

THE EFFECTS OF THE "BLIZZARD OF 1993" ON THE BREEDING CYCLE OF AMPHIBIANS IN NORTHERN VIRGINIA

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The Blizzard of 1993 may have had a significant effect on the breeding cycle and 1993 year class of amphibian populations in Prince William, Fairfax and Loudoun counties of Northern Virginia. Many amphibian species begin to appear at their ephemeral breeding pools in Northern Virginia in late February through March. Some of these species share the same breeding site, but, are rarely in competition for these sites, due to slight differences in niche requirements, including water and air temperatures and availability of specific food sources (Primack, 1993). The "Blizzard of '93" began the night of 12 March 1993 as several species were beginning to arrive at the temporary rainpools to breed. Some were caught in the blizzard. Others were delayed in arriving at the pools until late March, and were forced to share their sites with other breeding amphibian species with which they would not normally overlap in their breeding periods. Additionally, due to the delayed breeding by some species, many eggs and larvae were lost as the rainpools began to dry in late Spring.

The wood frog, *Rana sylvaticus*, is an early spring breeder, known to breed from mid-March through April (Wright and Wright, 1967). Their egg masses are often the first observed in Northern Virginia (Dr. Carl H. Ernst, pers. comm.).

The spotted salamander, *Ambystoma maculatum*, is known to breed in the early spring, under stimulus of warm rains (Bishop, 1941; Conant and Collins, 1991). Historically in Northern Virginia, male spotted salamanders migrate in late February to ephemeral rainpools, depositing spermatophores, which are usually taken up by the females within 2-3 days, followed by the female's subsequent depositing of egg masses (Dr. Carl H. Ernst, pers. comm.). Around the time the egg masses begin to appear, male upland chorus frogs, *Pseudacris feriarum*, arrive at these same pools and begin calling. Chorus frogs breed from February to late May in the North; during winter or early spring in the South (Wright and Wright, 1949).

Approximately one week after *P. feriarum* arrive, spring peeper males, *P. crucifer*, begin to appear and start vocalizing. The spring peeper breeds from late November to March in the South and in the spring through June in the North (Wright and Wright, 1949).

Approximately nine days after *P. feriarum* males begin to call, *P. feriarum* females arrive at the ponds for breeding purposes (Wright and Wright, 1967). Rainpools will sometimes contain several simultaneous mating pairs, and although they are normally shy and secretive by day, when found in amplexus, the pair can often be easily captured. Male northern cricket frogs, *Acris crepitans*, usually appear at the rainpools around the same time female chorus frogs appear. Cricket frogs breed from April through July (Wright and Wright, 1949). However, male cricket frogs have been captured at rainpools in Northern Virginia as early as late February.

While a few female *P. feriarum* tend to arrive early or late at the rainpools, most females seem to reach the rainpools within a two to three day period for communal breeding and then disappear into the woods until the following year. Once the majority of female *P. feriarum* have bred, female *P. crucifer* start to arrive at the pools. Initially, males of both *P. feriarum* and *P. crucifer* can be heard calling together; but, as the days pass, the number of calling *P. feriarum* becomes fewer and they are gradually drowned out by the burgeoning population of male *P. crucifer*. After this the *P. feriarum* follow their females back to the woodlands, and by mid-March male *P. feriarum* can only be heard calling from woodland rainpools and flowing creeks situated farther back in the woods.

The American toad, *Bufo americanus*, usually arrives within a week of the appearance of *P. crucifer*, and amplexus normally occurs within a week of the initiation of the male's calling trills. *B. americanus* breeds from March through July (Wright and Wright, 1949). The pickerel frog, *Rana palustris*, is usually the next to arrive in late March, and breeds from late April through mid-May (Wright and Wright, 1967).

The above was the normal pattern for the late winter-early spring breeding season for the years 1991 and 1992. However, 1993 was extremely different. Male *P. feriarum* did not begin to arrive at the rainpools until approximately 7 March. Prior to this, no egg clutches of any amphibians were observed.

Only overwintering larval marbled salamanders, *Ambystoma opacum*, and second year tadpoles of bullfrogs, *Rana catesbeiana*, were observed in some of the pools in Loudoun County. Two days later, on 9 March the first male *P. crucifer* was heard calling. On 10 March approximately 0.38 cm of snow (liquid equivalent), fell over the Northern Virginia area and the calling stopped.

Rainpool pH levels dropped an average of two units. The snow melted rapidly and by the evening of 12 March male *P. feriarum* again were calling with intensity as additional males joined the chorus. The night of 12 March the "Blizzard of '93" arrived and covered the ground, including the rainpools, with approximately 5.82 cm of snow and sleet (liquid equivalent). The snow remained on the ground and the rainpools were frozen until 22 March. On this day male *P. feriarum* began to return to the rainpools and resumed calling.

On 24 March the first spermatophores of the spotted salamander, *Ambystoma maculatum*, were observed. On 25 March, the first clutches of amphibian eggs were found in a rainpool located on the Loudoun/Fairfax County line. The eggs had been either deposited the previous night, or on the morning of 25 March, by a wood frog, *Rana sylvaticus*, which was found lying on top of an egg mass. She was near death, and internal hemorrhaging was observed through her somewhat transparent ventral abdominal skin. On this same date other decomposing *Rana* sp. females were found dead in the rainpools without egg masses present, possibly trapped after having appeared at the breeding pools prior to the snow storm.

On 27 March, the first *A. maculatum* eggs were observed. Also on this day the first amplexing pair of *P. feriarum* were captured. Oviposition occurred that evening in captivity. The majority of *P. feriarum* eggs were deposited between 27 and 29 March, almost one month late. Male *P. feriarum* seemed as plentiful as in past years, but significantly fewer females were seen/captured, and only a few amplexing pairs were found. Some of the more productive rainpools in previous years experienced very little, if any, breeding activity by *P. feriarum*. It is unknown whether this was due to the weather or to normal amphibian breeding patterns, where only a portion of a population breeds each year (Hustings, 1965). Additionally, there was extensive snowmelt and rainfall during the 1993 breeding season, which caused a murky condition in the water that may have made it more difficult to find breeding *P. feriarum*. Many of the smaller rainpools had only one breeding pair, and produced only 2 - 4 egg masses, probably indicating that only one female was present at each of these pools.

On 29 March, near Gainesville, Prince William County, a gravid female *P. feriarum* (George Mason University 3983), was captured and placed in a container with male *P. feriarum*. She allowed two males to attempt amplexus, but neither was successful. On 7 April she hemorrhaged and died. This female appeared melanistic. The white line on her upper lip was not readily apparent nor were the three lines, broken or unbroken, noticeable without magnification. However, identification was confirmed by Dr. Carl H. Ernst, George Mason University and Mr. Ronald I. Crombie of the National Museum of Natural History, Smithsonian Institution.

Spermatophores of *Ambystoma maculatum* were not found until 24 March, and egg masses not before 29 March, one month later than normal for the area (Ernst, pers. comm.).

Additionally, *P. feriarum* embryonic mortality was extremely high in some of the Loudoun/Fairfax rainpools. Prior to 1993, embryonic mortality in *P. feriarum*, in situ, had not been observed at any of these sites (pers. obs.). Some rainpools in Loudoun County had as much as 50% mortality in many of the egg masses.

The pH levels of these rainpools ranged from a low of 5.27 to a high of 6.58. However, these rainpools are shallow and instances have been observed where an acidic rainfall or snowmelt has lowered the pH level by an order of magnitude. Usually within 24 hours of exposure to acidic deposition, the pH begins to rise again. Lowered pH levels during sensitive amphibian embryonic stages may result in increased mortality (Padhye and Ghaft, 1988; Pierce, Hoskins and Epstein, 1984). The day the first *P. feriarum* eggs were found, 27 March, an acidic rainfall (pH 3.67) occurred. However, the electrode on the pH meter stopped functioning before the pH of the actual rainpool water could be measured.

Additionally, some amphibian species are more acid tolerant than others (Gosner and Black, 1957). *A. maculatum* embryos have been found to have a 50% mortality rate when exposed to a pH range of 5.0 - 7.0 (Pough and Wilson, 1977; Cook, 1983).

The adverse effects of the delayed breeding season continued through the Spring. The month of April, was very windy and the rainpools rapidly dried. Numerous egg masses of *A. maculatum* were exposed to the air for extended periods of time, and many eggs died from desiccation. Additionally, larvae of other amphibians hatched into extremely small amounts of water. While not tested, aquatic insect larvae which may be a significant food source for some amphibian larvae, may have already metamorphosed before the amphibian larvae would have been able to utilize them. The result of a shortened and delayed breeding season, is that the overall population size and survival of the 1993 year class of several amphibian species may have been greatly reduced.

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