# TAKING A LOOK AT RIVER MAINTENANCE

As fishermen paying an annual subscription, we expect to find the fishing reasonably accessible. In an attempt to produce accessibility it is very easy to damage the ability of the river to support a population of salmonids. It doesn't do any harm to take a closer look at the ecosystem itself and use this knowledge to find ways in which this can be avoided. All members of any ecosystem have evolved to utilise a range of abiotic conditions. If one of these conditions should change, some species will find the new environment less acceptable. Numbers of that species will then decrease. Over a long period of time, other species more suited to the new situation will be selected and occupy the vacant space. Compared with some habitats the river environment is a very stable one. However, fluctuations in the river environment occur and the same rules apply to this habitat as others, adapt to change or disappear.

## Abiotic Influences

- **The oxygen content of water**, is less than that of air. It is constantly replaced by diffusion through the surface of the water and by photosynthesis. There is a direct relationship between the oxygen content and temperature. As the temperature rises the ability to hold oxygen decreases. After global warming the oxygen content will drop and this may be an argument for using trees to shade the river.
- **The chemical composition** of the stream is fairly constant as well, but alters during times of flooding or drought.
- **External pollution** from the input of sewage will deplete the oxygen content, and consequently there will be a loss of species demanding high oxygen levels.
- **Fertiliser** may enter the river in runoff from recently fertilised fields which may lead to eutrophication.
- **Sodium, calcium and bicarbonate ions** are usually the most abundant inorganic substances with phosphate and nitrate generally less abundant. These are important as plant nutrients.
- **The pH** of the river may change with rainfall. In times of excessive rainfall on the moor the pH of the river will drop. Similarly the application of lime to farmland may increase the pH of the water.

## Species Adaptations

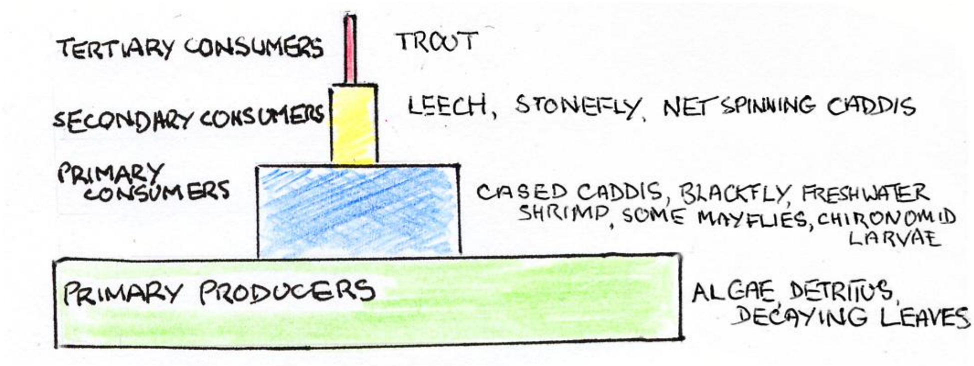
The Avon is a spate river and the velocity of the water can produce problems for the invertebrate fauna of maintaining position particularly in times of high water. Some organisms will achieve this by making adaptations: keeping their thin flat bodies flattened against the rock surface e.g. the flatworms; suckers e.g. leeches and the blackfly larvae; net spinning caddis anchor themselves with a silken web; many have grasping claws e.g. mayfly and stonefly nymphs; and Ecdyonurus has a flattened body that makes it easier to shelter under the protection of large stones; shrimps flattened laterally, can squeeze into cracks; Tubiflex and chironomid get their solution by living in the mud itself; and where this is free of organic matter you will find the nymph of the Caenis fly; The small freshwater limpet shell is shaped with a hooked top to offer less resistance to the water. The adaptations to survival in water are limitless.

## Food Chains and Food Webs

Community structure can be described in terms of food chains or food webs. All living organisms ultimately depend upon the sun. The ability of green plants to absorb sunlight and use their chlorophyll in converting carbon dioxide and water into carbohydrate makes them a suitable base for a food chain. They are described as the Primary Producers. Algae form a main photosynthetic producer of carbohydrate in a stream such as the Avon. The algae cover almost every submerged surface, be it stone or plant. Because of the overall speed of the Avon Current and lack of deposition of silt by the river, it is very hard for macrophytes or rooted plants to establish themselves. They are only found in larger quantities in a few parts of the river. Fontinalis is one that is common and survives in faster water because of its ability to cling to a rocky surface.
Members of the community can be placed in groups described as Trophic Levels.

- **Trophic Level 1** are the Primary Producers
- **Trophic Level 2** are the Primary Consumers. These are the herbivores and detritus feeders feeding on Trophic Level 1.
- **Trophic Level 3** are the Secondary Consumers. These are the carnivores feeding on the organisms in Trophic Level 2.
- **Trophic Level 4** are the Tertiary Consumers. This is the Top Carnivore and in our case would be the TROUT.

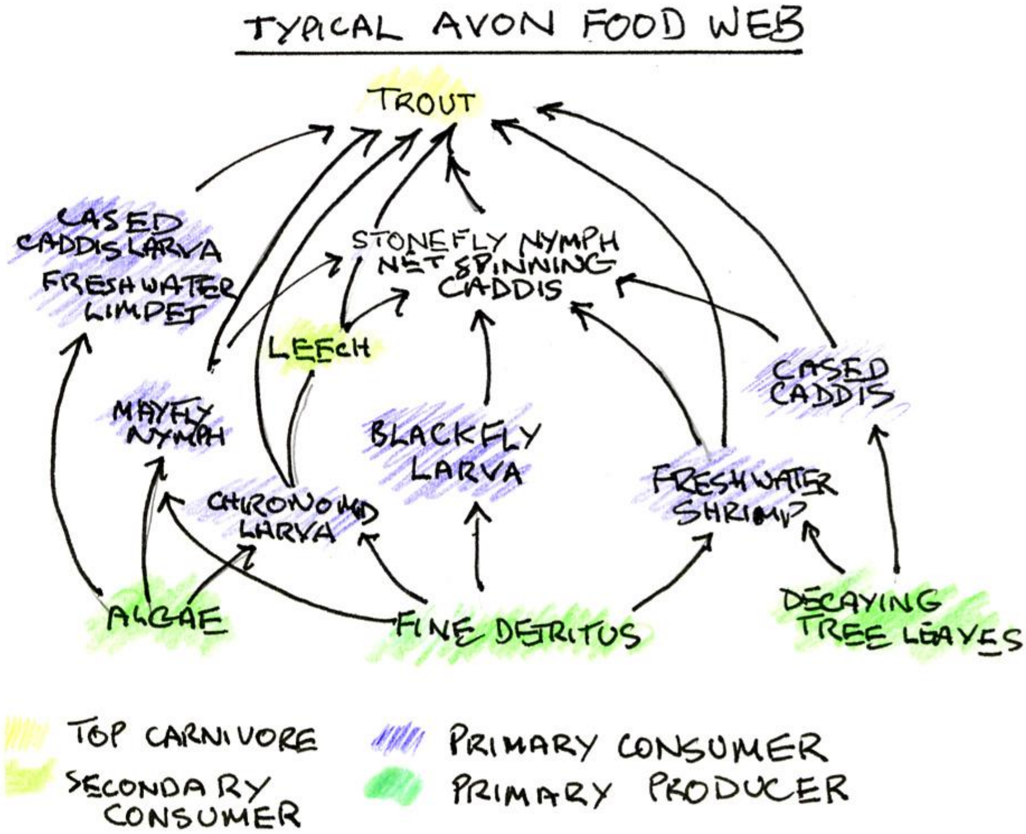
Although food chains can be longer than this they are seldom longer than 4 members. This can be explained by what happens at every passage from one tropic level to another. At every move there is loss of energy to the metabolism of the animal receiving the food. This is lost forever and cannot be transferred to the next level. A large mass of producer is required to produce a small mass of Top Carnivore. A pyramid structure goes far in representing the biomass at each tropic level and in many cases the number of animals at this level. Although the table reflects the changes in biomass or numbers it is better to look on it as a Table of ENERGY. The table below illustrates energy flow through the river system.




**Pyramid of Energy** (Not drawn to scale)

Equally important food chains begin in organic detritus. This represents dead animal and plant material which once lived in the stream or found its way into the stream from outside e.g. dead leaves or branches etc. Dead leaves are tough and indigestible which means that dissolved organic compounds are unavailable to larger organisms. Invertebrate detrivores, bacteria and fungi work together to process this material. Shredding detritivores attack the leaves reducing them to faecal pellets. Fungi are important in breaking down indigestible leaf tissue but are themselves digested by the shredders. Bacteria are involved in the breakdown of indigestible cellulose in the faecal pellets, which release minerals available to green plants. The bacteria will themselves form a food source for filterers like the blackfly larva. This produces faecal pellets thus releasing minerals.

The food web below shows the feeding relationship between various members of the community. The importance of dead plant material falling into the river cannot be overestimated.




## Adaptations to Oxygen Levels

Every animal living in water is dependent upon the presence of oxygen in the water but the amount required will depend upon the specific organism. The larger the organism the greater the oxygen demand. A similar correlation can be made between the level of activity and the oxygen demand. Organisms have produced numerous ways of ensuring absorption of dissolved oxygen. This can consist of the gas simply diffusing through the whole body surface. Red chironomid larvae can tolerate a very low oxygen environment because of a red pigment, which acts similarly to human haemoglobin. This enables the larvae to occupy sites of low oxygen content. A considerable number meet the demand by production of gills. We could make a list graded to show the differences in demand for oxygen of various groups of aquatic invertebrate. This hierarchy would have the highest demander at the top and the lowest at the bottom with those in-between placed in order of diminishing need. In terms of a 10 to 0 scale, mayflies, stoneflies, some caddis flies would be allocated a value of 10, whilst leeches, chironomids only 0. We have a useful tool here for investigating the health of the river. If a river is carrying a lot of organic pollution then this will reduce the oxygen content of the water largely as a result of bacterial respiration. Consequently, species at the top of the hierarchy will disappear showing that a problem exists in terms of oxygen content. The presence of large numbers of stoneflies, mayflies and caddis is a positive indication that things are well with the river. A method which involves a systematic sampling of the river invertebrate community gives a more comprehensive picture of the river's health.

## Sampling Techniques

The sampling technique is easy. It needs little more equipment than a few buckets, and trays and a net of a 1mm mesh which is small enough to trap any invertebrates dislodged when the sampler kicks a given area of river bed for a given amount of time. The specimens are held in buckets of water and identified or placed in alcohol for identification later. The identification is to the level of genus or species depending upon the system used. This is where the difficulty comes. It is time consuming and really needs a means of magnifying the specimen and the use of identification keys.

Several methods are available of evaluating the results but the best method is that of calculating the BMWP score for the sampling. Each genus of invertebrate is assigned a score based upon its pollution tolerance. By totalling the sum of the scores of the sample the BMWP is calculated. The higher the score the better is the water quality. This is then compared with a nationally computed score showing what is predicted for a similar habitat site under clean water. Any discrepancy between the BMWP score and the computer predicted score shows that the water fails to meet the required standard. This only gives the situation at the time of sampling.

The Wild Trout Trust in its booklet "The Wild Trout Survival Guide" contains a lot of wisdom and practical advice on management of a fishery. Included are suggestions of how the river can be "redesigned" to improve an increase in the variety of habitat type. It suggests that most anglers can recognise the type of ideal habitat in which they are likely to catch adult trout. This is where the water is usually above 30 cm in depth, the velocity of the water is 10-60 cms per sec and where there is plenty of bankside vegetation and instream cover. These conditions are unsuitable for the other stages in the trout's life cycle.

For successful spawning and development of the egg, the Survival Guide suggests that the optimum requirements are water depth of 25 to 60 cm, a mean water velocity of 25-75 cm per sec. The gravel substrate needs to be loose sorted, 5-50mm diameter in size, and contain little sediment. Cover is provided nearby by deeper water, undercut bank, boulders, weedbed or similar cover.

Different habitat requirements for fry and parr are given. It seems common sense to meet these needs if we want to realise the potential of the fishing. As well as this we must ensure that there is enough area of river available for each generation as it passes from one stage of development to the next. However large a population of fish leaving the fry stage, it will never reach its potential of developing into adult fish if there is insufficient specific habitat requirement at the parr stage. A bottleneck will have occurred and fewer fish survive to pass into the next stage. Size of population is directly linked to food supply. As the biomass of the fish population increases, so does the amount of food needed for its support.

**There are several obvious conclusions we can arrive at based on an understanding of what makes the river tick if we want it to reach its potential.**

1. Is primary production at the correct level to support enough of the top carnivore? Photosynthesis will be suppressed by dense shade. Organisms depending on the reduced photosynthesis will suffer. The answer is to let in more light. In some cases this would demand removal of some of the trees and filling in the space between with coppiced ash, hazel, willow or even alder, inspite of the current problems with disease. It is recommended that these holes in the canopy should be 5 to 10 metres apart. The coppice would then be managed on a 5 to 10 year basis. The aim of good management should be to produce a mosaic of trees with individuals at different stages of succession. This is more attractive to a wider range of species than woodland on its way to old age. It will also increase primary production in the river itself. Very little grows if light is suppressed. This is the reason that laurel was planted next to the river at Avonwick. Coppice allows growth of an impressive ground flora and a more diverse range of food chains emanates as a result. We should aim to produce the dappled shade effect in bank maintenance. It is suggested that where abandoned coppicing comes under treatment we might follow a rule of thumb removal of 80% of stems over riffles and only 40-60 % over pools. Stumps should not be removed to help to reduce the erosion of banks. Where possible material is cut out and should be stacked away from the river. Trees over 60 years of age should never be removed unless they are Unstable. The same applies to old diseased trees, which are likely to be occupied by bats, woodpeckers and even dormice.
2. A wide riparian border of trees and shrubby plants will help to stabilise the banks of the river and slow down run off of water from adjoining

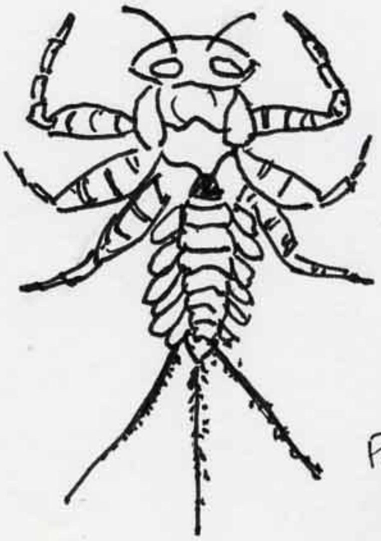
farmland. It will absorb fertiliser insecticide and fungicides and prevent them entering the river. It will not only give cover to the angler but shade and cover for the fish themselves. It will contribute at leaf fall to the necessary future detritus at the beginning of the chains.

3. We must get away from the mindset of removing everything that has fallen into the river. Just as we compost household vegetable waste for the garden, plant material should be left in the river to provide nutrients unless this is in danger of causing flooding. Fallen tree trunks should be pulled to the sides of the river and anchored there. Not only will they provide detritus and a base for colonisation by invertebrates but will allow the accumulation of sediment, which will protect the bank against erosion. As an alternative small trunks can be laid in the space between
two living trees and in this way reinforces the bank.
4. Salmon redds may need fencing to keep out stock and preventing them from muddying the water which would result in the mud settling and filling the air spaces in the gravel. Periodic aeration of the gravel might be necessary.
5. It might be interesting to carry out a survey of the fishery in terms of mesohabitats available for each trout life stage and consider ways in which new ones can be created. I am sure that the river is in good health. A survey using the Trent Biotic Index or better still that used by the Riverside Partnership Workshops would confirm this.

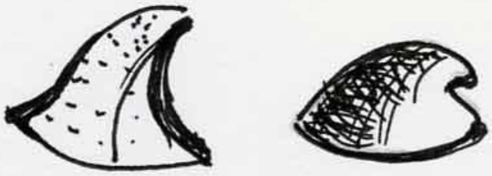
It is essential to look on the river not just as a river for fishing but to regard it as a diverse ecosystem, which should be managed not just for anglers but also for the rich community within it. An active Riparian Owners' Association might help to promote this aim. Like a garden a river needs a programme of care and attention and a rolling plan that directs in advance, any necessary work. Trees are to be enjoyed by everyone. If there is any doubt as to the whether material should be removed then it should be left untouched.

"The Wild Trout Survival Guide" (obtainable from the Wild Trout Trust) and "Rural River Habitat Management, Recommendation for Use in Agricultural Area" by River Trust and River Improvement Groups, are both good sources of advice.

# FRESHWATER INVERTEBRATES



Ecdyonurus
Mayfly nymph

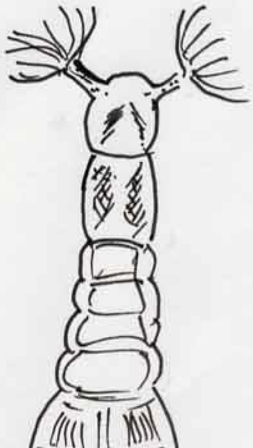


Freshwater
Limpet


Leech

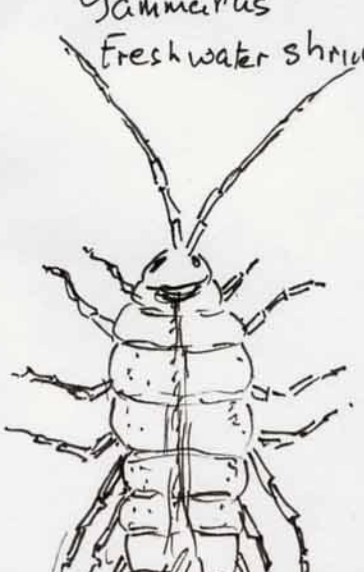

FLATWORM

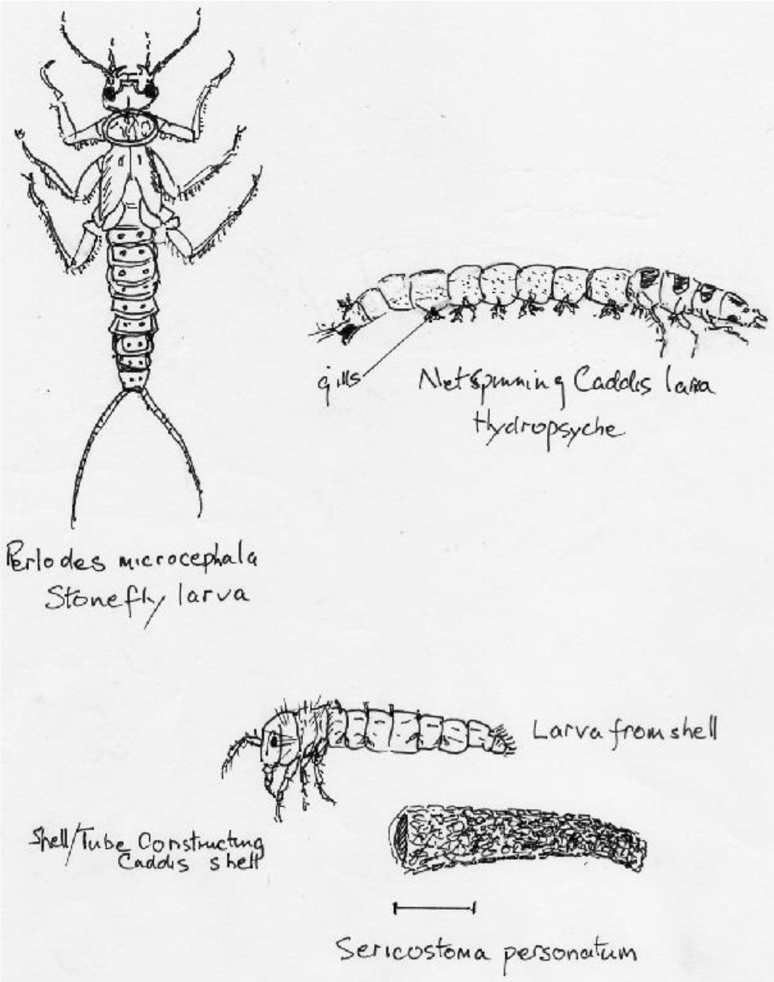
Gammarus
Freshwater shrimp



Blackfly larva

Chironomid
Bloodworm



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