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STATUS, DISTRIBUTION AND MICROHABITATS OF BLANCHARD'S CRICKET FROG *ACRIS BLANCHARDI* IN SOUTH DAKOTA

SETH L. BURDICK AND DAVID L. SWANSON[1]

Department of Biology, University of South Dakota, 414 East Clark Street, Vermillion, South Dakota 57069, USA
[1]Corresponding Author: david.swanson@usd.edu

***Abstract.*—Blanchard's Cricket Frog (*Acris blanchardi*) reaches the northwestern extent of its distribution in South Dakota. Historically these frogs ranged throughout much of southeastern South Dakota, but recent reports suggest that the species is a very rare resident within the state. We used standardized breeding-season auditory surveys coupled with visual encounter and mark-recapture surveys to assess the status and distribution of Blanchard's Cricket Frog in South Dakota. For sites with sufficient frogs, we also measured microhabitats to delineate microhabitat features of potential importance to cricket frogs. We found Blanchard's Cricket Frogs at scattered locations in southeastern South Dakota along the drainages of the Missouri, Big Sioux, and James rivers and Emanuel Creek. We detected no frogs along the Vermillion River drainage or in western portions of the historic range in South Dakota, suggesting that Blanchard's Cricket Frogs no longer occupy these sites, although more intensive surveys will be required to fully document their extirpation from these areas. Summer frog abundances were low, except at Springfield Bottoms, Bon Homme County, where we estimated population size along a 100-meter stretch of shoreline at 29 to 140 individuals. Microhabitats occupied by frogs were close to water (average distance to water 13–44 cm) and exhibited significantly less variable temperatures than random points, although mean temperature did not differ between occupied and random points. Substrates occupied by frogs included mud, vegetation, and mud-vegetation and water-vegetation borders, but distribution of frogs among substrates did not differ significantly from random. In summary, Blanchard's Cricket Frogs are seasonally common in southeastern South Dakota, but apparently occupy only portions of their former range within the state, and occur on mud or vegetation substrates close to stream or pond edges.**

Key Words.—*Acris crepitans*; *Acris blanchardi;* Blanchard's Cricket Frog; distribution; microhabitats; South Dakota

INTRODUCTION

Blanchard's Cricket Frog (*Acris blanchardi*) is a small Hylid frog that inhabits the margins of sluggish streams and shallow lakes and ponds with emergent or shoreline vegetation (Conant and Collins 1998; Ballinger et al. 2000; Smith et al. 2003). It ranges from central Nebraska, western Kansas and Oklahoma, and central Texas east to central Ohio and eastern Kentucky (Conant and Collins 1998; Nanjappa and Leininger 2000). Blanchard's Cricket Frog was formerly considered a subspecies of the Northern Cricket Frog, *A. crepitans*, but recent molecular genetic data suggest that *blanchardi* is sufficiently distinct from other cricket frog populations to warrant full species status (Gamble et al. 2008). Widespread population declines have been documented for the Northern Cricket Frog, particularly in the northern most portion of its range (Lannoo 1998; Gray and Brown 2005; Gray et al. 2005; Lehtinen and Skinner 2006), which is the region occupied by Blanchard's Cricket Frog (Gamble et al. 2008). Thus, Blanchard's Cricket Frog is a species of national conservation concern. Adult Blanchard's Cricket Frogs in South Dakota appear to survive only one or two breeding seasons, with highest frog abundance occurring in October or November due to surviving adults joining newly metamorphosed frogs in congregations along overwintering sites (McCallum and Trauth 2004). Low abundance occurs in spring due to winter mortality (McCallum and Trauth 2004).

The historical range of Blanchard's Cricket Frog in South Dakota occurred in southeastern and south-central portions of the state, with populations documented in Union, Clay, Yankton, Turner, Lincoln, Hutchinson, Bon Homme, Minnehaha, McCook, Hanson, Davison, Charles Mix, Gregory, and Tripp counties (Fishbeck and Underhill 1959, 1960; Dunlap 1967; Ballinger et al. 2000). Kiesow (2006) defined the western boundary of the Blanchard's Cricket Frog range in South Dakota as including Chouteau Creek and Lake Andes in Charles Mix County. South Dakota populations are considered the northwestern limit to Blanchard's Cricket Frog range, though Michigan populations occur at slightly higher latitudes (Harding 1997; Fischer et al. 1999; Hammerson and Livo 1999). Blanchard's Cricket Frogs were recently thought to be extremely rare or possibly extirpated within South Dakota by Fischer et al. (1999). More recent surveys, however, found frogs within portions of their historic range in South Dakota (Kiesow 2006). Given these conflicting reports and population declines in neighboring states, we undertook systematic surveys for Blanchard's Cricket Frogs throughout their historic range in South Dakota.

TABLE 1. Mean (±SE) distance to water and vegetation (cm) and substrate temperature (°C) at sites occupied by Blanchard's Cricket Frogs at Bolton Game Production Area (GPA, n = 6) and Springfield Bottoms (n = 56) study sites. Also included are proportions (%) of frogs occupying the various sunlight exposure and substrate microhabitats as well as the proportions of these microhabitats available at the Springfield Bottoms study site (Random column), where we found sufficient numbers of frogs for statistical comparisons. Sample sizes for each group are given in parentheses. We conducted temperature and microhabitat comparisons between random (n = 14) and occupied (n = 22) points at the Springfield study site only on the first day of the mark-recapture experiments to avoid any potential statistical problems associated with pseudoreplication.

	Bolton GPA	Springfield	Random
Distance to Water	43.5 ± 9.9 (6)	13.1 ± 4.0 (56)	---
Distance to Vegetation	6.5 ± 4.3 (6)	4.3 ± 1.0 (56)	---
Substrate Temperature			
Frog locations	28.3 ± 0.6 (6)	29.4 ± 0.3 (22)	---
Random points	27.4 ± 0.5 (16)	29.3 ± 0.8 (14)	---
Substrate Proportions			
Mud-Vegetation	50.0	32.4	35.7
Mud	50.0	29.4	7.1
Vegetation	----	23.5	28.6
Vegetation-Water	----	14.7	7.1
Water	----	0.0	14.3
Mud-Water	----	0.0	7.1
Sunlight Proportions			
Full Sun	50.0	57.1	42.9
Partial Shade	----	37.5	50.0
Full Shade	50.0	5.4	7.1

Cricket frog habitats include the muddy or rocky margins of stream or pond banks, usually close to water and shelter items, such as rocks, and away from vegetation (Burkett 1984; Smith et al. 2003). For example, Blanchard's Cricket Frogs along Rush Creek, Missouri, preferred mud and mud/rock substrates along the stream bank within 50 cm from water, but over one meter from the nearest vegetation (Smith et al. 2003). Blanchard's Cricket Frogs in Missouri also preferred shaded to partially shaded habitats, but did not avoid sun exposure (Smith et al. 2003). Cricket frogs occupy such microhabitats in both forested and grassland landscapes (Burkett 1984).

The purpose of this study was to survey Blanchard's Cricket Frog presence and abundance within the species' historic South Dakota range and to document microhabitat characteristics of points occupied by frogs for comparison with random points to elucidate microhabitat features potentially important to frogs.

MATERIAL AND METHODS

***Auditory surveys*.**—We used the DeLorme South Dakota Atlas & Gazetteer (DeLorme 1997) to identify potential wetland sites for nocturnal auditory surveys within the historical range of the Blanchard's Cricket Frog in South Dakota (Fig. 1). We chose suitable creeks and wetlands (i.e., lakes, ponds, marshes) within the historic range in South Dakota, based on published habitat preferences of aquatic-terrestrial edges with low emergent vegetation, dominated by rock, mud/rock, or mud substrates (Johnson and Christiansen 1976; Burkett 1984; Smith et al. 2003). We conducted auditory surveys (at least two observers per survey) from access points along roads and public lands, but we walked up to 100 m from the access points to survey areas of the site away from access points if frogs were not detected immediately. We conducted surveys between 2000 and 0100 (the most active period of calling; Bridges and Dorcas 2000) during the breeding seasons of 2005 and 2006. We were primarily interested in surveying aquatic/terrestrial edges and muddy margins along the Big Sioux, Missouri, Vermillion, James, and Keya Paha rivers, and Brule, Chouteau, Ponca, Emanuel, and Spring creeks, as well as wetlands associated with these drainages. We surveyed 125 sites over the two-year study period. Because our goal for auditory surveys was to cover the entire historical range of Blanchard's Cricket Frog in South Dakota, we surveyed a broad area but with generally only one visit per site each year. The limited number of survey visits prevented us from calculating detection or site occupancy probabilities (Mackenzie et al. 2002, 2003) in this study. We initiated surveys in early May, but detected calling frogs from 20 May through 10 July in 2005, and from 24 May through 24 July in 2006. We listened for a 10-min sampling period at each site, and conservatively counted and recorded the number of calling male frogs present. We used a relatively long (10-min) sampling period to help increase detection probabilities (e.g., Pierce and Gutzwiller 2004) because sites were typically

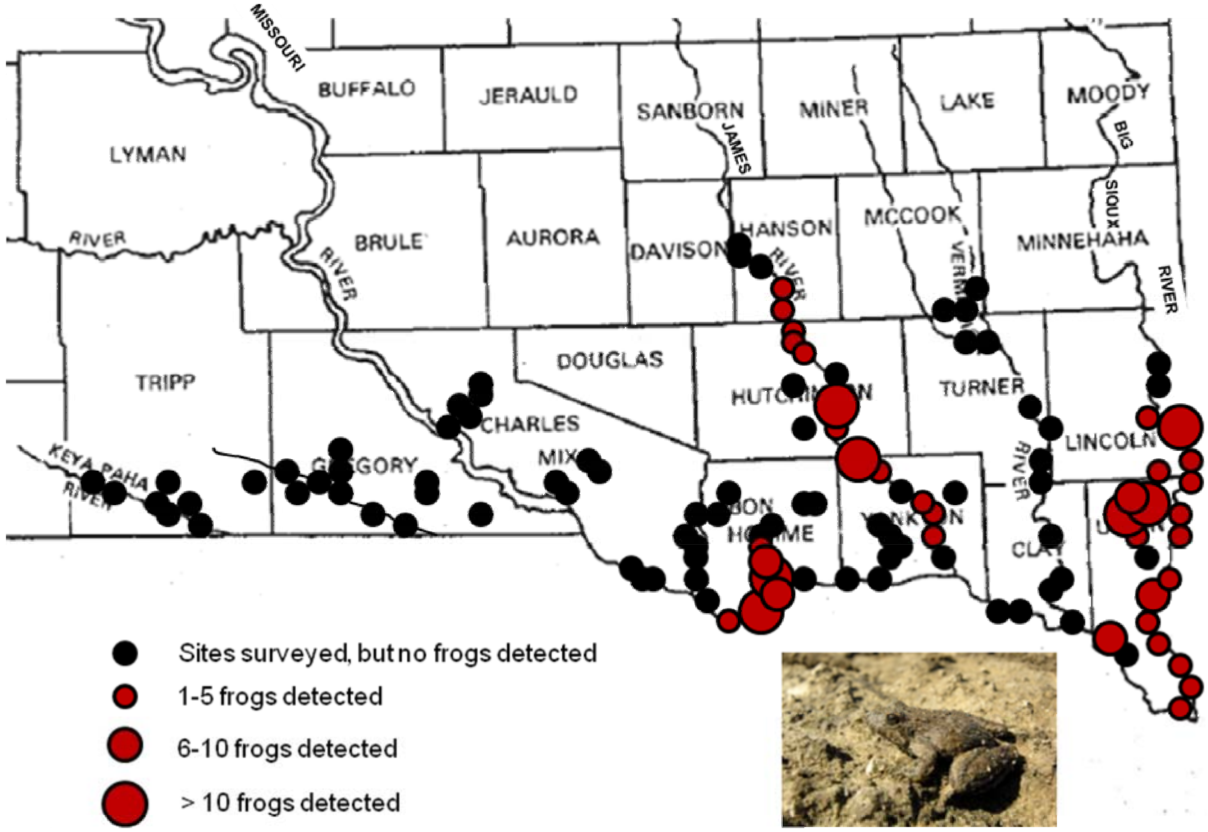

FIGURE 1. Range map of Blanchard's Cricket Frog presence or absence in southeastern South Dakota for the breeding seasons of 2005 and 2006. Number of frogs detected represents the maximum number detected at the site among the surveys. (Photograph by Aaron Gregor)

visited only once per year. We suspended auditory surveys during adverse weather (i.e., cold temperatures or high winds), as these conditions negatively influence frog calling behavior and detection probabilities (Heyer et al. 1994). We considered the maximum number of calling frogs detected at a particular site as the number from that site.

Visual encounter surveys.—We conducted visual encounter surveys (VES) to determine relative abundance after the breeding season (mid-July through early September) at several sites where we encountered frogs in numbers during auditory surveys or at sites where frogs congregated prior to fall hibernation. We focused VES transects (100-150 m in length) along bank margins at sites bordering the Missouri, Big Sioux, and James rivers. We conducted VES by walking slowly (at least two observers) along bank margins in the early evening (1830 to 2100 hours) during 2005, and late morning-early afternoon (1000 to 1400 hours) during 2006.

When we detected frogs during VES, we marked their location with a flag and subsequently measured microhabitat features at the point where the frog was located according to Smith et al. (2003). Measured features included distance to water, distance to vegetation, type of substrate occupied (mud, vegetation, water, water/mud border, water/vegetation border, vegetation/mud border), substrate temperature, and a simple index of sun exposure on the patch (full sun, partial shade, full shade). We also used the method of Smith et al. (2003) for random microhabitat sampling at VES study areas where frogs were located so that we could compare microhabitat features of points occupied by frogs with those at random points. For random sampling of microhabitats, we dropped a meter stick every 10 paces along VES transects, and measured sun index, substrate temperature, and type of microhabitat at locations at the two ends of the meter stick. We measured occupied and random microhabitat variables simultaneously so that results were comparable. We used Student's t-test or Mann-Whitney U-test (if sample variances were unequal) to compare substrate temperatures between random and occupied points and Fisher Exact test to compare the frequency of occurrence for sun-index categories and substrates between random and occupied points. To ensure accurate comparison of temperatures and microhabitat features, we only performed statistical analyses when we had sufficient number of random and occupied points from the same site and time. We performed all statistical analyses with SigmaStat Version 3.5 (Systat Software, San Jose, CA) and parametric tests were only used when data were normally distributed. We accepted statistical significance at $P \leq 0.05$.

***Mark-recapture surveys*.**—We only found frogs in sufficient density for mark-recapture surveys at a single site, Springfield Bottoms, Bon Homme County, during summer 2006. This site consisted of a muddy bank margin along the upper reaches of Lewis & Clark Lake. We set up a 100-m mark-recapture transect at the Springfield Bottoms site along a section of the muddy bank and captured all frogs encountered along this transect. We injected captured frogs in the footpad with a biologically inert, fluorescent-colored visible injectable elastomer (Northwest Marine Technology, Shane Island, WA) for identification. We marked frogs in the left rear foot the first day of marking, and the right rear foot in a different color on the second day of marking to avoid confusion. We used both Peterson and triple-catch methods for determining population size (Heyer et al. 1994) and made three visits to the site; 15 July (1215 to 1315), 18 July (0908 to 1008), and 24 July (1028 to 1128) during 2006. Two or three observers walked the 100-m transect slowly to capture frogs for a standard amount of 1-h for each visit. Frogs captured on the second and third visits were classified as new captures or recaptures, and third-visit recaptures were classified as marked on the first visit only, marked on second visit only, or marked on both visits.

RESULTS

***Auditory surveys*.**—We detected calling Blanchard's Cricket Frogs in Bon Homme, Clay, and Union counties along the Missouri River; in Union and Lincoln counties along the Big Sioux River and its tributary Brule Creek; in Hutchinson, Yankton, and southern Hanson counties along the James River; and along Emanuel Creek in Bon Homme county, but only for the first approximately 11 km from its confluence with the Missouri River (Fig. 1). We detected no Blanchard's Cricket Frogs along the Vermillion River in Turner, Clay, and McCook counties; along Chouteau, Spring, or Platte creeks in Charles Mix County; along the Keya Paha River in Tripp County; or along the Ponca Creek drainage in Gregory County (Fig. 1). The western sites in Charles Mix, Gregory, and Tripp counties were first surveyed rather late in the breeding season (10–12 July) in 2005, so we intentionally surveyed western sites in Charles Mix, Gregory, and Tripp counties during mid-June in 2006, which is during the peak of the breeding season. We did not observe calling frogs at these sites during either year. Sites where calling frogs were particularly abundant on auditory surveys included the James River in southern Hutchinson County, the Big Sioux River in southern Lincoln County, several small ponds along East Brule Creek in northern Union County, and Springfield Bottoms and Emanuel Creek in southern Bon Homme County (Fig. 1).

***Visual encounter surveys*.**—We experienced poor success in locating frogs during VES for both years of the study, as frogs proved difficult to locate when not calling. High vegetation density, the cryptic nature of the frogs, and summer being a low point in annual abundance conspired to make locating frogs difficult (McCallum and Trauth 2004). For example, we did not detect any frogs during VES at James River or East Brule Creek pond sites, where we heard frogs in good numbers during auditory surveys, suggesting movement of frogs to new sites or into nearby vegetation that obscured visual detection. We located sufficient frogs for statistical comparisons during VES at only two sites, Springfield Bottoms, Bon Homme County (42° 50' N, 97° 55' W), and Bolton Game Production Area (GPA), Union County (42° 42' N, 96° 48' W). We observed frogs at Springfield Bottoms along the margin of a pasture, where the pasture gave way to a wide muddy flat bordering a shallow, warm side-channel area of Lewis and Clark Lake on the Missouri River. We found frogs at Bolton GPA along the edges of a pond adjacent to the Missouri River that had become isolated from the river by low water levels. This site consisted of a cattail (*Typha* sp.) marsh to the northern end, which led down to a wide muddy bank (along which the frogs occurred) with some emergent vegetation. We sampled the Springfield Bottoms site by VES from 1100 to 1400 CDT during mid July, 2006, and the Bolton GPA site on 12 July 2005 from 1930 to 2100 CDT.

The frogs' mean (± SE) distance from water was 13.1 ± 4.0 cm ($n = 56$) at Springfield Bottoms and 43.5 ± 9.9 cm ($n = 6$) at Bolton GPA. Frogs at Bolton GPA occurred significantly farther from water than those at Springfield Bottoms ($U = 35.5$, df = 60, $P < 0.001$). Frogs at the two sites did not differ significantly in mean distance to vegetation; the mean distance of frogs from vegetation was 4.3 ± 1.0 cm at Springfield Bottoms and 6.5 ± 4.3 cm at Bolton GPA. There was no significant difference in substrate temperature between random and occupied points at either Springfield Bottoms or Bolton GPA, though temperatures were significantly more variable (Equal Variance Test, df = 34, $P = 0.03$) at random points compared to occupied points at Springfield Bottoms (Table 1). We achieved necessary sample sizes for statistical comparison of other microhabitat characteristics between occupied and random points only at the Springfield Bottoms site, and so sunlight index and microhabitat comparisons were limited to this site. Occupation of substrates by frogs did not differ significantly from random, although frogs tended to occur less in water substrate than its availability (Table 1; df = 1, $P = 0.081$). There was no significant difference in sun exposure among random and occupied points, suggesting that Blanchard's Cricket Frogs do not select microhabitat based on sunlight exposure (Table 1).

***Mark-recapture surveys*.**—For 2006 mark-recapture surveys along the 100-m transect at Springfield Bottoms, Bon Homme County, we captured and marked totals of 22 frogs on 15 July, 12 frogs on 18 July (three were recaptures from Day 1), and 29 frogs on 24 July (four were Day 1 recaptures, seven were Day 2 recaptures, and one was recaptured from both Day 1 and 2). Population estimates for the Springfield Bottoms study site ranged from 29–140 individuals for the triple-catch method and from 40–110 individuals for the Peterson method depending on specific dates included in calculations of population estimates.

DISCUSSION

Blanchard's Cricket Frog is clearly not extirpated from, nor extremely rare within, it's southeastern South Dakota range as previously suggested by Fischer et al. (1999). Blanchard's Cricket Frogs were concentrated in localized populations along the Big Sioux, Missouri, and James rivers and Emanuel and Brule creeks in varying abundance. The species does, however, appear to have a more restricted range in southeastern South Dakota than historically reported (Ballinger et al. 2000), with this study finding no evidence of frogs present in the western portion of the historic range in South Dakota, including the Keya Paha River in Tripp County and Ponca Creek in Gregory County. Because our auditory survey methodology did not provide sufficient site visits to effectively calculate detection probabilities (e.g., Mackenzie et al. 2002, 2003), we acknowledge that inferences regarding the distribution of Blanchard's Cricket Frog from our survey data are somewhat limited by the possibility of false negatives (i.e., frogs not detected when they were actually present). However, we used relatively long (10-min) survey periods, suspended surveys during periods of cold weather or windy conditions, and conducted surveys during dates and time periods of maximum calling activity, all of which should enhance detection probabilities (Heyer et al. 1994). Moreover, cricket frogs generally call continuously and demonstrate relatively high detection probabilities on auditory surveys (Pierce and Gutzwiller 2004; Gooch et al. 2006). Pierce and Gutzwiller (2004) documented a detection efficiency for Northern Cricket Frogs in central Texas of 0.82 for 10-min survey periods. Gooch et al. (2006) found that Northern Cricket Frog detectability in western North Carolina was 0.80, although it varied from 0.66 early in the breeding season to 0.90 during the height of the breeding season in mid-July. Using the equations provided by Pellet and Schmidt (2005), if we assume a detectability of 0.8 for Blanchard's Cricket Frogs in our study, then a 95% chance of detecting cricket frogs at a single site would require 1.9 visits, and two visits to a site would result in a 96% chance of detecting calling frogs. If we assume a detectability of 0.66, the lowest detection probability for early in the breeding season from Gooch et al. (2006), then 2.8 visits would be required for a 95% chance of detecting frogs at a single site and two visits to a site would result in an 88% probability of detecting frogs. Because we surveyed sites where we did not detect frogs during the first year again in the second year, and we surveyed 9 sites in the Keya Paha River drainage, 11 sites in the Ponca Creek drainage, and 13 sites in the Vermillion River drainage, we believe that our survey protocol provided a high probability of detecting frogs in these areas. Thus, it seems unlikely that breeding populations still exist in these drainages. We also found no evidence of Blanchard's Cricket Frogs along Spring and Chouteau creeks in Charles Mix County. Kiesow (2006) included Spring and Chouteau creeks as the western extent of the Blanchard's Cricket Frog range in South Dakota.

Thus, our data suggest that Blanchard's Cricket Frogs are now absent from western portions of their historic range in South Dakota. Reasons for this apparent retraction from the western portion of the range in South Dakota, as well as from other western and northern portions of the overall range, are not known and will require further study (Lehtinen and Skinner 2006). Introduced American Bullfrogs (*Lithobates catesbeianus*) have been implicated as possible determinants of cricket frog range contractions (Hammerson and Livo 1999), and Kiesow (2006) suggested that American Bullfrogs may have been involved in the extirpation of Blanchard's Cricket Frogs from the Keya Paha River in South Dakota because American Bullfrogs are now common there. However, American Bullfrogs are sympatric with Blanchard's Cricket Frogs throughout their range in southeastern South Dakota and multiple individuals were present at Springfield Bottoms, the site with highest summer abundance in this study, so it seems unlikely that American Bullfrogs are solely responsible for any contraction of the range of Blanchard's Cricket Frogs in South Dakota. Perhaps more puzzling is the apparent absence of Blanchard's Cricket Frogs from the Vermillion River drainage, where frogs formerly occurred in good numbers (Ballinger et al. 2000) and where frogs currently occur in drainages to both the east and the west. McCallum and Trauth (2004), in their study of museum specimens, noted that eight of nine specimens in their sample of Blanchard's Cricket Frogs from the Vermillion River, collected in 1958, had physical abnormalities of unknown origin, which was a much higher incidence of abnormalities than in frogs collected from other regions of the state. Perhaps the factors producing high levels of abnormalities in Vermillion River frogs in the 1950s contributed to their population decline and eventual extirpation from this drainage, although further study will be required to elucidate any causative factors. Of potential interest in this regard, Russell et al. (2002) documented the presence of organic environmental pollutants in tissues of Blanchard's Cricket Frogs from Ohio and suggested that such contaminants might be one factor involved in population declines in the northern portion of their range.

Cricket frogs apparently prefer a habitat characterized by slow-moving or still waters (Burkett 1984). The presence of a well-saturated bank of mud or mud/rock with low or absent emergent vegetation also seems to be a common factor of cricket frog habitats (Burkett 1984; Smith et al. 2003). Frogs typically occupy the region of bank near the water. Data in our study are consistent with this latter pattern, as frogs in our study occurred at average distances from water of less than 45 cm (Table 1). This is comparable to the 49.8 cm average recorded in a similar study along Rush Creek in west-central Missouri (Smith et al. 2003). Missouri frogs were reported as preferring a mud or mud-rock microhabitat (Smith et al. 2003). Distribution of frogs among the different substrates at our study sites did not differ from random, and frogs occurred on mud, mud-vegetation, water-vegetation, and vegetation substrates. No mud-rock or rock microhabitats were present at our study sites. Frogs occurred much closer to vegetation at our study sites (mean distance = 4–7 cm) than at the Missouri study sites (mean distance = 177 cm) of Smith et al. (2003). Smith et al. (2003) surmised that rocks were used as shelter by frogs at their study sites and that shelter items were an important factor in habitat selection. Because rocks were not present at our study sites, frogs may have substituted vegetation for shelter, which might explain the reduced distances to vegetation at our study sites.

Unlike Blanchard's Cricket Frogs from Missouri, which occupied shaded locations at higher proportions than their availability (Smith et al. 2003), frogs at Springfield Bottoms showed no preference for sun exposure in their microhabitat occupancy. Shade was scarce along the water margins at this site, so lack of a preference for shade might be due to a lack of availability of that microhabitat along the edge of the pasture, but this site was the only location we found frogs in sufficient abundance for mark-recapture surveys, suggesting that shady microhabitats are not critical for Blanchard's Cricket Frogs in South Dakota. Although mean substrate temperature did not differ significantly between random and occupied points at either Springfield Bottoms or Bolton GPA study points, temperature variability was greater at random points at Springfield Bottoms. This suggests that Blanchard's Cricket Frogs in South Dakota are selecting microhabitats that avoid particularly high or low temperatures. This is consistent with data on Missouri frogs, which also showed no difference in substrate temperature between occupied and random points, but showed a greater difference between air temperature and substrate temperature (with air temperature higher) at random than at occupied points (Smith et al. 2003).

Conservation implications and future research.—Our data suggest that Blanchard's Cricket Frogs currently occupy only a portion of their former range in South Dakota, apparently being absent from western portions in Charles Mix, Gregory, and Tripp counties and from the Vermillion River drainage. However, because our surveys were designed to sample many sites over a broad area, we were not able to calculate detection probabilities, so our data suggesting absence of Blanchard's Cricket Frogs from these areas must be interpreted cautiously. Further monitoring studies involving multiple site visits for auditory surveys within the known range in South Dakota to document detection probabilities in this area, coupled with multiple visits to potential western breeding locations, as well as larval sampling from these areas employing such methods as minnow traps, dip-netting, or seining, will be required to conclusively document the absence of Blanchard's Cricket Frogs from these regions. If frogs are absent from western regions of their former range in South Dakota, as our data suggest, reasons for their extirpation from these areas are not known and this lack of knowledge hinders appropriate development of conservation plans for Blanchard's Cricket Frogs in South Dakota. Investigation of potential changes in climate or water quality in areas where frogs have been extirpated and comparison of these factors with sites where frogs still occur would be worthwhile topics for further study.

Summer microhabitat preferences of Blanchard's Cricket Frogs in South Dakota, at the northwestern extent of their range, are generally similar to those for cricket frogs at other locations, although shady microhabitats are apparently not occupied as preferentially as at some other sites. This suggests that summer microhabitats may not limit populations in South Dakota. Microclimates of winter hibernacula are likely more important to population regulation for Blanchard's Cricket Frogs in South Dakota, and at other locations along the northern extent of their range, as cricket frogs are intolerant of freezing and temperatures within South Dakota hibernaculum sites may drop well below the freezing point of the frogs' body fluids for extended periods (Gray 1971; Irwin et al. 1999; Burdick 2008; Swanson and Burdick 2010). Thus, another fruitful avenue for future research would be to examine hibernacula microclimates and over-winter survival in Blanchard's Cricket Frogs at overwintering sites in South Dakota and at other sites along the northern range boundary. Such data would greatly benefit formation of conservation and management plans for Blanchard's Cricket Frogs in South Dakota and at other sites along the northern boundary of their range, where population declines have been most dramatic (Lannoo 1998; Gray and Brown 2005; Gray et al. 2005).

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Seth L. Burdick recently completed his M.S. degree in the Department of Biology at the University of South Dakota, where he studied the seasonal status and distribution and the overwintering ecology and physiology of Blanchard's Cricket Frog for his thesis, of which this study formed a part. Seth received his B.S. in Biology from Potsdam State University in New York. He is currently pursuing an additional degree in Animal Management at Jefferson Community College in New York, with the eventual goal to work as a curator of herpetology in a zoo setting. He will be completing a summer internship with the Reptile Department at the Toronto Zoo, and hopes to share his love of herps and their conservation with the general public through outreach and education activities. (Photographed by Eric Liknes)

David L. Swanson is a Professor in the Department of Biology at the University of South Dakota. He received his Ph.D. in Zoology from Oregon State University working on seasonal physiological adjustments to cold in small songbirds, which remains a current research focus. During this time, he also became interested in freezing tolerance and overwintering strategies in anurans and his current research interests also include the physiology and ecology of overwintering and patterns of seasonal habitat use in amphibians and reptiles inhabiting cold winter climates. (Photographed by Steven Higgins)