Columbia Spotted Frog (*Rana luteiventris)*
Toiyabe Great Basin Subpopulation
Long-term Monitoring Plan

Toiyabe Spotted Frog Technical Team
June 2004

ACKNOWLEDGEMENTS AND RESPONSIBILITIES

The Toiyabe Spotted Frog Technical Team (TSFTT) prepared the long-term monitoring plan for the Toiyabe subpopulation of the Columbia spotted frog. Each team member provided valuable information and assistance in the development of this plan.

Brigham Young University: Dr. Kent Hatch
Bureau of Land Management: Rhen Etzelmiller, Randy McNatt
Nevada Department of Wildlife: Brad Bauman, Anita Cook, Brian Hobbs, Jon Sjöberg
Nevada Natural Heritage Program: Glenn Clemmer, Jennifer Newmark
Nye County: Dr. Jim Marble
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US Forest Service: Lance Brown, Jim Harvey, Genny Wilson

Numerous other individuals contributed invaluable assistance, technical knowledge, and expertise in the development of the long-term monitoring plan. The TSFTT is grateful for their assistance.

The Toiyabe Spotted Frog Technical Team is committed to the implementation of this long-term monitoring plan over the next 10 years as described in Objective 2 of the Conservation Agreement and Conservation Strategy (2003). The TSFTT will evaluate the effectiveness of monitoring methods and strategies as outlined in the long-term monitoring plan on an annual basis. During such evaluations appropriate modifications will be made to the long-term monitoring plan in order to ensure scientific rigor and the efficiency of species monitoring efforts.

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I. INTRODUCTION

Over the past 20 years biologists, natural resource managers, land managers, and researchers have become critically concerned with the decline in amphibians, both on local and global scales (Semlitsch 2002, Semlitsch, 2000. Blaustein et al. 1994.) Certain amphibians may serve as indicator species to changes in the environment (Wake 1991). With the increasing concern about declining amphibian populations, and changes in land management practices where amphibians occur it will become critically important to monitor amphibian populations, their habitats and biology, in order to guide land and resource managers with information to modify land management practices that will benefit declining populations of amphibians.

The rangewide distribution of the Columbia spotted frog incorporates four populations (Figure 1). The northern population extends from Alaska to central Idaho and western Wyoming. The Wasatch and West Desert populations are small, isolated population groups occurring in central and western Utah. The Great Basin population occurs in eastern Washington and Oregon, southern Idaho and northern and central Nevada. At the southern extremities of its distribution the Great Basin population incorporates several isolated population groups (Engle 2001).

Columbia spotted frogs range from Alaska (northern extent) to Western Wyoming (eastern extent) To Eastern Oregon and Washington (western extent) to the Great Basin of Nevada and Utah (southern extent)(Figure 1). The Great Basin subpopulation occurs in parts to Idaho, Nevada, Oregon, and Washington (CAS 2003).

The Toiyabe Great Basin subpopulation of Columbia spotted frogs is a geographically isolated population of Columbia spotted frogs that occurs in central, Nevada. The Toiyabe subpopulation is also the southern most extremity of the Columbia spotted frogs known range (Figure 2) (CAS 2003).

Toiyabe spotted frogs are known to occur in seven drainages in Nye County, Nevada: Reese River, Cow Canyon Creek, Ledbetter Canyon Creek, Cloverdale Creek, Stewart Creek, Illinois Creek, and Indian Valley Creek (Figure 3). The majority of this subpopulation resides in the Reese River, Indian Valley Creek, and Cloverdale Creek (CAS 2003).

Approximately 90 percent of Toiyabe spotted frog habitat is on public land. The majority of the public land habitat (95%) is managed by the U.S. Forest Service (USFS), while the Bureau of Land Management (BLM) manages the remainder. Additional spotted frog habitat is under Yomba Shoshone tribal management and in private ownership (CAS 2003).

Potential threats that may compromise the existence to Toiyabe spotted frog are habitat degradation, disease and predation, inadequate regulatory mechanisms, and other factors.

Habitat degradation seems to be the most involved risk factor for the Toiyabe spotted frog. Water diversions from streams or wetlands where frogs exist may pose a significant threat to the Toiyabe spotted frogs in some locations. Livestock grazing impacts vary from degradation of bank stability to decrease in riparian cover. The development of stock ponds has proven to be beneficial in some areas where spotted frogs exist.

Disease is a risk factor through chytridiomycosis (chytrid), which is an emerging panzootic fungal disease among amphibians in the United States. Chytrid has been found in Columbia spotted frog populations in Utah and Idaho, but has not been detected in Nevada (Hatch et al 2002). Predation by snakes, fish, and bullfrogs pose a risk to Columbia spotted frogs. The Toiyabe spotted frog experiences predation by snakes and fish. The primary predators are the terrestrial grater snake (*Thamnophis elegans vagrans*), and salmonid fish native and non-native. Other factors that may compromise the existence of the Toiyabe spotted frog are drought, ultraviolet-B, toxins, and other land use and species recovery activities.

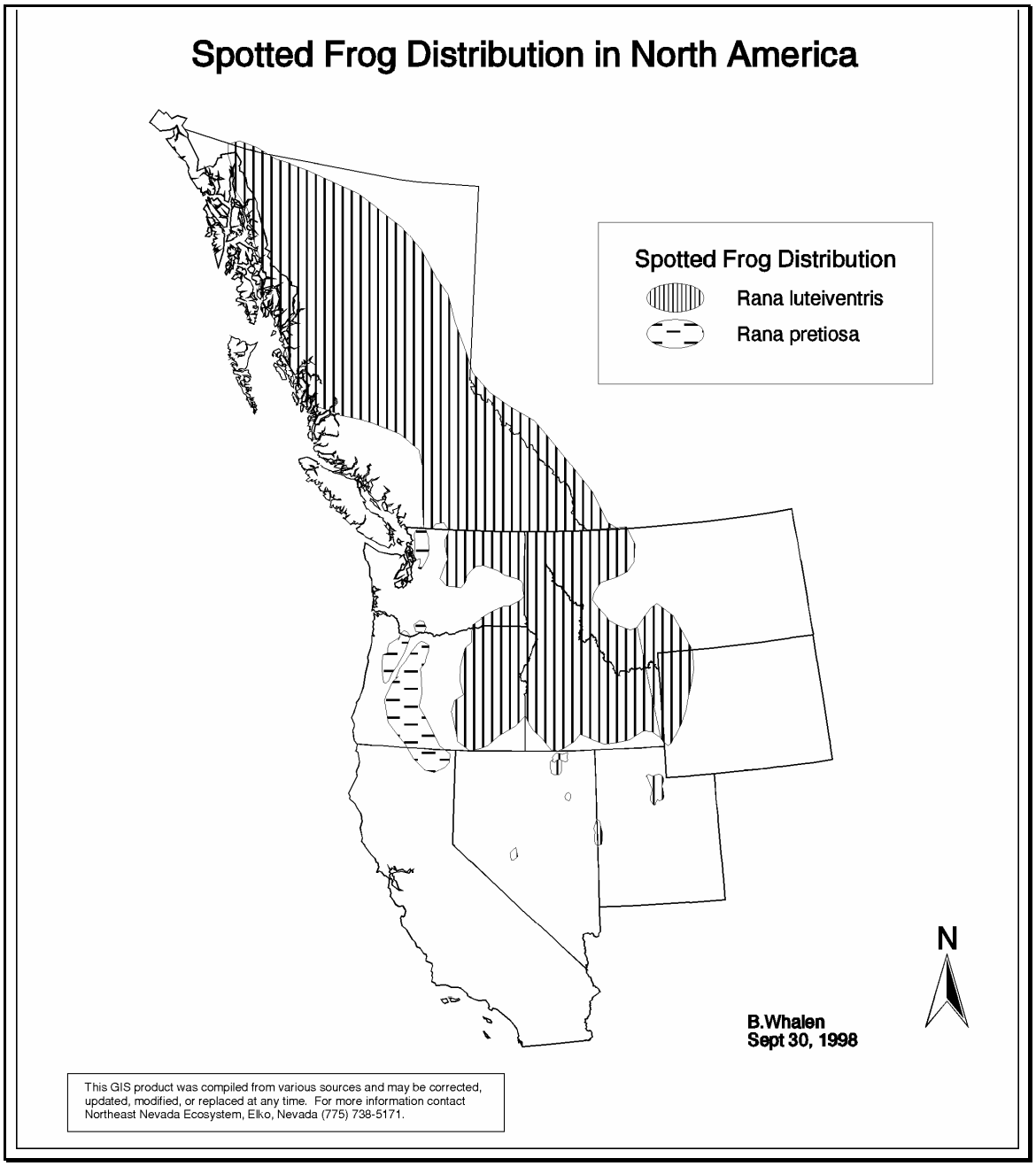


Figure 1. Distribution of Columbia Spotted Frog (*Rana luteiventris*) and the Oregon spotted frog (*Rana pretiosa*) in North America (from IDFG et al. 1995 Green et al 1996)

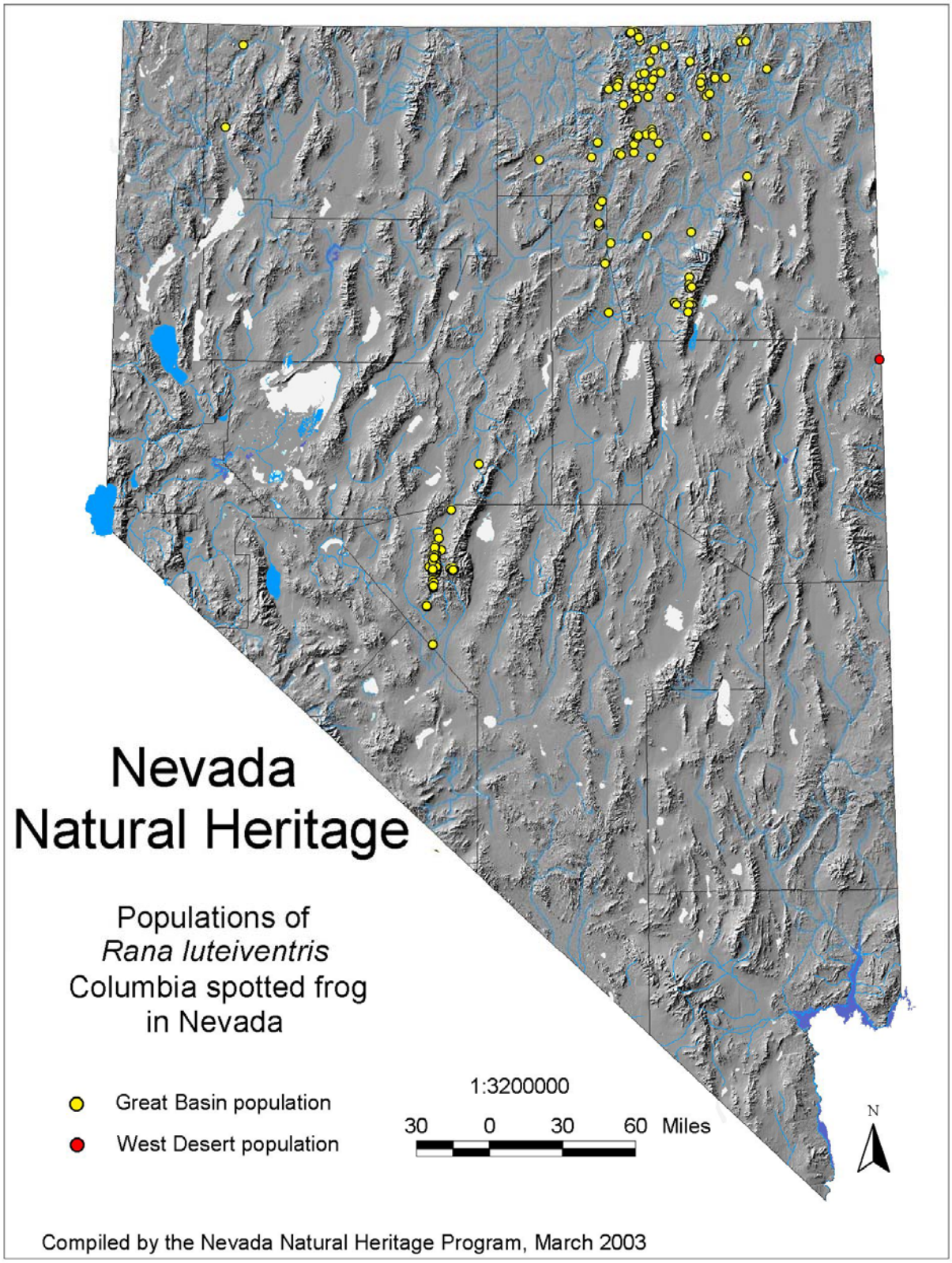


Figure 2. Distribution of Columbia spotted frog (*Rana luteiventris*) in Nevada.

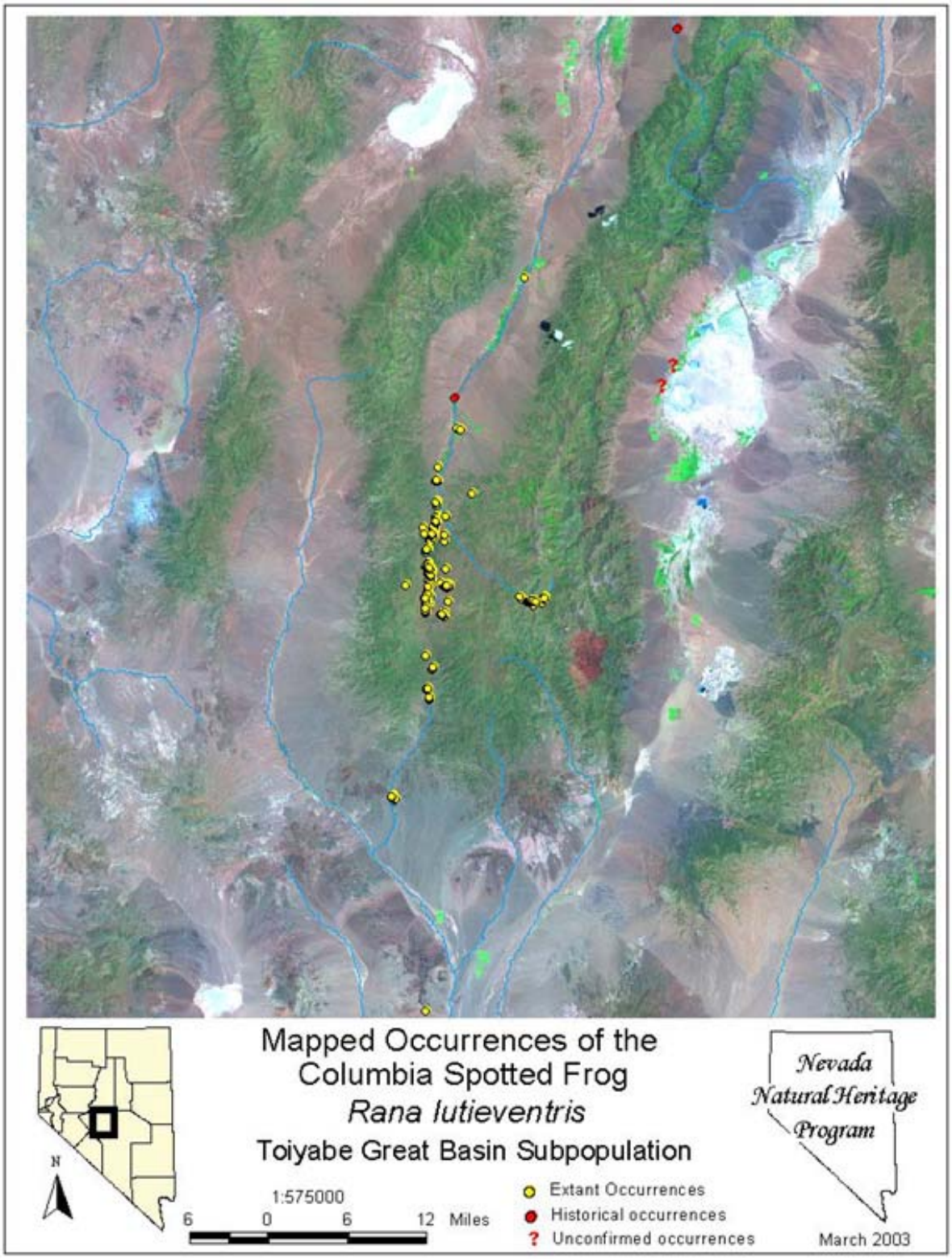


Figure 3. Current and historic distribution of Columbia spotted frog in Toiyabe subpopulation area.

II. PURPOSE OF THE LONG-TERM MONITORING PLAN

The long-term monitoring plan for the Toiyabe Great Basin subpopulation of the Columbia spotted frog is intended to address Objective 2 as described in the Conservation Agreement and Conservation Strategy 2003 (CAS) for the Columbia spotted frog Toiyabe Great Basin Subpopulation. The long-term monitoring plan will be implemented throughout the 10-year duration of the Toiyabe Spotted Frog CAS (table 1).

To accurately assess the status and distribution of any amphibian population comparable data sets collected and maintained over suitable time periods are essential. This reinforces the need for establishing long-term inventory and monitoring efforts using standardized methodologies. The variability inherent in inconsistent assessment efforts will compromise the ability to assess factors impacting amphibian populations and habitats (Olson and Leonard 1997).

The purpose of this long-term monitoring plan is to insure the consistent collection and analysis of population monitoring data for the Toiyabe Great Basin subpopulation of the Columbia spotted frog using standardized methods and protocols, incorporating monitoring at established representative (sentinel) sites as well as other key monitoring strategies. This plan will outline the population monitoring strategy for the Toiyabe spotted frog through 2014, during which population baseline and initial population trends within the known range of this subpopulation will be established. Monitoring data will assist the Toiyabe Spotted Frog Technical Team (TSFTT) in developing conservation strategies and actions, and in providing land management agencies with information that can be used to modify land management practices that will benefit the Toiyabe spotted frog. Through annual evaluation and review, the TSFTT may choose to modify elements of this plan based on new information and management needs.

TABLE 1. Outline of survey type, survey years, funding, and survey labor

SENTINEL SITE	***TYPE OF SURVEY***	***SURVEY YEARS***	***LAND OWNERSHIP***	***FUNDING SOURCES***	***SURVEY LABOR***
PASTURE A	Mark/Recapture and Egg Mass	2004 - 2014	USFS	USFS/USFWS/NDOW	All Agencies
PASTURE B	Mark/Recapture and Egg Mass	2004 - 2014	USFS	USFS/USFWS/NDOW	All Agencies
PASTURE C	Mark/Recapture and Egg Mass	2004 - 2014	USFS	USFS/USFWS/NDOW	All Agencies
PASTURE D	Mark/Recapture and Egg Mass	2004 - 2014	USFS	USFS/USFWS/NDOW	All Agencies
WARNERS RANCH	Mark/Recapture and Egg Mass	2004 - 2014	USFS	USFS/USFWS/NDOW	All Agencies
JAMIE'S SITE	Mark/Recapture and Egg Mass	2004 -2014	USFS	USFS/USFWS/NDOW	All Agencies
FARRINGTON RANCH	Mark/Recapture and Egg Mass	2004 -2014	USFS	USFS/USFWS/NDOW	All Agencies
COW CANYON	Mark/Recapture and Egg Mass	2004 -2014	USFS	USFS/USFWS/NDOW	All Agencies
LEDBETTER CANYON	Mark/Recapture and Egg Mass	2004 -2014	USFS	USFS/USFWS/NDOW	All Agencies
ARC DOME	Mark/Recapture	2004 -2014	USFS	USFS/USFWS/NDOW	All Agencies
CLOVERDALE RANCH	Mark/Recapture and Egg Mass	2004-2014	BLM/PRIVATE	USFS/USFWS/NDOW	All Agencies

III. MONITORING METHODS

Adequate assessment of an amphibian population requires the incorporation of multiple monitoring and survey methods, which are scale-and stage-appropriate to detect both recruitment and adult persistence over generations (Semlitsch 2002). The known distribution of the Toiyabe population of the Columbia spotted frog also incorporates spatially disjunct habitats varying in type, accessibility and level of perturbation, as well as areas of potential habitat that are poorly documented but may be occupied by frogs now or in the future. For these reasons several monitoring methods will be used in the implementation of this monitoring plan.

Mark and recapture surveys will be conducted annually at 11 specific sentinel sites over the ten-year period of the agreement to establish baseline and initial population trends. PIT tagging will be the marking method implemented. Population estimates using this mark and recapture method are accurate within the assumptions of: the population is open, and allows for recruitment and emigration/death, all emigration is permanent, equal survival rates for all age classes, that all frogs are equally likely to be caught, and that marking does not affect survival.

During the mark and recapture surveys sentinel sites will be search in their entirety during the middle of summer when adult frogs are likely to be present. Each sentinel site will be survey 4 times consecutively (4 days in a row) as long as survey conditions allow (table 2).

A team of surveys with dip nets will search for frogs visually. The number of surveyors will be dependent upon the water conditions of that particular year. When a frog is encountered it will be netted with the dip net, the frogs will be scanned with a PIT tag scammer to see if the frog has been captured previously, and then the frogs number will be recorded. When a frog is encountered that is not a recapture the frog will be marked with a PIT tag, and returned to the pool of capture. PIT tags will be inserted in frogs greater than 45 mm (SNVL). A small incision will be made in the epidermis on the back of the frog below the neck. The PIT tag will be inserted in the frog and work down the back of the frog until it rests on the posterior of the frog's pelvis. Bactine will be used on the incision as an antiseptic. A single unique toe clip will also be taken from each frog that is marked with a PIT tag in order to track PIT tag loss over time. The unique single toe clip will vary from year to year, and the toe to be clipped during a particular year will be determined prior to the survey. Other data to be collected when a frog is captured include snout to vent length (SNVL), sex of frog, and UTM location of capture (appendix A). Pictures will be taken at the start and end of each sentinel site. UTMs of photo locations and direction which photos will taken from are provided in appendix B.

Table 2. Outline of mark and recapture survey and teams of year at each sentinel site**.**

TEAM	DAY	SITE	PASS
1	1	Pasture A and Jamie's Site	1st
	2	Pasture A and Jamie's Site	2nd
	3	Pasture A and Jamie's Site	3rd
	4	Pasture A and Jamie's Site	4th
2	1	Pasture B	1st
	2	Pasture B	2nd
	3	Pasture B	3rd
	4	Pasture B	4th
3	1	Pasture C & D	1st
	2	Pasture C & D	2nd
	3	Pasture C & D	3rd
	4	Pasture C & D	4th
4	1	Warner' Ranch	1st
	2	Warner' Ranch	2nd
	3	Warner' Ranch	3rd
	4	Warner' Ranch	4th
5	1	Farrington and Cloverdale Ranch	1st
	2	Farrington and Cloverdale Ranch	2nd
	3	Farrington and Cloverdale Ranch	3rd
	4	Farrington and Cloverdale Ranch	4th
6	1	Cow Canyon and Ledbetter	1st
	2	Cow Canyon and Ledbetter	2nd
	3	Cow Canyon and Ledbetter	3rd
	4	Cow Canyon and Ledbetter	4th
7	1	Arc Dome	1st
	2	Arc Dome	2nd
	3	Arc Dome	3rd
	4	Arc Dome	4th

Visual encounter egg mass surveys will be conducted annually over the ten years of the agreement at 10 of sentinel sites in order to collect data on important breeding areas, and to monitor which breeding areas are the most productive (table 3.). The Arc Dome sentinel site is being left out due to remote access to the site. Egg mass surveys will consist of a team of surveys visually searching the sentinel in its entirety. When an eggs mass is encounter it will be marked with a flag and data recorded. Egg mass surveys should be conducted when conditions allow access to the sentinel sites, and there is open water. The time of year these surveys are conducted will vary depending on weather conditions of the particular year.

Table 3. Schedule for visual encounter egg mass surveys.

SURVEY	DAY	SITE
1	1	Warner's Ranch
	2	Jamie's Site & Pasture A
	3	Pasture B
	4	Pasture C & D
	5	Travel
2	1	Ledbetter & Cow Canyon
	2	Farrington Ranch
	3	Cloverdale Ranch
	4	Any makeup surveys
	5	Travel

Presence/absence surveys will be conducted in identified areas of suitable habitat continuously during the 10-year agreement in conjunction with the mark/recapture surveys. Presence/absence surveys will be conducted on an opportunistic basis after the survey crews have finished the mark/recapture surveys for the week. Presence/absence surveys will be visual encounter surveys (VES) conducted in areas that support spotted frog suitable but presumable unoccupied spotted frog habitat or locations with historic spotted frog records that now appear to be unoccupied by frogs. Table 4 outlines areas that are in need of presence/absence surveys. Presence/absence surveys will be valuable in determining frog recolinzation and pioneering into new or historic sites, to validate previous survey data indicating frog absence at historic locations. VES surveys will be conducted using the protocol developed for Toiyabe spotted frog by Hatch and Semandle (Appendix C).

Table 4. Areas identified as needing VES presence absence surveys.

PRESENCE/ABSENCE NEED	LAST KNOWN STATUS
Stewart Creek	Detected 1999
Little Jett Canyon	?
Illinois Creek	Detected 1994
Little Meadow	Detected 1999
Clear Creek	?
Tierney Creek	?
Sections Cloverdale Creek	?
Upper Peavine Creek	?
Sections of the Upper Reese	?
Sections of the Lower Reese	?

All survey crews will use established protocols for disinfections and disease prevention using the DAPTF (Declining Amphibian Populations Task Force) Code of Practice (Appendix D). The TSFTT has adopted the disease prevention protocol for working in wetland habitats from the DAPTF's Fieldwork Code of Practice. All resource and land management agencies are encouraged to follow this or a similar protocol to prevent or reduce the spread of amphibian and other aquatic borne diseases. Chytrid fungus and other highly contagious and deadly diseases are being reported worldwide, and may be a significant cause of amphibian population declines. Pathogens and parasites can easily be transferred between habitats on equipment and footwear of fieldworkers, spreading organisms to new locations containing species that have little or no resistance to the agents. It is vitally important for anyone involved in amphibian research and other types of wetland studies, including those on fish, bats, invertebrates and plants, to take steps to prevent the introduction of disease agents and parasites.

IV. DATA STORAGE AND ANAYSIS

All frog mark/recapture and presences absence location data will be collected in UTMs, and will be stored in the Nevada Natural Heritage Program (NNHP) GIS database. Information exchange between NDOW GIS program and NNHP databases occurs on a regular basis, so location data will be also be stored with NDOW. Original hard copy data will be provided to NNHP in order to maintain quality control of location data.

The program JOLLY will be used to estimate population size for each sentinel site. This program is based off of the Jolly-Seber model, which assumes that the population is open, and allows for recruitment and emigration/death. The Jolly-Seber model assumes the all emigration is permanent, equal survival rates for all age classes, that all frogs are equally likely to be caught, and that marking does not affect survival. Four visits per site are required to perform a goodness-of-fit test with this model.

Annual reports will be generated from the mark/recapture, VES egg mass, and presence/absence surveys. The reports will contain data analysis, of that particular years surveys and previous years surveys, along with detailed maps of survey locations and frog locations and distributions. Annual reports will be distributed to all interested parties.

V. DESCRIPTION SENTINEL SITES

A total of 11 sentinel sites have been identified for monitoring by the TSFTT for the Toiyabe spotted frog: Pastures A, B, C, D, Warner's Ranch, Farrington Ranch, Cloverdale Ranch, Jamie's Site, Cow Canyon Creek, Ledbetter Canyon Creek, and Arcdome/Upper Reese River (figure 4). Pastures A, B, C, D, Warner's Ranch, Jamie's Site, Cow Canyon Creek, Ledbetter Creek, and the Arcdome/Upper Reese River are all within the Reese River drainage. Farrington Ranch and Cloverdale Ranch are along Cloverdale Creek, which is not in the Reese River drainage. Cloverdale Creek terminates at a playa in Big Smoky Valley. The frog populations at these sentinel sites will be monitored annually throughout the ten-year agreement.

Sentinel sites1-4. Pastures A, B, C and D are located in Indian Valley, and are on USFS administered land with pasture "D" being the southern most pasture and pasture "A" being the northern most pasture (figure 4). As you move down stream the pastures start becoming more moist with pasture "A" being the wettest and "D" being the driest. Indian Valley was under private ownership until the USFS acquired the property in 1997/98. For this monitoring plan all of Pastures B, C, and D will be surveyed in the entirety, and a 750 m section of Pasture A will be surveyed except for the first year where Pasture A will also be entirely surveyed.

Sentinel sites 5 & 6. Warner's Ranch and Jamie's site are located in the northern most extent of Indian Valley (figure 4). Warner's ranch sentinel site is a 750 m section along Indian Valley Creek south of the Yomba Indian Reservation. Jamie's site is in between Warner's Ranch to the north and Pasture "A" to the south. This site is a 750 m section of mostly perennial stream that lies within a downcut of Indian Valley Creek. Both of these sites are on USFS administered land. Warner's Ranch was previously under private owner ship until the USFS acquired the property. Jamie's site is a 750 m section just north of pasture D, and a 750 m section of Warner's Ranch are the sites that will be surveyed.

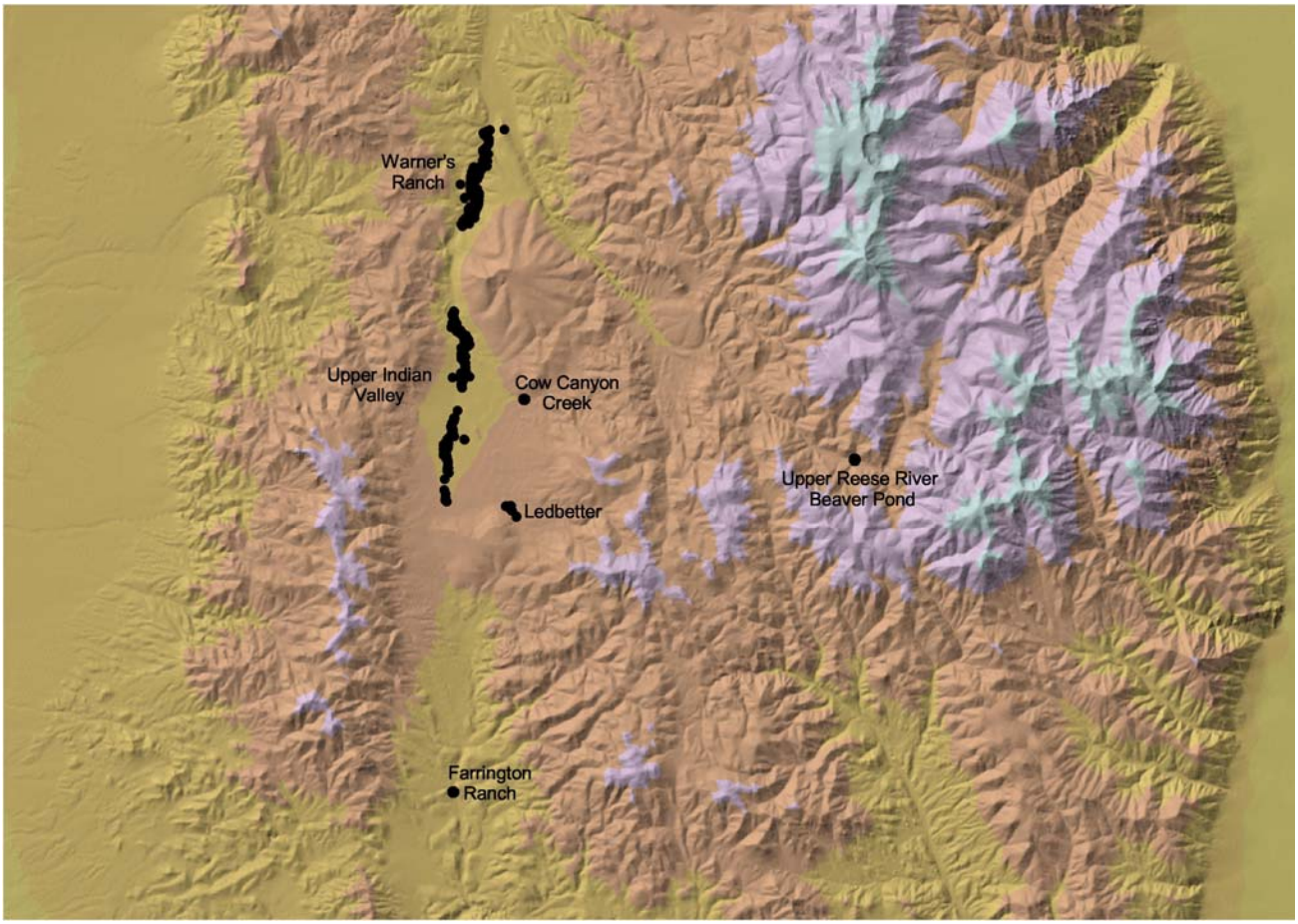
Sentinel site 7. Farrington Ranch is located on the upper end of Cloverdale creek approximately 6 miles south of Indian Valley on the east side of Forest Service road FS 018 (figure 4). Farrington Ranch was under private ownership up until the USFS acquired the property in 1994. The Farrington Ranch sentinel site is an artificial pond created as a water reservoir for the no longer functioning Farrington Ranch. The pond is created by diverting water from Cloverdale Creek, which flows immediately along the east side of the pond.

Sentinel site 8. Cloverdale Ranch is located on the lower end to Cloverdale creek at the mouth of the canyon on the edge of Big Smoky Valley, and is on BLM administered land. Cloverdale Creek is an ephemeral creek that runs south out of the Toiyabe Mountain in to Cloverdale Ranch, and then to Big Smoky Valley.

Sentinel sites 9 & 10. Cow Canyon Creek and Ledbetter Canyon Creek sentinel sites are located along Cow Canyon Creek and Ledbetter Canyon Creek, which are respectively east and southeast of Indian Valley (figure 4). The Cow Canyon Creek sentinel site is a 750 m transect of the creek. This site is an ephemeral stream where pools in the main channel remain moist most of the year. The Ledbetter sentinel site consists mostly of two meadows along Ledbetter Creek. Ledbetter Creek is an ephemeral creek that comes out of Ledbetter Canyon. A barbed wire fence surrounds the lower of the two meadows, and the upper of the two is not fenced. Both of these sentinel sites are on USFS administered land.

Sentinel site 11. The Arc Dome sentinel site is located along the upper Reese River in the Arc Dome Wilderness Area (figure 4). This sentinel site is in a remote wilderness area, and access to this sentinel will require packing in with horses or backpacking in

order to conduct surveys. The Arc Dome sentinel site consists of complex of beaver ponds and braided channels, adjoining wetland habitat, and approximately 100 m of stream above and below the ponds. The entire site is about 600 m long and 300 m wide and fills the entire area constrained by the canyon walls. Previous mark/recapture data for the Arc Dome sentinel site are summarized in table 10.



From Hatch et al. 2002

Figure 4. Location of 10 of the 11 sentinel sites (Cloverdale not included). Pastures A, B, C, D and Jamie's are all located in Indian Valley (Hatch et al 2002).

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Appendix A. **MARK/RECAPTURE DATA SHEET**

SENTINAL SITE:_____ **TIME:**_____ **DATE:**_____

SURVEY CREW:_____

START WATER TEMP:_____ END WATER TEMP:_____

START AIR TEMP:_____ END AIR TEMP:_____

START DISOLVED OXYGEN:_____ END DISOLVED OXYGEN:_____

New Capture #	Recapture #	Easting	Northing	SNVL	Sex	Time

New Capture #	Recapture #	Easting	Northing	SNVL	Sex	Time

Appendix B. UTM locations of the starting and ending points of each sentinel site, along with the bearing direction a photo needs to be taken.

SENTINEL SITE	***STARTING UTM***	***BEARING OF PHOTO***	***ENDING UTM***	***BEARING OF PHOTO***
PASTURE A (750m)	456470 E 4295820 N	180° & 360º	456450 E 4293515 N	180° & 360º
PASTURE B	456450 E 4293515 N	180° & 360º	456167 E 4292206 N	180° & 360º
PASTURE C	456167 E 4292206 N	180° & 360º	456185 E 4291459 N	180° & 360º
PASTURE D	456185 E 4291459 N	180° & 360º	456290 E 4290160 N	180° & 360º
WARNERS RANCH	457629 E 4302172 N	180° & 360º	456514 E 4299180 N	180° & 360º
JAMIE'S SITE	456371 E 4296336 N	180° & 360º	456470 E 4295820 N	180° & 360º
FARRINGTON RANCH	456384 E 4280990 N	Take Picture From Road	456400 E 4280932 N	Take Picture From Road
COW CANYON	458477 E 4293767 N	Upstream& Downstream	Will get UTM in July 04	Upstream& Downstream
LEDBETTER CANYON	458204 E 4290045 N	Upstream& Downstream	Will get UTM in July 04	Upstream& Downstream
ARC DOME	469196 E 4291572 N	Upstream& Downstream	Will get UTM in July 04	Upstream& Downstream
CLOVERDALE RANCH	Will get UTM in July 04	180° & 360º	Will get UTM in July 04	180° & 360º

Appendix C.

TOIYABE SPOTTED FROG VISUAL ENCOUNTER SURVEYS

Kent Hatch
Eric Simandle

Visual encounter surveys (VES) operate under the following assumptions: (1) All individuals of the target species have the same chance of being observed during the survey regardless of habitat type or differences in individual coloration and behavior. (2) All individuals of the species have the same chance of being observed regardless of season, weather, or time of day. (3) An individual is counted only once during the survey. (4) The results do not vary from one observer to the next (no observer bias). (5) Results of each observer do not change with time either positively due to gained experience, or negatively due to fatigue or boredom. Failure to meet these assumptions compromises the effectiveness of VES in estimating population sizes. While it is unlikely that the above assumptions can be met in full, we have generated the following list of recommendations to minimize biases and maximize the effectiveness of VES for surveying Spotted Frog populations.

General comments:

1. It is imperative that the surveying crew be well trained by experienced individuals. The crew should practice VES for at least 3 or 4 days in the field under realistic conditions before actually conducting VES.
2. Be as consistent as possible in survey methods.
3. Conduct surveys under similar weather conditions (as far as possible). Avoid rainy or cold days.
4. Use the same personnel for all VES if possible.
5. Keep detailed notes, especially of any changes in procedures or any anomalous conditions or events.

Survey sites:

6. Clearly delineate areas to be surveyed. If the site will be visited multiple times, mark areas with stakes or flagging if possible. If doing a one-time visit, using landmarks clearly and accurately the describe site. Make a sketch of the site with approximate scale.
7. Let the site dictate the search time. Different sites contain different habitats. Some sites may be easier to search than others. Spend more time at the more difficult sites and less time at the more easily searched sites. However, once the search time is established for a site and for each habitat in a site, the same search time and effort should be given on subsequent surveys of that site. Only if the habitat changes radically (e.g. pond dries up) should search time and effort be changed, and then it should be clearly noted.
8. Make reference photographs of site. Mark the position and direction that the photograph was taken from so that photos can be taken throughout the season to document changes in vegetation, disturbance, etc.
9. Use at least 2 people for the survey.

Before beginning the actual survey:

10. Record the initial data (location, date, time, weather conditions, surveyor's names, etc.)
11. Do a visual scan (with binoculars, if helpful) and plan survey of site (direction, individual responsibilities, etc.)

When conducting the survey:

12. Use binoculars when possible to survey 15 m ahead. Slowly walk, stopping every 2 m to scan. After 10 m are covered, scan with binoculars again.
13. When walking along the waterline or in water, probe under overhangs, in thick grass, thick brush, or in crevices for frogs. A dip net can be particularly useful for probing.
14. When in water, check submerged debris and underneath vegetation for frogs, especially under overhanging banks. Try not to disturb the stream/pond sediment in a way that would prevent seeing frogs.
15. When surveying a section of stream, start at the *down stream* end and work towards the upstream end. This will prevent sediment from obscuring one's view. This will also bring frogs that jump in the water down to one, rather than carrying them away from one.
16. Look for presence of eggs in the water. Document approximate size and number of egg masses and their location.
17. Look for presence of tadpoles in the water. Document approximate size and number of egg tadpoles and their location.
18. When helpful, use polarized sunglasses for seeing in the water better.
19. In all cases, allow more time for habitat that is difficult to search (e.g., thick vegetation). If significantly different habitats are being searched, break survey down by habitat type, recording the number of frogs seen, time of search, and area of search for each habitat type.
20. When a team is conducting the survey, all members of the team should proceed in unison. A single sweep of the area should be made rather than multiple sweeps in order to avoid disturbing frogs before they are seen. If the area to search is wider than the team can cover, proceed in a zigzag pattern as described in Figure 1.
21. If two people are surveying a very small stream, it may be helpful to have one on each bank. It is often easier for a person on one bank to see frogs on the opposing bank, especially if there is overhanging brush or other overhanging cover.
22. When the area of bank to survey is narrow, it may be helpful to have one person survey the bank, while the other walks in the stream a 2-3 meters behind. Often the person that is slightly behind will see frogs that the first person missed.
23. Record data as you go. Do not rely on memory. Use a hand held counter.
24. Use a stopwatch and record only the time when actively searching and not when one is writing data, moving around obstacles, photographing amphibians, chatting, or other non-search activities.
25. Take care to damage the site as little as possible during the survey.
26. Review data sheet at end of survey to make sure everything is filled in and recorded accurately.

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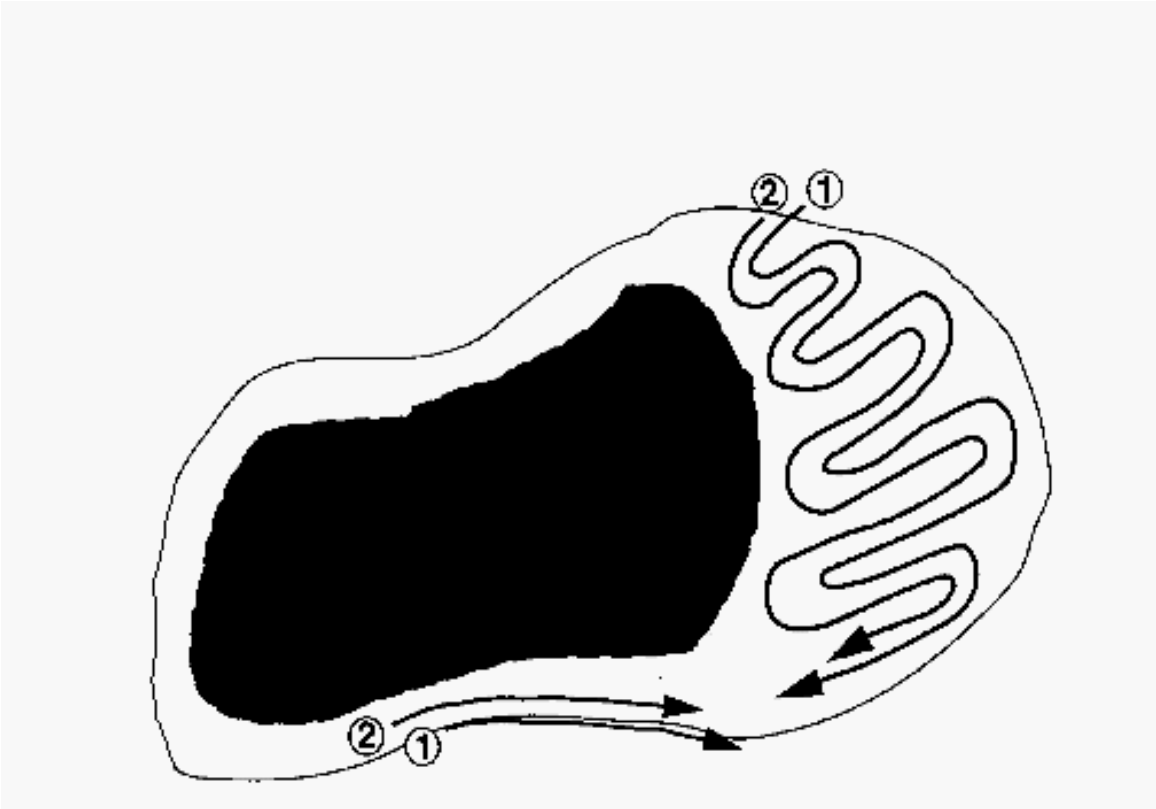

Fig. 1. Basic search pattern when area can be searched in a single, straight-line pass (bottom) and when search area is too wide to search in a single, straight-line pass (right). From Thoms et al. 1997.

Appendix D. Adapted disease protocol guidelines from DAPTF Fieldwork Code of Practice for Toiyabe spotted frog surveys.

Requirements for working on Toiyabe spotted frog surveys

1. Dedicated equipment will be used by survey crews, researchers, land managers, and others conducting surveys for Toiyabe spotted frogs. Dedicated equipment will be cleaned and stored separately.

2. Equipment will be rinsed and all debris removed. Surfaces, which should appear clean, will be scrubbed with a 10% bleach, 1.6% Quat-128, or 70% ethanol solution and rinsed with tap water. Footwear belonging to occasional users must be completely cleaned before and between visiting separate survey sites, with special attention paid to grips, cleats, and laces. Felt-bottomed wader boots are very difficult to clean completely and should be avoided whenever possible. To further reduce the risk of disease transfer, all equipment will be completely dried before re-use.

3. In remote locations, such as the Arc Dome sentinel site clean all equipment as described above upon return to the lab or base camp. If disinfecting in the field is necessary, sanitize all items before arriving at the next location. Used cleaning materials (including liquids) must be disposed of safely and if necessary taken back to the lab for proper disposal.

4. Survey crews will be provided with a chytrid information sheet, and advised of known chytrid locations throughout the region. Boots and equipment used in known chytrid locations should not be used at any of the sentinel or survey sites.

5. When working at sites with known or suspected disease problems, or when sampling populations of rare or isolated species, wear disposable gloves and change them between handling each animal. Dedicate sets of nets, boots, traps and other equipment to each site being visited. Clean and store them separately at the end of each field day.

6. Used cleaning materials (liquids etc.) should be disposed of safely and if necessary taken back to the lab for proper disposal. Used disposable gloves should be retained for safe disposal in sealed bags.