



THE COTTONMOUTH OR WATER MOCASSIN, *AGKISTRODON PISCIVORUS* (LACEPEDE), PART 3

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■ RANGE (CONTINUED)

South Carolina

Cottonmouths are primarily restricted to the Atlantic Coastal Plain region of South Carolina, which roughly corresponds to the area east of a line running from North Augusta, Northeast through Columbia, up to the North Carolina border. Cottonmouths are quite common in many areas, especially along the coast as reported by Jobson (1940) and Schmidt (1924). Further inland there are also many locality records, including the region of Columbia, Richland County as reported by Corrington (1929). This area is on the fall line between the Piedmont and coastal plain regions.

Texas

The western cottonmouth is common in eastern Texas, especially along the coastal plain region in the South-eastern part of the state. The westernmost limits of its range were at one time believed to be limited by a geological barrier known as the Balcones Escarpment (Smith and Buechner, 1947). Currently though, the westernmost locality records for *Agkistrodon piscivorus leucostoma* in the state are from Irion and Sterling Coun-

ties in west-central Texas, Raun and Gehlbach (1972) and Werler (1978). The range of *Agkistrodon piscivorus leucostoma* in south Texas is somewhat questionable, although the most widely accepted records seem to be from Neuces County (Corpus Christi area), and possibly Kleberg County which is located just south of Neuces County, Werler (1978). Four additional locality records for *Agkistrodon piscivorus leucostoma* in Texas are of particular interest;

- near Santa Rosa, Cameron County,
- Eagle Pass, Maverick County,
- Val Verde County, and
- Fisher County

The Cameron County record would put the cottonmouth in the Brownsville area near the border of Tamaulipas, Mexico. The records from Maverick and Val Verde Counties would extend the range west to the border of Texas and Coahuila, Mexico. The Fisher County record would extend the range several counties west of the known localities from North-central Texas. These records, along with others, have been reviewed by many authors over the years and are generally believed to be questionable or no longer extent. Below I have included a few of the reviews of these records. Gloyd and Conant (1943) included

all but the Fisher County record in their range map for *Agkistrodon piscivorus leucostoma* in Texas, stating the range as "The valley of the Rio Grande (Mouth of Devil's River and Eagle Pass) and the Gulf Coastal Plain of Texas...." Wright and Wright (1957) gave a similar range for *Agkistrodon piscivorus leucostoma*; "From Rio Grande Valley (Brownsville to Devil's River), North-east through east Oklahoma...." Burkett (1966) also reviewed these records and included information from Gloyd that a specimen supposedly from the mouth of the Devil's River was in fact marked as "near Santa Rosa, Cameron County, September 30, 1891." He went on to state that "No additional specimens have been taken in that area, and the range now probably extends no further south than Corpus Christi, Texas." Raun and Gehlbach (1972) excluded all four of the localities from their distribution map and said that they were all questionable. Other authors have also excluded these records from their maps, Behler and King (1979), Conant (1975), and Werler (1978).

Virginia

The eastern cottonmouth is found in South-eastern Virginia within the coastal plain region. Tobey (1985) showed the most northern localities for *Agkistrodon piscivorus* as being along the county line of Chesterfield and Prince George Counties. Belm (1981) reported that the most North-eastern locality was an isolated population "at the confluence of the Appomattox and James Rivers near Hopewell, Virginia." He stated that in this area they occur "in the lower reaches of Swift Creek, Chesterfield County, and

along both west and east banks of the Appomattox River." This locality is located at least 36 miles from the closest locality in the main part of the cottonmouths' range, Blum (1981). The most western locality record seems to be that shown by Tobey (1985) from Brunswick County, near the border of North Carolina. The division of South-eastern Virginia into counties is somewhat confusing because there are five counties that have been "absorbed by cities" Tobey (1985). The additional Virginia localities for *Agkistrodon piscivorus* that are listed below are counties or cities as defined by Tobey (1985); Brunswick, Chesapeake, Hampton, Newport News, Southhampton, Suffolk, Surry, Sussex, Virginia Beach, and York.

■ RANGE ADDENDUM

North Carolina

Brimley (1944) listed thirteen counties from which the eastern cottonmouth had been recorded, ranging from extreme Northeast to extreme Southeast North Carolina, as well as the central part of the state (in the vicinity of Raleigh). The list is as follows; "Currituck, Dare, Hyde, Beaufort, Carteret, Craven, Jones, Onslow, New Hanover, Brunswick, Columbus and Wake Counties, but only a single specimen in sixty years of collecting from the last named."

■ SIZE-AGE

Agkistrodon piscivorus piscivorus

The nominate subspecies is considered to be the second largest of the three cottonmouths attaining a maximum total length of 74 inches (188 cm; Conant 1975). Generally speaking,

male Crotalids in the United States are, on the average, larger than females. However, exceptionally large females are found occasionally as is the case with cottonmouths. Neill (1947) reported on four female cottonmouths that were collected on the same day and had total lengths of 59, 62, 63, and 67 inches (150 – 170 cm). The locality where these specimens were collected was given as "11 miles west of Waynesboro, Burke County, Georgia" which is located in East-central Georgia, near the South Carolina state line. The largest cottonmouth that Neill claimed he had ever seen also came from this locality. It was a female collected on June 13, 1937 and was "approximately 69 inches (175 cms) in length at the time of capture" (Neill, 1947). Adult *Agkistrodon piscivorus* do occasionally reach lengths of six feet (182 cm), but most adults however, average between 2 1/2-4 feet (76 – 122 cm) in total length.

Agkistrodon piscivorus conanti

This subspecies is reportedly the largest of the cottonmouths attaining a maximum length of 74 1/2 inches (189 cm; Conant, 1975). The next largest specimen that I have been able to find a record of was one reported by Allen and Swindell (1948). This specimen, a male, was collected in Marion County, Florida and had a total length of 72 inches (183 cm) and weighed 10 pounds 2 ounces (4,6 kg). In the same paper, they also reported on the largest specimens from a series of 221 cottonmouths (125 males, 96 females) that they had examined. The largest males were two specimens with total lengths of 68 inches (173 cm), one weighing 8 pounds 1 ounce (3,7 kg), the other, 9 pounds

(4,1 kg). The largest female was considerably smaller having a total length of only 49 inches (125 cm) and a weight of 4 pounds (1,8 kg). Most adult *Agkistrodon piscivorus conanti* average between 2 1/2-4 (possibly 4 1/2) feet (76 – 137 cm) in total length.

Agkistrodon piscivorus leucostoma

The maximum length of this form is somewhat debatable, but is most probably about 62 inches (157 cm). Several authors over the years have reported on the maximum length of *Agkistrodon piscivorus leucostoma*, some of which I have listed below in chronological order. Clerk (1949) reported the measurements taken from one hundred cottonmouths from Louisiana, the longest of which had a total length of 59 inches (150 cm). Smith (1956) gave the maximum length of *Agkistrodon piscivorus leucostoma* as 58 1/2 inches (148,5 cm). Wright and Wright (1957) and Anderson (1965) both gave 62 inches (157,5 cm) as the record length for this subspecies. Conant (1975) reported 55 1/2 inches (141 cm) as the maximum length for *Agkistrodon piscivorus leucostoma*. More recently, Tennant (1985) stated "The record western cottonmouth, taken on the Neches River by George O. Miller, is just over 5 feet (152 cm) in length." Adult *Agkistrodon piscivorus leucostoma* are usually smaller than the adults of the other two forms, averaging 2-3 feet (61 – 91 cm) in total length. Cottonmouths generally settle down in captivity and often do quite well, living for many years. Perkins (1955) listed a record longevity for *Agkistrodon piscivorus* (subspecies not specified) of 18 years 11 months. Minton (1983) and Pope (1978) have

both attributed a longevity of at least 20-21 years to the cottonmouth, as did Wright and Wright (1957). Bowler (1977) listed the following maximum known records for cottonmouths; *piscivorus* - 13 years, 1 month, 24 days; *conanti* - 15 years, 8 months, 7 days, *leucostoma* - 16 years, 6 months, 4 days.

■ HABITS

The disposition of *Agkistrodon piscivorus* in the wild has been described by numerous authors as ranging from docile to pugnacious, the latter description being somewhat more common. When approached in the wild, cottonmouths will frequently try to escape into the nearby water, thus avoiding confrontation. Specimens that don't retreat will stand their ground and exhibit a defensive display that includes gaping, tail vibrating, musking, and striking. Gaping is a behaviour in which the snake rapidly opens its mouth, thus exposing the interior white lining, hence the common name of cottonmouth. Usually, at this time the tail is vigorously vibrated against the substrate that the snake is lying on. Cottonmouths are quite adept at expelling musk from the glands located in the base of their tail. This fluid can be expelled up to a distance of at least five feet, Allen and Swindell (1948). Musking occurs whether the snake is left on the ground or is being restrained for capture. The above behaviours are frequently accompanied by intermittent striking that can be so forceful at times that the snakes body will be lifted off the ground, Allen and Swindell (1948), Neill (1947), and Strimple (personal observations) In captivity, cottonmouths often lose their aggressive dispositions, see-

ingly becoming quite docile at times. This "tamelessness" should not be considered too lightly because "tame" cottonmouths can become instantly pugnacious with little or no provocation, Allen and Swindell (1948) and Strimple (personal observations). Considering the fact that cottonmouths are often times pugnacious, and are also abundant in many areas throughout their range, it is interesting that attacks on man are rare. In fact, up until 1947 there apparently were no literature records of unprovoked attacks by moccasins. Neill (1947) reported on such an instance that occurred on August 8, 1946 in a small stream "about 11 miles south of Augusta, Richmond County, Georgia." The snake involved was observed on the opposite bank of the stream from the author, a distance of approximately twelve feet. It reportedly lunged in the direction of the author with such force that it ended up in the water. Neill continued his account as follows; "Piqued by such belligerency, I seized a stick and scrambled down the bank into the stream. To my surprise, the cottonmouth swam to meet me. I waved the stick over its head; it did not strike at it until touched on the anterior part of the body. It embedded its fangs in the wood for a moment and then swam toward my legs", Neill (1947). Allen and Swindell (1948) also reported on an attack by a cottonmouth as follows; "One three-footer, when approached, struck upward so hard that he lifted his body off the ground. He advanced, coiling and striking repeatedly, following the retreat of the observer." The authors however, do not state whether or not the attack was provoked in any way. An erroneous belief often stated

about water moccasins is that they cannot bite underwater. The truth is that they can, and do, strike or bite underwater as well as on the surface while swimming. Allen and Swindell (1948) published a photograph that showed a cottonmouth biting underwater to demonstrate this behaviour.

In the presence of king snakes, *Agkistrodon piscivorus* (as well as other Crotalids) have been reported to assume various, defensive postural responses. Carpenter and Gillingham (1975) used the terms "body bridging, inflation, negative behaviour, body flips, and body jerks" to describe these responses. Since king snakes are known to feed on cottonmouths, it is easy to understand this type of behaviour. On occasion though, it seems that some king snakes try to escape when placed in a cage with a smaller cottonmouth. Neill (1947) briefly mentioned his observations of this behaviour, stating "A tame, hungry king snake, placed in a cage with a moccasin two-thirds its length, usually becomes frightened, rooting about the cage in a desperate effort to escape." Cottonmouths are not normally gregarious snakes, however, there are times when small to large numbers of them have been observed together in the wild. Martin and Wood (1955) reported that cottonmouths found during the early spring, in Virginia, were usually solitary while those found from late March through mid-May were found in aggregations of from two to six or eight specimens. The authors suggested that these aggregations were "probably related to courtship and the 'combat dance'", Martin and Wood (1955). Aggregations of water moccasins at times of

feeding have been reported by several authors including Allen and Swindell (1948) and Bothner (1974). In both of these accounts, cottonmouths were found congregating around drying pools of water to feed on the dying fish. At these sites they have been observed to feed in the water as well as to carry their prey onto the bank to feed. Moccasins will remain at these pools, gorging themselves at each feeding, until the food supply is gone. Wharton (1969) reported on aggregations of cottonmouths that he observed around the bird rookeries on Sea Horse Key, Florida. Of the cottonmouth, in these areas, he stated, "Here it scavenges beneath the nest trees, apparently attracted by the odour of the excreta and the fish regurgitated by annoyed parent birds or dropped by clumsy nestlings."

The feeding habits of water moccasins have been discussed by several authors. Burkett (1966) stated that "Some captives lie in ambush and others crawl in active search." Allen and Swindell (1948) also discussed their feeding habits and said that the search for food occurs on both land and water. Methods of actual prey capture have been reported on numerous times, and have been generally classified as hold or release behaviours. Allen and Swindell (1948) reported that cottonmouths hold onto frogs and fish after they are struck and occasionally swallow them before they are dead. They also stated that when mice are the prey "the moccasin strikes and retains his hold. However, if the mouse bites at the snake, it is dropped and the snake waits until it succumbs", Allen and Swindell (1948). Burkett (1966) stated "Cottonmouths observed

by me retained a strong hold on fish, frogs, and sometimes mice, but almost always released large mice and baby chicks, which were not eaten until after death." Kardong (1982) conducted feeding experiments with cottonmouths and found that "the first mouse struck tended to be quickly released by the snake, but subsequent mice tended to be retained in the jaws." He admitted that the reason behind this behaviour was not clear, but he did suggest two possibilities, the first being that since the venom supply is likely to be reduced after each strike, cottonmouths compensate by holding onto the prey. This seems reasonable because it would prevent the prey from going beyond "the recovery range of a snake before it dies from the lowered, but eventually effective, envenomation", Kardong (1982). The other possibility that he suggested was related to the snake's appetite, stating "As each mouse struck was swallowed before the next in sequence was presented, perhaps the food in the snake's stomach was a proximate factor affecting behaviour", Kardong (1982). The prey capture sequences in cottonmouths was studied by Kardong (1975). In this study he described six (and postulated a seventh) phases of prey capture as; search, approach, glide, strike, bite release and post-release.

■ TAIL LURING

The presence of a light-coloured tail in juvenile snakes such as Boids, Crotalids, Viperids and Elapids has been documented for many years. The use of this coloured tail as a caudal lure has been observed and documented by numerous authors, the first of which was Ditmars (1907), who observed this in capti-

ve copperheads. An accurate description of caudal luring was given by Heatwole and Davison (1976) who stated: "Caudal luring is the waving or wriggling of a conspicuous tail by an otherwise cryptically coloured snake, thereby attracting small animals which attempt to feed on the worm-like or caterpillar-like tail, but themselves become prey when they come within striking distance of the snake." This behaviour has been reported for Elapidae, Viperidae and Crotalidae (including *Agkistrodon piscivorus*) by many authors including, in chronological order; Henry (1925), Kauffeld (1943), Neill (1948a), Allen (1949), Wharton (1960), Henderson (1970), Greene and Campbell (1972), Heatwole and Davison (1976), Carpenter, Murphy, and Carpenter (1978), and Jackson and Martin (1980). Comprehensive reviews on caudal luring have been done by Neill (1960) and Heatwole and Davison (1976), the latter of which summarized the observations of many of the above authors as follows;

- "Caudal luring is carried out primarily by juvenile snakes",
- "Caudal luring is especially prevalent in the crotaline vipers (pit vipers)", and
- "Caudal luring does serve to attract prey."

Caudal luring has been described for cottonmouths in some detail by Wharton (1960) who believed that his account was the first recorded for *Agkistrodon piscivorus*. In this account he included a series of sketches depicting the various positions of the tail-tip as they occurred. Not all authors have considered the light-coloured tail of Crotalids to be

adaptive colouration. Burger and Smith (1950) reported on broods of Fer-de-lances, *Bothrops atrox*, in which only males possessed a yellow tail tip, the females having tail tips that were either dark, or "slightly lighter than the rest of the tail." The authors explained this difference in coloration as sexually dimorphic, stating "Apparently here is a sexual character which, oddly enough, disappears before maturity." It is interesting to note, that the authors did report that some of the young *Bothrops atrox* held their tails up, although luring was not observed.

■ SEASONAL ACTIVITY

Throughout much of their range, cottonmouths are active from at least April through October. In areas where they hibernate, cottonmouths typically will migrate from the wet lowland habitats up into the surrounding wooded hillsides where they will den in the rocky bluffs and outcroppings. Depending on the area, this can occur between late August and early September, through October and even early November, as reported by several authors including Baker (1985), Barbour (1956), and Wood (1954). Water moccasins have been reported to den with, or in close proximity to, many other snakes including copperheads, rat snakes, king snakes, and coach whips, Dundee and Burger (1948), Neill (1947), and Wright and Wright (1957). The cottonmouths that are observed extremely late in the season are no doubt exposed to cold, sometimes dangerous, temperatures. Baker (1985) gives an account of a *Agkistrodon piscivorus leucostoma* that was collected on No-

vember 10, 1985 in Osage County, Oklahoma. This specimen was found away from the water, ascending a slope. The ambient temperature was reportedly 7 degrees C (approximately 44 degrees F). With the onset of warm weather in March and April, cottonmouths will emerge from their den sites to search for food and mates. Frequently, they will remain in the vicinity of the den site for a short period of time following emergence, but are usually dispersed throughout their lowland habitat by May or June. A few warm days in early March is all that is needed to bring them out. Martin and Wood (1955) gave March 5, as the earliest date that they observed or collected cottonmouths in Sum Swamp, Norfolk County, Virginia. In the southern parts of their range, water moccasins can be active almost, if not entirely, year-round. Tinkle (1959) reported on a *Agkistrodon piscivorus leucostoma* from Louisiana that was collected five times between November 15, 1953 and May 30, 1954, and was seen "on warm days throughout the year." Wharton (1966, 1969) has seen moccasins that were active in December in the Florida Keys, and on Sea Horse Key in particular, the earliest that he found them in dens was November 6. In these areas, where the winters are mild, he observed that these snakes seek temporary shelter from cool weather by utilising the stump holes of overblown trees. These retreats are usually less than a foot deep, and a single hole may contain as many as nine snakes. Denning sites, other than the more typical wooded hillside habitat, have been observed in several other areas as well. Strecker

(1926) found *Agkistrodon piscivorus* in rotten logs, and Allen (1932) found them under logs and stumps in Harrison County, Mississippi. Neill (1947, 1948b) found them in decaying pine stumps and under rotten logs in Georgia. Neill (1947) described the utilization of this particular type of hibernating site as follows; "On cold days the moccasins cannot be found, evidently retreating far below the surface in the pulpy medium. On warm winter days (which are frequent in this area), they lie just below the bark, usually well above ground level. Occasionally they emerge completely to bask several feet away from the stump." Dundee and Burger (1948) suggested some cottonmouths in Oklahoma may utilise "crayfish holes and rodent burrows" in their summer, lowland habitat. Burkett (1966) actually observed cottonmouths "crawling into crayfish burrows along the Gulf Coast of Texas."

■ COMBAT DANCE

There are several literature records of Crotalids engaging in a "dance" behaviour. Some of the early authors believed that this behaviour was related to courtship and mating; Carr and Carr (1942), Davis (1936), Gloyd (1947), Lowe (1942) and Whisenhunt (1949). Other authors have suggested that it could be a result of competition for food, territory, or mates (after it was discovered that participants in the "dance" are almost always males); Gloyd (1948), Lowe (1948), Lowe and Norris (1950), Ransey (1948), Shaw (1948), and Sutherland (1958). Allen and Swindell (1948) also recorded observations of a "dance" between two four-foot

cottonmouths from Florida, but did not record the sex of these snakes and made no mention as to the possible reason for this behaviour. More recently, Perry (1978) reported observing this behaviour between two *Agkistrodon piscivorus leucostoma* in the wild. The observations were made on September 4, 1976 in a "clear Ozarkian stream in southern Missouri, Ozark County", Perry (1978). The sex of these snakes was not determined, and this activity was not observed in its entirety. Because of this, the author made no definite statement as to the factors behind the "dance." She did however, state "I tend to agree with those who ascribe territorial significance to such displays." Fogleman, Byrd, and Hanebrink (1986) have seemingly reported the most recent case of male combat in the cottonmouth. The snakes involved were both males and the locality given was "in the Black Swamp area near Augusta in Woodruff County, Arkansas"; Fogleman et al. (1986). These observations, made on September 13, 1980, included "parallel alignment, body bridging, forward jerks, swaying, crawling over and entwining", Fogleman et al. (1986). The combat behaviour discussed above has been observed in other groups of snakes including Colubrids and Elapids. Shaw (1951) gives a review of these snakes and includes many useful references.

This is part three of a series of four.

Full list of references will be given in the last part of this series.