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Progress Report

Columbia Spotted Frog Great Basin Population (*Owyhee Subpopulation*) Long-term Monitoring Plan: Year 2009 Results

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ABSTRACT

The Idaho Department of Fish and Game (IDFG) continued long-term monitoring of the Owyhee subpopulation of Columbia spotted frog (*Rana luteiventris*) in 2009. This work included egg mass surveys at 4 sentinel sites, mark-recapture surveys at Sam Noble Springs and surveys for occupancy modeling. More egg masses were found at Circle Pond than in any other year of surveying. Other sites had egg mass numbers comparable with 2007 results. The total number of frog captures (n = 108) at Sam Noble Springs within the grazing exclosure is the same as 2007. However, the number of frogs captured at Ponds 13 and 14 was the highest since surveys began in 2006 (n = 12 and n = 47, respectively). We continued to survey catchment basins (CBs) in order to utilize occupancy modeling to estimate the proportion of area occupied by Columbia spotted frogs. We surveyed 53 CBs in 2009. However, 6 CBs did not provide suitable habitat for frogs, so the final model consisted of 47 CBs. Spotted frogs occupied 61% of the study area with a 96% detection probability within 2 visits.

INTRODUCTION

In 1993, the Great Basin population of the Columbia spotted frog was elevated to "candidate" status under the Endangered Species Act. A candidate species is one whose listing as threatened or endangered is warranted, but precluded by higher priority species. Spotted frog population declines were attributed to habitat loss through conversion of wetlands to irrigated pastures, de-watering of rivers for irrigation uses, drying of ponds due to drought or overuse, and reduction in riparian habitat quality due to overgrazing (Semlitsch 1983, Duellman and Trueb 1986, Turner 1993, Gomez 1994).

Researchers have studied the isolated subpopulation of the Columbia spotted frog in the Owyhee Mountains since 1994 (Munger et al. 1997). Because there were only 6 previously known occurrences, initial studies by Boise State University (BSU) focused on documenting the species' distribution in southwestern Idaho. Although researchers located spotted frogs at numerous locations in the Owyhee Mountains (Munger et al. 1994, 1995, 1997), occurrences were reportedly highly disjunct (Koch et al. 1997, Engle 2001a).

Beginning in 1997, researchers collected baseline data on the life history and ecology of this subpopulation (Engle and Munger 1998). In particular, studies examined spotted frog movements within watersheds and along wet corridors, and how this disjunct subpopulation functions as a metapopulation (Engle 2001a, Lingo in prep.). Engle (2001b) also developed a long-term (10-yr) monitoring plan for Columbia spotted frogs in Owyhee County, which has been followed every year since 2000 (Engle 2000, 2001a; Lingo and Munger 2002, 2003; Blankinship and Munger 2005; Munger and Oelrich 2005; Moser and Patton 2006).

The major components of the monitoring protocol (Engle 2001b) were: surveys of 4 sentinel sites 2-4 times in a season to estimate abundance and monitor for successful reproduction, rotating visits to 51 Element Occurrences (EOs) every 3 years to determine presence/absence, and exploration of potentially suitable habitat. The goals of the monitoring protocol were to:

1. Determine the long-term population trends and status of Columbia spotted frog populations occupying the Owyhee Uplands.
2. Develop frog conservation strategies to improve spotted frog productivity that are consistent with land management practices.
3. Provide the U.S. Fish and Wildlife Service (USFWS), U.S. Bureau of Land Management (BLM), IDFG, and the Idaho Department of Lands (IDL) with an index of ecosystem health and function since frogs are considered to be good indicators of ecosystem viability (Engle 2001a).

The 10-year annual population monitoring is a joint project among the BLM, IDFG, and USFWS. In previous years, BSU graduate students and field technicians, under a USFWS Section 6 agreement with IDFG, conducted the annual surveys. IDFG took over responsibility for the Columbia spotted frog program in 2006, which was the seventh year of the long-term monitoring plan. After the 2006 field season, cooperators formed a working group to evaluate the effectiveness of the monitoring protocol and the progress towards the stated goals.

The Owyhee Columbia Spotted Frog Working Group (OCSFWG) includes members from IDFG, USFWS, BLM, U.S. Geological Survey, IDL, and other interested individuals. After several meetings, the OCSFWG concluded that the 2001 long-term monitoring protocol was not able to adequately assess population trends at the site level. Furthermore, it did not provide the proper information to determine trends or population status across the range of the Columbia spotted frog in the Owyhees. Recent advances in survey methodology and mark-recapture models, along with a framework for adaptive management, have provided the tools to improve this long-term monitoring plan.

The OCSFWG has adopted the Amphibian and Research Monitoring Initiative (ARMI) pyramid (see Fig. 1, page 2 in Muths et al. 2006) as a guide for the revised long-term monitoring plan. At the base of the pyramid is distributional information and general inventories. ARMI has advocated the metric Proportion of Area Occupied (PAO) as the core tool to evaluate change in amphibian populations. This middle level is considered the core of ARMI monitoring. The peak of the pyramid includes “apex” sites, where biologists conduct detailed studies of populations and demographics. Our pyramid is presented in Figure 1.

Upon review of the ARMI pyramid and the previous long-term monitoring plan and its goals, the OCSFWG agreed that the plan needed to shift its emphasis from the top of the pyramid to the middle. Previous research by BSU and others have already addressed the base of the pyramid. Below we provide a brief introduction to apex and core studies, which are also discussed in more detail in the revised long-term monitoring plan (Moser and OCSFWG 2007).

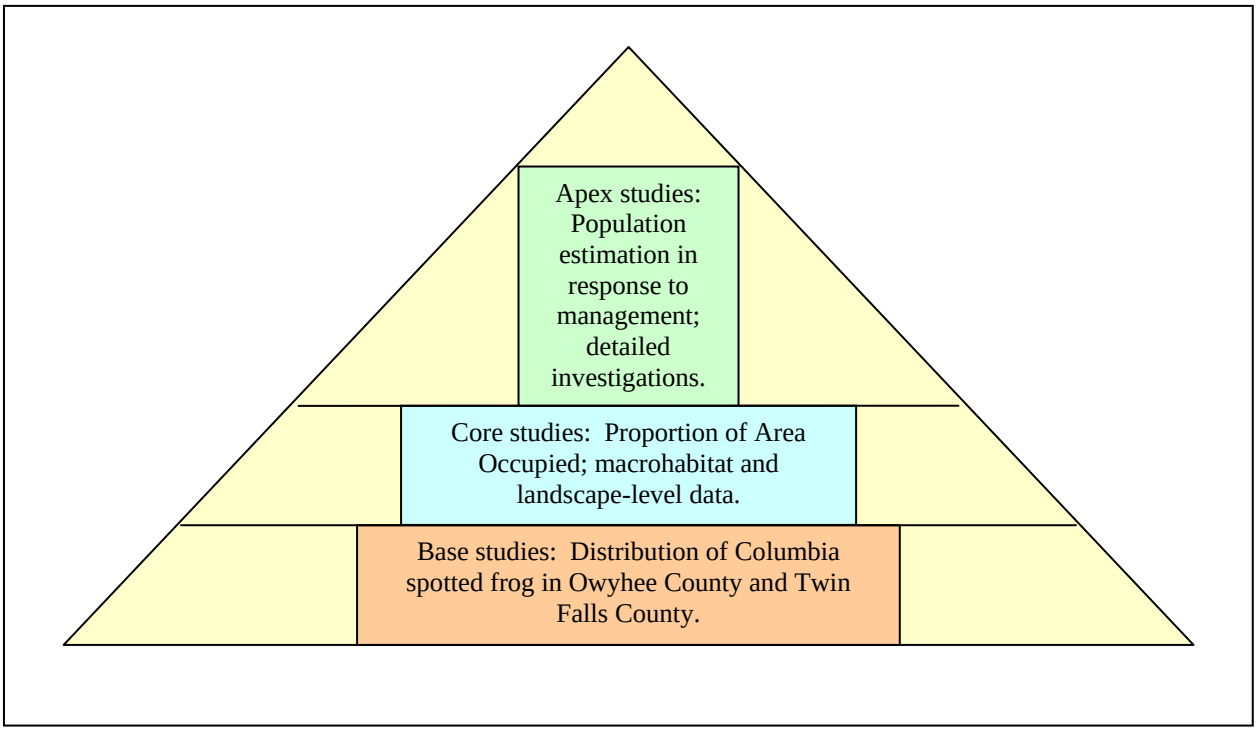

Figure 1. Pyramid for research and monitoring of the Owyhee subpopulation of the Columbia spotted frog in Idaho.

Apex Studies

Apex studies are a useful tool for detailed investigations that may be needed at any site, particularly when tied to a specific research or management question. Detailed investigations may include studies of basic ecology, demography, or population responses to habitat management. In particular, apex studies should be included in any habitat manipulations or restoration to benefit spotted frogs. Although the specific methods used in apex studies may vary with the research question, one of the main tools that may be used is mark-recapture to estimate population size and response. There is a wealth of literature on mark-recapture methodology; Lancia et al. (2005) provide a good introduction and references. Because 1 site, Sam Noble Springs, is now managed under a Candidate Conservation Agreement with Assurances (CCAA), the OCSFWG agreed we should continue apex studies at this site.

Core Studies

The EO surveys were originally designed to provide information similar to the middle level of the ARMI pyramid. The EOs were 51 sites known to be occupied by spotted frogs, and these were to be surveyed once every 3 years. Several of the EOs on private land were not surveyed after the initial observation because they were no longer accessible to researchers. The resulting data were presence or absence of frogs at a site in a particular year. What was lacking in the presence/absence protocol was: 1) incorporation of detection probability, 2) consistency among years in sampling effort and timing, and 3) a probabilistic sampling scheme so results could be

applied to the range of spotted frogs in Owyhee County. For example, Blomquist (2000) noted significant variation in results of visual encounter surveys for spotted frogs in Nevada. Results were often different at the same site 1 week later with a different crew, demonstrating the need to consider observer bias, timing, and weather in a monitoring protocol for spotted frogs.

Starting in 2007, we began using occupancy estimation and modeling as the core of the revised monitoring protocol for the Owyhee subpopulation of Columbia spotted frog. Occupancy models (also known as PAO) are advocated by ARMI as the primary metric by which to monitor trends in amphibian populations. Because abundance measures are very difficult and expensive to obtain at a large scale, occupancy can measure patterns and trends in occupied areas over time. The key to occupancy modeling is the ability to model detection probability over repeated visits. Traditional presence/absence surveys are fraught with bias, because it is often not known whether a recorded "absence" is a true absence or a problem with our ability to detect the species. Variation in detectability of a species may be due to habitat characteristics, observer experience, or weather; such variables are used as covariates in the modeling process. For more detail, please review the following: MacKenzie et al. 2002, 2006; Bailey and Adams 2005; and Muths et al. 2006, p. 18.

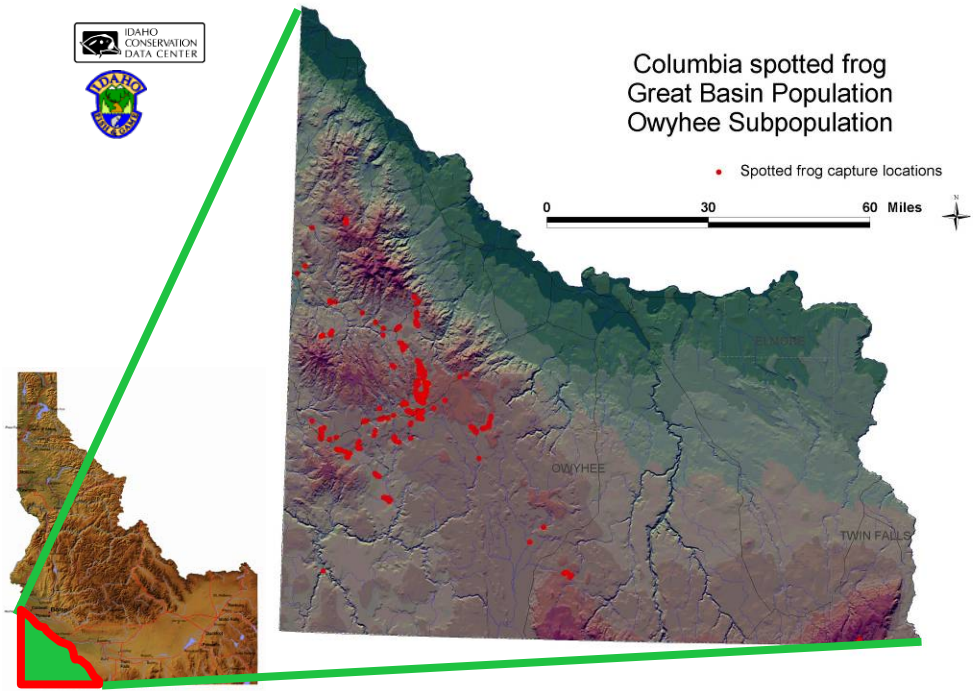

Figure 2. Location of study area.

STUDY AREA

The study area is located in Owyhee County in the southwest corner of Idaho (Fig. 2). The terrain varies from gently rolling uplands to rhyolite plateaus with deep, rugged canyons to mountains of up to 2,400 m in elevation. The habitat is characterized as sagebrush (*Artemisia tridentata*) steppe with scattered juniper (*Juniperus occidentalis*), and occasionally mountain mahogany (*Cercocarpus ledifolius*) and aspen (*Populus tremuloides*). Riparian areas are dominated by willows (*Salix* spp.). Although it is common for the Owyhees to receive over 1.5 m of snow at 1,800 m elevation, there is little or no rain in the summer months, making water a limiting resource for wildlife and other land use practices (Engle 2001b).

Sam Noble Springs is located on lands administered by the IDL. In October 2006, the IDL, IDFG, and USFWS signed a CCAA to protect Columbia spotted frogs at this unique site. (Idaho Department of Lands, Idaho Department of Fish and Game, Idaho Governor's Office of Species Conservation, and U.S. Fish and Wildlife Service 2006). IDFG is lessee of the land for 25 years. Included in the CCAA are 249 ha of IDL land and 10 ponds in a large valley (Fig. 3). These ponds were originally excavated in wet meadows or near spring heads to provide water for cattle. As agreed in the CCAA, IDFG will monitor the population status of frogs at Sam Noble Springs, while IDL will monitor vegetation. In particular, monitoring will provide data for adaptive management of the ponds at Sam Noble Springs.

Six ponds (Ponds 1, 1a, 2, 3, 4, and 10) are within a grazing exclosure; collectively these 6 ponds and the streams and wetlands associated with them constituted 1 of the original sentinel sites. In 2002, a fence was installed around Ponds 1, 1a, and 2; the permanent fence around all 6 ponds was constructed in 2003. Ponds 1, 1a, 2, 3, and 4 are interconnected by an intermittent stream that flows into and through an open meadow/wetland in the southwest corner. The wetland is dominated by rushes and is covered in standing water for much of the field season. The outflow from Pond 10 connects it to the wetland complex to the northeast. Each pond is described in more detail in Moser and Patton (2006).

There are 4 additional ponds outside of the grazing exclosure, 3 of which are currently occupied by spotted frogs. They are located west and southwest of Pond 10 (Figure 3). Ponds 11, 12, and 13 were checked for frogs in 2001, but none were observed (H. Lingo, personal communication); they were not visited again until July 2006 (Moser and Patton 2006). As part of the CCAA agreement, Pond 14 was excavated at a springhead in November 2003 and half of it was fenced in June 2007 to exclude cattle. It was surveyed for frogs for the first time in July 2006. Half of Pond 13 is also fenced.

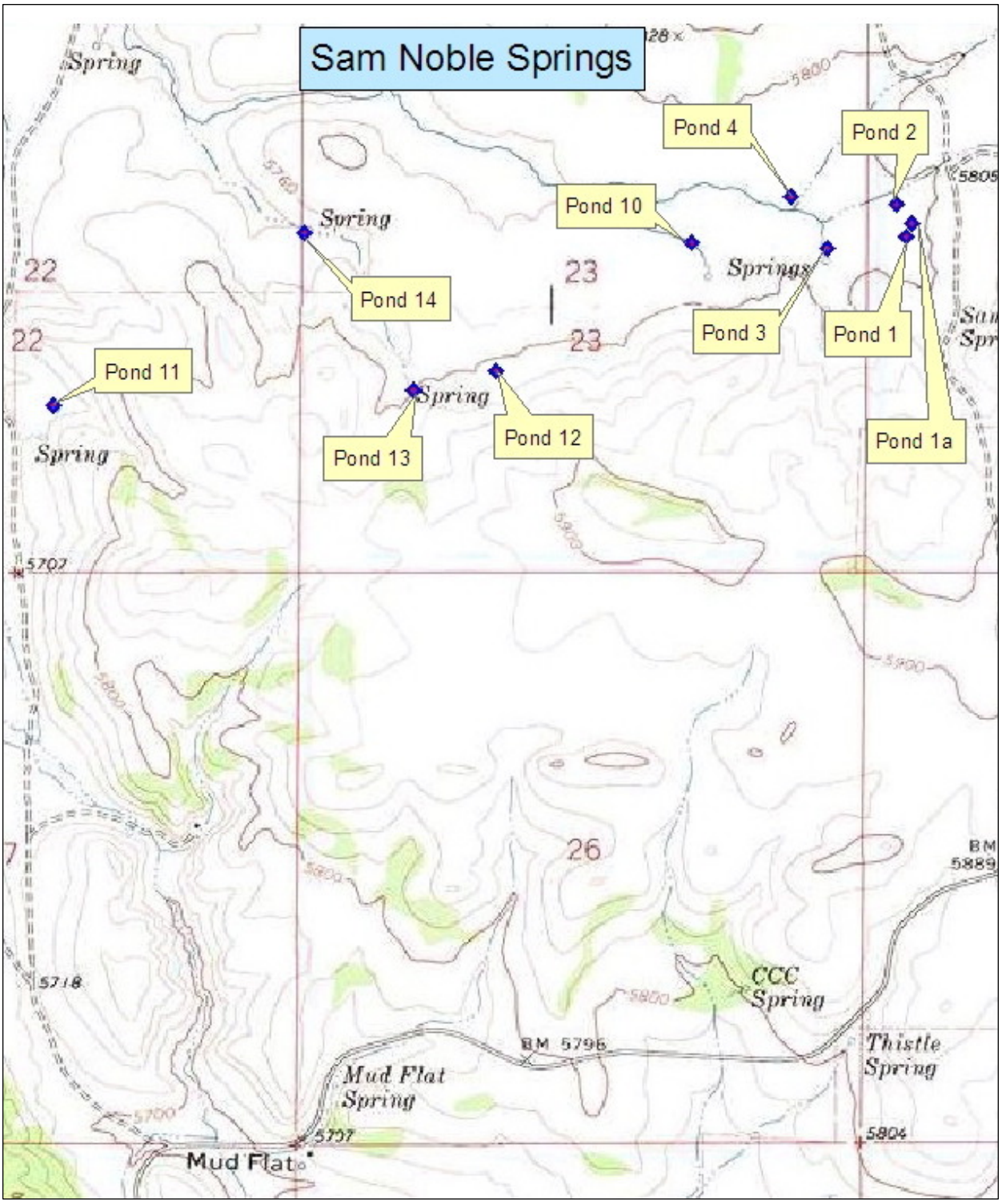

Figure 3. Location of ponds at Sam Noble Springs.

METHODS

Population Estimation at Sam Noble Springs

We used mark-recapture methodology to estimate the population size of spotted frogs at Sam Noble Springs. Previous work at Sam Noble Springs has shown that at least 4 capture events are needed to provide a reliable estimate of population size with sufficiently narrow confidence intervals to allow an interpretation of trend among years (IDFG unpublished data). To decrease bias and increase accuracy, methods used to survey Sam Noble Springs will be consistent within and among years (Moser and OCSFWG 2007). Capture/recapture events will take place once a week for 4 weeks from late May through June (i.e., four capture events). Because spotted frogs are not active on cold and rainy days, capture events did not take place during inclement weather. At each capture event, we attempted to capture and mark all adult frogs at each pond. We captured frogs with dip nets then placed them in a live well. We used drawstring bags to restrain them for weighing. We recorded each frog's mass, snout-vent length (SVL), sex, date, time, and UTM coordinates (NAD 83, zone 11) of the capture location within the site. Each newly captured individual with an SVL >40 mm received a PIT (Passive Integrated Transponder) tag (Reaser 1997). Using sterilized cuticle scissors, we made a small incision on the dorsal surface, approximately 1 cm (depending on SVL) behind the eye, and inserted the tag. To keep the tag from falling out of the incision, the tag was maneuvered to the frog's pelvic bones and the incision sealed with vitamin E oil. Each PIT tag has a unique number, as read with a battery-operated microchip reader. PIT tags persist for the duration of the frog's life and provide a unique code for each individual. We also recorded the number and location of frogs ≤40 mm SVL and any frogs we were unable to capture.

To minimize the potential for disease (specifically Chytridiomycosis fungus) transfer among sites, we cleaned all equipment (particularly live wells, nets, boots, and waders) with a 10% bleach solution after visiting a site. We saw no evidence of Chytridiomycosis during the 2009 field season.

We used an open population model (e.g., Jolly-Seber model in program MARK), which allows births/immigrations and deaths/emigrations. However, because the previous year's metamorphs can grow rapidly within a season, we chose to minimize "births" into the population by limiting the population estimate to frogs at or near sexual maturity. Sexually mature male frogs were ≥50 mm SVL and females were ≥55 mm SVL (Blomquist 2000, Bull 2005, IDFG unpublished data). Again, because frogs can grow several mm within a season, we used the earliest SVL measurements (i.e., closer to the breeding season) to determine whether a frog was a breeding adult.

We examined trends in spotted frog numbers at Sam Noble Springs in relation to total annual precipitation for the water year (1 Oct – 30 Sep). Precipitation was recorded at the nearest weather station at Triangle, Idaho and obtained from the RAWS USA Climate Archive (http://www.raws.dri.edu/).

Egg Mass Surveys at Sentinel Sites

We continued to monitor for successful breeding at the 4 sentinel sites (Stoneman Creek, Cottonwood Creek, Sam Noble Springs, and Circle Pond). We visited each site 2 times from late April to early May. Because ovipositing appeared to be delayed at Cottonwood Creek in 2008 compared with other sites, we conducted a third visit to ensure that all egg masses were counted.

Proportion of Area Occupied

We conducted a PAO pilot study in 2007. Within the range of the Owyhee subpopulation of Columbia spotted frog, IDFG subdivided the landscape into catchment basins (CBs) using GIS. CBs are hydrologic units that may represent an appropriate scale for which to measure occupancy for spotted frogs. CBs ranged in size from 297 to 5,830 ha. In 2007, 27 CBs were surveyed. After analyzing the data, we determined that 50 CBs would provide better estimates of occupancy and detection probability. In 2008, the study area was expanded from a 20-km to a 35-km radius circle centered at the Mud Flat Guard Station. To increase the sample size, we randomly selected an additional 50 CBs to sample. Several were eliminated after reviewing land access issues and habitat suitability. The final model in 2008 included 31 CBs. In 2009, we continued to add new CBs to our study area. Within each CB, we attempted to survey all suitable habitat located on public land. In areas with an abundance of streams, we prioritized by surveying 1-km stretches of the most accessible and best habitat within the CB. However, in many cases, the most suitable habitat was located on private land.

Each CB was visited 1-2 times within the field season. Once occupancy was determined for a CB, that CB was not visited again that season. This removal approach is appropriate for occupancy models (MacKenzie et al. 2006).

Surveys for spotted frogs were essentially visual encounter surveys (i.e., VES; Olson and Leonard 1997). Each surveyor worked independently and thoroughly searched each stream segment and spring/wetland for spotted frogs. Surveyors paid particular attention to pools and oxbows with emergent and riparian vegetation. Surveyors counted and recorded all spotted frogs observed. If the CB was surveyed a second time, different surveyors visited each reach or spring to distribute observer bias. Surveys did not take place during inclement weather.

We used the program PRESENCE (Hines 2006) to estimate occupancy and detection probability. Two single-season models are available: 1) constant detection probability and 2) survey-specific detection probability. We used Akaike's Information Criterion (AIC) to select the appropriate model.

Habitat Improvement at Sam Noble Springs

Under the CCAA, IDFG is responsible for the maintenance and refurbishment of ponds occupied by Columbia spotted frogs at Sam Noble Springs. We have observed that Ponds 1a and 10 are filling in with vegetation, thus reducing the size of the ponds. After discussing pond enhancement at Sam Noble Springs with the OCSFWG, we decided that Pond 1a would not be refurbished, i.e., vegetation removed with heavy equipment, in the near future because frogs could easily disperse to Pond 1. We also decided that we would not refurbish Pond 10 because

we did not want to disturb the existing frog population. Instead, we agreed that the best solution was to excavate a new pond adjacent to Pond 10. Additionally, the fence at Pond 14 was incorrectly installed in 2007 so that the springhead was not protected from cattle. We proposed to move the fence to protect the springhead and also widen the east side of the pond to provide an area with more shallow water for the frogs. As requested by biologists with the USFWS, we first consulted with a BLM hydrologist before conducting our pond enhancement projects. The work was conducted in November 2008 and was accomplished using a small excavator.

RESULTS

Population Estimation at Sam Noble Springs

We conducted 4 mark-recapture surveys at Sam Noble Springs from 4 June to 23 June with a week between each capture event. Previously, researchers reported results as total captures by pond in late spring, usually late May and early June. These data included any frog that was able to be PIT-tagged (>40 mm SVL). However, there was much variation in what researchers actually reported, thus numbers may not be comparable among years. We present these results as a historical comparison among the 6 sentinel ponds (Table 1). We also conducted mark-recapture surveys at ponds 12, 13, and 14 (Table 2). Pond 11 was visited twice in 2009, but no frogs were found.

Table 1. Total captures of Columbia spotted frogs in late spring at the 6 sentinel ponds at Sam Noble Springs, 1998-present.

	Late Spring Total Frog Captures						
Year	Pond 1	Pond 1a	Pond 2	Pond 3	Pond 4	Pond 10	Total
1998	32	40	16	33	15	8	144
1999	17	35	8	17	28	8	113
2000	17	25	13	20	8	11	94
2001	25	20	14	13	12	14	98
2002	20	9	10	14	15	12	80
2003	24	9	8	6	3	15	65
2004[a]	15	8	15	11	6	14	69
2005[a]	19	4	11	20	13	12	79
2006	25	4	7	15	7	9	67
2007	49	22	14	2	5	16	108
2008	40	16	21	4	3	13	97
2009	56	14	10	4	10	14	108

[a] Frog captures in 2004 and 2005 were for the entire season and may not be comparable to numbers from other years.

Table 2. Total captures of Columbia spotted frogs in late spring at 3 ponds located outside of the grazing exclosure at Sam Noble Springs, 2006-present.

Year	Pond 12	Pond 13	Pond 14
2006	2	8	24
2007	0	6	38
2008	0[a]	4[a]	29
2009	0	12	47

[a] During an incidental visit on 6 August 2008, one adult frog was observed at Pond 12, and 11 adult frogs were observed at Pond 13.

We used an open population model in program MARK to estimate the population size of adult frogs at the 6 sentinel ponds in 2009 (Table 3). Specifically, we used the POPAN formulation, which is a variation of the Jolly-Seber model (Cooch and White 2006). We were unable to produce a population estimate at Ponds 13 and 14, which may be due to the smaller sample size at these ponds.

We examined trends in frog abundance at Sam Noble Springs in relation to total annual precipitation for the water year. For this exercise, we used the population estimation when available and number of frogs with a capture record when not available. To better capture trends, we graphed total precipitation and frog numbers 1 year later (Fig. 4).

Table 3. Annual population size estimates for adult Columbia spotted frogs at the 6 sentinel site ponds at Sam Noble Springs. Adult frogs were males ≥50 mm SVL and females ≥55 mm SVL.

Year[a]	Number of Frogs with Capture Record	Population Size Estimate	95% Confidence Interval
2000	136	137	132-143
2001	103		
2002	68		
2003	64	66	57-78
2004	56		
2005	82	83	78-89
2006	85	91	85-98
2007	90	100	90-110
2008	73	80	66-93
2009	99	105	98-112

[a] Information on capture events for 2000-2007 are reported in Moser (2007).

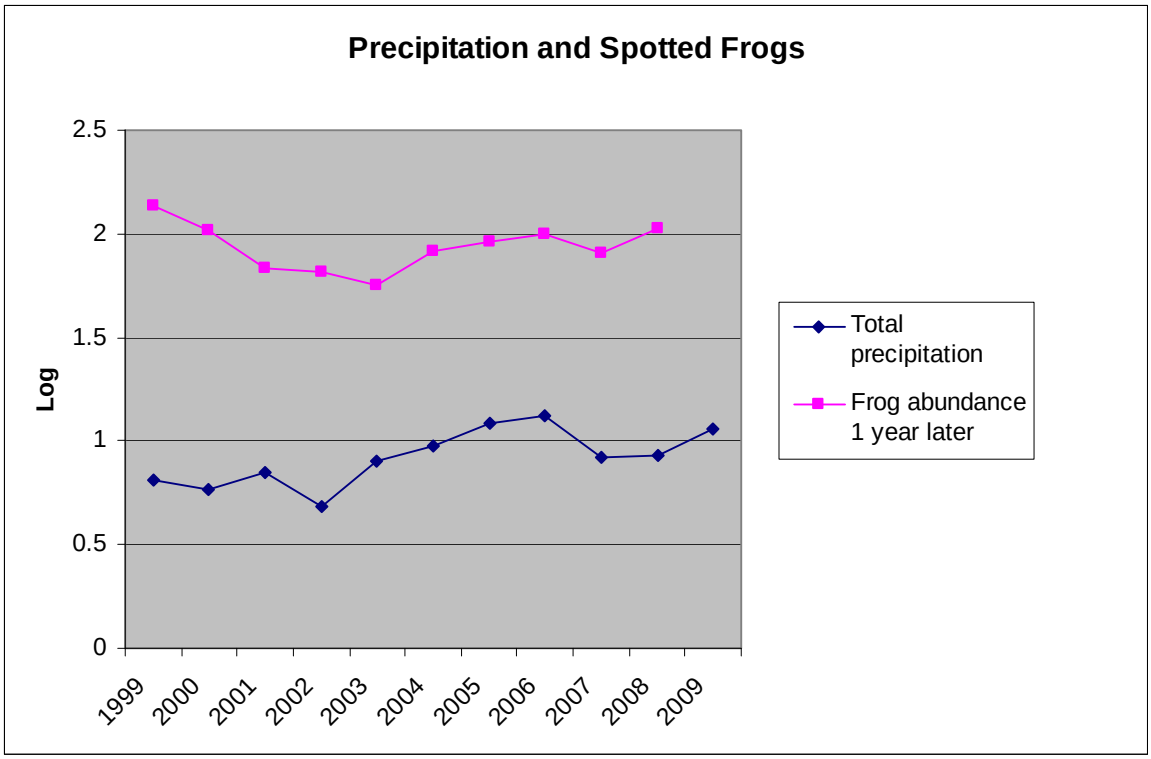

Figure 4. Total annual precipitation for the water year (1 Oct – 30 Sep) and abundance of Columbia spotted frogs at Sam Noble Springs 1 year later.

Egg Mass Surveys at Sentinel Sites

We continued to monitor for successful breeding at 4 sentinel sites (Stoneman Creek, Cottonwood Creek, Sam Noble Springs, and Circle Pond). We conducted our first egg mass survey on 21 April at Sam Noble Springs, which included Ponds 1, 1a, 2, 3, 4, and 10, and continued with egg mass surveys at the remaining sites the following day. A second round of surveys was conducted at Cottonwood Creek, Circle Pond, and Stoneman Creek on 30 April and at Sam Noble Springs on 7 May. Because ovipositing at Cottonwood Creek occurred later compared with other sentinel sites in 2008, a third visit was conducted on 7 May. By the second visit, however, most egg masses were accounted for at Cottonwood Creek (visit 1 and 2 = 23 egg masses, visit 3 = 25 egg masses). The number of egg masses was mostly consistent between the first and second visit, except for Stoneman Creek where the number increased from 28 to 79 egg masses. Total egg masses recorded at ponds from 2000-2009 can be found in Tables 4 and 5.

On 22 April and 7 May, we looked for egg masses at Ponds 12, 13, and 14. We did not find any egg masses during the first survey, but found 2 egg masses at Pond 13 and 22 egg masses at Pond 14 on the second visit (Table 6).

Table 4. Total number of egg masses observed at 3 sentinel sites, 2000-present.

	Egg Masses		
Year	Stoneman Creek	Cottonwood Creek	Circle Pond
2000	0	No survey	8
2001	0	No survey	Present
2002	1	8	2
2003	10	4	3
2004	29	8	0
2005	51	12	0
2006	120	11	1
2007	Present[a]	33	3
2008	93	6	3
2009	79	25	9

[a] 18 egg masses counted on road side of site, from beaver pond downstream.

Table 5. Total number of egg masses observed at each pond at Sam Noble Springs, 2000-present.

	Egg Masses						
Year	Pond 1	Pond 1a	Pond 2	Pond 3	Pond 4	Pond 10	Total
2000	12	12	7	5	1	8	45
2001	15	4	2	8	6	12	47
2002	12	0	5	0	8	9	34
2003	11	1	4	4	2	9	31
2004	8	0	0	2	0	3	13
2005	6	0	2	3	3	4	18
2006	10	1	1	5	4	4	25
2007	14	1	2	9	9	4	39
2008	26	7	3	8	5	8	57
2009	17	2	3	3	5	7	37

Table 6. Total number of egg masses observed at 3 ponds outside the exclosure at Sam Noble Springs, 2007-present.

Year	Pond 12	Pond 13	Pond 14	Total
2007	0	0	0	0
2008	0	0	11	11
2009	0	2	22	24

Proportion of Area Occupied

We visited 53 CBs in 2009 and utilized occupancy modeling to estimate PAO of Columbia spotted frogs. The PRESENCE methodology is based on a 2-visit protocol unless frogs are found on the first visit. Of the 53 sites visited, we dropped 6 CBs after the first visit due to unsuitable habitat (693, 829, 1174, 1328, 1457, 1708). Additionally, we dropped 3 CBs that were visited in 2008 (480, 657, 684) because we could not get permission to cross private land to access the sites. Therefore, the final model contained 47 CBs (Fig. 5). AIC model selection indicated that the model with constant detection probability best fit the data (AIC weight = 0.73). PAO was estimated as 0.6095 (SE = ± 0.0721) and detection probability was 0.9630 (SE = ± 0.0377). Therefore, spotted frogs occupied about 61% (90% CI = 47-75) of the study area with a 96% probability of detecting frogs within 2 visits.

Of the 47 CBs surveyed twice, 31 (66%) had historical occurrences of spotted frogs, although some of these occurrences occurred on private land, which we currently do not survey. Of those with historical occurrences, 28 (90%) were occupied by spotted frogs in 2009.

Habitat Improvement at Sam Noble Springs

In November 2008, we constructed a new pond and enlarged an existing pond at Sam Noble Springs. We excavated a small pond (6 x 3 m) less than 0.5 m from Pond 10 (Fig. 6). We dug a small channel to connect both ponds in June 2009 to provide a water source for the new pond and make it easier for frogs to move between the old and new pond. Adult frogs began using the new pond shortly after the pond filled with water. Subsequent checks of the pond, however, revealed that the new pond was not holding water adequately. In August, we added peat moss and sodium bentonite to help seal the bottom of the pond. We will continue to monitor water levels in the new pond next year and take measures to maintain the water level as necessary.

The fence at Pond 14 was adjusted so that the springhead was protected from cattle. Work began in November 2008 and was completed in June 2009. The shallow area that was excavated in 2008 is also located within the fenced area. In 2009, all 22 egg masses were located in the newly excavated area of Pond 14.

Areas of exposed soil resulting from the pond enhancement projects were seeded in November 2008 with a native seed mix consisting of Idaho fescue, yarrow, and blue flax. We had poor germination results with the Idaho fescue, moderate with the blue flax, but the yarrow seeded in very well. However, many of the plants that formerly occupied the excavation areas either survived or grew from a seed source within the soil. We will continue to monitor vegetation within the project area and reseed with native plants if needed.

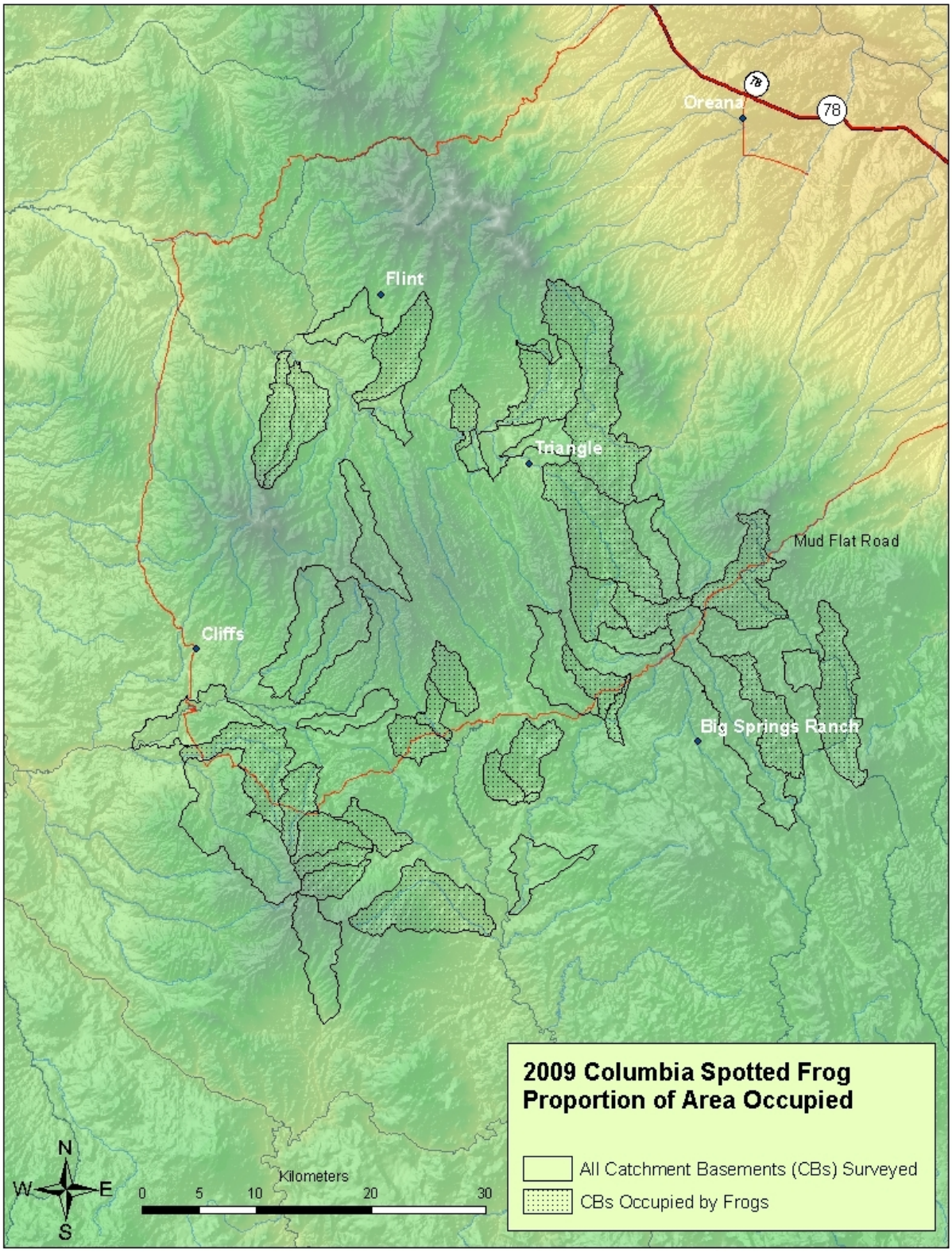

Figure 5. Study area and results for Proportion of Area Occupied, 2009.

Figure 6. Pond 10 enhancement project with existing pond on right-hand side of photo.

DISCUSSION

Sam Noble Springs

Total frog numbers at Sam Noble Springs continued to be relatively high for the third year in a row (Tables 5 and 6). Not surprisingly, it appears that frog numbers were correlated with annual precipitation (Fig. 4). We continued to see an increase in both adult frogs and number of egg masses at Pond 14. In fact, Pond 14 had the second highest number of frog captures and the most egg masses of any other pond at Sam Noble Springs. Although we cannot attribute the higher numbers at Pond 14 to our pond enhancement project, it is obvious that the frogs were not negatively affected by the construction work conducted the previous fall. This is encouraging since we would like to continue to maintain, improve, or develop frog habitat in the area.

Proportion of Area Occupied

We attempted to meet the recommendations of Moser (2007) by increasing the number of CBs surveyed in 2009 to 50. Although we surveyed 53 CBs, only 47 met model criteria. Thus, we were able to increase the number of CBs included in the model from 31 in 2008 to 47 in 2009.

We were able to survey a greater number of CBs in 2009 because we began our surveys in May. Therefore, it may be difficult to reach a target of 50 CBs in some years because weather conditions may preclude surveying until later in the season. We continued to have difficulties with access because of lack of roads and private land that created barriers to public land. In a few cases, private landowners gave us permission to either hike across their land or drive on roads through their property. Most of the time, however, getting permission was a tedious process because most landowners wanted to be contacted each time we planned to survey an area and wanted to know what day we would be working in that area. This became difficult due to lack of cell phone coverage and, in many cases, the ranchers were moving cattle and could not be reached. So although we were successful in adding new CBs because of private landowner cooperation, it may not be feasible to continue surveying these CBs in the future.

RECOMMENDATIONS

1. Continue estimating populations at Sam Noble Springs using the methods outlined in the new monitoring protocol (Moser and OCSFWG 2007).
2. Conduct a more thorough analysis of data collected from Sam Noble Springs for the 2010 final report, i.e., population estimates, sex ratios, and dispersal of PIT-tagged frogs within the wetland complex.
3. Conduct at least 2 egg mass surveys at each sentinel site.
4. Continue PAO study and attempt to increase the number of CBs to 50 if feasible.
5. Utilize multi-season models in PRESENCE as additional years of PAO surveys are completed.
6. Consider adding covariates to the PAO model (landscape-level habitat variables, observer bias, annual weather characteristics, and survey-specific weather) to improve understanding of what influences Columbia spotted frog occupancy patterns and detection probability.
7. Re-evaluate objectives and goals of the project at the end of 2010.

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