

STATUS OF PROTECTED ENDEMIC SALAMANDERS (*AMBYSTOMA*: AMBYSTOMATIDAE: CAUDATA) IN THE TRANSVOLCANIC BELT OF MÉXICO

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INTRODUCTION

Endemic species are common in the herpetofauna of México (Flores-Villela, 1992). Unfortunately, little is known about the biology of many of the endemic species in México, especially information pertinent to their status and potential conservation or management. A group of salamander species originally placed in the genus *Rhyacosiredon* but now placed in the genus *Ambystoma* (Family Ambystomatidae; see Reilly and Brandon, 1994) are restricted to the high mountains of the southern edge of the Transvolcanic Belt of México. These *Ambystoma* are of special concern because several species are endemic to the region surrounding México City, which is rapidly expanding. The sprawl of México City is potentially decreasing or degrading natural habitats in the Transvolcanic Belt. Urbanization and rapid growth of México City poses such a threat that the Secretaria del Medio Ambiente, Recursos Naturales y Pesca has accorded four species (*A. altamiranoi* Duges, *A. rivulare* Taylor, *A. leorae* Taylor, and *A. zempoalaense* Taylor and Smith) special protection due to their endemic status (in Diario Oficial de la Federación, 16 May 1994). The purpose of this paper is to report observations on the status of some populations of these *Ambystoma*, hopefully contributing to our knowledge of these endemic salamanders.

MATERIALS AND METHODS

Between May 1991 and March 1996, we visited and surveyed ten localities including the type localities of all species. On each visit, we recorded number of individuals, sizes of observed individuals with the use of a plastic ruler, and number of individuals with and

without gills. We also recorded any environmental conditions that may have influenced or might be influencing the population in question.

RESULTS

Ambystoma altamiranoi

1) Rio de las Navajas (also known as Rio de los Axolotes), México, Municipio de Isidro Fabela, km 39.0 Mexican Highway 4 (Naucalpan - Ixtlahuaca) at 3,330 m elevation. We observed 33 individuals along a 1 km stretch of the stream on 15 August 1993. Twenty-nine were juveniles with very small gills or without gills. One adult was 80 mm SVL and three others had SVLs of near 70 mm. No larvae were found.

Rio de las Navajas was also visited in 1991. Eight individuals were seen on 7 August: one adult with an SVL of 89.0 mm, and seven larvae ranging in size from 45 to 57 mm SVL. All individuals were first observed in small cavities along the edge of the stream. On 23 August, 14 individuals were observed. Five were adults (one with an SVL of 85 mm, and four with SVLs between 60 and 62 mm). Four small larvae (12 mm SVL) and five large larvae (40 mm SVL) were seen. Individuals were seen under rocks, in small cavities along the edge of the stream, or in the middle of the stream.

2) Las Palomas, México, Municipio de Isidro Fabela, km 38.5 Mexican Highway 4 (Naucalpan - Ixtlahuaca) at 3,300 m elevation. This population along a 1 km stretch of the Arroyo las Palomas was visited several times from 8 June 1991 through 7 August 1991. All individuals were observed under rocks and in or near small cavities.

On 8 June, one adult and 11 larvae were observed. Only one adult was found during the visit on 24 June. Ten individuals (two adults and eight larvae) were found on 18 July. The highest number of individuals (34) was found on 25 July (3 adults, 31 larvae). Only three adults were found on 7 August.

3) A small permanent stream "Arroyo Puenteillas", Municipio de Naucalpan de Juarez, México, Carretera libre Naucalpan - Toluca, 3,060 m in elevation. This population was surveyed on 5 August 1993. Fifteen salamanders were observed. Of the ten individuals captured, nine were less than 40 mm SVL. All were first seen in small cavities on the edge of the stream. A pair of adults was found 35 m S of the main population in a pool 0.60 m deep and 1 m in diameter.

4) Llano Viborillas, Municipio de Xonacatlan, México, 2970 m elevation. This population was surveyed on 5 August 1993. Seven individuals were observed. Three were adults without gills, and the others were juveniles with SVL \leq 40 mm.

Ambystoma leorae

1) Arroyo Tonatzin, Puebla, 12 km east of Rio Frio, state of México, 3,210 m in elevation. On 12 August 1993, we observed 59 individuals along a 600 m stretch of the Arroyo Tonatzin. Three of these were adults without gills, two were larvae of 22.0 and 25.0 mm SVL, and the remaining individuals were juveniles (with gills) measuring 60.0 to 65.0 mm SVL. All individuals were first seen in shaded areas, and were quite wary. Upon detecting our presence they hid under rocks or logs. These salamanders are cryptic and often difficult to see. Individuals tended to be in groups ($>$ five), and were rarely observed alone.

Ambystoma leorae were also abundant in a swamp at the headwaters of the Arroyo Tonatzin. However, in a seasonal stream flowing into the Arroyo Tonatzin, where the slope is often steep, no salamanders have ever been observed.

2) Campo Experimental Forestal "San Juan Tetla", municipio de Chiahutzingo, Puebla, 3,400 m in elevation. We observed six individuals along a 6 m section of the stream. Two were adults with gills (64.0 mm and 70.0 mm SVL), and the other four were juveniles with gills (33.0 - 42.0 mm SVL).

These salamanders have only been seen in limited regions of the Campo Experimental Forestal San Juan Tetla despite efforts to locate them throughout the area. Only three small creeks or streams have ever been found to have *A. leorae*: the small stream described here, the Rio Cotzala, and another small stream at 3750 m. However, no salamanders have been seen in the Rio Cotzala since local residents introduced fish into the stream.

Ambystoma rivulare

1) "El Salitre", Municipio de Villas Allende, state of México, 2600 m in elevation. We surveyed a small river (Arroyo El Salitre) on 10 March 1996. Visibility was low due to suspended particles and vegetation, therefore we used a net to sample the river. We caught three *A. rivulare* larvae. The river runs through the towns of El Salitre and San Felipe Santiago where local residents wash their clothes in the river.

2) Buenavista, state of México, km 19 Highway Toluca-Valle de Bravo, 3,100 m in elevation. On 26 July 1991, one adult (92 mm SVL) and 33 larvae (32 - 45 mm SVL) were observed along a 50 m section of a water canal. The adult was resting in a swamp that was 0.05 m deep. Most of the larvae (31) were seen along a 5 m section of the canal that was 0.30 m wide and 0.40 m deep. The other two larvae were seen in a swamp that was 0.10 m deep but which did not appear to be connected to the canal. Another 46 salamanders were observed on the same day at this locality but no data were collected on them. On 24 August 1991, 59 individuals were observed in the same locality. Thirty-eight were larvae ranging in SVL from > 55 mm, and 21 were larvae of 20 mm SVL.

The water in the canal originates in the sewers of Buenavista and La Puerta. Much of the canal was lined with garbage (e.g., plastic bags, tin cans, etc.) that the *A. rivulare* used as refugia. The sampled section of the canal was surrounded by houses.

Ambystoma zempoalaense

1) Vivero Acaextopan, Morelos, km 11.6 Highway Tres Marias-Zempoala, 2,750 m in elevation. We visited a swamp on the west side of Vivero Acaextopan several times between 12 October 1993 and 9 March 1996. Three streams enter the swamp. On 12 October 1993, there were 10-15 salamanders at each spot where one of the streams entered the swamp. We also observed three individuals (75 mm, 82 mm, 86 mm SVL) in a 4 m x 4 m pool (1.5 m deep). On the next visit (3 April 1994) we did not see any salamanders in the swamp as the area was quite dry and there was much more vegetation. However, two salamanders were seen in the 4 m x 4 m pool. Only one individual was seen in the pool on 11 June 1994, however it was raining and the water was not clear which may have prevented our seeing more. On the next visit (30 July 1994), seven salamanders were seen in the pool. On the last visit (9 March 1996), only four adults were seen in the pool.

DISCUSSION

Our observations provide some insight into the status of these salamanders, and may provide some suggestions as to their future. For the most part, the populations of *Ambystoma* we surveyed had good numbers and few indications of human encroachment. In many of these populations reproduction has been occurring as evidenced by the presence of larvae and juveniles. However, some populations may be potentially threatened.

One potentially threatened population is the *A. leorae* population in the Rio Cotzala in the Campo Experimental Forestal San Juan Tetla. No *A. leorae* have been observed in this stream since the introduction of fish by local residents. Thus it would appear that further introduction of predatory fish into streams with *Ambystoma* could have a devastating effect (see Tyler et al., 1998).

Among other potential problems is pollution of streams near residential areas. The pollution may derive from sewage systems (as at the water canal near Buenavista that contains *A. rivulare*) or from local residents washing clothes in the stream, potentially introducing detergents or other cleaning chemicals into the stream (as in the case of *A. rivulare* in the Arroyo El Salitre), which may have negative consequences for the salamander populations.

Increased human encroachment into the range of *Ambystoma* in the Transvolcanic Belt is likely as México City expands. In addition to increased pollution of streams, alteration of natural habitats may have detrimental effects on the viability of *Ambystoma* populations. Nearly all of the populations we surveyed were surrounded by forest or grasslands. Increased demands may lead to the conversion of these natural habitats into agricultural or residential areas. In addition to probable changes in the quality of the water, such changes will potentially alter water use. Increased water use may cause many of the shallow but permanent streams that *Ambystoma* inhabit to become temporary, possibly resulting in the extirpation of some populations. The need for permanent water is evidenced by our observations. *Ambystoma leorae* occurs in a permanent stream that feeds into the Rio Tonatzin but does not occur in a seasonal stream that also joins the Rio Tonatzin. Also, *A. zempoalaense* were not observed in the swampy area near the Vivero Acaextopan during a dry period, and have not been observed there since.

While populations of *Ambystoma* in the Transvolcanic Belt of México appear to be relatively healthy, there are signs that unless management and conservation of natural habitats near México City begins now, these populations may be in danger of being eliminated.

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