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Getting the Drift: Examining the Effects of Timing, Trap Type and Taxon on Herpetofaunal Drift Fence Surveys

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ABSTRACT.—The evaluation of appropriate sampling methodologies is critical for accurately determining the distribution and status of herpetofaunal populations. We report the results of a year-long drift fence study, using multiple trap types (large pitfall traps, small pitfall traps and funnel traps), of a species-rich herpetofaunal community (59 species) surrounding an isolated wetland in the southeastern United States. Specifically, we determined the effects that timing, trap type and taxon had on capture rates of herpetofauna. We found that funnel traps captured the greatest number of herpetofaunal species, but a combination of funnel traps and large pitfall traps yielded the greatest number of individual captures due to complementary biases in capture efficiencies among herpetofaunal taxa. With little exception, small pitfall traps were relatively ineffective for sampling herpetofauna. We also found that the timing of drift fence monitoring affected herpetofaunal species accumulation rates but that seasonal effects were taxon-specific. Our study affirms that drift fences are exceptional tools for inventorying and monitoring diverse species and large numbers of herpetofauna and also demonstrates the important effects that season and taxon can have on capture rates. Therefore, we recommend *a priori* delineation of project goals and the use of multiple trap types with careful attention to the timing of drift fence monitoring to maximize sampling efficiency and minimize biases associated with data collection.

INTRODUCTION

Reptiles and amphibians have historically been under-appreciated as components of many ecosystems (Gibbons, 1988; Bonnet *et al.*, 2002). As ectotherms, reptiles and amphibians make efficient use of energy (Pough, 1980) and, thus, many ecosystems are capable of supporting extraordinarily high densities of herpetofauna compared to endothermic vertebrates (Burton and Likens, 1975; Fitch, 1975; Godley, 1980; Petranka and Murray, 2001). The high densities of reptiles and amphibians found in many ecosystems provide a major thoroughfare for the trophic transfer of energy and matter (Gibbons *et al.*, 2006), and at least one study has shown that high amphibian densities affect ecosystem processes (Wyman, 1998). Moreover, the widespread decline of amphibians has generated considerable interest in documenting the abundance and status of amphibians on a global scale (Houlahan *et al.*, 2000; Collins and Storfer, 2003; Stuart *et al.*, 2004). Whereas the status of reptile populations has received less attention, concern is growing because of similar declines reported for many reptile species (Gibbons *et al.*, 2000; Winne *et al.*, 2007).

The importance of herpetofauna in many ecosystems, coupled with the increasing prevalence of reported declines, has led many agencies to reevaluate the goals of their wildlife inventory and monitoring programs (Hall and Langtimm, 2001). In many cases, monitoring programs have been created or reoriented to examine the distribution and status of herpetofaunal populations, particularly for threatened, endangered or declining species (Hall and Langtimm, 2001). In other cases, studies have been initiated to conduct fundamental herpetofaunal inventories for parks, refuges and other public lands to document the distribution and relative abundance of herpetofaunal species and to guide

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future monitoring programs or management (*e.g.*, Tuberville *et al.*, 2005). The need to collect basic distributional data on reptile and amphibian populations has even been extended to incorporate members of the public into rigorous, report-based inventory and monitoring programs (*e.g.*, Georgia Herp Atlas: Jensen and Moulis, 1997; United States Geological Survey North American Amphibian Monitoring Program: Weir *et al.*, 2005; National Wildlife Federation Frogwatch USA, 2006). Given the urgent need to sample herpetofaunal populations accurately, the evaluation of appropriate sampling methodologies is crucial.

Despite achieving high densities in the landscape, many reptiles and amphibians are difficult to sample quantitatively. Most salamanders, many snakes and several species of anurans and lizards are highly fossorial (Conant and Collins, 1998), making their capture difficult. Furthermore, the cryptic nature of herpetofauna, the winter dormancy of most temperate reptiles and amphibians (Zug *et al.*, 2001), and the influence of climatic factors on their activity and movement (*e.g.*, Gibbons and Semlitsch, 1987; Kam and Chen, 2000; Sun *et al.*, 2001; Brown and Shine, 2002; Todd and Winne, 2006) all affect the likelihood of successfully documenting the presence or abundance of herpetofaunal species. As a result, many methods have been developed to sample herpetofauna (Heyer *et al.*, 1994; Ryan *et al.*, 2002). In particular, several studies have suggested that drift fences with pitfall and funnel traps are a superior way to maximize the number of individuals and number of herpetofaunal species captured (Gibbons and Semlitsch, 1982; Enge, 2001; Ryan *et al.*, 2002). On the other hand, drift fence surveys can be time-intensive and inappropriate applications can result in low capture rates of some species (*e.g.*, Dodd, 1991) or, alternatively, in high mortality of captured animals. Furthermore, documenting the presence of all species occurring in a given area is difficult, if not impossible, and can be particularly time-intensive in systems with many rare species (Gibbons *et al.*, 1997). Thus, researchers often wish to maximize the number of observed species in a manageable unit of time.

Previous studies have compared the effectiveness of different trap types at capturing herpetofauna (*e.g.*, Greenberg *et al.*, 1994; Enge, 2001). However, the effects of taxon and timing of drift fence studies on herpetofaunal captures have seldom been reported (but *see* Dodd, 1991). We conducted a year-long drift fence survey, using multiple trap types (large pitfall traps, small pitfall traps and funnel traps), of a species-rich herpetofaunal community surrounding an isolated wetland in the southeastern United States. In particular, we address the following questions: (1) How effective are drift fences at sampling all herpetofaunal taxa and life-stages? (2) How does trap type affect the diversity and abundance of animals captured? and (3) How does seasonal timing of monitoring affect capture efficiency and species accumulation rate in drift fence surveys for various taxonomic groups? Our results offer significant insights that can further inform the design of herpetofaunal inventory and monitoring programs and reinforce previous findings that drift fences are a time-intensive but effective technique for sampling herpetofauna.

METHODS

STUDY AREA

Ellenton Bay is an isolated freshwater wetland located on the Department of Energy's Savannah River Site (SRS) in the Upper Coastal Plain of South Carolina, USA, and is a typical Carolina bay (*see* descriptions in Sharitz and Gibbons, 1982; Sharitz, 2003). Although water levels are extremely variable, the bay generally holds water year-round and when full, covers approximately 10 ha. Severe droughts have rendered Ellenton Bay dry on at least three occasions in the past three decades and, thus, Ellenton Bay is fish-free. The habitat surrounding Ellenton Bay is a mosaic of old-fields in various stages of succession and second-growth mixed pine-hardwood forest. Ellenton Bay has hosted several long-term studies of reptiles and amphibians (*e.g.*, Gibbons *et al.*, 1983, 2006; Seigel *et al.*, 1995a, 1995b; Willson *et al.*, 2006; Winne *et al.*, 2006, 2007) and is known to harbor a diverse assemblage of reptiles and amphibians (Gibbons and Semlitsch, 1991).

COLLECTION TECHNIQUES

In Feb. 2003 we repaired a terrestrial drift fence (Gibbons and Semlitsch, 1982; Semlitsch *et al.*, 1996), equipped with pitfall and funnel traps, that had been used in studies at Ellenton Bay for all or part of 19 of the 27 y from 1968 to 1994 (Gibbons, 1990; Seigel *et al.*, 1995a, 1995b). The continuous drift fence completely encircled the wetland and was monitored from 1 Feb. 2003 to 31 Jan. 2004.

The drift fence was constructed of aluminum flashing (1230 m long, 40 cm high) and was buried 10 cm into the soil (Gibbons and Semlitsch, 1982). The distance of the fence from the margin of the water varied with water level, but was <10 m in many places during parts of 2003. We installed 164 traps paired along opposite sides of the fence. Of these, 41 pairs of large (19-l) pitfall traps (plastic buckets), spaced approximately every 30 m along the fence, were in place on 1 Feb. 2003. On 24 Feb. 2003, we installed 21 pairs of small (2.3-l) pitfall traps (metal coffee cans) between every other pair of buckets along the fence (60 m apart). Beginning 27 Feb. 2003, 20 pairs of wooden box funnel traps were placed along the drift fence between every other pair of buckets, such that bucket pairs were followed alternately by cans and funnel traps. Funnel traps were rectangular, measuring 92.5 × 32.5 × 28.5 cm, with treated plywood sides and 0.6 cm hardware cloth funnels, extending 28 cm into the trap, with a square 3.5 × 3.5 cm funnel opening.

Pitfall and funnel traps were checked a minimum of once daily (0700–0900). During warm months, traps were checked again in the late afternoon (1700–2000). Sponges were placed in the bottom of buckets and cans to prevent animals from desiccating or drowning; standing water was also bailed from buckets and cans daily as needed. We classified captured amphibians as recently metamorphosed individuals or adults and released them approximately 10 m away on the opposite side of the fence (Gibbons *et al.*, 2006). Funnel traps were closed to captures for a few brief periods in May–Jul. to reduce mortality of metamorphosing amphibians emigrating from the wetland (Gibbons *et al.*, 2006).

During peak emigrations of recently-metamorphosed amphibians, counting all individuals of some species would have resulted in unnecessary mortality due to prolonged retention of animals in traps. Consequently, in these cases, we estimated the number of captured individuals of a species by counting the number contained in a handful or one sweep of a dipnet and the number of handfuls or dipnet sweeps necessary to empty the trap (Gibbons *et al.*, 2006). During mass emigrations, animals were released approximately 30 m on the outside of the fence to avoid inadvertent recapture in outside traps.

ANALYSES

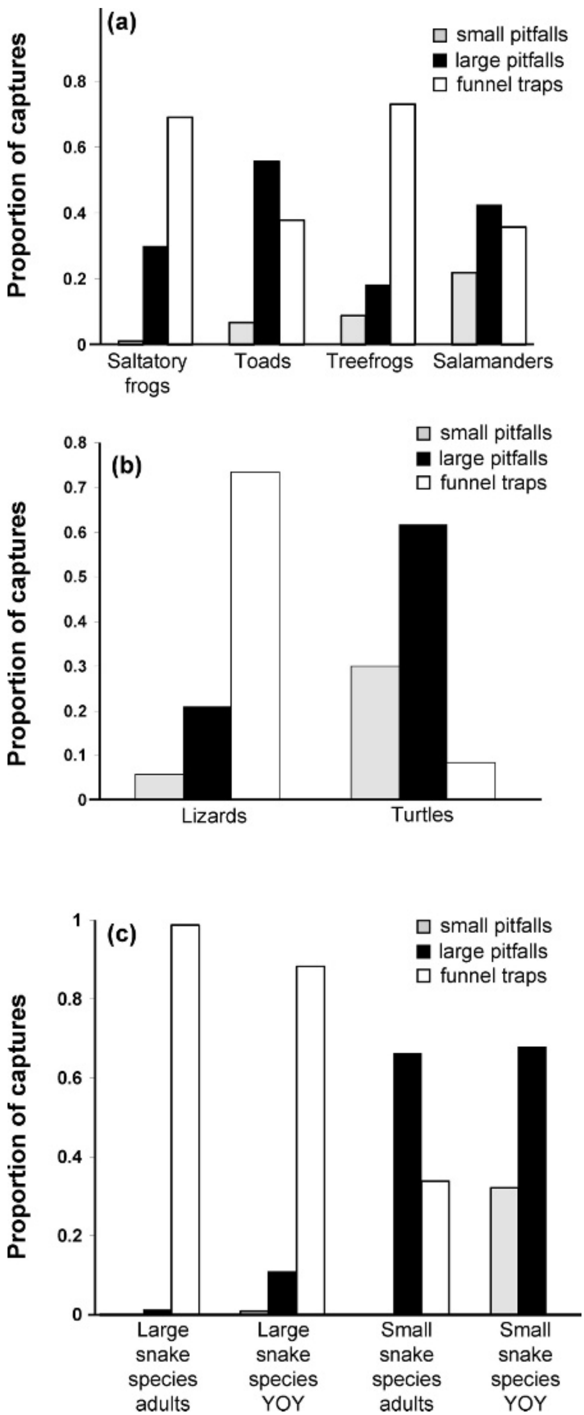
To determine the effect of trap type on the number of animals captured, we first separated animals into groups based on similarities in morphological traits and modes of locomotion. These groups included frogs that could jump well (saltatory frogs), toads, treefrogs, salamanders, lizards, turtles, large snake species and small snake species (*see* Table 1 for species list). Large snake species were defined as those in which maximum reported snout-vent length (SVL) exceeds 50 cm, based on the SRS snake database ($n = 15{,}697$; Andrews and Gibbons, 2007). We further categorized snakes as adults or juveniles

TABLE 1.—Categories used to group herpetofauna for abundance comparisons. The numbers in parentheses following species names are the total number of captures during the sampling year (1 Feb. 2003–31 Jan. 2004) at Ellenton Bay, Aiken, SC, USA. Some captured species were excluded from this list because they were not captured during the periods when all trap types were in use; subsequently they were excluded from statistical comparisons

Category	Species (number captured during entire year)
Saltatory frogs	*Acris gryllus* (658), *Rana catesbeiana* (433), *R. clamitans* (542), *R. sphenocephala* (243,572)
Toads	*Bufo terrestris* (135,184), *Gastrophryne carolinensis* (5,037), *Scaphiopus holbrookii* (1,893)
Treefrogs	*Hyla chrysoscelis* (9), *H. cinerea* (51), *H. femoralis* (3), *H. gratiosa* (654), *H. squirella* (30), *Pseudacris crucifer* (2,670), *P. ornata* (3,967)
Salamanders	*Ambystoma opacum* (207), *A. talpoideum* (13,193), *A. tigrinum* (1,505), *Eurycea quadridigitata* (18), *Notophthalmus viridescens* (6), *Plethodon chlorobryonis* (1)
Lizards	*Anolis carolinensis* (91), *Cnemidophorus sexlineatus* (30), *Eumeces fasciatus* (5), *E. inexpectatus* (4), *E. laticeps* (6), *Sceloporus undulatus* (1), *Scincella lateralis* (36)
Turtles	*Chelydra serpentina* (22), *Deirochelys reticularia* (11), *Kinosternon baurii* (4), *K. subrubrum* (96), *Pseudemys floridana* (8), *Sternotherus odoratus* (4), *Terrapene carolina* (1), *Trachemys scripta* (64)
Small snake species (<50 cm SVL)	*Cemophora coccinea* (1), *Diadophis punctatus* (8), *Seminatrix pygaea* (125), *Storeria occipitomaculata* (2)
Large snake species (>50 cm SVL)	*Agkistrodon contortrix* (1), *A. piscivorus* (105), *Coluber constrictor* (124), *Crotalus horridus* (3), *Elaphe guttata* (2), *E. obsoleta* (2), *Farancia abacura* (6), *F. erytrogramma* (7), *Heterodon platyrhinos* (11), *Masticophis flagellum* (1), *Nerodia erythrogaster* (7), *N. fasciata* (41), *Opheodrys aestivus* (1), *Thamnophis sauritus* (27), *T. sirtalis* (10)

born after 2002 (young-of-year; YOY) by visual inspection of size-frequency distributions, published data on snake sizes at birth and growth rates (Ernst and Ernst, 2003; Gibbons and Dorcas, 2004), and unpubl. data from the SRS snake database. For amphibians, preliminary analyses indicated that the proportions of recently metamorphosed juveniles captured in different trap types were the same as for adults of the same species. Therefore, captures of juvenile and adult amphibians were combined. For analyses, we used capture data collected over the entire year, excluding days when all trap types were not in use. Serendipitous hand captures along the drift fence during checks accounted for a large proportion of captures for turtles (131 of 210) and a smaller proportion of large snake species (43 of 337). We did not include active captures such as these in our analyses of passive trap effectiveness.

We used chi-square tests of independence to determine whether animals in a given species-group were captured more frequently by any single trap type than expected at random. We controlled for family-wise error rates using the sequential Bonferonni method. To compare daily species richness across trap types, we selected the 2-wk period when all trap types were operational and the highest average daily species richness was attained (18–31 Mar. 2003). To standardize trapping effort across trap types, we systematically omitted captures from every other pair of large pitfall traps (beginning with a randomly-selected pair) from the analyses and we eliminated captures from one randomly-selected pair of large and small pitfall traps such that 20 trap pairs of each trap type, equally spaced around the wetland, were included in analyses. We tabulated the number of species captured in


(a)
small pitfalls
large pitfalls
funnel traps
Proportion of captures
0.8
0.6
0.4
0.2
0
Saltatory frogs
Toads
Treefrogs
Salamanders
(b)
small pitfalls
large pitfalls
funnel traps
Proportion of captures
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
Lizards
Turtles
(c)
small pitfalls
large pitfalls
funnel traps
Proportion of captures
1
0.8
0.6
0.4
0.2
0
Large snake species adults
Large snake species YOY
Small snake species adults
Small snake species YOY

each trap type on each day and compared the mean daily species richness captured across trap types for lizards, salamanders, anurans, snakes, turtles and all species combined using non-parametric Kruskal-Wallis tests, controlling for family-wise error rates using the sequential Bonferroni method. We examined all data before analysis to ensure that statistical assumptions were met (Zar, 1998).

Rates of species accumulation are often examined by plotting the cumulative number of species observed vs. trapping effort (*e.g.*, trap nights), total number of individuals captured, area sampled, or length of sampling effort (days, weeks, etc.). Because we were interested in examining the effect of timing of survey initiation on the rate of species accumulated per unit sampling effort, we plotted the daily cumulative number of species captured for each three month period beginning with the start of the study on 1 Feb. 2003. Thus, we generated species accumulation curves beginning 1 Feb., 1 May, 1 Aug. and 1 Nov. We grouped animals as amphibians, turtles, or squamates (lizards and snakes) when constructing the accumulation curves because these groupings are typically the units of interest for study and management, rather than the more specific morphological or locomotory groupings that were necessary to use when comparing the effectiveness of different trap types.

RESULTS

We captured 409,642 amphibians representing 24 species and 1118 reptiles representing 35 species in drift fence traps from 1 Feb. 2003 to 31 Jan. 2004. For all herpetofaunal categories except adult small snake species, we found a significant effect of trap type on the number of animals captured (Fig. 1; statistical results reported in Table 2). Funnel traps captured significantly more saltatory frogs, treefrogs, and lizards than did other trap types (Fig. 1; Table 2). However, we captured significantly more toads, salamanders and turtles in large pitfall traps. Among snakes, funnel traps were significantly more effective at capturing both YOY and adult large snake species (Fig. 1c). We captured significantly more YOY small snake species in large pitfall traps than in other traps, but we found no significant effect of trap type on captures of adult small snake species. Small pitfall traps were the least effective traps for capturing herpetofauna.

We captured an average of 8.6–11.2 species per day during the two weeks when the highest average daily species richness was observed (and all trap types were operational). The numbers of lizard and salamander species captured were not significantly affected by trap type (Fig. 2; statistical results reported in Table 3). However, funnel traps captured significantly more anuran and snake species, as well as more total species per day, than did other trap types (Fig. 2; Table 3). For turtles, large pitfall traps captured a greater number of species per day than did other types of traps (Fig. 2; Table 3). Again, small pitfall traps were ineffective at capturing a large diversity of herpetofaunal species.

The rate of species accumulation depended on both the taxon and the period of drift fence sampling. Nevertheless, sampling from 1 Nov. 2003 to 31 Jan. 2004 resulted in the

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Fig. 1.—The proportion of drift fence captures trap type for each herpetofaunal category. Captures spanned the entire year of data collection but excluded brief periods when all trap types were not in use. *See* Table 1 for category descriptions and Table 2 for sample sizes and statistical results. Captures varied significantly by trap type in all categories ($P < 0.0001$) except adults of small snake species ($P = 0.11$)

TABLE 2.—Results of χ^2 tests of independence on the number of individuals captured in each trap type during periods when all trap types were operational

	Number of individuals captured in trap type				
	small pitfalls	large pitfalls	funnel traps	χ^2	P
Saltatory frogs	51	2788	3154	3405.49	<0.0001
Toads	821	13,535	4487	5120.191	<0.0001
Treefrogs	114	461	899	1095.95	<0.0001
Salamanders	1108	4189	1731	395.3313	<0.0001
Lizards	7	50	86	105.271	<0.0001
Turtles	15	60	4	24.097	<0.0001
Small snake species (young of year)	22	91	0	50.298	<0.0001
Small snake species (adults)	0	8	2	4.4393	0.11
Large snake species (young of year)	1	24	95	197.863	<0.0001
Large snake species (adults)	0	4	170	506.888	<0.0001

Note: *See* table 1 for category descriptions

fewest species captured for all taxa (Fig. 3). Also, sampling from 1 May 2003 to 31 Jul. 2003 yielded the quickest accumulation of new species for all taxonomic groups and also resulted in large numbers of total species captured (Fig. 3). For amphibians, the greatest number of species was captured from 1 Feb. 2003 to 30 Apr. 2003, although accumulation rates were higher during all other sampling periods (Fig. 3a). For all reptiles, the six warmest months of the year (*i.e.*, 1 May–30 Sep.) resulted in the most species observed and the quickest accumulations of new species (Figs. 3b, c).

DISCUSSION

Previous studies have documented the effectiveness of drift fences with associated traps for rapidly accumulating large numbers of reptiles and amphibians (Gibbons and Semlitsch, 1982; Greenberg *et al.*, 1994; Leiden *et al.*, 1999; Enge, 2001). And, at least one study has demonstrated drift fence sampling to be more effective in capturing herpetofauna than other commonly used methods such as coverboard arrays and time-constrained searches (Ryan *et al.*, 2002). Our results offer additional support that drift fences are useful for inventorying and monitoring diverse species and large numbers of herpetofauna. However, capture efficiencies and species composition of captured animals varied substantially depending on trap type and season and, thus, could profoundly affect conclusions about population status and community composition.

Funnel traps and large pitfalls were complementary in their strengths and weaknesses, an observation also reported by Corn (1994); Greenberg *et al.* (1994) and Enge (2001). Although both funnel traps and large pitfalls captured significant numbers of individuals, the more effective trap type varied depending on the taxon in question. Funnel traps captured large numbers of lizards, saltatory frogs, treefrogs and large snake species, agreeing with results found by Enge (2001). In contrast, large pitfalls were more effective at capturing toads, salamanders, turtles and small snake species. Small pitfalls captured the fewest animals for all taxa, except for turtles which were captured less frequently in funnel traps. The species diversity of captured animals also varied depending on trap type for most taxa. For snakes, anurans, and all herpetofauna collectively, funnel traps had the greatest mean daily number of species captured of all three trap types. The mean number of salamander and lizard species captured daily was not affected by trap type but was greatest in

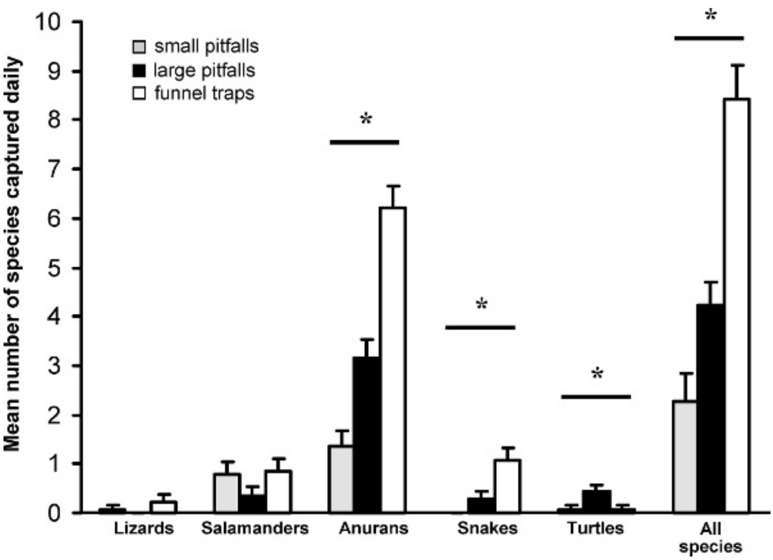


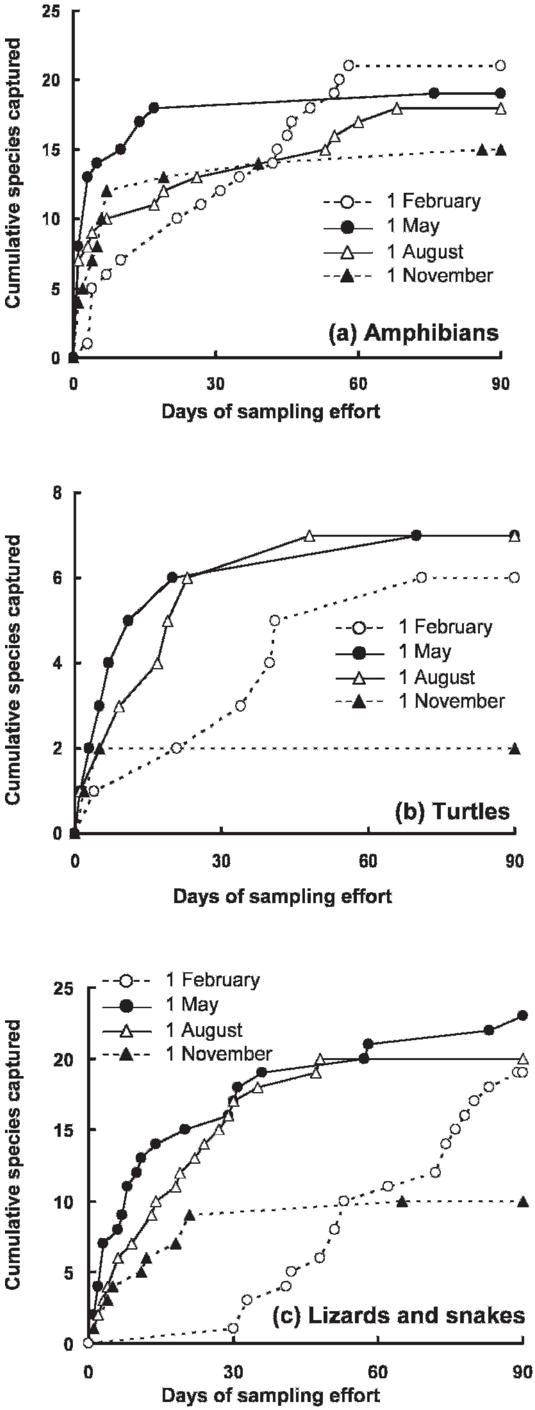
FIG. 2.—Mean number of species captured daily (±1 SE) in each trap type during the two consecutive weeks of greatest species richness in drift fence captures (18–31 Mar. 2003). An asterisk ('*') denotes a significant difference in the number of species captured for each group ($P < 0.05$)

large pitfall traps for turtles. Greenberg *et al.* (1994) and Enge (2001) both found that funnel traps were generally the only effective method for capturing large snakes, a conclusion also supported by our analyses. However, in our study, we hand-captured large numbers of both turtles and large snakes that we encountered during drift fence checks. Nevertheless, drift fences must include funnel traps if researchers hope to accurately sample most snakes.

Because many reptiles are thermophilic and many pond-breeding amphibians in North America undergo seasonal migrations to breeding habitats (*e.g.*, Paton *et al.*, 2000; Todd and Winne, 2006), activity patterns and subsequent captures can be influenced by the time of year during which areas are sampled (*e.g.*, Leiden *et al.*, 1999). Variation in activity patterns among herpetofaunal taxa is reflected in the disparate accumulation rates we observed depending on the date at which drift fence monitoring was initiated. Consequently, seasonal activity patterns of the target taxa must be taken into account when decisions are made about the timing of drift fence sampling. Ideally, the duration of sampling must be exhaustive or the particular activity periods of the species of interest should be comprehensively encompassed (*e.g.*, sampling during breeding migrations). Arbitrary

TABLE 3.—Results of Kruskal-Wallis tests for effects of trap type on daily species richness observed

	H	P
Anurans	27.58	<0.0001
Salamanders	2.70	0.26
Lizards	2.15	0.34
Turtles	7.54	0.02
Snakes	16.78	0.0002
All species	26.69	<0.0001



Cumulative species captured
Days of sampling effort
1 February
1 May
1 August
1 November
(a) Amphibians
(b) Turtles
(c) Lizards and snakes

application of drift fence sampling may result in variable abundance estimates from one sampling session to another that are more apparent than real. For example, eightfold more *Agkistrodon piscivorus* were captured at the drift fence in the month of Mar. compared to Jun. (30 vs. 4; Glaudas *et al.*, 2007).

To avoid biases in the interpretation of abundance data collected in drift fence surveys, sampling across years should be repeated with the same effort during the same months or seasons. However, for inventory purposes where the goal is identifying as many herpetofaunal species as possible, using drift fences during times when the majority of species have overlapping periods of activity (*e.g.*, early spring in the Southeast based on the current study) will maximize the number of species observed per unit time. Importantly, activity periods can vary by latitude (*e.g.*, *Crotalus horridus*, Ernst and Ernst, 2003), as well as by species, and some *a priori* knowledge about species' patterns of distribution and abundance at the study site can facilitate successful study of herpetofaunal communities.

Lastly, we distinguish between two common sampling applications of drift fences. Drift fences can be used in open arrays for sampling herpetofauna (Corn, 1994), or they can be constructed to encircle breeding ponds to intercept and capture migrating animals when monitoring herpetofaunal populations (Dodd and Scott, 1994). A typical assumption more important to pond-encircling fences is that all individuals entering or exiting a habitat are captured. However, for pond-encircling drift fences such as the one used in our study, not all animals are captured due to fence trespassing which may vary among species (*e.g.*, Dodd, 1991). Ultimately, both open arrays and pond-encircling drift fences have assumptions about detectability which can vary among species, habitats, seasons, and trap types. As a consequence, the use of capture-mark-recapture procedures is prescribed because it can allow estimation of both detection probabilities and fence trespass rates which can improve estimates of animal abundances and population sizes (Bailey *et al.*, 2004a, b). Without estimating detection probabilities, trap data from either application of drift fences are generally useful only for inventory work and analysis of species richness, and should not be used to compare the relative abundance of a species among habitats, or to compare relative abundances of different species which may differ in detectability.

CONCLUSIONS

No single trap type is likely to capture all herpetofaunal species in proportion to their abundance in the landscape. In particular, many lizards and large snakes are undersampled if researchers rely on pitfall traps alone (*see* also Campbell and Christman, 1982; Clawson and Baskett, 1982; Bury and Corn, 1987; Greenberg *et al.*, 1994). Additionally, differences in behavior, size, morphology and mode of locomotion can profoundly affect the capture success of a given trap type. For example, anurans with long hind limbs that can jump well, and treefrogs, which are adept climbers, were both underrepresented in small and large pitfall traps (*see also* Enge, 2001). In general, our results provide evidence that researchers should use a combination of large pitfall traps and funnel traps along drift fences to maximize the composition and diversity of species sampled. Biases resulting from the use of only one trap type could misrepresent community structure or population structure in species with large

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Fig. 3.—Cumulative number of species captured in drift fences during continuous daily sampling using all trap types and equal sampling effort for three month sampling intervals beginning 1 Feb., 1 May, 1 Aug. and 1 Nov. 2003. Variation in accumulation rates and the total number of species captured reflects seasonal differences in the activity patterns of herpetofaunal species

variation in body sizes (*e.g.*, many snake species). The use of multiple trap types during herpetofaunal drift fence studies has also been suggested by researchers working in other regions and habitats (Corn, 1994; Greenberg *et al.*, 1994; Enge, 2001). In studies with only one target species, or if target species are similar in behavior and ecology, only one trap type may be required to accurately monitor populations. Lastly, drift fences may not adequately census some species (*e.g.*, arboreal treefrogs, Gibbons and Semlitsch, 1982; Dodd, 1991), and additional capture methods involving coverboard arrays, hylid tubes or frog-call loggers may be required to survey herpetofaunal populations comprehensively (Heyer *et al.*, 1994).

Despite their usefulness, drift fences can require considerable amounts of time to install, maintain and monitor. Whereas researchers may diverge on the frequency with which they check pitfall and funnel traps along drift fences, in general, more frequent trap checking minimizes trap-related mortality (Enge, 2001). In the current study, we checked drift fences at least once daily and we often made multiple checks throughout the day and night during periods of high animal captures, requiring >600 man-hours to check the traps during the year-long study. Although our study may be atypical due to the remarkable numbers of individuals captured and the significant time required to monitor captures (Gibbons *et al.*, 2006), drift fences are frequently time-intensive and should involve diligent delineation of project goals before installation and use in studies. Our study demonstrates the important effects that trap type, taxon and timing of drift fence surveys have on capture rates and should inform subsequent inventory, monitoring and management programs.

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