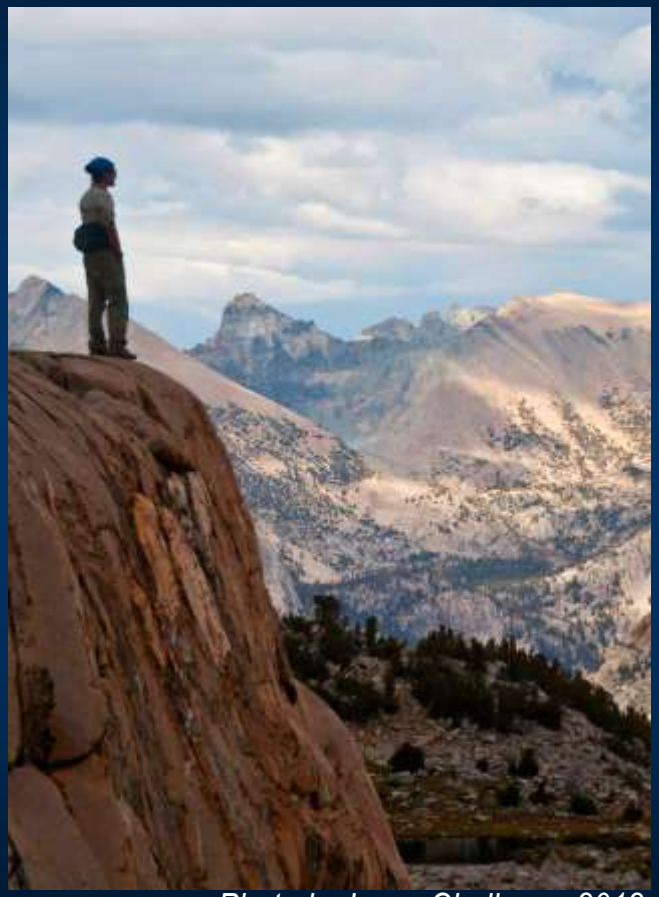


Photo by Isaac Chellman, 2012

NPS Management Policies 2006

The NPS will strive to restore native species to parks when:

- **Adequate habitat is available**
- **The species was diminished or reduced due to indirect or direct human influence**
- **Potential impacts have been carefully considered**

Photo by Isaac Chellman, 2012

NPS Management Policies 2006

Exotic species will be managed when:

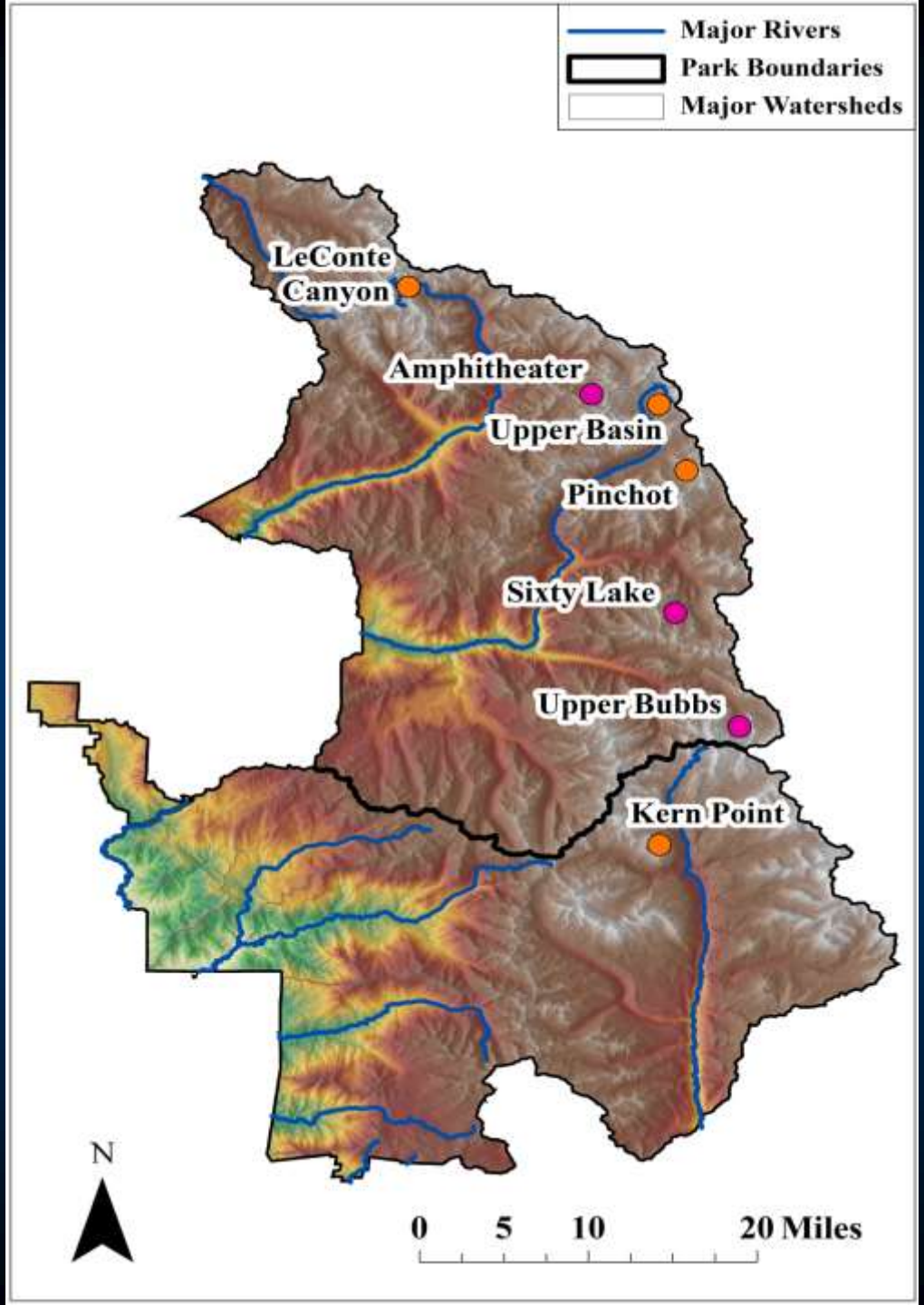
- **They interfere with natural processes, natural habitats or native species, or**
- **They disrupt the genetic integrity of native species**

Photo by Isaac Chellman, 2012

Current Restoration Efforts – Focus on Fish Removal

- 1997-1999 – Researchers restored 2 lakes
- 2001 – EA /FONSI approved NPS fish removal by gill netting & electrofishing
- 2001-2013: 13 lakes completed and 6 lakes nearly completed
- 2012: started final 5 approved lakes
- All sites expected for completion by 2016
- Measured large ecosystem responses in treatment areas

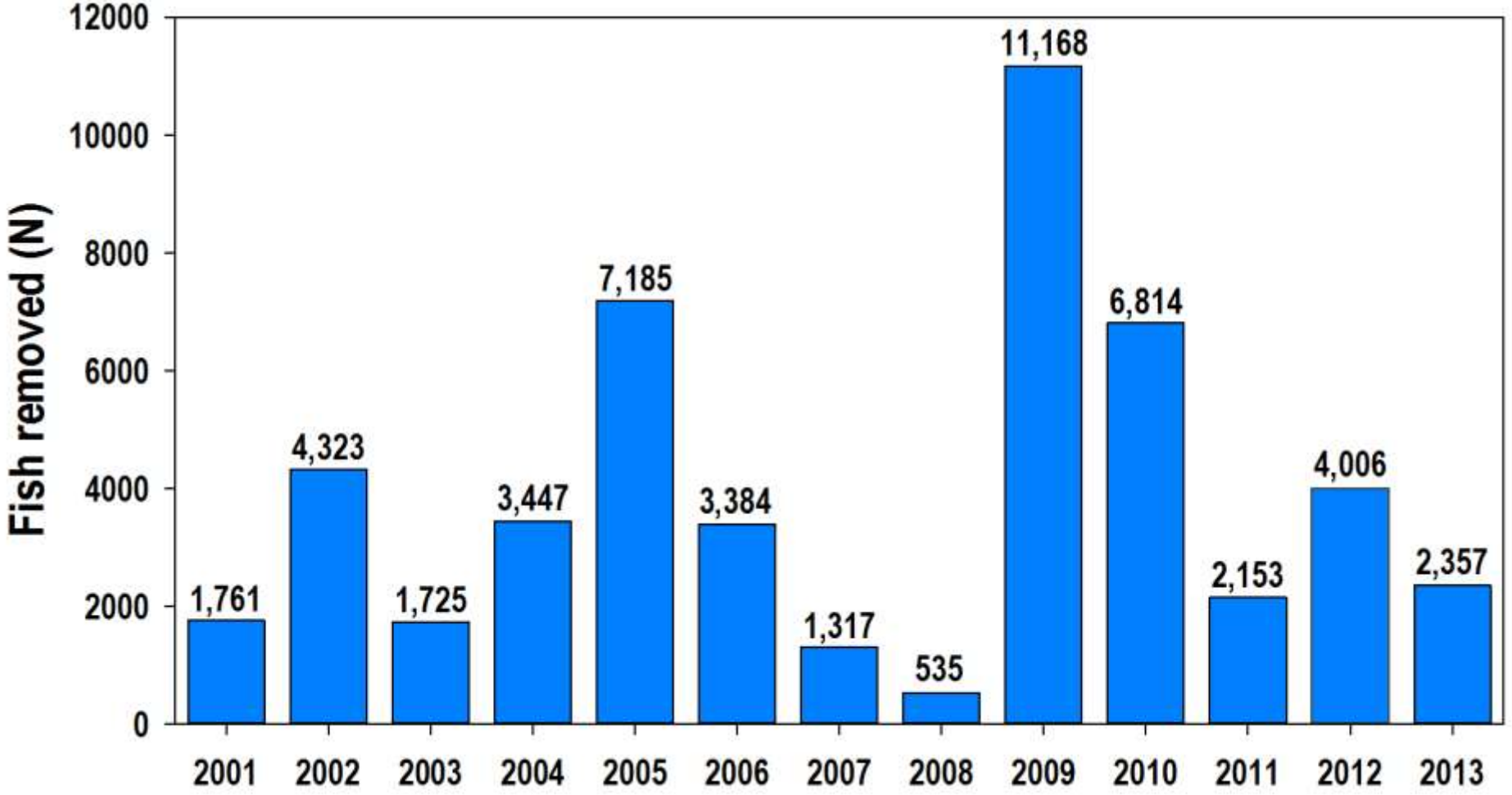
Photo by Isaac Chellman, 2012

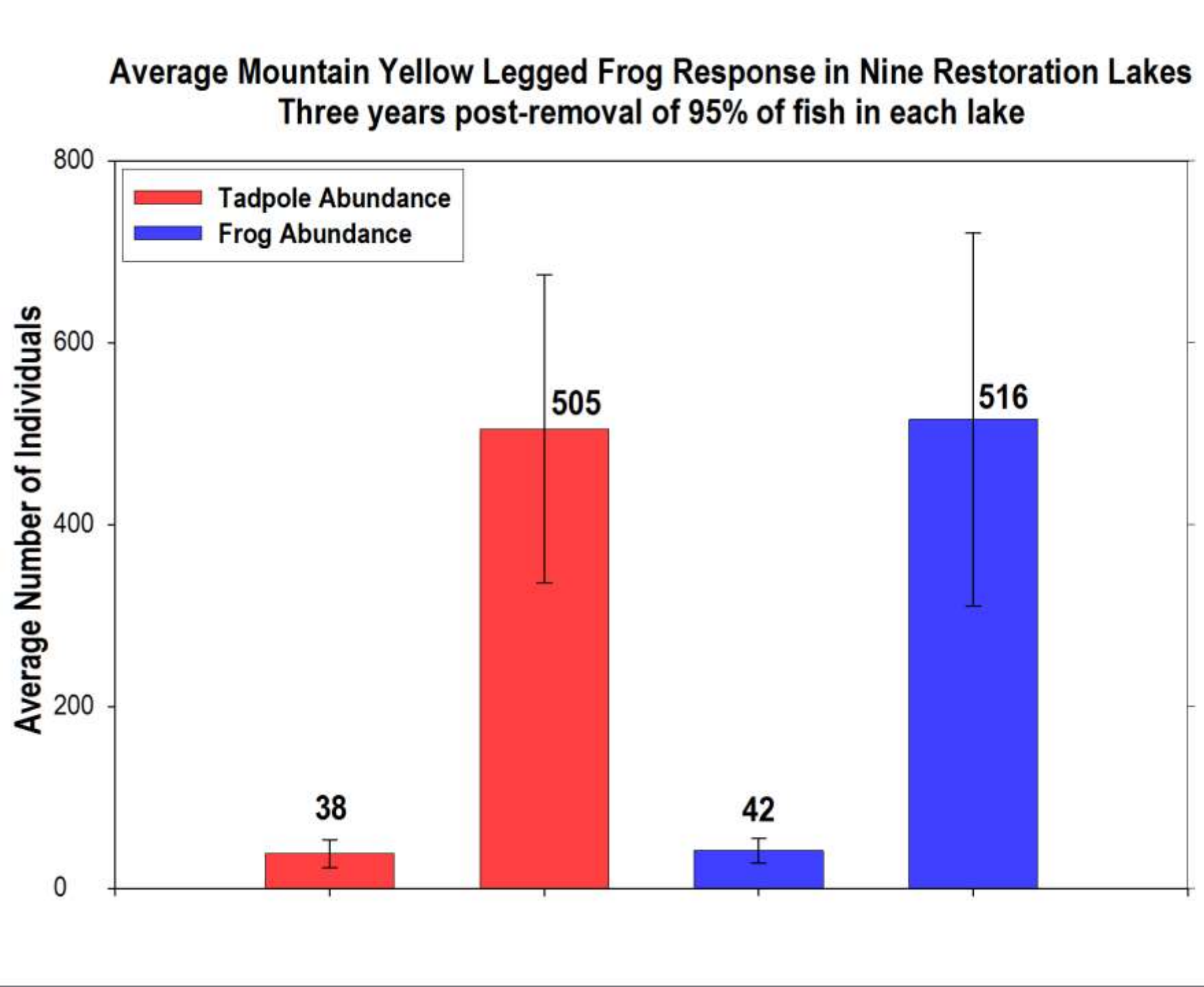


Completed / In-Progress Restoration Sites

Current Restoration: 2001-2013

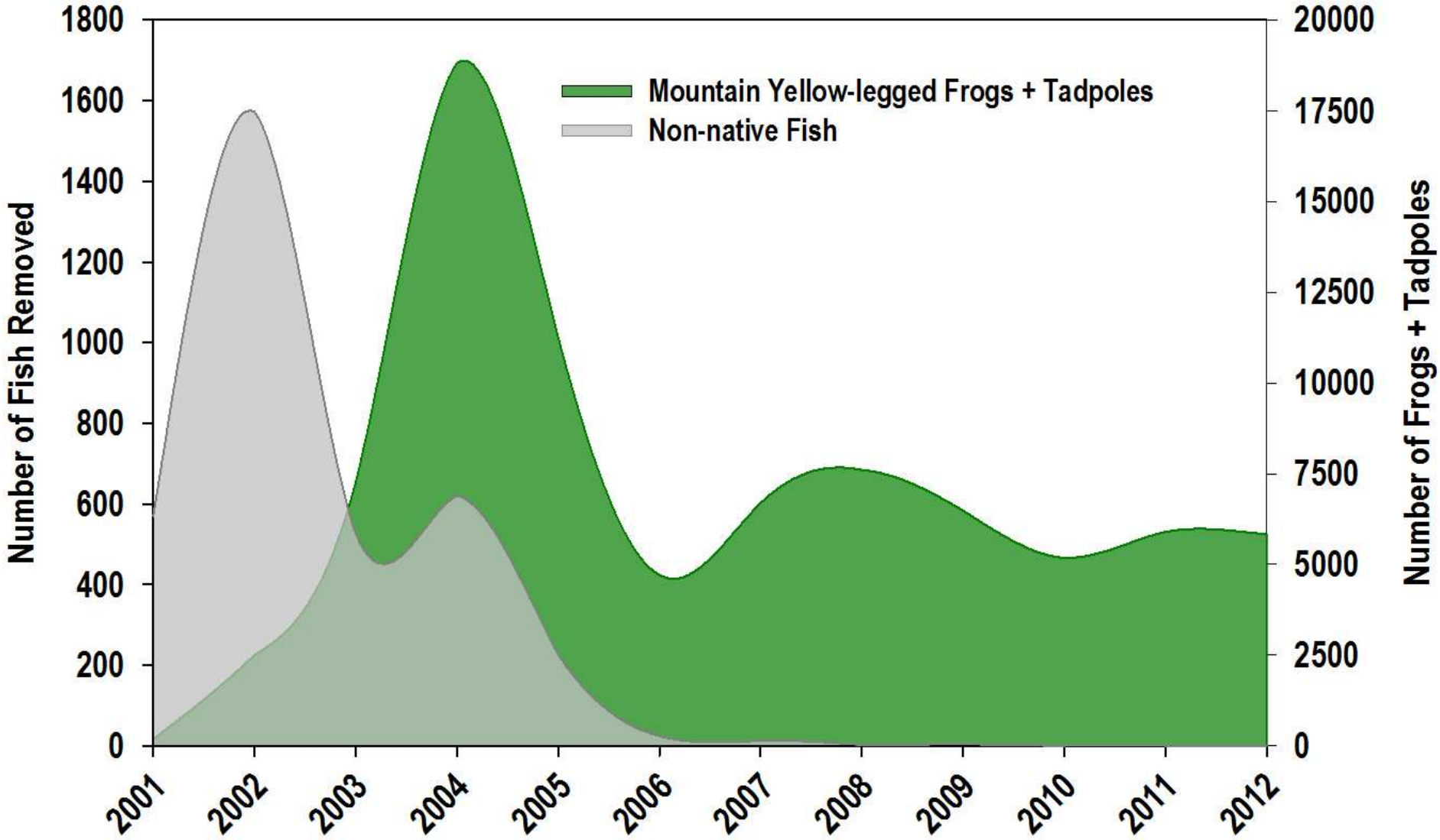
Total of 50,175 nonnative trout removed from 24 lakes and streams




Average Mountain Yellow Legged Frog Response in Nine Restoration Lakes
Three years post-removal of 95% of fish in each lake
Tadpole Abundance
Frog Abundance
Average Number of Individuals
800
600
400
200
0
38
505
42
516

LeConte: 2001-2012

Fish removed and max # of *R. sierrae* / survey in 3 fish removal lakes



Why the existing program needs to be expanded

- Current effort designed as preliminary restoration and sites are almost completed.
- Current methods are successful on a small scale but do not meet goals to restore and conserve aquatic ecosystems on parks scale.
- Rate of restoration and size of habitat that can be restored needs to be increased
  - average <1 lake is currently restored per year
  - only lakes with relatively-short associated streams are restorable using physical methods
- Populations of MYLFs continue to decline and additional treatments are critical to prevent species extinction.

Photo by Danny Boiano

Status of MYLFs

Federal ESA

- Southern California: *R. muscosa* listed as endangered in 2002
- Sierra Nevada: *R. muscosa* and *R. sierrae* proposed for listing as endangered in 2013

California ESA

- *R. muscosa* listed as endangered, and *R. sierrae* listed as threatened in 2012.

- SEKI is the only park that contains both species, making it a key site for their protection

- Disease is spreading through SEKI

Image courtesy of Dr. Roland Knapp, SNARL

Photo by Isaac Chellman, 2013

Disease : Chytridiomycosis

- Caused by amphibian chytrid fungus *Batrachochytrium dendrobatidis (Bd)*
- Throughout Sequoia and most of Kings Canyon.
- Arrival results in population crash, including possible extinction.

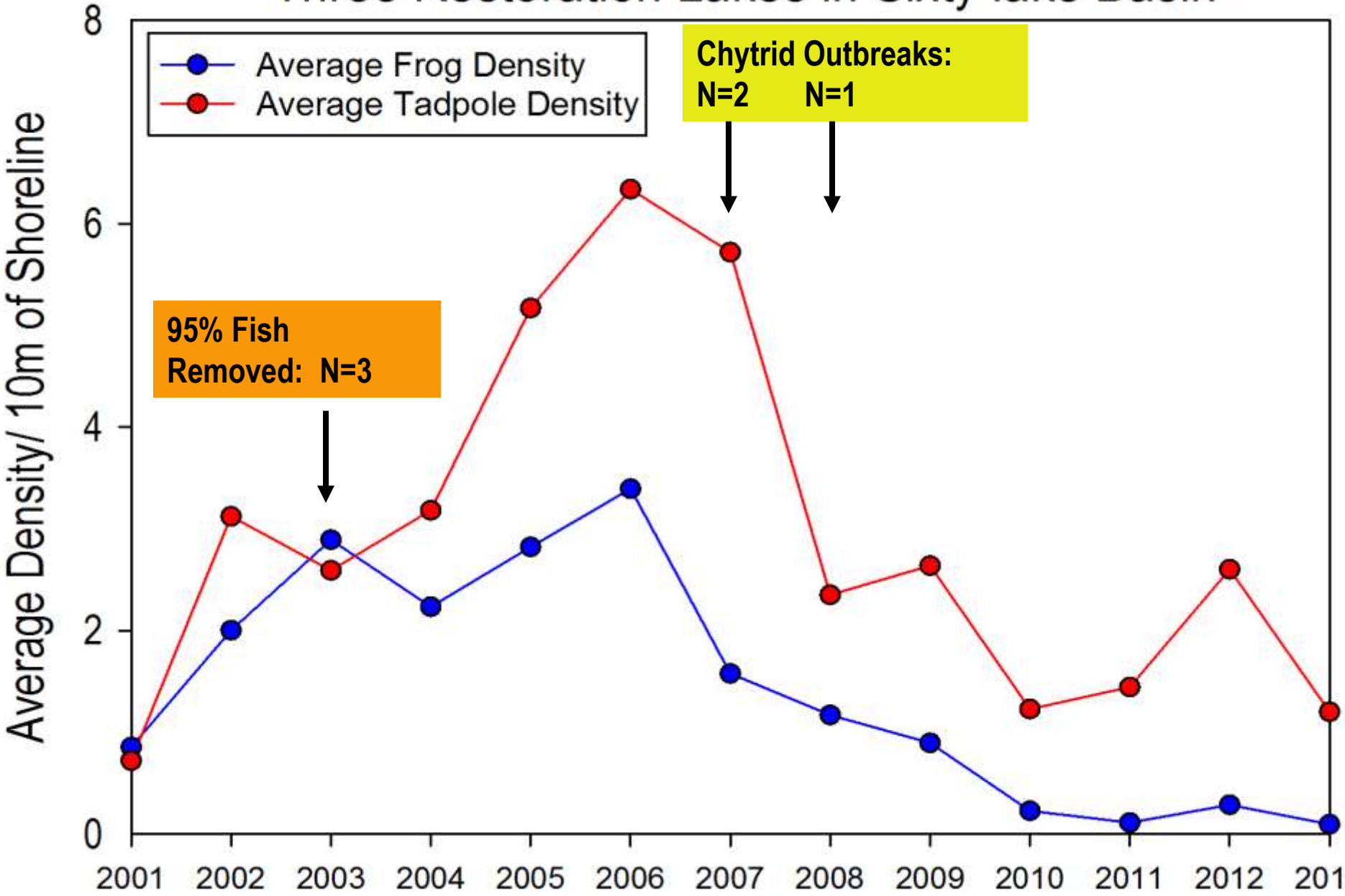
Dr. Roland Knapp, Sierra Nevada Aquatic Research Lab, CA

Disease : Chytridiomycosis

- A few infected populations are persisting (all were large pops when first infected)
- LeConte, Upper Bubbs, Kern Point: no restoration sites infected
- 60 Lake, Pinchot, Upper, and Amphitheater Basin: all restoration sites infected
- *Will fish removal help prevent extinction in a basin?*

Photo by Isaac Chellman, 2012

Average Mountain Yellow-legged Frog Density in Three Restoration Lakes in Sixty lake Basin



Expanding the restoration program would protect MYLFs and native species diversity across SEKI and increase ecosystem resiliency to uncertain future conditions (e.g., disease, climate change)

Photos by Danny Boiano , Bryan Czibesz and from CalPhotos

Proposed Restoration Plan/DEIS
Purpose of and Need for Action

- **Purpose: to restore and conserve native species and natural function to selected high elevation aquatic ecosystems that have been adversely impacted by human activities.**

- **Need: Nonnative fish have severely reduced native biodiversity and disrupted ecological function.**

Photos by Isaac Chellman, 2013

EIS alternatives under consideration

- Alternative A – No Action

- Alternative B (hybrid treatment)
  - fish would be removed from 87 lakes/ponds
    - 49 by gill netting and electrofishing
    - 38 using piscicides

Photo by Sean Giery

- Alternative C (physical treatment only)
  - fish would be removed from 49 lakes/ponds by gill netting and electrofishing

- Alternative D (piscicide treatment only)
  - fish would be removed from 87 lakes/ponds using piscicides

Selection Criteria

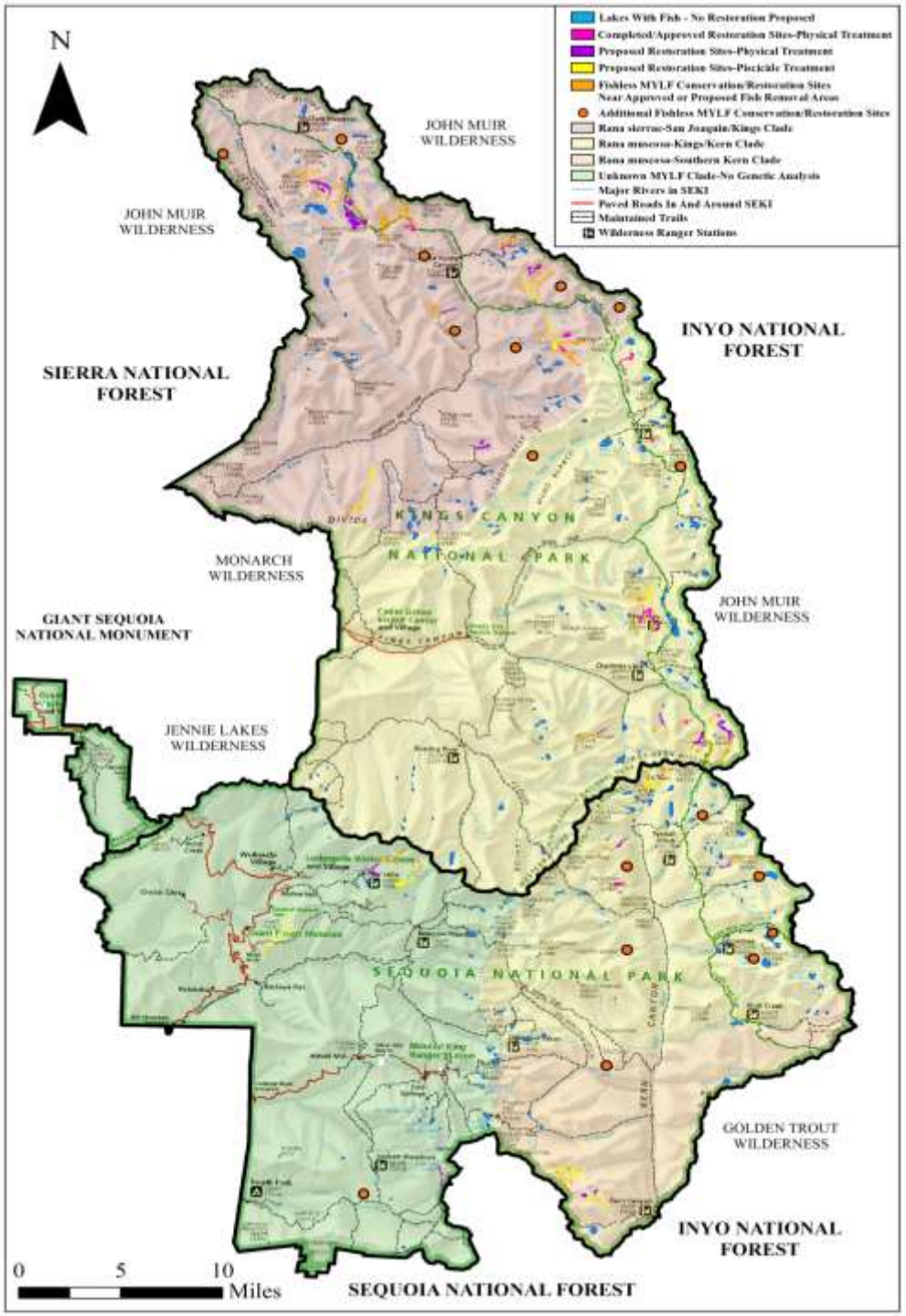
- Fish eradication is feasible
- MYLF populations present or recently present
- Avoid popular and trophy fishing areas when possible
- Most sites not close to popular trails

Photo by Isaac Chellman, 2012

Photo by Danny Boiano, 1997

Preferred Alternative B Expands the current program

- 87 lakes/ponds and 41 miles of stream over ~30 yrs are proposed for treatment.
- Self-sustaining trout populations would remain in majority of lakes/ponds (462)
- Treat MYLFs with anti-fungal agents
- Conduct MYLF reintroductions



Preferred Alternative B
Combination of Fish Removal Methods

- **Gill Netting and Electrofishing: Physical fish removal methods are preferred and would be used where feasible - 49 lakes/ponds and 14 miles of stream**

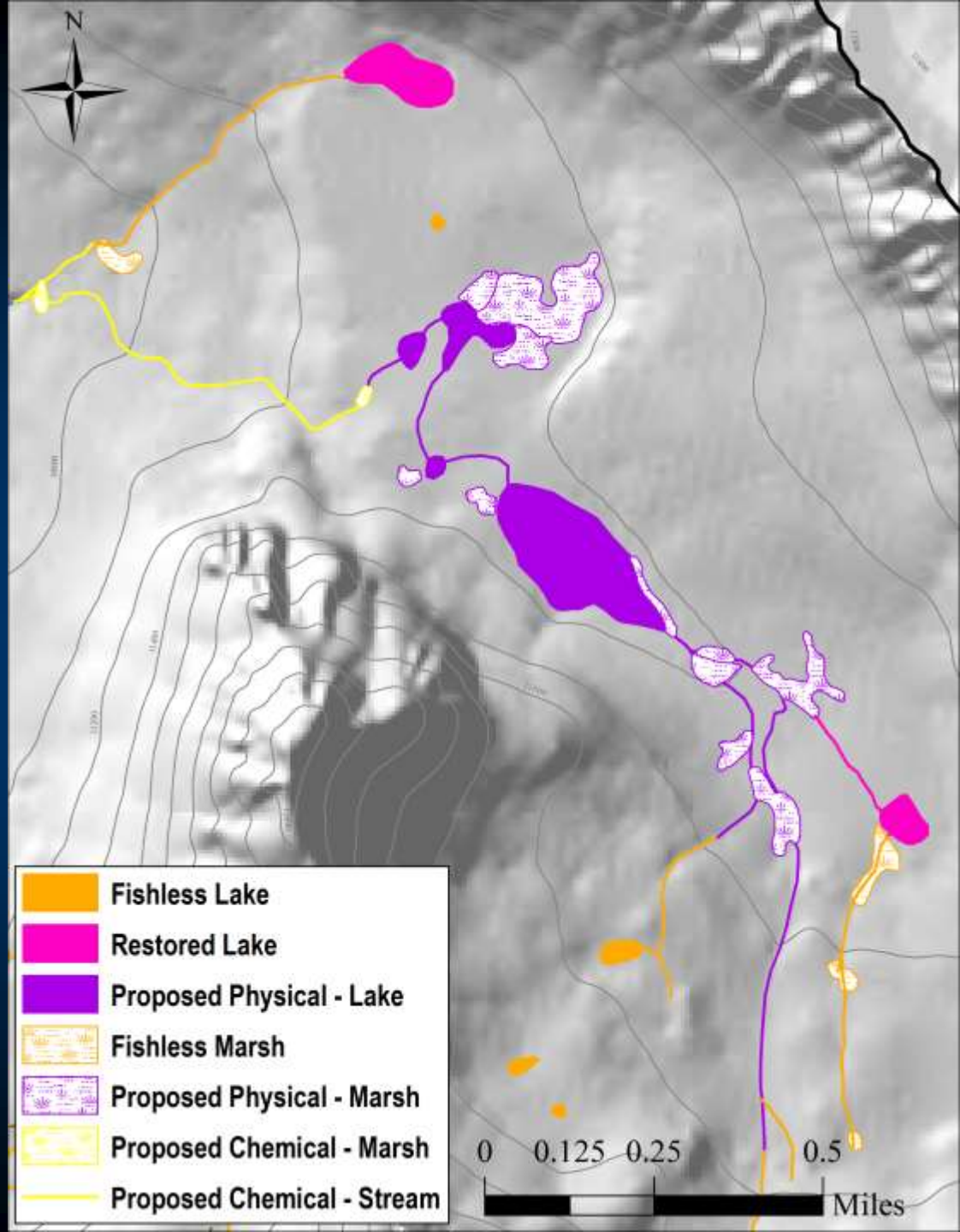
Photo by Isaac Chellman, 2012

- **Piscicide (fish specific pesticide): Rotenone is proposed for fish removal in areas where physical techniques would be ineffective – 38 lakes/ponds and 27 miles of stream**

Combination of Fish Removal Methods – Example

- Gill netting and electrofishing in lakes, some marshes, and some streams

- Piscicide in larger/more complex streams and marshes



Fish Eradication Using Piscicides

- Toxic to gill-breathing organisms: disrupts respiration at extremely low concentrations
- Use is highly regulated by USEPA – specific instructions required for piscicide applications
- Applications limited to low concentrations
- Degrade rapidly into non-toxic components - does not persist or bioaccumulate
- Neutralized with potassium permanganate at downstream end of restoration area

Piscicide applications in streams (above from GRSM NP Antimycin Fact Sheet; below from Rotenone Use in Fisheries Management, AFS 2000)

Piscicides have been used for decades to eradicate fish in national parks, including wilderness areas.

Piscicide effects vs. benefits of fish removal

- Effects: - short-term loss of invertebrate abundance and diversity
- short-term restrictions in public access
- trammel to wilderness

Photo by Danny Boiano

- Benefits: - long-term eradication of nonnative fish
- long-term improvement of natural quality of wilderness by improving ecosystem function
- improved resistance/resilience to future conditions by increasing population sizes and providing climate refuges in large connected habitats

Recreational Fishing Opportunities

- 26 of 575 lakes with fish previously approved for fish eradication
- Fish eradication proposed in an additional 87 (16%) of SEKI's remaining 549 lakes with fish
- Fish would remain in 462 lakes (84%) to support recreational fishing.
- Treatment sites are all remote and were selected to avoid most lakes with a reputation for good fishing
- Balances responsibility for native species conservation and continues to provide many fishing opportunities

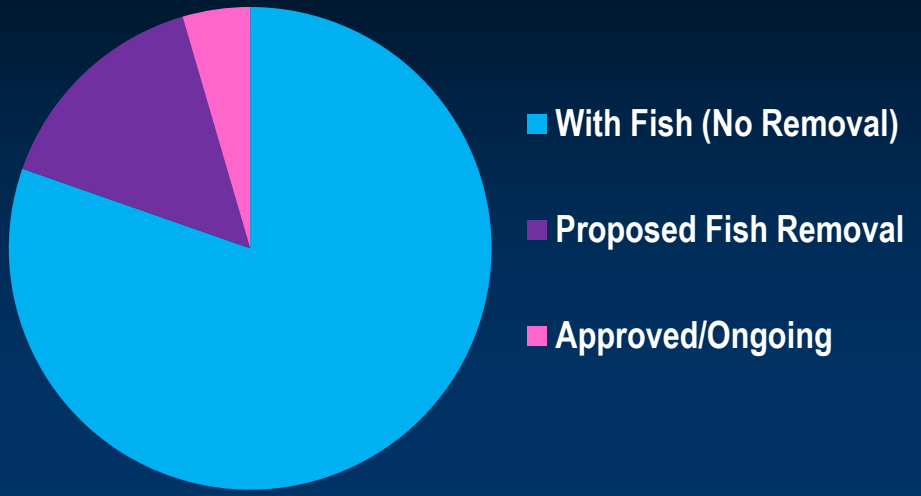


Photo by Richard James, 2008

Recreational Fishing Opportunities

- Fishing is an important part of the recreational experience in SEKI.
- This project will not affect a large majority of recreational fishing available in the parks.
- Ample fishing opportunities will still be available even if fish are removed from all proposed locations.

Photo by Isaac Chellman, 2012

Summary of Primary Threats to MYLFs

- Nonnative trout
  - clearly suppressing frog populations
  - removing fish allows frog expansion
- Disease (chytrid fungus)
  - decimating frogs in fishless areas
  - treating frogs may increase survival
- Climate change
  - will likely increase as a threat over time
  - removing fish from large connected habitats provides climate refugia
- Urgent intervention is needed to prevent potential extinctions

Proposed Plan is a Balanced Approach

- Restores conditions that protect endangered frogs and native biodiversity

- Designed with a hybrid approach that maximizes habitat restoration over 30 years while attempting to minimize environmental impacts

- Continues to provide ample opportunities for recreational access and fishing

How can you be involved?

Written comments must be submitted by December 17, 2013

On the project website:

http://parkplanning.nps.gov/aquatics

By writing, hand delivery, or fax to:

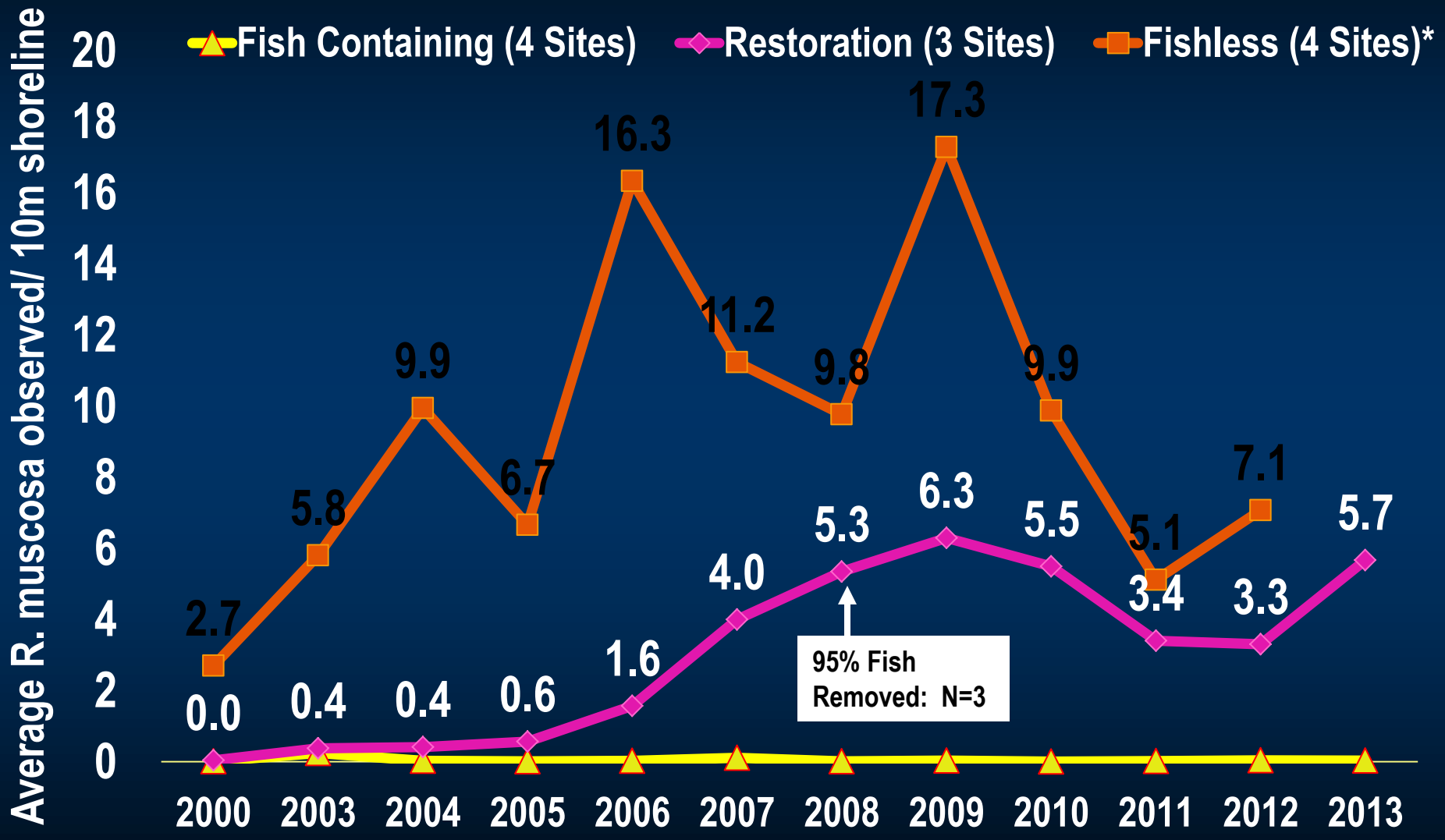
Superintendent
Sequoia and Kings Canyon National Parks
Attn: Restoration Plan/DEIS
47050 Generals Highway
Three Rivers, CA 93271

Fax: (559) 565-4202

Questions?

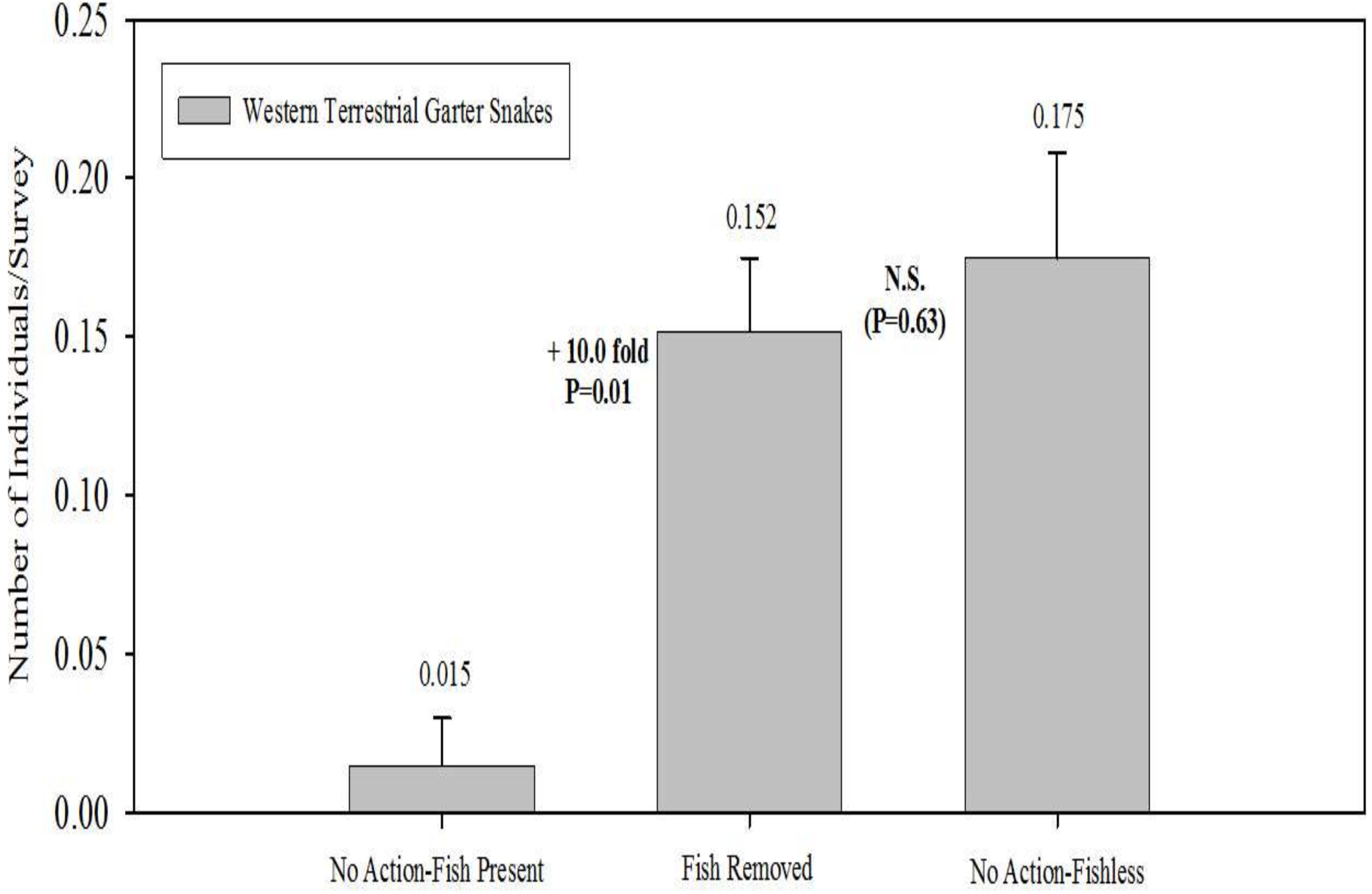
Upper Bubbs Creek Frog Surveys: 2000-2013

Average *R. muscosa* density/survey (includes frogs and tadpoles)



*No surveys were conducted in fishless lakes in 2013.

Total Number of Western Terrestrial Garter Snakes Observed, 2001-2012



Piscicide Applications in National Parks

Piscicides have been used for decades to eradicate fish in national parks, including wilderness areas.

National Park	Years	NEPA	Additional Methods
Yellowstone	1938, 1975, 1977, 1985, 2006-2013	EA (2006)	
Great Smoky Mountains	1957, 2000, 2003, 2005, 2008	EA (2000)	Electrofishing - 1996
Yosemite	1965, 1966		Physical - 2007
Mount Rainier	1965, 1986		Gill netting - 1993
Glacier	1966		
Sequoia & Kings Canyon	1979		Physical - 2001
Rocky Mountain	1996		
Crater Lake	2000		
Great Basin	2000, 2002, 2004	EA (1999)	
North Cascades	2009, 2013	EIS (2009)	Physical - 2009