

## Spawning Axolotls at IU: a Ten-year History

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The Axolotl Colony has been at Indiana University since 1957, and, as a result, we have rather extensive records. This essay is a short review of some of those records pertaining to spawning and the factors that influence spawning rates.

Success in obtaining spawns from axolotls depends upon several variables, including season, changes in photoperiod, the age of the animals being mated, and, possibly, changes in temperature or salinity of the water, as well as upon other variables that we haven't yet guessed. To me, however, success in obtaining viable spawns is the acid test of animal health, and, for a breeding colony such as ours, it is all that counts.

I have compiled spawning data and graphed our success rate by month for the ten complete seasons from 1981 to 1991 and for the current season from July 1991 through the end of April 1992. I have also graphed the cumulative data for the ten complete seasons. These graphs, if one knows how to interpret them, tell the story of the colony's successes and failures over these years.

Although the first graph is for the 81-82 season, some background is helpful. In 1978 and 1979 the colony suffered from severe disease problems and a high death rate. Much effort was expended trying to bring the situation under control, but, as near as I can tell from the records left, no one really grasped the big picture, and no lasting solution was implemented. The antibiotic gentamicin was used, probably with good effect, but its use was not followed up, perhaps because adequate records that would have made followup possible were not kept. (Generally speaking, one cannot tell by the responses of individual axolotls in the short term whether a treatment has had any beneficial effect. One must look at a population over the long term.) I speculate that by 1980 or so, the axolotls that survived the epidemic, with or without the help of antibiotics, constituted a core of disease resis-

tant animals in the colony. The maturing of this core group led to adequate spawning success during 81-82 and a 'bumper crop' in 82-83. By the time I arrived on the scene in late March, 1984, spawning success was down again, and nobody (I was told) understood why. Again I speculate that the disease resistant axolotls were now aging, relatively unproductive animals (I saw many of them in the colony when I came), and the younger animals lacked disease resistance and were, as I discovered, dying at a great rate from systemic bacterial infections.

During the spring and summer of 1984, I gradually came to understand, first, that there was indeed a disease problem, and, second, something of the nature of the problem. In search of a solution, I began experimenting with antibiotics. Unfortunately I was working blind. The literature was (and is) sparse, and the colony records were scarce and not very helpful. Nevertheless, I began tests using antibiotics that had been used previously in the colony. I had a successful trial with gentamicin that fall, but in the search for something easier and cheaper—that could be added to the water instead of injected—I also tried tetracycline. That was a bad idea (it does terrible damage to their skin before it reaches therapeutic levels in the blood), and it resulted in a lot of deaths in November 1984. Between the serious disease problem and my inexperience we had a terrible spawning season in 84-85.

In November 1985, I began an intensive treatment program with gentamicin with immediate encouraging results in the form of a dramatic decrease in the death rate. Unfortunately in March 1986, parasites were introduced with bait minnows used for feed, causing serious health problems in their own right and confusing the issue enough that I stopped giving antibiotics. We were able to rid the axolotls of internal parasites fairly quickly (we used Metronidazole), but a serious skin parasite problem remained. David Able (research technician in the colony at the time) began to explore treatments for the external parasites, and I went back to using antibiotics. This time I used amikacin, an aminoglycoside like gentamicin, but newer. As a result we had good spawning success in 86-87. The sharp decrease in April 1987 was due to a parasite treatment (using acriflavin) that was successful in that it completely eliminated all but one of the problem parasites, but proved to be unexpectedly harsh on a subset of the axolotls in the colony. The last skin parasite in the

colony, *Trichodina*, continues to be a nuisance but is impractical to eliminate.

I continued to use amikacin on symptomatic animals, and our spawning success also continued. We had a very good season in 87-88 and a surprisingly good fall in 1988. Then, beginning in January 1989, spawns, instead of getting easier to get as we entered our prime season, got harder and harder to get. Finally, at the end of May we noticed an accumulation of brass shavings from the ice machine in the mating tubs. (At that time we were routinely adding ice to the mating tubs.) We corrected the problem (a simple solution, much to my relief), and our success rate improved dramatically. In 89-90 we had another terrific year.

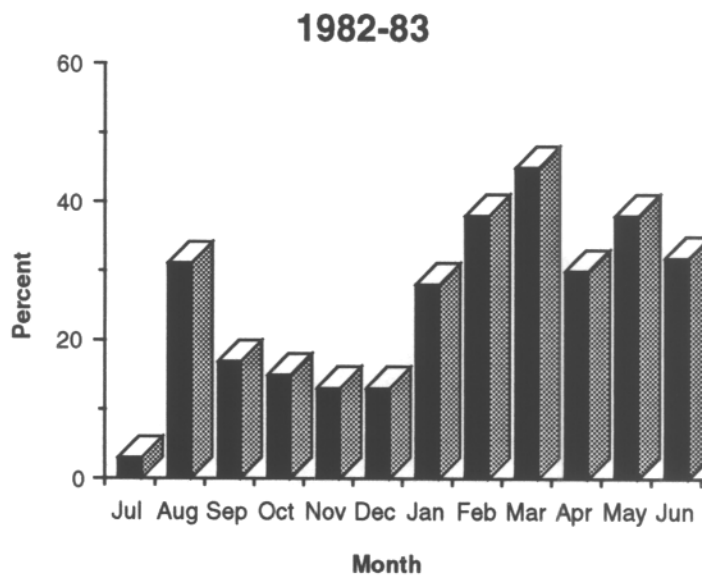
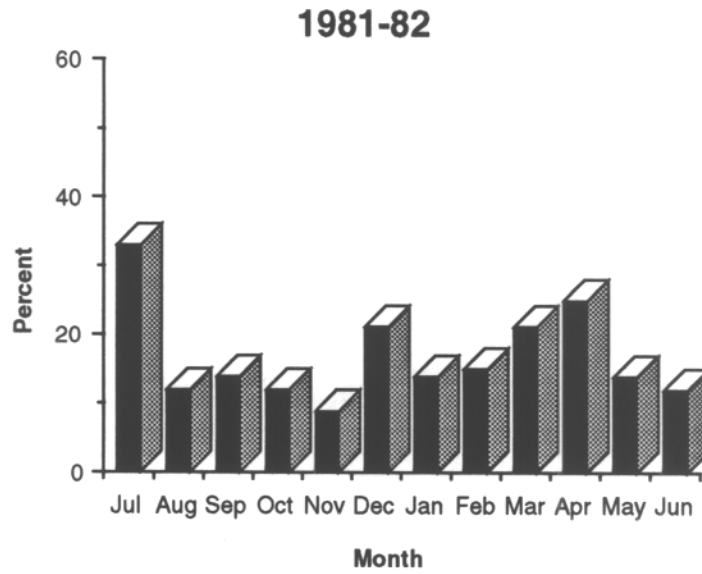
In 90-91, our last complete season, we had a mediocre year. I attribute our relatively poor showing to two primary factors. First, in our crowded temporary quarters, the lighting was terrible. Second, in the spring of 1989 we raised very few animals. Because demand was high and spawning was poor, we sent most embryos out. As a result in 90-91 we had a rather small group of axolotls in the 2-3 year old age group. This age group and the 1-2 year old group are the most important cohorts for successful breeding. In June, we moved again

to rooms with better lighting and temperature control and spawning rate began to rise.

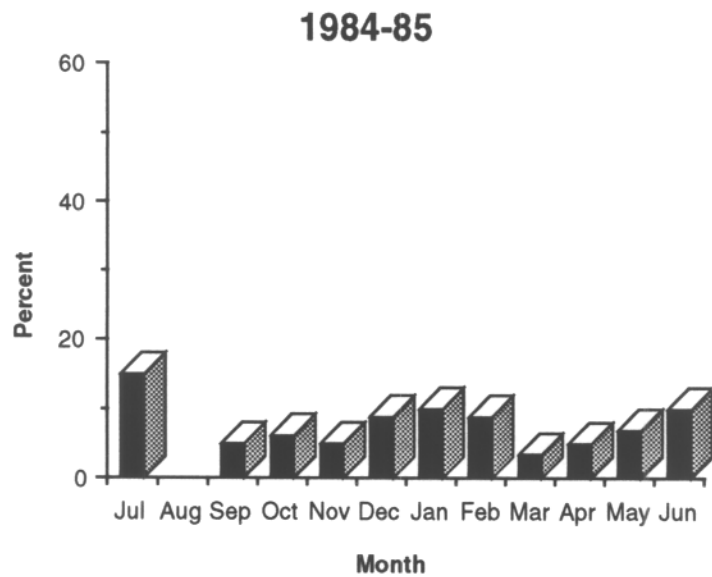
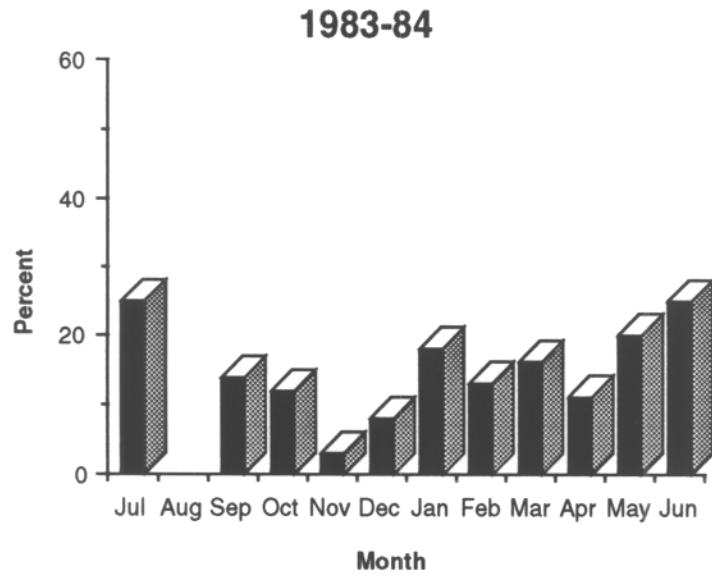
As I write this, moving days for the colony are over. We moved into our final renovated quarters this past January. For the first time in several years we have adequate space and excellent control over lighting and temperature. So far this season our success rate is good to excellent. As of the end of April we have had 350 spawns. That is already more spawns than we obtained for the whole year each of the previous 10 seasons. We still find it helpful to give antibiotics to symptomatic animals on an intermittent basis. We use amikacin, approximately 5mg/kg body weight. Each animal receives 3 intraperitoneal injections with about 48 hours between injections.

The cumulative graph is interesting because it shows seasonality—what there is of it. The best months are December through June. The rest are the 'off' season. The truth is, if the animals are healthy and temperature and lighting are controlled, spawns can be obtained easily at any time of year.

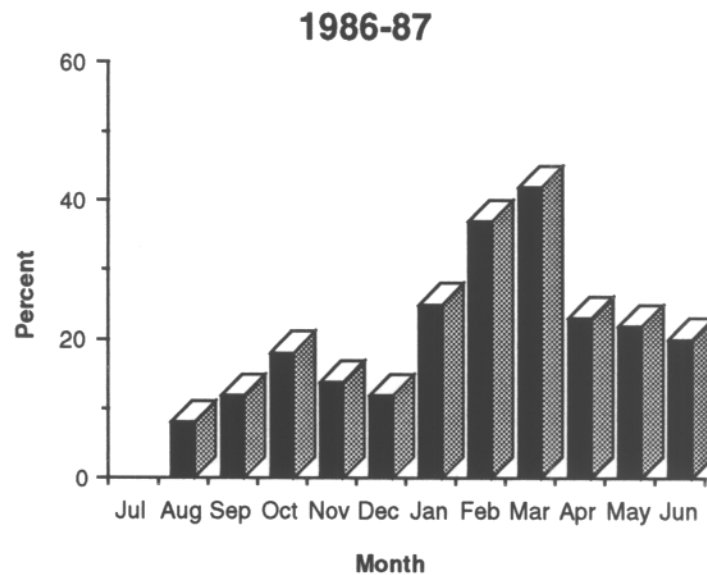
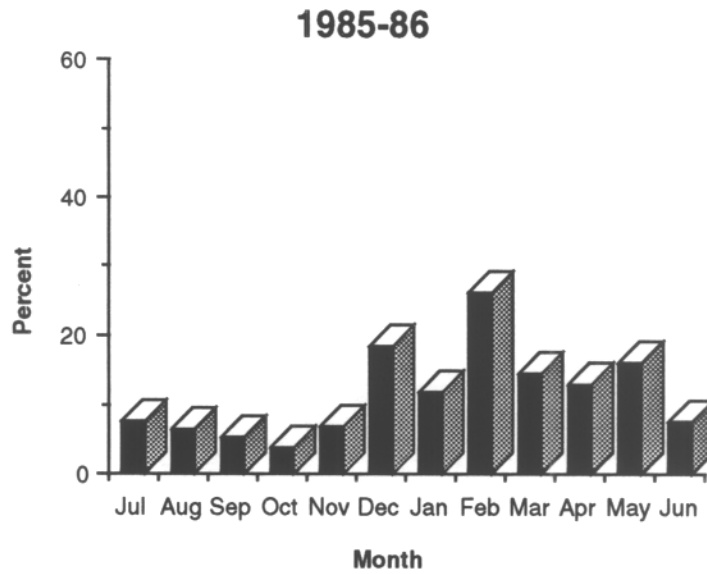
In the graphs presented on the following pages, the percent of all matings that resulted in spawns is represented on the vertical axis, and successive months of each spawning season are represented on the horizontal axis.



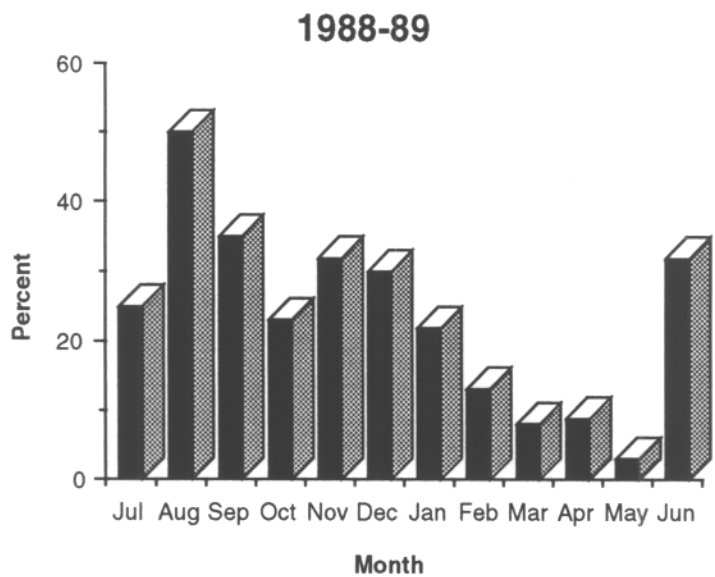
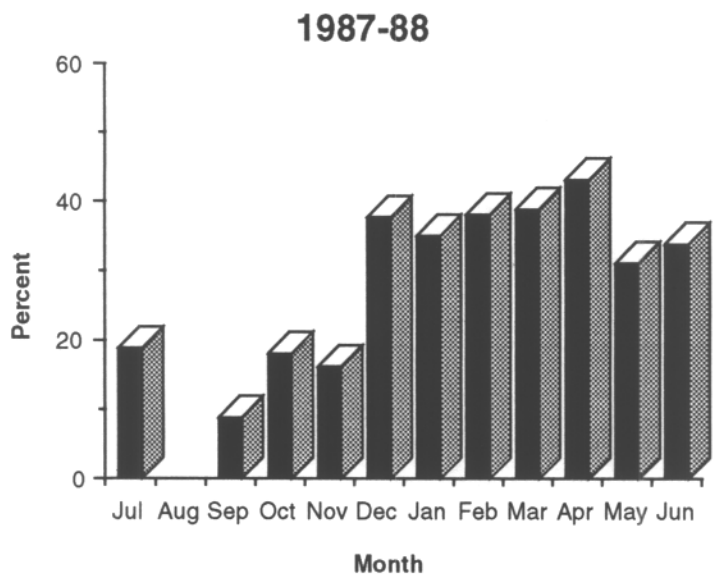
These represent recovery years after severe disease problems in 1978 and 1979. By January 1983, there was a core group of mature, disease-resistant animals available for spawning.



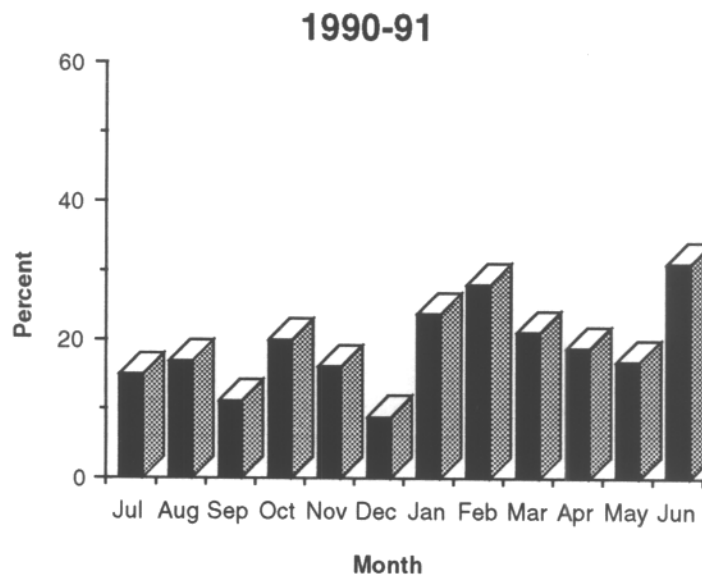
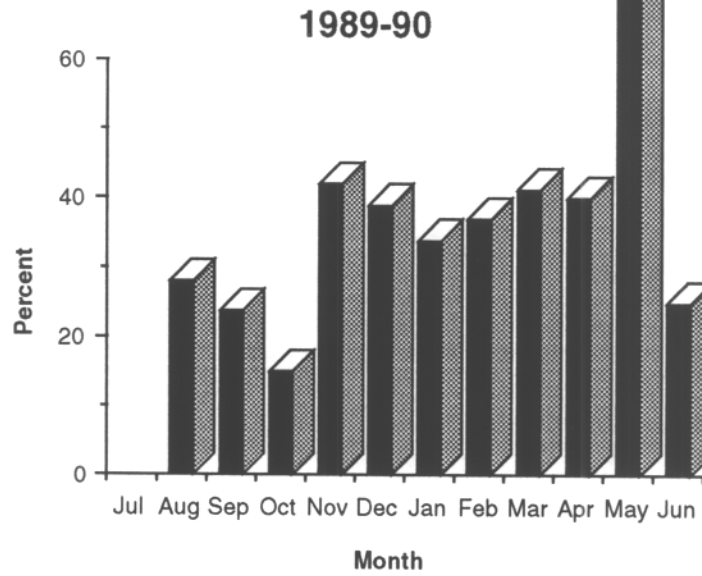
During these years the disease-resistant population became aged and unproductive. Younger animals lacked disease resistance, and disease was widespread in the colony. Experiments with antibiotics showed gentamicin to be useful, tetracycline to be dangerous.



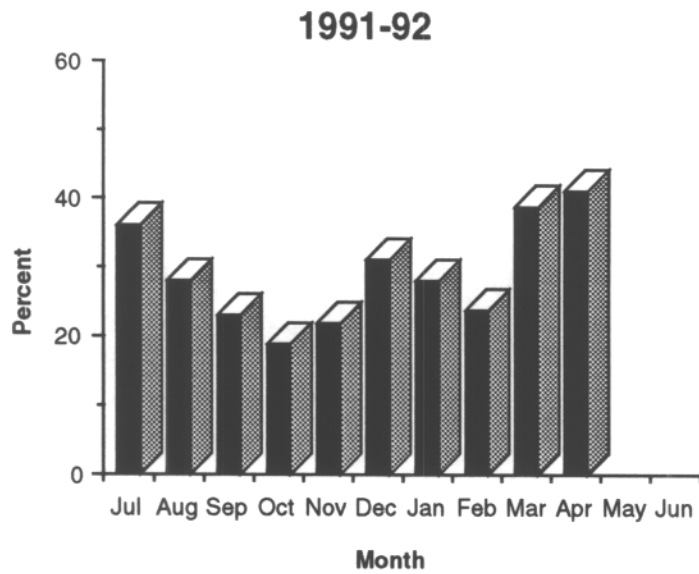
An intensive program of treatment with gentamicin was begun in November 1985. Parasites were inadvertently introduced in March 1986, and the use of antibiotics was temporarily suspended. Treatment with antibiotics (amikacin) resumed in September 1986. In April 1987, the colony was treated with acriflavin to kill skin parasites.



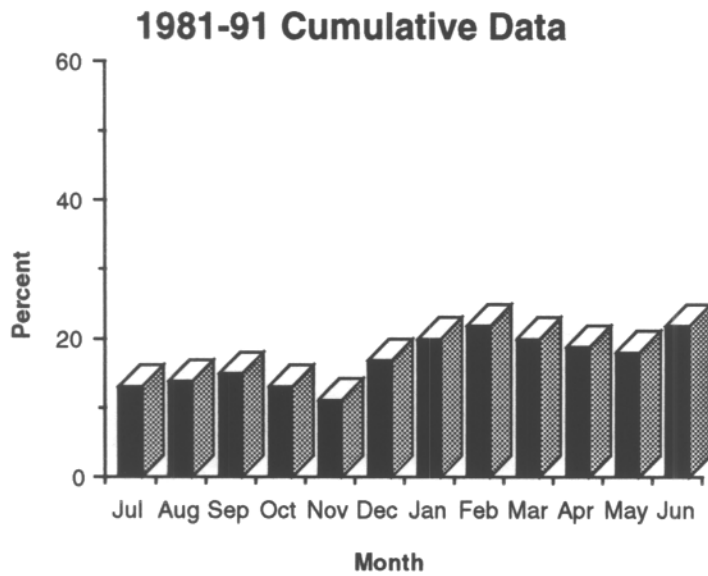
Regular use of amikacin on symptomatic animals led to consistent spawning success until a mysterious decline began at the close of 1988. Finally we discovered (June 1989) that brass shavings were accumulating in the mating pans, and we corrected the problem.



Spawning success returned until in June 1990, in anticipation of renovation, we moved to temporary quarters—crowded, with poor control over temperature and lighting. One year later (June 1991) we moved again to our second temporary home—still crowded, but with good lighting and temperature control. The unusually high rate of success in May 1990 is due to small sample size.



Our last move came in January 1992.



Seasonality is minimal, but the best months for spawns are December through June.