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The Illinois chorus frog (*Pseudacris streckeri illinoensis*) and the dredge material deposition sites at Beardstown, Illinois

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EXECUTIVE SUMMARY

The Illinois chorus frog (*Pseudacris streckeri illinoensis*), a state threatened amphibian, occupies a location where the U.S. Army Corps of Engineers' dredge material placement operations may cause incidental take. The purpose of the project is to monitor the response of the frog to the District's conservation plan at two placement sites and breeding sites to be constructed in the future. Population estimates for 2001 for Sites 1 and 5 were 230 and 180 frogs, respectively. Recruitment must have been small because no transforming Illinois chorus frogs were caught in 2001. The reasons for this are not known with certainty but may have been due to low rainfall in April and May and predation by salamander larvae. Experimental and empirical data suggest that under laboratory conditions that the Illinois chorus frog prefers to burrow in natural sand rather than newly placed dredged material. More study is needed to determine if dredged material would become more acceptable for burrowing with the passage time. Consequently, take due to beneficial removal will likely be small.

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INTRODUCTION

The Illinois chorus frog (*Pseudacris streckeri illinoensis*) is an anuran amphibian that occurs in areas of sandy soils in Arkansas, Illinois, and Missouri (Conant and Collins, 1991). This highly fossorial frog occurs in Illinois mainly along the central part of the Illinois River (Smith, 1961; Brown and Rose, 1988; Phillips et al., 1999).

This frog occurs in the Beardstown area where the District has placed dredge material from previous navigation channel maintenance on the Illinois Waterway. Future dredged material operations may cause incidental take of this Illinois threatened species. The District has developed a conservation plan for the species to comply with Illinois Department of Natural Resources (IDNR) incidental take authorization. This report contains results from the first year of monitoring pre-rehabilitation for Sites 1 and 5.

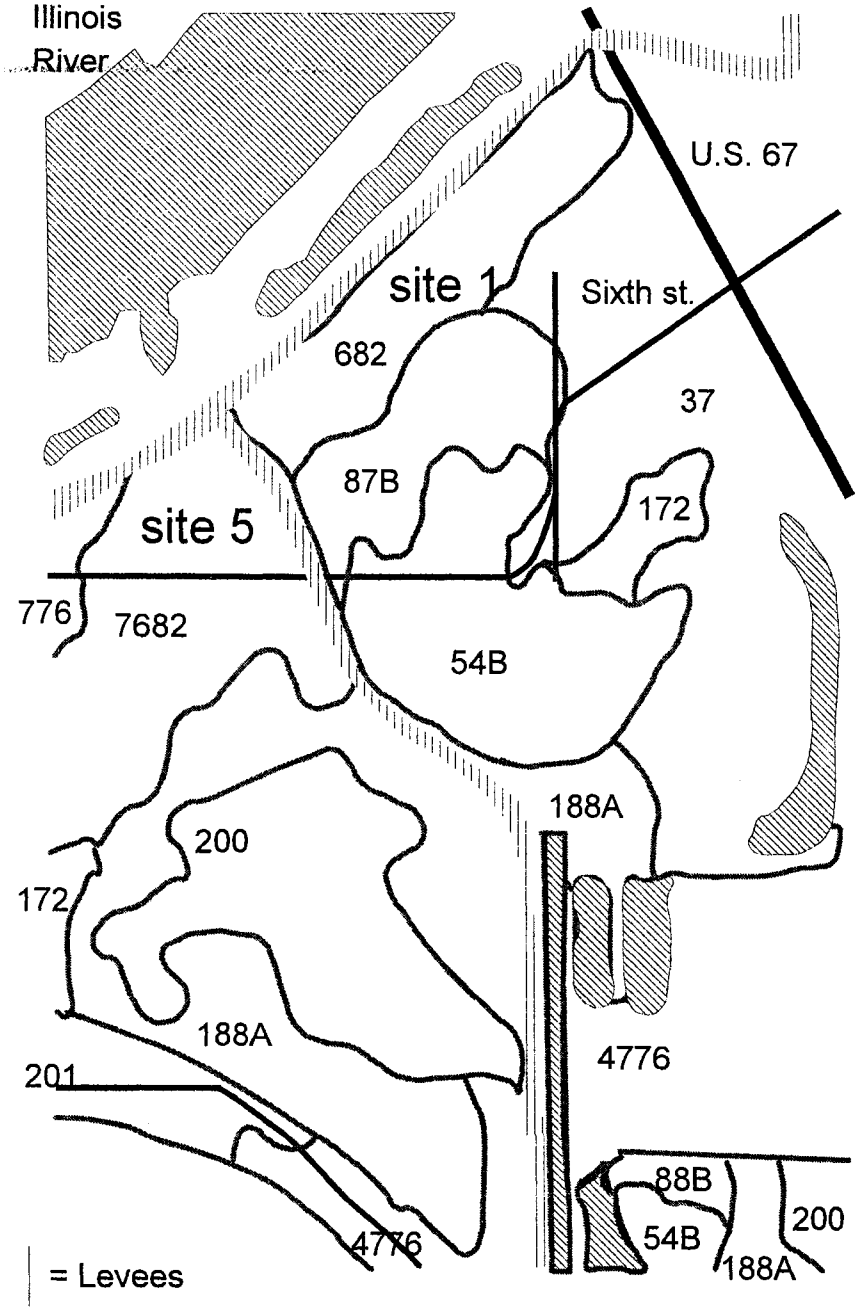
OBJECTIVES

The purpose of the project is to monitor changes in population size and to determine recruitment rate of the species at the dredged material deposition sites, and utilization at constructed breeding ponds in response to the District's conservation plan and conditions of the Incidental Take Authorization issued by the Illinois Department of Natural Resources. The first step in accomplishing this objective is to mark adult and newly transforming froglets for future recapture. Thus capturing as many frogs as possible in the first year of study was critically important.

METHODS

Study sites: The study sites are located at sixth street in the city of Beardstown, Illinois (SE, sec. 16, T18N, R12W). These border the east side of the levee on the eastern bank of the Illinois Waterway. The study area included two sites (Sites 1 and 5). Site 1 includes a previously established dredged material placement site of about 13 acres (5.2 ha)

Figure 1. Diagram showing soil types and locations of Site 1 and Site 5.



37 = Worthen Silt Loam
54B = Plainfield Sand
87B = Dickinson Fine Sandy Loam
88B = Sparta Loamy Sand
172 = Hoopston Sandy Loam
188A = Beardstown Loam
200 = Orio Loam
201 = Gilford Sandy Loam
682 = Medway Loam, frequently flooded
776 = Comfrey Clay Loam, frequently flooded

7682 = Medway Loam, rarely flooded

of which 4.8 acres (1.9 ha) has dredged material currently on it (Fig. 1). Site 5 is about 7.83 acres (3.13 ha) in size and has never been used for dredged material previously (Fig. 1).

Study organism: The Illinois chorus frog (*Pseudacris streckeri illinoensis*) has been confirmed in the project area. A voucher specimen had been previously deposited in the collection of the Illinois Natural History Survey (INHS 12952).

Interior and perimeter fences methods: The primary method of study was drift fence (*sensu lato*) monitoring (Corn 1994). Drift fences have proven effective in another monitoring project with *Pseudacris s. illinoensis* (Tucker and Philipp, 1999). Interior drift fences were constructed with 25-cm tall aluminum flashing with each fence being 30 m long. Three pitfall traps were set on each side of the fence. Recent research suggests that black colored pitfalls are more effective then white colored ones (Crawford and Kurta, 2001). Thus, black commercial grade flowerpots 27 cm deep with a top diameter of 30 cm with drainage holes present were used as pitfalls. All pots are Classic 2000 brand manufactured by Nursery Supplies, Inc., Chambersburg, PA.

Ten 30-m fences were located on Site 1, five on the portion with dredged material and five on the portion without dredged material. The center point of each fence in both habitat strata (with or without dredge material) were located randomly using a grid-overlay for each strata at Site 1. Fences were be oriented either parallel to the existing levee at Site 1 (i.e., north to south) or perpendicular to the levee (i.e., east to west) with the five fences in each orientation. Ten 30-m fences were also located on Site 5. Center points for these fences were located as for Site 1 except that the habitat is uniform throughout Site 5 so habitat stratification is not needed. Fences were also oriented north to south or east to west as for Site 1. At both

sites fence overlapping center points were excluded. All fences on both sites were removed at the end of the field season.

Perimeter barriers for Sites 1 and 5 were constructed with 1-m tall silt fencing. a fabric that allows passage of water but not silt. Fencing was installed in February, 2001. Pitfall traps were installed every 30 m along both sides of these two fences. Site 1 also had a cross-fence separating dredged material from portions of the site without dredged material. This section of silt fencing also had pitfalls installed as described above for the perimeter silt fencing.

Drift fences were monitored daily from March 1 to June 30, 2001. On each day, the technician removed any captured organisms (including invertebrates). Frogs were also captured in choruses during nocturnal visits to Site 1. Reptiles and amphibians were marked by toe clipping, measured, and weighed (see below) and have the fence number and pit number recorded (Corn, 1994). Each animal was then immediately released on the opposite side of the fence. A standard data sheet was used to record data for each organism (Corn, 1994, Fig. 2).

Toe clipping (ARMI SOP no. 110, Green, 2001) was used to mark each frog. Toe clips identified year of capture and whether the frog is an adult or juvenile when marked. Toe clips were not used for individual recognition. Toe clips were preserved in 70% ethanol for possible later use in studies of skeletochronology or for DNA analysis. The scissors used to perform toe clips, besides being kept as sharp as possible, were stored in alcohol (70% ethanol) while in the field to reduce the possibility of disease transmission.

Each anuran then had its snout to vent length (SVL) measured to 1 mm with a mm rule and was weighed to 0.1 g with a portable O'haus digital balance. Sex was recorded for adults when possible. Finally the reproductive state (i.e., gravid or spent) of females was determined when possible (e.g., Tucker, 2000).

Figure 2. Example of data sheet used to record data at Site 1 and Site 5.

Beardstown Illinois Chorus frog monitoring project

Date ________ Time _______ Air temperature ________ Soil temperature _______ Investigator ________

Precipitation ________ Data sheet number ________ Calling intensity ___________________

Site	Fence	Pit	Species	sex	mass	svl	Tail length	Capture	Comments

Reptiles or salamanders also had the SVL measured along with tail length for salamanders, lizards, and snakes. They were weighed as for anurans. Lizards and salamanders were marked by toe clipping whereas scale clipping was used with snakes. Turtles were marked by notching marginal scutes

Basic meteorological data was recorded at each site. These included precipitation measured with a rain gauge and air and soil temperature at 12 cm depth measured with Reo-temp brand thermometers.

Aquarium sand acceptance testing: Sand for this experiment came from Site 1. Experiments were conducted in the laboratory located in Brighton, Illinois. Eight-ten gallon aquaria were used. Each of these were fitted with a center divider. One side of an aquarium was filled with dredged sand and the other side of the aquarium was filled with sand dug from naturally occurring sand at Site 1. Sand was placed in each aquaria with the surface smoothed but not compacted. Aquaria were positioned so that natural sand sides alternated between adjacent aquaria. Sand was deep enough to just reach the top of the center divider. A male Illinois chorus frog was then placed into each aquarium. The frog was left for 24 hr. After 24 hr frogs were dug from the sand and scored as having been in natural sand or dredged sand. Sand was replaced with new sand after each replication.

Soil invertebrates: Sand was dug from 8 randomly located sites on the dredged material pile at Site 1 and from 8 randomly selected sites on areas at Site 1 without dredged material. Sand was dug from a one-quarter m^2 circle to a depth of 10 cm. Sand was sifted through screen wire with a 1 mm mesh. Organisms collected were preserved in 70% ethanol in the field. They were returned to the laboratory and identified. Weight was determined for each invertebrate collected to 0.001 g with an electronic balance.

Table 1. Amphibians and reptiles collected at Sites 1 and 5.

Species	Initial captures		Recaptures	
	Site 1	Site 5	Site 1	Site 5
Acris crepitans	1	0	0	0
Bufo americanus	12	2	4	0
Bufo fowleri	293	26	4	0
Hyla versicolor	1	0	0	0
Pseudacris s. illinoensis	96	25	70	4
Pseudacris triseriata	547	43	53	0
Rana blairi	70	9	2	0
Rana sphenocephala	127	56	1	0
Ambystoma texanum	491	5	33	0
Ambystoma tigrinum	133	0	8	0
Lampropeltis calligaster	2	0	0	0
Cnemidophorus sexlineatus	2	37	0	3
Coluber constrictor	3	1	0	0
Elaphe obsoleta	0	1	0	1
Heterodon platirhinos	5	1	0	1
Thamnophis proximus	3	0	0	0
Thamnophis sirtalis	1	0	0	0
Chelydra serpentina	1	2	0	2
Graptemys geographica	1	0	0	0
Sternotherus odoratus	1	0	0	0
Chrysemys picta	56	9	1	0
Trachemys scripta	100	42	0	0

RESULTS

Population estimates and recruitment: Over all, 2,137 reptiles and amphibians were collected at Site 1 and 267 at Site 5 (Table 1). These included 166 captures of 90 individual Illinois chorus frogs at Site 1 and 29 captures of 25 individuals at Site 5. Of the captures at Site 1, 102 were made in choruses and 64 were made with interior or perimeter drift fences. All captures at Site 5 were made with interior or perimeter drift fences.

The first Illinois chorus frogs were caught on 13 March 2001 and the last was caught on 1 May 2001 (Fig. 3). The days when many frogs were caught coincided with dates with rainfall (Table 2). Occurrence of salamander (Table 3) and turtle captures (Table 4) overlapped captures of Illinois chorus frogs and other anurans (Table 2).

Overall, seven of the 25 individuals initially marked and then released at Site 5 were recaptured at breeding choruses at Site 1. No Site 1 frogs were recaptured at Site 5. Since no calling frogs were found at Site 5, recaptures of Site 5 frogs at Site 1 suggests that frogs from Site 5 all breed at Site 1.

Newly transformed anurans were common for Fowler's toads and southern leopard frogs but few for western chorus frogs and none for the Illinois chorus frog (Table 5). This suggests that few individual chorus frogs survived to transform at Site 1. However, results are preliminary considering that only one breeding season was studied.

Preliminary population estimates based on capture/recapture estimates are about 230 frogs at Site 1 and about 180 frogs at Site 5. These estimates, though preliminary, suggest that in 2001 about one-third of the adult frogs at Site 1 were marked and about one-ninth of the frogs at Site 5 were marked.

Aquarium sand acceptance testing: Eight frogs were tested eight times each. In these 64 trials frogs were found buried in natural sand 46

Table 2. Month of capture for anuran amphibians at Site 1.

Species	March	April	May	June	July
Acris crepitans	0	1	0	0	0
Bufo americanus	0	4	0	0	0
Bufo fowleri	49	61	48	139	0
Hyla versicolor	0	0	0	1	0
Pseudacris s. illinoensis	42	123	1	0	0
Pseudacris triseriata	144	438	4	14	0
Rana blairi	4	32	1	27	8
Rana sphenocephala	4	6	104	14	0

Table 3. Month of capture for salamanders at Site 1.

Species	March	April	May	June	July
Ambystoma texanum	222	254	18	30	0
Ambystoma tigrinum	10	36	1	32	62

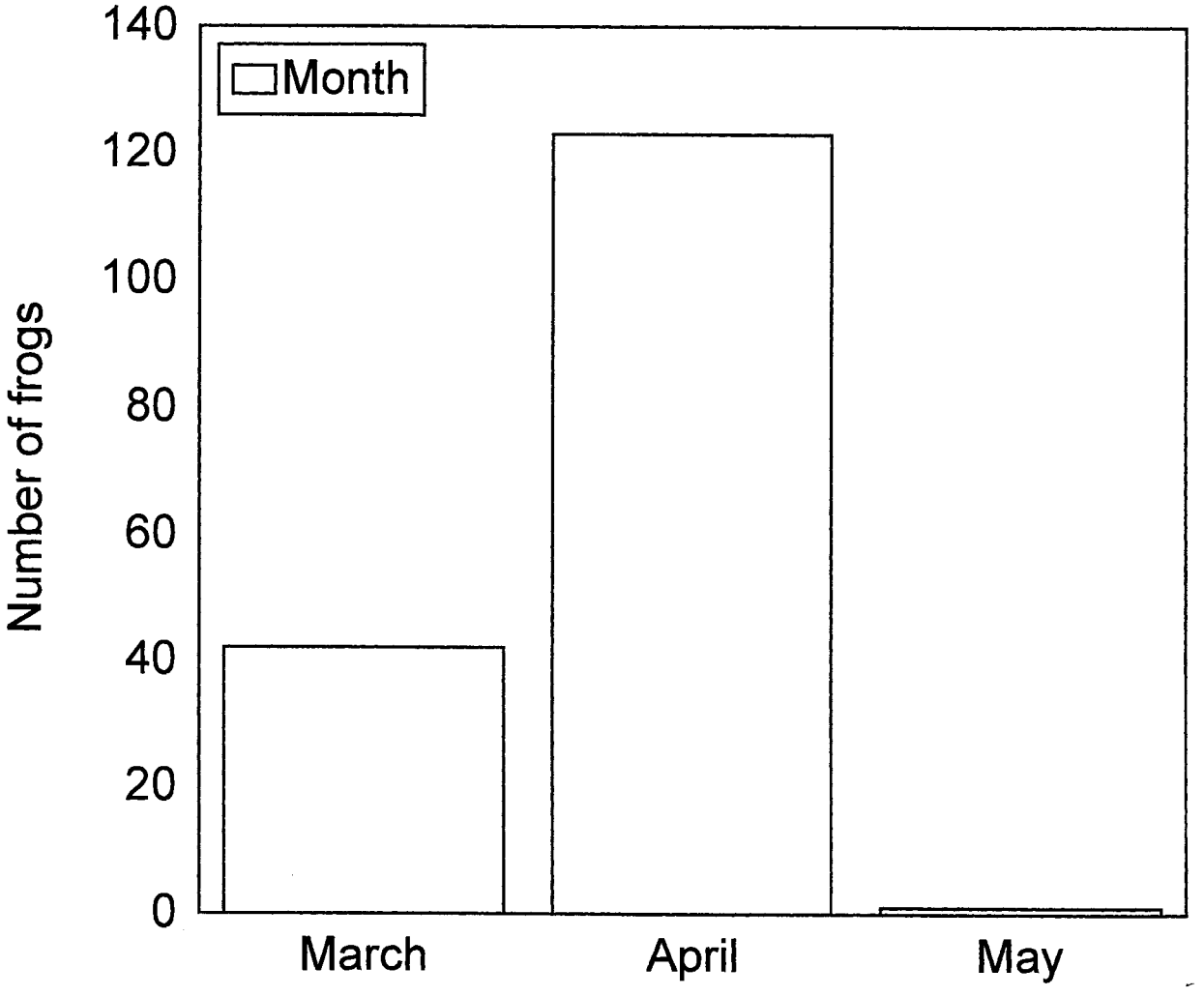
Table 4. Month of capture for two turtle species at Site 1.

Species	March	April	May	June	July
Chrysemys picta	1	18	5	19	18
Trachemys scripta	1	21	44	26	13

Table 5. Sex or life-stage of the five most common anuran amphibians caught at Site 1

Species	Male	Female	Juvenile
Bufo fowleri	60	27	210
Pseudacris s. illinoensis	37	129	0
Pseudacris triseriata	338	254	8
Rana blairi	23	11	38
Rana sphenocephala	9	0	119

Figure 3. Month of capture for Illinois chorus frogs from Site 1.


Month
Number of frogs
140
120
100
80
60
40
20
0
March
April
May

times or in 72% of the trials. This result differs from the 50% expected outcome significantly ($P < 0.05$).

Individual frogs varied somewhat in their selection of sand types. Two frogs did not discriminate (i.e., 3 of 8 in natural for one and 4 of 8 in natural for the other). The six other frogs preferred natural sand in 6 of 8 trial to 8 of 8 trials. However, when compared as an aggregate the sample was not heterogeneous ($P > 0.05$, $G = 0.987$). This suggests that variation observed was due to chance and not due to some frogs preferring recently deposited dredged material. Aquariums used in each experiment had no influence on sand choice ($P > 0.05$). Frogs occurred in natural or dredged sand at equal rates in all the aquariums. This suggests that aquarium placement within the experimental room was not a variable in the findings.

Soil invertebrates: No invertebrates were recovered from the dredged material sampling sites. Soil invertebrates were observed present on the dredged material site but were not frequent enough to be collected in the few samples made. In contrast, soil invertebrates were recovered in every one of the sampling sites in the natural area. Invertebrate biomass varied with vegetation cover (Fig. 4). Generally, more and heavier invertebrates were collected at sites with more vegetation. Oligochaetes strongly influenced results because they were numerous in areas with 50% or more vegetation cover (Table 6).

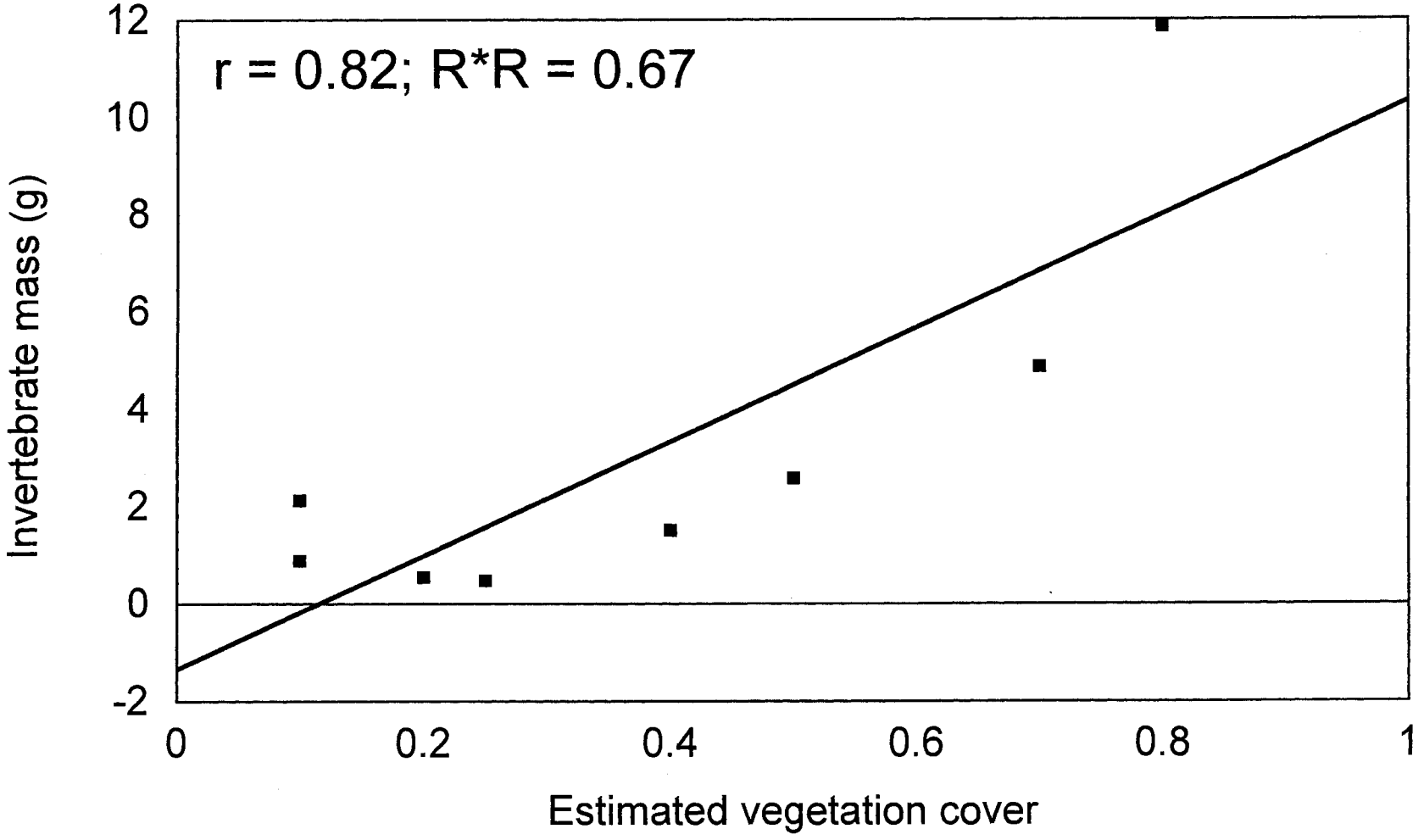
DISCUSSION

Population estimates and recruitment: The population estimates and estimates of the percentage of frogs marked are important estimates because recapture rates in 2002 should approach 33% and 11% at Site 5 assuming no new frogs (i.e. recruitment) are added to the population or removed from the population. If the rate is reduced, then new frogs were likely added to the population. If the rate is higher or about the same, then frogs were lost from the population or few were added. At

Table 6. Invertebrate samples from naturally occurring sand at Site 1. No invertebrates were collected in 8 samples from dredged material.

Sample number	1	2	3	4	5	6	7	8
Veg. cover	75%	10%	20%	25%	10%	40%	70%	50%
Oligochaetes	11.780	0	0	0.034	0	1.267	4.420	2.079
Coleoptera	0.066	1.667	0.292	0.441	0.886	0.197	0.327	0.227
Hymenoptera	0	0.021	0	0	0	0	0	0
Lepidoptera	0	0	0.215	0	0	0	0.103	0.109
Hemiptera	0	0	0.037	0	0	0	0	0
Arachnida	0	0.431	0	0	0	0.040	0	0

Figure 4. Relationship between vegetation cover and invertebrate biomass at eight sample locations at Site 1.


r = 0.82; R*R = 0.67
Invertebrate mass (g)
12
10
8
6
4
2
0
-2
0
0.2
0.4
0.6
0.8
1
Estimated vegetation cover

present, this will be the only method available to estimate recruitment from 2001 in 2002.

No newly transformed Illinois chorus frogs were caught in 2001 suggesting that recruitment was very low. Similarly, only eight newly transformed western chorus frogs were caught in 2001 (Table 5). Apparently conditions were not good for *Pseudacris* species at Site 1. This low rate of recruitment may reflect low rainfall in May of 2001. Many Illinois chorus frogs bred in the shallow ephemeral puddles and ditches along the access road to Site 1. These sites dried up before any tadpoles could transform.

Nonetheless water was present in the small ponded area at Site 1 and in the sump area of Site 1. Some froglets should have been expected from those sites. In fact, many newly transformed individuals were caught for Fowler's toad (*Bufo fowleri*) and the southern leopard frog (*Rana sphenocephala*) (Table 5).

Clearly drought alone cannot account for the near absence of *Pseudacris* froglets. The finding that many *Rana* and *Bufo* tadpoles were able to transform, whereas few *Pseudacris* tadpoles transformed is likely due to interactions between anuran larvae and salamander larvae (e.g., Connell, 1983). The hypothesis suggested by this outcome is that predatory salamander larvae reduced the number of *Pseudacris* survivors compared to the number of *Rana* and *Bufo* survivors. *Bufo* tadpoles are protected by toxic skin secretions and *Rana* tadpoles grow to large sizes quickly, which may prevent salamander predation. *Pseudacris* tadpoles are much smaller at transformation and are present at a time when predatory salamander larvae are reaching large sizes.

Aquarium sand acceptance testing: One concern in the dredge material placement impact on Illinois chorus frogs is the impact of piling sand on top of the deposition site and then subsequent beneficial removal of the sand. Both actions could cause incidental take. However,

Figure 5. Diagram showing location of initial captures of Illinois chorus frogs at Site 1.

Site 1

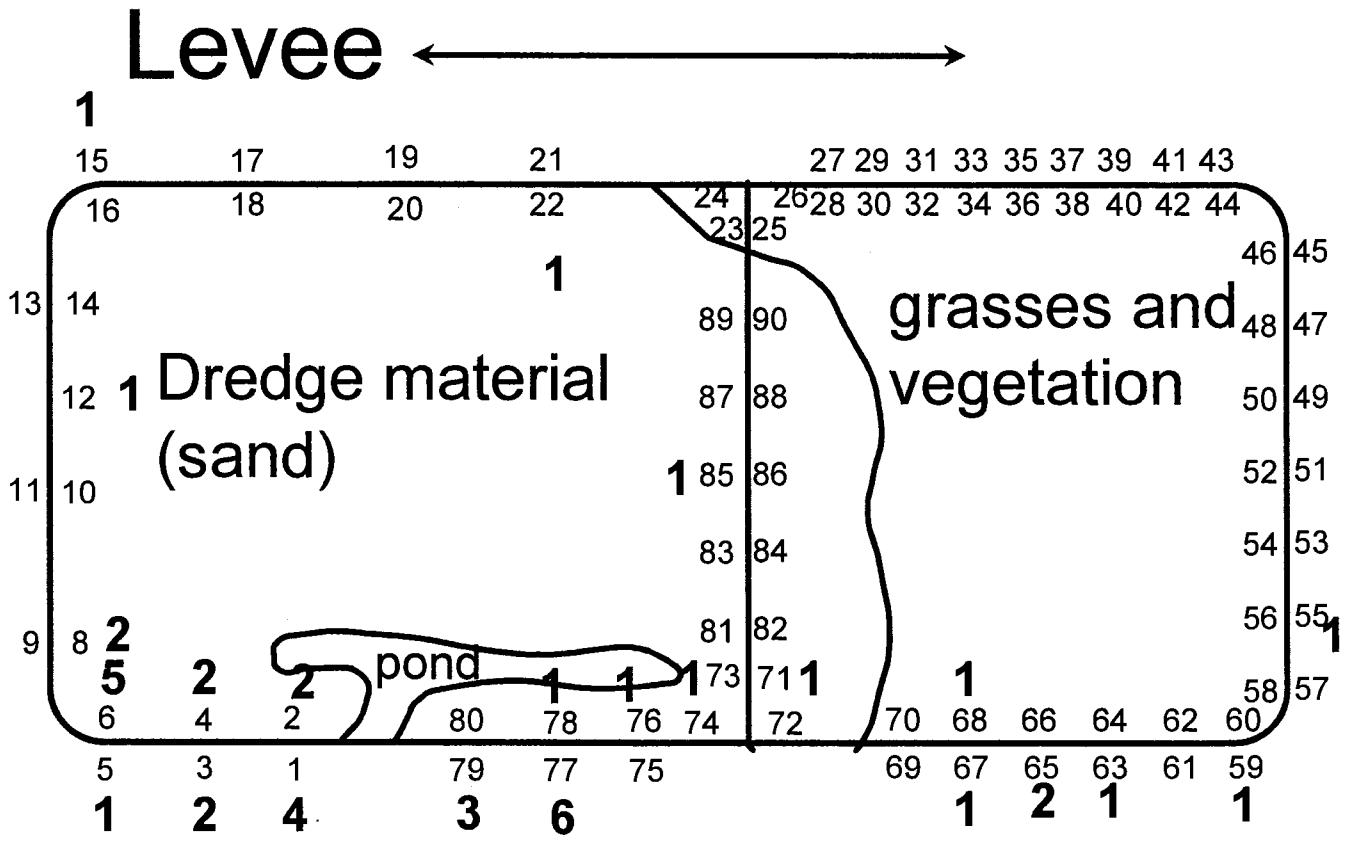
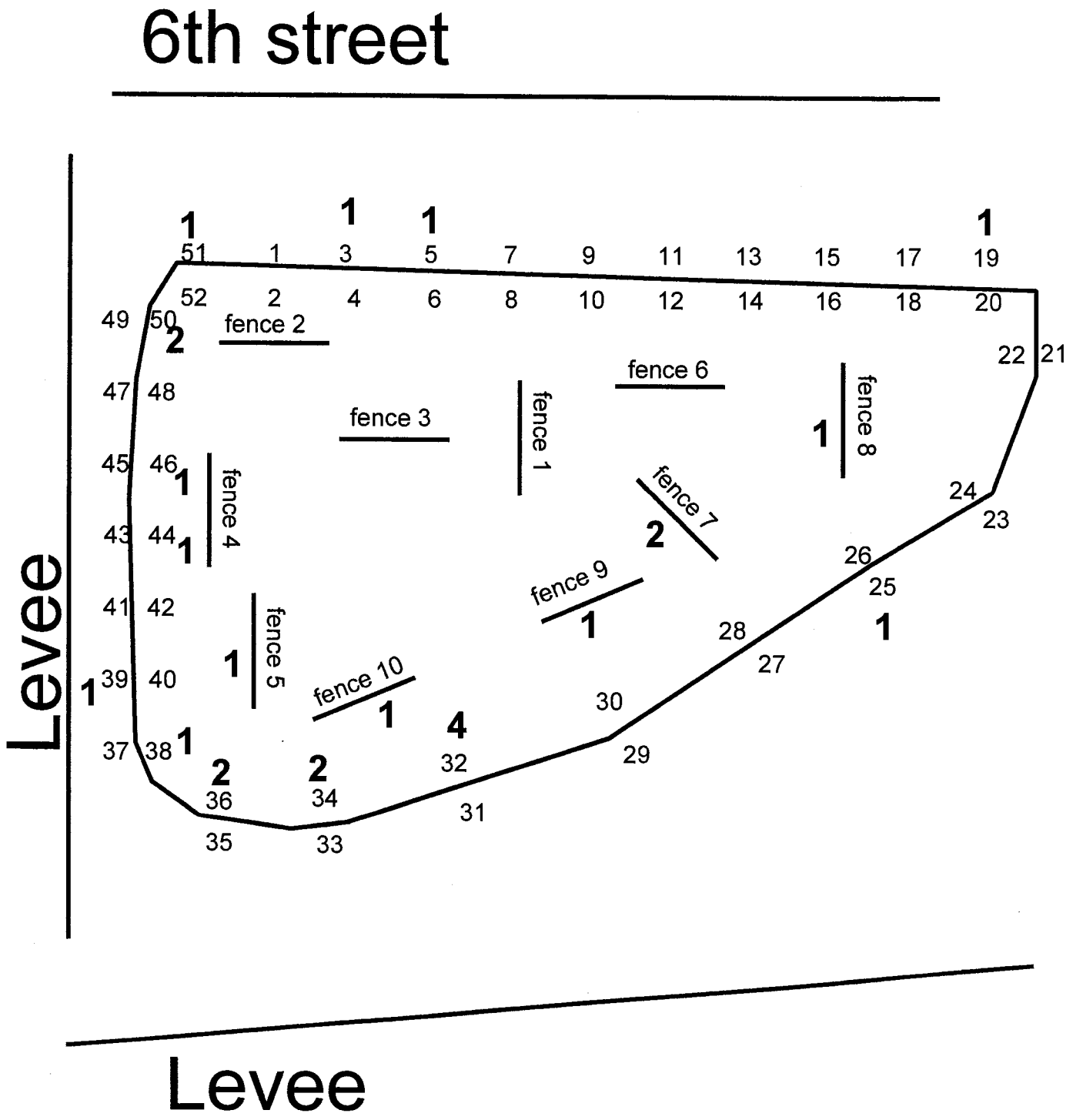

Levee
Dredge material (sand)
grasses and vegetation
pond
Access Road

Figure 6. Diagram showing location of initial captures of Illinois chorus frogs at Site 5.

Site 5


6th street
Levee
Levee
fence 1
fence 2
fence 3
fence 4
fence 5
fence 6
fence 7
fence 8
fence 9
fence 10
1 51 1 3 5 7 9 11 13 15 17 19
52 2 4 6 8 10 12 14 16 18 20
49 50 48 47 46 45 44 43 42 41 40 39 38 37
36 35 34 33 32 31 30 29 28 27 26 25 24 23 22 21

incidental take will only be important if many frogs live in the dredged material or live where dredged material will be deposited. The sand acceptance testing suggests that few frogs will voluntarily burrow into the sand recently dredged from the Illinois River. If few frogs use the recently deposited dredged sand, then few frogs will be taken during beneficial removal.

The reason why frogs would not burrow into dredged sand is not known. However, grain size is much coarser in the dredged material and shell fragments (gastropod and pelecypod) are present, whereas the natural sand has a finer grain size and few shell fragments. Shell fragments may interfere with burrowing. Larger fragments may act as physical impediments to burrowing while sharp edges of shell fragments may injure the frog.

Moreover, recently placed dredged material had almost no invertebrate fauna. The Illinois chorus frog, which feeds underground, needs invertebrates for survival.

The experimental and invertebrate data are supported by the pattern of captures on the perimeter drift fence. Relatively few frogs were initially caught on the dredged material side of the fence (Fig. 5). Almost all captures on the dredged material side of the fence were recaptures of frogs returning from the ponded area at Site 1. Thus, these preliminary results strongly suggest that few Illinois chorus frogs currently use the dredged material site for nonbreeding habitat. Most captures at Site 5 were in the corner closest to Site 1 consistent with the hypothesis that frogs from Site 5 move to Site 1 to breed (Fig. 6)

Other findings: Site 1 is inhabited by many other species besides the Illinois chorus frog (Table 1). None of these species are threatened or endangered but understanding the faunal components may be important in planning site modification. The most numerous animal captured was the smallmouth salamander (*Ambystoma texanum*). Most of these captures

Table 7. Sex or life-stage of two common turtles caught at Site 1

Species	Male	Female	Juvenile	Hatchling
Chrysemys picta	21	25	1	14
Trachemys scripta	12	23	12	58

occurred in areas bordering the levee. Apparently these salamanders are living in the thatch of the grasses along the levee. Their larvae and those of the tiger salamander (*Ambystoma tigrinum*) are predatory and may have an impact on *Pseudacris* survivorship (see above).

Site 1 is also used as a turtle nesting area (Tables 4 and 6). The most common turtle species were the red-eared slider (*Trachemys scripta*) and the painted turtle (*Chrysemys picta*). Most captures were of nesting females and migrating hatchlings (Table 7).

The findings further suggest that beneficial use would essentially have no effect on the Illinois chorus frog. Since the frog does not appear to use the recently deposited dredged material as a habitat, few frogs would likely be in material removed from the site. However, nothing is known about the effect of ageing on the recently deposited material. With time, invertebrates can be expected to colonize it and the amount of fines from wind deposition and organic matter from plant colonization will likely increase. In time, the newly deposited material may become acceptable to the chorus frog.

Future activities at the sites are suggested from this first years results. First, a calling record will be added to the data sheet (Fig. 2). Thus, if nocturnal visits are made to the breeding area at Site 1, the intensity and species of calling anurans can be recorded. Results from 2001 indicate that the interior drift fences at Sites 1 and 5 were relatively ineffective for the amount of effort required to keep them functioning. These fences were removed at the end of July in 2001 and will not be reinstalled.

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