COPPERBELLY WATER SNAKE

Nerodia erythrogaster neglecta

Identification, Status, Ecology, and Conservation in the Midwest

IDENTIFICATION

Copperbellies clean up pretty well. Their dark dorsal coloration contrasts with a yellow or orange belly and throat color. Photo by M. Myers.

General Appearance

Adult copperbellies are uniformly dark brown to black on their dorsal surface, and have an orange, red, or perhaps even yellowish belly, the color of which extends up onto the chin. The dark dorsal may appear as 'finger-like' projections of color 'bleeding' down from the lateral scales. In some cases, the dark coloration can heavily invade the belly color as dark bands. However, the dark coloration never occurs in half-moon crescents. Copperbellies can be quite large, with adults growing to lengths of 40-50 inches. Juveniles, in contrast to the adults, have a strongly blotched and banded pattern similar to that of other young water snakes.

Comparisons Amongst Subspecies

The copperbelly is the Midwestern representative subspecies of the "plainbelly" water snake, *Nerodia erythrogaster*, which ranges throughout the central and southeastern United States. The most similar plainbelly subspecies is the Redbelly Water Snake (*N. e. erythrogaster*). However, this is an East Coast form. The Yellowbelly Water Snake (*N. e. flavigaster*) is the subspecies that is closest to the copperbelly geographically. Yellowbellies and copperbellies co-occur in areas of southern Illinois and western Kentucky, and some intergradation is apparent. As suggested by the name, the belly color of the yellowbelly is more typically yellow rather than orange. The dorsal color of the yellowbelly is more of a light brownish than the dark brown or "black" of the copperbelly. Another feature which defines the copperbelly from the yellowbelly is that, in the former but not the latter, the dark color on the back protrudes in finger-like extensions onto the belly.

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Comparisons with Other Water Snakes

There are several superficially similar looking water snakes which share habitat with the copperbelly. In the northern part of their range, the copperbelly is most often confused with the Northern Water Snake (*Nerodia s. sipedon*), while to the south confusing species include the Midland Water Snake (*Nerodia sipedon pleuralis*), the Diamondback Water Snake (*Nerodia rhombifer*), and the Cottonmouth (*Agkistrodon piscivorus*). Northern and Midland Water Snakes have very similar characteristics, so will be described together.

Adult Northern and Midland Water Snakes may vary substantially in coloration. The typical pattern is a tan or brown background with a series of very broad black or dark brown bands on the back and sides. **In some individuals and populations, the background color is quite dark and blends closely with that of the bands.** As a result, the snake appears uniformly dark in color (especially when the skin is dry), and then may be easily confused with the copperbelly. Even experts may be fooled in some cases until they pick the snakes up. **Keep in mind the lack of dark crescents on the belly of copperbellies for those difficult cases.**

Certain color morphs of the Northern Water Snake look like copperbellies because of the dark dorsal coloration. Photo by B. Kingsbury

Young midlands and copperbellies may look rather similar, depending on individual coloration. Photo by E. Laurent.

There are distinctions between the dorsal coloration of the juvenile "common" water snakes (*Nerodia sipedon*) and copperbellies, but they are subtle. Juvenile copperbellies are thus easily misidentified. A challenging, but potentially useful distinguishing feature to tell young *Nerodia erythrogaster* (copperbellies and related species) from young *Nerodia sipedon* (northerns, midlands, etc.), is the subtle variation in dorsal pattern.

The copperbelly juveniles have few if any bands completely crossing the neck, while such bands occur on the front third of most *N. sipedon*. Just remember, a key separator is the lack of dark crescents of color on the belly, a feature which is present in species like the Northern Water Snake.

The Diamondback Water Snake has a chain-like pattern. Photo by J. List.

The Diamondback Water Snake occupies similar habitats to the copperbelly in the southern part of the copperbelly's range. However, diamondbacks are associated with deeper water. Diamondbacks are typically tan to brown with a darker chain pattern along the back, giving the impression of tan, diamond-like shapes. This pattern is more apparent towards the head.

The pattern of the Diamondback Water Snake in contrast to the uniform dark coloration of the copperbelly. However, as mentioned earlier, color and pattern intensities do vary between individuals, and identification may be particularly confusing when the snake is dry. The belly of diamondbacks is an ivory color and the throat is yellow, but in contrast to the copperbelly, black coloration does not 'bleed' into the ventral scales. Juvenile diamondbacks are patterned similarly to adults, and as such, may be confused with juvenile copperbellies. But again, it is the ventral scales which will help distinguish the two apart.

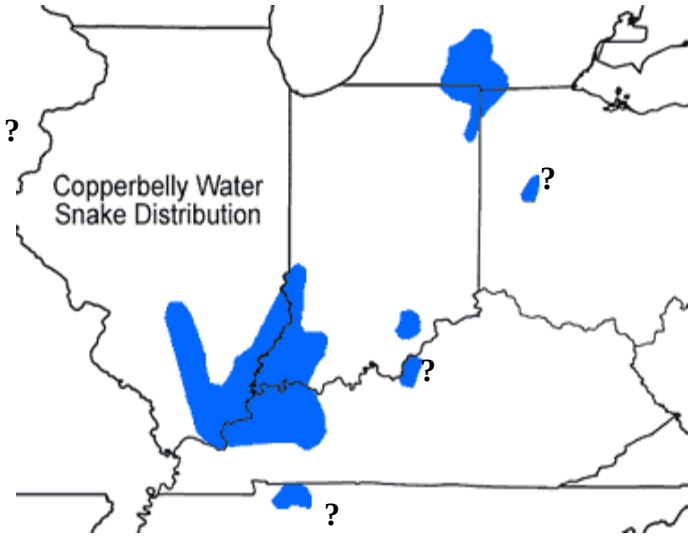
Certain color morphs of the Northern Water Snake look like copperbellies because of the dark dorsal coloration. Photo by M. Redmer.

The Western Cottonmouth shares habitat with the copperbelly in the southernmost parts of the latter's range. Unlike the other water snakes in the Midwest, the cottonmouth is **poisonous**. Adult cottonmouths are mostly uniformly dark brown or black with faint traces of crossbands on the body. Juveniles are adorned with a striped pattern that fades with age. **Cottonmouths lack the ventral coloration common to the copperbelly. Adults have diagnostic features of the viper family such as a wedge-shaped head, sensory pits between the eye and nostril, and have elliptical "cat-like" pupils.** Cottonmouths also have the unique behavior of holding their mouth open when threatened.

DISTRIBUTION AND STATUS

Distribution

From the south, the range of the copperbelly begins in southeastern Illinois, western Tennessee, and northwestern Kentucky. In these areas, the copperbelly often co-occurs with the yellowbelly. Most copperbelly populations, and most of the individuals, occur within southernmost portion of the snake's range. In southern Indiana, populations occur along the floodplains of all of the southwestern streams. As these flood zones narrow, copperbellies disappear.



A disjunct set of populations occurs in the vicinity of Muscatatuck National Wildlife Refuge, then a large gap occurs before copperbellies reappear in northeasternmost Indiana. A few populations used to occur in northern Indiana, but these may have been reduced to one population in Steuben County.

Most of the remaining so-called "northern" copperbellies are found in Williams County, Ohio, and adjacent areas of Hillsdale County, Michigan.

Status

The copperbelly is listed as Endangered by the states of Indiana, Michigan, and Ohio, and conferred special legal protection in Illinois and Kentucky. The copperbelly is also listed as Threatened at the Federal level by the United States Fish and Wildlife Service (USFWS) above the 40 Parallel, which means that only the disjunct northeastern populations are Federally listed.

South of the 40th Parallel, copperbellies have been protected by the Copperbelly Water Snake Conservation Agreement, formed in early 1997. The "Agreement" was intended to preclude the need to list the snake by removing threats to its existence through cooperation of interested parties, both public and private.

ECOLOGY

Wetland Use

Copperbellies are associated with shallow open wetlands. Wetland types frequented by these snakes include shrub swamps, emergent wetlands, and floodplain forests. They also often frequent larger bodies of open water if shallow edges are available. Copperbellies shy away form moving water such as rivers, and also tend not to use marshes, with their extensive areas of cattails.

Copperbellies typically forage in extremely shallow water, in the order of 5-10cm, or even less. While they may rest and bask on logs and shrubs in areas with deeper water, they do not utilize deep, open water except as a travel lane. To thermoregulate, and perhaps to just get out of the water, copperbellies will rest on logs and low branches, often just a few cm above the water. They will also use shorelines and levees. If surprised or disturbed, they will slide into the water to escape.

Copperbellies forage in very shallow wetlands. Pho by B. Kingsbury.

Copperbellies forage opportunistically on small amphibians and fish, but appear to favor adult and larval frogs (tadpoles). As a result, areas that have ample frogs are also good for copperbellies. Related to this, the reproductive efforts of many species of amphibian are impacted by the presence of fish that prey on the larvae. Consequently, high densities of fish may reduce the quality of a wetland for copperbellies.

Upland Use

Copperbellies make extensive use of uplands around wetlands. Photo by J. Roe.

Uplands also provide important habitats for copperbellies. Unlike many other water snakes, copperbellies may travel hundreds of meters away from wetlands. This tendency appears to be more pronounced for the northern populations, but is still true for the more southerly ones. Uplands are used for a variety of reasons, for example for travel, shedding, birthing, digestion, refuge during stressful weather (hot and cold), and other times when the snakes may be more vulnerable in wetlands.

Given their mobility on uplands, copperbellies can be found far away from water, but also at farm ponds and other wetlands that are situated well away from the floodplain. Excursions into uplands usually last from one to several days, but have been recorded as long as two weeks. When not in wetlands the snakes are often found in very thick vegetation, under mats of detritus, or in burrows. They will also exploit springs adjacent to floodplains if suitable emergent or shrubby habitat is available. Individuals using uplands favor forest gaps and forest/field margins. They usually avoid farm fields, but may use old fields adjacent to forest and wetlands.

Hibernacula

Copperbellies typically hibernate in crayfish burrows. Photo by B. Kingsbury.

Copperbellies typically hibernate in crayfish burrows in areas that may be prone to spring flooding. These areas are generally above the water table in the fall, but come spring they may be inundated by several feet of water. Copperbellies will not leave their overwintering sites during the winter if they are flooded, and can survive underwater for extended periods (weeks) if the water is cold. A high water table protects the ground from freezing. This is what protects the copperbellies in the winter as they hibernate. Drawing water down in wetlands during the winter may thus have a devastating impact on copperbellies as well as other herpetofauna overwintering there.

Copperbellies exhibit fidelity to hibernation areas year after year, though not necessarily to particular burrows. They do not appear to use modified, though otherwise apparently suitable, areas such as levees or farm fields.

Patterns of Movement

Copperbellies use large areas. For example, average seasonal home range sizes from recent studies on northern copperbellies have found them to use an area of approximately 15 ha or more over the course of an active season. Within this large home range area, copperbellies exploit wetland networks. Recent studies of northern copperbelly populations have also documented that copperbellies use an average of 3 to 5 wetlands over the course of an active season, and that they move between these wetlands regularly (an average of eight wetland shifts was recorded in one active season). Wetland shifts have been related to foraging activity interspersed with other activities. The total distance traveled between these wetlands may also be of considerable distance. Range lengths of a kilometer or more would not be unusual. Because copperbellies are a highly vagile species that uses multiple wetlands, and because they move between wetlands regularly, a mosaic of wetlands within the landscape will encourage metapopulation maintenance.

THREATS TO COPPERBELLIES

Copperbelly populations are in decline across their range largely as a result of habitat destruction and fragmentation. Efforts need to be made to improve the situation for this imperiled species. The following management recommendations will, if incorporated, considerably improve the future outlook for this important species.

Hibernation sites are particularly important to protect. Suitable hibernacula may be limited, as suggested by the congregation of individuals at those sites which are used. It appears that the snakes do not hibernate in restored, seemingly suitable, habitat. Thus, easy replacement of lost areas is unlikely, making the protection of known hibernacula particularly critical.

Capture in the field for use in the pet trade is a secondary threat to this species. Although habitat loss is no doubt the biggest problem, vigilance thought to occur, but is not viewed as a\the principal threat to the species.

MANAGEMENT GUIDELINES

Conservation and Management of Existing Wetlands

Shallow wetlands should be vigorously protected, even those that dry out in the summer (ephemeral/seasonal wetlands). Shallow wetlands are vulnerable to draining or deepening, but a variety of studies now show that they as critically important. **Existing shallow wetlands should not be modified to form deeper systems.** If deeper systems are desired, they could be constructed at sites that have already been disturbed so severely that shallow wetland recovery is unlikely, or simply inappropriate.

Wetlands should be viewed in the context of wetland complexes. All wetlands should be preserved in areas targeted for copperbelly conservation. Copperbellies need numerous adjacent wetlands to persist because of their diverse habitat use and vagility. They require a mix of shallow wetlands in relatively close proximity to one another.

Wetlands should not be stocked with fish. Many fish prey on amphibian eggs and larvae of frogs, the chief food source for copperbellies. Introducing fish thus potentially impacts the prey base of the copperbelly. Areas could, however, be stocked with eggs or larvae of amphibians native to the region and obtained locally.

The activity of beavers should not be discouraged unless clearly detrimental. Over time, dam construction forms desirable wetland structure, as well as refugia for the snakes, and beaver foraging activity helps to maintain an open canopy within forested areas of the wetlands.

Debris such as logs and flotsam provide important structures for refugia and basking for many wetland species, including copperbellies, and thus should be left on-site rather than "cleaned up." To make constructed wetland areas more "friendly" to amphibians and reptiles in general, debris can be added.

Copperbellies commonly use logs as loafing sites. Photo by B. Kingsbury.

Managing Adjacent Uplands

Management plans that focus only on the protection of wetlands without including the protection of surrounding upland habitats will be inadequate for the copperbelly. Successful habitat management for copperbellies must also consider the uplands around the wetlands. Although conservation of the wetland area itself has been stressed for the successful preservation of this species, intact adjacent upland habitats must also be preserved to ensure the copperbellies continued existence. Preservation of only wetland habitats may provide adequate resources for foraging and hibernacula locations, but copperbellies are one of the more terrestrial semi-aquatic snakes and have been observed using upland areas at substantial distances from wetlands.

Intact land-water interfaces protect adjoining aquatic resources by filtering chemical pollutants, moderating temperatures, and reducing siltation from activities in the surrounding landscape . Because of these factors, upland habitats are extremely important for copperbellies, as well as for other species whose life history requires seasonal migrations away from wetlands.

Upland habitats adjacent to wetlands also provide corridors to other wetland patches. Copperbellies have been shown to use upland areas for direct movement from one wetland to another, as resting, basking, and refugia sites, and occasionally for hibernation. Adequate upland must be available to satisfy these needs. Upland areas surrounding wetlands should principally be closed canopy forest but include some open terrain, providing necessary forest edge.

Timber management and harvesting should be conservative around and between wetlands . While forest edges confer thermoregulatory opportunities, and appear to provide a staging ground for the snakes to forage in adjacent woodlands and wetlands, extensive openings are not needed. Perhaps ten percent or less of the canopy need be open. In fact, openings caused by tree falls may be adequate for the snakes when away from wetlands.

Reforestation efforts should initially be aimed at achieving a complete canopy. Thinning or old field development could take place once the forest matures when less dense areas, or "thin" spots, can be readily identified. **Park-like management practices (i.e., mowed lawns, etc.) should be avoided anywhere but in the immediate vicinity of buildings or other sites where personal safety is a concern.** Otherwise, rank growth, small trees, and other "wild" habitat attributes should be left intact.

Corridors between wetlands and wetland complexes should be of sufficient quality and width to be attractive and safe to use. To function, corridors cannot be intimidating, and they must also be adequately safe to protect the snake and other wildlife from elevated predator and human encounters. They could include habitats such as riparian buffer strips, short stretches of

upland forest, and more narrow stretches of ephemeral wetland complexes. At the simplest level, corridor "design" may involve avoiding intensive farming of land in between wetlands. Corridors should be as short and as wide as possible: a width/length ratio of 1/5 is suggested as a lower limit.

The implementation of habitat buffers around areas regularly used by copperbellies should be considered. A buffer typically consists of a band of vegetation along the perimeter of a wetland or water body, preferably natural habitat, but including previously altered, stable native or introduced species. It is important that upland activities, such as row crops, do not come right up to the wetland edge. At least 10-20 m (30 to 70 feet), and hopefully more, of ground around wetlands should not be farmed or similarly manipulated. Manipulating uplands right up to the wetland edge could have devastating effects, not only by direct mortality, but also by loss of habitat and destruction of hibernation areas.

Edge habitat intended for copperbelly use should also be buffered from human activities. Road and agricultural margins should not be the only edge habitat available.

Agricultural fields should be offset from forest instead of running right up to the tree line. An unfarmed strip of 3-5 m (10-20 feet) in width between the forest and agricultural field would confer most of the benefits of an even broader buffer, because the snakes tend to stay close to the woods.

If agricultural areas are not too extensive or intrusive in terms of breaking up wetland complex structure, then perhaps the greatest immediate concerns are timing and implementation of management and farming practices. Agricultural practices adjacent to copperbelly wetlands, as well as in travel corridors, could favor crops that require the least amount of manipulation during the activity season. Similarly, any maintenance activities on these areas, such as brush hogging or mowing, should be implemented in winter, before the snakes emerge from hibernation.

Whenever possible, a buffer of at least 100 m should be protected from intensive manipulation during the active season. This may be hard to do in some cases, but will be very beneficial for copperbellies and other wetland wildlife that also have upland needs.

Wetland Restoration

When designing and constructing wetlands within the range of copperbellies, emphasis should be placed on shallow systems. Shallow wetlands, less than 30 cm (~ one foot) in depth are vitally important for copperbellies. They are conducive for anuran breeding, and consequently provide important food resources for copperbellies.

Shorelines of constructed wetlands should be complex, undulating in form rather than being relatively straight. This will increase the available shoreline, as well as shallow water areas close to shore. Levee and wetland design should take advantage of existing topography to maximize this effect, by backing water against substrate of gradual, undulating form. **Whenever possible, wetland shores should not have steep banks. Strive for slope ratios 1:5 or better.**

Hydrology should be spatially and temporally variable. Most, but not necessarily all, of the wetlands should be ephemeral in nature, such that they completely dry down every 1-3 years. This prohibits the development of fish populations, and allows the germination of vegetation requiring complete drying of the wetland.

Most of the shoreline should be of shallow slope, so that as the wetland dries, areas of less than 30 cm (about 12 inches) in depth are extensive. These shallow environs provide the required developmental habitat for anuran larvae, in addition to providing good foraging habitat for the copperbelly. Alternatively, when deeper wetlands are desired, they could be incorporated into a larger wetland complex constructed with extensive shallow peripheral areas that dry every 1-3 years. The interior portions could maintain water throughout the year and support moderate fish populations.

When replanting areas, native vegetation, preferably from the immediate area, should be used whenever possible. Buttonbush (*Cephalanthus occidentalis*) should be planted in those areas that tend to stay flooded, and bottomland forest trees planted in those areas that tend to dry down the most predictably. Willows (*Salix sp.*) should not be used in place of buttonbush.

Studies have indicated that overwintering snakes showed a preference for crayfish burrows that, at least at the onset of hibernation, were not flooded. Snakes were not found to utilize structures that were flooded, or beneath water at the onset of hibernation, although snakes tolerated flooding after beginning hibernation. Given the tendency for copperbellies to not use modified habitat for hibernation, known hibernacula should be protected. Nevertheless, reclaimed substrates within which we hope copperbellies might *eventually* hibernate should support crayfish colonization and have extensive areas just above most flooding.

When feasible, the water supply for wetlands should be fed by spring or surface runoff rather than floodwaters from riverine systems. Floodwater is sediment-laden and may be otherwise of questionable water quality. It will also contain fish. In many cases such influxes are unavoidable, so to minimize the influx of sediment with the water, settling areas should be included in wetland system designs. Whenever possible, floodwaters should *back* into wetland systems to maximize sediment deposition before the water infiltrates the habitat.

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This species description was created by staff at the Center for Reptile and Amphibian Conservation and Management. For related information please visit the Herp Center's website at: http://herpcenter.ipfw.edu. Funding for this project was provided by the U.S. Fish and Wildlife Service, and from the KY Dept. of Fish and Wildlife Resources via a US FWS Candidate Conservation Grant. v. 2/04