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Herpetofaunal Abundance and Distribution in Northern Minnesota: Contributions of Ecological Land Units and Assessment of Sampling Methodology

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Herpetofaunal species distributions need to be understood and mapped using landscape descriptions that incorporate important habitat features and ecological processes. An ecosystem management effort in northern Minnesota is characterizing a landscape as a coarse filter for ecological communities. The coarse filter approach involves looking at communities in different successional stages and habitat types in a region (Haufler et al. 1996). Documenting distributions and abundances of herpetofauna using this coarse filter approach will allow data about these species to be incorporated in landscape planning efforts.

This study is part of a cooperative ecosystem management study between Michigan State University and Boise Cascade Corporation (BCC) in northern Minnesota. BCC's coarse filter approach involves using an ecosystem diversity matrix (EDM) to characterize their lands. In this matrix, habitat types classified by soil moisture and soil nutrients, such as hydric soils with very poor nutrient levels, are on one axis, and successional stages, such as saplings, are on the other axis. Where the two axes intersect is called an ecological land unit, or ELU.

In their study BCC is interested in documenting the presence or absence, abundance, distribution, and diversity of birds, small mammals and reptiles and amphibians among their ELUs. The objectives of this portion of the study were: to determine herpetofaunal species abundance, distribution, richness, and diversity in the different ELUs; to compare different sampling methods for effectiveness in surveying herps in northern Minnesota; and to provide recommendations to BCC for continued monitoring of herps on their lands.

METHODS

This study took place in International Falls, Minnesota, on lands owned by BCC, the state of Minnesota, and Koochiching County during the summers of 1996–98. Sites were originally chosen using gross site characteristics and a preliminary EDM according to BCC protocol during the summer of 1996. These sites eventually helped define BCC's full EDM which was completed in the spring of 1998. Because of this process, the resulting number of ELUs sampled does not represent the entire matrix, and there is not equal replication within the ELUs that were sampled. There were a total of 12 ELUs sampled, each designated by successional stage (early, late), soil moisture (dry, mesic, wet), and soil nutrients (very poor, poor, poor-medium, medium; Table 1).

The sampling methods used in this study were time-constrained searches, area-constrained, or plot, searches, and drift fences with *pitfall and funnel* traps, in addition to incidental sightings while in the stands. All animals were toe-clipped for recognition and released, with the exception of the incidental observations, which were not toe-clipped. All animal handling procedures were approved by the MSU All University Committee on Animal Use and Care (# 06/96-066-00).

Time-constrained searches (TCS) consisted of one 60-min search per site within 48 h after rainfall. Area-constrained, or plot searches, included examining one 5 × 20 m plot for every 30 acres (12.1 ha) of a site within 48 h after rainfall. This method was different from TCS in that it more thoroughly examined a smaller area. Both methods were used throughout the summer.

One drift fence array, consisting of three arms of aluminum sheeting, partially buried in the ground and 7.0 m long, radiating out 120° from each other was installed per site. Pitfall traps were each constructed of two number 10 cans silicone-sealed together, and buried at each of the ends of the drift fences. Funnel traps were placed on one side of each of the drift fences, and were constructed of window screening rolled into a cylinder with a cone in each end. The traps were opened for five consecutive nights each month for 3 mo, during which time they were checked daily.

RESULTS

The majority of the animals captured in time-constrained searches were American toads (*Bufo americanus*) and wood frogs (*Rana sylvatica*). Additionally, some spring peepers (*Pseudacris crucifer*) and two boreal chorus frogs (*P. triseriata maculata*) were captured. This is the only method in which we captured boreal chorus frogs (Table 2).

American toads and wood frogs were also the main species captured in plot searches, with the addition of blue-spotted salamanders (*Ambystoma laterale*). No animals were captured in either the LW(vp) or the EW(m) ELUs using this method (Table 2).

Many more individuals were caught in pitfall and funnel traps than in either the time or plot searches, including a majority of American toads and wood frogs. Additionally, more species were captured, including the gray tree frog (*Hyla versicolor*), Northern leopard frog (*Rana pipiens*), and Eastern garter snake (*Thamnophis s. sirtalis*). All species caught in TCS or plot searches were also caught in traps, with the exception of the boreal chorus frog (Table 2). In incidental sightings the same species were found as were found in traps, excepting the gray tree frog, but fewer numbers of individuals were found, especially for the American toads and wood frogs.

Species diversity was calculated using the Shannon-Weaver diversity index (Shannon and Weaver 1949), using data collected from all methods (plot searches, time searches, traps) and corrected for number of plots searched and sites. Diversity was very similar among most of the ELUs (Table 3). The ELU with the highest diversity was

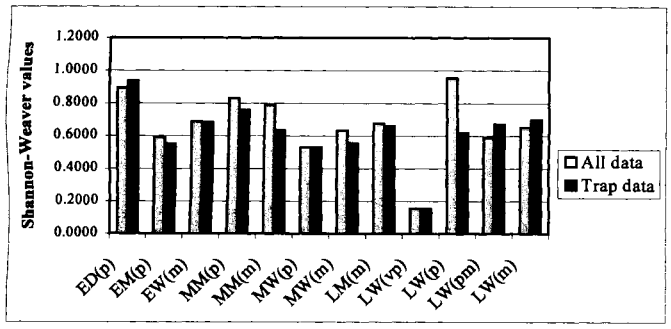

Fig. 1. Shannon-Weaver diversity index values for all data combined (plot searches, timed searches, and traps) and trap data alone.

Table 1. List of ELUs, corresponding MSU codes, and number of sites used in the study.

ELU	MSU code	No. Sites
Early Dry (Poor)	ED(p)	1
Early Mesic (Poor)	EM(p)	4
Early Wet (Med)	EW(m)	2
Med Mesic (Poor)	MM(p)	1
Med Mesic (Med)	MM(m)	4
Med Wet (Poor)	MW(p)	2
Med Wet (Med)	MW(m)	2
Late Mesic (Med)	LM(m)	4
Late Wet (Very Poor)	LW(vp)	4
Late Wet (Poor)	LW(p)	2
Late Wet (Poor-Med)	LW(pm)	4
Late Wet (Med)	LW(m)	2

LW(p), and that with the lowest diversity was LW(vp). Evenness of ELUs was calculated using Pielou's J (Hayek and Buzas 1997) and was approximately the same among all ELUs (Table 3). The Shannon-Weaver Diversity Index was also calculated for each of the methods alone, demonstrating that the trapping data were the most similar to that of the overall data in terms of diversity (Fig. 1).

Table 3. Shannon-Weaver diversity index values (H') and Pielou's J values for trapping data and all data (traps, plot searches, time searches) combined.

	All data		Trap data	
ELU	H'	J[1]	H'	J
ED(p)[2]	0.8935	0.6344	0.9368	0.6758
EM(p)	0.5888	0.6064	0.5513	0.6381
EW(m)	0.6873	0.8088	0.6849	0.8059
MM(p)	0.8298	0.5986	0.7598	0.6916
MM(m)	0.7890	0.9287	0.6352	.
MW(p)	0.5306	0.7655	0.5300	0.7647
MW(m)	0.6328	0.5737	0.5562	0.6066
LM(m)	0.6767	0.6378	0.6618	0.6211
LW(vp)	0.1559	.	0.1559	.
LW(p)	0.9545	0.7161	0.6192	0.7331
LW(pm)	0.5873	.	0.6730	0.7174
LW(m)	0.6534	0.7540	0.7005	0.8168

[1]A period indicates where a J evenness value could not be calculated due to a richness value of 1 in at least one site.
[2]Codes in Table 1.

DISCUSSION

The conclusions thus far for the study are as follows: (1) Species diversity and richness in northern Minnesota ELUs is generally low, with American toads and wood frogs being by far the most abundant species (Table 3); (2) There was no consistent pattern in species diversity with successional stage, soil moisture, or soil nutrients. The most diverse habitat type was LW(p), and least diverse was LW(vp), although this pattern was not consistent between other ELUs (Table 3, Fig. 1); (3) Species evenness was approximately the same across ELUs (Table 3); (4) The most efficient sampling method was the pitfall/funnel trap array. We expended approximately 1980 h on installation of the arrays and checking the traps. In contrast, the combination of traps and searches of herptiles yielded results similar to that of the traps alone, and we expended approximately 2344 h on this combination of methods; (5) Pitfall and funnel traps were the most reliable methods for observing uncommon species. Plot and

Table 2. ELUs and species found within them according to search methods defined as follows: P indicates plot search, T indicates time search, and Tr indicates use of a trap.

	American toad	Blue-spotted salamander	Boreal chorus frog	Eastern garter snake	Northern leopard frog	Spring peeper	Wood frog
ED(p)[1]	PTTr	PTr					PTTr
EM(p)	PTTr	Tr				TTr	PTTr
EW(m)	TTr				Tr		TTr
MM(p)	PTTr	Tr				T	PTTr
MM(m)	TTr	Tr				TTr	PTTr
MW(p)	PTTr						PTTr
MW(m)	PTr		T			Tr	Tr
LM(m)	PTTr	Tr		Tr		TTr	PTTr
LW(vp)	Tr						Tr
LW(p)	PTr	Tr	T			P	PTTr
LW(pm)	PTTr	Tr			Tr		TTr
LW(m)	PTTr					Tr	PTr

[1]Codes in Table 1.

time searches were beneficial for presence/absence data, but did not give useful information for species evenness (Table 2); (6) Species were detected differentially with each of the sampling methods, but again, the most efficient and effective sampling method was the pitfall/funnel trap array (Table 2); (7) Species least observed were the boreal chorus frog, the gray tree frog, and the Northern leopard frog. The Eastern garter snake was the only reptile observed; it was caught once in a LM(m) funnel trap and was observed four times in incidental sightings. The blue-spotted salamander was the only salamander species to be observed, and was mainly caught in pitfall traps. Spring peepers were never caught in pitfall traps (Table 2); and (8) Almost every species that was observed through trapping or searches was also observed in incidental sightings, with the exception of the boreal chorus frog and gray tree frog.

Recommendations to BCC for their continued monitoring of amphibians and reptiles include using pitfall/funnel trap arrays as opposed to plot and time searches and to use more than 1 array per site to increase the chances of capturing more of the less common species on their lands.

LITERATURE CITED

HAUFLER, J. B., C. A. MEHL, and G. J. ROLOFF. 1996. Using a coarse filter approach with a species assessment for ecosystem management. Wildlife Society Bulletin 24:200–208.

HAYEK, L. C. and M. A. BUZAS. 1997. Diversity indices. Pages 346–377. *In* Surveying natural populations. L. C. Hayek, ed. Columbia University Press, New York.

SHANNON, C. E. and W. WEAVER. 1949. The mathematical theory of communication. University of Illinois Press, Urbana, Illinois.