

THE MASSASAUGA RATTLESNAKE IN PENNSYLVANIA: CONTINUING HABITAT LOSS AND POPULATION ISOLATION

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ABSTRACT

The geographic range of the massasauga in Pennsylvania has always been limited to the extreme western portion of the state. Literature reports and museum records define a historic distribution that included 19 separate localities in six western Pennsylvania counties. A survey in 1977 and 1978 indicated that the occurrence of this species had been substantially reduced to 11 localities in four counties. Damming and highway construction were observed to be the major contributing factors in the decline of populations and the loss of habitat prior to 1978. A more recent (1988) survey found that the loss of populations and habitat has continued, and massasauga populations appear to presently exist at only eight localities in three counties. In many cases, natural succession of woody vegetation has been the leading cause of recent habitat deterioration. The one locality that has maintained stable habitat conditions has been subjected to intensive management to retard woody vegetation growth. Existing massasauga populations in Pennsylvania have become increasingly isolated by long distances and strong dispersal barriers.

INTRODUCTION

The massasauga (*Sistrurus catenatus*) reaches the eastern terminus of its geographic range in western Pennsylvania and central New York. In western Pennsylvania this species has historically been reported from the following six counties: Allegheny, Butler, Crawford, Lawrence, Mercer and Venango (Atkinson, 1901; Atkinson and Netting, 1927; Swanson, 1930, 1952; Reinert, 1985). The preferred habitat of the massasauga in this portion of its range includes low-lying, poorly drained meadows and adjacent "old field" situations (Reinert and Kodrich, 1982). Its occupation of western Pennsylvania is probably a consequence of a post-glacial extension of the midwestern prairies (Schmidt, 1938). It is unlikely that the range of this species extended any further east in Pennsylvania because of the higher elevation and mountainous physiognomy of the central portion of the State. Although its distribution in Pennsylvania has apparently always been somewhat disjunct (even prior to 1900) in certain areas it was considered locally common (P.L. Swanson, pers. comm.). Farmers and landowners in these areas were well acquainted with the snake and often wore burlap leggings for protection when harvesting hay or marsh grasses (S.W. Nunemaker, pers. comm.). However, in unpopulated and less agricultural areas its existence may have gone unnoticed due to its small size, secretive habits, and preference for wetland habitats.

An intensive investigation of the past and present occurrence of the massasauga in western Pennsylvania was conducted from 1977 to 1978. Ten years later, a second survey was performed in an effort to assess changes in massasauga populations over the intervening decade. The results of these studies were submitted as confidential reports to the Pennsylvania Fish Commission (Reinert and Kodrich, 1978) and to the Carnegie Museum of Natural History (Reinert, 1990). A generalized summary of both reports follows. Precise locality data have been purposely omitted in an attempt to protect currently extant populations from unscrupulous collectors.

MATERIALS AND METHODS

The first published records of the occurrence of massasaugas in Pennsylvania were those of Atkinson (1901). Additional locality records were subsequently reported by Atkinson and Netting (1927) and Swanson (1930, 1952). These data in conjunction with the locality records of the Carnegie Museum of Natural History, Pittsburgh, and the unpublished notes of P.L. Swanson confirm the presence of the massasauga at 19 distinct localities in six western Pennsylvania counties since the mid-1930's (Figure 1A).

During 1977 and early 1978, these 19 localities were evaluated for the presence of massasaugas or suitable habitat. A total of 15 localities were visited, with many areas visited repeatedly. Additional information concerning these and the four remaining localities was obtained from current topographic maps, museum records, and interviews with several hundred landowners, farmers, rural mail carriers, Fish Commission and Game Commission personnel and biologists.

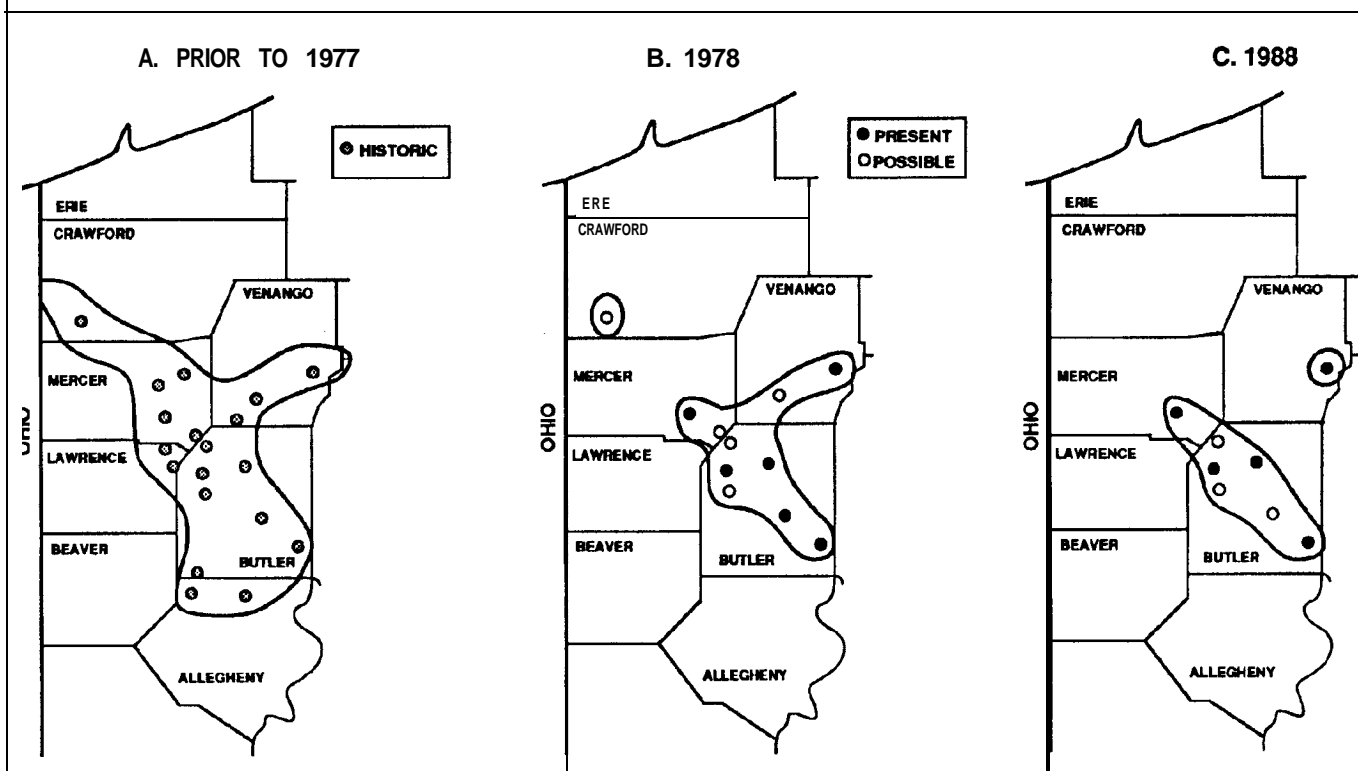


Figure 1. Changes in the occurrence of the massasauga in Pennsylvania.

Ten years later in 1987 and 1988, eight of the localities determined to have extant or possibly extant massasauga populations during the prior survey were revisited over a period of 22 field days. In addition to extensive time spent actively searching for snakes and evaluating habitat, a substantial amount of time was again spent interviewing local residents and other individuals having field experience in the vicinity of massasauga localities. This produced updated information on the remaining three localities that were known or thought to harbor extant populations during the prior investigation.

The massasauga was considered "present" at a locality if specimens were observed by the authors, or if verified reports indicated that the snakes had been observed recently in the vicinity. The presence of snakes was listed as "possible" if suitable habitat was found to exist at a locality and if unverified reports indicated recent observations of the massasauga. The presence of the snake was considered "doubtful" if the habitat appeared unsuitable or severely decreased, and/or no specimens had been reported for 25 years or more. In this context, verified reports were those backed by specimens or identifiable parts of specimens (e.g. skins or rattles), museum records, or the observation of reputable observers. Unverified reports were those in which the identity of the snake in question could not be ascertained with complete certainty, but available information strongly suggested that it was a massasauga.

RESULTS

Of the 19 localities investigated in the late 1970's, six were found to definitely harbor extant massasauga populations. These included four localities in Butler County, one in Mercer County and one in Venango County. In view of the habitat conditions at that time and unverified reports, it was determined that massasauga populations were possibly present at two additional Butler County localities, one Crawford County locality, one Mercer County locality and one Venango County locality (Figure 1 B).

The remaining eight localities examined had either unsuitable habitat or such severely decreased habitat that the presence of the massasauga was considered very doubtful. This included all of the Allegheny and Lawrence County localities, two Mercer County localities, one Butler County locality and one Venango County locality. In addition, seven of the localities having extant or possibly extant populations also exhibited signs of habitat deterioration which probably resulted in decreased population densities. Damming, highway construction,

urban expansion, forest succession, surface mining and agriculture were observed to be the major factors responsible for altering massasauga habitat in Pennsylvania (Table 1). In the period prior to 1978, damming of low-lying areas to form lakes and ponds and the construction of roadways (mostly interstate highways) were the two major factors contributing to a reduction in massasauga habitat at the localities surveyed. Damming had adversely affected massasauga habitat at six localities (32% of the localities surveyed), while the construction of roads had a negative impact at four localities (22% of the localities surveyed). Investigation in the late 1980's revealed a further decline in massasauga populations (Figure 1 C). Massasaugas were found to be present at five localities. These included three in Butler County, one in Mercer County and one in Venango County. The presence of the massasauga was deemed possible in three additional localities in Butler County. The presence of massasaugas in the remaining two localities in Crawford and Mercer Counties, was determined to be doubtful.

Continued loss of habitat since the late 1970's was observed to have occurred at all but one of the eight localities visited during the late 1980's. The major factor attributing to this loss was the encroachment of woody vegetation into meadow and old field habitats at massasauga localities (Table 1). This natural forest succession was observed at six localities (75% of the eight localities ground surveyed). The previously important factors of damming and roadway construction had produced no noticeable habitat loss between 1978 and 1988. The only locality which appeared to have maintained stable habitat conditions since 1978 had been managed by the Pennsylvania Department of Natural Resources to retain a remnant prairie.

Table 1.
Factors responsible for altering massasauga habitat in Pennsylvania.

FACTOR	PERCENT OF SITES IMPACTED*	
	TO 1978	1978-1988
Damming	32%	0%
Highway construction	21%	0%
Housing and urban expansion	16%	12%
Forest succession	10%	75%
Surface mining	5%	12%
Agriculture	5%	0%

* Based upon the evaluation of 19 sites prior to 1978 and 8 sites from 1978-1988.

DISCUSSION

The distribution of the massasauga in Pennsylvania has greatly decreased since the turn of the century. Once reported from 19 localities in six counties, it is currently thought to be extant at only eight localities in three counties. In addition to this significant reduction in the number of extant populations, continued habitat loss seriously threatens practically all existing populations.

Prior to the late 1970's, damming was the greatest threat to massasauga habitat, with highway construction following a close second. During the 1980's, however, forest succession appeared to be the major factor contributing to habitat loss. Forests have long been cited as the major natural factor limiting the massasauga's distribution (Atkinson and Netting, 1927; Schmidt, 1938; Swanson, 1952) and several studies have indicated the preference of this species for early successional seres (Wright, 1941; Maple, 1988; Reinert and Kodrich, 1982). As a result, encroachment of woody vegetation may seriously degrade all of the remaining localities unless management procedures are invoked to maintain suitable, open habitat. A management programme of prescribed burning and mowing to retain a remnant prairie condition at one Pennsylvania locality is no doubt largely responsible for the concurrent maintenance of an apparently stable massasauga population.

Surface mining has negatively impacted several of the localities investigated and the recent demand for coal may threaten an increasing number of sites. Surface excavations to obtain clay, sand and gravel may also increase in future years. Oil mining contributes at least temporarily to loss of habitat through the leakage of oil and brine solution. However, Swanson (1952, and pers. comm.) believed that the open habitat created in the vicinity of oil wells was beneficial to massasaugas.

Active agricultural efforts have affected some localities, but the impact of this factor will probably remain minimal due to the poor soil quality of most massasauga habitats. Abandoned agricultural land has developed into suitable habitat at some localities. The decline of agriculture and the succession of agricultural land to "old field" habitats may have actually caused massasauga populations to increase in Venango County during the 1950's (W.S. Nunemaker, pers. comm.)

As a result of loss of habitat, the remaining massasauga populations in Pennsylvania are becoming increasingly isolated. The confirmed population in Venango County is separated from the nearest population in Butler County by approximately 40 km, a major river (the Allegheny) and an interstate highway (Interstate Rt. 80). Since the activity range length of massasaugas in Pennsylvania averages only 0.089 km (Reinert and Kodrich, 1982), it is unlikely that gene flow will occur between these two populations. Moreover, the loss of optimal habitat at the remaining extant localities is probably resulting in smaller population sizes. It has been proposed that a minimum effective population size of 500 individuals is necessary to maintain genetic vigor, and thereby long-term viability of a population (Franklin, 1980). Since the effective population size only considers the breeding members of a population, the actual population size required to maintain an effective size of 500 may be much greater than 500 (reviewed in Lande, 1988). Therefore, population fragmentation and habitat loss is likely to exert increasing negative pressures on the genetic fitness of the remaining massasauga populations in Pennsylvania.

The massasauga was placed on the Pennsylvania Fish Commission's list of endangered species in 1978. This action prohibited the catching, taking, killing, or possessing of specimens under penalty of a \$500.00 fine. Although local residents occasionally kill massasaugas when encountered, the authors are aware of no organized, large scale effort to eradicate this species. Likewise, commercial or private collecting has probably had little impact upon populations because of the difficulty of finding these secretive snakes in substantial numbers. Consequently, the regulatory action taken by the Fish Commission has not specifically confronted the major factors responsible for the decline of this species. In fact, since listing the massasauga as an endangered species, the Commission has failed to develop any definite programme of habitat acquisition, management, research, education, or conservation for this species. Such benign neglect has resulted in continued deterioration of habitat and loss of massasauga populations since 1978.

It is clear that if the massasauga is to continue as a viable element of Pennsylvania's native fauna, immediate action needs to be taken. A comprehensive management programme should be established that includes: 1) an active programme of habitat acquisition, protection and management, 2) the intervention in all construction, mining, or drainage operations on both public and private land which potentially threaten the remaining massasauga populations, 3) an education programme, 4) a survey and monitoring programme of population densities, and 5) a programme of research to examine habitat requirements, individual and population responses to habitat management procedures, the genetic composition and viability of existing populations, and the potential impact of the translocation of specimens between existing populations or into suitable habitat where extirpation has occurred.

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