Restoring and Managing Habitat for

Reptiles and Amphibians

Iowa houses a diverse assembly of reptiles and amphibians, collectively called herpetofauna. Iowa is inhabited by 22 species of amphibians and 46 species of reptiles. Herpetofauna play an important role as insect and rodent predators and as valuable prey for various birds, mammals, fish and insects. Four of Iowa's amphibians (18%) and fifteen of Iowa's reptiles (33%) are listed as either threatened or endangered species. The leading causes for herpetofaunal decline in Iowa and across the world are attributed to habitat destruction, degradation, and fragmentation.

The successful restoration and management of wildlife areas for herpetofauna must take all stages of their life history into account. Restorations must provide access to food, shelter and migration corridors as well as hibernation, aestivation, breeding, and nesting sites. This document provides recommendations for restoring and managing prairies, woodlands, streams, rivers, and wetlands for Iowa herpetofauna.

The Blanding's turtle is a threatened species in the state of Iowa. This species is an indicator of diverse wetland complexes with intact aquatic migration corridors needed to meet this turtles life history requirements. A female Blanding's turtle can reach 80+ years of age and may travel over a mile to reach nesting grounds in the spring. (Photo by Jennifer Anderson-Cruz)

Amphibian: Amphibians are vertebrate animals such as frogs, toads, and salamanders. Amphibians have a moist, permeable skin and are cold-blooded. Amphibians lay shell-less eggs in water which later hatch into gilled aquatic larvae (ex. tadpoles). The aquatic larvae metamorphose into lunged adults that may or may not leave the water depending on the species.

Amphibians have an elevated exposure risk to pollutants due to their absorptive skin, bi-phasic aquatic and terrestrial life stages, and migratory behavior patterns. The northern leopard frog has been declining throughout its range and has been plagued by unexplained malformations over the last several decades. It is suspected that several environmental and land use factors may be to blame. (Photo by Jennifer Anderson-Cruz)

Reptile: Reptiles are cold-blooded vertebrates such as snakes, turtles, lizards, and crocodiles that breathe with lungs and have dry skin covered with scales and horny plates. Reptiles lay shelled eggs on land with the exception of several species of snake which retain the eggs and give live birth. Reptiles do not have a larval stage.

The Great Plains Skink is an endangered reptile species in Iowa.The dry skin and scaled body allow this lizard to live in dry prairies where its claws are used to burrow into loose soils to escape hot summer days or cool nighttime temperatures. (Photo by Jeff LeClere)

Habitat Management Practices

Management practices commonly used to manipulate the structure and composition of vegetation within restorations can exert immediate, short-term, and long-term effects on herpetofaunal assemblages. Prescribed fire, mowing, grazing, and forest thinning are examples of disturbance techniques habitat managers employ to mimic the natural process that shaped unique and contrasting ecosystems prior to European settlement. Many of Iowa's historic habitats, including chestnut-oak-hickory forests, wetlands and prairies were created and maintained by predictable, periodic disturbances (fire, flood, wind, herbivory) of varying intensity, frequency, and duration. Within an ecosystem, a diversity of plant and animal species are housed, each with its own tolerance for disturbance. Balancing the needs of disturbance adapted and conservative "climax" species within a restoration takes an understanding of how each management technique works and the ability of a site's plant and animal life to cope with the impacts of management, both in the short and long-term outlook. Within this section we will look at how habitat management practices may affect herpetofauna and how negative effects can be minimized.

In Iowa, cricket frogs prefer water bodies with exposed, muddy banks commonly associated with early successional environments. A study found that 100 of these nickel-sized frogs can eat more than 480,000 insects in one season. The Blanchard's cricket frog is undergoing range restriction in the Midwest for unknown reasons. (Photo by Jennifer Anderson-Cruz)

The best method for avoiding herpetofaunal mortality due to site management is to conduct any of the below mentioned management treatments outside of herpetofaunal activity periods. In general, Iowa's herpetofauna hibernate from mid-October through March and are least impacted by management during this time period. If management is to occur within the herpetofaunal active season, several different approaches may be taken to minimize impacts. Herpetofauna are most active when air temperatures are between 50-80 degrees F and after rain or flood events; therefore, a suitable time to conduct management is during the hottest part of the day, during a dry spell, or on unseasonably cool days. The highest potential for mortality due to site management occurs during spring and fall migrations to and from breeding or wintering habitats. Becoming familiar with the migratory behavior of herpetofaunal species known to occur within the restoration area is critical in formulating a management plan that will reduce the chances for management during mass movement of herpetofauna. Due to the weak dispersal capabilities of many herpetofauna, emigration of animals during and immigration of animals post-management is most successful for sites within 200 meters of suitable untreated habitat. It is therefore advised that a site be managed on a rotational basis with no more than 1/4 of the site impacted in any given year.

Prescribed fire is commonly used to reduce the presence of unwanted, weedy vegetation, to encourage oak dominance in woodlands, and native vegetation in wetlands, prairies, and savannas. To a certain degree, herpetofauna have physiological and/or behavioral strategies for surviving events of fire. Examples of fire avoidance include the fossorial behavior of salamanders and toads, the use of mammal burrows by the bull snake, and the use of crayfish burrows by wetland dependant snakes and frogs. Several studies on the effects of prescribed fire have shown negative immediate impacts on herpetofaunal communities, but upon further study it was found that herpetofaunal communities responded positively over the long-term with increased species richness on sites where burns had occurred within the past decade.

The effects of fire vary depending upon the frequency, intensity, and season within which the prescribed burn is conducted. (Photo by Angela Biggs)

The herpetofaunal species most sensitive to the effects of fire are those whose habitat requirements include significant amounts of leaf litter, duff, or other cool, moist substrate normally consumed during a burn. Many of Iowa's salamander species fall into this category and may not return to a burned site until litter has accumulated for several years after a burn. In such situations, it may be wise to create fire breaks around cover objects, brush piles, etc., to protect these vital habitat components. As with all distur-

Habitat Management Practices cont...

Toads are hardy amphibians with burrowing capabilities that allow them to escape fire. Toads also have a drier skin than most amphibians which reduces evaporative loss in drier, recently burned habitats. The American toad is the only amphibian that has been found to increase in population in response to urbanization in Iowa and Wisconsin. (Photo by Jennifer Anderson-Cruz)

bances, frequency will determine whether a given species will persist or expire on a site; therefore, fire intervals of 3-7 years or greater have been recommended in order to maintain a healthy plant and herpetofaunal community.

Mowing an area from the center out allows wildlife a greater chance of escape than traditional mowing patterns.

Mowing is a common management technique used to manipulate vegetation, especially on sites where fire may not be feasible. Herpetofauna may be run over by a mower or killed by the mowers blades; instances found to cause mortality of herpetofauna if conducted during peak foraging times or during migrations. Increasing the deck height of a mower to 10-12 inches will reduce the potential for herpetofaunal run-ins with blades and meets the requirement for mowing warm season vegetation. When possible, begin mowing at the center of a treatment area, progressively mowing out from the center to allow wildlife to flee in all directions and not become trapped to one side. To reduce the area impacted by the mowers tires, effort should be made to follow the outermost tire track of a previous pass which will reduce animal mortality and soil compaction. Cover objects, logs, or other potential refugia should be avoided and left undisturbed while mowing.

There are several disking techniques used to restore or maintain early successional plant communities and associated wildlife. In this particular area, the US Army Corps Of Engineers is utilizing strip disking which will create a mosaic of early successional and established plant stands. (Photo Courtesy of USACOE)

Disking is a practice used to control unwanted vegetation and to provide areas of bare ground and sparse vegetation to encourage inhabitance of early successional species such as the cricket frog and massassauga. Disking should be no more than 6 inches deep and occur on a rotational basis outside of herpetofaunal activity periods. Areas containing turtle nesting grounds, hibernation areas, woody debris, or other cover objects should be avoided.

If managed properly, **grazing** can improve grassland habitats for herpetofauna by maintaining evenness in the vegetative community and by providing basking areas. Prescribed grazing and flash grazing are examples of suitable grazing practices whose intensity and frequency can be set to achieve the maximum benefit for cattle and wildlife. If located within pasture, it is advised to minimize access to water bodies (streams, rivers, wetlands, and ponds) through controlled access, constructed crossings, or to exclude cattle from the riparian corridor with fencing. It is important to include riparian buffers in a pasture management plan to protect shoreline habitat and water quality (see section on buffers).

Fencing cattle from stream corridors will promote both instream and riparian habitat for wildlife, including herpetofauna.

Nutrients and pesticides may be used for various reasons on and/or adjacent to restoration areas, posing serious risks to herpetofauna if used incorrectly. Prior to the purchase and application of fertilizers or pesticides, there are several things to consider.

Habitat Management Practices cont...

The first consideration; what's to be accomplished? If attempting to improve soil fertility, conduct a soil test to determine which nutrients are deficient, where they are deficient, and the amount of each nutrient needed to reach set goals. If trying to rid a site of unwanted pests and plants, scout the area to determine whether

Scouting for pests to catch infestations early may reduce the amount and extent of pesticide needed, reducing the use of potentially harmful chemicals that could pollute herpetofaunal habitats and food items.

the entire site needs to be treated or whether there are certain "problem areas" that can be spot treated. Secondly, be sure to apply nutrients and pesticides at the correct time and in the approved places. All pesticides have use restrictions. For example, some pesticides should not be applied near water bodies or above certain air temperatures. Whether used on a restoration site, crop field, or an urban lawn, all chemical applicators should be regularly maintained and calibrated to ensure nutrients and pesticides are being applied at the correct rate. Over-applying fertilizers and pesticides or applying them at the incorrect time and/or place poses risks for transport to surface and ground waters or to the air through volatilization. Several studies have found that high nutrient or pesticide content in breeding ponds can cause malformation and death in larval amphibians or have indirect effects on growth and food resources. Becoming familiar with the restrictions and instructions for the fertilizer or pesticide planned for use will ensure your treatment is effective, safe, and legal.

Low to no input nutrient and pest management techniques are effective in protecting environmental quality and reducing the long-term costs of site management. Planting a wide array of plant species will reduce the risk of catastrophic disease or pest infestation within a restoration and will increase resource competition reducing the threat of invasion by unwanted plants. Legumes, plants that house nitrogen fixing microrhiza, can be planted within a restoration to improve soil fertility in a slow release, plant available fashion. Organic fertilizers, like legume manufactured nutrients, are systemically released into soils during optimal microbial conditions which coincide with optimal plant growth. Organically derived nutrient sources are stable and relatively unavailable for transport by water, posing little risk for surface or ground water contamination compared to those that are applied chemically. Another way to reduce potential contamination and reduce the risks to non-target species would be to use biological controls (i.e. ladybugs, preying mantis, BTI, etc.) for pest management.

Applicable Iowa NRCS Standards - Habitat Mgmt. Practices
314 Brush Management
338 Prescribed Burning
472 Use Exclusion
528A Prescribed Grazing
590 Nutrient Management
595 Pest Management
645 Upland Wildlife Habitat Management
647 Early Successional Habitat Development

Woodlands

Woodlands are vertically stratified into vegetative zones including the forest floor, understory, shrub, sub-canopy and canopy, providing structural complexity for herpetofauna to exploit. Promoting structural and species diversity within the forest plant community can be accomplished through manipulation of the forest canopy, by using prescribed fire, and by undertaking invasive species control. Each of these management techniques should be used according to site conditions and with the assistance of a forester.

Forest management strategies for reptiles differ from those for amphibians. Amphibians prefer forests with dense canopy cover that promotes a shaded, cool, moist environment with sparse understory vegetation and a high amount of litter on the forest floor. Salamanders have been found to prefer woodland habitats with low edge to volume ratios, whereas the presence

Woodlands cont...

Berry's Woods Preserve, Warren County, Iowa. (Photo by Jennifer Anderson-Cruz)

of frog and toad species do not seem to be as affected by this habitat attribute.

Forest openings as well as walking paths and roadways promote warmer, drier forest conditions by allowing air flow, a consideration that should be addressed if such openings are expected to be part of a management plan. Drier, more open woodland habitats are generally preferred by reptiles. Managing habitat for reptiles may include tree harvesting (thinning, regeneration cuts, shelter wood cuts, clear cuts, selective cuts) every 10-20 years to open the forest canopy or by introducing prescribed fire. Woodland areas visited by ornate box turtles and wood turtles may be enhanced by the establishment of fruiting species such as wild raspberry, blackberry, plum, strawberry, and grape which constitute a large part of the turtles diet during part of the year.

Wood turtles frequent riparian woodlands in search of food and shelter. When in fruit, plants such as blackberries, wild grape, plum, and strawberry become important wood turtle food plants. (Photo Courtesy of Cornell College)

Due to the stark differences in woodland habitat preference between reptiles and amphibians, rotational management techniques are stressed to provide cover and refuge for both faunal groups within a restoration.

Applicable Iowa NRCS Standards - Woodlands
314 Brush Management
338 Prescribed Burning
612 Tree/Shrub Establishment
643 Restoration and Management of Declining Habitats
645 Upland Wildlife Habitat Management
666 Forest Stand Improvement

Prairies and Savannas

Prairies and savannas can be maintained for herpetofauna by providing a structurally and species diverse plant community that will support diverse food resources as well as animals that construct burrows used by prairie dependent herpetofauna for shelter, nesting, and as hibernacula. Cover objects, constructed hibernacula, brush and rock piles are commonly missing in traditional restoration plans and should be included to provide an array of habitat for prairie dwelling herpetofauna (see microhabitat section).

Remnant sand prairie, Polk County, Iowa. (Photo by Jennifer Anderson-Cruz)

Dense tallgrass stands are unsuitable for most herpetofauna due to impedance of movement and a lack of suitable basking habitat. Increasing the forb and short-grass components of a seeding mix will result in greater vegetative coverage by plants that provide interstitial space conducive to herpetofaunal movement and basking. This is especially true when using various hemiparasitic plants such as lousewort, toadflax, or paintbrush. Within existing grass stands, managed grazing practices, mowing, disking and interseeding can be implemented to open the grass canopy, improving its appeal to herpetofauna and other wildlife alike. Conversely, frequently and/or recently **disturbed sites** with sparse vegetation offer too little shelter from temperature extremes, the sun, and predators. Examples of this condition may be apparent in over-

Prairies and Savannas cont...

grazed pastures, recently disturbed fields, or in urban environments. When dealing with sites under such condition, reduce the frequency and intensity of the disturbance affecting the site and develop a management plan to improve the vegetative community. The creation and placement of suitable shelter throughout the site will provide refuge for herpetofauna

Herpetofauna such as the smooth green snake may use ant mounds for basking, shelter, and as hibernacula. (Photo by Jennifer Anderson-Cruz)

while natural refugium is developing. Prescribed burning is often used as a management tool to deter encroaching woody and invasive vegetation in prairie habitats and to manipulate the structure and composition of native vegetation. Prairie burns are generally hotter and more intense than those in woodlands. A hot, high intensity burn may reduce organic matter, result in elevated soil temperatures that are intolerable for burrowing organisms, and cause deleterious effects on the vegetative community. Cautiously planning and conducting a prescribed burn with a trained professional will prevent unintended, adverse effects on a site's flora and fauna and will offer a safer burning environment. As always, rotational management will ensure that there are areas within the prairie with sufficient duff to provide cool, moist, shaded habitats preferred by some herpetofauna.

Applicable Iowa NRCS Standards - Prairies and Savannas
314 Brush Management
338 Prescribed Burning
327 Conservation Cover
528A Prescribed Grazing
643 Restoration and Management of Declining Habitats
645 Upland Wildlife Habitat Management
647 Early Successional Habitat Development

Rivers and Streams

Many of Iowa's streams have been physically degraded through bank and channel modifications such as hard bank stabilization, channelization, dredging, and the construction of culvert and impoundment structures. Resultantly, these streams have lost their sinuous riffle-run-pool sequences along with associated point bar, beach, and bank habitats important to riverine herpetofauna. Modifications of stream flows have also taken a toll on herpetofauna by hindering the maintenance and creation of habitat within both the channel and adjacent floodplains.

Skunk River, Polk County, Iowa

Iowa's water snakes are often mistaken for the venomous cottonmouth which is not found in Iowa. When water snakes prey upon fish, the fish are often sick or old. By partaking in this hunting strategy, water snakes are a natural means of promoting healthy fish populations. (Photo by Jeff LeClere)

Fortunately, streams and rivers are dynamic systems capable of repairing themselves when extraneous forces are ceased. Lessening or removing the disturbances contributing to an imbalance in stream function will allow the stream to progress to equilibrium naturally, a process that may take decades. In situations where stream improvements are urgent, active approaches may have to be taken to help the stream evolve into a self-sustaining body. Active management techniques can include tow stabilization, stream bank bioengineering, dam removal, and stream length, pool-riffle sequence, and grade restoration. The development of a stream restoration and management plan is complex, must be well thought-out, include

Rivers and Streams cont...

guidance from many resource professionals, and must individually suite the watercourse at hand. Stream restoration extends far beyond the scope of this document; therefore, it is recommended that stream restoration specialists be contacted to initiate such projects.

Adjacent land use practices may have profound impacts on the water quality and quantity of a river or stream. The use of best management practices (no till, nutrient and pest management, grassed waterways, buffers strips, etc.) will reduce offsite movement of soils and pollutants, increase infiltration recharging aquifers, and provide corridors and habitat for many species of wildlife including herpetofauna. Monitoring the quality and quantity of water in a stream may help identify resource concerns and best management practices required to address these concerns. The most successful way to improve the water quality and quantity of a stream or river is to use a watershed-based approach with community-led conservation and participation by local stakeholders. There are numerous state and federal programs aimed at providing funds and assistance for watershed based projects. Contact your local NRCS Service Station to learn more about the various watershed-based programs available in your area.

Woody cover provides essential habitat for stream related herpetofauna and their prey. Herpetofauna use emerged logs for basking and submerged logs as underwater cover.

Restoring diversity in the physical structure of a stream will offer an assortment of habitats for wildlife to exploit, assuming water quality and quantity issues have been addressed. Lack of suitable instream habitat such as woody debris, snags, leaf litter, boulders, clean sand, gravel, or cobble substrate will limit diversity and density of herpetofauna, the food resources they require, and organisms such as the salamander mussel which requires the presence of an amphibian, the mudpuppy, to complete its life cycle. Instream habitat restoration (bank hides, gravel beds, log and boulder structures, etc.) has become a popular practice in recent years, providing carefully placed and anchored cover where naturally forming cover may be aesthetically displeasing or poses risk to infrastructure (bridges, culverts, etc.).

Other than highly aquatic turtles and the mudpuppy, riverine herpetofauna spend the majority of their time along stream shores, shallows, and adjacent floodplains. Managing stream banks to support a multitude of habitats including sand and gravel bars, overhanging vegetation and natural cut-banks will offer refugia and foraging habitat for numerous species. In developing restoration and management plans for a riverine site, provisions for a friendly, traversable connection to the upland landscape are essential. For instance, where barriers lie between riparian and upland habitats, refer to the corridor and safe passage sections of this document to develop potential solutions.

Applicable Iowa NRCS Standards - Rivers and Streams
326 Clearing and Snagging
390 Riparian Herbaceous Cover
391 Riparian Forest Buffer
393 Filter Strip
395 Stream Habitat Improvement and Management
410 Grade Stabilization Structure
580 Streambank and Shoreline Protection
582 Open Channel
584 Channel Stabilization

Wetlands

Wetlands are important habitat components of prairie, forest, and riverine ecosystems. Naturally occurring wetlands are incredibly important attributes to local wildlife. Restoring wetland function is extremely challenging; therefore, the protection of existing wetlands is strongly recommended. Breaking and removing tile, filling ditches, or creating berms are effec-

Wetlands cont...

tive ways to create wetlands or to restore the natural hydrology of a site that has been manipulated in the past. Restorations requiring little to no excavation with very gradual side slopes (>20:1 optimal) will maximize the shallow wetland habitats (<4-6") that are the most attractive to a broad range of herpetofauna.

Sedge meadows are dominated by saturated soils with pockets of water held in depressions during the spring months. Research in the Midwest has found that wetland areas containing less than 6 inches of standing water provide extraordinary herpetofauna habitat. Duke Prairie, Clinton County, Iowa. (Photo by Jennifer Anderson-Cruz)

Iowa experiences 10-11 year drought cycles rendering wetlands suitable for inhabitance by herpetofauna in wet years unsuitable in dry years and vice versa. Consequently, wetlands constructed for herpetofauna should be restored in a mosaic pattern with wetlands of varying shape, depth, and proximity to each other to provide needed habitat throughout time and space. Diverse water regimes should be included with a minimum hydroperiod of 2.5 months and shallow ephemeral pools no further than 300 meters from a permanent water source

Many herpetofauna utilize crayfish burrows to reach the groundwater table during dry spells or for hibernation. Recognizing the dependency of selected herpetofaunal species on other wildlife is essential in conserving these species in Iowa. (Photo by Jennifer Anderson-Cruz)

to provide herpetofauna with water during drought periods. Water levels should not be manipulated during the breeding or hibernation seasons, a practice that may result in the desiccation and death of hibernating herpetofauna or amphibian eggs and larvae (see table 1 for egg laying and larval periods for amphibians).

Fish and bullfrogs should not be introduced into natural or restored habitats that do not or did not naturally house these species. Predatory fish and bullfrogs will eat amphibian eggs, larvae, and adults; therefore, most amphibians require wetlands devoid of these predators. In addition, several studies have found that the presence of non-predatory fish in breeding pools can reduce larval survival of many amphibians by disrupting predator avoidance behaviors. Fish and bullfrogs can be excluded from and controlled within a restoration by minimizing permanent water and by creating stands of water that are shallow enough to cause hypoxia and desiccation during drought years.

To improve the vegetative quality of an existing wetland, mowing, prescribed burns, or light disking may be used following the methods mentioned in the management practices section. For newly restored wetlands, leaving the site rough rather than smoothing it out adds complexity to the wetlands bottom structure resulting in variable water depths, chemistry, and aspect which improves the site's ability to house numerous plant species. The use of aquatic herbicides and pesticides within wetlands is discouraged, due to the potential for negative impacts on a wide range of non-target species, including amphibians. Emergent wetland, sedge, and wet meadow habitats with 50-80% vegetative cover offer optimal shelter, food, foraging habitat, and egg attachment sites for most herpetofauna; whereas, wetlands with sparse plant, algal, and periphyton communities house minimal food resources for tadpoles and turtles with herbaceous diets. Urban, industrial, and agricultural pollutants (nutrients, pesticides, heavy metals,

The natural range of the American bullfrog occurred over the southern 1/3 of Iowa and up the Missouri and Mississippi River Corridors. Today, the bullfrog can be found in permanent waters state-wide due to anthropogenic introduction which is wrecking havoc on amphibian species not adapted to life with this foreign predator. (Photo by Jennifer Anderson-Cruz)

Wetlands cont...

organo-chemicals, sediment, etc.) pose serious risks to herpetofaunal communities; therefore, potential sources of pollutants should be identified and addressed in a wetland management plan prior to restoration.

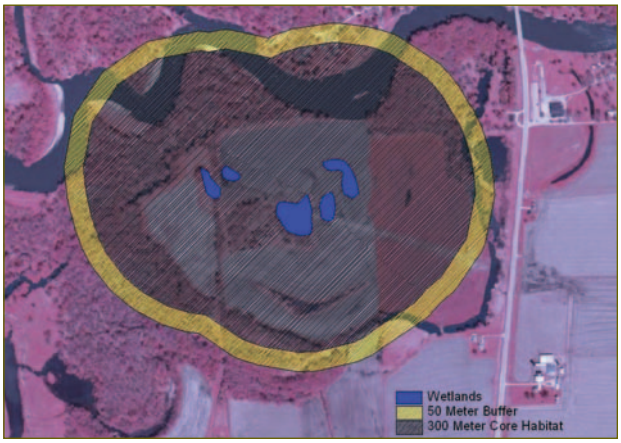
Diverse plant communities offer shelter, food, and water purification while regulating climatic conditions such as temperature and humidity in wetland habitats. These newly metamorphosed chorus frogs are using wetland plants as emergence strata.

Applicable Iowa NRCS Standards - Wetlands
327 Conservation Cover
338 Prescribed Burning
391 Riparian Forest Buffer
393 Filter Strip
472 Use Exclusion
643 Restoration and Management of Declining Habitats
644 Wetland Wildlife Habitat Management
647 Early Successional Habitat Development
657 Wetland Restoration
658 Wetland Creation
659 Wetland Enhancement

Core Habitat, Corridors, Buffers, and Ecotones

In a recent study on riparian dependant herpetofauna, it was suggested that habitat should, at a minimum, be protected within a 300-meter radius from the edge of a wetland or stream; an area termed **"core habitat"**. The establishment of core habitat is essential to the survival of riparian herpetofauna that require upland habitat for foraging, nesting, aestivation, and hibernation. It is also suggested that a 50-meter buffer zone be created adjacent to core habitat (see buffer section below) and land use zones be delineated to set use restrictions for hiking, birding, etc.

The creation of a **buffer zone** will reduce off-site impacts on core habitat and herpetofaunal contact with unfriendly land use. Buffer zones are used to protect restored areas from pollutants such as nutrients, pesticides and sediments, and from physical impacts such as encroachment. The desired width of a buffer zone is dependant upon topography, adjacent land use, and the home ranges of the herpetofauna present. It is generally recommended that buffer zones be a minimum of 50-meters wide.



Providing 300-meters of core habitat from the edge of any water body will protect the home range of most Midwestern herpetofauna. The addition of a 50-meter buffer protects core habitat from offsite pollutants and land use.

Edge habitats, also called **ecotones**, create unique ecosystems that buffer the effects of one habitat as it merges into the next by gradually shifting plant composition, moisture regime, and climate across the landscape (i.e. prairie - forest transition). Several herpetofauna, such as fox snakes and brown snakes, are edge species requiring ecotone habitats. Recent studies in Iowa have shown that as length of edge habitat increases amphibian use increases, making edge habitat an important factor to consider when developing a management plan for amphibians.

Connecting critical habitat by strategically placing wildlife corridors will allow herpetofauna to exploit a multitude of resources without traversing unfriendly surfaces such as barren fields, roads, or mowed lawns.

Herpetofauna require **corridors** to facilitate everyday home range movements, seasonal and breeding migrations, dispersal, and range shifts in

Core Habitat, Corridors, Buffers, and Ecotones cont...

response to environmental and climatic changes. Corridors connecting fragments of isolated habitat provide a safe and friendly passageway allowing for immigration and emigration of animals aiding gene flow and decreasing the chance of local herpetofaunal extinction events. It has been found

Safe crossings and road barriers help keep wildlife off roads, preventing animal mortality, road hazards, and accidents. (Photo Courtesy of FHWA/US DOT)

that wetland areas adjoined by forest or prairie have greater herpetofaunal diversity and have higher colonization rates after restoration than isolated wetlands without corridors. Suitable corridors can be constructed by planting grasses, trees, and shrubs in wide strips connecting two habitats isolated by barriers such as crop fields and roads. The most effective wildlife corridors are those constructed along riparian areas, which also improve water quality, bank stability, and instream habitat.

In areas with high road density, **safe passages** should be provided for herpetofauna, especially in areas where roads bisect important corridors (i.e. roads that parallel water bodies). Barriers that run parallel to roads may be constructed to prevent herpetofauna and other wildlife from crossing roads, thus reducing animal mortality and road hazards. There are a variety of road barriers in use, ranging from fencing and sheet piling to concrete walls. Road barriers may be used in conjunction with pre-existing (culverts, bridges, etc.) or constructed "safe crossings" to route wildlife to safe passageways under or over roadways.

Applicable Iowa NRCS Standards - Core Habitat, Corridors, Buffers, and Ecotones
380 Windbreak/Shelterbelt Establishment
386 Field Border
391 Riparian Forest Buffer
393 Filter Strip
472 Use Exclusion
612 Tree/Shrub Establishment
650 Windbreak/Shelterbelt Renovation

Microhabitats

Microhabitats are very small, specialized habitats located within larger habitats. Constructing various microhabitats within any restoration will

Brush piles shelter a whole host of wildlife species and are just as effective underwater as they are on land.

Newly constructed snake hibernacula on a Wetland Reserve Program easement in Clinton County, Iowa.

improve habitat quality for a number of herpetofauna and other wildlife.

Brush Piles: brush piles provide shelter from wind, rain, and other environmental stressors. Brush piles should be 15'W x 15'L x 8'H in size and number 3-4 per acre. The foundation of the pile should be designed with 6-10 inch diameter logs placed parallel to each other one foot apart (old pallets make excellent foundations for a brush pile). Secondly, place branches and logs perpendicularly on top of the foundation. Lastly, smaller debris is added on top to form a mound. Brush piles may be placed randomly on land or partially submerged at the waters edge.

Rock Piles: Pile rocks (riprap, concrete, etc.) up to 12 inches high. Finish by angling several 4-6 inch diameter logs over the rock pile.

Hibernaculum: hibernacula are permanent below-ground structures that provide shelter for hibernating reptiles. Constructed hibernacula should face south, preferably along a sheltered wooded edge. To build a hibernacula (made available by the Iowa DNR), dig a hole 10'Wx15'Lx6-10'D; fill the hole with logs, rocks and

Microhabitats cont...

debris in a pile 4 ft. higher than ground level; place rock on the south facing side of the hibernacula; cover all but the south facing side of rock with 3 ft. of soil and seed with native short grasses and forbs. If space and materials are lacking, a second design is available utilizing 36" cement culvert pipe, riprap, flagstone, and engineering fabric. The culvert pipe, with the bottom covered with engineering fabric, should be set into a hole at least 7 ft. deep and be several feet below the high water table if placed within wetland or riparian areas. Once in place, fill the culvert pipe with riprap or rerod-free broken concrete. As a final step, loosely place flagstone or flat rocks 2' high over the top of the culvert.

The climatic conditions developed under woody debris are very stable while providing excellent substrate for the colonization of macroinvertebrate decomposers which serve as a food source for herpetofauna. (Photo by Jennifer Anderson-Cruz)

Cover Objects: Cover objects can be logs, rocks, boards, etc. placed out in the open, along forested edges, or partially in or underwater. It is very important that cover objects be scattered along the length of corridors to protect migrating amphibians from desiccation. Large objects such as slabs of concrete, limestone, and logs are suitable cover objects that are inexpensive and easy to provide. Cover objects have a dual purpose in

Rocks and boulders absorb the suns heat energy during sunlight hours and release it slowly, providing a source of warmth for reptiles during cool evening and morning hours. (Photo by Jennifer Anderson-Cruz)

providing above ground basking platforms and below ground shelter from the midday sun. Cover objects also concentrate invertebrates and become an important feeding area for insectivorous herpetofauna. The development of suitable conditions (temperature, humidity, etc.) under cover objects may take a considerable amount of time; therefore, disturbance of such habitat should not occur.

Nesting sites: Traditional nesting sites may be scarce or have unique characteristics that can not be recreated; hence, the disturbance of known nesting sites should be avoided at all costs. Suitable reptilian nesting habitat may be created by providing cover objects, den trees, or constructed sand piles on south and west facing slopes in full sun. Amphibian breeding ponds should be monitored for water quality to determine whether the site provides a safe environment for developing eggs, larvae and aquatic adults. Many amphibian species attach eggs to submerged vegetation and debris, habitat attributes that should be provided if not naturally present.

Many turtle species return to maternal nesting sites to lay eggs generation after generation. The loss of a maternal nesting site may result in the local extinction of certain turtle species. (Photo Courtesy of Missouri Dept. of Conservation)

Den sites: Dead den trees, logs, and snags should be included in the management plan to provide shelter and nesting sites for herpetofauna. Optimally, a minimum of five den trees/logs/snags per acre should be provided to benefit herpetofauna and other wildlife alike. If ample den sites are not naturally present, trees can be girdled or stumps and logs from off site can be brought in and placed randomly throughout the restoration area.

Inventory and Evaluation of a Restoration

Inventory and evaluation of a restoration's success in attracting herpetofauna can be easy, enjoyable, and allows a restorationist to deduce whether successional progression of flora and fauna is taking place or whether further management is needed to achieve the restoration goals for the site. As a site matures, herpetofaunal use will shift from a community of early successional exploiters to a stable, even climax community. Above and beyond monitoring adult animals, one must

Inventory and Evaluation of a Restoration cont...

remember to monitor nest sites, juvenile and larval stages of herpetofauna to ensure that reproductive success is taking place and that a site is not acting as a population sink. Listed below are numerous programs and materials available to those interested in monitoring herpetofauna and their habitat in the Midwest. In addition, there are several documents listed within the reference section below that are of great value in the identification and habitat requirements of Midwestern herpetofauna.

Due to the creation of manmade ponds, tiger salamanders are one of the few Midwestern amphibians that have increased in number since European settlement. Voracious aquatic predators, one larval tiger salamander can eat as many as 300 mosquito larvae in one hour. (Photo by Jeff LeClere)

The following documents require Microsoft Excel.

AMPHIBIANS OF IOWA*

REPTILES OF IOWA*

*Adapted from PARC document

Amphibian Index of Biotic Integrity (AmphIBI) for Wetlands
Ohio EPA 2002.
Wetland Ecology Group
Division of Surface Water
122 South Front Street, P.O. Box 1049
Columbus, Ohio 43216-1049

Frog Watch USA
National Wildlife Federation
11100 Wildlife Center Drive
Reston, VA 20190-5362
Phone: 1-800-822-9919

Iowa Frog and Toad Survey
Iowa Dept. of Natural Resources
Wildlife Diversity Program
1436 255th Street
Boone, IA 50036-7557
Phone: (515) 432-2823

Iowa Nature Mapping
Iowa State Extension Service
Ecology and Management
124 Science II
Iowa State University
Ames, Iowa 50011-3221
Phone: 515-294-6440

Iowater
Iowa Department of Natural Resources
Wallace State Office Building
502 East 9th Street
Des Moines, Iowa 50319
515-281-6640

Methods for Evaluating Wetland Condition: Using Amphibians in Bioassessments of Wetlands
U.S. EPA. 2002. Office of Water
U.S. Environmental Protection Agency
Washington, DC. EPA-822-R-02-022.

Partners for Amphibian and Reptile Conservation
Midwest Region
Bruce Kingsbury, Director
Center for Reptile and Amphibian Conservation and Management
Science Building
Indiana-Purdue University
2101 East Coliseum Blvd.
Fort Wayne, IN 46805-1499
herps@ipfw.edu
(260) 481-5755

Resources for Monitoring Pond-breeding Amphibians in the Northcentral USA
by Knutson, Lyon, and Parmelee
USGS Upper Midwest Environmental Sciences Center
2630 Fanta Reed Road
La Crosse, Wisconsin 54603

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Christiansen, J.L.; Baily, R.M. 1991. The Salamanders and Frogs of Iowa. Iowa Department of Natural Resources. Des Moines, Iowa. 24pp.

Christiansen, J.L.; Baily, R.M. 1991. The Snakes of Iowa. Iowa Department of Natural Resources. Des Moines, Iowa. 24pp

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Forman et. al. 2003. Road Ecology: science and solutions. Washington, DC: Island Press. Pp 481.

Habitat Management Guidelines for Amphibians and Reptiles of the Midwest. 2002. Partners in ReptileConservation. http://herpcenter.ipfw.edu/index.htm http://herpcenter.ipfw.edu/outreach/MWHabitatGuide/index.htm&2

Iowa Herpetology www.herpnet.net

Knutson, MG; Sauer, JR; Olsen, DA; Mossman, MJ; Hemesath, LM; Lannoo, MJ. 1999. Effects of Landscape Composition and Wetland Fragmentation on frog and toad abundance and Species Richness in Iowa and Wisconsin, U.S.A. Conservation Biology. Vol. 13, no. 6, pp 1437-1446.

Lannoo, M. ed. 1998. Status and Conservation of Midwest Amphibians. University of Iowa Press, Iowa City, IA. Pp 448.

Lannoo, Michael. 1996. Okoboji Wetlands; a lesson in Natural History. University of Iowa Press. 156pp.

Natural Resources Conservation Service Agronomy Technical Note 27 Guidance for Seeding Pothole, Floodplain, and Other Wetlands.

Natural Resources Conservation Service Biology Technical Note 24 Shallow Water Excavation for Wildlife.

Natural Resources Conservation Service National Biology Handbook Part 190, Part 614.4 Conservation Corridor Planning at the Landscape Level: managing for wildlife habitat.

Parmelee, J. R., M.G. Knutson, and J.E. Lyon. 2002. A field guide to amphibian larvae and eggs of Minnesota, Wisconsin, and Iowa. U.S. Geological Survey, Biological Resources Division, Information and Technology Report USGS/BRD/ITR-2002-0004, Washington, D.C. iv + 38 pp. http://www.umesc.usgs.gov/terrestrial/amphibians/mknutson_5003869_field_guide.html

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