TWENTY YEARS OF GARDEN PONDS

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INTRODUCTION

This article is the story of amphibian activity in three garden ponds that were built at my home shortly after we moved in during the winter of 1976-7. Mostly I have just watched the animals in these ponds for pleasure, but I have also kept records of obvious events such as numbers of frogspawn clumps laid each year, and numbers of frogs killed and left lying around the garden by predators (mainly foxes). In 1986 I estimated population sizes of the four newt species in the 3 ponds using a mark-recapture method, and celebrated the first ten years of observations with an article in the BHS Bulletin (Beebee, 1986). Another ten years on I repeated the mark-recapture exercise again using the same methods, and here I report all the information put together to cover the entire 20 years 1977-1996 inclusive. One significant addition to the pond environment was the introduction, in 1991, of Three-Spined Sticklebacks to the largest pond (number 3). These fish have bred prolifically over the past 5 years, but no other fish are present in pond 3 and there are still no fish of any kind in ponds 1 and 2.

OBSERVATIONS

Frogs and Toads

Common Frogs were introduced to the ponds as a few spawn clumps in spring 1977. As shown in Figure 1, frog numbers (as judged by spawn clump counts) rose sharply over the first 5 years and remained high throughout the 1980s. Virtually all frog breeding has always been in just one of my three ponds, the largest and sunniest (pond 3). However, in the early 1990s there was a sharp decline and for the past three Springs spawn clumps have been at less than 20% of their average number during the 1980s. Although not measured properly, it was clear that this decline followed breeding failure which set in during the late 1980s, and scarcely any froglets have emerged from the pond over the past decade. This in turn followed a huge increase in newt populations, which by the mid 1980s had reached several hundred individuals. The newts could be watched after dark lining up around hatching frog-spawn and devouring tadpoles with devastating efficiency. I have no doubt that it was the success of the newts which led to problems for the frogs. There have been no outbreaks of frog disease in my garden or anywhere near it as far as I know, and no other reason has presented itself (or seems necessary) to explain the frog declines.

As also shown in Figure 1, quite a few frogs have been killed by foxes in the garden during the spawning seasons. Altogether over the past 20 years I have counted 190 corpses, with almost twice as many males (122) as females (68) being killed in this way. There does seem to be a weak density-dependence to this predation, with more frogs killed in years when lots of spawn was laid than in years when fewer frogs were about (as shown in Figure 2). However, the trend was only just statistically significant ($r = 0.496$, $df = 16$, $P<0.05$) and I suspect predation rate depends largely on where the nearest fox happens to be living at the time.

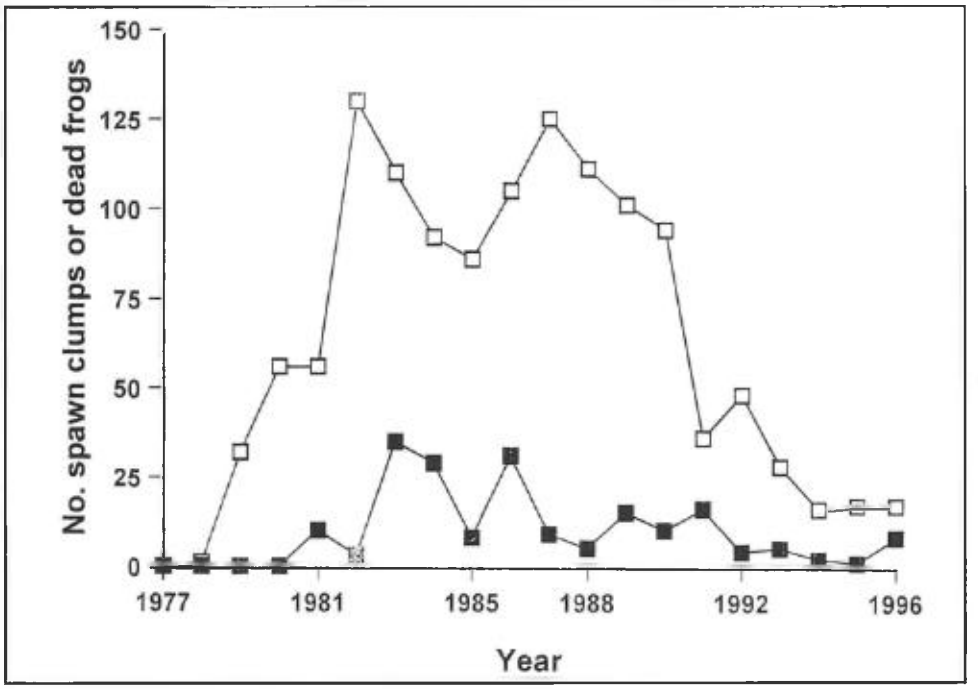

Figure 1. Numbers of frog spawn clumps (■) and of frogs killed by predators (□) over 20 years.

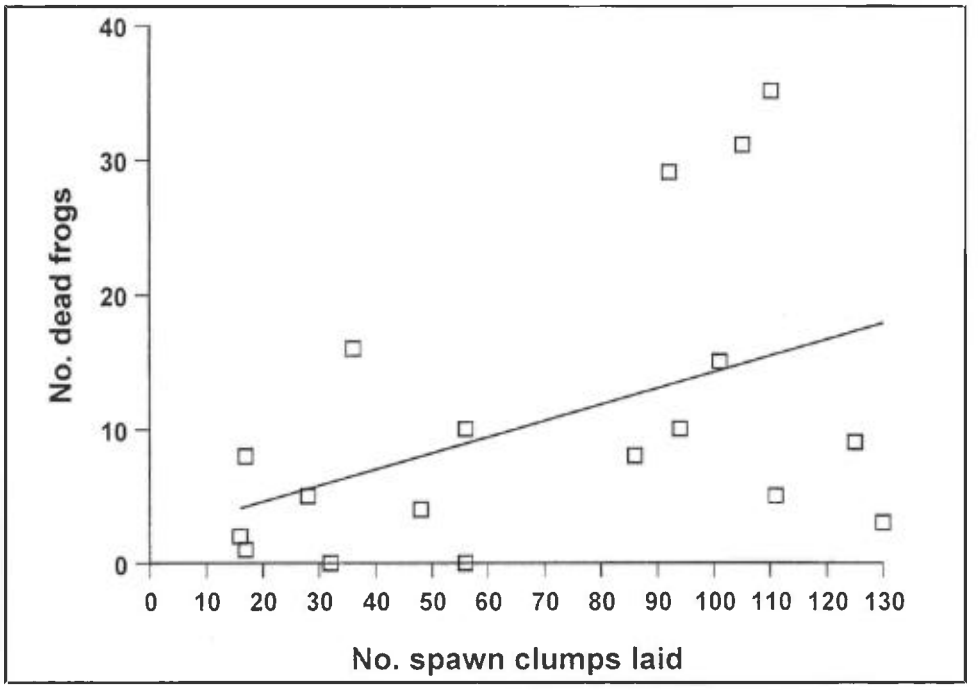

Figure 2. Correlation between spawn laid and predation of adult frogs.

Common Toads have never established themselves in any of the three ponds despite many efforts over the first decade to introduce them as spawn. For some inexplicable reason toad spawn and tadpoles develop very slowly in my ponds and scarcely ever survived to metamorphosis even before newt numbers became high. I have tried to find out what happens to kill off the toad tadpoles, but without much success. There are, for example, three beasts in pond 3 which I suspected might be predators of the toad tadpoles: Alpine Newts, Horse Leeches and large (hawker) dragonfly nymphs. But when I carried out trials under controlled conditions, neither the newts nor the leeches took any toad tadpoles at all and even the dragonfly nymphs didn't catch more than one or two over 24 hours. Predation could not in any case explain the peculiarly slow growth rates of toad tadpoles, which I see every year whichever pond I put them in and which are quite unlike those of frogs in the same pond. Tests with pond water were inconclusive, except in one trial with water and pondweed which did seem to replicate events in the ponds. The guts of the tiny tadpoles became packed with huge numbers of a ciliate protozoan, which might be a parasite but which equally could be a result rather than a cause of the tadpoles' difficulties. I would be interested to hear from anyone else who has this kind of experience with toad tadpoles. However, on a brighter note a single pair of toads spawned in my ponds in 1995 and two pairs in 1996 (the second right at the end of May!) and there may be some hope for the future now pond 3 has been deserted by Crested Newts; all the other newt species leave the distasteful toad tadpoles alone. A small mixed population of Edible and Pool Frogs (about 20 adults) also lives in and around the three ponds, and enjoys occasional breeding success in warm summers. 1995 was particularly good.

Newts

The three native newts and just 5 Alpine Newts were introduced to the ponds in 1977. Ten years later all four species were still present and breeding regularly, with Smooth Newts dominant but Alpines also dramatically successful. As shown in Table 1, all four species were still present after 20 years but there were some changes. The introduction of sticklebacks to pond 3 was made with the express purpose of reducing newt numbers in that pond, and thus relieving pressure on the frogs. Sticklebacks are thought to be highly effective predators of newt larvae, but in my experience have little or no impact on frog tadpoles.

Table 1. Estimates of newt numbers.

Numbers are mark-recapture estimates, with standard deviations in parentheses.

	1986				1996			
Species	Pond 1	Pond 2	Pond 3	Total	Pond 1	Pond 2	Pond 3	Total
Smooth	115(32)	48(15)	364(111)	527	23(12)	25(5)	55(29)	102
Palmate	8(3)	5	13(4)	26	9(5)	0	6(3)	15
Crested	12(4)	0	7(2)	19	7(2)	2(1)	0	9
Alpine	43(12)	16(8)	39(21)	98	33(19)	29(7)	41(10)	103

There were three main changes in the garden newt populations between 1986-1996:
1) Smooth Newt numbers declined substantially, and are currently at only about 20% of

their mid 1980s high. There are still plenty of them, though, and the decline has been greatest (about sevenfold) in pond 3 where the sticklebacks live. The mark-recapture results confirmed in all cases the impressions I was getting from regular torch inspection of the ponds. In 1985-6 the pond floors in mid-spring were virtually carpeted with Smooth Newts, but numbers declined progressively after that time.
2) Unique among the four species, Alpine Newt numbers have remained at more or less exactly their 1986 levels. Because of the Smooth Newt declines this means they are now the co-dominant species in the ponds. They have not declined at all in the stickleback pond, although it is now rare (but not unknown) to see any newt larvae in that pond.
3) Crested Newts, uniquely among the four species, have deserted the Stickleback pond altogether. This did not happen immediately; adult Crested Newts continued to use the pond, in slowly decreasing numbers, between 1991 and 1995 (when a single male was seen there). In 1996 no Crested Newts at all were seen in pond 3, and there have certainly been no Crested Newt larvae in there since 1991.

A particularly interesting discovery in pond 1 in 1996 was a male newt fitting the description of a Smooth x Palmate hybrid, as reported previously on only one other occasion in the wild as far as I know (Griffiths, Roberts & Sims, 1987). This animal, duly photographed, had a low and weakly-undulating crest, strongly-spotted sides and belly and red and blue streaks along the bottom of the tail, all typical Smooth Newt characters; but also prolific golden spots on the head, "palmaty" lateral tail colouration, a squarish body section with pronounced lateral folds and a distinct tail truncation and filament, all characteristic of Palmates. The hindfeet had intermediate webbing, and total length was about 93 mm, both features halfway between what is typical of the two species.

DISCUSSION

Garden ponds, with their relatively small sizes and artificial liners, undoubtedly differ from natural pools with respect to the types of wildlife that prosper in them. Even so, carefully designed garden ponds do have realistic natural attributes and at least in some respects may serve as models for what happens in wilder places. In my garden, the impression over the first 20 years is that frogs are very effective pioneers, colonising rapidly and expanding quickly to high numbers. However, as tadpole predators that increase more slowly (in this case newts) become established there may be a kind of natural succession in which frogs are reduced and perhaps, in a few more years, they will be eliminated altogether. It is certainly striking that in dewponds on the Downs, the nearest natural ponds in our area, newt populations are widespread but frogs and toads are very rare except in new or newly-renovated ones. Interestingly, most garden ponds have goldfish and this seems to be good news for frogs. Although the fish undoubtedly eat some tadpoles, it is very unusual to find any type of newt doing well in goldfish ponds and frog populations seem to survive, in quite large numbers, for decades in such ponds (several of which I know in the Brighton area).

Toads have proved very enigmatic. Most garden colonies of toads in Brighton are in the oldest (>20 years) ponds, and I wonder whether mine might eventually be taken over by them. The recent breeding efforts by a single pair, unassisted by me in any way, are a curious contrast to all the abortive efforts I made in the first decade to establish the species. Even more puzzling has been the reason for the past failures, notably the very slow embryo and tadpole growth rates followed by inexplicable disappearance before metamorphosis. This problem may well be peculiar to my ponds, but it happened in all 3 of them, with both plastic and concrete liners, and it seems to me there is a real mystery here worthy of some further research.

As for the newts, control by sticklebacks has proved ineffective except for Great Crested which seemed, as has long been suspected, particularly susceptible to fish predation of their larvae. It looks as if adult Crested Newts had no way of recognising that sticklebacks made the pond useless for them; they kept trying for years, maybe until adults born in that pond died out. Experiments with American ambystomid salamanders that produce larvae vulnerable to fish predation also showed that the adults had no ability to distinguish fishponds from fish-free ponds, so this may be a general failing of amphibians. Numbers of the other newt species have remained high enough in the stickleback pond to devour virtually all the frog tadpoles, so no salvation for frogs is yet in sight. Maybe bigger fish would do the trick.

The extraordinary success of Alpine Newts has continued for the full 20 years. I am now rather concerned that this might eventually be at the expense of Common Newts, which are evidently in decline. Only more decades will reveal the outcome of all these struggles for survival in a quiet urban garden.

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