

Suction Dredge Permitting Program Supplemental EIR-CEQUA

Mill Creek, Plumas County CA



Thomas A. Wess

May 5, 2011

Mark Stopher
California Department of Fish and Game
601 Locust Street
Redding, CA 96001

Re: Suction Dredge Permitting Program Supplemental EIR-CEQA

Dear Mr. Stopher,

I am submitting this letter because of the Class A restriction listed in the Draft Proposed Suction Dredge Regulations (February 28, 2011) for Mill Creek in Plumas County (Page 47). Class A is described as "No dredging permitted at any time" due to the presence of the Sierra Nevada Mountain Yellow Legged Frog (SNMYLF) (*Rana Sierrae*).

I am a co-owner of two mining claims (placer) on the lower reaches of Mill Creek above the East Branch of the North Fork Feather River near Rich Bar. The other co-owners are my brothers. These two claims have been in the family for 98 years. My grandfather moved to Rich Bar in 1907 working on the construction of the railroad and obtained partnership to the claims in 1913. My father was taken to live on the claim at the age of three months in 1924. My grandfather built a two story four bedroom home on the claim in 1925 and it remained a family residence until its forced removal in the 1970's due to government regulations of the US Forest Service.

I have been going to and staying on the claim since my birth in 1951 and continue to do so today along with my wife, children and now my grandchildren. I have fished in, hiked near, swam in, bathed in, drank from, dredged in, and jumped rocks over Mill Creek my entire life and I have never seen one frog nor tadpole of any type. I have seen deer, bear, bobcats, mice, snakes, fish, bees, birds and lots of mosquitoes, but never any frogs. I listened to the call of the SNMYLF online and can positively say I have never heard the croak of that specific type of frog. The sound is most distinct and it would have certainly peaked my curiosity as to the source of the sound.

I have enclosed a letter from Bob Callahan who is the only other individual which we have allowed to work our claim. He has been in the area since childhood (1950's) and has no memories of seeing any frogs in or around Mill Creek.

Because of the restrictions on Mill Creek, I have extensively researched the SNMYLF and found a great amount of information on the subject. One of the first things I discovered in common among all articles and studies regarding the habitat was that the SNMYLF is a mid to high altitude frog commonly seen above 6,000 feet and is most typically found as high as 11,000 to 12,000 feet in high open alpine lakes. (See attached pictures of sample lakes.) Any streams shown are of the high meadow variety. Furthermore I found no evidence of habitats in faster moving waters, steeper slopes, or rocky, tree lined streams.

Further research revealed the primary reason for lack of the SNMYLF to be in Mill Creek. The natural enemy, which feeds on the eggs and young tadpoles, is the native trout which are present in Mill Creek. Depending on water temperatures, the time to reach maturity can be up to four years, allowing ample time for the trout to consume the eggs and small tadpoles. A reasonable conclusion can be made that the SNMYLF does not exist at lower sections of the stream because there are native trout in the stream. The SNMYLF historically has inhabited the higher lakes because the native trout from the lower streams were unable to reach the headwaters and higher lakes due to natural barriers of steep rocky terrain and waterfalls. Thus, the frogs were able to thrive without the threat of the aggressive trout.

One of the primary reasons consistently listed in the studies for the decline of the SNMYLF is due to the introduction of non-native trout in the higher lakes for recreational fishing. This is not the case in Mill Creek because the trout are already there. Other primary factors are disease, pesticides and some mention of global warming.

Our claim is located on the lower section of Mill Creek and is bounded by Bucks Lake Wilderness. (See the attached map filed with BLM showing the boundaries of our claims and the wilderness area.) In measuring the primary streams of Mill Creek, Fales Creek and Clear Creek there is approximately 53,600 feet of stream. Only the lower section, about 6,600 feet or 12% of the streams, lies outside of the wilderness area, has been open to dredging. The remaining 88% is closed to any use of internal combustion engines thus preventing the use of a dredge. The upper headwaters of Mill Creek are already protected by the Bucks Lake Wilderness and federal regulations.

Another major issue discovered is regarding the locations of where frogs have been reported. I was able to find the locations of and related documentation regarding the finds on AmphibiaWeb using the Berkeley Mapper Point Mapping Service. The locations of the four finds of *Rana Muscosa* are at Silver Lake, Rock Lake, Gold Lake and along a tributary coming down from Rock Lake (Exhibit A1 through A6). There have been no reported finds of the SNMYLF at on or around Mill Creek in Plumas County.

The next important information is the boundary line between watersheds. While reviewing topographical maps of the area, I noticed a ridge running between Silver Lake (including the lakes where the frogs were reported) and the Mill Creek headwaters (Exhibit B1 & B2). I was then able to locate a US Fish and Wildlife Service mapping program which identifies the same ridge as the official dividing line between Mill Creek and Spanish Creek (Exhibit C). This is also confirmed with the USGS Viewer (Exhibit D1 & D2).

The location of the known SNMYLF is not in the same watershed as Mill Creek and all streams or lakes where there are known SNMYLF flow southeasterly away from Mill Creek and its headwaters.

The use of watersheds as boundary lines is supported using the Aquatic Biodiversity Management Plan prepared for the California Department of Fish and Game. In the plan it states *"most units are defined by watershed boundaries..... Management plans for these areas should be site specific....."* (Exhibit E page 1). This is also supported using the California Department of Fish and Game CNDDDB QuickViewer. According to the California Department of Fish and Game website *"The CNBBD Quick Viewer tool provides the user with a list of all CNDDDB elements (species or natural communities) that have been documented by the CNDDDB to occur on the selected USGS 7.5' topographic quad. This list may include both recent and historical records."* The map is divided into counties and quadrangles. The program will list if the SNMYLF is present within that quad or not. The lower reaches of Mill Creek and our claims are in the Caribou Quad, and the list for that section shows no SNMYLF. The Bucks Lake Quad does show the presence of the SNMYLF. (Exhibits F1 through F4). While this may be correct the information on this quad does not differentiate between watersheds and the Bucks Lake Quad contains parts of both watersheds which drain in different directions. An error would be made to assume the presence of the SNMYLF throughout an entire quad. The only legitimate determining factor would be based upon watersheds, as the aforementioned CA Department of Fish and Game (Exhibit E) suggests.

Recommendation: With the absence of the affected species, I respectfully request the removal of Mill Creek in Plumas County from the "Class A" status as currently listed in the Draft Proposed Suction Dredge Regulations (page 17, Line 28).

Sincerely,



Thomas A. Wess

April 11, 2011

Good day, Tom.

I trust this brief missive will find you and yours, well.

In reference to your inquiry to me regarding frogs at the claims:

I'm not sure which year I worked your lower claim, nor the elevation I worked at.

However, I can say that since 1959, since I began coming to Mill Creek, Clear Creek, and French Creek, up until my last passage there (2003?) I do not recall seeing any frogs or toads during my hiking, exploring, and dredging.

Certainly, this is not to say there are no frogs or toads in that region, but only to say I cannot recall seeing any, or hearing any stories about frogs or toads.

Like many children that grew up when I did, I took interest in turtles, frogs, toads, and other critters that provided amusement. I believe that had I seen any frogs or toads around the Mill Creek area, I probably would have taken the time to amuse myself with them, and therefore may have some memory of them.

I simply have no memories of seeing any.

Please pass on our best to Susie and the family.

Best regards,



Bob and Maryann Callahan



Rana sierrae - Sierra Nevada Yellow-legged Frog

Formerly *Rana muscosa* - Mountain Yellow-legged Frog



Eggs

Mature Tadpole

Habitat



Habitat in breeding season, 8,800 ft.,
Alpine County



Habitat in breeding season, 8,800 ft., Alpine County



Habitat in breeding season, 8,800 ft.,
Alpine County



Close-up of breeding location, 8,800 ft.,
Alpine County



Breeding and egg-laying habitat, 8,800 ft., Alpine County



Habitat, breeding season, Fresno
County © Vance Vreedenburg

Rana sierrae - Sierra Nevada Yellow-legged Frog

Formerly *Rana muscosa* - Mountain Yellow-legged Frog



Adult male (bottom of picture) calling from quiet channel flowing into lake, 8,800 ft., Alpine County



Tadpole habitat, 8,800 ft., Alpine County



Habitat, Alpine County



Habitat, 8,800 ft., Alpine County



Habitat, 8,800 ft., Alpine County



Habitat, Mono County



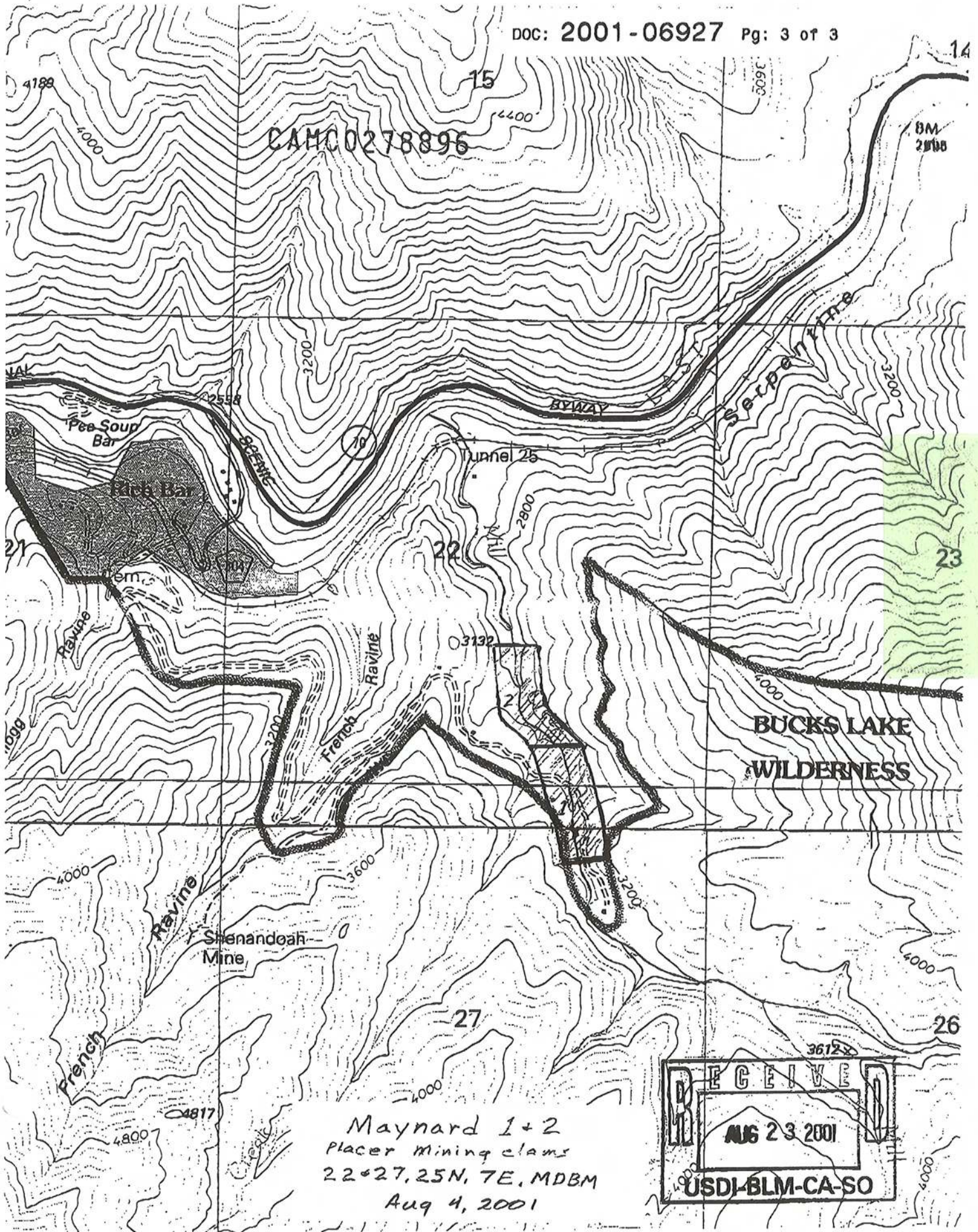
Habitat, Fresno County © Vance Vreedenburg



Habitat, Inyo County © Todd Battey

DOC: 2001-06927 Pg: 3 of 3

CAMC0278896



Maynard 1+2
 Placer Mining claims
 22+27, 25N, 7E, MDBM
 Aug 4, 2001

RECEIVED
 AUG 23 2001
 USDI-BLM-CA-SO



Berkeley Mapper

Restrictions on data use.



To see detailed information about the specimen points below, go to [HerpNET](#).



The shaded files below (shaded maps) are from [IUCN](#).

Map Controls

- Pan: Click & drag to pan
- Zoom by Box: Click Zoom-in icon to begin. Click once to start box. Click again to close zoom box.
- Spatial Query: Click spatial query icon to begin digitizing. Click on map to define polygon points.

Markers

- Click Marker: Click a marker symbol to see point information
- One item at this location
- More than one item at this location

Refresh populates markers or restores working state

[Help document](#)



AmphibiaWeb Species Map: *Rana muscosa*

Show Point Records

Exhibit A1

HERPNET
To see detailed information about the specimen points below, go to [HERPNET](#).

amphibiaweb
The IUCN Red List of Threatened Species
The shape files below (shaded maps) are from [IUCN](#).

Restrictions on data use.

Map Location

Map Satellite Hybrid Terrain Photo Topo

Map Controls
Pan: Click & drag to pan
Zoom by Box: Click Zoom-in icon to begin. Click once to start box. Click again to close zoom box.
Spatial Query: Click spatial query icon to begin digitizing. Click on map to define polygon points.
Markers
Click Marker: Click a marker symbol to see point information
One item at this location
More than one item at this location
Refresh populates markers or restores working state
Help document

Feature	Location
Scientific Name	Rana muscosa
Institution Code	CAS
GUID	CAS-209386
Decimal Latitude	39.95894444
Decimal Longitude	-121.1358889

Map scale: 1,000 ft / 300 m

Exhibit A2

CAS Herpetology Collection Database

①

AM 209386 ***Rana muscosa*** Ranidae Tissues Collected

Country: USA State: California County: Plumas Island(s):
 Co.

Locality: Plumas National Forest, Silver Lake, Collector(s): J.A. Wilkinson and J.V. Vindum
 T24N R7E Sec1 (SE 1/4 of SE 1/4), Date Collected: 22 Aug 1999
 39 57 32.2 N, 121 08 09.2 W Collector's (Field) Number: JVV- 6370 Field Notes:

Altitude: 39° 57' 32.2" N Coord. Source: Garmin 12 GPS

Longitude: 121° 8' 9.2" W Georef. By: J.V. Vindum

Max. Lat/Long Error Georef. Remarks:

Detailed Locality: California: Plumas Co.: Plumas National Forest, Silver Lake, T24N R7E Sec1 (SE 1/4 of SE 1/4),
 39 57 32.2 N, 121 08 09.2 W, 5820 ft

Life Stage: Juv Sex: Preservative: Alc Identified: J.V. Vindum, 3 Sep 1999

Elev: 5820 ft Habitat: ca 1730 hrs. Air temp. 24.0 C, water temp. 21.8. At shoreline.

Remarks: [Publications](#)

[Close and Return](#)

Exhibit A3

CAS Herpetology Collection Database



CAS 209404	<i>Rana muscosa</i>		Ranidae	Tissues Collected
Country:	USA State:	California County:	Plumas Island(s):	
			Co.	
Locality:	Plumas National Forest, Rock Lake, T24N R7E Sec13 (NE 1/4 of NE 1/4), 39 56 29.22 N, 121 08 29.29 W	Collector(s):	J.A. Wilkinson and J.V. Vindum	
		Date Collected:	23 Aug 1999	
		Collector's (Field) Number:	JVV- 6388	Field Notes:
Latitude:	39° 56' 29.22" N	Coord. Source:	Terrain Navigator, Bucks Lake Quadrangle, 1979	
Longitude:	121° 8' 29.29" W	Georef. By:	J.V. Vindum	
Max. Lat/Long Error		Georef. Remarks:		
Stated Locality:	California: Plumas Co.: Plumas National Forest, Rock Lake, T24N R7E Sec13 (NE 1/4 of NE 1/4), 39 56 29.22 N, 121 08 29.29 W, 6240 ft			
Life Stage:	Juv Sex:	Preservative:	Alc	Identified: J.V. Vindum, 3 Sep 1999
Elev:	6240 ft	Habitat:		
Remarks:				Publications

[Close and Return](#)

Exhibit A4

CAS Herpetology Collection Database

3

CAS 227668	<i>Rana muscosa</i>		Ranidae	Tissues Collected
Country:	USA	State: California	County: Plumas	Island(s): Co.
Locality:	Plumas National Forest, Bucks Lake Wilderness, effluent of Rock Lake, T24N R7E S13 (SW 1/4 of NE 1/4), 39 56 25.7 N, 121 08 25.5 W		Collector(s): D.G. Mulcahy and G.O.U. Wogan	Date Collected: 30 Aug 2003
Latitude:	39° 56' 25.7" N		Collector's (Field) Number: DGM- 1631	Field Notes:
Longitude:	121° 8' 25.5" W		Coord. Source: Garmin 12 GPS	
Max. Lat/Long Error			Georef. By: D.G. Mulcahy	
Stated Locality:	California: Plumas Co.: Plumas National Forest, Bucks Lake Wilderness, along drying tributary coming down from Rock Lake, T24N R7E S13 (SW 1/4 of NE 1/4), 39 56 25.7 N, 121 08 25.5 W, 6230 ft			
Life Stage:	Larva	Sex:	Preservative:	Form Identified: D.G. Mulcahy, 5 Sep 2003
Elev:	6230 ft	Habitat:	1645 hrs. In puddle, ca 1 m wide, 20 cm deep, along drying tributary coming down from Rock Lake. Water temp. 18 C.	

Remarks:

Exhibit A5

4

CAS Herpetology Collection Database

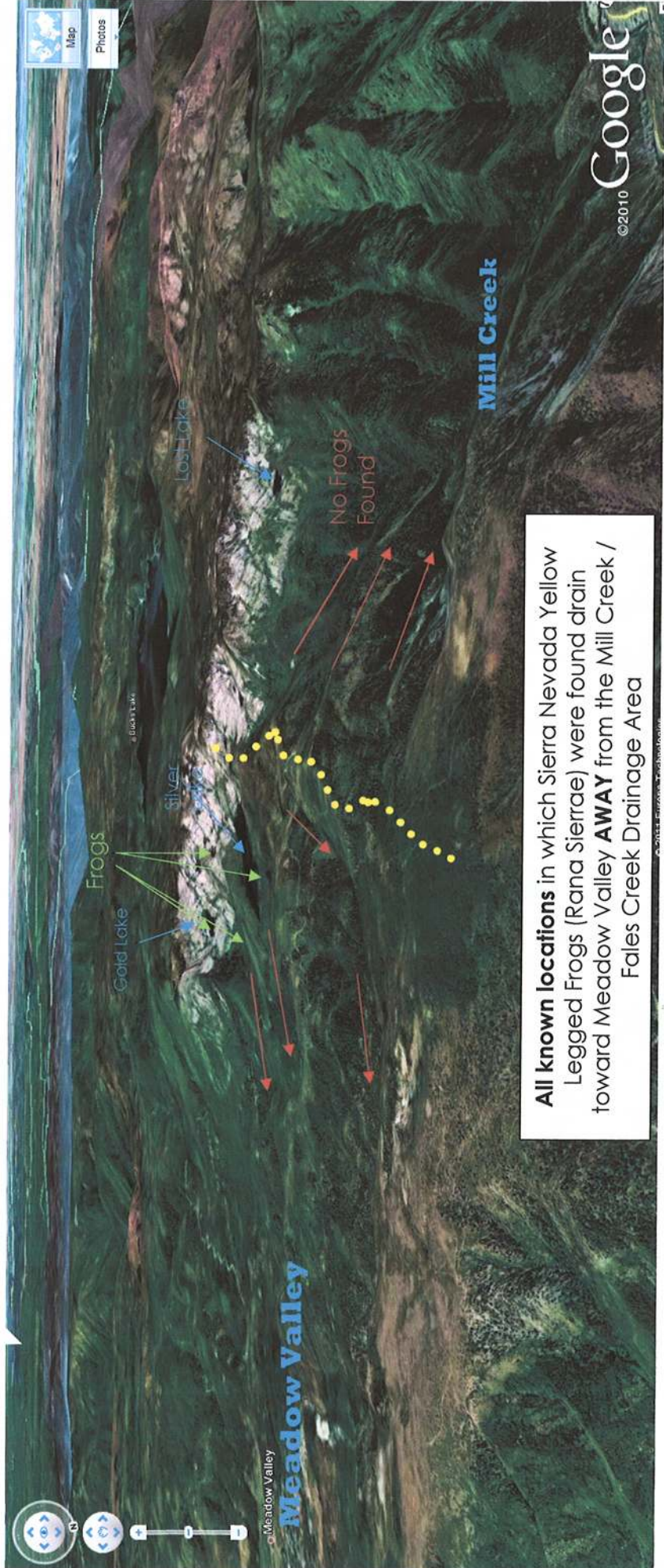
CAS 227259	<i>Rana muscosa</i>		Ranidae	Tissues Collected
Country:	USA	State: California	County: Plumas	Island(s): Co.
Locality:	Plumas National Forest, Bucks Lake Wilderness Area, outlet of Gold Lake, T24N R8E S18 (SW 1/4 of NW 1/4), 39 56 33.93 N, 121 08 06.44 W		Collector(s): M.S. Koo, L. Baron and I. Stull	Date Collected: 7 Aug 2003
Latitude:	39° 56' 33.93" N		Collector's (Field) Number: MSK- 506	Field Notes: 506
Longitude:	121° 8' 6.44" W		Coord. Source: Garmin III Plus GPS	
Max. Lat/Long Error			Georef. By: M.S. Koo	
Stated Locality:	California: Plumas Co.: Plumas National Forest, Bucks Lake Wilderness Area, Gold Lake, near outlet of Gold Lake to Jacks Meadow, T24N R8E S18 (SW 1/4 of NW 1/4), 39 56 33.93 N, 121 08 06.44 W, 5920 ft			
Life Stage:	Adult	Sex:	Preservative: Alc	Identified: M.S. Koo, 25 Aug 2003
Elev:	5920 ft	Habitat:	1130 hrs. In water on substrate, ca 8 inches deep.	

Remarks:

[Close and Return](#)

Exhibit A6

Ridge line separating drainage areas.



All known locations in which Sierra Nevada Yellow Legged Frogs (*Rana sierrae*) were found drain toward Meadow Valley **AWAY** from the Mill Creek / Fales Creek Drainage Area

Exhibit B1

Ridge Elevation 5932 Feet
Silver Lake Elevation - 5780 Feet
152 Feet

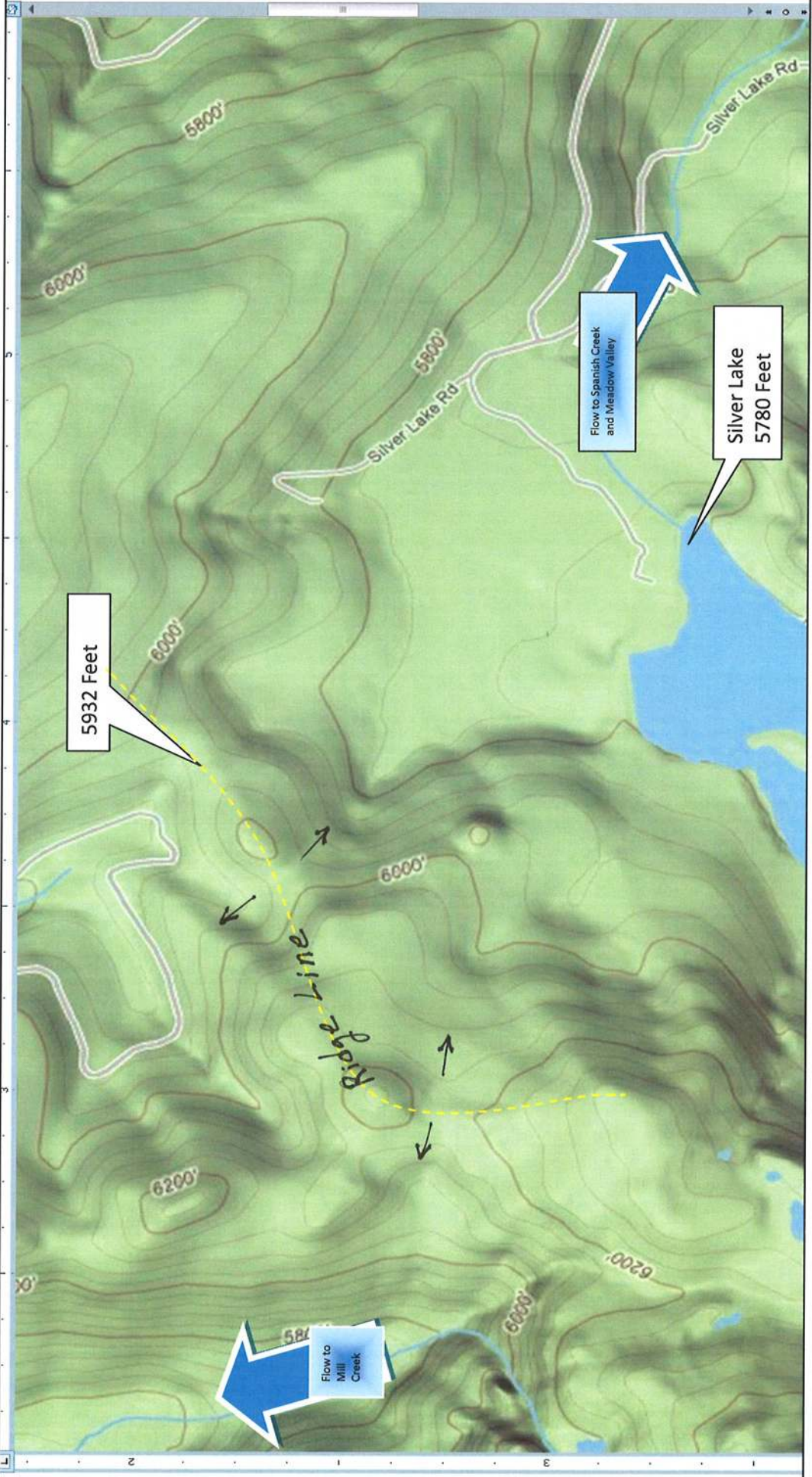


Exhibit B2

USGS - The National Map

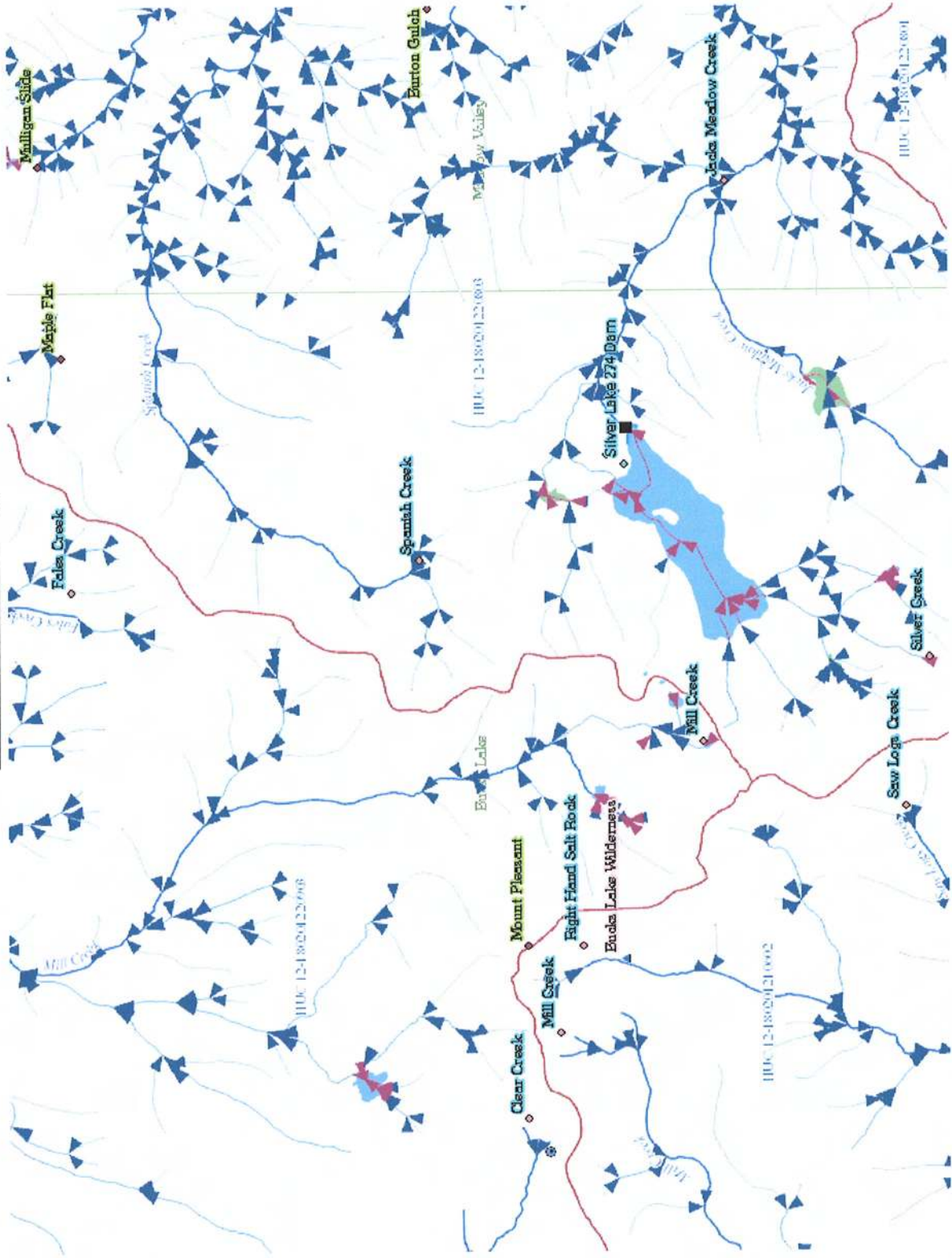
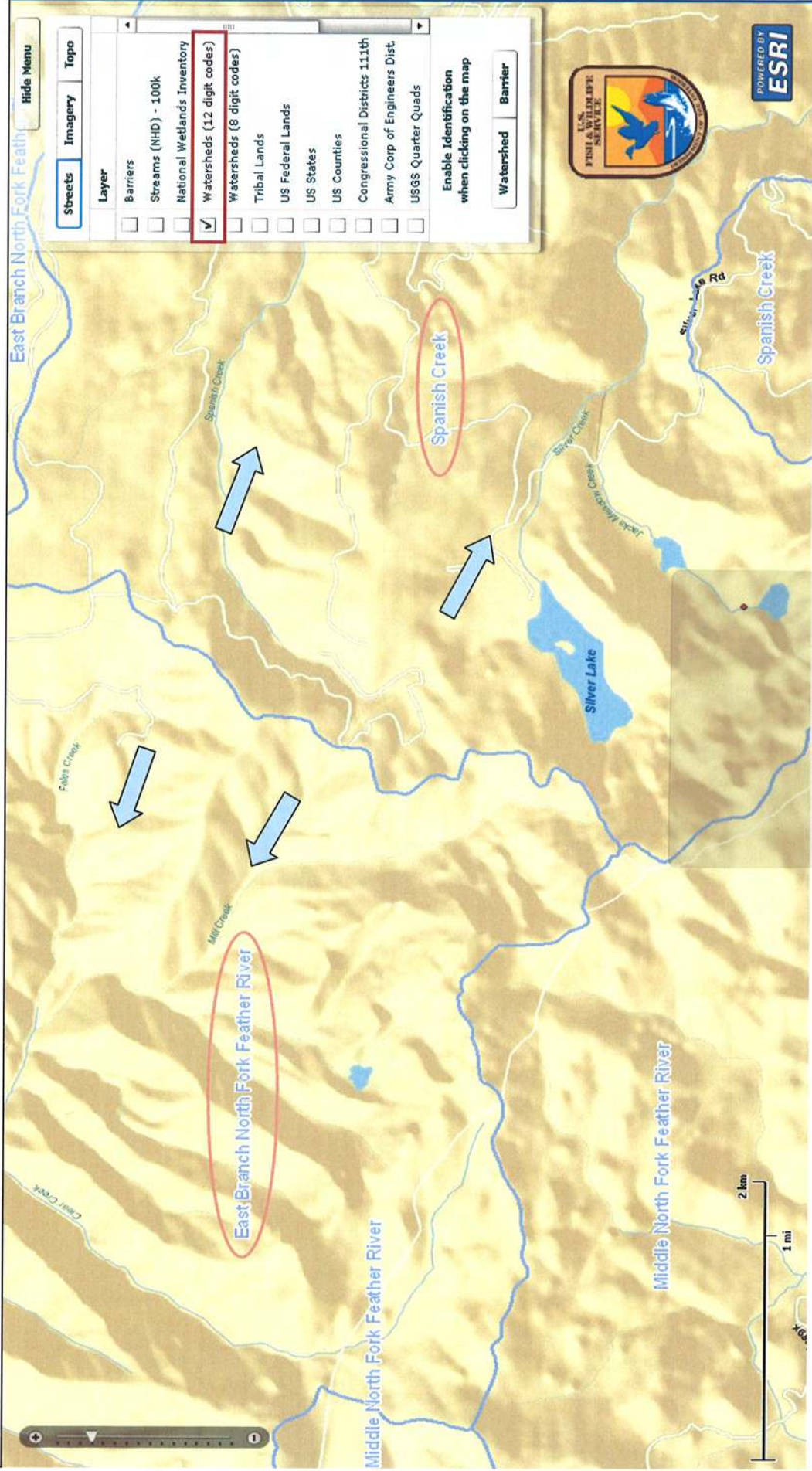


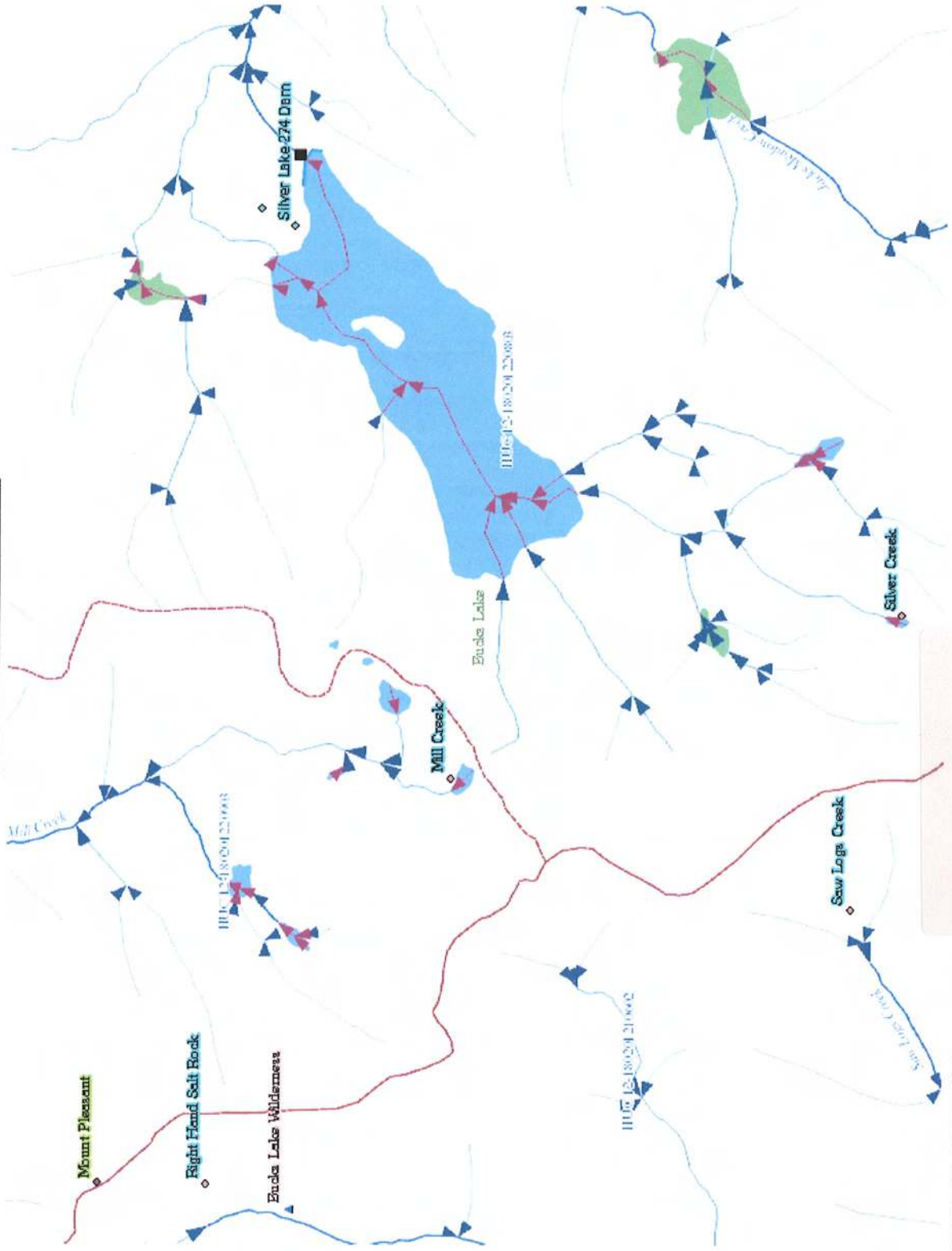
Exhibit C

US Fish and Wildlife Service shows the division line between Watersheds.

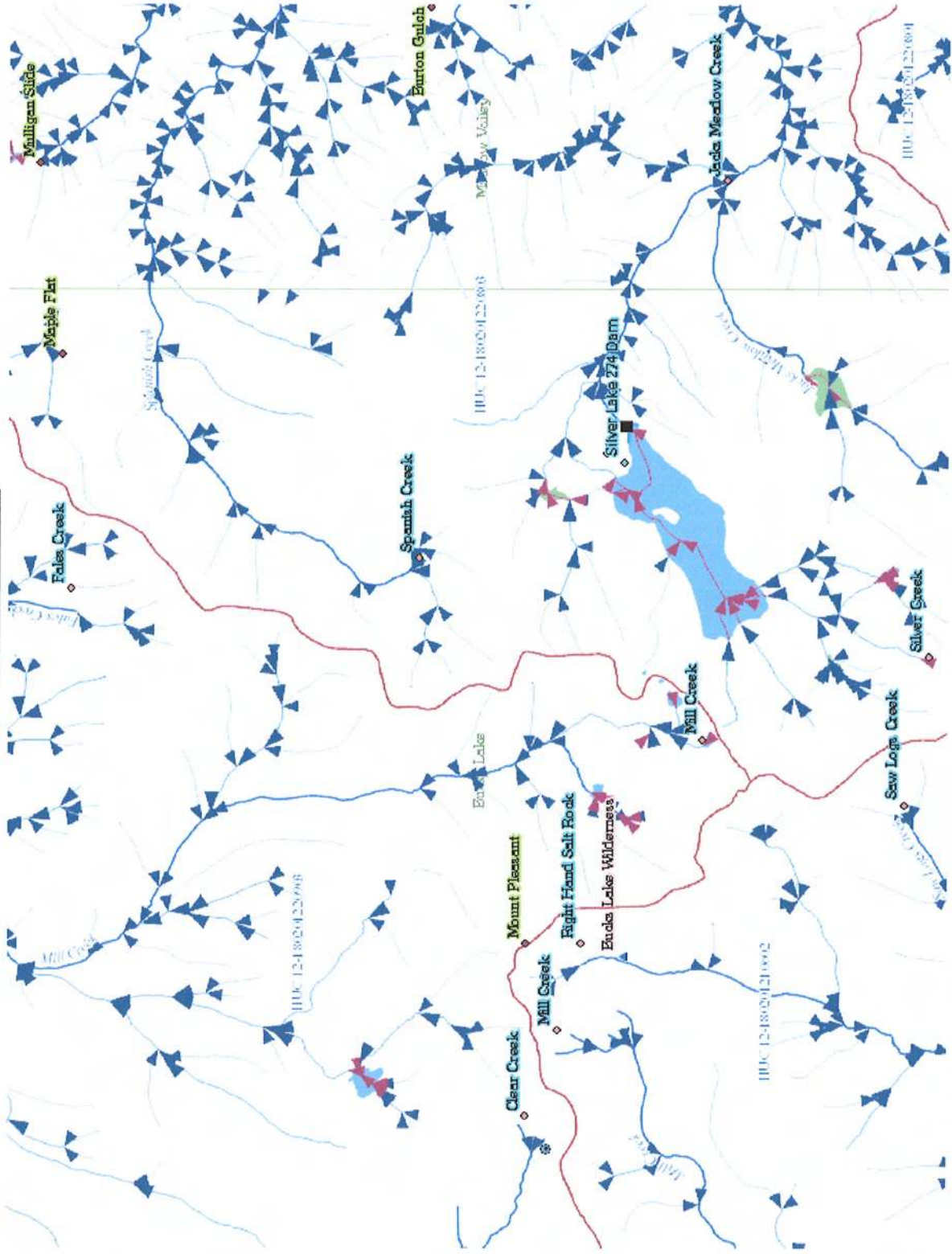
Silver Lake, Gold Lake, Rock Lake, Mud Lake and Jacks Meadows, where the Sierra Nevada Yellow Legged Frog (*Rana sierrae*, Formerly *Rana muscosa* - *Mountain Yellow-legged Frog*) were located, all drain into the Spanish Creek Watershed, AWAY from Mill Creek and the East Branch North Fork Feather River Watersheds.



USGS Watershed Boundary



USGS - The National Map



State of California
The Resources Agency
DEPARTMENT OF FISH AND GAME

**AQUATIC BIODIVERSITY MANAGEMENT PLAN FOR
THE BIG PINE CREEK WILDERNESS BASIN OF THE SIERRA NEVADA
INYO COUNTY, CALIFORNIA, 1999 - 2005**

BY

Curtis Milliron, Associate Fishery Biologist
Eastern Sierra and Inland Deserts Region
Bishop, California

*The Mission of the Department of Fish and Game is to manage California's
diverse fish, wildlife, and plant resources, and the habitats upon which
they depend, for their ecological values and for their
use and enjoyment by the public.*

Exhibit E

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INTRODUCTION AND OBJECTIVES

The movement of trout into wilderness waters of the eastern Sierra began in earnest around the turn of the 20th century. Historical stocking registers account for the quantity in milk cans of brown (often referred to as Loch Leven), brook, rainbow and golden trout stocked into wilderness basins. Cans were transported by packstock to nearly every accessible named lake in the Sierra. The California Department of Fish and Game (CDFG) now utilizes a twin engine turboprop airplane equipped with bomber doors and a GPS (global positioning system) tracking system to stock approximately 246 of the 600 named lakes above 9000 ft elevation in the eastern Sierra fisheries management unit. However, fisheries management activities, including fishery monitoring and evaluation, have not kept pace with fish movement technology. Most of the allotments for trout stocked into these lakes were determined over 30 years ago by experienced biologists using their best judgment and factors such as angler use, lake size, desirable species (from a recreational fisheries perspective), and some site specific fish growth or condition data. Adjustments to trout stocking allotments were made for individual lakes only during years when CDFG staff could spend time away from the demands of other important front-country fishery issues. Until recently, impacts on native biotic communities went largely unnoticed by CDFG biologists, because most lakes had not been revisited for decades.

Reported Sierra amphibian declines (Bradford, 1989) prompted a larger effort toward amphibian population surveys by the CDFG and U.S. Forest Service. With additional documented population losses of the mountain yellow-legged frog (MYLF), *Rana muscosa*, the CDFG began increasing wilderness resource assessment activities and initiated a fisheries and ecosystem management planning program for the eastern Sierra.

One of the major causes of MYLF population losses has been the introduction of trout into originally fishless habitats (Cory 1963; Bradford et al. 1993; Bradford et al. 1994; Jennings 1996; Knapp 1996). Site specific fisheries management plans are needed for all high Sierra waters to assure that trout fisheries are managed in a manner compatible with other native aquatic and riparian resources. Area fisheries management plans will need to comply with individual future species recovery plans or conservation strategies which may impart additional fisheries management constraints. CDFG plans should attempt to optimize recreational benefits while maintaining natural biodiversity using a basin-by-basin approach. The MYLF is a California State and Federal Species of Special Concern, and the U.S. Fish and Wildlife Service is currently assessing the need to list this species as Threatened or Endangered. As of this writing, a MYLF conservation strategy is near completion.

Twenty-one management units, mostly in the eastern Sierra, have been identified for management by CDFG's Bishop office (Figure 1). **Most units are defined by watershed boundaries;** however, several adjacent smaller basins may be combined to form a management planning unit. **Management plans for these areas should be site specific,** based on current assessments of fish and amphibian populations, angler use, and the status of key native biota and habitats. Input from CDFG stakeholders will be included.

This first plan focuses on the North and South Forks of the Big Pine Creek Basin. The following objectives are being used to develop the current plan:

Objective 1: Manage wilderness lakes in a manner which maintains or restores native biodiversity and habitat quality, will support viable populations of native species, and provides for recreational opportunities considering historical use patterns. In some areas, most or all of the lakes may be managed as natural reserves, with little or no angling available. Likewise, in areas of high recreational demand, most or all of the lakes may be managed for recreational angling.

Objective 2: Refinements to trout stocking allotments should be based on recent, site-specific data.

Objective 3: For each lake, the species, frequency, and number of trout stocked should be guided by the following provisions:

A) Since MYLF abundance in lakes has declined and is negatively correlated with trout presence, lakes with extant populations of MYLF, or other species of concern, should generally not be stocked. Where a MYLF population exists within close proximity to an established wilderness fishery, an assessment of fishing use and the feasibility of trout removal should be made to determine if the water could be converted to a fishless condition in order to benefit MYLF. Wilderness fisheries management should incorporate objectives of the MYLF Conservation Strategy.

B) Golden trout should be given priority over other trout species and stocked into waters following existing Fish and Game Commission policy (Appendix II). Other species of trout may be stocked to meet other fishery management objectives and for experimental stocking programs; however, the stocking of brook trout should generally be avoided because they are lake spawners and have a greater potential for establishing overabundant, self-sustaining, stunted populations. Brook trout should not be stocked where their range may be extended.

C) Wilderness lakes should be managed to optimize angling opportunity within a given basin. For example, some lakes might be managed for trophy-sized fish, some for fast-action on smaller sized fish, and others for species diversity.

D) Trout should not be stocked into waters with existing self-sustaining trout populations unless needed to meet goals for improving angling diversity, trophy or fast-action fishing, or research. Experimental planting of trout to control undesirable fish populations is not restricted under this provision.

E) In addition to the application of chemicals in lakes, new and innovative non-chemical means to control undesirable fish populations should be encouraged, including the use of stocked, sterile, predatory trout, strains or species of fish not previously stocked, or physical means of removal.

ENVIRONMENTAL SETTING

The Big Pine Creek Basin is within the John Muir Wilderness of the Inyo National Forest on the east slope of the Sierra Nevada. The North Fork Big Pine Creek drainage contains eleven named lakes (Big Pine Lake # 8 is the only CDFG designated name) and numerous unnamed ponds. The South Fork Big Pine Creek drainage contains six named lakes and numerous unnamed ponds. Although Willow Lake is included in this lake listing, it is actually a stream/marsh complex rather than a true lake. Lake maps with associated fishery data are in Appendix I. The Palisade Glacier complex is a prominent feature of the basin.

Area of the basins are approximately 31.7 square miles and 39.0 square miles west above Little Pine Creek and west above the town of Big Pine, CA, respectively. The 50-year average mean water content of the snowpack on April 1 for all snow courses is 18.3 inches, and the average (100% normal) precipitation at the Glacier Lodge rain gage is 16.89 inches (Steve Keef, Los Angeles Dept. of Water and Power). See Appendix II for data on Big Pine Creek total and mean flows from 1932 to 1997.

METHODS

Public scoping to address issues which should be considered in the fisheries management plans for both the Big Pine and Convict Wilderness basins was held on November 26, 1996. Fifteen interested individuals representing local agencies and organizations attended (Appendix II). Major issues included the desire to continue trout stocking activities and to manage for a balance between recreational fisheries and other aquatic species. Representatives from the Eastern Sierra Packers Association suggested that pack train use for trout stocking should be re-instituted where feasible in lieu of aerial stocking.

Fish and amphibian surveys were conducted in the North and South forks of the Big Pine Drainage following the protocol designed by Fellers and Freel in 1995 and modified by Knapp (University of California, Sierra Nevada Aquatic Research Laboratory, pers. com.). To collect fish, each lake was netted with two lightweight Swedish experimental gill nets measuring 1.8m x 36m and having six panels with a mesh size ranging from 10mm to 38mm. Otoliths were extracted from most of the trout caught in gill nets for age determination. Each lake was visually surveyed for the presence and abundance of amphibians. One day of field work was generally required to complete field study objectives for each lake surveyed by a two person crew. Additional surveys were conducted to cover all amphibian habitats, including ponds and streams, and to determine the presence of existing or potential key fish barriers. Fish barriers were identified in the North Fork drainage using the following criteria: presence of a rock barrier with a vertical drop of more than five feet; or a shorter drop, if fish were absent

upstream; or a continuous reach of stream with high gradient and no holding/resting water for trout. Using ArcView GIS software, data were archived and analyzed, and plan alternatives were generated.

Angler use at each water in the basin was estimated through volunteer angler surveys. Two "iron rangers", or metal survey stations, were put at the wilderness access trailheads, encouraging anglers to provide data for this management plan. The survey form (Appendix II) queried anglers on date, location, fish species caught, number of trout kept and released, trout lengths and condition, fishing effort, and satisfaction. The most useful data appeared to be location(s) fished, since much of the remaining data were of poor quality. To help anglers identify waters, a simple GIS map of the basin was printed on the back of each survey form.

To minimize optical distortion, lake images were scanned from the central third of aerial photographs (approximately 1:15,840 scale; 1993-94) obtained from the Inyo National Forest. Scanned images were georeferenced using Geographic Transformer AVX™ as an ArcView GIS software extension. For comparison of lakes with each other, images were scaled at 1:2,400 (Appendix I).

FISHERIES RESOURCES

Brown (BN), rainbow (RT), brook (BK), golden (GT), and cutthroat trout (CT) have been stocked in the Big Pine Basin (Table 1). CDFG calendar year end stocking records date back to the 1960's, though trout were likely first stocked into some Big Pine lakes near the turn of the 20th century. Further information on fish presence and past stocking allotments are contained in the stream and lake files of the CDFG's Bishop office.

Wilderness fisheries have been managed for wild trout and "put and grow" hatchery fingerling trout. Many strains of rainbow trout, brown trout, and brook trout have been stocked into backcountry lakes and tributaries, and many of these trout have successfully spawned, producing "wild trout" progeny. The term "wild trout" should not be confused with "native trout", which refers to trout that existed in watersheds prior to European settlement and have a defined natural range without human intervention. All waters in Inyo and Mono counties south of the Walker River drainage, including waters in the Big Pine Basin, have no native trout.

A reduction of stocked trout in 1999 is supported by data collected for this management plan. Stocked trout were observed in many cases to compete with an already overabundant wild brook trout population resulting in slow growth of all trout. In the case of the Thumb lakes, golden trout were simply too numerous in habitats with too little food to yield desirable trout growth.

Hatchery allotments are "goals", and production shortfalls and surpluses may occur in some years. Actual numbers stocked can be affected by the availability of strains, CDFG hatchery budgets, drought, disease, and the severity of winter conditions.

Table 1. Fish species stocked and recent management of the Big Pine Basin lakes.

<u>Name of lake</u>	<u>Fish species stocked historically</u>	<u>1996 fish stocking</u>	<u>1999 fish stocking</u>
First	BN, RT, BK	6,000 RT	6,000 RT annually
Second	BK, RT	9,000 RT	2,000 RT annually or experimental*
Third	BK, RT	5,000 RT	3,000 RT annually
Fourth	BK, RT, BN, CT	5,000 RT	1,000 RT annually
Fifth	BK, RT, BN	8,000 RT	2,000 RT annually
Sixth	BK, RT, BN	Not stocked	Not stocked
Seventh	BK, GT	Not stocked	Not stocked
Eighth	GT	Not stocked	Not stocked
Summit	BK, RT, CT	Not stocked	250 GT annually
Black	BK, RT, BN	4,000 RT	Not stocked or experimental
Sam Mack	BK, RT	Not stocked	Not stocked
Willow	BK	Not stocked	Not stocked
Brainard	BK, RT, GT	Not stocked	Not stocked
Thumb, lower	BK, RT, GT	1,000 GT	500 GT every even year
Thumb, upper	BK, RT, GT	1,000 GT	Not stocked
Finger	GT	Not stocked	Not stocked
Elinore	BK	Not stocked	Not stocked

* Experimental management is discussed in the FUTURE FISHERIES RESEARCH section of this plan.

Brook trout are no longer stocked in the Big Pine Creek Basin, since they generally overpopulate, become stunted, and maintain this condition almost indefinitely. Although brook trout are a prized sport fish, they are commonly a nuisance species in backcountry lakes, and their presence frequently precludes other more desirable resource management options.

Angling regulations for all waters in the Big Pine Creek Basin follow the Sierra District general regulations that allow anglers to harvest 5 trout per day with 10 trout in possession. Additionally, up to 10 brook trout per day less than 10 inches total length may be taken and possessed over and above the other daily bag and possession limits specified. The brook trout "bonus bag limit" was adopted to encourage the harvest of brook trout from overpopulated waters such as those found in the Big Pine Creek Basin.

Fifteen Big Pine lakes currently offer anglers the opportunity to catch four trout species. Fish species distributions are derived from stocking records and gill net data (Figure 2). Rainbow trout are stocked and may be maintained through natural reproduction in Black

Lake and Big Pine lakes First through Fifth. However, no rainbow trout were sampled from Second Lake, and only one rainbow trout was caught in Fifth lake, despite 9,000 and 8,000 rainbow trout stocked in each lake, respectively, in previous years. Rainbow trout coexist with brown trout in Big Pine Creek below First Lake. With little or no spawning habitat available, rainbow trout in Sixth and Summit lakes are expected to become extirpated without further stocking. Wild brown trout are present in First Lake and downstream in Big Pine Creek to the Owens Valley. Golden trout are maintained in lower Thumb lake through stocking. Golden trout in upper Thumb lake appear to be maintained by stocking and may become extirpated if stocking were halted. Brook trout are present in all waters, except the Thumb lakes, Summit Lake, Finger Lake, and Eighth Lake.

Most trout caught with gill nets were aged using otoliths. Fork lengths at each annulus were graphed for each species present in each lake (Figure 3.). Trout ages ranged from one year to an estimated 15 years old, with the average age being five years old. In many cases, trout growth slowed after age four, because of a lack of food for larger trout. The exception was brown trout in First Lake, where two large individuals (2,110 g and 1,740 g) were captured that had partially shifted from invertebrates to fish as a primary food source. Trout condition may degrade with age as observed for Sixth Lake brook trout and Black Lake rainbow trout (Figures 4 and 5, respectively).

A total of 152 anglers responded to the volunteer angler use survey (Figure 6). Generally, angler use was not well correlated with angler success, fish size, or angler satisfaction; use was greatest at waters near lower elevation hiking trails; and use was much greater in the North Fork lakes than in the South Fork lakes. The light use of the South Fork lakes is probably due to fewer fishing opportunities and more difficult access to the lakes.

AMPHIBIAN RESOURCES

The CDFG is concerned about MYLF declines in the Sierra range and southern California. Because of competition and predation by trout on MYLF and the similar habitat requirements of these species, introductions of non-native trout in high mountain lakes have been shown to be a major cause of MYLF declines. This fisheries management plan includes MYLF population assessments, and CDFG's future management direction will include these findings to provide more protection and improvement for Big Pine Basin MYLF populations.

Four MYLF populations were present within the NF Big Pine Creek drainage in 1998 (Figure 2). Two populations, one in Eighth Lake and the other in Sam Mack Meadow (Figures 7 and 8, respectively), are in good condition and appear to be at carrying capacity for the habitats available. Both populations have approximately 700-1,000 individuals (adults and tadpoles combined). The remaining two populations, one in a

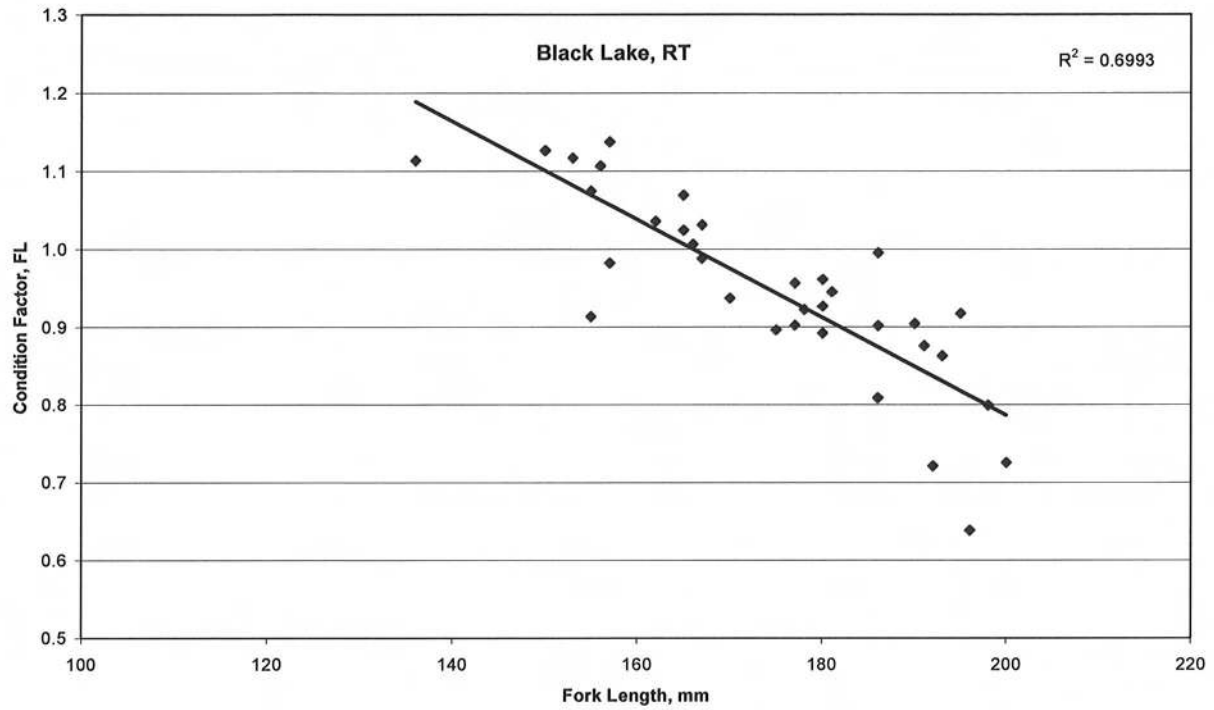


Figure 4. Condition factor at length for Black Lake Rainbow Trout. August, 1996.

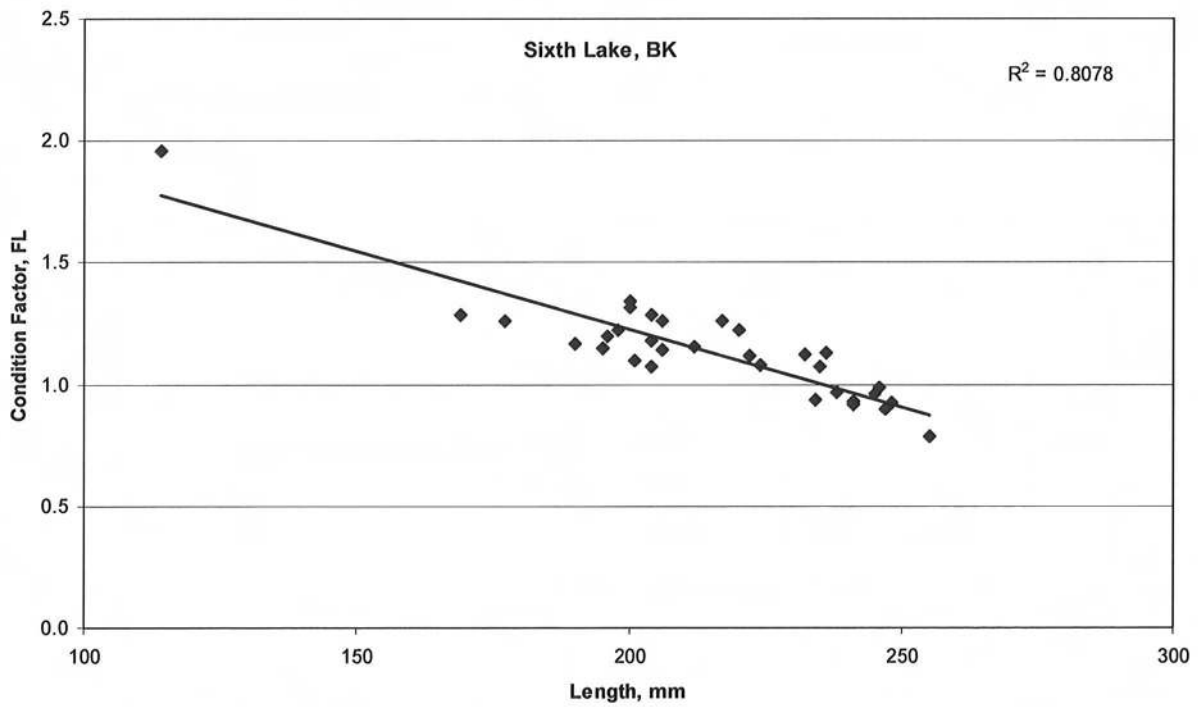


Figure 5. Condition factor at length for Sixth Lake Brook Trout. August, 1996.

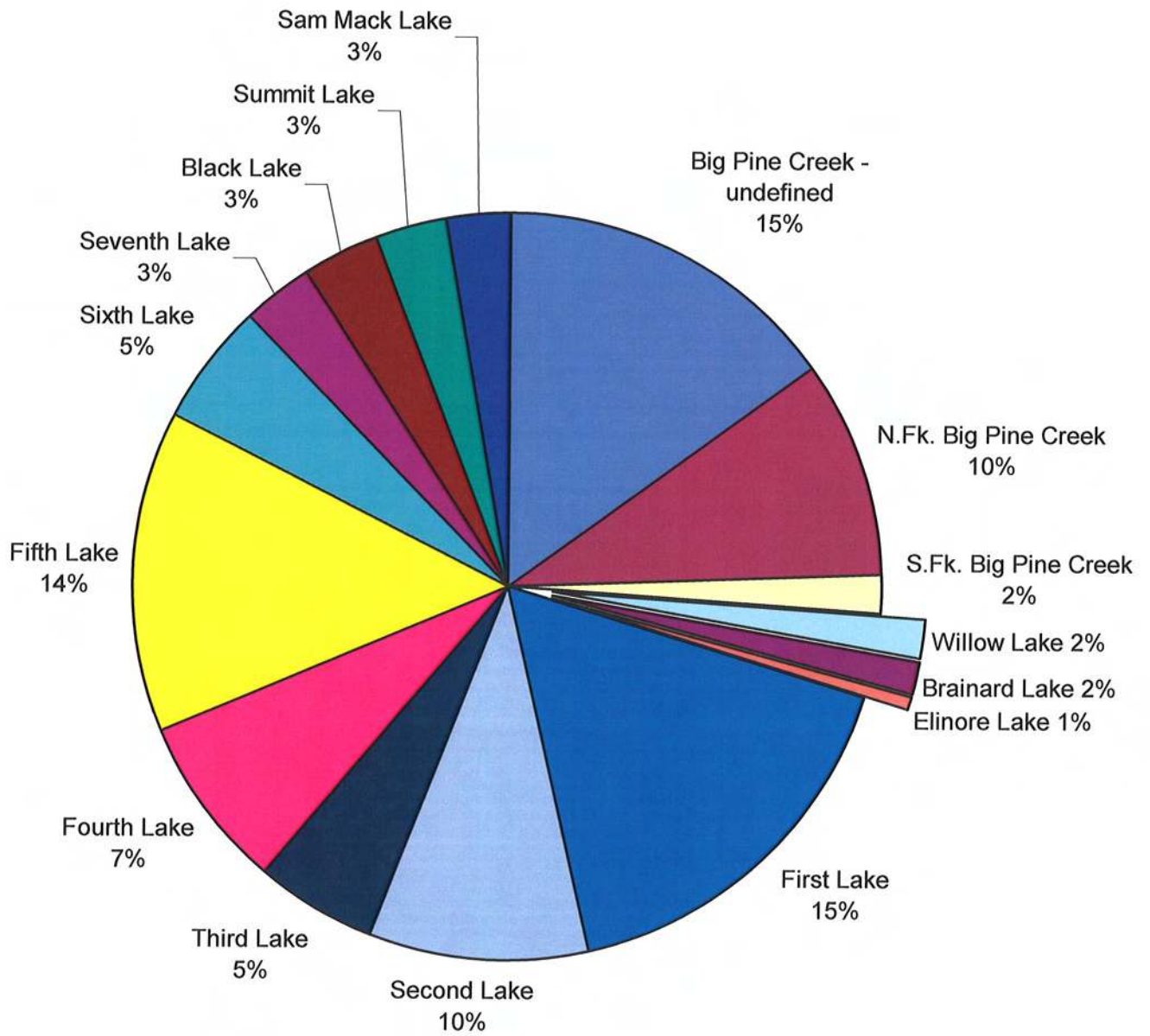


Figure 6. Angler use in the Big Pine Basin from volunteer angler surveys collected, 1995-98.

pond near Seventh Lake (Figure 7) and the other in a meadow south of Summit Lake (Figure 9), were considered in poor condition, with each having an estimated population of less than 70 individuals (adults and tadpoles combined), in 1998. The pond population near Seventh Lake was extirpated in 1999.

Eighth Lake was stocked prior to 1989 with golden trout, but the allotment was canceled that year due to a severe winter, which caused a complete winter kill of trout. Lake surveys have determined that, in the absence of trout, MYLF have proliferated within the lake and surrounding waters. This response is one of the few known examples of natural MYLF population recovery after trout extirpation.

MYLF are currently common in the outlet of Eighth Lake downstream to a small fish barrier. Below the barrier, trout are common and no MYLF were found. A few adult MYLF were observed around the margins of Sixth Lake, but no fishless breeding area is available in the lake. A small population of MYLF inhabited several shallow ponds (<1m deep) adjacent to Seventh Lake in 1998. However, no MYLF were observed in Seventh Lake, located just 2 meters away, but teeming with brook trout. This population became extirpated in 1999 when brook trout invaded the pond habitat.

Trout populations within this upper complex of three lakes (Sixth through Eighth) are isolated from lower elevation populations through a series of fish barriers. To benefit MYLF, these populations could be eradicated, with no chance of unaided trout recolonization,

The small MYLF population below Summit Lake and near Fourth Lake exists in very small isolated pools within an ephemeral stream channel. MYLF recruitment was very low during the three years of recent observation. MYLF are long-lived, and this characteristic has allowed them to survive in the marginal habitats available since the introduction of trout into Fourth Lake. Their status is tenuous and will remain so, unless additional trout-free habitat becomes available, or they may become extirpated.

MYLF in Sam Mack Meadow are isolated from trout and other MYLF populations, and no habitat is available for population expansion. This population needs to be monitored to assure that no trout are introduced into the ponds or adjoining waters.

Tree frogs, *Hyla regilla*, were more common than MYLF in the Big Pine Creek Basin (Figures 10 and 11). No other amphibian species were observed during our aquatic habitat surveys.

FUTURE FISHERIES RESEARCH

Fisheries managers possess several "tools" which they use to manage sport fish populations. Restricting angler harvest of fish through angling regulations are an effective means of protecting fish populations that are vulnerable to overfishing, such as roadside trophy trout fisheries. However, in high mountain lakes, liberal angling regulations to increase harvests rates of over abundant stunted fish populations often do not achieve desired objectives. For example, it is doubtful many anglers take advantage of the brook trout bonus bag regulation (allows 10 brook trout < 10" in length, in addition to the Sierra District 5 trout limit). Because of their remoteness, even an unlimited possession limit may not produce an appreciable increase in trout harvests in many high mountain lakes. Another tool managers use is fish stocking, which is an effective means of maintaining trout populations that are not self-sustaining, increasing species diversity to a fishery, and improving trout growth by altering population density. However, the biggest problem with fish stocking is that it is difficult to remove an unwanted fishery after an introduction has occurred. Fish removal has traditionally been accomplished by using the piscicide, rotenone, which is derived from the roots of several tropical and subtropical plants. While rotenone is also toxic to certain non-target species (gill-breathing invertebrates and tadpoles), these species generally recover rapidly after a chemical treatment. An alternative to rotenone on some smaller waters is trout eradication using gill nets. Some success has been achieved using gill nets to eradicate several small populations of golden and rainbow trout and one very small population (N=97) of brook trout (Knapp, 1998). However, control of most brook trout populations through this method would be difficult because of the large number of fish present, high reproductive potential of this species, and large size and depth of many lakes. More tests of this method of eradication, and other possible fish population control methods, need to be conducted.

In the Big Pine Creek Basin, brook trout are overpopulating 9 of the 15 lakes that contain trout, resulting in poor growth and marginal sport fisheries. The development of other practical means to control brook trout, either through reducing population abundance or by complete population eradication, is necessary. Two experimental approaches for brook trout population control are proposed. The first is to eliminate the stocking of fingerling rainbow trout into Second and Black lakes and replace them with fewer, but much larger, trout that are able to immediately prey upon the abundant supply of smaller brook trout. The objective is to increase brook trout growth by reducing intraspecific competition for the limited food supplies in these lakes. This approach holds promise since these stocked trout would not need to compete with brook trout to attain a large size, but would require a larger food item (brook trout fry and fingerlings) for continued growth and survival. Any trout species of a large size could meet the management objective; however, large brown, cutthroat or tiger trout (sterile hybrid between brown trout and brook trout) are highly piscivorous and may be longer lived and/or more difficult to harvest than large rainbow trout.

A second method, proposed for Sixth and Seventh lakes, uses gill nets and other harvest gear (traps, seines, angling, etc.) to directly remove brook trout. The objective would be to remove all trout from these two lakes during a two-year intensive gill-netting operation. These two lakes would then be left barren of trout to benefit native species, especially MYLF. Brook trout spawning areas (Figure 7) would also be disrupted or made unusable. The full proposal is presented in Appendix II.

These methods, if successful, could be used in many other Sierra lakes to meet site-specific fishery objectives, improve angling recreation, and implement responsible native species management objectives.

PROPOSED MANAGEMENT DIRECTION

Several management directions were developed for this plan to explore the range of fisheries management possibilities. The analysis included actions to 1) increase MYLF (and other native fauna) populations, with the decrease in angling opportunities offset through improved fisheries management elsewhere in the basin, 2) maximize recreational fisheries with increased potential to harm native fauna, 3) increase MYLF (and other native fauna) populations to the extent feasible with a large decrease in angling opportunities, and 4) no action which depicts current fisheries management based on recent assessments. CDFG's management direction, action "1" above, is presented in this section, while evaluations of the other three actions are presented in Appendix II.

This plan is directed mostly toward management of the North Fork of the Big Pine Creek Basin. The South Fork lakes offer less opportunity for fisheries enhancements or amphibian reintroductions. If experimental fisheries management techniques prove successful and cost effective, then Brainard and upper Thumb lakes in the South Fork Basin would be candidates for future management actions.

CDFG's management direction proposes experimental fisheries management in Second and Black lakes initially, with more lakes to follow if results are favorable (Figure 12). A trophy fishery would be established in Summit Lake utilizing golden trout. Trout will be removed from the upper North Fork Basin (Sixth and Seventh lakes) where MYLF should quickly re-colonize former lake habitats. On the South Fork, trout will no longer be stocked at upper Thumb Lake, which will be monitored to determine if the present golden trout population is self-sustaining. MYLF may be reintroduced with an intra-basin transfer into Upper Thumb. Stocking allotments in other basin waters are based on the findings from fisheries resource assessments to date. This management direction is outlined further in the schedule of activities.

EXPECTED BENEFITS

This management plan was developed with a set of objectives based on the CDFG's responsibility to manage all of California's diverse fauna, CDFG policies and management authorities, and our desire to fairly balance the demands upon our venerable resources. It is clear that to develop and implement comparable management plans for all back country waters will be a demanding task requiring cooperation and even encouragement from our stakeholders. However, every future visitor of the Big Pine Basin will not be entirely satisfied with the outcome of our management. Some will contend that all non-native trout should be eliminated, a task not likely to ever be accomplished. Others have difficulty accepting the inherent values of things non-consumptive, like the mountain yellow-legged frog. The intent of this plan is to provide for improved recreational opportunities while maintaining biodiversity. It is our collective responsibility to pass on to future Americans the natural components that we inherited - clean water, beautiful landscapes, wild lands, and the fisheries and native fauna of the Big Pine Creek Basin and elsewhere.

Throughout the Big Pine Creek Basin, fisheries management is being refined based on new information and our current biological understanding of high elevation trout and frog populations. In most cases, trout stocking allotments were reduced to decrease competition for the limited food supplies available in these waters. As a result, trout average size should increase moderately in these lakes. Since brook trout are so very abundant in the basin, there will be no shortage of angling opportunities or fast action waters.

We propose to initiate several experimental trout stockings in Black Lake and Second Lake, and possibly several other lakes containing stunted brook trout, depending on realized benefits. Stocking large piscivorous (fish eating) trout will reduce the enormous numbers of young brook trout, resulting in substantial growth increases of both predatory and remaining brook trout. The current Black Lake fishery is mainly comprised of very slender undernourished trout, averaging only seven inches and 1.3 ounces and almost unsuitable for human consumption. Our goal is to raise the average size by at least an inch and double the current average weight. Black Lake should remain a fast action water, and also provide anglers with healthy, attractive trout.

Summit Lake is the only lake in the North Fork of Big Pine that does not provide spawning habitat suitable for trout, including brook trout. A unique opportunity exists here to manage this water as a trophy fishery. Since no trout reproduction occurs, the CDFG can control which species of trout is stocked and at what density it is maintained (i.e. # of trout/surface acre). A low density trout population, as is present in Summit Lake, yields higher individual fish growth than a high density population. Maintaining this condition will provide angling opportunities for larger (12 to 16 inch) trout, but with lower catch rates (# fish/hr.). Stocking golden trout is favored by the local packer and meets the Fish and Game Commission policy for golden trout management; however, any trout species could be managed to produce a trophy fishery in Summit Lake. The

development of this trophy fishery and improved recreational fisheries management in other waters will offset lost angling opportunities in the two waters that will be converted to a fishless state for the benefit of native fauna.

Removing trout populations from the two upper North Fork waters, Sixth and Seventh lakes, will greatly increase the abundance and stability of the MYLF population that currently inhabits Eighth Lake. These two lakes supported approximately 10% of fishing recreation in the Big Pine Creek Basin in 1999. The loss of angling opportunity at these two lakes should be offset through implementation of fisheries management programs mentioned above. Trout populations in this upper subbasin are isolated from downstream waters by natural fish barriers. Trout above the barriers will be removed by netting and trapping adults and juvenile fish, and by blocking access to spawning habitats. This project is a multi-year effort, and if successful, techniques for conversion of other brook trout waters in the Sierra to either a fishless condition, or in preparation for improved trout management, could be developed.

Finally, golden trout in upper Thumb Lake will no longer be stocked. Use of this fishery is very low, average trout size is poor, and the habitat may not support natural reproduction. A good golden trout fishery still exists in nearby lower Thumb Lake. If golden trout do not maintain a population in upper Thumb Lake, an intra-basin MYLF relocation will be attempted to reestablish them in the South Fork drainage.

SCHEDULE OF ACTIVITIES

Present Plan to Stakeholders:

Meet with Inyo Forest personnel and Eastern Sierra Packers Association and present management plan for discussion and comment.

Spring 1999
Completed

Initiate Experimental Management:

Determine species and strain of trout to stock into Black Lake for experimental management.

Spring 2000
Completed

Secure approval from the Chief of the Department's Fisheries Programs Branch and from the Inyo Forest Supervisor if using a new species or hybrid of trout, as per MOU.

Spring 2001

Collect additional baseline data for future analysis of population response to treatment at Black and Second lakes.

Summer 2000
Completed

Coordinate with the local packer to stock approved trout when available.

Summer 2000

Stock GT into Summit Lake to Initiate Trophy Trout Program:

Secure approval from the Chief of the Department's Fisheries Programs Branch and from the Inyo Forest Supervisor, as per MOU.

Spring 1999
Completed

Determine stocking rates and frequency and add to hatchery allotment.

Spring 1999
Completed

Remove Trout from the Upper North Fork Basin:

Collect information on BK population density, size distribution, general movement patterns, and the timing and location of spawning.

Fall 1998
Completed

Remove adult trout in Sixth and Seventh lakes by gill nets.

Summer 1999
and 2000
Completed

Remove trout in stream between Sixth and Seventh lakes by electrofishing and trapping.

Summer 1999
and 2000
Completed

Disrupt spawning by covering BK spawning habitat, dispersing gravels, directed netting, destroying embryos, etc.

Fall 1999 and
2000

Remove subadult trout in Sixth and Seventh lakes by gill nets.

Completed
Summer 2000

Monitor success of the project and remove remaining trout.	Summer 2001 and 2003
Monitor re-colonization of MYLF to upper basin habitats	2003 and 2005
Monitor Upper Thumb Lake's Trout Population and Potential for MYLF Re-introduction.	
Survey upper Thumb Lake trout spawning habitat and young-of-the-year.	Summer 2001
Set gill nets at upper Thumb Lake to determine if GT are self-sustaining.	Summer 2002
Reintroduce MYLF with an intra-basin transfer to Upper Thumb Lake.	When GT are extirpated
Maintain Current Fisheries Management in Other Big Pine Basin Waters.	
Implement trout stocking allotments.	Annually

ACKNOWLEDGMENTS

The research, development, and implementation of this management plan was funded under the Sport Fish Restoration Act, Project #44, Eastern Sierra Fisheries/Ecosystem Management, and the California Department of Fish and Game. Many individuals contributed their time and talents. I would especially like to acknowledge the following: Dr. Thomas Jenkins, Robert and Kimberly Russell, and Tom Russell as the core of the field team; The Bishop fisheries staff, including Alan Pickard, Darrell Wong, Steve Parmenter, Dawne Becker and Phillip Kiddoo; Bruce Kinney, Eastern Sierra and Inland Deserts Hunting and Fishing Supervisor; Drs. Roland Knapp and Kathleen Matthews for their continued excellent research on amphibian and fish interaction; and Chuck Knutson, Senior Biologist Supervisor of the Wild and Heritage Trout Project for your critical editing of this plan. I extend my most sincere thanks to the people of Big Pine and the Glacier Pack Train for putting up with the uncertainties of this new approach to management of our resources. My intention is to establish an understanding and appreciation of our management approach with a favorable outcome that successfully bridges the incongruity of values and interests in our community.

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APPENDIX I

MAPS AND SURVEY DATA SUMMARIES FOR BIG PINE CREEK BASIN LAKES

The following section provides maps and associated fishery survey data pertinent to aquatic resource management by the CDFG. Each water body being considered in this plan is displayed as a GIS layout with an overlay of current fisheries data (length frequency histogram from gill netting). Each layout has been scaled to 1:2,400 which allows for a quick impression of the relative size of the lake in comparison to all other waters in the basin. Additionally, the scanned aerial photographs are of sufficient detail to characterize surrounding land forms and vegetative types.

Lake Name	Elevation (Feet)	Surface Area (Acres)
First	9,958	7
Second	10,056	28
Third	10,247	12
Fourth	10,720	8.3
Fifth	10,787	20
Sixth	11,088	8
Seventh	11,160	4
Eighth	11,080	1
Black	10,647	9
Summit	10,890	2.5
Sam Mack	11,793	9
Elinore	10,988	6.4
Willow	9,561	2
Brainard	10,234	6
Thumb, lower	10,758	2
Thumb, upper	10,955	1
Finger	10,785	6.5

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- Counties (100K)
- Quadrangles (24K)

Zoom to quad: Select a quad: Go

v2.11 [CNDDDB Website](http://www.cnddb.com)

Welcome to the CNDDDB Quick Viewer!

The tools at the top of this window allow you to move around the map, zoom-in and zoom-out, and list all CNDDDB elements (species or natural communities) that have been documented by the CNDDDB to occur on a particular USGS 7.5' topographic quad or in a California county. For more information about these tools, click on the Help tab in the left-hand column. Clicking on the Refresh button will redraw the map and legend.

Exhibit F1

Results for **CARIBOU Quad** (4012112) - 17 elements selected

<u>ecord</u>	<u>QUADNAME</u>	<u>ELMCODE</u>	<u>SCINAME</u>	<u>COMNAME</u>	<u>FEDSTATUS</u>	<u>CALSTATUS</u>	<u>DFGSTATUS</u>	<u>CNPS</u>
1	Caribou	ABNKC01010	Pandion haliaetus	osprey	None	None	WL	
	Caribou	ABNKC10010	Haliaeetus leucocephalus	bald eagle	Delisted	Endangered	FP	
3	Caribou	AMACC01020	Myotis yumanensis	Yuma myotis	None	None		
4	Caribou	CTT51120CA	Darlingtonia Seep	Darlingtonia Seep	None	None		
5	Caribou	PDAST8H182	Packera eurycephala var. lewisrosei	Lewis Rose's ragwort	None	None		1B.2
6	Caribou	PDBET02030	Betula glandulosa	dwarf resin birch	None	None		2.2
7	Caribou	PDBRA06090	Boechera constancei	Constance's rock-cress	None	None		1B.1
8	Caribou	PDCRA0A030	Sedum albomarginatum	Feather River stonecrop	None	None		1B.2
9	Caribou	PDFAB0F9J0	Astragalus webberi	Webber's milk-vetch	None	None		1B.2
10	Caribou	PDFAB2B1A0	Lupinus dalesiae	Quincy lupine	None	None		4.2
11	Caribou	PDLAM180L0	Monardella stebbinsii	Stebbins' monardella	None	None		1B.2
12	Caribou	PDLAM180W0	Monardella follettii	Follett's monardella	None	None		1B.2
13	Caribou	PDONA050Q2	Clarkia mildrediae ssp. mildrediae	Mildred's clarkia	None	None		1B.3
14	Caribou	PDPOR04020	Lewisia cantelovii	Cantelow's lewisia	None	None		1B.2
15	Caribou	PDRHA0C010	Rhamnus alnifolia	alder buckthorn	None	None		2.2
16	Caribou	PDRHA0H061	Frangula purshiana ssp. ultramafica	Caribou coffeeberry	None	None		1B.2
17	Caribou	PMCYP03CE0	Carex sheldonii	Sheldon's sedge	None	None		2.2

Results for BUCKS LAKE Quad (3912182) - 15 elements selected

Record	QUADNAME	ELMCODE	SCINAME	COMNAME	FEDSTATUS	CALSTATUS	DFGSTATUS	CNPSLIST
1	Bucks Lake	AAABH01340	Rana sierrae	Sierra Nevada yellow-legged frog	Candidate	Candidate Endangered	SSC	
2	Bucks Lake	ABNKC10010	Haliaeetus leucocephalus	bald eagle	Delisted	Endangered	FP	
3	Bucks Lake	CTT51120CA	Darlingtonia Seep	Darlingtonia Seep	None	None		
4	Bucks Lake	NBMUS4L020	Meesia triquetra	three-ranked hump moss	None	None		4.2
5	Bucks Lake	PDASTEAO20	Oreostemma elatum	tall alpine-aster	None	None		1B.2
6	Bucks Lake	PDBRA06090	Boechera constancei	Constance's rock-cress	None	None		1B.1
7	Bucks Lake	PDCAR0X0M0	Stellaria longifolia	long-leaved starwort	None	None		2.2
8	Bucks Lake	PDCAR17010	Eremogone cliftonii	Clifton's eremogone	None	None		1B.3
9	Bucks Lake	PDFAB2B1A0	Lupinus dalesiae	Quincy lupine	None	None		4.2
10	Bucks Lake	PDLAM180W0	Monardella follettii	Follett's monardella	None	None		1B.2
11	Bucks Lake	PDONA050Q2	Clarkia mildrediae ssp. mildrediae	Mildred's clarkia	None	None		1B.3
12	Bucks Lake	PDSAX0W010	Hemieva ranunculifolia	buttercup-leaf suksdorfia	None	None		2
13	Bucks Lake	PDSCR1L4Y0	Penstemon personatus	closed-throated beardtongue	None	None		1B.2
14	Bucks Lake	PMCYP037K0	Carex limosa	mud sedge	None	None		2.2
15	Bucks Lake	PMORC0M050	Corallorhiza trifida	northern coralroot	None	None		2.1

Print table Show entire table in new window Export entire table to a text file

Results for MEADOW VALLEY Quad (3912181) - 16 elements selected

<u>Record</u>	<u>QUADNAME</u>	<u>ELMCODE</u>	<u>SCINAME</u>	<u>COMNAME</u>	<u>FEDSTATUS</u>	<u>CALSTATUS</u>
1	Meadow Valley	AAABH01050	Rana boylei	foothill yellow-legged frog	None	None
.	Meadow Valley	AAABH01340	Rana sierrae	Sierra Nevada yellow-legged frog	Candidate	Candidate Endanger
3	Meadow Valley	ABNKC01010	Pandion haliaetus	osprey	None	None
4	Meadow Valley	ABNKC12060	Accipiter gentilis	northern goshawk	None	None
5	Meadow Valley	AMAJF03010	Gulo gulo	California wolverine	Candidate	Threatened
6	Meadow Valley	CTT51120CA	Darlingtonia Seep	Darlingtonia Seep	None	None
7	Meadow Valley	NBMUS13010	Bruchia bolanderi	Bolander's bruchia	None	None
8	Meadow Valley	PDASTEAO20	Oreostemma elatum	tall alpine-aster	None	None
9	Meadow Valley	PDBRA06090	Boechera constancei	Constance's rock-cress	None	None
10	Meadow Valley	PDCAB01010	Brasenia schreberi	watershield	None	None
11	Meadow Valley	PDFAB2B1A0	Lupinus dalesiae	Quincy lupine	None	None
12	Meadow Valley	PDLAM180W0	Monardella follettii	Follett's monardella	None	None
13	Meadow Valley	PDRHA0H061	Frangula purshiana ssp. ultramafica	Caribou coffeeberry	None	None
14	Meadow Valley	PDROS0X0Q0	Ivesia webberi	Webber's ivesia	Candidate	None
15	Meadow Valley	PDSCR1L4Y0	Penstemon personatus	closed-throated beardtongue	None	None
16	Meadow Valley	PMCYP03C90	Carex scoparia	pointed broom sedge	None	None

Print table Show entire table in new window Export entire table to a text file

Exhibit F4



Sierra Forest Legacy

Protecting Sierra Nevada Forests and Communities

Fire and Forest Ecology

Sierra Nevada Mountain Yellow-Legged Frog (*Rana sierrae* and *Rana muscosa*)

Threats

Once the most abundant frog in the Sierra Nevada, the mountain yellow-legged frog is now critically endangered in the Range of Light. Populations of mountain yellow-legged frogs have declined dramatically and they are now found in fewer than 7 percent of their historic localities. This decline is due to a number of factors, including the stocking of fish in high elevation lakes, many of which did not contain fish historically. As a result of these fish stocking efforts, which continue today, more than 90% of Sierra Nevada lakes which were naturally fish-less now contain introduced trout. There is abundant scientific evidence that predation by non-native trout on mountain yellow-legged frog tadpoles, as well as adults, is a major factor in the decline of this amphibian. Other factors leading to declines in population include toxins from pesticides and herbicides, livestock impacts, chytrid fungal infection, and off-highway vehicle (OHV) recreation.



Habitat

The habitat of the mountain yellow-legged frog consists of glaciated lakes, ponds, tarns, springs, and streams in the upper elevations (above 6,000 feet generally) of the Sierra Nevada. The adaptations that allow them to live at these high elevations and cold temperatures have made them highly vulnerable to introduced fish species. The species is usually associated with montane riparian habitats in lodgepole pine, yellow pine, sugar pine, white fir, whitebark pine, and wet meadow vegetation types, and range from southern Plumas County to southern Tulare County.

Conservation

Nearly all the remaining populations of mountain yellow-legged frog occur on public lands, and studies have demonstrated that in the absence of disease, it is possible to bring these species back to recovery. Recent surveys, however, have shown an increase in the deadly disease, chytridiomycosis. The Sierra Nevada Framework Plan provides strategies to reduce all the factors causing a decline in mountain yellow-legged frog populations including prohibition of pesticides from frog habitat, removing livestock near lakes and pond areas, prohibiting development of new recreation trails that would affect known frog sites, and the identification of Critical Aquatic Refuges to protect sensitive species. It also calls for the removal of exotic fish from frog habitat. The 2004 revisions to the Framework have weakened the protections for the mountain yellow-legged frog by failing to maintain grazing restrictions for amphibian species in key habitats. A return to a robust monitoring and restoration program as promoted and required by the original Sierra Nevada Framework is vital to protect the species from disappearing from the Sierra Nevada altogether.

Status

Until recently, the mountain yellow-legged frog in the northern and central Sierra Nevada, and those in the mountains of southern California, were thought to be the same species. Today the Sierra Nevada mountain yellow-legged frog--specifically, those frogs north of Mather Pass--is recognized as a unique species, *Rana sierrae*. The species are thought to have diverged more than 2 million years ago. Both species are critically endangered with extinction. Surveys have shown that 93% of the *R. sierrae* and 95% of *R. muscosa* historical populations are now extinct.

In 2003 the U.S. Fish and Wildlife Service (USFWS) determined that the Sierra Nevada population of the mountain yellow-legged frog should be protected under the Endangered Species Act, but that listing the species under the Act is "warranted but precluded" by the agency's backload of priorities and budget constraints. Subsequent legal action on behalf of the species resulted in a 2007 USFWS 12-month petition finding (see below, in Supporting Documents) that the mountain yellow-legged frog is still precluded from listing under the Endangered Species Act, basically due to the agency's lack of funds and priority allocation. Such administrative delaying is pushing the species closer to extinction throughout the Sierra Nevada.

On September 15, 2010, the California Fish and Game Commission accepted a petition from the [Center for Biological Diversity](#) to list all populations of the mountain yellow-legged frog (*Rana muscosa* and *Rana sierrae*) as "endangered" under the California Endangered Species Act. As a result, on October 1 both species were listed as "candidate" species and will be managed as "endangered" until the final decision on whether to list the species is made.

For more information about the mountain yellow-legged frog, visit the mountain yellow-legged frog website of Dr. Roland Knapp, at <http://www.myfrog.info>.

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Supporting Resources

[2007 Finding by USFWS of Warranted but Precluded listing under ESA \(69KB PDF\)](#)

[2006 9th Circuit Court of Appeals ruling requiring USFWS to substantiate Warranted but Precluded listing \(57KB PDF\)](#)

[2003 Finding by USFWS of Warranted but Precluded listing \(126KB PDF\)](#)

[2003 Complaint to USFWS challenging delay of listing by Earthjustice on behalf of the Center for Biological Diversity and Pacific River Council \(139KB PDF\)](#)

[2000 Petition to USFWS to list as Endangered by the Center for Biological Diversity and Pacific Rivers Council \(230KB PDF\)](#)

[California Department of Fish and Game Natural History Information \(URL\)](#) --This California state website contains rather limited and old information but is a good basic background composite for the species. Choose from a drop-down list to select the animal you are interested in.

Dramatic decline of native Sierra Nevada frog linked to introduced trout



An adult female mountain yellow-legged frog outfitted with a radio belt for tracking in the Sixty Lake Basin of Kings Canyon National Park. Below: Part of the basin, where UC Berkeley researchers removed trout from several lakes to re-establish native frog populations. (Photos by Vance Vredenburg/UC Berkeley)



Data gathered over seven years by a University of California, Berkeley, researcher have played a key role in convincing the National Park Service and the California Department of Fish and Game to remove trout from some high-altitude lakes in California's Sierra Nevada to save the disappearing mountain yellow-legged frog.

UC Berkeley post-doctoral fellow Vance T. Vredenburg showed that introduced trout have devastated native frog populations over the past 50 years in formerly fish-free high-Sierra lakes, but that removing the fish can allow the frogs to flourish once more.

Vredenburg's study was published this week in the online edition of the Proceedings of the National Academy of Sciences.

"The mountain yellow-legged frog used to be the most common inhabitant of the high Sierra, but frog populations have declined dramatically enough to put it on the endangered species list," said Vredenburg, who works at the campus's Museum of Vertebrate Zoology. "I'm not saying that other things didn't cause a decline as well, but this report shows that most of the problem came from fish."

Though anglers might resist efforts to remove trout from Sierra lakes, Vredenburg's preliminary data and the results of an earlier survey of Sierra frog populations were critical pieces of evidence that led the park service and Fish and Game to consider that approach, at least on a limited basis.

"People want their trout, but they don't realize what they're getting along with their trout - changed ecosystems, diseases and all sorts of things," noted David Wake, a UC Berkeley professor of integrative biology who organized the first international conference on amphibian decline in 1990.

In a 1915 survey of wildlife in the Sierra Nevada, UC Berkeley biologist and museum director Joseph Grinnell complained that mountain yellow-legged frogs (*Rana muscosa*) were so abundant that his survey team was stepping on them. Today there are probably fewer than 200 populations of the frogs - perhaps 5,000 adults - in their range from north of Lake Tahoe to below Sequoia National Park, Vredenburg said. (A separate endangered population, and perhaps a distinct species, exists in the San Gabriel and San Bernardino mountains of southern California.)

Non-native trout dumped into the high-Sierra lakes have been suggested as one cause of the decline, but many biologists dismissed this as improbable, since the trout - rainbow, golden and brown - were introduced more than 100 years ago, while the decline has been noted only since the 1980s. Some biologists even claimed that trout don't eat tadpoles, Vredenburg said.

Vredenburg's study, conducted in a remote and rugged area of Kings Canyon National Park, shows both these assumptions to be false. He noted that, while trout were planted in the fishless high-altitude lakes beginning in the late 1800s, mules carrying fingerlings in milk cans could not reach many lakes because of their remoteness and the lack of trails. Thus, the main habitat of the mountain yellow-legged frog - clear, cold, rocky lakes up to 12,000 feet - remained free of fish.

All that changed when the California Department of Fish and Game began planting fish by airplane in the 1950s and '60s, flying low over thousands of lakes in the Sierra and dumping fingerlings everywhere. Today, some 17,000 lakes in the American west are stocked with fish, while 90 percent of the habitat of the mountain yellow-legged frog is now home to introduced trout.

Vredenburg demonstrated in his study that trout are voracious eaters, quickly decimating the tadpoles in a lake. The delay in the decline of adult frogs is most likely due to the fact that they probably live 10 years or more, so the loss of tadpoles would not produce a dramatic drop in adult frogs for a decade or longer.

As part of his study, he and UC Berkeley undergraduate volunteers removed trout from five lakes and documented a rebound in the frog population in all of them. Three years after trout removal, the frog populations in all five lakes were indistinguishable from populations at lakes that had never seen a trout.

"The response was incredibly dramatic and rapid," Vredenburg said. "Every time you plant hundreds of thousands of fish, you're hammering a nail in the frogs' coffins. But we can certainly do something about it, we can turn the decline around if the political will is there for people to do it. We know it's possible."

"The results are very convincing," Wake said. "The mountain yellow-legged frog has suffered a 90 percent decline in the Sierra, and here is remedial action that can restore the natural populations. There are other problems these populations face, but this immediate problem is solvable."

"Vance's study is fabulous and of tremendous importance," agreed David Graber, senior science advisor to Kings Canyon and Sequoia national parks. He said that the parks are now engaged in a 10-year "management experiment" to see if removing fish from 11 high-elevation lakes will bring back frog populations. So far, with six of the lakes expected to be declared fish free this summer, it seems to be working.

Nevertheless, he admits that doing this broadly in the high Sierra is neither physically nor politically feasible. Many lakes are too large and deep to allow removal of fish without the use of poisons, and fishermen would protest any loss of trout lakes, no matter what the impact on native amphibian populations.

"This is a stopgap. At this point, we are just simply trying to prevent extinction," Graber said. "These frogs have nearly disappeared from the high Sierra, so we're (conducting) a panicked rear-guard action."

There also are other possible causes of frog declines, he said, including a fungus now attacking frogs worldwide and pesticides blowing into high-altitude lakes from the Central Valley.

"We don't want to interfere with recreational fishing, but create reserves to help recover the species," added Harold Werner, wildlife ecologist for the two parks. "We want to give the public options."

Fish and Game also is testing fish removal as a way to help declining frog populations, Werner said, and the National Forest Service is interested in the approach.

Vredenburg began his study in 1996 in the Sixty Lake Basin, a bare, rocky landscape between 10,000 and 11,500 feet in elevation that is a two-day hike from the nearest roadhead. He spent several years, from June until the snows came in October, documenting the fish and frog populations at the more than 60 lakes in the basin, and noticed a trend first established by UC Santa Barbara researcher Roland Knapp in an earlier survey of Sierra lakes.

"I documented a pattern that showed there are lakes with frogs only, lakes with fish only and some overlap, but in the lakes with both fish and frogs, there were very few frogs or tadpoles," he said. "The question was, 'Why?'"

Using gill nets, he and his undergraduate assistants removed trout completely from three lakes and greatly reduced the population in two other lakes. In all lakes, both tadpoles and frogs rebounded within three years to levels found in naturally fish-free lakes.

In three other fish-free lakes, he fenced off a small portion and introduced a few trout along with masses of frog eggs. The trout ate every tadpole in all three enclosures.

"It's clear that trout are largely responsible for the decline of this frog, that they explain a vast amount of the decline," Vredenburg said. "It wasn't until the 1950s and '60s, when Fish and Game began dropping fish out of airplanes, that the landscape really changed. The reason there were no native fish in lakes above 6,000 feet is that they couldn't get there, so when you put them in at the top of the watershed, they swim downstream and really alter the ecosystem."

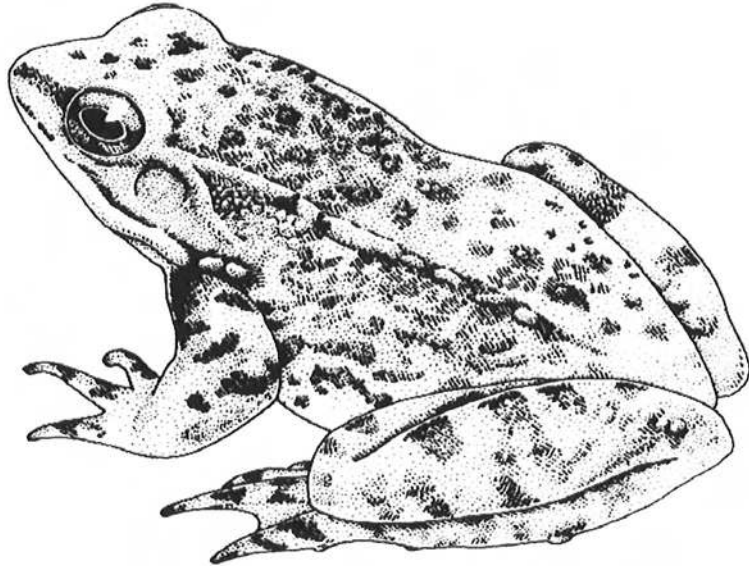
Vredenburg, who has conducted more than 900 censuses of the frog population at lakes throughout the basin, is continuing his studies of the mountain yellow-legged frog to find out how far the frogs roam, where they breed, and with whom. He has already implanted microchips in 1,200 frogs to enable easy identification, like running a bar code across a scanner, and has outfitted many frogs with radio transmitters.

He also has teamed up with other researchers at the Museum of Vertebrate Zoology and at UC Berkeley's departments of integrative biology and plant and microbial biology to determine the effect of a chytrid fungus, *Batrachochytrium dendrobatidis*, on the mountain yellow-legged frog. The fungus, which is threatening frog populations around the world, attacks the mouthparts of tadpoles as well as adults, and can kill adult frogs. It was discovered in the Sierra Nevada in 2001.

The research is supported by a grant from the Ecology of Infectious Disease Program that is run jointly by the National Institutes of Health and the National Science Foundation, and by the U.S. Geological Survey.

**California Wildlife Habitat Relationships Program
California Department of Fish and Game**

**HABITAT SUITABILITY MODELS FOR USE WITH ARC/INFO:
MOUNTAIN YELLOW-LEGGED FROG**



CWHR Technical Report No. 11
Sacramento, CA
June 1995

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MOUNTAIN YELLOW-LEGGED FROG

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Suggested Citation: Timossi, I. C., E. L. Woodard, and R. H. Barrett. 1995. Habitat suitability models for use with ARC/INFO: Mountain yellow-legged frog. Calif. Dept. of Fish and Game, CWHR Program, Sacramento, CA. CWHR Tech. Report No. 11. 11 pp.

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ACKNOWLEDGMENTS

The primary credit for this document must go to the field biologists and naturalists that have published the body of literature on the ecology and natural history of this species. They are listed in the References section. Ecological information of this sort is generally very expensive and time-consuming to obtain. Yet this basic ecological understanding is exactly what is needed most if the goal of accurately predicting changes in distribution and abundance of a particular species is ever to be achieved. The CWHR System is designed to facilitate the use of existing information by practicing wildlife biologists. We hope it will also stimulate funding for basic ecological research. Funding for producing this model was provided by the California Department of Forestry and Fire Protection and the University of California Agricultural Experiment Station.

We thank Barry Garrison, Karyn Semka, and Sandie Martinez of the California Department of Fish and Game for their assistance in typing, editing, and producing this report.

MOUNTAIN YELLOW-LEGGED FROG (*Rana muscosa*)

HABITAT USE INFORMATION

General

The mountain yellow-legged frog (*Rana muscosa*) occurs primarily at elevations above 1,800 m (5,940 ft) in the Sierra Nevada from Plumas County to southern Tulare County (Zeiner et al. 1988). In the north, a population in Butte County is separated from the main Sierra group by the Feather River Canyon. In southern California, isolated populations exist on Mount Palomar and in the San Gabriel, San Bernardino, and San Jacinto mountains. Mountain yellow-legged frogs are found from 1,380 m (4,500 ft) to over 3690 m (12,000 ft) in the Sierra Nevada and from 370 m (1,200 ft) to 2,310 m (7,500 ft) in southern California (Zeiner et al. 1988). This species is associated with streams, lakes, and ponds in most montane habitats.

Food

Mountain yellow-legged frogs feed primarily on aquatic and terrestrial invertebrates, but they tend to prefer terrestrial insects (Stebbins 1951). Adults have been observed eating tadpoles of the Yosemite toad (*Bufo canorus*) (Mullally 1959), and cannibalism in captivity has been reported (Heller 1960). Tadpoles graze on algae and diatoms along rocky bottoms in shallow water of streams, lakes, and ponds.

Water

Mountain yellow-legged frogs are associated with streams, lakes, and ponds in montane habitats and are seldom found more than two or three jumps from water (Mullally and Cunningham 1956; Stebbins 1985). They prefer lakes or streams with slow to moderate water flow (Mullally and Cunningham 1956; Heller 1960). Tadpoles may require up to three over-wintering periods to complete their aquatic development (Cory 1962).

Cover

In the Sierra Nevada, mountain yellow-legged frogs are associated with streams, lakes, and ponds in montane riparian, lodgepole pine (*Pinus contorta* var. *murrayana*), subalpine conifer, and wet meadow habitat types. In southern California, populations are restricted to streams in ponderosa pine (*P. ponderosa*), montane hardwood-conifer, and montane riparian habitats (Zeiner et al. 1988). Streams or lakes with sloping banks and a depth of several centimeters at the water's edge are preferred to those with water that is more than 0.6 m (2 ft) deep at the shore (Mullally and Cunningham 1956). The terrestrial component of their environment is composed of rocks, logs, and vegetation occurring on the bank or protruding from the water. Lakes or streams with gently sloping banks that are covered by conglomerates of rocks 15-61 cm (6-24 in) in diameter are preferred over aquatic habitats with banks covered by sand or large boulders (Mullally and Cunningham 1956). In the San Bernardino Mountains, Mullally (1959) found these frogs exclusively in streams where they exhibited a preference for large, clear pools up to 1 m (3 ft)

deep. Mountain yellow-legged frogs usually crouch on rocks or clumps of grass within a few jumps of water. When disturbed, they dive into water, take refuge under rocks, or rest exposed on the bottom. Less commonly, frogs bury themselves in bottom sediments, and during dry conditions they may use rodent burrows (Stebbins 1985).

Reproduction

At high elevations, mountain yellow-legged frogs breed from May to August depending on local conditions. In southern California, reproduction takes place from March to May (Stebbins 1985). Usually 200 to 300 eggs are laid in shallow water and attached to sedges (*Carex* spp.), gravel or rocks (Stebbins 1985), but occasionally clusters of up to 500 eggs are found. Tadpoles generally over-winter and mature the next spring (Stebbins 1985). However, at high elevations two or three over-wintering periods may be necessary to complete metamorphosis (Cory 1962).

Interspecific and Competition

No studies have been published on home range size of the mountain yellow-legged frog. Typical home ranges for this species are probably less than 10 m (33 ft) in the longest dimension. Occasional movements of up to 50 m (165 ft) may be associated with habitat deterioration, where these animals may move to avoid desiccation (Zeirer et al. 1988). Males probably defend the area around themselves during the breeding season, and weak vocalizations given by males during this season may function in territorial defense (Zeirer et al. 1988).

Special Considerations

Recent, dramatic population declines have been reported for mountain yellow-legged frogs in montane environments (Phillips 1990, Bradford 1991). Several factors, both natural and anthropogenic, may in part be responsible for these declines. Extreme climatic conditions at high elevations can cause severe natural population fluctuations of this species (Bradford 1991). Over-wintering frogs may die when subjected to oxygen depleted waters in shallow lakes or streams (Bradford 1983). Localized population declines may also result from the predation of metamorphosing tadpoles by Bewe's blackbirds (*Euphagus cyanocephalus*) (Bradford 1991) and of tadpoles and adults by introduced salmonids (*Salmo* spp and *Salvelinus* spp) (Cory 1963; Zweifel 1968; Bradford 1989). Red leg disease caused by the pathogen *Aeromonas hydrophila* may also cause mass extinction events (Bradford 1991). Acidification by atmospheric deposition of high elevation breeding waters may cause sublethal effects such as reduced embryo body size and premature hatching of mountain yellow-legged frog eggs (Bradford et al. 1992). The possible long-term effects of acidification or airborne toxins on the health of frog populations is unclear.

HABITAT SUITABILITY INDEX (HSI) MODEL

Model Applicability

Geographic area.

The California Wildlife Habitat Relationships (CWHR) System (Airda 1988; Meyer and Laudenslayer 1988; Zeirer et al. 1988) contains habitat ratings for each habitat type predicted to be occupied by mountain yellow-legged frogs throughout California.

Season.

This model is designed as a year-round model for the mountain yellow-legged frog.

Cover types.

This model can be used anywhere in California for which an ARC/INFO map of CWR habitat types exists. The CWR system contains suitability ratings for reproduction, cover and feeding for all habitats predicted to be occupied by mountain yellow-legged frogs. These ratings can be used in conjunction with the ARC/INFO map to model wildlife habitat suitability.

Minimum habitat area.

Minimum habitat area is defined as the minimum amount of contiguous habitat that is required before a species will occupy an area. Specific information on minimum areas required for mountain yellow-legged frogs was not found in the literature. Our model assumed two home ranges as the minimum area required to support a mountain yellow-legged frog population.

Verification level.

The spatial model presented here has not been field tested. The CWR suitability values used are based on a combination of published literature and expert opinion. We strongly encourage field testing of both the CWR Database and this spatial model.

Model Description

Overview.

This model uses CWR habitat type as the initial factor determining suitability of an area for this species. In addition, proximity to permanent water is used to further constrain suitability. Further spatial modeling was not performed on this species. Our habitat maps had a patch size smaller than two hectares (5 acres). Many mountain yellow-legged frog home ranges will fit in each habitat patch. If geographic data of a higher resolution were available, this model could be modified to include additional spatial analysis. If the cover value is greater than zero and the cell is close enough to water, it is included as suitable habitat.

A CWR habitat type map must be constructed in ARC/INFO GRID format as a basis for the model. The GRID module of ARC/INFO was used for these models because of its superior functionality for spatial modeling. Only crude spatial modeling is possible in the vector portion of the ARC/INFO program and much of the modeling done here would have been impossible without the abilities of the GRID module. In addition to more sophisticated modeling, the GRID module's execution speed is very rapid, allowing a complex model to run in less than 30 minutes.

The following sections document the logic and assumptions used to interpret habitat suitability.

Cover component.

A CWR habitat map must be constructed. The mapped data (coverage) must be in ARC/INFO GRID format. A grid is a GIS coverage composed of a matrix of information. When the grid coverage is created, the size of the grid cell should be determined based on the resolution of the habitat data and the home range size of the species with the smallest home range in the study. You must be able to map the home range of the smallest species with reasonable accuracy. However, if the cell size becomes too small, data processing time can increase considerably. We

recommend a grid cell size of 30 m (98 ft). Each grid cell can be assigned attributes. The initial map must have an attribute identifying the CWHR habitat type of each grid cell. A CWHR suitability value is assigned to each grid cell in the coverage based on its habitat type. Each CWHR habitat is rated as high, medium, low or of no value for each of three life requisites: reproduction; feeding; and cover. The cover value was used to determine the base value of the cell for this analysis (for this species cover and feeding suitabilities are identical). The geometric mean would have resulted in a base map with no suitable habitat since mountain yellow-legged frogs reproduce only in lacustrine and riverine habitats.

Distance to water.

Mountain yellow-legged frogs require free water. All cells further than 30 m from water received a suitability rating of zero.

Species' distribution.

The study area must be manually compared to the range maps in the CWHR Species Notes (Zeiner et al. 1988) to ensure that it is within the species' range. All grid cells outside the species' range have a suitability of zero.

Spatial analysis.

Ideally a spatial model of distribution should operate on coverages containing habitat element information of primary importance to a species. For example, in the case of woodpeckers, the size and density of snags as well as the vegetation type would be of great importance. For many small rodents, the amount and size of dead and down woody material would be important. Unfortunately, the large cost involved in collecting microhabitat (habitat element) information and keeping it current makes it likely that geographic information system (GIS) coverages showing such information will be unavailable for extensive areas into the foreseeable future.

The model described here makes use of readily available information such as CWHR habitat type, elevation, slope, aspect, roads, rivers, streams and lakes. The goal of the model is to eliminate areas that are unlikely to be utilized by the species and lessen the value of marginally suitable areas. It does not attempt to address all the microhabitat issues discussed above, nor does it account for other environmental factors such as toxins, competitors or predators. If and when such information becomes available, this model could be modified to make use of it.

In conclusion, field surveys will likely discover that the species is not as widespread or abundant as the predictions by this model suggest. The model predicts potentially available habitat. There are a variety of reasons why the habitat may not be utilized.

Application of the Model

A copy of the ARC/INFO macro (AML) can be found in Appendix 1.

To create the HSI Coverage, the first step is to eliminate areas too far from water. If the grid cell is more than 30 m from water it receives a suitability value of zero. All other grid cells retain their original values. Since the home range size of the mountain yellow-legged frog (100 m²) is much smaller than the size of our habitat patches at 2.02 ha (20,235 m²), no additional spatial analysis is necessary.

Problems with the Approach

Habitat map accuracy.

The resolution of the CWHR habitat map (2.02 ha) is probably too low to give an accurate assessment of how much area is available to this species.

Habitat elements.

Habitat elements are very important to most amphibian species. Without additional information about the distribution of essential elements, suitability maps will typically overestimate actual habitat.

Element map accuracy.

Since this model is based almost solely on permanent stream location, it is vital that the stream coverages be accurate. The stream coverages we were provided were accurate at 1 to 250,000. This accuracy is unacceptable. We edited these files to include all water courses identified on 1:24,000 USGS quadrangles. This may still be insufficient since some small permanent streams are not included on these maps.

SOURCES OF OTHER MODELS

No other habitat models for mountain yellow-legged frog were found.

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Roland A. Knapp

Research Biologist



Current Research

I am a field ecologist who uses large-scale observational studies, natural experiments, and field experiments to provide insights into how natural and anthropogenic stressors influence the structure and function of aquatic ecosystems. Addressing these often complex questions in a meaningful way requires expertise from a wide range of scientific disciplines, and most of my current research involves collaborative studies with mathematical ecologists, molecular geneticists, taxonomists, and other field biologists. I am keenly interested in applying our research findings to the management and restoration of aquatic ecosystems in the Sierra Nevada.

Effects of Introduced Fish on Lake Ecosystems

The introduction of predatory fish into naturally-fishless lakes typically results in dramatic changes to species composition and to ecosystem processes such as nutrient cycling. In 1995, I began studying the effects of nonnative trout on Sierra Nevada lake ecosystems and on the ability of these systems to recovery following fish removal. This research involved (1) surveys of amphibians, reptiles, invertebrates, and fish at more than 7,000 lakes and ponds, and (2) a whole-lake fish removal experiment designed to quantify faunal recovery in alpine lakes following removal of nonnative trout. The results of much of this research has been published (see [Publications](#)), but I continue to monitor the whole-lake fish removal experiment.

The whole-lake fish removal study was initiated in 1996, and involved the removal of nonnative trout from five lakes that were fishless historically. Changes in vertebrate and invertebrate communities in these lakes are being compared to those in three adjacent trout-containing lakes. The majority of taxa expected to have occupied these lakes prior to fish introduction recolonized within five years of fish removal, but continued monitoring indicates ongoing changes in species composition and densities.

We are now using this experiment to study how trout alter linkages between lake and terrestrial ecosystems. For example, large aquatic insects are abundant in fishless alpine lakes but are virtually eliminated by fish introductions. Research by my colleague, Peter Epanchin, shows that alpine-nesting birds forage preferentially at fishless lakes due to the increased abundance of insects relative to their abundance at fish-containing lakes.

Role of an Emerging Disease in Driving Amphibian Declines

The mountain yellow-legged frog was once one of the most abundant vertebrates in the Sierra Nevada, and occupied thousands of lakes and ponds throughout the range. During the past century, this frog has disappeared from more than 90% of its historic habitat, and is now being considered for listing under the U.S. Endangered Species Act. (For more information about the mountain yellow-legged frog, check out www.mylfrog.info.)

Although introduced trout are undeniably a major cause of this decline, our recent research indicates that an emerging disease is also playing a critically important role. Chytridiomycosis is a disease caused by the amphibian chytrid fungus, *Batrachochytrium dendrobatidis*. This recently-described pathogen is causing amphibian declines worldwide, and its effects are particularly severe for amphibians living in montane habitats. In the Sierra Nevada, several amphibian species are known to be infected with chytridiomycosis, and the mountain yellow-legged frog is particularly impacted by this disease. Our research has demonstrated that *B. dendrobatidis* probably arrived in the Sierra Nevada relatively recently, has now spread across most of the range, and is responsible for the recent extinction of hundreds of mountain yellow-legged frog populations.

Although most mountain yellow-legged frog populations crash to extinction following the arrival of *B. dendrobatidis*, some populations survive the crash and subsequently persist with the disease. We are currently using field surveys, field and laboratory experiments, molecular genetic techniques, and mathematical modeling to understand these different disease outcomes (extinction versus persistence). Possible mechanisms include differences in frog susceptibility to chytridiomycosis, differences in pathogen virulence, effects of habitat conditions on susceptibility and/or virulence, and density-dependent disease dynamics.

Taxonomy of Lake-dwelling Fauna

Despite decades of interest by both the general public and scientists in the Sierra Nevada, most of the attention has focused on terrestrial ecosystems. The fauna of aquatic habitats, especially lakes, has remained largely undescribed. Given that detecting future faunal changes requires knowing what species currently occur, we are using morphological keys and DNA markers to identify lake-dwelling taxa to the species level. This is a long-term project that requires collaboration with taxonomic experts because a significant number of collected taxa are unknown to science and will need to be described. In addition, required morphological keys are often outdated and incomplete. For a list of taxa that we have identified to date, see the [Lake Fauna](#) page.

• Other Scientists at the Sierra Nevada Aquatic Research Laboratory

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MARCH 16, 2009

Anybody Have a Spare Pond?



The ongoing severe declines of mountain yellow-legged frogs in the Sierra Nevada make it all but inevitable that these populations will eventually be listed under the federal Endangered Species Act. Such a listing will trigger the writing of recovery plans for *Rana sierrae* and *Rana muscosa*, plans that will undoubtedly call for the development of captive breeding programs. If successful such programs could provide frogs for reintroductions back into the wild and for experiments that are critical to our understanding of important issues related to frog conservation.

As I've discussed in previous posts captive breeding has an increasingly important role to play in species conservation programs but because maintaining frogs in artificial environments (e.g., indoor aquaria in zoos) is very labor intensive (think of the time required to feed 100 frogs every day, change their water, and clean their enclosures), this gets expensive in a hurry. A cheaper and potentially more productive route would be to hold frogs in natural or semi-natural ponds outdoors. This would greatly reduce the resources needed to maintain these populations because the frogs could feed themselves. All we need are some ponds that would provide suitable habitat for mountain yellow-legged frogs. Ideal ponds would be located at elevations above 6000', be deep enough to allow frogs to overwinter (>10 feet), and have reasonable access. Ponds would also need to be surrounded with a frog-proof barrier to ensure that frogs don't wander off.

If we can't locate such ponds we need to consider constructing them. As I write this I'm staring out the window at my back yard, wondering if maybe we could replace that useless lawn with a frog pond. But seriously, we need to engage any interested agency or member of the public and provide the resources necessary to make this happen. Might there be a national forest ranger district out there with a pond near a district office that could be turned into a frog pond? Are there any private landowners who might be willing to have one of their ponds put to such a use?

If any of you readers have any ideas I'd love to hear them.

Back to [The Mountain Yellow-legged Frog Site](#).

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[Back to The Mountain Yellow-legged Frog Site.](#)

POSTED BY ROLAND KNAPP 

MAY 2, 2008

Frogs at 12,000 feet?



In the back of our minds, I think most of us have a picture of what frog habitat looks like, perhaps a warm pond filled with lily pads and logs. Given this preconception, it comes as quite a surprise to see mountain yellow-legged frogs basking by the thousands at lakes in the Sierra Nevada that lie well above timberline, some at elevations as high as 12,000' (3,660 m). How do they survive in these cold, stark conditions?

The fact that frogs are ectothermic, as described in my 4/25/08 [post](#), plays an important role in allowing mountain yellow-legged frogs to flourish at high elevations. Given the cold water and air temperatures even in mid-summer, food requirements are relatively modest, allowing frogs to add the necessary fat reserves to get them through the long winter despite low densities of prey.

Despite the general paucity of food in this harsh environment, food is actually plentiful during short periods and mountain yellow-legged frogs take full advantage of this ephemeral abundance. In early summer (a few weeks after ice-out), mayflies and chironomids ("midges") transform from aquatic larvae into terrestrial winged adults and provide a brief dietary bounty for the frogs. The mayfly, *Ameletus edmundsi*, thrives in cold, high elevation lakes, and its emergence style makes it particularly vulnerable to frogs. Unlike many mayfly species that emerge well offshore, *A. edmundsi* crawls up onto a shoreline rock and emerges there. In lakes harboring mountain yellow-legged frog populations, I've watched frogs eyeing *A. edmundsi* larvae from the second they crawl out of the water and then engulfing the winged adult just as it completes metamorphosis. Midges provide a similar feeding

opportunity for frogs. On windy days, chironomid adults aggregate in mating swarms on the lee side of boulders. Within minutes of these aggregations forming, mountain yellow-legged frogs will arrive and spend hours picking off chironomid adults when they land on the rock to rest.

During late summer, most aquatic insect emergences are over and mountain yellow-legged frogs depend more heavily on terrestrial prey. Anything crawling along the lake shore that fits in their mouths is fair game. I've watched grasshoppers get blown into the water, swim back to shore, and be eaten by a frog as soon as they crawl up onto a shoreline rock. Although mountain yellow-legged frogs generally spend their time right at the lake shore, some take advantage of another food source away from water: ants. Frogs will position themselves along ant trails and pick off the hapless ants as they pass by. The metamorphosis of Pacific treefrogs (*Pseudacris regilla*) from tadpole to froglet in late summer provides another food source. The froglets don't have the well-developed hopping skills of adults and make easy prey for the much larger mountain yellow-legged frog.

Despite the various tricks that mountain yellow-legged frogs employ to fill their bellies, food is scarce in this high elevation environment, especially when there are thousands of frogs at a lake all competing for the same limited food resource. And yet, these high elevation lakes offer the frogs an important advantage over lakes at low elevations: a lack of snake predators. More about that next week....

[Back to The Mountain Yellow-legged Frog Site.](#)

POSTED BY ROLAND KNAPP 

APRIL 25, 2008

For The Frogs, It Is Still Winter



Here in the eastern Sierra Nevada, signs of spring are everywhere. After a winter during which the only common birds were Mountain Chickadees and Dark-eyed Juncos, a host of birds not seen for months are now in every bush and tree. The aspen and cottonwood trees are clothed in catkins, and the trunks of Jeffrey pines smell strongly of vanilla-scented sap. With all of these reminders that summer is on its way, I've been busy preparing for another field season studying mountain yellow-legged frogs up in the High Sierra. On a warm day down here at 7,000' it's easy to forget that for the mountain yellow-legged frogs in the high country it is still winter and will be for another month.

In the fall when the air turns cold and insect prey becomes scarce, mountain yellow-legged frogs retreat into the deep waters of lakes, coming to shore to sun only on the warmest of days. By late October, the lakes are skimmed with ice and by November or December the landscape is clothed in a thick blanket of snow. For the next seven months, the frogs live underwater in a world of near-freezing temperatures and complete darkness, breathing solely through their skin. Like many amphibians, mountain yellow-legged frogs capture prey primarily with their sticky tongues, but this method doesn't work underwater. So, for these seven months the frogs probably don't feed at all, living solely off of the fat reserves they accrued during the previous summer. Most mammals, including humans, die from starvation after a few weeks without feeding, and yet the mountain yellow-legged frog can survive without food for seven or more months! How do they do it?

This survival ability is a direct consequence of amphibians being ectothermic (often called "cold-blooded"), meaning that body temperature is controlled by factors outside of their bodies (e.g., air or water temperature). Body temperature of ectothermic animals controls metabolism, with body temperature and metabolism being positively correlated. During winter, the body temperature of mountain yellow-legged frogs is near the freezing

point and their metabolism is therefore extremely low. As a consequence, their need for food is also greatly reduced. The mountain yellow-legged frog pushes this ability to survive without food to an extreme seen in few other amphibians. During winters with unusually heavy snowfall, lakes can thaw as late as August and then freeze over again in October. Under these conditions, mountain yellow-legged frogs can be without food for ten months and have only August-October to replenish their fat reserves for the next winter.

When spring finally comes to the high-elevation haunts of the mountain yellow-legged frog, lakes thaw and frogs crawl to shore in search of warmth, mates, and food. What has always amazed me when I've been at a lake during this time is that the frogs aren't particularly skinny. They haven't eaten anything for months and yet they are only slightly less plump than they were the previous fall.

I wish I could go months without eating. That ability would certainly make my backpack a lot lighter during the summer when I'm doing my frog research in the Sierra Nevada backcountry.

POSTED BY ROLAND KNAPP  