Migratory Stopover Habitat for Shorebirds

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Shorebirds are a remarkably diverse and adaptable group of birds. Most shorebirds have small bodies with long, thin legs for wading (Figure 1). Shorebirds travel thousands of miles between Arctic nesting grounds and wintering grounds in Central and South America. To survive this journey, a critical need is adequate stopover habitat. Many shorebirds migrate through the Delta, where they follow the Mississippi River and its tributaries. Some shorebirds also migrate through the central and western portions of Arkansas.

Figure 1. A typical shorebird has a small body with stilt legs and sometimes a long neck, like this occasional visitor, an American avocet.

Approximately 34 shorebird species migrate through Arkansas each year, with six species comprising most observations in the Delta: least sandpiper (*Calidris minutilla*), killdeer (*Charadris vociferus*), semi-palmated sandpiper (*Calidris pusilla*), black-necked stilt (*Himantopus mexicanus*), pectoral sandpiper (*Calidris melanotos*) and lesser yellowlegs (*Tringa flavipes*). With the exception of the black-necked stilt, which is a short distance migrant, these species are both migrants and residents of Arkansas and the lower Mississippi Alluvial Valley. One shorebird that inhabits Arkansas is listed as threatened – the piping plover (*Charadris melodus*). Some additional species of concern (www.wildlifearkansas.com) are sanderling (*Calidris alba*), least sandpiper, buff-breasted sandpiper (*Tryngites subruficollis*), dunlin (*Calidris alpina*), semipalmated sandpiper, black-bellied plover (*Pluvialis squatarola*), upland sandpiper (*Bartramia longicauda*), stilt sandpiper (*Calidris himantopus*), western sandpiper (*Calidris mauri*), short-billed dowitcher (*Limnodromus griseus*), Wilson's phalarope (*Phalaropus tricolor*), American avocet (*Recurvirostra americana*), lesser yellowlegs, greater yellowlegs (*Tringa melanoleuca*) and solitary sandpiper (*Tringa solitaria*).

Migration

Approximately 500,000 shorebirds travel through the Mississippi Alluvial Valley each spring and fall as they migrate between breeding grounds in the northern hemisphere and wintering grounds in the southern hemisphere. Some shorebird species migrate thousands of miles between breeding and wintering grounds. To survive their migration journey, a critical need is adequate stopover habitat. Stopover habitat provides undisturbed resting sites and forage for shorebirds to reenergize during their long journey.

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For many shorebirds, spring migration begins in March or April and peaks in May, while fall migration begins in late July and peaks in August or September (Figure 2). Adult birds precede juveniles in migration. Males and females sometimes differ in their migration timing. These differences are consistent within species, but different species may employ very different migration strategies. Their annual migration through Arkansas can be tracked in real time at www.ebird.org. Citizen birders report species, location and number of birds observed. Data from current and past years are available for viewing and downloading.

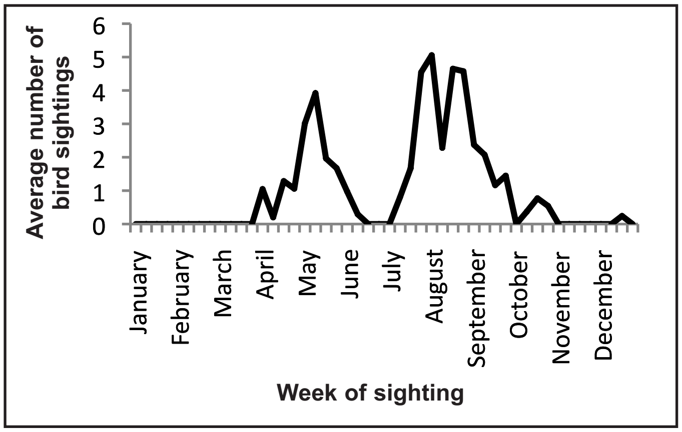

Figure 2. Average number of semipalmated sandpiper sightings reported each week by citizen birders from 2008-2012 in Arkansas (www.ebird.org).

Spring migration is shorter than fall migration. Fall migrations tend to be drawn out, as there are fewer ecological disadvantages to arriving later on the wintering grounds. In spring, there can be very real ecological disadvantages to late arrival on the breeding grounds. The faster a bird can reach the breeding grounds, the better chance it has to compete for prime breeding sites. By arriving as quickly as possible, individuals also allow time for renesting if initial attempts are unsuccessful.

Foraging Behavior

Shorebirds consume many types of foods during their life stages (Table 1). Those migrating through Arkansas consume relatively large quantities of moist-soil invertebrates. Shorebirds forage by probing through mud and shallow water for invertebrates (Figure 3). Because shorebird species have various leg and bill lengths and display distinct foraging behaviors, several species can forage at the same location and not compete with each other. For example, least sandpipers feed on insects in drier wetland mud, while greater yellowlegs feed in deeper water. An average-sized shorebird needs approximately a quarter of an ounce (6 grams) of invertebrates daily in order to maintain its body mass and meet the increased energy requirements of migration. Given the tiny size of invertebrates, shorebirds are often observed busily seeking their prey.

Figure 3. A least sandpiper forages for invertebrates along a shoreline.

Invertebrates are a high energy source for the short or long flights that shorebirds make between stopover areas. Invertebrates consumed by shorebirds are present in wet soils from flooding (Table 2). Shorebirds consume a variety of invertebrates and seem to express no clear preference for any particular invertebrate species. The diversity of species present is less important than their abundance. Shorebirds maintain their energy by feeding on an abundant supply of invertebrates that are easy to catch. Ideally, at least 100 individuals should be present

Table 1. Common shorebird foods (Plauny 2000)

Category	Species
Aquatic insects	Water boatmen, backswimmers, water scorpions, giant water bugs, diving beetles, dragonfly nymphs, caddis flies, mayfly nymphs, pill bugs, and larvae of mosquitoes, midges, horseflies and water beetles
Crustaceans and other aquatic invertebrates	Crayfish, clams, mussels, snails, amphipods and copepods
Terrestrial invertebrates	Grasshoppers, flies, gnats, wasps, crickets, beetles, caterpillars, cutworms, earthworms, bloodworms, spiders, ants, weevils, mites and ticks
Fishes	Very small minnows, dace, killifishes and other small fish
Reptiles and amphibians	Skinks, small frogs, tadpoles and salamander larvae
Plants (minor part of diet)	Grasses, sedges, tender shoots, wild berries, roots and tubers of aquatic and marsh plants, pondweeds, seeds of bulrushes and smartweeds

Table 2. Moist-soil invertebrates present in four southeastern Arkansas study sites during fall and spring migration of shorebirds (2010-2012) (Aycock 2012) with associated common names and estimated number of species in North America

Classification*	Common Name(s)	Number of Species	Fall	Spring
Amphipoda	lawn shrimp	90	X	X
Ceratopogonidae	biting midges, punkies, no-see-ums	603	X	X
Chironomidae	non-biting midges, blind mosquitoes, common midges	1,050	X	X
Chrysomelidae	leaf beetles	1,900	X	
Corixidae	water boatmen	125	X	X
Dytiscidae	predaceous diving beetles, water tigers	500	X	
Entomobryidae	slender springtails	4		X
Elmidae	riffle beetles	100	X	
Gerridae	water striders, pond skaters, Jesus bugs, water skippers	46		X
Haliplidae	crawling water beetles	70	X	X
Hirudinae	leeches	26	X	X
Hydracarina**	water mites	5,000	X	
Hydrophilidae	water scavenger beetles	260	X	X
Isopod***	pillbugs, cressbug, sowbug, woodlouse, rock slater, roly-poly	10,000		X
Leptoceridae	long-horned caddisflies	115	X	
Libellulidae	skimmers	109	X	
Nepidae	waterscorpions	13	X	
Notonectidae	backswimmers, water bees, water wasps	32	X	
Odonata***	dragonflies, damselflies	462	X	X
Oligochaetae	earthworm	235	X	X
Physidae	bladder snails	80	X	X
Planorbidae	lung breathing snails	5	X	
Poduridae	podurid springtails	1		X
Psychodidae	moth flies, sand flies, drain flies, sewage flies, filth flies	113	X	
Psychomyiidae	net tube caddisflies	1	X	
Stratiomyidae	soldier flies	250	X	X
Sminthuridae	springtail type	140	X	
Staphylinidae	rove beetles	4,400	X	
Tabanidae	horse flies, deer flies, bulldog flies, clegs, yellow flies, greenheads, gad flies, copper heads	495	X	X
Tipulidae	large crane flies	550	X	X

*Classification is by Family unless indicated otherwise. **Classification is by Group. ***Classification is by Order.

every 11 square feet (one square meter) (Eldridge 1992). Midge larvae are often the most abundant invertebrate (Eldridge 1992), though other invertebrates are present when shorebirds migrate through Arkansas (Table 2). A shorebird's survival depends on finding an abundance of these invertebrates during migration.

Life History of Moist-Soil Invertebrates

A basic understanding of invertebrates and their life history is helpful when managing stopover habitat. Many moist-soil invertebrates have adapted to the timing, depth and duration of flooding. Following are four major life history strategies of invertebrates (Helmers 1992):

- **Type 1:** In a seasonal wet area (i.e., one that periodically floods and dries), invertebrates develop drought-resistant eggs, build cocoons or burrow into the substrate when conditions get dry on the surface. These invertebrates emerge again after flooding occurs. Pond snails are an example of this adaptation.
- **Type 2:** These invertebrates emerge and lay eggs in standing water or fly to and colonize newly flooded areas. Midges are examples of

this adaptation. Midges have four life stages: egg, larva, pupa and adults.

- **Type 3:** Some insects lay eggs on mudflats or moist substrate during drawdowns. Eggs hatch once flooding reoccurs, and the larvae provide a food source for shorebirds. Examples are mosquitoes and dragonflies.
- **Type 4**: Some invertebrates cannot survive drought conditions and must move to other water bodies to survive. Examples are water boatmen and diving beetles.

Many migrating shorebirds feed predominantly on midges (Type 2) that produce bloodworm larvae (Figure 4) (Helmers 1992, Eldridge 1992). Bloodworms are the larval stage of midges in the family Chironomidae. Larvae occur in open, shallow water with a silt substrate relatively free from vegetation. They are unusual insects because their blood contains hemoglobin. With hemoglobin, they can withstand water with low levels of dissolved oxygen. Bloodworms feed by burrowing throughout the detritus (i.e., decaying organic material including dead plants and organisms) and consuming algae or grazing on algae that thrive on plants. Bloodworms are an important food item for many freshwater fish and other aquatic animals.

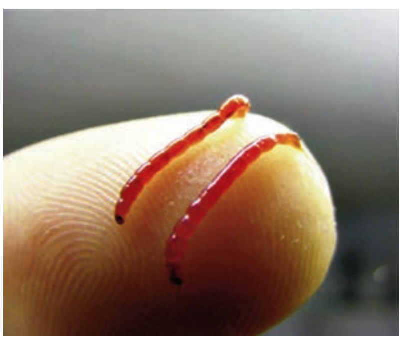

Figure 4. Shorebirds consume moist-soil invertebrates, such as bloodworms (*Glycera* spp.) in receding water. *Image printed with permission of CC Moore Quality Fishing Baits (www.ccmoore.com).*

Detritus plays a major role in providing invertebrates their food base (Helmers 1992, Eldridge 1992). Invertebrates consume microorganisms in the water such as plankton, algae, bacteria or fungi. When detritus is flooded, it releases nutrients and provides a substrate for plankton, algae, bacteria and fungi to grow. For example, rice stubble which has been flooded and rolled makes excellent detritus, which in turn provides habitat for invertebrates, which are then consumed by shorebirds and waterfowl.

Stopover Habitat

Landowners can help migrating shorebirds by providing stopover habitat where birds can rest and replenish fat reserves before continuing their flight. Ideal stopover habitat contains numerous invertebrates that are easily accessible to shorebirds. During migration, shorebirds generally forage in mudflats, wetlands, impoundments or flooded agriculture fields in water depths of less than 4 inches (Helmers 1992). Taller birds, such as yellowlegs, medium sandpipers, and curlews, can forage in water deeper than 7 inches, but small sandpipers, such as least sandpipers and sanderlings, prefer less than 4 inches of water.

Invertebrate abundance and accessibility depend on seasonal flooding. Seasonal flooding creates environmental conditions necessary for invertebrates to thrive, grow and multiply at certain stages of their development. Early colonizing midges flourish in wet areas maintained in an early successional stage by flooding. Abundant invertebrates need to be available when shorebirds are migrating in March and April then again in July through September.

Availability of stopover habitat tends to be highly dynamic and unpredictable. Typically, less stopover habitat is available during the fall migration when shallow water is more difficult to find. What may be ideal stopover habitat one year may be flooded or too dry the next year.

Shallow water flooding creates environmental conditions conducive to producing large populations of midge larvae (bloodworms). During spring, shorebirds congregate where large bloodworms have overwintered and are exposed in the shallows of gradually receding water. Annual or biannual water fluctuations keep the plant-invertebrate community at an optimal stage. Shallow water kills water-intolerant plants, which decompose and provide a food base for invertebrates, and reduces plant cover, which is preferred by migrating shorebirds. When the shoreline is dry, disking can keep invading plants from overtaking the wet area. These dead and decaying plants provide substrate for invertebrates when the area is reflooded.

Managing stopover habitat is basically (1) proper vegetation control and (2) water management. The two are related, as water management can be used for vegetation control. Water control structures, such as flashboard risers or pipes with shutoff valves, are used to direct water, whether entering or leaving an impoundment. Sometimes a series of pipes can be used to move water between impoundments or from a reservoir to shallow water fields. Constructed impoundments designed with higher and lower elevations can create micro shallow water areas as water is drained.

Vegetation Control

Most shorebirds prefer open habitat with little (< 25 percent) canopy cover and short, sparse vegetation (< 8 inches) (Helmers 1992) (Figure 5). Shorebirds can use vegetated areas with up to 75 percent cover, but the majority use mudflats or sparsely vegetated sites with less than 25 percent cover.

Shorebirds tend to prefer vegetation that is less than half the height of the bird (Helmers 1992). Dense vegetation can limit feeding activity and decrease a shorebird's ability to detect predators.

Figure 5. Several migrating shorebird species prefer open mudflats with minimal vegetation. *Image courtesy of Allison Crosby, flickr.com.*

Several water management strategies described in the next section will help control vegetation, but periodic disturbance may also be necessary. Sparse vegetation may be more easily achieved in spring due to natural processes such as defoliation, fragmentation and decomposition of vegetation through winter. Dense vegetation in late summer and fall can be reduced by mowing, shallow disking or controlled burns. Dry shorelines or basins can be lightly disked or burned every two or three years to remove thick, emergent vegetation that is not favored by shorebirds. Disking incorporates organic plant material back into the soil, which attracts invertebrates when flooded.

Note that invasive plants may flourish under moist soil conditions. Depending on their characteristics, some invasive plants can be controlled by changing the flooding regime, use of herbicides or other measures. Contact your local county Extension office for information about controlling invasive plants.

Water Management

Water management is important for creating the plant-invertebrate community that provides stopover habitat for shorebirds. Migrating shorebirds typically prefer water depths of 4 inches or less (Eldridge 1992, Helmers 1992). Water management strategies for permanent, semipermanent and temporary wet areas are as follows.

- **Permanent water.** In some circumstances, water levels cannot be controlled. In natural wetlands where installing a water control structure is not feasible or allowable, natural hydrologic cycles periodically provide high-quality shorebird habitat. In this system, habitat quality depends on rainfall and other external factors; therefore, habitat quality is not consistent between seasons (Aycock 2012). Note it may be illegal to alter a natural wetland, such as by adding a water control structure. Check first with the U.S. Army Corps of Engineers before altering any wet area.

- **Semipermanent water.** Semipermanent water is where the basin of the impoundment is permanently covered with water throughout the year, but with dramatically fluctuating shorelines and mudflats. Draining and flooding can be planned using water control structures to mimic natural flooding cycles to benefit shorebirds, waterfowl and other wildlife.
    - ***Upland flooding.*** Flood in the early spring to kill plants, and midges will colonize the detritus. Slowly lower the water during spring migration to a normal level in the late summer.
    - ***Periodic drawdown.*** Draw down the water every three to ten years depending on the size of the basin. Draw down slowly to coincide with the spring or late summer migration. If there are several wetlands, time the drawdowns so they occur asynchronously, such that at least one basin is available to shorebirds each year.

- **Temporary wet areas.** Temporary wet areas are completely dry during a portion of the year. Drying helps control invasive plants, fish and reptiles while providing habitat for salamanders and other ephemeral species. When water control structures are present, draining and flooding can be planned to mimic natural flooding cycles to benefit shorebirds, waterfowl and other wildlife. Seasonal flooding and sequential drawdown of water levels in moist-soil areas provide productive shorebird foraging substrates.
    - ***Spring flooding and summer drawdown.*** Water is slowly removed in the summer and the basin is dry in winter before being reflooded in the spring. Specifically, a slow drawdown should begin in early to mid-July. Midge larvae will need time to form cocoons and prepare for dry conditions. Leave the soil moist throughout the summer to encourage growth of annual moist-soil plants. The area can remain dry throughout the winter because vegetation decomposes more rapidly than if covered by water. Return water slowly to the basin early the following spring to inundate the decomposing vegetation. The newly flooded basin has a flush of nutrients, and the overwintering larvae grow

rapidly. Keep the water shallow and warm to encourage algal growth and nutrients for midge production. When shorebird migration begins, start a gradual drawdown (e.g., 1 inch per week). Maintain at least 2 inches of water in the basin to maximize invertebrate abundance while migration is underway.

  - ***Spring drawdown and late summer flooding***. Water is drained slowly in the spring, and the basin is dry in late spring and summer before being reflooded in the late summer to coincide with the fall migration. Water is left in the basin throughout winter. Specifically, begin drawing down water slowly in mid-April and through May, when shorebirds are migrating through the area. Return water in late summer after substantial annual plant growth has occurred. Larvae continue to grow until late fall and over-winter as larger, older forms, providing spring migrants with a better food source.

- **Agricultural impoundments.** Flooded agricultural lands can make productive wintering and migrating shorebird foraging habitats (Figure 6). Where water control structures and levees provide water management opportunities on crop fields, water management can greatly improve shorebird habitat. After crop harvest in the late summer or early fall, allow fields to flood via rainfall. Capturing rainfall will reduce the amount of sediments, nutrients and pesticides entering the watershed. It may also attract blue-winged and green-winged teal, typically the first ducks to arrive in September.

Figure 6. An intermittently flooded rice field can provide habitat for shorebirds. *Image courtesy of Brent Griffin, University of Arkansas.*

Agricultural fields flooded during winter can be dewatered at a rate of 1 inch per week beginning in late February or early March to benefit early migrants. The types of crops, planting dates and harvest dates determine drawdown rates and how long fields are flooded.

Invertebrates in cultivated and wild rice fields in the Mississippi Alluvial Valley provide food resources for shorebirds and other wildlife. Dr. Joe Massey, Mississippi Agricultural and Forestry Experiment Station, determined that intermittent flooding of rice fields saves the producer money by limiting the need to pump water as frequently. Intermittent flooding helps maximize rainfall capture and reduces overpumping without affecting rice quality or yield. Keeping shallow water (< 4 inches) on at least a portion of fields is better for shorebirds. One producer in Massey's study conducted eight wetting and drying cycles during a growing season. Altering water levels and creating mudflats using this practice would likely benefit shorebirds.

- **Multiple impoundments.** If water levels can be manipulated in several impoundments, vary the time when water is drawn down in each impoundment either seasonally or within the same migration season. Water regimes can be manipulated asynchronously so that, in any given year, some shorebird habitat is available during both spring and fall migration. Shorebirds also migrate at different times within seasons, so varying drawdown stages by several weeks can be beneficial to a number of different shorebird species. Implementing various flooding and drawdown regimes can improve chances that the timing of peak invertebrate production and migration will coincide in one or more impoundments.

For semipermanent, temporary and agriculture wet areas, reclaiming water for flooding can be challenging. If nature complies, rainwater can be recaptured by replacing riser boards in levees before rain events. Though water pumps and electricity can be expensive, pumping water from wells, reservoirs, rivers or other available water sources is the most reliable option. Note that permits and/or prior approval may be needed from the Army Corps of Engineers or other government entities before pumping water.

Managing Waterfowl Areas to Include Shorebirds

Typically, practices for attracting waterfowl result in vegetation that is too dense for shorebirds, but with a little planning, waterfowl areas can benefit both waterfowl and shorebirds.

- Since both waterfowl and shorebirds consume aquatic invertebrates, consider using a rotational approach to drawdowns to maximize invertebrate production and create an interspersion of habitat types where both shorebirds and waterfowl benefit.

- Avoid steep banks and develop a gradient on at least one side of a reservoir or pond to provide habitat for both waterfowl and shorebirds.

- In waterfowl management, water control structures are used to regulate water levels to stimulate the growth of wetland plants whose seeds and tubers are consumed by waterfowl. Shorebirds can take advantage of the rich invertebrate populations found in the saturated and flooded edges of wetlands managed for moist-soil plants.

Additional Considerations

Some additional helpful management practices are:

- Protect wetlands, marshes, lakes and ponds from siltation and nonpoint source pollution by fencing off livestock. Protect native vegetation to stabilize banks and shorelines.

- Reduce pesticide use, especially near water, where applications reduce invertebrates.

- Limit human disturbance when shorebirds are feeding to reduce unnecessary energy expenditures.

Studies show that people disturb and negatively affect shorebirds by walking, walking dogs and allowing them to chase birds, intrusive bird watching, fishing and other activities (Plauny 2000). Migrating shorebirds need to build fat stores, and birds that are forced to fly underweight may not survive. Therefore, minimal disturbance of shorebirds is recommended.

Putting It All Together

Management plans for stopover habitat should focus on developing a continuous food base for migrating shorebirds. Doing so may be easier said than done. Wildlife biologists note that managing stopover habitat is both a science and an art. Many variables can affect outcomes, including soil type, seasonal temperatures, rainfall or lack thereof, seeds present/absent in the seedbed and other factors that affect vegetation responses and invertebrate abundance. Practices implemented on one impoundment may yield different results on an adjacent impoundment. Developing a management plan and recording results will improve your chances of achieving ideal stopover habitat, whether managing one or multiple locations.

Keeping records of rainfall, drawdown dates, vegetation types and density, shorebird visitations and other notable observations should be documented. Accumulating and reviewing information from previous years becomes an invaluable resource for making better management decisions in subsequent years. Keep records for each impoundment or wetland, since results can differ dramatically among locations. As more information is accumulated, deciding which management practices to implement and when can become more refined toward the goal of creating ideal habitat for shorebirds.

For those who appreciate data collection, an invertebrate index of relative abundance can be determined from taking core samples in mud and counting the number of invertebrates present. Construct a collection tube from a 4-inch diameter PVC pipe. Draw a line on the outside of the pipe 1 inch from the end of the tube, and drive the pipe 1 inch into the mud. Deposit the core sample on a screen (e.g., hardware cloth) and wash mud. Count invertebrates on the screen. Take at least three core samples along the same shoreline before moving to another location. Use the same procedures each time core samples are collected during spring and/or fall migrations to build a data set of invertebrate production for your wet areas. Use this invertebrate index along with other information to determine which practices to implement.

Shorebird Conservation

Shorebird conservation is a priority for a number of wildlife agencies and conservation organizations. Although no shorebirds are considered threatened or endangered in Arkansas, their numbers have declined most likely because of fewer sandbars and mudflats along rivers in the state. Their annual round-trip migration between nesting and wintering grounds necessitates national and international cooperation if conservation efforts are to be successful. Quality stopover habitat is needed to survive the journey.

Assistance is available to farmers who do not have water control structures on their reservoirs and who desire to improve water quality and shorebird habitat on their property (Figure 7). The Environmental Quality Incentive Program is a "farm bill" program that provides cost-share assistance for installing water control structures. Contact your local district conservationist at a USDA Service Center in your area (http://offices.sc.egov.usda.gov/locator/app) or a

Figure 7. Water control structures are tools for providing shorebird habitat in impoundments. *Image courtesy of Becky McPeake, University of Arkansas.*

private lands biologist with the Arkansas Game and Fish Commission (www.agfc.com, 1-800-364-4263). If not eligible for the farm bill program, contact the U.S. Fish and Wildlife Service's Partners for Fish and Wildlife Program in Conway (www.fws.gov/partners/, 501-513-4470) to help locate other sources of funds for water control structures and other practices benefiting shorebirds.

Your county Extension agent (www.uaex.uada.edu) can provide information about water control structures and agronomic practices, as well as invasive weed control, and help locate local natural resource professionals who can provide assistance for planning shorebird habitat on your land.

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Acknowledgment – We appreciate Dr. Robert E. Kissell, Jr., professor - wildlife at the University of Arkansas at Monticello, for reviewing this fact sheet.

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FSA9108-PD-2-2015RV