Residual Seasonality in Laboratory Axolotls

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The axolotl colony at the University of Ottawa was established in 1973. Since then, we have had over 1500 spawnings. For this report, we have analyzed the data in an attempt to see what factors may improve spawning success.

Though many of our early spawnings were spontaneous, that is, not hormonally induced, we soon concluded that spawning success was unsatisfactorily low. We therefore adopted the procedure of inducing the female with follicle stimulating hormone, sometimes supplemented with luteinizing hormone. Consequently, we have insufficient data on uninduced spawnings to accurately assess whether they were seasonal, though our impression is that they were.

With hormonal stimulation, spawning success was greater, but analysis of the data indicates some seasonality remained. The largest spawnings were obtained in the spring of several years, but in 1977 the peak occurred in the fall. During this period, the animals were kept in a room with windows. The natural lighting was supplemented with fluorescent lights, but these were turned on and off as people came and went. The possible effect of photoperiod on the seasonality cannot, therefore, be readily assessed.

About 5 years ago, as the result of a comparative study, we switched to induction by human chorionic gonadotropin (Sigma). Some of these results were reported in Axolotl Newsletter No. 10 (pp. 1-4, Winter 1981), though the emphasis in that article was on attempts to stimulate the male. About the same time, the animals were transferred to a room without windows and with the lights regulated on a 12 h on/12 off cycle.

The data for this period have been analyzed in two ways. First, the number of eggs per spawning was plotted against date. There is considerable variation in egg number, but when the numbers were averaged on a quarterly basis, it was evident that there was still some residual seasonality, with a spring peak (Fig. 1). Second, we plotted spawning "success" on a monthly

basis with the years pooled. Again there was a spring peak (Fig. 2). A successful spawning was arbitrarily established as one in which there were at least 100 fertile eggs. This is purely a practical choice of what might be considered a useful number for experimental purposes.

Why is there residual seasonality in these laboratory animals seemingly cut off from environmental cues and hormonally induced to spawn? Perhaps there is enough light from the adjacent room or perhaps they are entrained by more subtle environmental cues such as the lower average atmospheric pressure in the winter. What we should probably emphasize, rather than the residual seasonality, is the fact that we have reduced this seasonality to a minor inconvenience and can get reasonably good spawnings year round.

Our selection of animals for spawnings is, of course, not unbiased. We try to select animals that appear to be in prime spawning condition as judged by their plumpness. During the last year we have instituted a policy of isolating females needed for a particular spawning, but not judged to be in prime condition, and feeding them daily rather than the regular 3 times per week. We have also replaced the "cool white" with "daylight" fluorescent lights and have installed filters on our water line to remove algae and other particulate matter from the city water. We have not done a controlled experiment to see which of these factors has benefitted the animals the most, but we feel that the marked increase in the number of eggs per spawning seen in Figure 1 speaks for itself.

The behaviour of male axolotls is quite a separate question, but one that deserves comment. In the Newsletter article referred to above, we concluded that hormonal stimulation had no significant effect. Rather, the success in getting a male to produce spermatophores appears to depend largely on the willingness of the female. Entry of stem cells into spermatogenesis appears no longer to be seasonal, though it does remain cyclic with different animals initiating their cycle at different times throughout the year (Miltner & Armstrong JEZ 227:255-263(1983)).

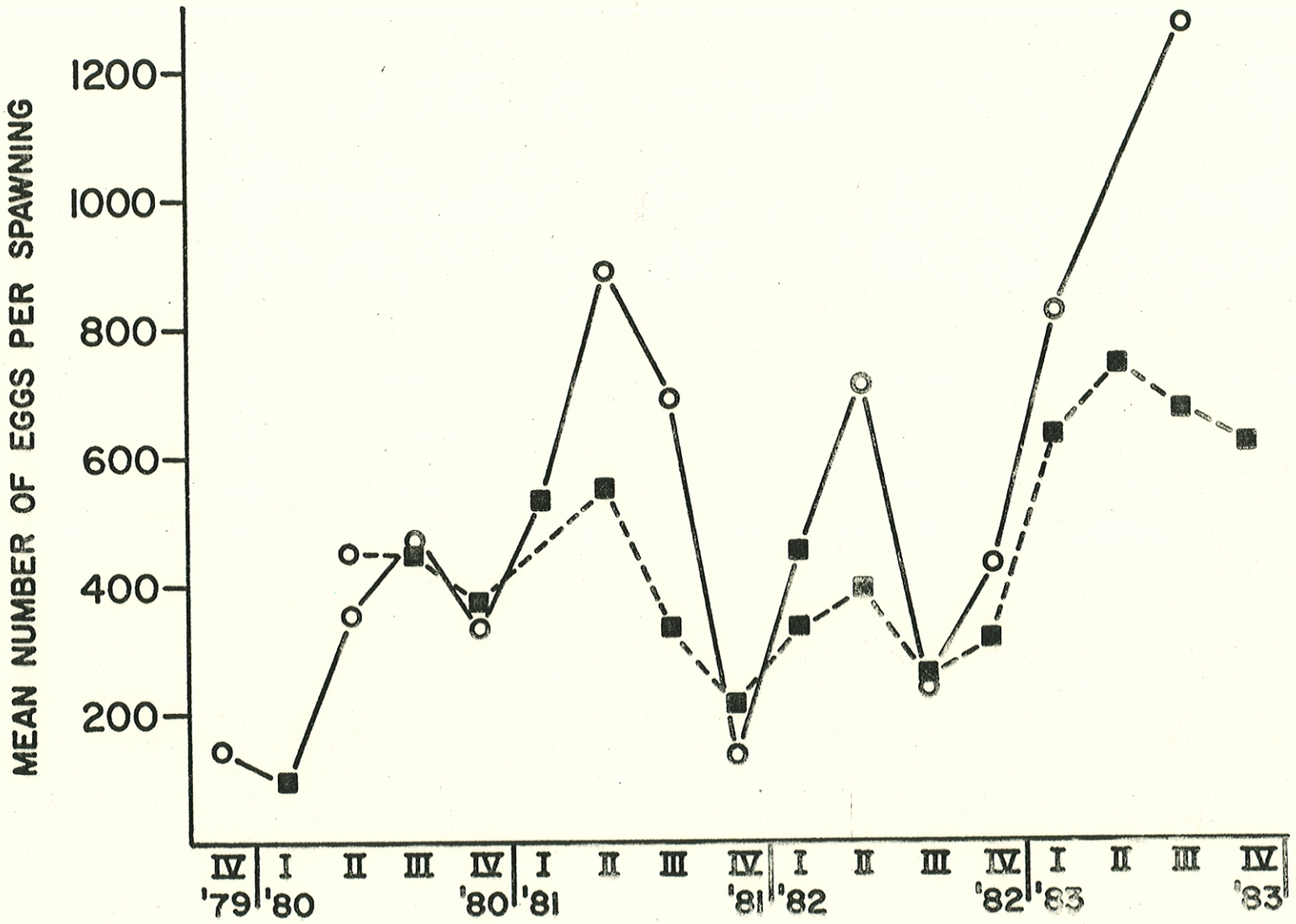

Figure 1. Mean number of eggs per spawning calculated on a quarterly basis. Dashed line: 250 units HCG; solid line: 500 units HCG. Squares: quarters in which there were 15 or more spawnings; circles: quarters in which there were less than 15 spawnings.

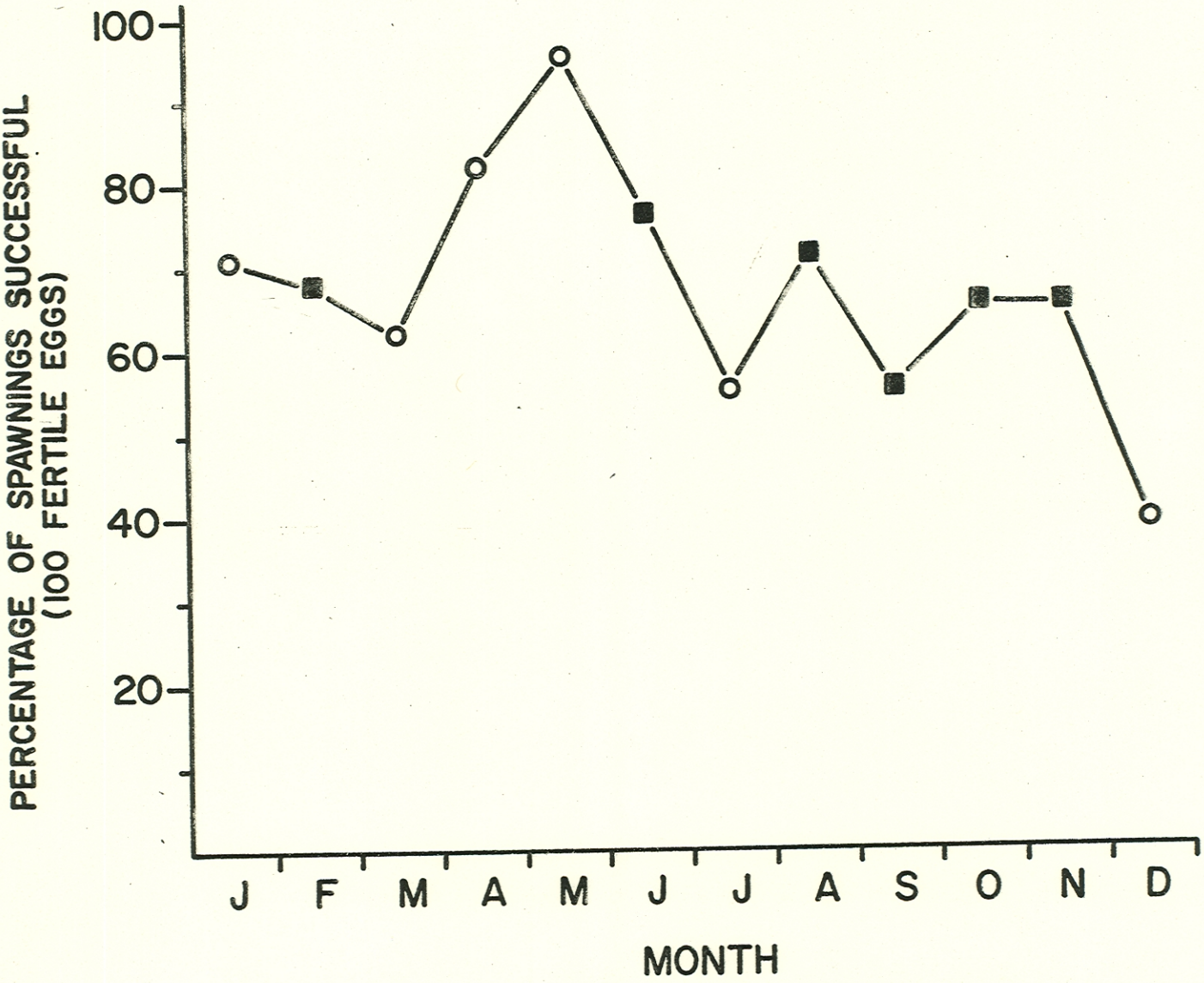

Figure 2. The data for 1979-83 were pooled on a monthly basis and the percentage of spawnings judged successful was calculated. Squares: months in which there were 25 or more spawnings; circles: months in which there were less than 25 spawnings.