The No.1 Aquaponics magazine
for the backyard enthusiast.

Issue 7
Fourth Quarter 2009

Bringing Food Production Home

Backyard Aquaponics

Commercial Aquaponics Part II

In **Harmony** with the Environment

Swiming with **Silver Perch**

Welcome

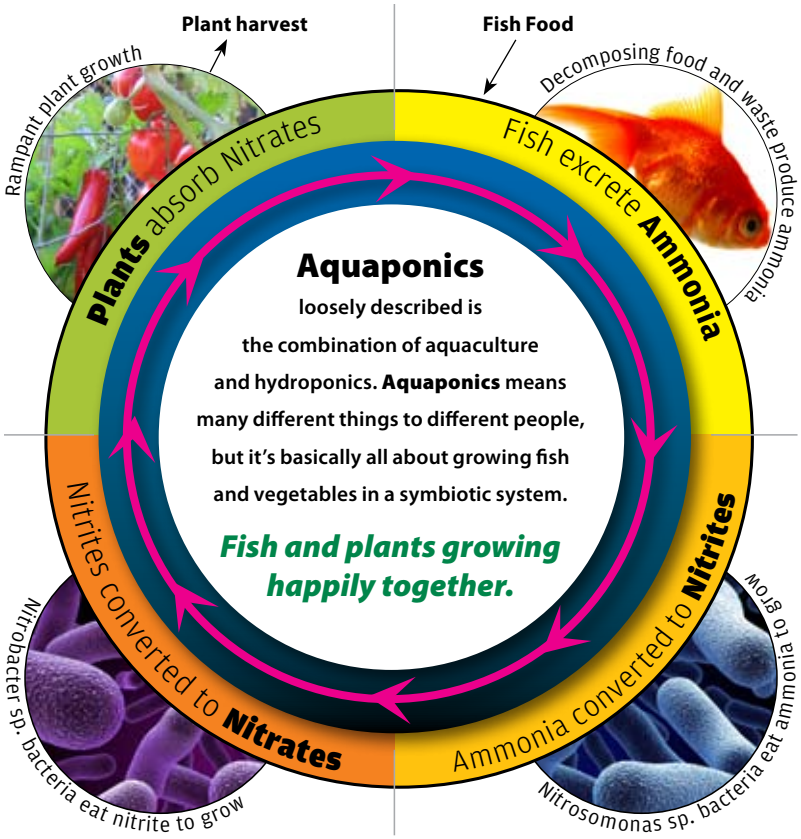
It's become quite difficult over recent months to pick through the chaff and find the useful online information and news relating to the world of aquaponics. Just in the last few months at least three manual/book/e-books have been released. It seems as interest grows there's no end of people writing about their experiences and their knowledge of aquaponics, and unfortunately in some cases, rewriting what has already been said, just to make themselves known.

In many ways this is great; it creates a very organic mix of information with plenty of variety, which is always a good thing, because no two people have the same experience with aquaponics. There's also been some negativity in what some people have been saying, with some proponents "bagging" various methods and practices, but I imagine that this won't last long. As the old saying goes, "there's more than one way to skin a cat".

In this edition we have included a couple of updates on some school systems, in Western Australia. Many schools are beginning to appreciate the learning aspects of an aquaponic system, in fact just last week I had a call from a school in Wagga that set up two four bed aquaponic systems about four months ago. The teacher rang me whilst amongst the systems, with a class of students who were harvesting plants, and catching and measuring the yabbies and fish so they could record growth rates. The excited chatter and laughing in the background made it very obvious that the kids loved what they were doing; probably not even noticing that they were learning whilst having so much fun! ●

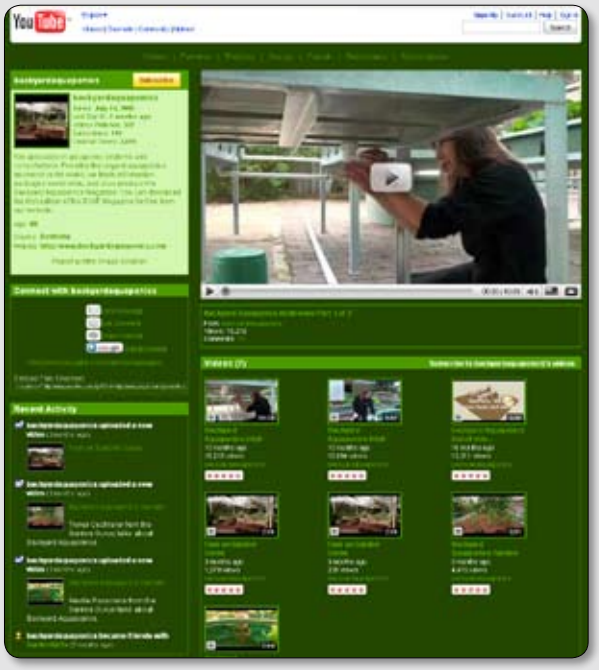
Joel Malcolm, *Editor*

The Nitrogen Cycle



Backyard Aquaponics on the tube

There is a whole range of aquaponics videos that you can view on youtube, visit the link below and see us in action! http://www.youtube.com/user/backyardaquaponics



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The nuts and bolts of a commercial aquap

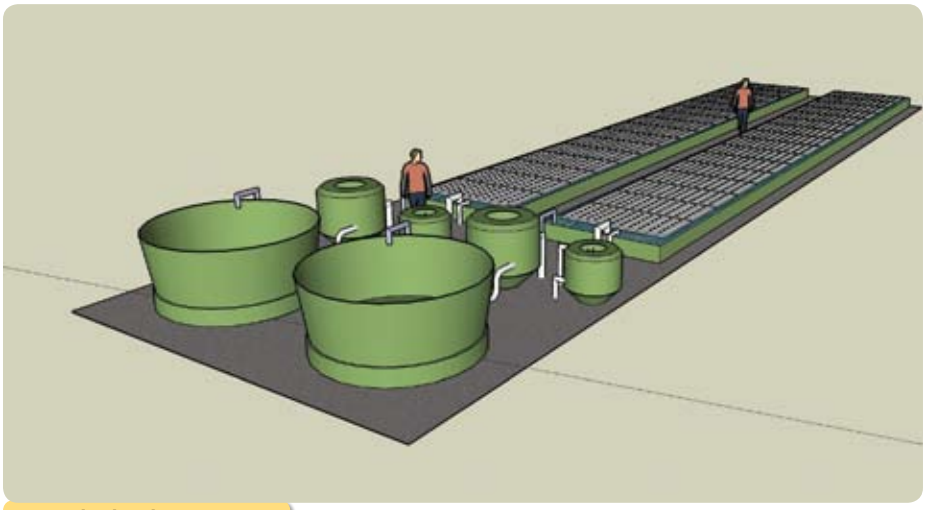
PART 2

Once the theory was established as to how the system was going to be setup and operated, the planning, purchasing of equipment and construction was all that remained...

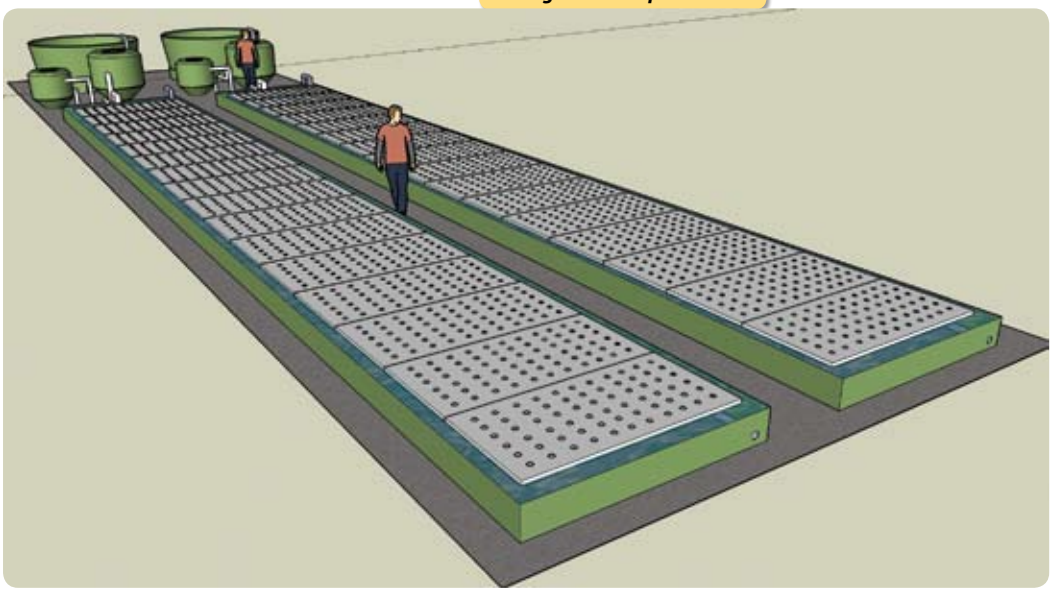
By Joel Malcolm

The system layout was done in *Google Sketchup*, this fantastic software can be downloaded free and makes it very simple to lay everything out and be sure that everything is going to fit within the area. As the software displays objects in 3D, it is perfect for setting all the levels for water flow, ensuring that all system components are placed at the right height.

The site area was levelled with a bobcat and the raceways were dug out at the same time. Great care was taken using the laser level to be sure that all the ground works were level, when you have long raceways filled with water you have to be sure that the levels are perfect, otherwise it will be very obvious and one end of the long raceway would end up considerably shallower.



Google Sketchup in action



CHANNELS

The decision to use a wider than normal Deep Water Culture (DWC) channel was fortuitous, as the pond liners came in a number of different standard widths and one of them was ideal for the channels that we

onic system

> **“Great care was taken** using a laser level to be sure that all the ground work was level”

First rubber liner installed, filling the channel

Weed mat being installed in the second channel

were building. We had a couple of choices for lining material that seemed suitable for the job, so we decided to try two very different products and compare the results. Prices were comparable and there was little difference in the cost. The first liner was *Firestone EPDM 1.14mm rubber liner*. Firestone had a good reputation for liners that are extremely tough and last well, while also have a fair amount of flexibility. This liner was extremely easy to install, just roll it out over the raceway and away we go. The second liner was something totally different, labelled as a *Xavan liner by Dupont*, this liner is much thinner than the rubber at only 0.55mm, it is constructed with multiple layers of *thermoplastic-elastomer*, and is meant to have greater tear and puncture resistance than the rubber liner. The down side to this liner is its stiffness, which ultimately made it difficult to install.

We found during installation that the rubber liner was exceptionally easy to handle and laying it out in the channel was a breeze. The Xavan liner was harder to work with because it was less flexible, but at the end of the day both liners were suitable for the job. In future we will use the rubber liner for the ease of installation and handling.

We decided to have the channels half submerged under the ground level for a few reasons. Firstly it meant that less side supports were required for the channels thus cutting some of the associated costs of building the system. Secondly, with the channels dug into the ground the water within the system is less affected by ambient air temperature. This has proved to be very successful as we still have rainbow trout in the commercial systems, due to the decreased water temperature, unlike the other systems where we have had to harvest the trout due to increasing temperatures.

The side supports for the channels have been made from treated pine timber, 185mm x 25mm, attached to 16mm reo-bar stakes that have been hammered into the ground. Once all of the earthworks were completed we carefully set up string lines ensuring that the site was square over the length of the area. The string lines provide an essential guide for installing the timber and supports for the channels.

The reo-bar is 16mm diameter, and cut

Pipe from swirl seperator to channel

New plants showing impressive growth

into 600mm length stakes, if the channels were going to be above ground, we would have used 20mm reo-bar to allow for the extra pressure exerted by the large water volume. The stakes were hammered in at 1m intervals down the sides of the channels; on the corners we added an extra stake, for added support. They were hammered down to the level of the string line where the height of the channel was going to be set with the timber.

Next the timbers were attached to the reo-bar stakes. We did this by using copper saddles that are often used in plumbing. These copper saddles were ideal because of their flexibility which you don't get with steel saddles. It was a fairly simple job for two people to line up the timber with the string lines and screw on the copper saddles to the reo-bar stakes. As the timber sides were being installed we were double checking them with a spirit level along the way to ensure the levels. Every second reo bar stake had two saddle clamps for additional support, as well as a screw into the wood at the top of the reo-bar to stop the timber sliding down the stakes. Where the timbers meet at the corners of the channels we used 90° brackets screwed into both pieces of timber to add extra support. Once all timber sides were installed and secured in place the channels were raked over a number of times using a course nail rake, then two people walked up and down the channel removing any debris that might cause damage to the liners. We then covered the whole channel and sides in two over-lapping layers of weed matting. The weed matting was not necessary but it created an extra layer to protect the liner from any damage from small rocks in the base of the channel, or from any sharp splinters on the timber sides.

Laying-out and attaching the weed matting is best done on a calm day, when there is no wind, because excessive wind makes it difficult to move large strips of cloth. The matting was brought up and over the sides of the channel and stapled on with a staple gun. After the whole run was laid out with a double layer of weed mat and all the folds were removed, extra staples were added to keep the mat permanently in place.

To install the liner we began at one end and carefully unrolled the folded liner into the base of the channel, once the complete length was unrolled we were able to carefully manoeuvre the rubber to ensure that it ran squarely down the length with no folds. The liner we used was a little wider than required which meant we had some extra material to play with that could be cut off later. As with the weed matting the liner was folded over the outside of the timber side and stapled with a staple gun at intervals of 1m. Then more staples were added once we were sure everything was right. At this stage we took a lot of care to use generous amounts of staples around the corners to hold the liner securely where it was folded. Excess liner was also cut off at this stage just above ground level on the outside of the timber.

The beauty of this design compared with various other commercial designs, is that we did not need to add fittings into the liner. Attaching fittings to a liner creates a weak point, a point prone to failure, plus it's more work and more materials.

Our pump was placed at the far end of the channel, the

> **"The beauty of this design** compared with some other commercial sized designs, is that we did not need to add fittings into the liner"

Notice the regular air stones and vortex in centre of tank

Carl inspecting the strainer at the base of the fishtank

return pipe was then running up the inside of the channel, sitting in the base of the channel off to one side, when it reaches the opposite end of the channel the pipe was brought straight up and out, then down under ground to the fish tank.

FISH TANKS

Ultimately I would have liked to include two smaller fish tanks per system of around 2500L but the 5000L conical base tanks were readily available and easier to fit into our area. The reasoning behind the two smaller tanks is so that fish stocks can be staggered, for more even cropping of the fish and more constant nutrient supply for the plants.

The 5000L fish tanks we were using were supplied by our regular tank supplier, though normally we use flat bottomed tanks. For this system we opted for tanks with a sloping base and a fitting in the bottom for maximum solids removal. These tanks come in two parts, the base support, and then the main tank that sits on the base. There is a small sump in these tanks that allows pipe fittings to be attached, and here is where we ran into the first of our problems. We were using *uni-seals*, a rubber grommet fitting that allows pipe to be joined directly into almost any shaped surface with no adhesives, the strength and water tight seal is built into the design of the uni-seals. Now our original plan was to come out from the base of the fish tanks using 100mm pipe to allow for maximum flow, we bought all of the 100mm pipe work along with the associated fittings and uni-seals, before we bought the fish tanks. We then discovered that the small sump in the base of the fish tank was just a little bit too small for the 100mm pipe and uni-seal.

Oh well, we'd just have to downsize a little to 90mm, realistically the 100mm was probably a little over-sized anyway. Care was taken to ensure that the tank bases were installed horizontally, hole-saws were used to drill the correct size hole in the small sumps of the fish tanks, and the fish tanks were placed in position. Now came the tricky process of installing the 90mm pipes through the *uni-seal* fitting and into the sump. This took quite a bit of work. Following the instructions for the *uni-seal* installation was all very well but we just couldn't get the pipe into the fitting. Eventually after a lot of cursing and banging with hammers and applying copious amounts of dishwashing liquid as a lubricant, we decided to take a slightly different approach. We made numerous small saw cuts in the end of the pipe about 1cm deep, these small cuts were spaced all around the end of the pipe at intervals of around 1-2cm. Then using a heat gun we gently heated the end of the 90mm pipe, squeezing the end of the pipe inwards, closing up the saw cuts to create a small angled bevel in the end of the pipe. Now the pipe had a small taper in the end, we lined

Fishtank base

it up with the uni-seal fitting, lubed-it-up again and gently hit the end with a rubber mallet. The pipe slid into the fitting with relative ease.

There are many different methods of plumbing in an overflow in a fish tank, because of the tanks we were using we decided on something that is not very conventional, but we've found it to perform well in the time that the system has been operating. We used a 90mm 90° elbow and glued a short piece of 90mm pipe (about 30cm) into this with a cap on the end of it. The elbow, cap and pipe was then drilled out with 10 mm holes all over it till it looked almost like a piece of mesh. This was to be our strainer in the base of the fish tank, short enough so that it always draws from the base of the tank, drawing the solids from the base, while having enough holes so that leaves or fish that happen to be sucked against it, would not stop the water from flowing freely. This small mesh of fittings and pipe was then glued to the end of the

> “We found during installation that the **rubber liner** was exceptionally easy to handle and laying it out in the channel was a breeze”

Swirl separator's outlet pipe

90mm pipe poking through the sump in the base of the fish tank.

SOLIDS REMOVAL

The swirl separators we used are quite large being about 1000L in volume. The principle idea of a swirl separator is that the water flows into the chamber, at an angle, creating a circular flow or current. This circular flow creates a vortex that moves all the solids into the centre. The fact that the water also slows down when it enters the separator allows the heavier solid particles to drop from the water flow, into the bottom of the separator. So both the action of the swirling flow around the separator tank, and the slowing of the water flow when it enters the large separator, causes the waste solids in the water to drop down to the bottom and collect in the centre. Aiding the collection towards the middle is the fact that the separator has a conical base. Both the separator and the *bio-digester* that we used have conical bases, they are actually manufactured as heavy duty buoys for marine applications, but we felt they would suit our purposes quite well.

We had some heavy duty three legged stands made for the separator and digester, which were made from rolled galvanised pipe designed to sit just under the straight sides where the tanks tapered in. Three legs were ideal for the purpose, so much easier to level than if they had four legs. Mounting the separator at the right height is very crucial, as the exit pipe from the separator is going to set the height of the water level in the fish tank. The stands were a little taller than what we needed so they had to be dug into the ground and paving bricks were put under each leg, for added support. The separator itself was reasonably heavy and there was going to be close to a tonne of water in it, once the system was under normal operation.

As the pipe work came out from the bottom of the fish tank we used two 45° fittings to bring it up to a vertical then a 90° fitting off into the swirl separator, through another *uni-seal* fitting. Just inside the swirl separator we cut off the pipe leaving just enough length to attach a 90° elbow, the 90° elbow directs the water sideways and creates the swirling motion. The elbow was not glued to allow for some adjustment of the water direction, at a later stage. In the centre of the base of the separator we installed a 50mm drain fitting. This is for the solids removal from the separator, a pipe led from this drain through a ball-valve and into the digester. This would allow us to open the valve, sucking out the solids from the separator, dumping them into the digester. This only happens once or twice a day to remove the solid matter, most of the water flow continues through the separator and back into the growing channel.

The inlet from the fish tank comes into the separator quite low down, while the outlet pipe is up closer to the top. The outlet pipe is about 20cm from the top of the separator chamber, the 90mm pipe comes through the side wall, once again using a *uni-seal,* and the pipe then comes across to the centre of the tank with a 90mm elbow pointing straight up. A small piece of 90mm pipe is then inserted into the elbow, this piece of pipe, or rather the opening at the end of it sets where the maximum water level is going to be, in the fish tank, so shouldn't be glued in position to allow for adjustment later, if required. It may be a little difficult to understand exactly how this sets the fish tank pipe, but hopefully it will all make sense as I explain further. This exit pipe comes out the side of the separator and down underground, along to the plant growing channel, then up out of the ground and straight into the centre of the channel.

WATER FLOW

The water is pumped from the end of the growing channel, up the length of the channel, out from the channel, and underground to the fish tank. This is all 50mm piping, the 50mm pipe then comes up out of the ground beside the fish tank, and then over the side of the fish tank, where it's then directed into the fish tank at a 45° angle to create a swirling motion,

within the fish tank. The water then flows out through the base of the fish tank and into the separator. As the water level rises, it flows over the top of the exit pipe in the separator and back into the growing channels. If we lower the level of the exit pipe within the separator, the water level within the fish tank will lower as well because of the gravity forcing the water from the higher level to the lower level, until both tanks are level with each other.

The pump we have used in this system is a 12 000LPH pump with quite low power consumption at only 200W. All of the irrigation piping from the pump, to the fish tank is slightly oversized at 50mm rather than 40mm; this is to ensure that there are minimal losses from friction, especially where we have used numerous fittings that can restrict water flow.

BIO-DIGESTER

All of the larger solids from the fish tank end up in the base of the separator where they are periodically purged into the bio-digester. The digester has a high overflow outlet pipe. This pipe is fitted with a filter, made from shade cloth, to keep the larger solids within the digester at all times. When the valve from the base of the separator is turned, so that it is open, the solids mixed with water flow into the digester. As the water level rises in the digester, excess water flows through the shade cloth filter and down the overflow outlet pipe. This filtered water then flows underground and into the growing channel. So if you turn on the valve for two to three minutes and let say 30-40 litres of solids and water flow from the separator into the digester, the water level in the digester rises and about 30-40 litres of water flows out of the digester, through the shade-cloth filter and into the growing channel. So the level of liquid in the digester always remains constant.

BUT WHAT ABOUT THE SOLIDS?

There are two high capacity air stones in the base of the digester and these pump air 24 hours a day. This means that within the digester the water solid mix is in a highly aerobic state. Because of the large air flow, it also keeps the digesters contents constantly churning and moving around, gradually breaking solids down into smaller and smaller particles. This highly aerobic environment allows nitrification to take place, breaking down the ammonia wastes into useful nitrates. There are many other biological processes going on within the tank at the same time, and in the future I'd like to experiment with varying aerobic and anaerobic stages, in a similar way that they treat human effluent in large sewerage plants. For now all that matters is that the plants get a dose of rich waste water fed to them once or twice a day when the valve is turned open. To-date there have been no wastes removed from the system at all. The digester also has a drain in the base of the tank along with a valve, this will allow us to empty the tank and to drain the heavier solids from the bottom should we decide to do so or need to, but to-date we have grown a crop of 350 trout in each system without any solids removal.

> "To date there has been **no wastes removed** and we have grown a crop of 350 trout in the system and a large amount of leafy vegetables"

AERATION

Aeration for these systems consumes more power than the water pumping, but aeration is very important. The piston aerators we use are mounted in a small box, the outlets from the aerators comes out from the pumps and straight up into the air higher than the height of the fish tanks. The idea being that this means no water can travel back down the air lines and into the air pumps. We use 25mm PVC piping for the main airlines up into the fish tanks, from here we convert over to 19mm standard reticulation hose and fittings. The reticulation pipe and fittings are easy to work with and the pipe flexibility is essential for this next step. The main air line loops around the fish tank, at the water surface and in fact, the pipe actually floats on the top of the water because it's constantly pressurised with air.

We then use high volume air stones and standard aquarium air tube to run the air lines. Every 60cm around the rim of the fish tank, an air tube with air stone on the end of it drops down to almost the bottom of the fish tank. This means there's a total of fifteen air stones per fish tank as well as the two air stones in the digester tank. The air line to the digester is run underground to the tank and both the fish tank and the digester tank have valves on the main aerator line so they can be turned off if need be.

The last component of the system is a net covering the top of the fish tank. Many people who see this ask if it's to keep birds out of the fish tank. Normally you only have to throw one handful of feed into the tank and they quickly work out that the cover is to keep the fish in. These covers are very simple to make from a couple of lengths of 20mm PVC pipe, some bird netting and a few cable ties.

Next edition I will go further into the operation of the system, things I would or wouldn't change about the design, and a few other bits and pieces relating to setting up and running a large aquaponics system. We'll be including details about constructing foam rafts as well as planting and harvesting of different plant species. ●

Fishing for

Will the oceans run out of fish

answers

A recent two-week spate, of ominous oceanic fishing reports, has lent credence to the projection, from a group of scientists that the oceans will run out of fish within the next forty years.

The latest report was delivered on September 13, by the San Jose Mercury News "In an ominous environmental sign, California regulators this month closed all herring fishing in San Francisco Bay for the first time ever, shutting down the last commercial fishery in the Bay… Populations have been falling recently, and last year state scientists found herring numbers were down 90% from historic levels."

That 90% figure is more ominous than it might seem. In a report published in Science Magazine in November of 2006, an international team of scientists concluded that a decline of 90%, of a species of fish in a marine system, can lead to a domino effect that can threaten all the marine life in that system. Boris Worm of Canada's Dalhousie University said "Whether we looked at tide pools or studies over the entire world's ocean, we see the same picture emerging. In losing species we lose the productivity and stability of entire ecosystems.
I was shocked and disturbed by how consistent these trends are."

> "In losing species we lose the productivity and stability of **entire ecosystems**"

The study was conducted at the National Centre of Ecological Analysis and Synthesis, at the University of California, over a four year period. The team researched the historical records of sixty-four oceanic regions across the globe, representing 83% of the fish species in the world. They also studied forty-eight marine reserves and fishing grounds. The scientists projected that the oceans would, baring significant changes, become barren of fish by 2048.

The recent string of bad news began on August 24, 2009, when the Atlantic States Marine Fisheries Commission, which regulates migratory fish on the eastern U.S. coast, announced they were considering a complete ban on harvests of weakfish, after weakfish stocks had hit an all-time low of three million pounds. And these stocks had fallen in spite of the fact that harvests had dropped over the last three decades. In 1980, the harvest of weakfish was eighty million pounds and by 1986 it had fallen to thirty-one million and in 1993 to eight million.

Further bad news came on August 28, when a group of scientists from the Scripps Institute of Oceanography, at the University of California, reported that a gigantic floating mass of trash had much more debris in it than expected. And some of the debris, including plastic, had broken down into bite-sized chunks that fish, birds and plankton had been ingesting, apparently killing some of them. The massive patch, commonly known as the Great Pacific Garbage Patch, is approximately half a million square miles in size and has been a matter of great concern for some time. The National Oceanic and Atmospheric Administration of the U.S. have estimated that 100 000 marine mammals die of trash-related deaths every year.

The bad news continued on September 10, when the UK Times Online, reported that researchers have concluded that cod in the North Atlantic are doomed to disappear because of rising water temperatures, brought on by climatic changes. If true, it could have a devastating impact on the English fishing industry.

On September 13, the *New York Times* reported that the New Zealand government had slashed the allowable catch of Hoki, from about 275 000 tonnes in 2000 and 2001 to about 100 000 tonnes in 2007 and 2008. The New Zealand Hoki fishery

had been considered by many to be a showpiece of oceanic sustainability, but now that it has cut its harvest by almost two-thirds, that picture is fading. This failure has cast doubts on whether any ocean fishery can be considered truly sustainable in these days of environmental instability.

WORLD-WIDE DECLINE OF FISH STOCKS

The recent spate of bad news caps off a continuing series of ominous fishing reports this decade. In February 2002, after an oceanic survey, scientists warned that high-tech fishing was emptying the deep seas of fish and threatening their existence. The report stated that modern technology has enabled fishermen to harvest areas they previously had been unable to reach.
In 2003, a group of scientists reported that many large marine species like tuna, sharks, marlin, swordfish, cod and halibut had declined in numbers to only 10% of their historical levels. And these predators, so important in maintaining an ecological balance, were discovered to now be less than half as large as they used to be.

In March 2009, the Food and Agriculture Organisation of the United Nations reported that over 70% of fish species were currently endangered. After monitoring over 600 species of fish, they concluded that 52% of them were fully exploited, 19% were over-exploited and 8% were depleted.

In that same time period, Oceana released a report predicting that the ocean's ecosystems will collapse if the over-harvesting of small fish like herring, sardines and menhaden continues.

Even though fish stocks have steadily dwindled over the years, commercial fishing companies haven't shown much willingness to voluntarily lower their harvests. This isn't surprising, because unless every fishing company across the globe agrees to limit their catch, the ones who do agree will place themselves at a competitive disadvantage. And even if every fishing company does agree to limit their harvests, the numerous illegal fishers won't comply.

For health reasons, fish has gained popularity over the past two decades. The demand for fish has steadily climbed over the past three decades, even above the growth rates of populations and gross national products. Demand is expected to continue to rise, which means the price of fish will also rise. So even though it is getting harder and harder to find good fishing spots, the harvests will continue to be worth more and fishing will continue to be profitable. It's going to be very difficult to limit worldwide harvests.

ENVIRONMENTAL FACTORS

But limiting fish harvests might not guarantee the full recovery of fish. The cod fishery of Grand Banks of Newfoundland, once the world's richest fishery, placed a moratorium on cod fishing in 1992, after cod stocks had dropped to dangerous levels. And today, though the moratorium is still in place, the cod have still not recovered. Many analysts believe that the ecology of the area has changed to the point where the cod may never recover.

Many scientists believe that climatic changes have caused problems for the fishing industry in many places throughout the world, though

> "Commercial fishing companies **haven't shown much willingness** to voluntarily lower their harvests"

this has been difficult to prove conclusively. But it's reasonable to assume that, if global warming continues, it will contribute significantly to the current environmental instability.

Environmental pollution has also caused major problems for the oceans. Several oil spills have devastated areas for many years. The oceans have grown increasingly more acidic, and some scientists project that by the end of the century the oceans will become more acidic than they've been in hundreds of millions of years, with potentially catastrophic effects on ecosystems.

A United Nations report in 2004 said that, the number of oceanic dead zones (oxygen-deprived areas where no fish or marine animals can survive) had steadily increased to about 150, some as large as 45 000 square miles. One of the main causes of the dead zones is nitrogen run-off from chemical fertilisers.

AQUACULTURE

Many people believe that aquaculture, or fish farming, is a potential solution to future fish demand. In 1980, aquaculture accounted for 9% of the world's fish production by weight, and by 2005 that percentage had grown to 43%. If that number surprises you, it's because over 90% of that aquaculture occurred in Asia, mostly in small ponds.

Large commercial fish farms are not without problems, especially those in the oceans. Most farms in North America use cages for their fish that aren't closed off from the ocean environment and because the waste treatment at most of these farms is inadequate, nitrogen from fish wastes builds up and leaches out into the surrounding ocean, creating dead zones around the fish farms. And there have been incidents where sea lice—common in salmon farms—have spread from caged salmon to wild salmon, killing up to 95% of the juvenile wild salmon in the area.

On the other hand, the small aquaculture farms of Asia have proven successful for thousands of years. Their methods may seem antiquated to the modernised fishermen in technologically advanced countries, but perhaps they have something to teach the rest of us. ●

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Harvest Day at Westfield Park Primary School

By **Mike Burns** - Teacher

On the hectic day to day life of a school, the exact date has long since vanished from my memory, but the looks on the student's faces whilst they ate the beautiful food; their co-operation in preparing it and the smiles all around, will stay in my mind forever.

Leading up to the big day, we had our fair share of disasters. It began with the loss of some of our rainbow trout to a power failure, over the mid semester break, and then the remaining fish to vandalism. Suddenly the school harvest and planned celebration seemed like an impossible dream. Fortunately the day was saved with a generous donation of plate-sized trout to the school by Backyard Aquaponics. Thanks to them, we were back in business.

With the temperatures rising, a sense of urgency grew. The menu and cooking process was planned in two parts. Trout dishes were to be managed by Tim, our school Principal, whilst I prepared the vegetable dishes with the assistance of my colleagues.

We aimed to provide a meal for every student who had been involved in, building and maintaining the dirt gardens and the aquaponic system this year. This included all students from Year three to seven, a total of about 100 students.

The menu included:

Much to our delight, our fresh produce included lemons, garlic, onions, shallots and capsicums, as well as a variety of assorted produce all harvested from our gardens. Because our school kitchen is still under construction, we had to perform the majority of the cooking practises in outside classrooms. All the meals were prepared entirely by our year five, six and seven classes, before being thoroughly enjoyed by all.

Other than seeing the student's efforts and dreams for the year become a reality, the best part of the day was watching the students learn and have fun in what is now a dynamic outdoor classroom. Seeing students diligently preparing the trout and listening to their conversations as they cleaned, gutted and filleted them was amusing to say the least.

"Ewww! Look it's a brain!"

"Brain, where is your brain?"

"In my head"

"So would a trout's brain be in its guts?"

"Oh yeah"

A student learning through exploration is such a magical experience. Integrating an aquaponics system into our existing food production gardens has been a fantastic experience. The school community has ultimately benefitted from the increased interest and awareness shown by the students, parents and teachers. We are seeing a positive shift in the student's retention and involvement in all aspects of education, because of this unique, hands-on learning approach.

step closer guys, don't be scared of the apron...

Show me the BRAINS!

I'm sure I saw a hobbit in there

JULY 2009

M	T	W	T	F	S	S
		1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
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27	28	29	30	31		

AUGUST 2009

M	T	W	T	F	S	S
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10	11	12	13	14	15	16
17	18	19	20	21	22	23
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31						

SEPTEMBER 2009

M	T	W	T	F	S	S
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OCTOBER 2009

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NOVEMBER 2009

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DECEMBER 2009

M	T	W	T	F	S	S
	1	2	3	4	5	6
7	8	9	10	11	12	13
14	15	16	17	18	19	20
21	22	23	24	25	26	27
28	29	30	31			

In the Garage

Drop my contact lens in here somewhere...

Hmmmm - I'm going for seconds

Bring on the salads

Look dad bet you can't use 2 tongs at the same time

Garrett Marino

Aquaponics in Harmony with the environment

By **Alison McKenzie**
- Teacher and Co-ordinator of sustainability

Harmony Primary School opened in 2004, in Harvest Lakes, Western Australia, as the first government sustainably built school in W.A. The school is built as a model of sustainability through energy efficient design and practices.

As a merit-select school, Harmony strives to employ teachers who understand and embrace the education of sustainable practices and environmentally-friendly alternatives. Staff members are committed to sharing knowledge and increasing the schools resources.

The school garden was established in 2006 and is used as an outside classroom, by the students and their teachers. All years are involved from kindergarten right up to year six, with classes tailored to each year group.

The first stage of the permaculture garden was to establish an area of 12 m by 14 m, which totalled 168 m^2. With increasing awareness and interest from the school and community, the garden was extended to a total area of 560 m^2, in 2008. It is fenced with 2.1 m high cyclone fencing around the parameter of the garden, with double and single gates that allow street and school access. It provides an education facility for students to learn practical life skills, in Science, Society and Environment, and Technology and Enterprise learning areas. It models and supports healthy lifestyles through its productive vegetable gardens and fruit trees.

Alison harvesting with the students

Admiring the plants

In the Garage

The recent addition of a Backyard Aquaponics system, consisting of six growbeds, a 3000 litre fish tank and a drain tank, provided the school with the potential to supply twelve classes with a fortnightly meal. As a successful applicant of the Stephanie Alexander Kitchen Garden Project, which is a federally funded initiative that connects children's health and well-being to their food choices, the school required a system that was efficient, effective, sustainable and economic in space. An aquaponics system supplied all of these needs and many more.

The students can't wait to get to the rainbow trout, a winter cold water fish, they just love watching them feed and splash around in the tank. The 120 fingerlings, which we introduced to their 3000 litre 'home' in May, 2009, have grown enormously and will be ready for harvest in November when they will reach an impressive plate size, of 500g.

Harmony Primary takes its sustainable practices seriously and under the guidance of the schools sustainability co-ordinator, Alison McKenzie, it has enhanced its public profile enormously during its five year history.

The harvest of our first crop of radishes was very exciting and we were able to use them in a variety of ways. Radish dip, radish salsa, roast radish are just three examples. We have harvested our first herbs of parsley, coriander and chives. Vegetables such as peas, broccoli, beans and a huge range of greens, are harvested regularly for our kitchen garden program.

A group of students are in charge of regularly testing the water, to maintain optimum health and growth of both plants and fish. Understanding the nitrogen cycle has been a wonderful experience for the students in the science classes, in fact it is one of the highlights of their week because they get to use the information and graph it over time and present the information to the school at assemblies. Enhanced literacy and numeracy skills have resulted from the many classes involved with the aquaponics system. Many of the students keep journals of their observations and experiences which include participation in planting, harvesting and feeding the fish. Other students graph the weekly growth of the fish through estimation, observation and an occasional close encounter with them.

After school finishes for the day a large group of parents are often ushered into the garden by their children to show off the work that they have been involved in during the day or just to show them the fish.

The aquaponics system has been a showcase of sustainability and productivity. Environmentally it demonstrates huge savings in water consumption, and does not pollute waterways with harmful fertiliser run-off. Social sustainability is demonstrated through the huge numbers of people from other schools, community groups, parents, students and recently a lifestyle program called Nuts and Bolts Goes Green due to be screened later this year.

Aquaponics has definitely created great interest in the Harmony Primary School Community and has extended and enhanced various classes, not to mention the effect it has had on the students, they just can't wait to get out there and learn about aquaponics. ●

Leek and potato soup

Generally aquaponic systems aren't well known for growing potatoes, but leeks grow fantastically well and we had some bumper crops this year.

The origins of potato and leek soup seem lost in time, though it is thought to have probably originated in Wales or Ireland. The leek is native to areas throughout Europe, and it's one of the national emblems of Wales. Potatoes made their way to Europe in the 1500's from South America, so it was probably some inventive Welsh person back in the 1500's looking at ways to incorporate this new vegetable, the potato, into traditional leek recipes.

More recently a cold version of potato and leek soup called "Vichyssoise" gained popularity in the 20th century. It's debated whether the dish is French or American, but it's popularity in restaurants around the world is not under debate.

Method

- Slice leeks and put into a large pot. Add a dollop of butter and sautee under a medium heat until golden.
- Add diced potatoes to leeks and cover with chicken stock. Make sure the stock covers all of the potatoes, if it doesn't add some water to top it up.
- Cook potatoes for 30 minutes or until soft.
- Remove from heat and allow soup to cool slightly.
- Add salt, pepper, and finely diced chives and parsley.
- Blend ingredients, until smooth.
- Slowly add the cream and blend soup until it is light and creamy.
- Serve either chilled or warm. Top with a dollop of cream and some chives.

Swiming with Silver Perch

By **Carl Schmidt**

Silver Perch, *Bidyanus bidyanus*, also known as Murray Perch or Silver Bream, are a freshwater fin-fish, native to the inland Murray-Darling River System, of South-Eastern Australia. They are found in parts of Queensland, New South Wales, Victoria and South Australia. The scientific name *Bidyanus* comes from an aboriginal name for the species, *Bidyan* that the famous explorer Major Mitchell recorded on his 1832 expedition of South Australia. In past years habitat destruction, severe drought, fishing and the construction of dams and weirs on major rivers have led to the decline of wild silver perch populations resulting in the species being listed as vulnerable, in New South Wales. The production of silver perch in NSW in 2007-08 was approximately 200 tonne valued at $2.25 million with the majority of fish being supplied to both markets and restaurants in Sydney, Melbourne and Brisbane.

In the wild, silver perch inhabit rivers, streams, lakes and impoundments. They are considered omnivores feeding on a variety of aquatic insects, snails, molluscs, crustaceans and worms. It is reported they become more herbivorous as they get older although research has shown little change in their diet, within cultured populations. Silver perch can measure up to 500mm in length and weigh 8 kg, although most adult fish that are caught are around 1.5-2 kg. A typical adult silver perch is silver-grey in colour with a deep body, smallish head and white underbelly. The meat recovery percentage is thought to be as high as 40%.

The majority of fish take between 3-4 years to mature with males maturing earlier than females. Spawning occurs in the wild during the summer months from October to March following an upstream migration, usually brought on by an increase in water level combined with an increase in water temperature above 20°C. Silver perch eggs sink and are required to be kept in suspension in order to develop.

Artificial spawning is conducted in tanks with both female and male brood-stock injected with a hormone known as human chorionic gonadotrophin (HCG). Once injected, females usually spawn within 36 hours. The process can be quite aggressive and can often lead to scale loss and fin damage. A single adult female can release up to 500 000 eggs with development and hatching occurring only 24 hours later. The larvae survive on the yolk-sac until they start feeding at day five.

They are then transferred into purpose-built earthen ponds, where they are grown for six to eight weeks, feeding on algae and zooplankton before being harvested and sold as fingerlings. Once graded, the fish are then sold on to commercial growers in large quantities to be on-grown or purchased by farmers wanting to stock their dams for recreation. Silver perch are a favoured species to stock into an aquaponic system. They are hardy and can be grown year-round tolerating water temperatures between 2°C and 35°C. Their optimal water temperature is thought to be 24°C and growth is reported to be negligible below 12°C. They readily accept pelletised feeds, either a floating or sinking pellet and given optimum conditions, can grow to 500g within 12 months. Commercially produced feed contains around 35% protein.

Silver perch on average have been found to have a food conversion ratio (FCR) of 1.5:1. This means for every 1.5 kg of food consumed, the fish will gain one kilo in body mass. Although a freshwater fish, they will tolerate salinity levels up to

12ppt, making them a suitable species for water that is slightly saline. There is increasing interest for the culture of silver perch in inland saline water, however further research needs to be conducted to determine the commercial viability of growing them in such environments.

As is the case with any fish in an aquaponic system, one must be aware of the environmental conditions that influence the species being cultured. It is important to know and understand the basic parameters such as temperature, pH, and dissolved oxygen requirements in order to keep your fish happy and veggies growing.

The firm white flesh can be cooked in a variety of ways

Silver perch are regarded as an excellent eating fish with white flesh that is high in healthy omega 3 oils. The fish can be cooked either pan-fried, steamed, battered or smoked and for this reason they are very popular among the Asian population. Fish that are cultured in earthen ponds or dams can take on a muddy flavour. This is thought to be from the weeds they consume. To overcome this, the majority of commercial growers purge their fish for seven to ten days in clean water before they are sold at the market.

All things considered, silver perch are an excellent all-round species for the backyard aquaponics enthusiast. Able to survive year-round tolerating a range of temperatures and readily accepting artificial feeds, they are great in the tank and great on the plate! ●

Eggplant

The king of vegetables

By **Doug Blake**

Eggplant, *Solanum melongena*, is a member of the nightshade family, along with the tomato, potato and capsicum. The fruit is also known as *melanzana* in Italy, *brinjal* in India and *aubergine* in France and England.

Eggplant is a delicate perennial in subtropical climates, but in temperate climates it is an annual. It normally grows 40 - 150 cm in height, though in the wild it can be much taller. It has a wide variety of shapes, sizes and colours, particularly in India, where it still grows wild. Botanically, it is classified as a berry.

China is the leading grower of eggplant, producing approximately 56% of the world's eggplant. India is second with 26% and Egypt is third at 3%.

HISTORY

Eggplant is native to India and Pakistan, and has been in cultivation there since prehistoric times. It was introduced to China, in about 500 BC, where it became a culinary favourite for generations of Chinese emperors. Arab traders introduced it to Europe in the 14th century, where it was received sceptically. Because of its association to nightshade, many Europeans thought

it induced insanity and christened it "Mad Apple." Many 16th century Spaniards, however, considered eggplant a powerful aphrodisiac and referred to it as "*Berengenas*" or the "Apple of Love." Eggplant didn't become popular throughout Europe until the 18th century. Thomas Jefferson shipped eggplants from Europe to the United States in 1806. Eggplant wasn't introduced to Australia until 1850, and didn't become popular there until the 1950s.

USES

Eggplant is one of the most widely-used, versatile and popular vegetables in the world, and is considered a delicacy in some cultures. You can bake, grill, fry, sauté, roast, boil, pickle, mash or stuff it. You can also use it for stews, soups, kebabs, curries or as a garnish. It tends to absorb the flavour of whatever food it's cooked with.

Eggplant is low in calories, fat and sodium but high in fibre. It is a good source of vitamin C and potassium, and also contains magnesium and vitamins A and B6, along with other nutrients. Eggplant helps to lower blood cholesterol levels and to regulate high blood pressure. Its bulkiness makes it a good meat substitute for vegetarians.

Because of its versatility and popularity, eggplant is known in India as the "King of Vegetables." The Indians grill and mash it, and then mix it with onions, tomatoes and spices to make *baingan ka bhartha*. They also use it in chutney, curry, *sambhar, achaar* and many other dishes.

The Chinese also use eggplant extensively, for braising, stewing or stuffing. People from many other cultures stew it, as in the Italian *melanzane alla parmigiana* (eggplant parmesan), the Arabian *moussaka* and the French *ratatouille*. You can roast it in its skin until charred and then scoop out the pulp and blend it with other ingredients, as in the Middle Eastern *baba ghanoush* and the Greek *melitzanosalata*. You can also stuff eggplant with meat, rice or other fillings and then bake it, as in *nigvziani badrijani* (the Caucasus). In Bangladesh, they marinate it with salt and chilli powder and then deep-fry it for a snack called *Beguni*. Other cultures batter it and deep-fry it, and then serve it with various sauces based on yogurt, tahina or tamarind.

For frying, pre-heat a little olive oil and fry the eggplant slices or pieces for 5 -7 minutes per side, or until the pieces turn brown and tender. For grilling or broiling, lightly oil the pieces first and then cook them until they turn brown and tender, which should take 10 minutes for grilling or 5 minutes for broiling.

You can also stir-fry eggplant with other vegetables. Eggplant absorbs a lot of oil when frying, but you can solve this problem by breading it with either bread crumbs or a mix of flour and eggs.

Another way to cook it is to cut slits into a whole eggplant and stuff a few slices of garlic into each slit. Roast it at 200°C, for 40 - 60 minutes. Then peel the eggplant and chop it or mash it into a purée.

Many of the older varieties of eggplant can be somewhat bitter, especially when the fruit is large or not harvested on time, but cooking eliminates most or all of the bitterness. You can also decrease the bitterness by:

- peeling the skin
- soaking the eggplant in water for 15 minutes before using it
- cutting it into strips and salting it, letting it sit for 20 minutes in a colander, and then rinsing it (this is called "degorging")

You shouldn't eat raw eggplant, because it contains chemicals that can upset your stomach. You also shouldn't use a carbon blade or an aluminium pan for eggplant because they can cause discolouration. The flesh also discolours quickly after you cut it, but you can lessen this by lightly splashing the slices with a bit of lemon juice.

Eggplant has been used as an antidote for poisonous mushrooms (Duke and Avensu 1985), and as a poultice for

"**Eggplant is one of the most widely-used**, versatile and popular vegetables in the world"




haemorrhoids, abscesses and cracked nipples. The leaves are toxic and narcotic, but you can use a decoction of the leaves for sores that are discharging or for internal haemorrhaging. You can apply a poultice of leaves to burns, cold sores, abscesses and similar skin conditions. You can treat piles, toothache and intestinal haemorrhages with the ashes of the peduncle too. You can also use a decoction of the root as an astringent.

CULTURE

Eggplant is even more sensitive to cool conditions than tomatoes or peppers. At 30˚C, seeds will germinate in about five days. But at 20˚C, seeds may take up to thirteen days to germinate. The plants grow best when daytime temperatures are from 26 - 30˚C and night-time temperatures are from 20 - 25˚C. Periods of weather where temperatures fall below 18˚C can retard plant growth and reduce yields. Eggplant dislikes temperatures above 35˚C, and it likes a consistently warm medium.

If transplanting, sow the seeds in large peat pots at least eight weeks before setting them out. The seedlings need full sunlight as soon as they emerge, or they'll get spindly. When the leaves start to overlap, you can prune two or three leaves from each plant; you can safely do this twice. You can also prune suckers.

Under proper growing conditions, some of the modern varieties can fruit in as little as sixty days after setting out, but for best yields eggplant likes five or six months of warm-to-hot conditions. The plants will continue to develop fruit for several weeks.

Eggplant is also sensitive to water stress, so it's important to maintain a proper supply of water; at least 2.5 cm per week is needed, and more than that in areas of low humidity or abundant wind. Eggplant performs best in full sun, but young seedlings may need protection from high winds. Eggplant is a heavy feeder; it needs abundant phosphorous and a fair amount of potassium and nitrogen. But once the fruit starts to form, you should cut back your nitrogen applications by one-third, or the foliage will continue to grow at the expense of the fruit.

> **"Eggplant grows well in a greenhouse** and is well-suited for hydroponics and aquaponics"

Eggplant grows well in a greenhouse and is well-suited for hydroponics and aquaponics. When growing hydroponically, you should stake or trellis plants to keep the fruit up and to support the plants' growth, particularly if the roots are shallow. For container planting, you should use at least a two-litre pot. You can use shredded coconut fibre or expanded clay balls as a medium, or use a mixture of one-quarter sand and three-quarters clean sawdust, peat moss or perlite.

Eggplant is susceptible to various pests. Cutworms can feed on the stems of young plants or on new leaves. Tomato russet mites, spider mites, potato beetles, flea beetles and leaf-eating ladybirds can eat the leaves. Aphids, tomato caterpillars, looper caterpillars, eggplant caterpillars and fruit flies can feed on fruits or flowers. Root knot nematodes can attack the roots.

Harvest the fruit while the skin is still shiny and smooth and the fruit is still firm. Fruit that is overly mature will be soft. When harvesting, you should clip the fruit with a sharp knife or scissors to avoid damaging it. You should wear gloves when harvesting, because the short stem that attaches the fruit to the stalk sometimes contains sharp spines.

To save seed, let the fruit grow far beyond the edible stage. Because the seeds are slippery and firm, you can safely grate or blend the eggplant fruit. Put the gratings into a bowl of water and squeeze them, forcing the good seeds to the bottom. ●

New aquaponics book released by Earth Garden

Earth Garden Magazine is quite well known throughout Australia for their "sustainable living" type quarterly magazine as well as their many published books on various subjects like Backyard Ovens, The Good Life Bread Book, Green House Plans, Backyard Self-sufficiency, Green Power Today, Home Farmer, and many more. In total they have published a total of 30 different books. They have now release their latest book called "Easy Aquaponics". This latest edition to their raft of successful books brings together numerous stories and experiences of people around Australia that have been practicing and aquaponics in a variety of ways. You'll hear about people's successes and failures in setting up their own systems. You'll see and read about examples of systems made from all sorts of recycled materials as well as kit systems or systems made from commercially available components. This book brings together some of the most skilled and experienced aquaponics people within Australia to share their views, experiences, and tips to help you get a firm grasp of what aquaponics is about. The book is available through most newsagents in Australia or through online stores such as Earth Gardens' book store "The Good Life Book Club", or through the Backyard Aquaponics website.

INTRODUCTION IN FRONT OF BOOK BY FIONA TUNNICLIFF AND ALAN GRAY, EDITORS.

Have you been dreaming of a way to grow your own healthy organic food without haveing to break your back or your budget? Interested in a system that uses a lot less water than a conventional garden? Do you fancy a beautiful fresh trout to go with your home grown salad? And how would you like all of this within easy reach – right in your very own back yard or even on your balcony? Welcome to the brave new world of aquaponics.

Working on this book has been an absolute eye-opener for the editors. We're astounded by the knowledge, commitment and especially the passion offered so willingly by all of our contributors. Aquaponics is the perfect marriage between hydroponics and aquaculture. Yes – you can grow your own veggies and your fish too! In these pages you will meet a diverse range of aquaponicists who will happily guide you through the unchartered waters. If it's a low cost, super easy, ready-to-go system you're after – you'll find it here. If you want to put it all together yourself using recycled materials – we've got plenty of examples, tips and advice. And if you want inspiration from experts who have tried and tested all things aquaponics – you'll get it. Not only does this book offer practical do-it-yourself tips and tricks on putting together your own system together, it has loads of advice on fish species, feeding and fundamental care. Not sure what kind of fish will thrive best in your area? We'll answer that and much more. We have no doubt that after you've read this book, you will agree with us that aquaponics is easy! Not to mention fun, sustainable and extremnely rewarding. Aquaponics is definitely a bug you'll want to catch. ●

The antics of Aphids

There are many types of aphids all over the world and they are commonly known as greenfly and blackfly as well as plant lice

By **Faye Arcaro**

They are quite small usually 1-2mm, and come in a range of colours from green, yellow, black, pink and grey. Aphids are well-known pests, due to their sap-sucking nature and can cause great damage with their piercing mouthparts.

Gardeners are likely to find aphids on flower-buds, leaves and stems causing

Aphid mummies are prolific

Hoverfly larvae eat aphids as well

Crab spider looking for aphids

Green lacewing, a beneficial insect whose larvae prey on aphids

Ladybird larva feasting on an aphid

them to curl, distort and wilt. They also leave behind a sticky coating on the surface of the affected leaves, this is known as honeydew. Honeydew is adored by ants who often farm or protect their aphid friends in order to take advantage of this sticky secretion.

Aphids may also lay eggs in the ants nest and the ants will protect the eggs and eagerly await the rich rewards. They are considered to be pests and become annoying or harmful when they invade homes, entertaining areas, gardens and aquaponic systems and are a serious problem for commercial growers.

LIFE CYCLE

When spring arrives nymphs will hatch from eggs as wingless females. They go through four stages of molting during a one week period before becoming mature and at this stage they will commence giving birth to live young *parthenogenetically*, without the need for a male.

They are prolific breeders of the *Aphididae* family and are capable of giving birth to five offspring per day, during their one month life cycle. Periods of hot weather or when food supplies are reduced, trigger the production of both winged males and females. This is when sexual reproduction occurs and the pair mate, producing eggs for the following year. The eggs over-winter, producing the emergence of the nymphs and the cycle starts all over again. Once again in the bug world males are only required to reproduce.

CONTROL METHODS

There are more than 3 000 000 insect species worldwide and of those less than 100 are known to adversely affect crops, animals, health and property. Here we aim for a common-sense approach and offer alternative strategies; the objective being minimal or acceptable levels of damage and looking at positive ways to avoid the adverse effect to beneficial insects and the environment. We also acknowledge the role of insects in the food chain and as pollinators.

Biological

Predators include hoverfly larva, aphid midge larva, ladybirds and their larva, birds, spiders and syrphid fly. Lacewing larva can consume sixty aphids in an hour and will stack the dead aphids on their back and carry them around as a form of camouflage.

Parasites

Wasps deposit an egg inside an aphid host that hatches as a grub and grows inside the host, making the aphid swell and turning a papery brown colour, this is known as an aphid mummy. The larva pupates before developing into an adult wasp which then

Yellow aphids

cuts an opening in the back of the dead aphid, so it can search for a mate. The female then goes looking for host aphids to lay her eggs and may parasitise as many as 100 aphids in her short lifetime of 5-14 days.

Pathogens

Aphids are prone to fungal disease during humid conditions. Their dead bodies may appear fuzzy and dehydrated, with a red-brown appearance.

Mechanical

Traps, barriers, lures and baits can be an easy to use and quite effective method of controlling aphids. Aphids are attracted to the colour yellow and when they land on a sticky trap there is no way out.

Chemical

Some of the chemical products available are not compatible with fish and may have an adverse effect on beneficial organisms, therefore they are not recommended for use in an aquaponic system, as there are often safer methods available.

Organic

Aphids may be dislodged by simply applying a jet of water to the plant. Wiping the leaf or stem gently removes them from the plant as well as squishing them between your fingers or gloves. Garlic and chilli sprays act as a deterrent. You could also plant pest repellant plants such as French marigolds, garlic or onions, all of which repel a range of insects while others such as fennel, parsley and dill attract beneficial insects. Maintaining healthy growth helps plants resist attack from pests and diseases. Ensure plants receive sufficient amounts of light and good air flow. Remove heavily infested plants and maintain good hygiene, to stop the spread of pests or diseases.

INTERESTING FACTS

- The term *parthenogenesis* is derived from the Greek word parthenos, which means virgin or genesis-creation. Therefore the word parthenogenesis can be described as virgin creation.
- Ants are attracted to the honeydew produced by aphids and can often be seen protecting or farming the aphids. An ant milks an aphid by gently stroking it, which stimulates the aphid to produce drops of honeydew.

Rosebud with aphid

Ant herding his aphids

Aquaponic workshops

Aquaponics has grown substantially over the past three years and interest as well as enthusiasm in the industry has dramatically increased. With a rise in people interested in setting up their own aquaponics systems at home, seasoned aquaponics enthusiasts are sharing their extensive knowledge in the field, by hosting aquaponic workshops.

Workshops have been held at the Backyard Aquaponics shop every month since May, 2009. The first workshop spanned a comprehensive three hours and covered the basics on aquaponics, particularly focused on our climate and region of Western Australia. The Backyard Aquaponics workshops now run for two hours and cover a wide range of information. Each participant takes home an information package with course notes as well as electronic copies of the BYAP magazine. Our workshops are quickly booked out and we often have waiting lists for our next workshop.

Aquaponics workshops have proved to be popular and a few workshops have also been held down the east coast of Australia by local aquaponic system suppliers. Often workshops and get togethers are hosted by small groups of forum members who bring together all of their knowledge and experience on aquaponics, these workshops are often advertised on the BYAP forum and in local newspapers. They vary in time and information but are always great fun to attend and worthwhile.

Aquaponics workshops are not just limited to Australia; they have even been hosted overseas, particularly in the United States. These workshops are held by various people, most notably Rebecca Nelson and John Pade, who have been involved in aquaponics for many years. Rebecca Nelson is a well-known author, who has published several very informative manuals on aquaponics and continues to develop her ideas and theories, which are shared with participants at her workshops. Her Partner John Pade, also plays a pivotal role in their workshops. Travis Hughey has also held some workshops on barrelponics (building a system using barrels) in the U.S.

No matter where or which workshop you attend, all are a fantastic place to meet like-minded people who are passionate about aquaponics and growing their own fresh produce at home. Workshops offer all participants a chance to express their ideas, share their experiences and learn something new and most of all, ***have fun!***







CONVERSION TABLES

For your reference

Metric Length		Imperial
1 millimetre [mm]		0.03937 in
1 centimetre [cm]	10 mm	0.3937 in
1 metre [m]	100 cm	1.0936 yd
1 kilometre [km]	1000 m	0.6214 mile

Imperial Length		Metric
1 inch [in]		2.54 cm
1 foot [ft]	12 in	0.3048 m
1 yard [yd]	3 ft	0.9144 m

Metric Volume		Imperial
1 cu cm [cm³]		0.0610 in³
1 cu decimetre [dm³]	1,000 cm³	0.0353 ft³
1 cu metre [m³]	1,000 dm³	1.3080 yd³
1 litre [l]	1 dm³	1.76 pt
1 hectolitre [hl]	100 l	21.997 gal

Imperial Volume		Metric
1 cu inch [in³]		16.387 cm³
1 cu foot [ft³]	1,728 in³	0.0283 m³
1 fluid ounce [fl oz]		28.413 ml
1 pint [pt]	20 fl oz	0.5683 l
1 gallon [gal]	8 pt	4.5461 l

USA Volume		Metric
1 fluid ounce	1.0408 UK fl oz	29.574 ml
1 pint (16 fl oz)	0.8327 UK pt	0.4731 l
1 gallon	0.8327 UK gal	3.7854 l

Metric Mass		Imperial
1 milligram [mg]		0.0154 grain
1 gram [g]	1,000 mg	0.0353 oz
1 kilogram [kg]	1,000 g	2.2046 lb
1 tonne [t]	1,000 kg	0.9842 ton

Imperial Mass		Metric
1 ounce [oz]	437.5 grain	28.35 g
1 pound [lb]	16 oz	0.4536 kg
1 stone	14 lb	6.3503 kg
1 hundredweight [cwt]	112 lb	50.802 kg
1 long ton (UK)	20 cwt	1.016 t

Temperature Celcius		Fahrenheit
0°C		32°F
5°C		41°F
10°C		50°F
15°C		59°F
20°C		68°F
25°C		77°F

This edition of the magazine sees us take things forward another step with a printed version becoming available. The magazine will be available either as an electronic subscription, or in a printed format. For current subscribers who wish to receive printed editions, we will be sending out details of how to upgrade soon.

Work is well under way on the **eighth edition** of the magazine. We will continue to showcase systems belonging to members of the online discussion forum, there will be information on vegetables and plants well suited to aquaponics systems, plus lots of useful hints and tips.

It's promising to be an exciting issue, packed full of information.

Issue 8 OUT SOON

Backyard Aquaponics Magazine
Future Editions and Subscriptions

The ***Backyard Aquaponics Magazine*** can be purchased and downloaded in PDF format from ***www.byapmagazine.com*** either as individual issues, or as a yearly subscription. Alternatively, we can mail you a copy of the magazine on CD-Rom, or DVD.

If you have any queries, please don't hesitate to contact us.

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