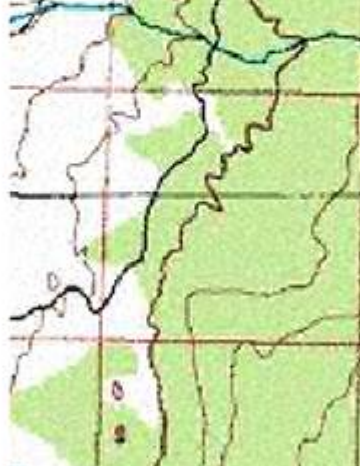


New Mexico Boreal Toad Repatriation 2009 (Year Two)



Photograph: L. Pierce, NMDGF



Photograph: H. Snell



Photograph: H. Snell



8 February 2010

Introduction

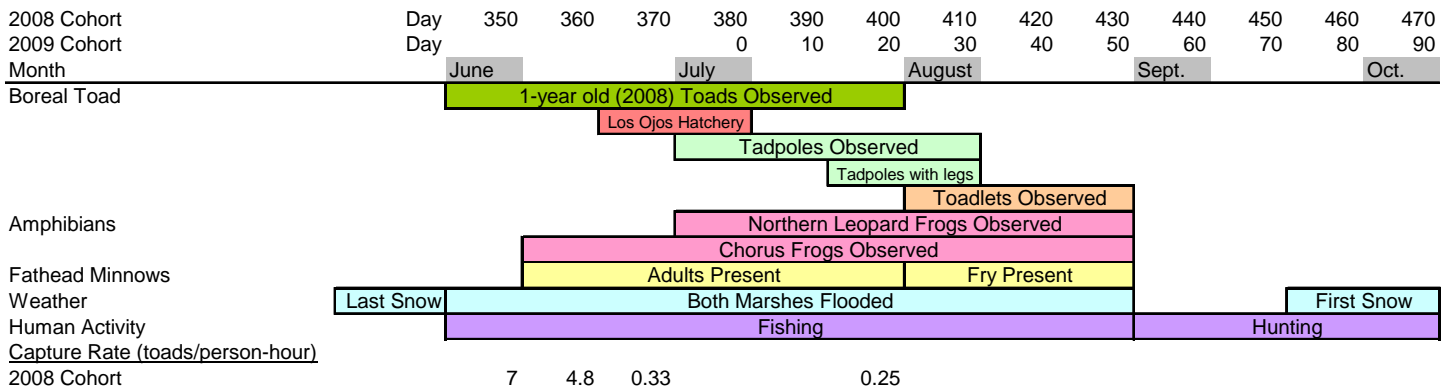
This is a report on the second year of the program to repatriate the Boreal Toad to Trout Lakes in Rio Arriba County, NM. These efforts followed the development of a recovery plan for New Mexico, formation of a recovery team in the state, extensive interaction with the Colorado recovery team, and interaction with the USFS, on whose property Trout Lakes are situated. Included in the report are notes on how toads were processed when captured, results of testing for presence of chytrid fungus (*Batrachochytrium dendrobatidis*), field notes from the monitoring efforts, maps and photographs, a time-line of events during the second year, a checklist of other species observed, the proposed monitoring protocol for the 3rd year of the repatriation effort, and a list of potential research questions based upon observations to date.

Summary of Season

Surveys were conducted as soon as road in to Trout Lakes was passable, starting with 5 June 2009, at which time multiple 1-year old toads were found, as well as 1 dead toad. Another toad was subsequently found on 16 June, but the number of active 1-year old toad remained active. This number declined (as measured in increasing person hours to find a single 1-year old toad) until no more were seen after the end of July. One last 1-year old toad was found dead on the final survey day at the end of August. All dead toads were kept for testing for chytrid fungus and preserved at the University of New Mexico Museum of Southwestern Biology.

Arrangements were made with NMDGF Los Ojos Fish Hatchery to house and maintain the 2nd year cohort of tadpoles for two weeks to allow them to grow further prior to release into the release site pond. Tadpoles were delivered from the Colorado Division of Wildlife Native Aquatic Species Restoration Facility in Alamosa to the Hatchery in Los Ojos on 23 June and the tadpoles were released at Trout Lakes on 8 July.

In December, results came back that all but one boreal toad chytrid sample was positive for the fungus, with the same for the chorus frogs swabbed. All three dead toads came back positive for the fungus.



Time-line for 2009 boreal toad repatriation season.

Processing of Toads

Each 1-year old toad and toadlet was measured for snout-vent length (SVL). One-year old toads were also given a unique combination of toe-clips to identify recaptures until such time that the toads attain sufficient size to accept a Passive Integrated Transponder (PIT tag). Additionally 1-year old toads were swabbed for chytrid fungus. When possible, photographs were taken of the bellies of both 1-year old toads and 2009 toadlets to further explore using this process for recapture identification. Please see Figure 14 for an example of the field sheet used, which includes the marking scheme for toe-clipping 1-year old toads.

Chytrid Fungus

Amphibians caught during the field season (starting on 30 June) were swabbed for chytrid fungus and the samples sent on to Pisces Molecular; in 2009, only chorus frogs and boreal toads were captured (leopard frogs were seen but none caught). All but one of the samples for boreal toad came back highly positive for the fungus, which was not found in 2007 or 2008. Likewise, all but one of the chorus frogs caught and sampled for the fungus came back highly positive.

Species	Date	Identification	X Coordinate	Y Coordinate	Bd Sample
Bufo boreas boreas	5-Jun-09	Dead	376861	4052066	+++
Bufo boreas boreas	16-Jun-09	Dead	376775	4052023	++
Bufo boreas boreas	30-Jun-09	33	376819	4052004	+++
Bufo boreas boreas	30-Jun-09	23	376819	4052004	+++
Bufo boreas boreas	28-Jul-09	33	376819	4052004	-
Bufo boreas boreas	28-Jul-09	42	376819	4052004	+++
Bufo boreas boreas	26-Aug-09	Dead	376775	4052023	+++
Pseudacris maculata	30-Jun-09	Live Specimen, Unmarked	376775	4052023	-
Pseudacris maculata	30-Jun-09	Live Specimen, Unmarked	376775	4052023	+++
Pseudacris maculata	30-Jun-09	Live Specimen, Unmarked	376775	4052023	+++
Pseudacris maculata	30-Jun-09	Live Specimen, Unmarked	376775	4052023	+++

Results of chytrid fungus samples at Trout Lakes, Rio Arriba County, NM, in 2009. Note that '+' denotes presence of the fungus and '+++' denotes highest rating for it.

Field Notes

5 June 2009 (Day 353 for Boreal Toad tadpole cohort released in 2008):

Surveys conducted for 1-year old toads in vicinity of release site pond. Day overcast and cool, with occasional breezes. Both main and north marshes flooded and stream flow strong between release site pond and secondary pond (See Figure 3 for a schematic map of the site). Five 1-year old Boreal Toads captured and 2 more seen basking on logs in release site pond in 30 minute haphazard walking survey by 2 experienced herpetologists (person-hour rate of 7 1-year old toads/hour). Each captured toad was processed (see Table 1). Additional walking surveys conducted around upper fishing ponds, with one dead toad found in a small pond upstream from release site: dead toad appeared to be a recent fatality, not emaciated or showing other

signs of distress (see Figures 2 & 5). Specimen kept for chytrid fungus testing.

Additional Notes: Road into site still slightly muddy, indicative of recent precipitation. Three or four fishermen present at lower fishing pond, but not present at release site pond. No dragonflies present but large hatch of mayflies prevalent, as well as water striders at release site pond. No fathead minnows present at release site pond. No other amphibians observed or heard. Ravens heard and northern flickers observed. Squirrel activity down when compared to the same time of year in the previous season, with 1 red squirrel heard and 1 least chipmunk and 1 Abert's squirrel seen, but no golden-mantled ground squirrels.

Personnel Present: L. Pierce, J. Stuart, NMDGF

16 June 2009 (Day 364): Surveys conducted for 1-year old toads in vicinity of release site pond. Day clear and warm. Both main and north marshes flooded and stream flow strong between release site pond and secondary pond, but water level reduced from 5 June. Twelve 1-year old toads captured in 30 minutes by 5 persons of varied herpetological experience (4.8 1-year old toads/person-hour). One toad was a recapture from 5 June, based upon belly photograph. Seven 1-year old toads captured near release site pond, and 5 more from the area around the secondary pond. All captured toads were processed. One dead toad found at release site and kept for chytrid testing. Another live toad observed at lower of the upper fishing ponds, approximately 30 – 35 mm in length (Figure 2). No other toads found in neighboring ponds.

Additional Notes: Road into site almost dry. One fisherman present, 1 USFS vehicle, no one present at release site pond. Large numbers of caterpillars present, as well as small numbers of adult dragonflies. Fathead minnows now present in release site pond. Two chorus frogs observed in marsh above release site. Voles observed by release site pond and within main marsh. Small numbers of golden-mantled ground squirrels observed on road in to site.

Personnel Present: L. Pierce, R. Jankowitz, M. Watson, NMDGF, J. Martinez, F. Slattery, USFS.

23 June 2009: 3,445 tadpoles delivered from Colorado Department of Wildlife Native Aquatic Species Restoration Facility (NASRF) in Alamosa, CO to NMDGF Los Ojos Fish Hatchery in Los Ojos, NM (see Figure 1). Tadpoles raised from eggs collected in Caffe County, CO. Tadpoles placed in rearing trough in shed separate from rest of hatchery (see Figures 6 & 7). Tadpoles maintained following regime prescribed by NASRF personnel.

30 June 2009 (Day 378): Surveys conducted for 1-year old toads in vicinity of release site pond. Day overcast, with thunderstorms in region and rain toward end of session. Both main and north marshes flooded and stream flow strong between release site pond and secondary pond, with increased water levels from 16 June. Two 1-year old toads caught, 1 a recapture based

upon belly photograph and mark, and the other a new capture, in 1 hour by 6 experienced herpetologists (0.33 1-year old toads/person-hour) . Four chorus frogs were also captured (0.66 chorus frogs/person-hour). Both toads were processed, and all amphibians sampled for chytrid fungus. No other toads seen at any of the neighboring ponds.

Additional Notes: Road in to site somewhat muddy, indicative of recent precipitation. One fisherman present briefly at lower pond in late afternoon, with no one present at release site pond. Few dragonflies present. Fathead minnows present in release site pond. Terrestrial Garter Snake collected at main upper pond. One Abert's squirrel observed on road in, but no red squirrels in vicinity of release site pond. Cattle present in forest by road in to site.

Personnel Present: L. Pierce, NMDGF, Dr. H. Snell, H. Snell, T. Giermakowski, M. Ryan, and C. Wilson, University of New Mexico.

8 July 2009 (Day 386 for 2008 cohort/Day 0 for 2009 cohort): Approximately 3,445 tadpoles delivered from Los Ojos Fish Hatchery to release site pond. Day clear and warm, no breeze. Tadpoles taken by bucket up to release site. Tadpoles released in shaded portion of pond, where water temperature cooler (See Figures 3 & 8). Pond water was added to the buckets to better equilibrate pH and temperature over half hour period. Tadpoles released at 1500 DST. No 1-year old toads observed.

Additional Notes: Road in to site dry. Large number of fishermen (over 10) at lower main fishing pond but no one present at release site pond. Few adult dragonflies present, with dense bloom of horseflies evident. A photograph observation led to a state record for a dragonfly, Boreal Whiteface (see Figure 11). Leeches and water striders present at release site pond. Northern leopard frog seen at lower main fishing pond, otherwise no amphibians observed. Terrestrial Garter Snake observed at release site pond.

Personnel Present: L. Pierce, R. Jankowitz, NMDGF; B. Sands, S. Beaver, T. Sintas, NMDGF-Los Ojos Hatchery; E. Nelson, J. Martinez, D. Storch, USFS.

28 July 2009 (Day 406/20): Surveys conducted for 1-year old toads and to monitor development and location of tadpoles. Day partly cloudy and warm. Both main and north marshes flooded and stream flow strong between release site pond and secondary pond. Two 1-year old toads captured in 1 hour with 8 persons of varying herpetological experience, both up at secondary pond, one toad a recapture from 16 and 30 June (0.25 1-year old toads/person-hour). Both toads processed. 500 – 1000 large, oval tadpoles seen on west shore (see Figure 3), some showing rear legs.

Additional Notes: Road in to site mostly dry. No fishermen present. Few adult dragonflies present. Fathead minnow fry present in release site pond. Northern leopard frog observed at upper fishing pond and down at lower Trout Lakes. Kingfishers present at lower Trout Lakes and many more northern flickers present. Large number of young of year least chipmunk and golden-mantled ground squirrel present by road in to site.

Personnel Present: L. Pierce, NMDGF, T. Giermakowski, C. Wilson, UNM, D. Shaw and 4 students from Bosque School.

11 August 2009 (Day 420/34): Surveys conducted for 1-year old toads, tadpoles, and toadlets. Day clear and very warm. Both main and north marshes flooded and stream flow strong between release site pond and secondary pond. No 1-year old toads observed. No tadpoles observed. 25 – 50 toadlets observed, some more developed than most (slightly larger and rounder, more toad-like in appearance; see Figure 3).

Additional Notes: Road in to site dry. No fishermen present. Some dragonflies present. Fathead minnow adults and fry present at release site pond. Twenty – thirty young of the year northern leopard frogs observed at lower Trout Lakes (See Figures 2 & 12). No other amphibians observed or heard. High number of golden-mantled ground squirrels observed, as well as red and Abert's squirrels. Some cattle present near road on way in to site.

Personnel Present: L. Pierce, J. Stuart, NMDGF.

25 August 2009 (Day 423/48): Surveys conducted for 1-year old toads and toadlets. Day overcast and cool. Both main and north marshes flooded and stream flow strong between release site pond and secondary pond. No 1-year old toads observed and 4 toadlets observed and 27 captured. Captured toadlets were processed, having a mean SVL = 18.5 mm, sd = 1.4 (see Figure 9). Survey time of two hours for two people using haphazard searching, personnel of varied herpetological experience (6.75 toadlets/person-hour). Considerable number of toadlets caught or observed on dry hillside up from release site pond and near log leading out from release site pond (see Figures 3 & 10).

Additional Notes: Road in slightly muddy. No fishermen present. Some dragonflies present. Fathead minnows present in release site pond. Single young of the year northern leopard frog seen in marsh above release site pond, and chorus frogs heard. Northern Goshawk heard calling, as were red squirrels. Western jumping mouse seen by upper fishing pond (see Figure 13). Cattle present near road in to site.

Personnel Present: L. Pierce, R. Jankowitz, NMDGF.

26 August 2009 (Day 424/49): Surveys conducted for 1-year old toads and toadlets. Day clear and warm, with cumulus clouds building up late in afternoon. Both main and north marshes flooded and stream flow strong between release site pond and secondary pond. One dead 1-year old toad found, with no others observed, and 163 toadlets caught and processed, with 5 people searching 1.5 hours in haphazard survey, personnel of varied herpetological experience (21.7 toadlets/person-hour). Mean toadlet SVL = 18.3 mm, sd = 1.7. Of the toadlets caught, 6 were recaptures from the previous day, based upon photographs of bellies. Based upon its condition the dead and unmarked 1-year old toad likely died that morning, and measured 45 mm SVL.

Additional Notes: Road in less muddy than previous day. One fisherman seen, briefly, at the lower main fishing pond late in the afternoon. Dragonflies present, but in lower numbers than in 2008 for the same time of year.

Fathead minnows present. Northern leopard frogs seen at release site pond and upper fishing pond, and chorus frogs heard calling. Northern Goshawks heard calling. Cattle present on and by road to site.

Personnel Present: L. Pierce, C. Hayes, NMDGF, D. Storch, J. Martinez, Ariel Storch, USFS.

APPENDICES

Tables

Date	Day	ID/Toe Clip	Recap?	SVL
6/5/2009	353	1	N	25
6/5/2009	353	2	N	26
6/5/2009	353	3	N	24
6/5/2009	353	4	N	28
6/5/2009	353	11	N	35
6/16/2009	364	12	N	28
6/16/2009	364	13	N	26
6/16/2009	364	14	N	30
6/16/2009	364	20	N	28
6/16/2009	364	21	N	26
6/16/2009	364	23	N	27
6/16/2009	364	24	N	30
6/16/2009	364	31	N	29
6/16/2009	364	32	N	22
6/16/2009	364	33	N	25
6/16/2009	364	34	N	28
6/16/2009	364	40	N	22
6/30/2009	378	33	Y	29
6/30/2009	378	23	Y	28
7/28/2009	406	33	Y	38
7/28/2009	406	42	N	30

Table 1. Data on 1-year old toads captured during surveys in 2009. Note that all captures were either at release site pond or secondary pond above it.

Figures

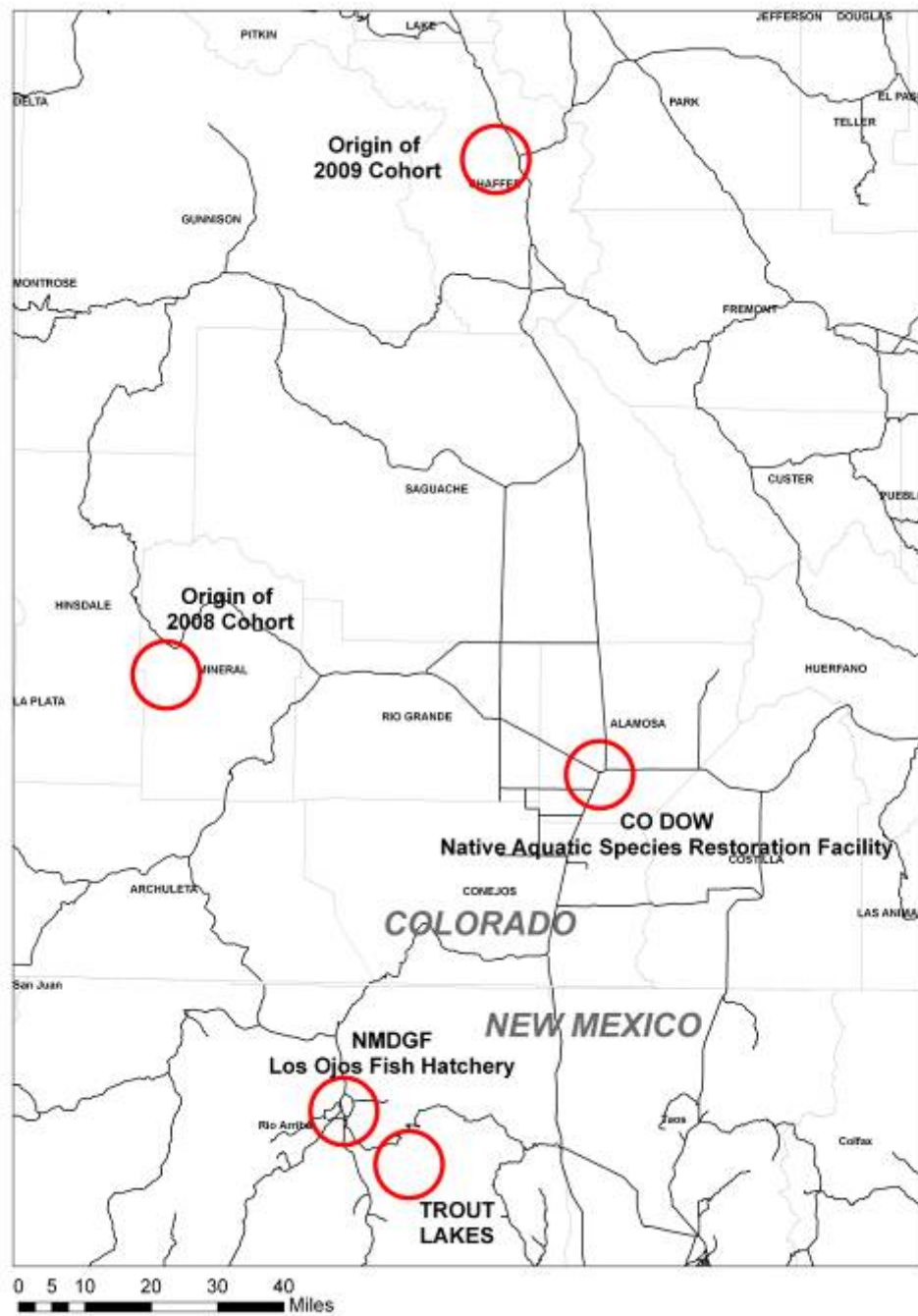


Figure 1. Map of region with pertinent locations identified.



Figure 2. Map of Trout Lakes and location within New Mexico (inset).

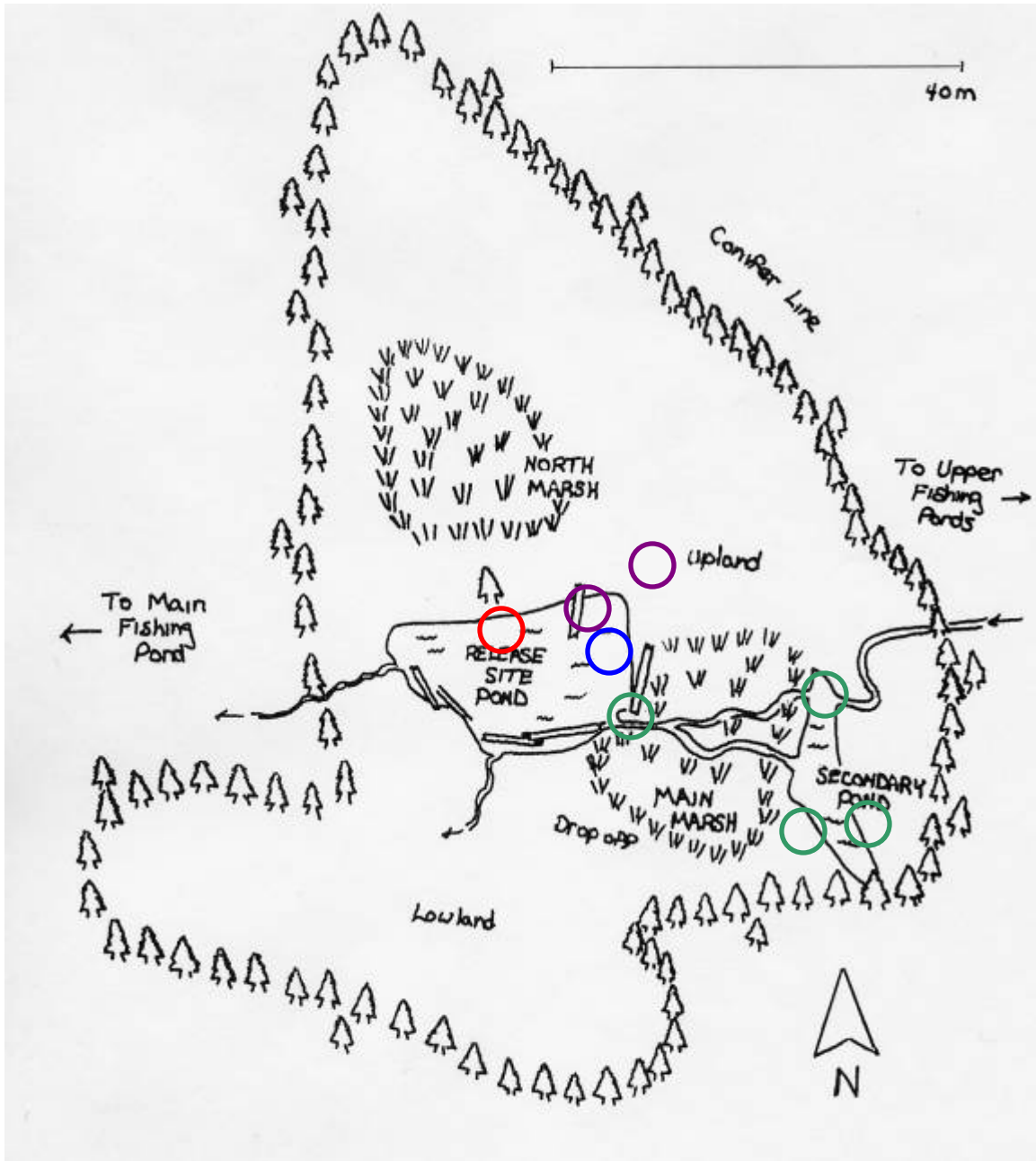


Figure 3. Schematic map of release site locality, with pertinent locations indicated as follows: 2009 tadpole release point (red circle), subsequent tadpole locality (blue), toadlet localities (green), and upland toadlet localities, including the log from the release site pond to the upland area (purple).



Figure 4. One-year old toad, 5 June 2009 (Day 353). Photograph: J. Stuart, NMDGF.



Figure 5. Dead 1-year old toad, 5 June 2009 (Day 353). Photograph: J. Stuart, NMDGF.



Figure 6. Boreal Toad Tadpoles at NMDGF Los Ojos Fish Hatchery, 30 June 2009, one week after delivery from NASRF. Photograph: H. Snell, UNM.



Figure 7. Removing tadpoles from shed at NMDGF Los Ojos Fish Hatchery for delivery to Trout Lakes, 8 July 2009, 15 days after delivery from NASRF. Photograph: L. Pierce, NMDGF.



Figure 8. 2009 tadpole release crew, 8 July 2009. Back row, left to right: Donna Storch, USFS, Juan Martinez, USFS, Tim Sintas, NMDGF-Los Ojos Fish Hatchery, Billy Sands-NMDGF-Los Ojos Fish Hatchery. Front Row, left to Right: Esther Nelson, USFS, Susan Beaver, NMDGF-Los Ojos Fish Hatchery, Rachel Jankowitz, NMDGF. Photograph: L. Pierce, NMDGF.



Figure 9. Boreal Toad toadlet showing capacity to scale smooth surfaces at a particular size, 25 August 2009. As of day 48 from release of this cohort, the mean SVL of toadlets caught was 18.5 mm. Photograph: L. Pierce, NMDGF.



Figure 10. Log extending from repatriation pond up to slopes above the pond. Many toadlets were caught within proximity of, on or underneath log, suggesting this might be a conduit for the recently metamorphosed toads. August 25, 2009. See also Figure 3. Photograph: L. Pierce, NMDGF.



Figure 11. Boreal Whiteface Dragonfly, 8 July 2009. Photograph: L. Pierce, NMDGF.



Figure 12. Young of year Northern Leopard Frog, 11 August 2009. One of over twenty observed at a single pond in the lower Trout Lakes. Photograph: L. Pierce, NMDGF.



Figure 13. Western jumping mouse observed by upper fishing pond at Trout Lakes, 25 August 2009 (red arrow). Photograph: L. Pierce, NMDGF.

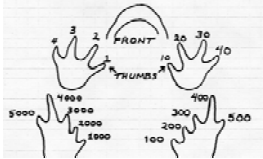
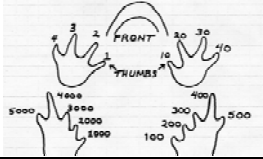
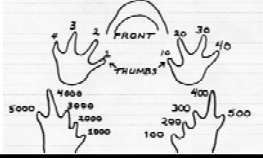
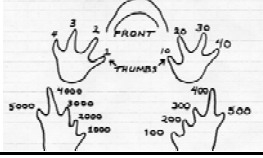
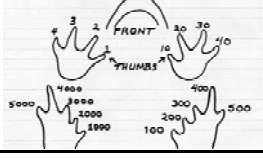
Date:		Observers:	
Start Time: AM PM		End Time: AM PM	
GPS Settings:			
Climate			
Air Temp:		Water Temp:	Wind:
Notes:			
Samples Collected			
Water	Chytrid	Toe	Other:
Egg Masses & Tadpoles			
# Egg masses:			
Tadpoles: <100 100-500 500-1000 1000-2000 >3000			
Notes:			
Toad Observations			
ID:	Age:	Sex: M F	
SVL:	Mark: Toe PIT Other:		
Recap? Y N	Notes:		
ID:	Age:	Sex: M F	
SVL:	Mark: Toe PIT Other:		
Recap? Y N	Notes:		
ID:	Age:	Sex: M F	
SVL:	Mark: Toe PIT Other:		
Recap? Y N	Notes:		
ID:	Age:	Sex: M F	
SVL:	Mark: Toe PIT Other:		
Recap? Y N	Notes:		
ID:	Age:	Sex: M F	
SVL:	Mark: Toe PIT Other:		
Recap? Y N	Notes:		
Notes:			
Egg Masses & Tadpoles			

Figure 14. Sample Field Sheet. Note marking scheme figure repeated on sheet.

Other Species Observed

(*-indicates observed at the release site pond)

- A. Invertebrates (Dragonflies and Damselflies)
 - a. Northern Spreadwing, *Lestes disjunctus**
 - b. Boreal Bluet, *Enallagma boreale*
 - c. Paddle-tailed Darner, *Aeshna palmata**
 - d. Boreal Whiteface, *Leucorrhinia borealis**
 - i. State Record
 - e. Four-Spotted Skimmer, *Libellula quadrimaculata**
 - f. Black Meadowhawk, *Sympetrum danae*
 - i. County Record
 - g. Cherry-faced Meadowhawk, *S. internum**
 - h. Striped Meadowhawk, *S. pallipes**
- B. Amphibians
 - a. Northern leopard frog, *Rana pipiens**
 - b. Chorus Frog, *Pseudacris maculata**
- C. Reptiles
 - a. Terrestrial Gartersnake, *Thamnophis elegans*
- D. Birds
 - a. Turkey Vulture, *Cathartes aura*
 - b. Cooper's Hawk, *Accipiter cooperii*
 - c. Northern Goshawk, *A. gentilis* (heard)*
 - d. Greater Roadrunner, *Geococcyx californianus*
 - e. Broad-tailed Hummingbird, *Selasphorus platycercus**
 - f. Belted Kingfisher, *Ceryle alcyon*
 - g. Northern Flicker, *Colaptes auratus*
 - h. Downy Woodpecker, *Picoides pubescens*
 - i. Steller's Jay, *Cyanocitta stelleri*
 - j. American Crow, *Corvus brachyrhynchos**
 - k. Common Raven, *C. corax**
 - l. Black-capped Chickadee, *Poecile atricapilla*
 - m. American Robin, *Turdus migratorius*
 - n. Yellow-rumped Warbler, *Dendroica coronata*
- E. Mammals
 - a. Golden-mantled Ground Squirrel, *Spermophilus lateralis*
 - b. Rock Squirrel, *S. variegatus*
 - c. Least Chipmunk, *Tamias minimus* (most likely)
 - d. Red Squirrel, *Tamiasciurus hudsonicus**
 - e. Abert's Squirrel, *Sciurus aberti*
 - f. Vole, *Microtus* spp.*
 - g. Cattle. Several herds notable along road in to the lakes, and occasional sign observed within 10m of release site pond

Proposed Monitoring Protocol for 2010

Mid to Late May.

Make an effort to get up into Trout Lakes, conduct haphazard search of release site area, looking for 2- and 1-year old toads. Search would be timed (number of toads observed/person-hours) and not intensive. Toads under 40 mm would be considered 1st year toads. If possible, delineate other ponds in area with Global Positioning Units (GPS).

- Do we want to actually catch any toads?
- Protocol of not stepping into the marsh or streams-use instead binoculars

First or Second Week of June.

Set up transects that cross the release site area (see Figure E-1) using GPS and flags. Set up 1 – 2 centralized stations where toads would be measured, toe-clipped (if necessary), swabbed for chytrid fungus, and their bellies photographed. Transects to be walked simultaneously by personnel and timed (toads/person-hour/transect). All toads would be taken to a station for processing then returned. Experience with amphibians helpful but not critical for these surveys, as boreal toads are readily apparent when in the area. The goal is to see if toads survived the winter and approximate how many are in the area. With transects crossing more than just the actual release site pond a better idea of dispersal would be gathered as well.

- Only wear clothing for that site

Also do intensive searches of adjoining ponds in the area, up to and including flipping downed logs and rocks. Personnel with such experience would be best as the toads will not be so readily apparent. All toads would be processed at a station nearby, with the GPS location for their capture taken. The goal is to identify what ponds the toads are visiting, with the long-term goal of knowing where they are when they reach breeding age (2013).

- Different clothes from that used in the release site

Repeat monthly.



Proposed transect pattern that crosses north marsh, release site pond, main marsh, secondary pond and up into surrounding conifers.

Research questions and hypotheses

Impact of fathead minnows on boreal toad eggs and very young larvae.

Observations (B. Christman, C. Fetkavich, L. Pierce) suggest that fathead minnows can be present when boreal toad eggs are laid.

- **Do fathead minnows prey upon boreal toad eggs?**
- **Do fathead minnows prey upon boreal toad larvae?**
- **Do fathead minnows disturb boreal toad larvae?**
- **Are there differences in behavior between boreal toad larvae in the presence of fathead minnows vs. boreal toad larvae not in the presence of fathead minnows?**

Natural history observations of boreal toads in NM versus those in Colorado that provided the stock for the New Mexico repatriation.

- **Are growth rates similar?**

Response of boreal toads to landscape features. Based upon observations of 1-year old toads and toadlets:

- **How do toadlets respond to stream flow?**
- **Do toadlets follow habitat features for dispersal, such as the log jutting out from the pond (see Figures 3 & 10), or do they randomly leave from the pond?**

- **As toadlets disperse how do they use retreats available to them, particularly when away from ponds, streams, and marshes, and is there a correlation between available retreats and survival of the toadlets to the following year?**
- **Do toadlets and juvenile toads use the same cues for dispersal or do they follow other toads?**
- **How do toadlets respond to changes in topography?**

Dragonflies are a prominent organism in the Trout Lakes system, and likely the most common predator type for boreal toad tadpoles.

- **Does the dragonfly larvae community vary across ponds within the system both spatially and temporally?**
- **Are certain dragonfly larvae and dragonfly larvae communities more of a threat to boreal toad larvae than others?**

Trout Lakes system as important site of biological diversity. The observation of the boreal whiteface dragonfly, well outside of its given range, as well as the potential presence of American marten and confirmed presence of northern leopard frog suggests the system at Trout Lakes is an important site for biological diversity in northern New Mexico.

- **How does the biological diversity at Trout Lakes compare to other local communities (such as Canjilon Lakes, Hopewell Lake, Lagunitas Lakes, Cumbres region, Cruces Basin) in terms of species composition, population density and other indices of biological diversity?**
- **Are boreal toads more likely to have persistent populations in sites with higher biological diversity? Lower?**