Practical Aquaponics.

Issue #2 The Bi-monthly Aquaponics HQ e-Zine May 2007

In This Issue

Aquaponics HQ
The Changing Face of Aquaponics

The response to the first issue of the Practical Aquaponics magazine was amazing; so much so that it caused us to re-examine the best way to communicate with people who, like us, are passionate about Aquaponics.

While we enjoyed putting the first issue of the magazine together, it was a heap of work and it was expensive. Also, while your feedback indicated that you liked what we did with the magazine, we felt that we were still too remote from our readership.

The outcome of that deliberation, as you will have observed, is the Aquaponics HQ web site.

To promote greater interactivity, we installed the Aquaponics HQ Forum to serve as a meeting place for those who want to discuss, to contribute and to learn.

The fact that you're reading this 'zine evidences our ongoing commitment to the production of a bi-monthly magazine. The differences between Issue #1 and those that follow is that they will be a bit slimmer and they will be FREE. Aquaponics HQ members can access it through the Forum.

The Forum and the Practical Aquaponics e-Zine are just the beginning. Watch this space and you'll begin to understand why this web site is called Aquaponics HQ.

Murray H and Gary Donaldson

Running Your System Using Timers

The flood and drain cycles in Aquaponics systems are controlled by electric timers, float switches, auto-syphons or a combination of these.

The simplest control systems (in terms of set up) are timers. Timers are of two main types:

- Electric – adjustable in increments of 15 minutes
- Electronic – adjustable in increments of minutes – usually programmed to provide six on/off cycles.

These commonly available timers can be purchased in supermarkets and hardware stores. I run a small flood and drain gravel grow bed which is fed by a 20w submersible pump on a timer.

The pumping cycle is on for about 15 minutes and off for 45 minutes during which the grow bed drains. This simple arrangement has operated for months now without problems.

Using a timer to act as a fail-safe when moving water around is a useful precaution.

For example, if you are removing water from a tank that contains fish, it makes sense to control the transfer of the water with a timer.

That way, if you forget that you are pumping, you will not empty the tank (and kill your fish).

Gary Donaldson

Timers - essential tools for the Aquaponicist.

My Grow Beds and Fish Tank are set up….what do I do now?

The three essential elements in any Aquaponics system are fish, plants and beneficial bacteria.

Your first task, once your fish tank is set up, is to "cycle" your system. The purpose of cycling is to ensure that your system is colonised by beneficial bacteria so that ammonia can be converted to nitrites and then for the nitrites to be converted to nitrates (plant food).

Once your fish tank is full, start your pump and begin recirculating water from your tank through your grow beds and back to the tank.

Next, you add a source of nitrogen to the tank.

Some people use live fish to cycle their systems. This is a questionable practice because it puts the fish at risk.

I prefer Nitrogen Dosing.

A nitrogen source like fish food, cooked or uncooked prawns or pure ammonia – is added to the fish tank.

Ammonia levels will begin to rise and colonisation of Nitrosomonas bacteria (which are naturally present in the air and water) will start to occur.

Bacteria numbers will increase to the point where the ammonia begins to convert to nitrite. The presence of nitrite in your system will encourage the colonisation of a second group of bacteria (known as Nitrobacter) and these will begin the conversion of nitrites to nitrates.

After you've added the nitrogen source to the fish tank, commence daily water tests.

Once your system has registered ammonia and nitrite readings of at least 5ppm and then returned to ZERO, it is cycling.

How quickly your system cycles will depend on a number of factors including water temperature, bio-filter size, media type and water volume. It could happen with a couple of weeks if you take a diligent approach or it could take considerably longer in more adverse circumstances.

It is now time to add some fish.

Continue to closely monitor water quality until you confirm continuous nitrate production and, If you haven't already planted out your grow beds, you can do so now.

The presence of detectable levels of ammonia in your system from this point on suggests a problem and should be addressed quickly.

Gary Donaldson

What Should I Feed My Fish?

If you want to achieve optimum growth for your fish, you should feed them a pelletised ration that has been formulated for that particular species. You can buy native fish pellets from feed stores.

Fish pellets come in a range of sizes to suit the size of fish you are feeding. Some pellets will be made to float (while others will sink quite quickly) to suit the feeding habits of particular species.

Pelletised fish food comes in a variety of sizes.

If you would prefer a more natural diet, and you are prepared to accept slower growth rates, you may be able to supplement your pellets with duckweed or Azolla. You can also feed worms, soldier fly larvae, mealworms or other live food.

How much you feed your fish is probably of equal importance to what you feed them.

About 3% of the total weight of fish per day is a useful guide. For example, if your fish weigh about 200 grams each, and you have 100 of them, you have about 20kg of fish in your tank. You would then feed 600 grams per day.

While you don't have to be too precise, if your fish receive too little feed, they'll take longer to grow out.

If they receive too much, it will remain in the water and will contribute to poor water quality. Some species of fish may also develop too much body fat as a consequence of overfeeding.

You can also adjust your feeding schedule to reflect your need for nitrates. If your plants are growing slowly, gradually ramp up your feeding.

Initially, this creates more ammonia, then nitrites and eventually more nitrates. You can then reconcile your feeding with the capacity of your plants to absorb the extra nutrients.

Of course, all of this assumes that your tank is at optimum temperature. If the water is colder than optimum, you can expect that the fish will eat much less.

It's also best to spread the daily ration across several smaller feeds rather than one large one.

Remember, uneaten food eventually becomes ammonia. If you see food accumulating on the bottom of your fish tank, stop feeding for a day or two. Withholding feed for a day every now and then will probably do more good than harm.

Gary Donaldson

How Many Fish Can I Keep In My Tank?

Because fish come in different sizes from tiny fingerlings to big ones, fish numbers are pretty meaningless when it comes to deciding of the capacity of an Aquaponics system.

A much more accurate standard is kilograms of fish per 100 litres.

The weight of fish that can be kept in an Aquaponics tank will be determined by factors like:

- The size of your tank
- The size of the fish
- The species of fish
- The Dissolved Oxygen levels in the water.
- The bio-filtration capacity of your system
- The level of risk that you wish to assume

Theoretically, the amount of fish that can be kept in any system is limited only its ability to convert ammonia and nitrites to nitrates (bio-filtration) and to maintain appropriate levels of oxygen in the water.

For practical purposes, however, the level of risk is proportionate to the stocking rate. What this means is that, if you are just managing to stay ahead of the requirement for ammonia/ nitrate removal and dissolved oxygen in the system, you will have very little margin for error or mishap.

If your stocking rates are high, you will need to have warning or back-up (preferably both) systems in place if you are to avoid injuring or killing fish in the event of a power or equipment failure.

Conversely, if you have a very low stocking rate you may not have sufficient nitrates to feed your plants. Aquaponics is a balancing act that must be managed effectively if useful productivity is to be achieved.

Gary Donaldson

Why I Chose Silver Perch for my Aquaponic System.

The short answer is, that this species is pretty tough and they are easy to get.

Many people begin by wanting to keep Barramundi in their aquaponics system.

Barramundi are well known as a good eating fish. In that respect, Silver Perch are not even close in terms of their public profile.

I have dozens of visitors to see my system every month and very few of them have even heard of Silver Perch.

Silver Perch are far easier to keep than Barramundi.

Silver Perch are very tolerant of lower water temperatures that typically occur in the winter months.

My Silvers are still eating well and are moving briskly around in the tank when the water temperature gets down to 15 deg C.

Barramundi would be starting to slow down at 15 deg C and it would not be good to have the water temperature much lower that that for them.

Silver Perch are not as likely to succumb to such diseases as white spot and fungal attack.

Silver Perch tend not to bother smaller fish co-habiting in the tank with them. I have large Silvers (1.5kg) and Silver fingerlings sharing the same tank and the big fish do not bother the smaller ones.

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Duckweed...fast food for fish

Duckweed is one of the best-kept secrets of Aquaponics.

It is a high quality feedstuff that can be produced in useful quantities at little cost and with little effort. Of equal interest (particularly in an Aquaponics context) is its ability to remove nutrients from water.

We began growing duckweed in 2004. Initially, we used it to supplement the pelletised rations that we fed to our Japanese quail. In more recent times, it has become an important part of the diet that we provide to our Jade Perch.

Duckweed - among the smallest flowering plants in the World - and an excellent natural food for fish.

In the right conditions, this tiny plant can double its mass every 24 – 48 hours.

Its explosive growth rate enables you to harvest and feed fresh duckweed on a daily basis.

At 35% to 40%, it has a higher protein level than Soya beans and higher concentrations of the essential amino acids, lysine and methionine than most plant proteins.

The other great news is that growing duckweed is easy - particularly in the small ponds and tanks favoured by backyard food producers.

You can purchase your initial stocks from most aquarium supply shops.

You can use any open tank, large tub or in-ground pond. Place smaller containers in semi-shade or somewhere that you are able to shelter them from the worst of the summer heat.

You should aim for complete and dense cover of duckweed (within the range 0.6kg/m^2 – 1.2kg/m^2) for backyard farming purposes. Much below this and algal blooms will be an issue and much above it will cause it to self-mulch. Wind or fast-flowing water will also cause diminished production due to self-mulching.

While a variety of organic materials can be used to supply nutrients for duckweed, the logical source for Aquaponicists is their fish tanks. Of particular importance to aquaponicists, is the plant's nutritional preference for nitrogen in the form of ammonia.

While it is not essential, recirculating water from your fish tank is desirable. Aside from saving you the effort of bucketing water from your fish tank, recirculating the water will ensure that the nutrient levels in your duckweed pond remain at a consistent level.

This arrangement will also help to remove any traces of ammonia that may be present in the tank water.

Duckweed is capable of rapid growth in water containing just trace elements of nutrients. Interestingly, we almost killed off a batch of duckweed through overdosing it with poultry manure.

Temperature and sunlight are more important growth parameters than nutrient concentrations.

Duckweed grows across a wide temperature range – between 6^{o}C and 33^{o}C – but we've determined that it grows best in a range of 18^{o}C to 24^{o}C. We know that growth slows progressively up to 30^{o}C and the plant begins to die off quickly at around 33^{o}C.

While it will live in pH 5 to 9, the optimum pH for growing duckweed is in the range of pH 6.5 to 7.5 – also the preferred range for aquaponics systems.

Feeding out duckweed is as simple as dragging a kitchen sieve through the duckweed tank and placing it into your fish tank.

To avoid the duckweed from being pumped out of the tank, we made up an inexpensive duckweed feeder from a bucket with the bottom removed. The bucket is suspended in the water and the duckweed is placed into the bucket. This arrangement allows the fish to access the duckweed without distributing it throughout the tank.

Surplus duckweed can easily be dried and stored for later use. When drying small quantities, we allow the duckweed to drain in a kitchen sieve and then spread it thinly over several thicknesses of newspaper or kitchen towel. Turn it over several times each day for two or three days. Store it in an airtight plastic container.

Freezing is actually our preferred duckweed storage method. We simply gather up the tiny plants in a small kitchen sieve and squeeze the excess water out of them before arranging the mass in a shallow plastic container.

Surplus duckweed can be frozen and fed out during colder weather when growth may slow down.

After freezing, we turn it out of the plastic mould and place the duckweed biscuit into a large storage container. Whenever we need duckweed for our fish, we select what we need from the storage container in the freezer and float it on the surface of the fish tank.

To summarise, duckweed is a high quality source of plant protein that grows quickly, costs virtually nothing to produce and requires little labour. It offers the added benefit of being able to remove nutrients from water.

Our first challenge was to learn how to grow duckweed in consistent, predictable quantities.

Our current focus is on the full integration of the plant into an aquaponics system. We want to be able to grow duckweed to remove nutrients, feed fish and other small livestock and to conserve water through reduced evaporation.

Duckweed is a *must have* for the backyard Aquaponicist.

Bio-security Warning

Duckweed (and all other aquatic organisms in an Aquaponics system) should not be allowed to make their way back into any natural watercourse. Plants from an aquaponics system that are introduced into the wild may be carrying disease organisms that can be transmitted to other plants, animals or fish. Cover duckweed tanks with mesh to prevent birds from drinking from the tank and transferring the duckweed on their feathers.

Gary Donaldson

Why I chose Silver Perch….cont'd

This is a useful trait for small systems. It allows you to have Silver Perch of various ages growing out in the one tank, thus providing a steady stream of ready-to-harvest fish for the table.

I have just harvested a good number of my bigger fish and added 200 more fingerlings to the same tank. In around 12 months I will have the next crop coming along.

Silver Perch are readily available from fish hatcheries right across Australia. In most cases, it is possible to obtain small quantities for as little as one dollar per fingerling.

Silver Perch represent good value and are easy to manage for the home hobby system and the commercial enterprise alike.

Murray H…

How to Build a Grow Bed Stand.

How to make a very strong and attractive grow bed stand from easily obtainable materials at a economical cost.

This grow bed stand will support a standard grow bed with the base at a height of 450mm above ground.

Materials needed are:

- 8 standard concrete blocks
- 3 x 50mm x 2400mm pine/hardwood sleepers.

Tools needed are:

- A square nosed shovel.
- Long spirit level.
- Hand or power saw.
- Set square.
- Tape measure and pencil.

The cost of the materials will vary slightly from town to town. In Brisbane, at my local landscape supplies place, the concrete blocks cost $3.50 each and the sleepers were $15.00 each for a total tab of $73.00. Shopping around may produce a better price.

Confirm the location for the grow bed. You need to get this right because, once it is filled, the grow bed will be far too heavy to move.

Getting the grow bed level is the next priority. It helps if you have a level piece of ground to start with. I determined that there was about 25mm fall from one end of the space to the other.

Start by scraping the dirt back at the high end first to get a level site.

By placing one block down at each end and using one of the sleepers on it's edge and using the spirit level you will be able see if it is level.

Gradually scrape away small amounts of dirt where required until it is level both ways.

This phase of the construction may take some time, but be patient and spend the time to get it right.

In positioning the blocks make sure you leave enough room at one end for the drain outlet from the grow bed.

Once the blocks are in position and level, fill them with some

of the same gravel that you will use in the grow bed.

This helps to stabilise the blocks a little and has the effect of helping spread the load by transferring the load over the whole footprint of the blocks.

Filling the blocks with concrete will make the structure stronger. Depending on the nature of your soil, you may even decide to lay concrete footings.

Once this is finished, lay the sleepers in place.

Level ends at one end and trim the other end using your circular saw or hand saw to a length to suit the grow bed.

Notice the middle sleeper has been left short to allow for the drain pipe to come out for the return line. Now put the grow bed in place ready to load the gravel and fit the pipe work.

How easy is that?