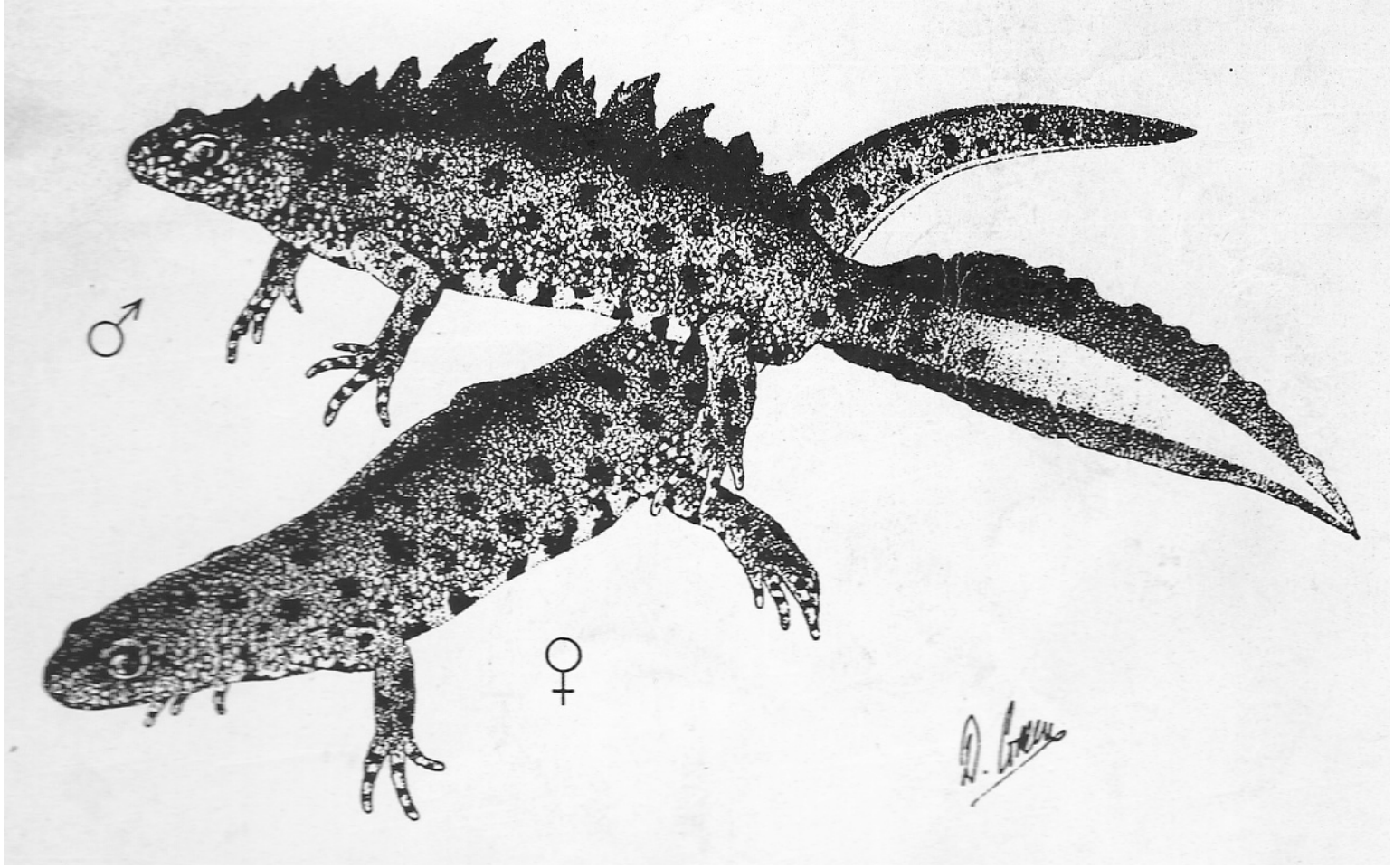
# Dave Green's
# Notes on the Ecology of
# Great Crested Newts




## Written and drawn by
## Dave Green in 1984.
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# NOTES ON EGG-LAYING

The duration of egg-laying for this species in Durham ranges from mid-March to late July, with the main laying spell being from early evening to early morning, bright sunshine tending to halt such activities. During this time the females actively search out leaves of favoured aquatic plant species on which to lay their eggs. The total number of eggs laid during the course of the season is between 200-300.

Over the choice of leaf the female shows considerable patience and care. She smells and examines it thoroughly before mounting, though even then may release her hold if not totally satisfied. During the two minute process of egg-laying it is only the hind feet that are in contact with the chosen leaf, being used to fold it in two and therefore form a receptacle into which to release, and thus hide, a single egg. The toes usually interlock to give added grip, for during this period the female remains quite motionless and can, depending upon the plane of the leaf, be in almost any position imaginable The tail is used to full advantage in maintaining balance at such times and the fore-limbs use any available support. Although highly vulnerable, an egg-laying female will rarely be tempted away from completing her task.

When first laid the cream-white embryo measures 2¼mms x 2mms and is protected by a clear, glutinous egg-jelly which adheres to the leaf and maintains the fold. The females fastidious behaviour concerning the egg-leaf now becomes apparent, for such leaves must be capable of retaining their fibre over a period of upto 9 weeks or the eggs will become exposed to such enemies as caddis larvae (Limnephilus spp.), great pond snails (Lymnaea stagnalis), anuran tadpoles and newts. In general great crested newts prefer fairly broad leaves of good fibre, and whilst it is the fresh leaves that are generally most favoured, it is only the previous year's decaying leaves of the bur-reed (Sparganium) and reedmace (Typha) that are used, as they decay at a very slow rate and the fresh shoots are too strong to fold.

The most commonly used aquatic plants are listed below, roughly in order of preference-

forget-me-not (Myosotis caespitosa and M.scorpioides)
water-cress (Nasturtium officinale)
willow herb (Epilobium spp., including E.hirsutum)
bur-reed (Sparganium erectum)
flote-grass (Glyceria fluitans)
reedmace (Typha latifolia)
reed-grass (Phalaris arundinacea)
fool's water-cress (Apium nodiflorum)
brooklime (Veronica beccabunga)
water speedwell (Veronica anagallis-aquatica)
submerged terrestrial grasses (Alopecurus etc.)
broad-leaved pondweed (Potamogeton natans)
reed sweet grass (Glyceria maxima)
water plantain (Alisma plantago-aquatica)
water mint (Mentha aquatica)

It is only when all suitable leaves of such plants have been utilised that females unwillingly lay upon decaying tree leaves, Elodea spp., duckweeds (Lemna spp.) and even water lilies (Nymphaea alba). Under such conditions they seem stressful and may abandon their meticulous care, laying exposed eggs, sometimes in strings of upto four at a time.

During the breeding programme I collected 1,220 eggs from my own ponds, all of which were laid on water-cress, the only suitable egg-laying plant in the ponds at the time. In 95% of the cases one egg was present per leaf; almost without exception the large terminal leaf, the smallest used being 12mms x 9mms. The eggs were positioned close to the margin, though the leaf fold angle was variable. Two separate eggs on one leaf (one fold) were also found and these showed the precision of the female, for in such cases she would of had to slip the second egg into the open end of the pre-made fold.

Double folded leaves also occured, though only half contained an egg in the secondary fold. Alternatively, though rare in occurence was the use of upto four small leaves to conceal a single egg. This probably occurs as a result of a shortage of good leaves.

Whilst collecting eggs for the first three years of the breeding programme I was able to calculate the daily rates for the first two months of the laying season, knowing both the dates that the water-cress was planted/removed and the number of egg-laying females present in the ponds. In mid-March the newts averaged only 2 eggs per day, but this increased to 6 per day a month later and to 9 per day by mid-May. Although I initially took this increase to be due to higher temperatures, it could well be that this species shares three similar egg-laying phases as suggested by Bell & Lawton (1975) for the smooth newt (Triturus vulgaris) which has a major phase between mid-April - late May followed by a decline in egg production. As the rate of mortality decreased during the major phase they concluded that unidentified events in the pond conspired to make conditions especially suitable for egg survival at this time. The main phase of egg-laying for great crested newts in Durham would apparently seem to be between late April and early June.

## LARVAL ECOLOGY

Adult great crested newts show a tendency towards egg-laying upon marginal water plants and it is within the shallows that their newly-emerged larvae tend to remain. Their striped pattern camourfages them well against the stems and foliage on which they hang motionless for long periods. However, at stages comparable to between the 5th-10th Weeks (see the Introduction to Larval Development) they become excellent open-water swimmers, and this striped pattern is lost. Their increased swimming abilities are primarily a result of the relative increase in size of the tail-fins and the development of a tail-filament. During this time they are often seen swimming leasurely by a steady, graceful series of tail-flexing movements,or hanging motionless in mid-water. However, this calm is somewhat deceptive, for when threatened they are capable of great speed and at such times take to the cover afforded by thick vegetation and/or substrate mud. The larvae are ecologically opposite to the bottom-dwelling adults over this period, and this is not more clearly seen than when they are both surfacing for air, for whilst the larvae, after an initial downward thrust of the tail, usually keep to the open-water, the adults immediately return to the bottom. Like the adults, however, the larvae are most active after the sun has lost its intensity.

Well developed larvae, due to the absorbtion of their swimming aids frequent shallow water, where they essentially keep to the cover of thick vegetation. When efts, they leave the water for short spells in search of food, such excursions usually taking place on warm, wet evenings. As they become more confident they wander further afield, though some individuals, like some adults, remain closely tied to their watery environment and may be seen their at any time of the year. Their black and yellow colouration gives warning to would-be predators of their poisonous defences. In the Durham area sexual maturity is reached in 3-4 years.

## Predators

Little work has been undertaken on the predators of great crested newts. Due to their large size and particularly their poisonous skin secretions, they are protected from many of the animals that feed on both the smooth and palmate newts. Although top predators in most of their breeding ponds, great cresteds are known to be eaten by fish, such as trout (Salmo spp.), pike (Esox lucius) and perch (Perca fluviatilis). Whether the terrestrial threat of crows (Corvids), hedgehogs (Erinaceous europaeus) and brown rats (Rattus norvegicus), which have learned to eat the slightly less poisonous common toad, attack this species is, to my knowledge, unknown.

When the larvae gain the poisonous secretion is also unknown, though if, as seems likely, it develops at the same time as the warty skin, then it is not until late, at a stage equivalent to the 10th Week (see the Introduction to Larval Development). Thus the larvae are prone to attack from a number of pond dwellers throughout much of their development.

As with adults, fish species form the major threat to larvae, bearing in mind the open-water nature of the latter. Fish were present in eleven of the surveyed ponds and at the five sites where large species were recorded none had good great crested newt populations, and in four of these the fish had been introduced within the last 10 years. Even small fish, which are capable of only taking small larvae, such as the three-spined stickleback (Gasterosteus aculeatus) has been known to severely decimate larval populations (G.A.C. Bell, 1970 & others). However, as eight of the ponds contained this species, and at Pond 18 both have survived together for at least 25 years, it seems unlikely that this fish alone, although certainly not beneficial, is likely to cause the extinction of great crested newts in large ponds with sufficient cover.

Other major vertebrate predators of larvae must include the adults of other newt species, particularly the smooth newt, which was found in all but three of the surveyed ponds. This association of the two species has been noted throughout the country, and a strong predatory connection may well exist between them. Whilst adult great crested newts may be regarded as bottom-dwellers and their larvae open-water swimmers, the adult and larval smooth newts are the exact opposites,- the adults of one species therefore acting as the major predator on the larvae of the other. Apart from this, it could be expected that the smooth newt, being by far the commoner and better coloniser of ponds would be found in the great majority of crested sites, both species showing preferences for lowland ponds of similar water chemistry. Well developed great crested larvae also have cannibalistic tendancies, though after a period comparable to the 11th Week they become ecologically separated from younger larvae.

The effects of waterfowl on the species is less obvious, though Nicholson (personal comm.) indicates that it seems to suffer more by their presence than the other newts. Although absent from only twelve of the surveyed ponds, at only three were they plentiful, the usual situation being a single pair of either moorhen (Gallinula chloropus) or mallard (Anas platyrhynchos) per pond. Although these species may well supplement their diet with newt larvae the main losses probably occur unintentionally, the birds feeding on egg-bound vegetation.

A number of invertebrates feed on crested newt eggs (see Notes on Egg-laying) and larvae. Young larvae are preyed upon by the adults and larvae of the larger water beetles (Agabus, Colymbetes, Acilius, Ilybius etc.), alder-fly larvae (Sialis lutaria), damselfly nymphs (Zygoptera spp.) and caddis larvae (Limnephilus spp.). The latter three groups, however, pose only a serious threat to newt larvae laid early in the season, for, from mid-May - early July most have hatched into flying adults. Of a more permanent threat are adult water scorpions (Nepa cinerea) and the nymphs of dragonflies (Anisoptera spp.). However, as they were found in relatively

few of the surveyed ponds (see the Animal Abundances List) &, being confined as they are to the substrate and areas of vegetation, they are ecologically separated from larvae older than at a stage comparable to the 5th Week. The two major invertebrate predators of great crested newt larvae appear to be the backswimmers and their nymphs (Notonecta spp.), recorded at thirty-seven ponds, and the great diving beetle and its larvae (Dytiscus marginalis), recorded at nineteen ponds. Both inhabit the same open-water areas as newt larvae, can tackle larvae of upto a large size, and are present in ponds throughout the whole year.

To conclude, it is worthwhile reflecting on the fact that the major egg-laying phase of great crested newts in Durham appears to be between late April-early June, and that it is presumed that such a major phase coincides with a high larval survival rate. Bearing this in mind, the main benefits to these larvae, which hatch between early July-mid August, are the absence in the ponds of the predacious caddis larvae (Limnephilus), damselfly nymphs (Zygoptera spp.) and alder-fly larvae (Sialis lutaria), as already mentioned. However, of much greater significance, is that the timing also coincides with the moving back onto land of smooth newts, which are primary predators.

Prey

The adult newts are voracious predators, feeding on earthworms, slugs, snails, crustaceans and a wide variety of insects when on land, and water louse (Asellus spp.), lesser water boatmen (Corixids), aquatic worms, insect larvae (Chironomidae etc.), newt larvae and frog tadpoles when in water.

Due to the lack of information concerning larval prey a number of feeding experiments were conducted. In each experiment a well-developed larva (approximating to the 8-11 Week stages) was placed in a 32cms x 19cms water vessel for 12 hours. The vessel contained set numbers of invertebrates and in order that the latter could not hide, mud and vegetation were absent. For this reason certain invertebrates, such as the worms Lumbriculus variegatus and Tubificidae, mayfly nymphs (Caenis horaria) and damselfly nymphs (Zygoptera) were handicapped and their casualties over-exaggerated. Very small invertebrates were not included because of the size of the experimental larvae and the difficulties of isolating set numbers.

The results of the experiments are shown below, the number in brackets reflecting the number of times the group/species was involved.

| | | |
|---|---|---|
| Lumbriculus variegatus (worm) | 90% | ( 3) |
| Stylaria lacustris & Dero spp.(Naididae worms) | 84% | ( 5) |
| Tubificidae (Tubifex worms) | 82% | ( 5) |
| Chironomus spp. (midge larvae) | 76% | (10) |
| Chaoborus sp. (phantom midge larvae) | 75% | ( 3) |
| Cragonyx pseudogracilis (water shrimp) | 75% | ( 2) |
| Culicidae (mosquito larvae) | 66% | ( 7) |
| Cloeon dipterum (mayfly nymphs) | 55% | (14) |
| Zygoptera (small damselfly nymphs) | 55% | ( 6) |
| Glossiphonia heteroclita & Helobdella (leeches) | 50% | ( 2) |
| Asellus spp. (water louse) | 48% | (12) |
| Corixids (lesser water boatmen nymphs) | 47% | (10) |
| Tubifera sp. (rat-tailed maggots) | 40% | ( 2) |
| Notonecta glauca (backswimmer nymphs) | 23% | ( 3) |
| Caenis horaria (mayfly nymphs) | 20% | ( 9) |
| Ceratopogonidae (biting midge larvae) | 16% | ( 2) |
| Coleoptera spp. (beetle larvae) | 16% | ( 4) |
| Dixidae spp. (midge larvae) | 9% | ( 2) |
| Gasterosteus aculeatus (3-spined stickleback) | 8% | ( 3) |
| Gerris spp. (pond skater nymphs) | 7% | ( 3) |
| Nemoura cinerea (stonefly nymphs) | 5% | ( 1) |

None eaten- Gastropoda (snails)(6), Acari spp.(water mites)(2), Triclads (flatworms)(1), Coleoptera spp.(water beetles)(2), Trichoptera spp.(caddis lar.)(3), Hydra spp.(4), Pisidium sp. (Cockles)(1) and Ptychoptera spp.(fly lar.)(1).

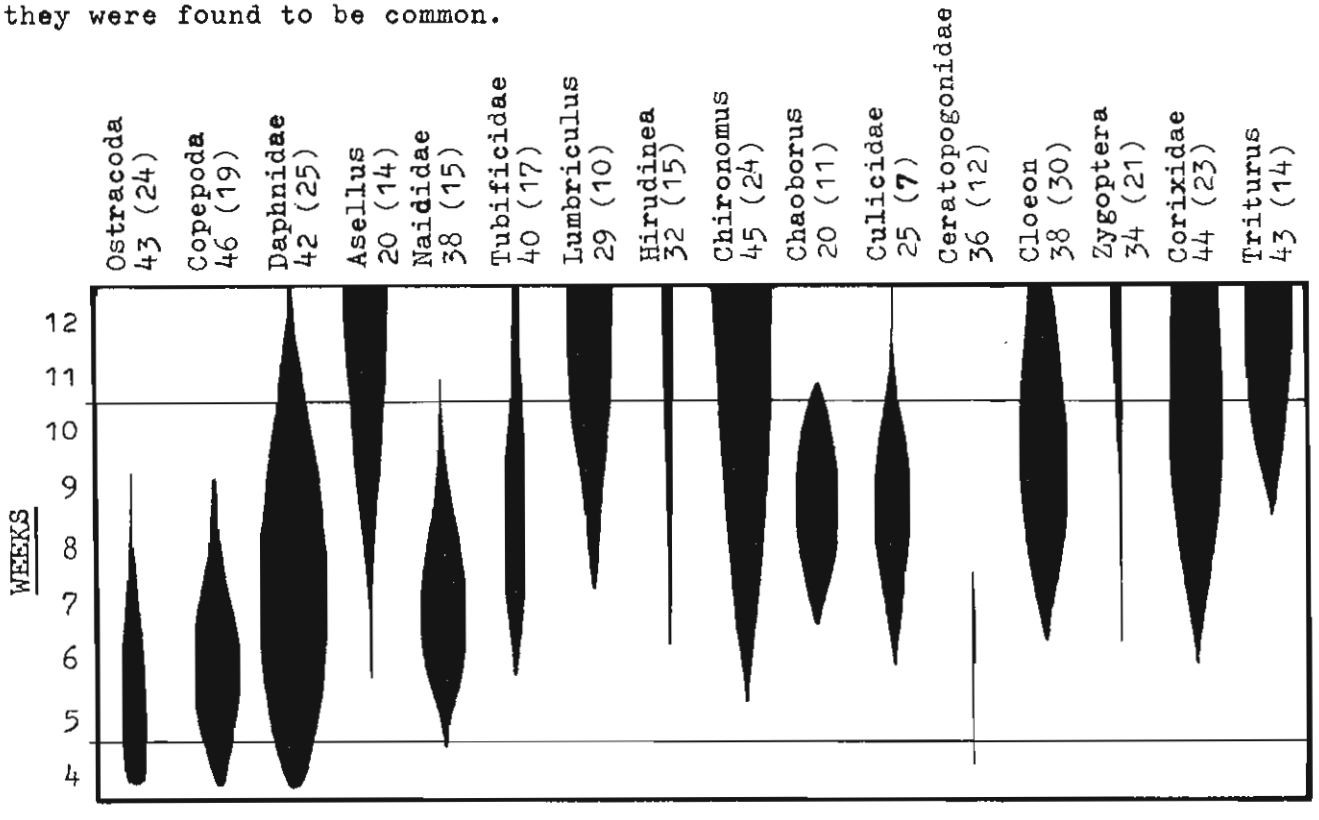
The information gained from these experiments can only be looked upon as a very rough guide to prey, due in part to reasons already given, and also because the groups were not represented evenly in the experiments. The following notes are my own assessment of the larval needs at their various ecological stages.

In the period relating to the 4th Week the larvae, unable to swim well, lie motionless for long spells either on the substrate or vegetation. Although initially subsisting on their yolk-sac, they soon begin to feed on Copepods, 'water-fleas' or Cladocera (adult Chydorus ovalis and young Daphnidae) and Ostracods. Their method of attack consists of a clumsy and often unsuccessful, short upward lunge.

In the free-swimming period, between the 5th-10th Weeks they become voracious feeders, taking relatively large, open-water prey. Naididae worms, adult Daphnidae, fly larvae and pupae (Chaoborus, Chironomus and Culicidae), mayfly nymphs (Cloeon dipterum) and lesser water boatmen nymphs (Corixids) now form the major part of their diet, augmented by drowning insects and bottom-dwelling invertebrates such as water louse (Asellus spp.) and the worms Lumbriculus variegatus and Tubificidae. Whilst the wary larvae of Chaoborus and the Culicidae are hunted with slow, deliberate patience, Daphnia and Chironomids are actively persued and, due to lightening reflexes, they can even take swimming Cloeon and Corixid nymphs. There is certainly a strong relationship between activity and predation, and even inedible items such as water mites (Acari) are regularly taken because of their speedy movements, and then, just as regularly spat out. On one occasion even a sinking leaf was attacked!

During the final weeks the larvae, due to fin and filament absorbtions, become bottom-dwellers. At this time species such as Lumbriculus variegatus, Asellus, Corixids and fly larvae (Chironomids) form the bulk of their diet, whilst small newt larvae and slow developing frog tadpoles are also taken.

The following table shows the predation pattern outlined. The widths of the pathways indicate the importance of the various prey species at different periods of larval development. The figure by the species indicates the number of times they were found in the forty-six surveyed great crested newt ponds, the bracketed figure showing the number of sites in which they were found to be common.



# ANIMAL ABUNDANCES IN GREAT CRESTED NEWT PONDS

The lists below show the major animal forms found in the forty-six surveyed ponds, either as species, genera or families. Underlined species are included under larger groupings elsewhere in the lists.

The number of times a group was found to be common is given in brackets by the total. * on the left side indicates prey of great crested newt larvae, whilst + indicates their predators.

## INVERTEBRATES

*Cyclopoid copepods.....46 (19)
*Chironomus spp.....45 (24)
*Corixidae spp.....44 (23)
*Ostracoda spp.....43 (24)
*Daphnidae spp.....42 (25)
*Tubificidae.....40 (17)
*Tanypus spp.....40 (16)
Hydroporus spp.....40 (10)
*Simocephalus sp.....39 (17)
*Cloëon dipterum.....38 (30)
+Limnephilidae spp.....38 (23)
*Naididae spp.....38 (15)
Lymnaea spp.....37 (15)
+Notonecta spp.....37 (14)
?*Ceratopogonids.....36 (12)
Gerris spp.....36 (12)
Helophorus spp.....36 (13)
Hygrobatidae spp.....36 ( 3)
Haliplus spp.....35 (11)
Lymnaea peregra.....35 (10)
*+Zygoptera spp.....34 (21)
*Corynoneura spp.....33 (10)
*Hirudinea spp.....32 (15)
+Limnephilus spp.....31 (16)
Hydroporus palustris....31 ( 8)
+Limnephilus vittatus....30 (13)
Pisidium spp.....29 (11)
*Lumbriculus variegatus..29 (10)
Planorbis spp.....29 ( 9)
+Agabus spp.....29 ( 8)
Limnocaridae spp.....28 ( 7)
*Daphnia spp.....27 (12)
?*Nematoda spp.....27 ( 5)
Hydrobius fuscipes.....26 ( 3)
Rhabdocoelid spp.....26 ( 3)
*Culicidae spp.....25 ( 7)
+Agabus bipustulatus.....24 ( 6)
*Chydoridae spp.....24 ( 6)
*Harpacticoid copepods...23 ( 5)
*Chydorus ovalis.....23 ( 4)
Planorbis crista.....22 ( 6)
*Asellus spp.....20 (14)
Triclads.....20 (13)
*Chaoborus spp.....20 (11)
Hydra spp.....20 (11)
Hygrotus inaequalis.....20 ( 6)
+Dytiscus marginalis.....19 ( 4)
Leptoceridae spp.....18 ( 5)
Dixa spp.....18 ( 2)
+Sialis lutaria.....15 ( 3)
Hydroporus planus.....15 ( 1)
Sphaerium spp.....14 ( 8)
*Helobdella stagnalis....14 ( 7)
*Glossiphonia heteroclita14 ( 4)
Triaenodes bicolor.....14 ( 4)
+Anisoptera spp.....13 ( 5)
Erpobdella testacea.....13 ( 3)
Ptychoptera spp.....13 ( 2)
Pyralidae spp.....13 ( 1)
Haemopis sanguisuga.....11 ( 2)
Lymnaea stagnalis.....10 ( 5)
+Nepa cinerea.....10 ( 1)
*Caenis horaria..... 8 ( 5)
+Colymbetes fuscus..... 8 ( 2)
Phryganeidae spp..... 8 ( 2)
Theromyzon tessulatum... 8 ( 2)
Ectoprocta spp..... 7 ( 2)
+Agabus nebulosus..... 6 ( 2)
+Acilius sulcatus..... 6 ( 1)
+Ilybius feluginosus..... 6 ( 1)

## VERTEBRATES

+Triturus vulgaris.....43 (14)
Rana temporaria.....29 ( 9)
+Gallinula chloropus.....24 ( 3)
Bufo bufo.....22 (11)
+Anas platyrhynchos.....20 ( 2)
+Triturus helveticus.....10 ( 2)
+Gasterosteus aculeatus.. 8 ( 3)
+Fulica atra..... 6 ( 2)
+Perca fluviatilis..... 3 ( 1)

NB. It must be remembered that the ponds were surveyed over many months and that groups with terrestrial adults will be therefore underestimated, due to their absence in ponds during this phase.