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An Altered Amphibian Assemblage: Dickinson County, Iowa, 70 Years after Frank Blanchard's Survey[1]

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ABSTRACT.—In light of the reports of declines in amphibian numbers we have repeated Blanchard's (1923) survey of the amphibians of Dickinson County, Iowa. We found that five species reported by Blanchard persist: the eastern tiger salamander (*Ambystoma tigrinum tigrinum*), the American toad (*Bufo americanus*), the western chorus frog (*Pseudacris triseriata triseriata*), the gray treefrog (*Hyla versicolor/chrysoscelis*) and the northern leopard frog (*Rana pipiens*). Two species reported by Blanchard were not found: the mudpuppy (*Necturus maculosus*) and Blanchard's cricket frog (*Acris crepitans blanchardi*). We collected two species not found by Blanchard: the Great Plains toad (*Bufo cognatus*) and the bullfrog (*Rana catesbeiana*). The Great Plains toad may have migrated into Dickinson County from the west. The bullfrog was introduced by state fisheries biologists. From descriptions of the turn-of-the-century commercial "frogging" industry in Dickinson County, we estimate that the number of leopard frogs has declined by at least two, and probably three, orders of magnitude. This decline may be due more to the loss of wetland habitat than past market hunting pressure. In our opinion, the most immediate threat to the existing populations of native amphibians comes from the impact of the introduced bullfrog.

INTRODUCTION

Biologists have recently become alarmed about a possible worldwide decline in amphibian numbers (*e.g.*, Barinaga, 1990; Blaustein and Wake, 1990; Wyman, 1990; Pechmann *et al.*, 1991; Wake, 1991). To document this decrease properly, changes should be quantified; existing distributions and abundances of species need to be compared with past distributions and abundances where these data are available. The Iowa Lakeside Laboratory, a biological field station, was founded in 1909 and preserves—in more than 400 published papers and in its gazetteer—a record of the flora and fauna of northwestern Iowa (Baker, 1990). This information provides a basis for assessing the biological changes in this region during this century.

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In the summer of 1920 Frank Blanchard (1923) visited the Lakeside Laboratory and conducted what may have been the earliest study of Iowa amphibian populations. His expressed purpose was to provide baseline data for future herpetological surveys: "It is highly important that faunistic studies be undertaken here, and throughout our country, at as early a date as possible if we are to have any record of the composition and distribution of our native fauna, and if we are to deal intelligently with its preservation" (p. 20).

We repeated Blanchard's survey, and recorded the current amphibian diversity and relative abundance in Dickinson County. In addition to Blanchard's results, we rely on two locally written natural history accounts in determining the changes in amphibian populations. The first account (Anon., 1907) estimates the number of *Rana pipiens* taken from the region by commercial hunters. The second account (Barrett, 1964) is a reminiscence about this early 1900s "frogging" industry in Dickinson County. These two accounts, while anecdotal, are independent observations of the same event and corroborate each other. We use these comparisons to estimate the changes over the past 85 years in what may be considered a typical upper-midwestern amphibian assemblage. The present paper marks a first step towards a continuous program of summer monitoring of the amphibians in this region.

METHODS

Study site.—Dickinson County geology is characterized by glacial knob and kettle terrain, reflecting a terminal morainal landscape. This region was glaciated 11–12,000 years ago by the Altamont advance of the Des Moines lobe, during the Wisconsin glaciation (summarized in Prior, 1991). This recently deposited landscape is poorly drained and has a large number of prairie potholes ranging in size from small, shallow, temporary wetlands to large, deep, recreational lakes.

Survey techniques.—We surveyed Dickinson County for amphibians during the spring and summer of 1991 and 1992. The spring of 1991 began the first year of normal water levels following three years of drought. In this region, periods of drought appear to occur on a ten-year cycle, roughly corresponding to the ends of decades (National Oceanic and Atmospheric Administration Climatological Data). In other regions, amphibian abundance has been shown to vary across years (Christiansen and Bailey, 1991; Pechmann *et al.*, 1991; Cook, 1992), and to be correlated with environmental factors such as water regime. In Dickinson County, MJL (pers. observ.) has observed fluctuations in amphibian abundance roughly corresponding to the drought cycle.

Amphibians were sampled in three ways: by listening for adult breeding choruses (frogs only), seining wetlands for larvae (frogs and salamanders) and collecting adults (frogs and salamanders). A combination of sampling methods is often the best approach to monitoring amphibian populations (Berrill *et al.*, 1992). A portion of the calling data was collected as part of the statewide survey of anurans conducted by the Non-Game Division of the Iowa Department of Natural Resources (DNR). Additional data on calling frogs were collected in Emmet County, the adjacent county to the east. Data obtained by seining were collected as part of conservation biology class exercises in Field Vertebrate Zoology (MJL, instructor) and Aquatic Ecology (KL, instructor) courses taught at the Iowa Lakeside Laboratory. Approximately 500 to 600 person-hours were spent sampling amphibians for this survey.

The primary technique used to sample wetlands for adult amphibians was to visit wetland sites and listen for breeding choruses. Wetlands were surveyed for approximately one-half hour for one night in each of three months—April, May and June—by the DNR surveyers (TW and GSP), and more informally, but on a widespread basis, in late May and June by Lakeside Laboratory faculty (MJL and KL). Noncalling adults, including postbreeding

animals, newly metamorphosed animals, and tiger salamander (*Ambystoma tigrinum*) adults were observed on upland sites. Sampling for these animals did not involve a rigid schedule, but did include the upland areas of wetlands seined for larvae. In a special attempt to collect mudpuppies (*Necturus maculosus*), the littoral region of Little Miller's Bay, West Lake Okoboji, which is adjacent to the Lakeside Laboratory, was thoroughly seined in both 1991 and 1992.

Wetland basins were seined for amphibian larvae. In each basin at least three 20-m seine hauls were made. Hauls were made from shore to shore in smaller basins. More hauls were made in larger basins. Within each basin, shoreline and deep-water sites were sampled. Our seine measured 3 by 1.5 m with a 1-cm mesh. This mesh was small enough to capture larger *Bufo* tadpoles, the smallest larvae in the region. Tadpoles were identified either using Altig's (1970) key, or by rearing the larvae through metamorphosis at the Lakeside Laboratory. No amphibians were preserved as voucher specimens, since these species are common and well documented. Photographs of representative specimens were taken and will be on file in the Lakeside Laboratory gazetteer. Animals that were maintained through metamorphosis were released along the shore of the wetland in which they were collected. At each site the species collected were recorded.

Data analysis.—The presence and relative abundances of species were recorded and compared with the data from earlier studies. Blanchard (1923) provided a list of species present and their relative abundances in 1920. He collected in Dickinson County from 22 June to 31 July 1920. Blanchard does not record his collecting techniques in either his 1923 paper or in his field notes. From Blanchard's field notes it appears that he collected by himself or with no more than a few colleagues. He sampled both upland and wetland sites. He did not record breeding choruses, probably because his visit occurred later in the summer. To determine relative abundance, we compared the number of sites where a species was found with the number of sites sampled. Two sites (Hale Slough and Spirit Lake School Wetland) were sampled only for calling frogs and toads.

The Okoboji Protective Association's account (Anon., 1907) of market hunting for *R. pipiens*, and Barrett's (1964) independent corroboration of this account, permit an estimate of the size of the leopard frog population at the turn of the century. The anonymous (1907) account was recorded locally, when the commercial "frogging" industry was at its peak. Barrett's (1964) account is a reminiscence of his experience as a commercial frogger.

When defining sampling sites, connected or adjacent wetlands of similar sizes were combined into a wetland "complex." These complexes were then considered to be a single habitat. Our wetland complexes were the Gull Point, McBreen, Jemmerson Slough and Spring Run areas. We did not combine sampling sites in the Kettleson Hogsback, Hottes Lake, Marble Lake region because these sites contain a larger diversity of wetland and upland habitats. Our site names are identical to those used in the Lakeside Laboratory's gazetteer.

Reviewing Blanchard.—The specimens collected by Blanchard, as well as his field notes and his Dickinson County map, are housed in the Herpetology Division of the University of Michigan Museum of Zoology (U.M.M.Z.). One of us (MJL) has reexamined this material.

RESULTS

Species presence.—During the summers of 1991 and 1992, we found seven species of amphibians in Dickinson County (Table 1): the eastern tiger salamander (*A. t. tigrinum*), the American toad (*Bufo americanus*), the Great Plains toad (*Bufo cognatus*), the western chorus frog (*P. t. triseriata*), the gray treefrog (*Hyla versicolor/chrysoscelis*), the northern

TABLE 1.—Dickinson County sites sampled during the summers of 1991 and 1992, including township, range and section number, and the amphibian species found at each site

Site	Township		Section	*Ambystoma tigrinum*	*Rana pipiens*	*Rana catesbeiana*	*Bufo americanus*	*Bufo cognatus*	*Pseudacris triseriata*	*Hyla versicolor/chrysoscelis*
Silver Lake Fen	Silver Lake	(T-100N,R-38W)	32		X		X			
Diamond Lake	Diamond Lake	(T-100N,R-37W)	14, 15		X					
Grovers Lake	Diamond Lake	(T-100N,R-37W)	12			X	X			
Northeast McBreen Marsh	Diamond Lake	(T-100N,R-37W)	12	X	X				X	
Big Spirit Lake North	Spirit Lake	(T-100N,R-36W)	6			X				
McBreen Marsh Complex	Diamond Lake	(T-100N,R-37W)	12	X	X		X		X	
Hottes Lake	Spirit Lake	(T-100N,R-36W)	17, 18, 19		X					
Marble Lake	Spirit Lake	(T-100N,R-36W)	17, 18, 19, 20		X		X		X	
Kettleson Hogsback	Spirit Lake	(T-100N,R-36W)	19	X	X		X		X	X
Bedell Marsh North	Spirit Lake	(T-100N,R-36W)	19		X					
Bedell Marsh South	Spirit Lake	(T-100N,R-36W)	20						X	
U.S. Highway 86 S.W. Welsh	Diamond Lake	(T-100N,R-37W)	26	X	X				X	
Hale Slough	Spirit Lake	(T-100N,R-36W)	14, 23		X		X		X	
Christofferson Slough	Superior	(T-100N,R-35W)	13, 14							
Highway 9 Pond	Diamond Lake	(T-100N,R-37W)	36				X			
Jemmerson Slough Complex	Spirit Lake	(T-100N,R-36W)	31, 32		X	X	X			
	Center Grove	(T-99N,R-36W)	5, 6							
Orleans Hatchery Ponds	Spirit Lake	(T-100N,R-36W)	33, 34		X	X				
Spirit Lake School Wetland	Spirit Lake	(T-100N,R-36W)	3				X		X	
Yager Slough North	Excelsior	(T-99N,R-38W)	14						X	
Cayler Prairie	Lakeville	(T-99N,R-37W)	17	X	X		X	X	X	
Lakeside Laboratory	Lakeville	(T-99N,R-37W)	23	X	X		X	X	X	
Backporch Pond	Lakeville	(T-99N,R-37W)	26	X	X				X	
Beck's Canal	Lakeville	(T-99N,R-37W)	24, 25			X				
Gull Point Marsh Complex	Lakeville	(T-99N,R-37W)	24, 25	X	X				X	
Fairy Shrimp Pond	Lakeville	(T-99N,R-37W)	34, 35	X	X		X		X	
Little Sioux River	Lakeville	(T-99N,R-37W)	33		X					

TABLE 1.—Continued

Site	Township		Section	*Ambystoma tigrinum*	*Rana pipiens*	*Rana catesbeiana*	*Bufo americanus*	*Bufo cognatus*	*Pseudacris triseriata*	*Hyla versicolor/chrysoscelis*
Freda Haffner Kettlehole	Lakeville	(T-99N,R-37W)	33	X	X		X	X	X	
U.S. 86 Deerland/Shuck's Slough	Lakeville	(T-99N,R-37W)	35	X	X		X		X	
3-Corners Pond	Lakeville	(T-99N,R-37W)	34, 35	X	X	X	X		X	
	Okoboji	(T-98N,R-37W)	3, 4							
Garlock Slough	Lakeville	(T-99N,R-37W)	35			X	X			
Henderson Slough	Center Grove	(T-99N,R-36W)	29		X	X				
Horseshoe Bend	Okoboji	(T-98N,R-37W)	15		X		X			
Prairie Lake	Center Grove	(T-99N,R-36W)	23				X			
Spring Run Complex	Center Grove	(T-99N,R-36W)	12, 13, 24	X	X				X	
	Richland	(T-99N,R-35W)	7, 18, 19							
Total number of sites collected				13/32[1]	24/34	8/34	18/34	3/34	18/34	1/34

[1] Hale Slough and Spirit Lake School Wetland were sampled only for calling amphibians and therefore were not included as sites sampled for the non-vocal *Ambystoma tigrinum*.

TABLE 2.—Ranking of relative abundances of Dickinson County amphibians in 1920 and in 1991/1992

1920	Ranking	1991/1992	Ranking
Rana pipiens	1	*Rana pipiens*	1
Ambystoma t. tigrinum	2	*Bufo americanus*	2
Bufo americanus	3	*Pseudacris t. triseriata*	2
Acris c. blanchardi	3	*Ambystoma t. tigrinum*	4
Pseudacris t. triseriata	5	*Rana catesbeiana*	5
Hyla versicolor/chrysoscelis	5	*Bufo cognatus*	6
Necturus maculosus	5	*Hyla versicolor/chrysoscelis*	7

leopard frog (*R. pipiens*), and the bullfrog (*Rana catesbeiana*). We did not distinguish between the tetraploid *Hyla versicolor* and the diploid *Hyla chrysoscelis*, because we collected only calling data, which is known to be an unreliable indicator (Conant and Collins, 1991). We did not find two species recorded by Blanchard. The mudpuppy (*N. maculosus*) was not collected and to our knowledge has not been collected since Blanchard's study. Blanchard's cricket frog (*Acris crepitans blanchardi*) was also not found, despite collecting in the areas where Blanchard reported their presence. Cricket frogs are present in Emmet County (GSP, pers. observ.; D. Reeves, pers. comm.), immediately east of Dickinson County. They are also reported from Clay County, immediately south of Dickinson County (D. Reeves, pers. comm.). We add two species to Blanchard's (1923) list of Dickinson County amphibians. *Bufo cognatus* is known from four adults collected at three sites in Lakeville Township; their tadpoles were not found. Great Plains toads were reported by Bailey and Bailey (1941) in Osceola and O'Brien counties, the counties immediately to the west and southwest of Dickinson County. Calling Great Plains toads were reported from Emmet County by Reeves (1984). A second species, *Rana catesbeiana* was introduced in the late 1960s and has become established along the margins of the lakes and throughout the larger wetlands across the county.

Relative abundance.—During 1991 and 1992 amphibians in order of decreasing abundance were (Table 1): *R. pipiens, B. americanus, P. triseriata, A. tigrinum, R. catesbeiana, B. cognatus* and *H. versicolor/chrysoscelis.*

Blanchard (1923) described the relative abundance of Dickinson County amphibians in 1920: *Rana pipiens* ("... the widespread and abundant amphibian of the region"); *A. t. tigrinum* ("Common throughout the region ... at least one specimen was found in nearly every pond seined."); *B. americanus* ("Common but not abundant."); *A. c. blanchardi* ("Common but not abundant. It was found in all suitable localities."); *Pseudacris t. triseriata* ("Two adults were found ..."); *Hyla versicolor/chrysoscelis* ("A single adult was found."); *Necturus maculosus* ("One specimen was seined ... It is probable that another specimen was taken ..."). From these descriptions we rank species according to their relative abundance in 1920 (Table 2) and compare these rankings to those obtained from our data in 1991/1992.

DISCUSSION

Species presence.—Of the seven species present in Dickinson County in 1920, five persist: *Ambystoma t. tigrinum, Rana pipiens, Pseudacris t. triseriata, Hyla versicolor/chrysoscelis* and *Bufo americanus.* Two species listed by Blanchard (1923) were not found in our survey. One of these, *Acris c. blanchardi*, was common in 1920. The cricket frog has also declined in Ontario (Oldham, 1992). Among the factors thought to be responsible for the Ontario

decline are bullfrog predation and the presence of the common carp (*Cyprinus carpio*). Bullfrogs and carp are nonnative species now present in Dickinson County wetlands. *Necturus maculosus* may never have been abundant and may now be locally extinct. The most recent, unconfirmed report of mudpuppies was by skin divers in Emerson's Bay, West Lake Okoboji, and is now 25 years old (Eugene Stoermer, pers. comm.). Mudpuppy declines in Dickinson County correspond with declines reported throughout the state (Christiansen, 1981).

Two additional species are reported. *Bufo cognatus* may have always been present, but overlooked. A second possibility is that *B. cognatus* has recently migrated into the area. Bailey and Bailey (1941) did not report *B. cognatus* in Dickinson County in 1941, although they found it to the west. Reeves (1984) found *B. cognatus* to the east of Dickinson County (he did not sample Dickinson County). Taken together, these results suggest that between the early 1940s and the early 1980s the Great Plains toad may have expanded its range eastwardly and in the process entered Dickinson County. *Rana catesbeiana* has been introduced to the county by state fisheries biologists and has spread throughout the county. In the largest basin of the Jemmerson Slough complex, the bullfrog is the most conspicuous and probably the most abundant amphibian. *Rana pipiens*, once common in this basin (MJL, pers. observ.), were found only in the smaller fringing basins in 1992.

Species abundance.—We cannot directly compare our abundance data with Blanchard (1923) since Blanchard recorded only where he collected amphibians, rather than including sites where he did not find them. Nevertheless some information can be gleaned from comparing his descriptions of abundance to our data. There appears to have been several changes in the relative abundance of amphibian species since 1920 (Table 2). *Bufo americanus* and *P. triseriata* now rank higher in relative abundance than in the past. *Ambystoma tigrinum* now ranks lower. Blanchard (1923) stated that nearly every wetland he sampled had tiger salamander larvae. Today, between one half to one third of our sites (13 out of 32) contain tiger salamanders (Table 1). One cause for concern over this decline is that Dickinson County tiger salamanders, unlike any other known population of the eastern tiger salamander, have larvae that are polymorphic, exhibiting typical, cannibal and intermediate morph phenotypes (Lannoo and Bachmann, 1984; Lannoo *et al.*, 1989; 1990).

Although not showing up in the rankings, *Hyla versicolor/chrysoscelis* has also declined. The Little Sioux population reported by Blanchard now appears to be gone. Further, the Kettleson Hogsback population reported by Blanchard may be in serious decline. In 1991, a single gray treefrog male was heard calling from the Kettleson Hogsback Woods. In 1992, no gray treefrogs were heard calling from this location. Listening for calling males is a sensitive indicator for the presence of *H. versicolor/chrysoscelis* populations (Berrill *et al.*, 1992). *Hyla versicolor/chrysoscelis* is not known to occur anywhere else in the county.

Our data also allow us to comment on the changes in the absolute abundance of Dickinson County amphibians. At the turn of the century it was reported that twenty million *R. pipiens* were shipped per year from Dickinson County (Anon., 1907). Any tendency towards exaggeration in this number can be countered by the fact that not all leopard frogs could have been collected. We therefore take 20 million as a minimum estimate of the number of frogs present at this time. The magnitude of this estimate is corroborated by Barrett (1964) who reports that "frogging" was a major industry at the turn of the century. At "around 20 cents a dozen . . . [t]housands of dollars of frog checks were cashed at the banks of Spirit Lake. The whole town was frogging in those days. Men went and even children because they could make such good money at it . . ." (Barrett, 1964).

We estimate that today somewhere between 50 and 200 wetlands exist in Dickinson County that provide habitat for leopard frogs. Most of these wetlands are small basins and

their numbers vary with water regime. Some of the larger basins which historically have produced leopard frogs (*e.g.*, Welch Lake, Sunken Lake and Garlock Slough) have been developed for domestic or commercial use, altered by state fisheries biologists to raise gamefish or now contain bullfrogs (*see* Bovbjerg, 1965 for a history of the rapid decline of leopard frogs in Garlock Slough). Each of these factors has reduced or eliminated the ability of these wetlands to produce leopard frogs (MJL, pers. observ.). We estimate a 1992 summer population of perhaps 50,000 leopard frogs based on the number of remaining wetlands and the number of frogs that they support. Therefore, it appears that leopard frog numbers have declined between two and three orders of magnitude (closer to three orders of magnitude) since the turn of the century. Because *R. pipiens* retains its rank as the most abundant amphibian in the county, we can assume a similar magnitude of decline in Dickinson County's other amphibians. Most of this decline is probably due to wetland drainage, rather than past commercial hunting pressure. In fact, an estimate of amphibian declines based solely on habitat loss (wetland drainage, estimated at between 90 and 98% of presettlement wetlands in Iowa) would be about two orders of magnitude.

The future.—It remains to be seen whether amphibian declines will continue, or whether previous declines have now stabilized (*i.e.*, are fluctuating yearly around a mean value). We believe that two primary ecological factors will determine the future of the native Dickinson County amphibians: habitat availability and the expanding range of the introduced bullfrog. Unlike in many areas, habitat availability appears to be stable or is increasing—a response to aggressively applied local, state and federal wetland acquisition programs. However, the impact of the expansion of the range of the bullfrog has yet to be determined. Christiansen and Bailey (1991), Conant and Collins (1991) and many others cited in Hayes and Jennings (1986) have noted the negative impact of bullfrogs on other amphibian species. Christiansen and Bailey (1991) observed that in southeastern Iowa, bullfrog numbers decline following droughts, and, as a result, the numbers of other amphibians increase. In the future we will attempt to document trends such as this for our region. Yearly data will be housed in the gazetteer at the Lakeside Laboratory and in the Iowa DNR Non-Game Wildlife Biology office in Boone, Iowa.

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