FINAL REPORT

Colonization of newly-constructed wetlands by an amphibian community.

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INTRODUCTION

This report details a 1.5-year study completed at Wildcat Hollow State Habitat Area (WHSHA), Mason Township, Effingham County, Illinois, a property overseen by the Illinois Department of Natural Resources (IDNR). The overall project concerns the monitoring of amphibian populations that colonize breeding ponds recently constructed in several areas of the property. This report will describe the species composition of the reptile and amphibian community in the habitats where ponds were constructed and, more specifically, the frequency with which amphibians used these ponds as breeding sites.

Objectives

The present report provides data illustrating the colonization and use of newly-constructed ephemeral ponds by the amphibian community found at WHSHA. I also report on the presence of other reptile and amphibian species using the wetland and surrounding habitat at WHSHA. Lastly, I provide recommendations to IDNR for the continued management of amphibians at WHSHA.

MATERIALS & METHODS

In Summer 2005, 12 ponds were constructed in the southwestern portion of WHSHA (Figure 1) using a small bulldozer to excavate soil down to a clay layer. Removed soil was placed at the low end of the basin for each pond and compacted so as to help retain water. These ponds were sited in old-field habitat within 25 m of forest edge (mesic hardwoods). A pre-existing permanent pond is also located in the old-field habitat, within 25 m of one of the newly-constructed ponds. A drift fence-pitfall trap array was constructed around six of these

ponds in November 2005. Construction-grade silt fencing and wooden stakes were used to erect the drift fence to a height of 40 cm, with 10 cm of fencing material buried below ground level. Pitfall traps comprised of 2.5-L buckets inserted into the soil such that their rims were flush with the ground surface. Fences completely encircled all ponds, and pairs of pitfalls were placed on either side of the fence every 7.5 m.

In December 2006, an additional eight ponds were constructed within the hardwood forest habitat with minimal disturbance to the surrounding vegetation (bulldozer access along a fire trail). Drift fence-pitfall trap arrays were erected around a subset of four of these ponds in late February 2006. At the conclusion of this second round of construction, all pitfall traps at all ponds were opened to sample populations using these ponds throughout the 2006 amphibian activity season. All traps were sealed with lids in early December 2006 to prevent capture of non-target organisms during winter dormancy. Traps were re-opened from 15 February to 30 June 2007.

During the activity season, the entire drift fence-pitfall trap array was monitored every 48 hours. Individuals collected in the traps were measured (snout-vent length [SVL] or total length), and toe-clipped to indicate their capture during a particular year (cohort-specific; Dodd and Cade 1998) and at a particular pond. Any recaptured individuals were noted and, where possible, the gender of captured individuals was determined.

This project was conducted with assistance from Timothy Buhnerkempe and Samantha Adams, students in my laboratory. They were primarily responsible for conducting the monitoring effort at WHSHA since the drift fences were installed in November 2005. The funds from the current grant period were used to provide a 1.5-month salary to Miss Adams during Summer 2007, to reimburse both students for travel to/from the field site, and to

purchase supplies necessary to maintain the integrity of the drift fences/pitfall trap arrays surrounding the four ponds at WHSHA.

RESULTS

Not all ponds held water for a sufficient duration of the amphibian activity season to allow for successful breeding in those ponds (Table 1). By 8 March, all ponds contained sufficient water to support amphibian reproductive efforts; but, a combination of factors resulted in two of the ponds going dry within three weeks. This time interval is not long enough to allow complete development of any amphibian species in Illinois. In at least two cases, crayfish burrows that penetrated the clay lens under the pond basin allowed the water to drain from ponds sited in the old-field habitat. The failure of the berm constructed at the down-slope end of another of the old-field ponds, allowing water to gradually flow out of this basin, also led to a premature dry-down date.

Efforts to maintain an effective drift fence-pitfall trap network around several ponds in the old-field habitat were also hampered by a combination of heavy precipitation events and high winds. Runoff resulting from the heavy rain events eroded the pond banks underneath the fencing material. As a result, amphibians could trespass under the fence without being trapped in the buckets. A rapid rise in the water level at two of the ponds also displaced several of the buckets (being pushed out of the soil by the rising water table). The force of occasional strong winds against the fencing along the old-field ponds either pushed the fencing material flat against the ground surface, or separated the fence from the stakes meant to hold it erect above the soil. The combination of these problems rendered ineffective the

continued monitoring efforts at five of the six ponds sited in old-field habitat. As such, most of data included in this report were generated from monitoring efforts at the four ponds within the forest habitat, and only one of the old-field ponds (Pond H, within 8 m of forest habitat).

Table 2 lists the species of amphibians and reptiles that have been observed at WHSHA since the beginning of the study (taxonomy follows Phillips *et al*. 1999). Qualitative levels of abundance for each species are based on numbers of individuals captured in the pitfall traps (per unit sampling effort), as well as specimens observed during visual encounter surveys (VES) and choruses of male frogs during each species' breeding season. The ponds were sited within only the southern portion of WHSHA; as such, other amphibian and reptile species are likely present on the property (*e.g*., *Rana sylvatica* (wood frogs) have been collected from lowland areas within the northeast portion of WHSHA; T. Esker, pers. comm.). Based on VES and breeding chorus surveys, the pre-existing pond mentioned above contained breeding populations of bullfrogs, southern leopard frogs, and Blanchard's cricket frogs. Because specimens at this pond were not marked, it is not known if these populations served as a source for colonization of the newly-constructed ponds.

More individuals were trapped during the 2006 activity season as compared to the first half of the 2007 activity season (Figure 2). Table 3 lists mean body sizes for those species for which there are adequate data (from collection in pitfall traps), as well as the occurrence of recaptures. Not all of the amphibian species found at WHSHA are represented in Table 3 because some species are not conducive to the trapping regime used in this study (*e.g., Acris crepitans blanchardi, Pseudacris crucifer*), or were never observed using the ponds but were seen in close proximity to them (*e.g., Plethodon glutinosus*). The following paragraphs summarize each of the species' usage patterns of the ponds since the beginning of the study.

Ambystoma texanum – This species appears to utilize ponds in both forest (44.4 % of individuals captured) and old-field (55.6 %) habitat; however, individuals utilized only forest ponds in the second breeding season. Both males (57.1 %) and females (28.6 %) were represented among the trapped individuals, with the remainder being juveniles. Two individuals were recaptured (one in each season), and more individuals were caught in March (55.6 %) than any other month during the activity season.

Bufo fowleri – More individuals of this species were captured (152) than for all other amphibians combined. Most of the specimens trapped were juveniles emerging from ponds (79.6 %), and the peak in this activity occurred in June and July. The majority of collected toads (87.5 %) were associated with ponds within the forest habitat (Figure 3). Of the adults whose sex could be accurately ascertained, 80 % of these were male. One of the recaptured adults from an old-field pond had a noticeable limb deformity where all toes on the left posterior appendage were fused.

Hyla chrysoscelis x *versicolor* – The population status of this species at WHSHA ponds is difficult to assess because treefrogs can avoid being trapped in a drift fence array. All but one of the 29 individuals were juveniles trapped during the first activity season, and there were no recaptures. More specimens were trapped in August (65.5 %) than during other months of the study, and none of the individuals were caught in old-field ponds.

Pseudacris crucifer – The population trend for this species at WWNP is difficult to assess because, as a group, treefrogs can easily escape from pitfall traps and climb over drift fences. Nevertheless, breeding choruses have been heard regularly, but only at the ponds within the

forest habitat (where all individuals were trapped). Three juvenile individuals were all observed in July 2006, with one of those specimens being re-caught in the following year.

Rana catesbeiana – This species is a generalist with individuals being active between March and November. Because *R. catesbeiana* larvae require a full year of development before metamorphosis to a subadult, breeding efforts in all ponds that dry-down within one activity season will fail. Nevertheless, most of the individuals captured in this study were subadults (64.3 %), likely as they dispersed through the habitat. One recapture was recorded, and individuals were observed only using the ponds within the forest habitat.

Rana utricularia – This species tended to be active at WHSHA from March to September, and was observed more often at ponds in the old-field habitat (40.0 %) than other amphibian species (Phillips *et al*. 1999). Like bullfrogs, most of the individuals trapped were subadults (64.7 %).

STATUS & RECOMMENDATIONS

The construction of wetland habitat to support breeding populations at WHSHA initially appears to have been successful. As evidenced by the appearance of egg masses within the ponds, adults of several amphibian species were observed using the constructed ponds as breeding sites. Furthermore, juvenile amphibians were captured as they emerged from the ponds and dispersed to the surrounding habitat. The disparity between the numbers of individuals observed in each year (Figure 2) is likely due to the fact that the study concluded before the end of the 2007 activity season (also, see below). Although it is possible that pond hydroperiod contributed to the lower number of individuals trapped in 2007, the study did not

extend into the months when the juveniles of several species would disperse from their natal ponds following metamorphosis.

I do not believe that IDNR should be concerned about the population status of any of the species recorded at WHSHA because these species all have healthy populations elsewhere in their geographic distribution (Conant and Collins 1991) &/or do not rely on the ponds as breeding habitat (*e.g.*, *Plethodon glutinosus*). If adequate funding &/or man-power is available, I suggest continued monitoring of amphibians in the four ponds within the forest habitat of WHSHA. Long-term monitoring not only assures that management objectives for WHSHA are being met, but will also provide a valuable data set that contributes to the understanding of changes in amphibian populations (Semlitsch *et al*., 1996).

The failure of several of the newly-constructed ponds to hold water for durations long enough to support successful amphibian breeding activity was an unfortunate, but unforeseen, outcome of this study. I recommend that IDNR re-excavate those ponds in the old-field habitat that dried-down within 45 days and did not refill for periods longer than 14 days (ponds E, F, and G). Ensuring that these sites have a hydroperiod long enough to support the larval portion of at least one amphibian species (minimum of 60 days) will help establish a network of wetland habitat that promotes amphibian population health. Excluding crayfish from each of these ponds will also likely help ensure a longer hydroperiod, but this is a more challenging proposition than simply re-packing the berms and assuring the integrity of the clay lens below the basin of each pond.

Because collection efforts around several of the ponds in the old-field habitat were discontinued early in the study, the data set is biased by a more intensive sampling effort of ponds in the forest habitat. If the sampling effort is standardized across the number of ponds,

however, there were still fewer amphibians trapped at ponds in the old-field habitat. Excepting the southern leopard frog and the western chorus frog, the amphibian species observed at WHSHA typically favor forest habitat or an ecotone that includes a forest edge. Should additional ponds be constructed at WHSHA in the future (see precautionary statements about this practice, below), I recommend that a majority of these be placed in immediate proximity to (≤ 5 m), or within, the forest habitat. Previous research has shown that survivorship of juvenile amphibians is higher in ponds sited in forest habitat, as compared to those in old-field habitat (Rothermel and Semlitsch 2002).

As expected for any amphibian community, not all species were most abundant at the same time period during the study. The difference in the timing of peak reproductive activity likely reduces competition for resources amongst the larvae of the various species (Faragher and Jaeger 1998). Of the species recorded at the new WHSHA ponds, those that breed earlier in the activity season (e.g., *Ambystoma texanum, Pseudacris crucifer*, and *Rana utricularia*) should experience greater reproductive success. This is because those are the months (late February through early May) that the ponds are more likely to contain water from snow melt and higher Spring precipitation patterns that will support larval development.

All but two of the amphibian species (*Plethodon glutinosus* and *Acris crepitans blanchardi*) were recorded from at least one of the ponds in both years of the study. For all species, the numbers of individuals recorded for each were always fewer in 2007 as compared to 2006. I am not surprised by this trend, however, for at least three reasons. First, as noted above, the 2007 sampling effort did not extend into the second half of the activity season and, therefore, might have missed the emergence of juveniles of some species. Second, amphibians can take several years to establish stable populations in wetland habitat, even if

that habitat had been used previously by the same species (Dodd and Johnson 2007). Third, the moderate drought experienced across east-central Illinois in 2006 produced conditions that made amphibian breeding at these ponds a challenging endeavor. Because many amphibian species exhibit natal site fidelity when choosing breeding sites (Stebbins and Cohen 1995, Weyrauch and Amon 2002), a poor reproductive effort in 2006 might have restricted the number of adults returning to these ponds during the following year. Furthermore, several of these species take more than one year following metamorphosis (as a subadult) to reach a sufficient body size where they can successfully allocate enough energy to reproduction (Semlitsch et al. 1996, Dodd and Cade 1998). Some of the individuals that were able to complete metamorphosis in 2006 might still return to these ponds in future breeding seasons.

If the management objectives concerning the amphibian community at WHSHA are to be met, I recommend that IDNR consider the re-excavation of the three ponds that experienced hydroperiods shorter than 60 days. I also suggest that monitoring efforts at a subset of ponds in both habitat types (forest and old-field) be maintained for the next several years. At the very least, monitoring efforts should include breeding chorus surveys for frogs (Florey and Mullin 2005), and periodic surveys on warm rainy nights in the early Spring (for salamanders). Just as long-term monitoring can reveal trends about the recovery of amphibian populations from environmental stress (Walston and Mullin 2007), so can this technique provide insights as to the most effective method(s) of establishing new amphibian breeding sites. Until this monitoring effort is completed, I recommend that IDNR not construct any additional wetlands at WHSHA; rather, the amphibian community should get accustomed to the availability of the ponds constructed at the beginning of this study.

Acknowledgments – I thank A. Fornell, L. Gross, K. Harper, M. Olds, R. Tomshack, M. Wilson, and especially S. Adams and T. Buhnerkempe for their assistance with maintaining the drift fence/pitfall trap arrays and monitoring the arrays to collect amphibians. I am grateful to IDNR for partially offsetting the funding for this project. I am also indebted to T. Esker for advice, and to C.M. Moomey for granting permission to conduct research on IDNR property.

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Table 1. Relative canopy closure and hydroperiod and for ponds at WHSHA monitored for amphibian breeding activity between 15 February 2006 and 30 June 2007. Canopy closure was assessed using a spherical densiometer during October 2006 (0 % = no canopy). Where no date is listed, ponds contained at least some water throughout activity season.

Pond	Habitat	Canopy closure (%)	Hydroperiod (1st dry-down date)
A	forest	51.7	--
B	forest	61.7	* 28 April
C	forest	38.3	--
D	forest	38.3	--
E	old field	0	* 20 March
F	old field	0	* 24 March
G	old field	0	* 20 March
H	old field	0	* 22 April
I	old field	0	* 22 April
J	old field	0	* 24 April

* = ponds that re-filled after heavy precipitation events, and experienced more than one dry-down within an activity season.

Table 2. Species list of amphibians and reptiles observed at Wildcat Hollow State Habitat Area, Effingham County, Illinois, between November 2005 and June 2007. Qualitative assessments of abundance of amphibian species are provided based on trapping and other survey efforts. * = species for which sufficient data collected during funding period (2006-2007) exist to illustrate pattern of pond use – see Figure 2. † = one specimen accessioned with INHS to update biogeographic records for Effingham County.

Taxon		Relative abundance
ORDER URODELA		
Family Ambystomatidae –	*Ambystoma texanum*	common
Family Plethodontidae –	*Plethodon glutinosus* †	moderate (not a pond-breeder)
ORDER ANURA		
Family Bufonidae –	*Bufo fowleri* *	common
Family Hylidae –	*Acris crepitans blanchardi*	moderate
	Hyla chrysoscelis x *versicolor*	common (regularly heard)
	Pseudacris crucifer	moderate
	Pseudacris triseriata	moderate (regularly heard)
Family Ranidae –	*Rana catesbeiana*	common
	Rana utricularia	common
ORDER CHELONIA		
Family Emydidae –	*Terrapene c. carolina*	
ORDER SQUAMATA		
Family Scincidae –	*Eumeces fasciatus* †	

Table 1, cont'd.

Eumeces laticeps

Family Iguanidae – *Sceloporus undulatus hyacinthinus* †

Family Colubridae – *Coluber constrictor foxii*

Diadophis punctatus edwardsii

Pantherophis spiloides †

Table 3. Mean adult body size (± 1 standard error) and number of recaptures of post-metamorphic amphibians trapped in drift fence-pitfall arrays around 10 ponds at Wildcat Hollow State Habitat Area between 15 February 2006 and 30 June 2007. Only those species for which sufficient data are available are listed. (SVL = snout vent length; n = sample size for SVL measurements).

			# of recaptures	
Species	SVL (mm)	n	2006	2007
Ambystoma texanum	69.5 ± 3.8	4	1	1
Bufo fowleri	31.6 ± 2.0	10	12	2
Hyla chrysoscelis (x *versicolor*)	42	1*	1	0
Pseudacris crucifer	29.1 ± 2.4	41	1	0
Rana catesbeiana	56.7 ± 3.3	3*	0	1
Rana utricularia	56.2 ± 8.4	5*	0	0

* = many more young-of-the-year frogs caught during study period.

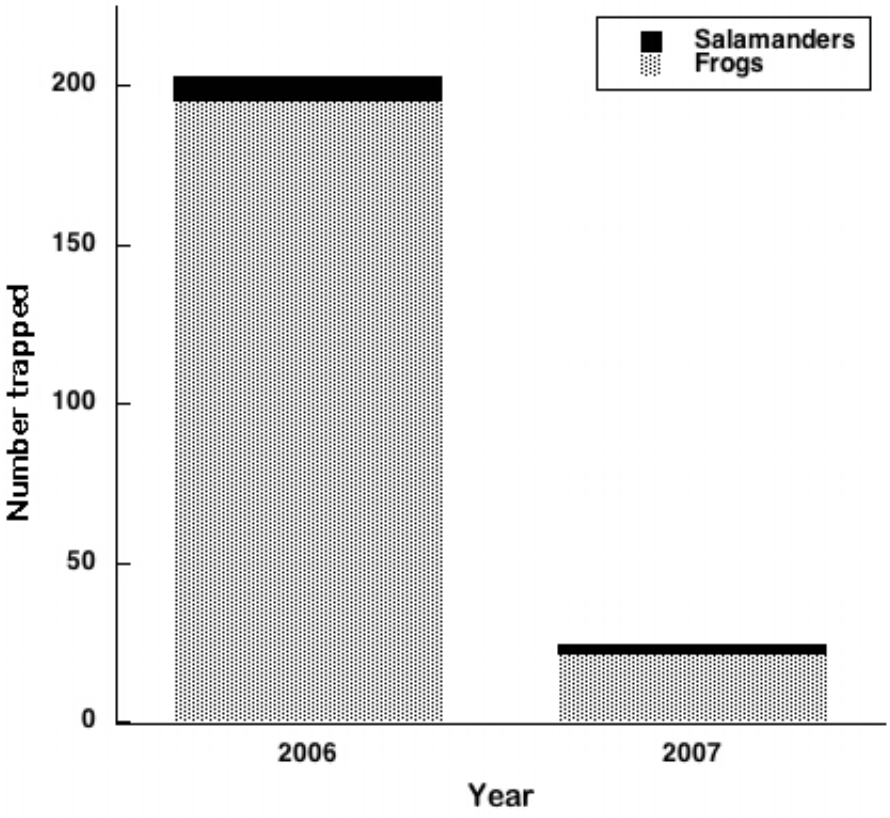

Figure 2. Number of amphibians trapped at recently-constructed ponds in Wildcat Hollow State Habitat Area, Effingham County, Illinois, from 15 February 2006 to 30 June 2007.

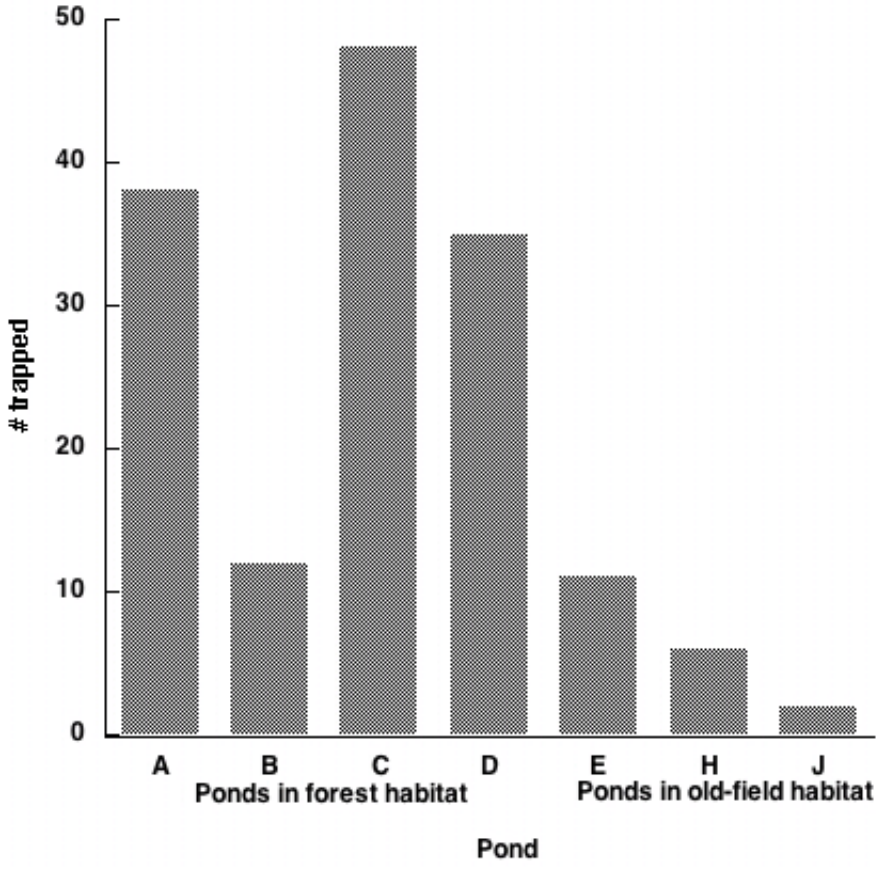

Figure 3. Number of Fowler's toads (*Bufo fowleri*) captured in each of several ponds at Wildcat Hollow State Habitat Area, Effingham County, Illinois, between 15 February 2006 and 30 June 2007. Ponds A-D were each surrounded by deciduous hardwood forest, whereas ponds E, H, and J were each located in old-field habitat.

24 July 2007

Terry Esker, Natural Heritage Biologist
Illinois Dept. of Natural Resources
4295 North 1000th Street
Newton, IL 62448

Dear Terry:

Thank you and IDNR very much for helping offset the costs associated with conducting research on the herpetofauna of Illinois. I am pleased to include the enclosed Final Report for the portion of my study covered under the grant (#07-011W), " Colonization of newly-constructed wetlands by an amphibian community." The report details the background of the project, and the information that was gathered during the grant period.

Based on my understanding of the amphibian community at WHSHA and IDNR management objectives for this site, I consider the construction of the wetland habitats an initial success. I would recommend that the IDNR re-excavate three of the ponds that weren't able to hold water for periods of longer than 45 days, and to otherwise allow the amphibian community to adjust to the presence of these ponds for several years.

I understand that you already have the Payment Request Form from EIU's Business Office. Please feel free to contact me should you have any questions concerning my report. Thanks again for your cooperation.

Cordially,

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Enclosure.