KW: amphib, hell

BREEDING ACTIVITIES OF THE HELLBENDER IN MISSOURI

The last description of hellbender (*Cryptobranchus alleganiensis alleganiensis*) breeding activities based on extensive sampling during the breeding season was by Smith (1907, 1912a). This study involves making such observations for the entire length of the breeding period concurrently with a study of movement and dispersal. Except in the Spring River, Arkansas (unpublished data), hellbenders breed from late summer to early fall, mostly September, throughout their range (cf. Nickerson and Mays 1973). Males can be distinguished by enlarged cloacal glands during that time (Reese 1904). Fertilization is external (Smith 1907).

From 4 September to 7 November 1985, 21 surveys were made in a 100 m section of the Niangua River, Laclede County, Missouri. Hellbenders were caught by hand during daylight by overturning rocks, reaching into crevices, and occasionally breaking bedrock with a crowbar. An attempt was made to reposition rocks. An average (± SE) of 9.7 ± 1.1 males and 16.2 ± 0.9 females was captured per survey. Newly captured individuals were marked by heat-branding before being released. No juveniles were captured.

On 11 September, a male and female were observed under the same rock for the first time during the study. On 13 September, two males were observed expelling milt upon capture. On 16 September, a clutch of eggs was found in the open near the bank. Neither eggs placed in an aquarium nor those left in the stream from this clutch exhibited any development; the eggs were likely not fertilized. Also, a male and female were found under a single rock, and two females and a male were found in contact with each other in a hole in the bedrock. A rock covered most of the opening of the cavity.

At 1020 h on 18 September, 13 hellbenders were observed nestled together in a narrow strip about 1 m long extending parallel to the stream flow between rocks. A few of these occluded a hole in the bedrock; only their heads were exposed. An egg string trailed from the cavity. Eleven of the 13 were males. Six of them had not previously been captured, so they were placed in a sack for marking. The hole extended farther into the bedrock than I could reach. At 1545 h, after the day's sample had been completed, 8 hellbenders were observed at the same location, including 3 more unmarked individuals. When hellbenders occluding the hole were removed, others took their place, and those gently removed would try to return rather than attempt to escape. Besides these animals, several other hellbenders were caught in the open rather than under shelters. Two hellbenders were observed to inspect holes in a mud-gravel bank, and one was repulsed (snout bitten) by another hellbender occupying a hole. Moreover, while I was branding on the bank, two males at different times walked into the shallows (< 20 cm; I never saw a hellbender there before or after) where the sack containing the unmarked animals was fastened. A female had released some eggs in the nylon mesh sack. Each male appeared to inspect the sack before returning to deeper water. Within the study site, 49 hellbenders were captured that day, 19 more than in any other single day. Fourteen of the 26 new captures were never seen again. This was one of two surveys where males (28) outnumbered females. On the last survey, 11 of 15 were males. Nine of the males plus two females were captured by breaking bedrock on that date.

On 24 and 26 September, an individual was found with a short egg string extending from the cloaca, and a male and female were captured (under the rock covering the hole in the bedrock) where three hellbenders were caught on 16 September. The male had been there on the earlier date but not the female. One of the females of that earlier date was under a rock 24 m downstream on 24 September, sharing the rock with a different male. On 1 October, two hellbenders had egg strings protruding, and a different male and female were found under one rock. This was the last time that more than one hellbender was caught under a single shelter. On 6 October, two females with eggs trailing from their cloacae were observed for the final time.

On 7 October, the snout of a hellbender was observed in the entrance (about 10 cm wide) of a hole in the mud-gravel bank previously mentioned about 15 cm below the surface. The hellbender was not caught, the hole being too extensive, but embryos of two different clutches (based upon stage of development) were found. Developmental stages were approximately 13 and 17 or about 11 and 15 days old (Smith 1912b).

On 2 November, nine hatchlings measuring 25-27 mm total length were removed from this hole. One that was still half within the gelatinous envelope measured 27 mm, thus I inferred that the others were newly hatched. Embryos were also observed on 6 October at the entrance to an extensive cavity under the bedrock and were found with adult males on 15 October and 7 November by breaking bedrock; none represented an entire clutch. Continued flooding after the latter date prevented further sampling.

DISCUSSION

As suggested by Ingersol (1982), the breeding season in the Niangua seemed to extend from the second week of September through the first week of October. Dundee and Dundee (1965), however, found eggs in the Niangua on 3 September 1954, and on 14 November they collected two ripe females. Ingersol (1982) reported that 27.5% of the Niangua females did not spawn and that their ova were atretic. This may explain the collection of ripe females in November.

Smith (1907) reported diurnal congregations of 6-12 hellbenders during the breeding season. Several times he observed them "to pile up in crevices between rocks, two or three lying alongside each other, or two or more trying to force their way into the same crevice." Bishop (1941) stated that these activities were apparently a "kind of nuptial congress" to stimulate mating. He similarly observed a male return to a nest (occupied by three other males) after it was thrown about 6 m upstream. Males are usually found in possession of nests after spawning rather than females (Smith 1912a). The attraction of two males to the capture sack fastened in the shallows in this study suggests that olfactory signals are probably important in these mating activities.

There is only one report in the literature of hellbenders using a cavity in the bank for shelter and spawning (Nickerson and Tohulka 1986), and it was a crevice in bedrock along which there was no noticeable current. In contrast, I found a nest cavity at the base of a 2-m high mud-gravel bank that was slowly being eroded by a moderate current. The defense of a similar cavity as observed on 18 September was not unexpected. Hillis and Bellis (1971) reported that released animals were repulsed when they sought shelter occupied by another hellbender, and both Smith (1907) and Bishop (1941) described the vicious defense of a nest by one male against other hellbenders. Further, fierce defense of shelters has been observed in large river aquaria (Karen McKinnis and Robert Wilkinson, pers. comm.).

Smith (1912a) stated that he found relatively few eggs that were not fertilized. However, besides the Niangua clutch that did not develop, I have found clutches in the Spring River, Arkansas, that also did not seem to be fertile. Unlike the nonfertile clutch, the embryos found under bedrock did not represent an entire complement of about 170-650 eggs (Topping and Ingersol 1981). Whether some had been swept away or were eaten is unknown. Both sexes will consume ova (Smith 1912a).

Bishop (1941) reported that eggs deposited 3-17 September hatched between 7-14 November in northwestern Pennsylvania, and the hatchlings were 27-33 mm long. He also reported that more than one female may lay eggs in the same nest. The hatchlings found in this study are believed to have been no more than 45 days old. Temperature is undoubtedly a major factor in determining the length of the embryonic period and possibly the size at hatching.

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HERPETOLOGY IN HUNGARY

Hungary has never been an important center for herpetological research for several reasons. In the entire country there are only 16 species of amphibians and 15 species of reptiles. Our geographical situation and world political position, such as the absence of possessions, contribute to the general lack of professional interest in herpetology. Lajos Mehely (1862-1953) is probably the best known Hungarian herpetologist.

The official center for herpetological research is the Herpetology Department of the Hungarian Natural History Museum of Budapest. Only a few other scientists conduct herpetological research. Working mostly on their own, without benefit of colleagues in their own institutions, their research follows mostly ecological, faunistic, taxonomic and toxicological themes. Unfortunately, herpetology in Hungary has neither a unifying organization nor its own periodical. The more significant papers are scattered primarily in the following periodicals: Allattani Kozlemenyek, Vertebrata Hungarica, Acta Zoologica, and Acta Biologica Szegediensis. Only rarely are Hungarian authors able to publish in foreign herpetological periodicals.

Officially, all herpetofauna in Hungary are under total protection as a means of conservation. Hungary is also a member of the "Washington Convention" since 1985. Several notable herptiles which are found in our country include: *Ablepharus kitaibelii fitzingeri* (Mertens), *Coluber jugularis caspius* (Gmelin), and *Vipera ursinii rakosiensis* (Mehely).

The once rich herpetofauna of Hungary has suffered reductions in population sizes, as is the case in many parts of the world. The primary reason for this is large scale farming and increased use of chemicals. Also, in the early 1960s, animal collecting campaigns accompanied the land-drainage programs in some of the marshy habitats. Today, all habitats which are home to the meadow viper are under strict protection, and some smaller "Sanctuaries" are completely fenced to protect the species. Nevertheless, there is much to be done to promote conservation techniques which will support population growth of this viper.

In 1985 and 1987, Mr. Keith F. Corbett and several other herpetologists visited Hungary on behalf of the Conservation Committee of the Societas Europea Herpetologica. Their purpose was to advise on the means of habitat protection for *V. ursinii rakosiensis*, as well as to help in determining the current population status of this species.

The First Herpetological Congress of Socialist Countries, in 1981, was the most important herpetological event in Hungary in the last decade. It was organized by Mr. Oliver Gy. Dely and was attended by a number of prominent herpetologists, including several from the Western Hemisphere. This meeting was extremely valuable in promoting interchange among scientists from different countries.

In recent years, the keeping of amphibians and reptiles by amateurs has become more widespread than ever before. Individual pet keepers have not been able to successfully form any major herpetological societies. There are about five or six organized amateur groups in the country, but their membership is small and they function only sporadically. The most reliable of these groups is the "Herpetological Studio" in the town of Érd; this group publishes the periodical *Terrarium*.

The total number of amateur and professional herpetologists in Hungary is estimated to be about one hundred individuals, but only a dozen or so can be considered scientists.

A proposal has recently been made to create a herpetological section within the National Environment and Nature Protection Office, in order to help coordinate the herpetological activities occurring within our country. Possible activities of this office include establishing training camps for youths interested in amphibians and reptiles and preventing the destruction of frogs and toads as they cross roads to reach their breeding site.

Very few books in the area of herpetology are published in the Hungarian language. In order to remain current in the field, amateur and professional herpetologists must read literature in English, German, or Russian. Only ten books relating to herpetology were published in Hungarian in the last twenty-two years, and most of these were popular/educational books.

Current trends indicate that there will be increasing numbers of both amateur and professional herpetologists in the near future in our country and we anticipate significant advances in Hungarian herpetology.

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HERPETOLOGICAL HUSBANDRY

See Herp. Review 19(1) for author's instructions.

CAPTIVE REPRODUCTION OF THE SAN FRANCISCO GARTER SNAKE *Thamnophis sirtalis tetrataenia*

The San Francisco garter snake *Thamnophis sirtalis tetrataenia* is a peninsular race of the common garter snake endemic to the San Francisco Peninsula and known only from San Mateo County, California (Fox 1951; Barry 1978). It is currently listed as endangered by the U.S. Fish and Wildlife Service, the International Union for Conservation of Nature and Natural Resources (I.U.C.N.), and the California Department of Fish and Game. The status of wild populations has been reported by Bury (1971), Medders (1976), and Barry (1978).

On 7 March 1983, the Dallas Zoo (D.Z.) and the Fort Worth Zoo (F.W.Z.) received a group of confiscated *T. s. tetrataenia*. Captive reproduction for this subspecies has not previously been reported. Data on six captive breedings of *T. s. tetrataenia* are presented here.

MATERIALS AND METHODS

Each zoo received three juvenile snakes and one subadult. The snakes represent two broods from two wild-caught, gravid females originally collected in the Pescadero Creek area of San Mateo Co., California (K. McCloud, pers. comm.). The juveniles were believed to be siblings from one wild-caught, gravid female, and the subadults siblings from another wild-caught, gravid female. Therefore, two different broodlines were available for breeding.

Sexing revealed a ratio of one juvenile male, one subadult male, and two juvenile females (F.W.Z.); and three juvenile males and one subadult female (D.Z.). Fecal examination revealed the presence of a coccidea infestation in all of the snakes, which was treated with daily oral administration (injected into the food items) of sulfamethazine at a dosage of 75 mg/kg body mass for seven days.