



Ecology of freshwater aquaculture ponds

Freshwater crayfish are frequently described as omnivorous or opportunistic feeders, meaning that they will eat almost anything that is available. Just because they will consume something does not necessarily mean that they will grow well on it. Very little is known about the exact nutritional requirements of freshwater crayfish. When crayfish are kept in artificial tanks and fed the best of the currently available formulated diets, the growth rates are considerably less than for crayfish grown in earthen ponds. This is because in a pond situation the yabbies have access to the full range of naturally occurring feeds.

Aquatic life in ponds is also very important for a number of our native fish species. This is particularly so for small fingerlings whose regular diets comprise of zooplankton and phytoplankton found in ponds.

Types of food

The food that is available in ponds can be divided into three broad categories these being plant material, animal material and detritus (decomposing fragments of organic material derived from both plants and animals).

Plant material

Plant material can come from many sources including aquatic plants, flooded crops, reeds and grasses growing on the pond edge, or from added fodder i.e. bailed hay or lucerne. With all of these fresh plant materials, especially ones containing low protein, the actual nutrient value to yabbies is relatively low. Crayfish can not digest cellulose and so in many cases when they are eating fibrous plant material they are only acquiring a few vitamins and minerals.

Plant materials become far more nutritious after they have been in the pond for a couple of weeks after they begin to decompose. At this stage they are colonised by tiny aquatic animals, bacteria and fungi and begin to break down into detritus.

Ground cover plants should be encouraged to grow around the edge of the ponds not only for additional food value but also to stabilise the banks.

Animal material

The most important form of animal material in a crayfish or fish diet comes from the ponds aquatic insects and zooplankton (tiny aquatic animals). There are a number of different species of animals that inhabit the pond (see attached "Water insect and Zooplankton identification chart). These animals are very high in protein which is necessary for growth. Zooplankton are an important part of the diet of all freshwater crayfish and fish. Crayfish and fish will seek out and eat aquatic worms, snails, insect larvae and when they can catch them, the free swimming insects. The fast free swimming insects such as corixids and notonectids more frequently enter the diet when they die and settle to the bottom.

Juvenile crayfish and fish are more predatory than the adults and require a higher proportion of animal protein in their diets. They are active predators and are well adapted to catching the smaller free swimming forms such as daphnia, copepods and scuds.

All forms of zooplankton should be encouraged. This can best be done by promoting phytoplankton (microscopic free floating algae) and suitable water quality. Large amounts of meat should not be used to feed ponds as it is bad for water quality and is an expensive, ineffective method for feeding crayfish and fish.

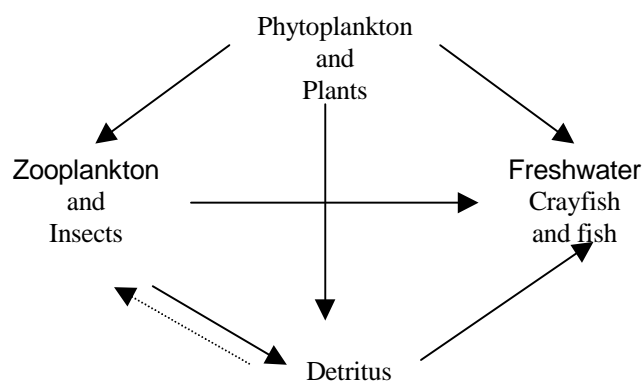
Detritus

As plants decompose they become broken down into tiny fragments. The fragments become colonised by bacteria and fungi which feed off the decomposing material. These tiny fragments and the microscopic plants, animals, bacteria and fungi associated with them are known as 'detritus'. Detritus is a major component of a freshwater crayfish's diet at all stages of its life cycle. The tiny plant fragments themselves are not very nutritious but the micro-organisms associated with them are a readily digestible, nutritious, protein rich food source.

The naturally occurring detrital food available can be supplemented by adding plant materials such as hay and lucerne. Phytoplankton cells in the water eventually die and settle to the bottom to form detritus. Organic materials will break down most rapidly and effectively to form healthy detrital communities in slightly alkaline waters (pH 7.4 to 8.5).

The pond ecosystem

All factors occurring in the pond, whether physical, chemical or biological, influence the pond ecosystem. The pond ecosystem is only just beginning to be understood and is of course extremely complicated and intricate. As aquaculturalists, we try to manipulate the ecosystem so as to produce an optimal environment for crayfish and fish growth. Food is just one component of this complex system. A simplified diagram representing pond feeding relationships is shown to the right.



Although little live phytoplankton is eaten directly by crayfish and fish, it is one of the most important components of the pond food chain. In fact trying to grow crayfish and fish in a pond without phytoplankton or suspended clay particles can be likened to growing sheep on bare sand. Some ponds will support adequate plankton communities without any assistance. However most ponds require a form of fertilising in order to promote productivity. There is no point fertilising ponds that have very low pH values (< 5) or very low total hardness (< 20ppm). In these situations liming is first required.

Likewise ponds with a very high clay turbidity will not respond to fertilisation. However suspended clay particles can provide suitable sites for active bacterial colonisation and these ponds often have very good natural zooplankton populations.

Fertilisation

If waters are very clear a fertilisation program should be started. Pond turbidity should be monitored with a Secchi disk (black and white disk with a diameter of 20 to 25cm) and when the Secchi disk visibility (the depth at which the white zones on the disk can no longer be distinguished from the black) is greater than 60cm, some form of fertiliser should be added.

Fertiliser can be organic in the form of a flooded crop, hay or even manure. If organic fertilisers are used, only small amounts should be added as large amounts will cause oxygen depletion. Inorganic fertilisers should not be thrown straight into the ponds as the nutrient will become bound up in the bottom mud and will not be available to the phytoplankton. The best way to

apply fertiliser is to place it on some sort of tray such as a piece of corrugated iron placed 20 to 30 cm under the water. Some fertilisers can also be dissolved in a bucket and poured into the pond.

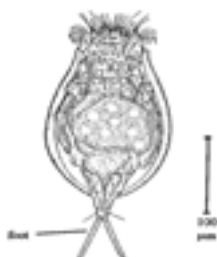
Fertilising ponds should not be a one-off process but a continuing activity with small amounts being added every time a pond begins to clear. Caution should always be used when fertilising ponds as more fertiliser can easily be added, whereas over-fertilisation can result in serious water quality and oxygen problems. Plankton induced secchi readings should not be allowed to drop below 25cm. When deciding upon a fertiliser it is important to consider the nitrogen to phosphorous to potassium ratio (N:P:K). As a general rule it is usually phosphorus that is limiting to plankton growth however in SA nitrogen is often also limiting. Phytoplankton actually require more nitrogen than phosphorous and some local farmers have had very good results with high nitrogen fertilisers. If a pond has not previously been fertilised a slight initial application may be used.

Water Insects and Zooplankton Identification Chart

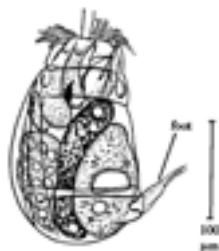
The following identification charts gives the reader a general idea on the aquatic life that can be found in freshwater aquaculture ponds. For further information, the following book, referred to for this chart, is recommended.

Ingram, B.A., Hawking, J.H. and Shiel, R.J. (1997). Aquatic Life in Freshwater Ponds – A guide to the identification and ecology of life in aquaculture ponds and farm dams in South Eastern Australia. Co-operative Research Centre for Freshwater Ecology NSW.

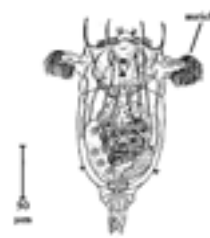
Rotifers



Euchlanis dilatata



Gastropus hyptopus



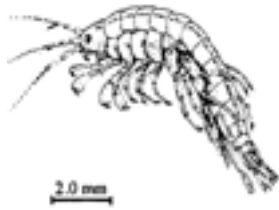
Synchaeta oblonga

Molluscs



Physa acuta

Crustacea



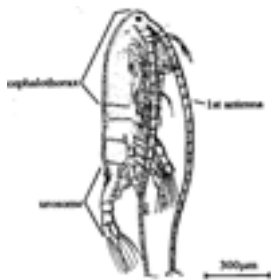
Amphipoda



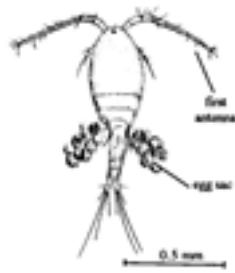
Branchinella sp. (Anostraca)



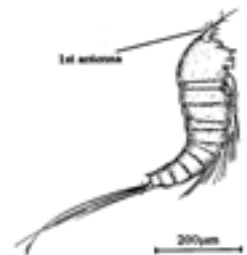
Daphnia carinata



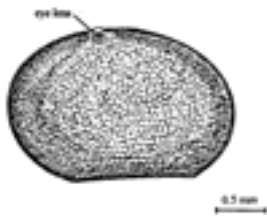
Boeckella sp.
Calanoida copepod



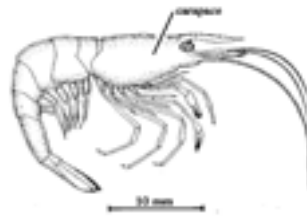
Eucyclops sp.
Cyclopoida copepod



Canthocamptus sp.
Harpacticoida copepod

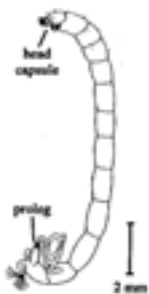


Newnhamia sp.
Ostracoda



Paratya australiensis
Freshwater shrimp

Insects



Chironomus sp.
Fly larvae



Berosus sp.
Water beetles
(Coleoptera)



Coleoptera
larva

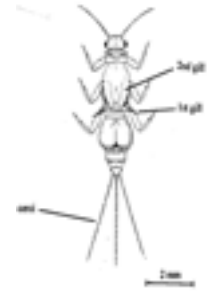
Insects (cont...)



Centropilum sp.

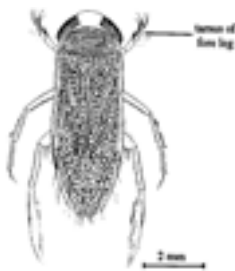


Tasmanocoenis sp.

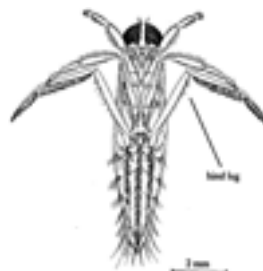


Atalophlebia sp.

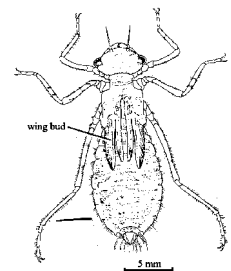
Three different species of Mayfly larvae



Sigara sp.
Corixidae
(Water Boatmen)



Anisops sp.
Notonectidae
(Water Boatmen)



Hemicordulia tau
Dragonfly larvae

It should be noted that a healthy plankton population has many benefits in addition to providing suitable crayfish and fish food. Birds are visually oriented predators and, as such, any form of turbidity will reduce bird predation. It is also considered that crayfish are less stressed in turbid water than in clear water and will spend more time feeding and less time crowding into any available deep water, shadow or shelter. Furthermore, a healthy phytoplankton population will effectively shade the pond bottom preventing filamentous algae or other undesirable water plants from choking ponds.

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