AQUATIC TURTLES OF DIVERSELY MANAGED WATERSHEDS IN THE OUACHITA MOUNTAINS, ARKANSAS

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Abstract—Aquatic turtles were trapped using hoop nets in creeks and ponds located in four Ouachita Mountain watersheds (Little Glazypeau, North Alum, Bread, and South Alum Creeks). These watersheds range in management from one dominated by industrial loblolly pine (*Pinus taeda* L.) plantations to one having virtually no management for many decades. Trapping effort consisted of 212 trapnights (192 in streams, 20 in ponds) during July and August 1995 and 1996. There were 63 captures for a success rate of 0.297 captures per trap-night. Captured turtles were individually marked and released. Stream characteristics potentially related to turtle habitat were evaluated at each trapping site. Common snapping turtles (*Chelydra serpentina* L.) were the most common species captured, occurring in all watersheds and in both streams and ponds. Five other species were captured, notably the razorback musk turtle (*Sternotherus carinatus* Gray), not previously known to occur in Saline County, and the alligator snapping turtle (*Macroclemys temminckii* Harlan), an Arkansas protected species. Both species richness and number of captures were highest in the more heavily managed watersheds (Little Glazypeau and North Alum). These are also the largest creeks, so effects of management are obscured. The presence of fire-fighting ponds in these watersheds did increase richness. Excluding recaptures, number of turtles captured in streams was positively correlated ($p = 0.0059$) with an index of pool size at the trap site.

INTRODUCTION

Wildlife habitat quality may be influenced by processes beyond the scale of the traditional stand-level study. The Phase III watershed research described in many of the papers in this volume is an attempt to document the impact of forest management on plant and animal communities at a landscape scale. The four Phase III watersheds were chosen to represent a range of management intensities from industrial forestry at one extreme to a virtually unmanaged forested watershed at the other extreme.

The Little Glazypeau Creek watershed (LG) is 1740 ha in size and is the most intensively managed of the four watersheds. LG consists largely of loblolly pine (*Pinus taeda* L.) plantations less than 35 years old, interspersed with natural second growth pine-hardwood stands on ridges and near large streams. LG is owned and managed primarily by Weyerhaeuser Company. Plantations are harvested by clearcutting and regenerated by planting of seedlings. The North Alum Creek watershed (NA) is 3800 ha, and is owned and managed by Weyerhaeuser Company and the Ouachita National Forest (ONF) in about equal proportions. NA is managed operationally by Weyerhaeuser and ONF, so its management is like that described for LG and Bread Creek, respectively. The Bread Creek watershed (BC) is 1255 ha and is owned and managed primarily by ONF. BC is managed operationally for multiple uses. The ONF management regime is less intensive than Weyerhaeuser management, with longer rotations, natural regeneration of shortleaf pine (*Pinus echinata* Mill.), and in general, no clearcutting. The South Alum Creek watershed (SA) is 1460 ha and is the least intensively managed watershed of the four. SA includes an experimental forest and with the exception of a few small experimental cutting treatments, it consists of mature second growth pine-hardwood forest. NA, BC, and SA are all located in Saline County, AR in the Saline River drainage basin. LG is located in Garland County, AR in the Ouachita River drainage basin. Detailed descriptions of these watersheds are found elsewhere in this publication (Tappe and others, in press).

This study was designed to supplement intensive studies of reptile and amphibian communities on the four watersheds (Fox and others, in press; Shipman and others, in press). These studies were designed to compare diversity, richness and abundance of all herpetofaunal species. Because their methods did not adequately sample aquatic turtles, this trapping effort was initiated.

METHODS

Turtles were trapped with baited hoop nets (Lagler 1943, Legler 1960). In 1995, chicken liver and strawberries were used as bait. In 1996, fish and creamed corn were used. Nets consisted of 2.5-cm nylon mesh stretched over 3 hoops of galvanized steel 75 cm in diameter. Nets were approximately 2 m in length. They had a funnel entrance at the downstream end and were closed at the other end. Nets were placed in pools that were deep enough to submerge the bait but shallow enough to allow for breathing space at the top, and were associated with cover (undercut banks, woody debris, rocks) when possible. In 1995 only, ponds were sampled in the LG and NA watersheds. The SA and BC watersheds lacked ponds large enough to allow trapping.

Each trap was kept in the same location for five nights in 1995 and six nights in 1996. Traps were checked daily and bait replaced as needed. All trapping occurred between 11 July and 29 July 1995, and between 15 July and 19 August 1996. Trapped turtles were identified to species, given a unique mark by notching the carapace with a triangular file, measured with tree calipers to the nearest half-centimeter, and released where caught. Exceptions were one razorback

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musk turtle (*Sternotherus carinatus* Gray) that was donated to the Arkansas State University vertebrate museum on request, and one common map turtle (*Graptemys geographica* LeSueur) that appeared to have drowned in the trap.

Habitat data were collected at all 1996 trapping locations. Pool width and length, and maximum depth of each pool were combined into an index of pool size. Substrate compositions of each pool were estimated as percentages in each of four substrate classes: bedrock/boulder, cobble/gravel/sand, silt/mud, or detritus. Boulders were defined as rocks greater than 30 cm diameter. Rocks of smaller size were classified as cobble or gravel. The presence of one or two undercut banks was noted, as was the presence of accessible basking sites (large logs, large rocks).

Relationships between 1996 turtle captures and habitat features were investigated using the SAS PROC CORR procedure (SAS Institute 1993). Pearson correlation coefficients between all habitat variables and number of 1996 turtle captures (all species, excluding recaptures) were calculated.

RESULTS AND DISCUSSION

In 1995, 64 trap-nights were completed in streams and 20 in ponds. In 1996, 128 trap-nights were completed, all in streams. Fifty-five individual turtles representing 6 species were captured a total of 63 times over the 2 years (table 1). NA and LG watersheds had the richest turtle fauna with four species each, and these watersheds also had the largest number of captures, with 19 and 29, respectively. The two watersheds representing the highest level of management intensity therefore produced the most abundance and richness. This relationship is obscured by the fact that these are also the largest watersheds. It is clear that the presence of large ponds in NA and LG added captures, and these ponds are a direct result of management.

The most frequently captured species was the common snapping turtle (*Chelydra serpentina* L.), with 31 individuals captured 39 times in all four watersheds. The presence of ponds in NA and LG contributed to these watersheds having large numbers of common snapping turtle captures. Eleven snapping turtles were captured in 20 trap-nights in ponds (0.55 captures per trap-night). In streams, 28 common snapping turtles were captured in 192 trap-nights (0.15 captures per trap-night). Although it is a habitat generalist (Ernst and others 1994), ponds may be an important habitat feature for this species.

All recaptures were common snapping turtles. This may indicate a strong bond to home range (Ernst and others 1994). In fact, two individuals were captured in the same location in both years. A third individual captured in 1995 moved upstream a short distance and was recaptured in 1996. All other recaptures involved turtles that were released from a trap and then caught again in the same trap within a few days.

Nine razorback musk turtles were captured, all in the Saline County watersheds. This species is near its northern limit in the Ouachitas, and these appear to be the first documented records for this county. No razorback musk turtles were captured in Garland County, although four previous records exist (Personal communication. 1998. Stan Trauth. Arkansas State University, State University, AR 72467). Seven common musk turtles (*Sternotherus odoratus* Latreille) were captured among three watersheds.

All five captures of common map turtles occurred in LG, the only watershed in the Ouachita River drainage basin. Besides geographic isolation, there may be subtle physical differences that make LG a better habitat for this species. Habitat features that may be important to common map turtles include rocky or gravelly substrates (Fuselier and

Table 1—Aquatic turtles captured with hoop-nets in four Ouachita Mountain watersheds by species (Arkansas), 1995 and 1996 combined data

	Watershed				
Species	NA	LG	SA	BC	Total
Common snapping turtle	4 + 3[a]	13 + 8	7	4	28 + 11
Razorback musk turtle	8	0	0	1	9
Common musk turtle	3	1	3	0	7
Common map turtle	0	5	0	0	5
Red-eared slider	0	0 + 2	0	0	0 + 2
Alligator snapping turtle	1	0	0	0	1
Total	16 + 3	19 + 10	10	5	50 + 13

NA = North Alum Creek; LG = Little Glazypeau Creek; SA = South Alum Creek; BC = Bread Creek. Watersheds listed in order of decreasing size.
[a] Data are combined for ponds (20 trap-nights in NA and LG) and streams (192 trap-nights in all watersheds). Where pond captures are present, data presented as (stream captures) + (pond captures).

Edds 1994), in-stream basking sites (Pluto and Bellis 1986), and plentiful mollusk food items (Vogt 1981). Red-eared sliders (*Trachemys scripta elegans* Wied-Neuwied) were also captured only in LG, and these were only in ponds. This species is known to occur in both streams and ponds, but prefers slow-moving or still waters with muddy bottoms (Ernst and others 1994).

One alligator snapping turtle (*Macroclemys temminckii* Harlan) was captured, in the largest pool in NA. This species is protected by the states of Arkansas and Oklahoma, and is thought to be in decline throughout its range. Possible factors include over-harvest and impoundment of rivers (George 1987, Pritchard 1989).

Pearson correlation coefficients relating habitat variables to number of 1996 captures are shown in table 2. Number of 1996 turtle captures was significantly correlated only with the index of pool volume, indicating that larger pools produced more captures. Percent cobble/gravel/sand was significantly negatively correlated with percent rock/bedrock and percent detritus. There are several possible reasons for the relationship between pool size and turtle captures. Larger pools are more persistent throughout the dry summer season. They provide greater cover in the form of deep water than smaller pools. They may provide a greater diversity of habitats such as different water depths. Finally, they may not provide better habitat, but just more of it. If each trap tended to attract all the turtles from the pool in which it was placed, it is obvious that traps in larger pools would attract more turtles.

The lack of correlation between basking sites and turtle captures may be due to the heavy bias towards common snapping turtles, which do not usually bask, and to the use of presence/absence data, rather than number or density of basking sites. There were very few large logs in the stream channels near trapping sites. This is a potential area where turtle habitat could be improved actively in all four watersheds. Besides serving as basking and hiding habitat for turtles (Pluto and Bellis 1986), large logs contribute to pool formation and encourage growth of macro-invertebrates that form the basis of aquatic food webs (Hilderbrand and others 1997). As the stream-side forests mature into old-growth stands, the input of large logs will increase. Removal of timber near streams should be restricted, and managers should consider adding woody debris to the streams actively.

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Table 2—Pearson correlation coefficients (and p values) relating habitat features to each other and to number of aquatic turtles captured at 32 trapping sites, Ouachita Mountains, Arkansas, 1996

	Captures	Volume	Percent cobble	Percent rock	Percent detritus	Percent silt	Bank	Bask
Turtles captured (no.)	1.0 (p = 0.0)	0.47612 (p = 0.0059)	0.10530 (p = 0.5663)	- 0.06058 (p = 0.7419)	- 0.09431 (p = 0.6077)	0.07240 (p = 0.6938)	- 0.20777 (p = 0.2539)	0.00242 (p = 0.9895)
Pool volume index		1.0 (p = 0.0)	0.07619 (p = 0.6785)	- 0.12352 (p = 0.5006)	0.07044 (p = 0.7017)	- 0.06625 (p = 0.7186)	0.10908 (p = 0.5523)	0.13873 (p = 0.4489)
Cobble in substrate (%)			1.0 (p = 0.0)	- 0.77357 (p = 0.0001)	- 0.46312 (p = 0.0076)	0.02425 (p = 0.8952)	0.09338 (p = 0.6112)	- 0.01367 (p = 0.9408)
Rock in substrate (%)				1.0 (p = 0.0)	- 0.17032 (p = 0.3513)	- 0.13039 (p = 0.4769)	- 0.20775 (p = 0.2539)	0.17730 (p = 0.3316)
Detritus in substrate (%)					1.0 (p = 0.0)	- 0.13730 (p = 0.4537)	0.17483 (p = 0.3386)	- 0.24942 (p = 0.1686)
Silt in substrarte (%)						1.0 (p = 0.0)	- 0.22504 (p = 0.2156)	0.07059 (p = 0.7010)
Banks overhanging (no.)							1.0 (p = 0.0)	0.14832 (p = 0.4179)
Presence/absence of bask site								1.0 (p = 0.0)

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