



PHOSLOCK[®]

**Phosphate Reduction
Pond Additive**

www.phoslock.com.au

**Why is too much Phosphate (PO_4) a
problem in aquaculture ponds?**

Phosphate and BGA

Too much PO_4 will cause proliferation of Blue Green Algae (BGA –cyanobacteria)

BGA can be harmful

BGA can be toxic

BGA can produce off flavors in fish and prawns

BGA can cause an increase in TAN

BGA can increase sludge load on the pond bottom

Oscillatoria

Oscillatoria blooms are a good example of nuisance and harmful BGA

Oscillatoria are smelly: this causes off flavour in shrimp

Oscillatoria are toxic and can cause chronic illness in shrimp

Oscillatoria are able to fix N and can increase TAN in the pond

Remove PO_4 , remove Oscillatoria

By removing excess PO_4 , Oscillatoria will gradually die out and green chlorella like blooms will be able to dominate the pond bloom

PO_4 and toxic algae

Too much PO_4 can also allow other toxic algae to grow

These toxic algae include the fish killers such
as *Prymnesium parvum*

Other toxic algae such as dinoflagellates can also
bloom in high PO_4

Excess PO_4 leads to boom and bust blooms

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Too much PO_4 puts the algae into overdrive

This means that the algae grow very quickly

It also means that the algae crash very quickly

So excess PO_4 leads to boom and bust blooms

Excess PO_4 does NOT lead to stable blooms

Removal of excess PO_4 leads to more stable blooms

Excess PO_4 means excess fertiliser

Farmers are buying pond additives to help them with their pond problems

These problems in their ponds include:

Excess algae caused by overly fertilised water

Wrong types of algae: e.g. BGA, brown flagellates, dinoflagellates

Off flavours: caused by BGA

Excessive swings in DO and pH: caused by photosynthesis in overdrive

Bloom crashes

Build up of sludge: exacerbated by excessive production of algae

Treat the cause, not the symptoms

The root cause of many of these issues is excess PO_4 .

By removing the root cause many of these problems can be controlled

The cost to remove the PO_4 is considerably less than the cost of all the additives which treat the symptoms, not the cause

Phoslock treats the cause of these problems by removing excess phosphate

Dissolved oxygen volatility

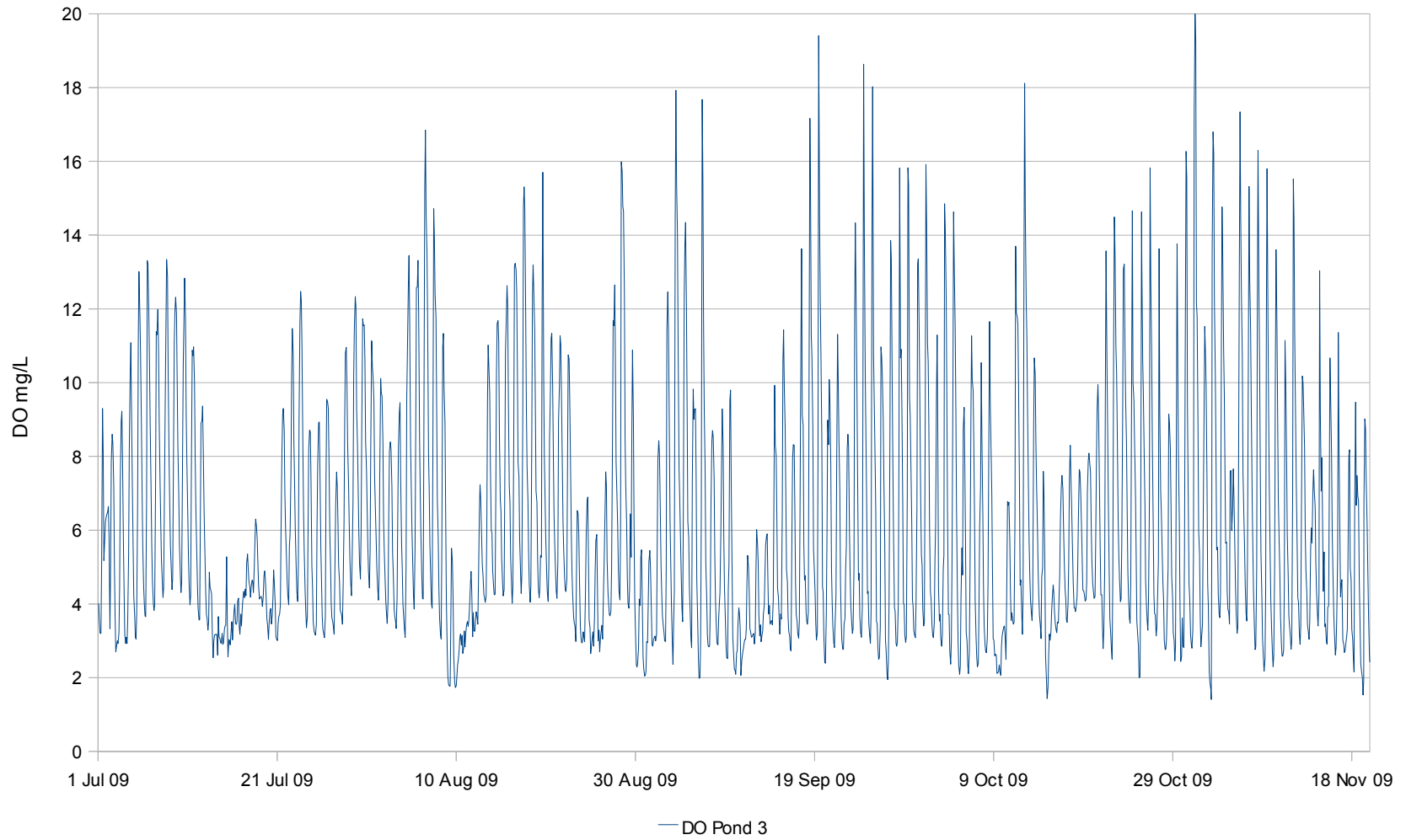
DO volatility is one measure of excess PO_4

The following graphs compare a pond with no control of PO_4 , to a pond with PO_4 control

The pond with no PO_4 control shows high daytime DO (up to 300% saturation) and large swings over time as blooms come and go

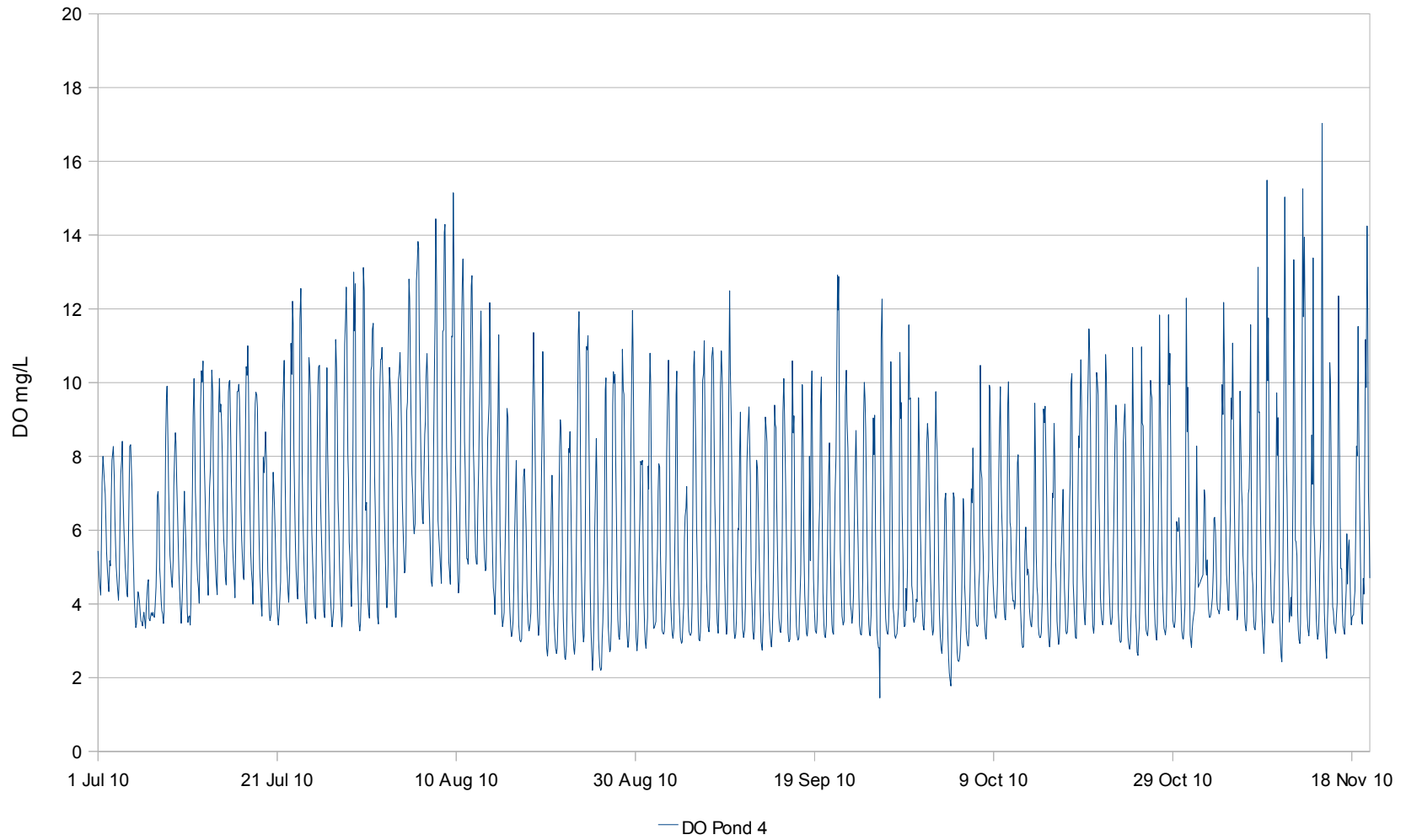
The pond with PO_4 control shows daytime DO around 150% and much less change in the blooms over time

Pond 3



Pond 3 has no PO₄ control: DO volatility is high

Pond 4



Pond 4 has PO_4 and pH control: DO volatility is reduced

Why is excess PO_4 a cause of these problems?

PO_4 - along with Nitrogen - is a basic nutrient of algae

The optimum ratio of N:P for algae is known as the Redfield ratio and is 16:1

By keeping the ratio close to the optimum, then all the different types of algae have a chance to grow and compete with each other

If the ratio moves too far away from the optimum when there is too much PO_4 in the water, then the P loving algae such as the BGA will dominate

Why has this not been done in the past?

Why has phosphate control not been targeted as a way to help farmers?

The answer is that there has not been a way to safely remove PO_4 in aquaculture ponds. The only way to safely remove the excess PO_4 has up till now been to exchange water.

So no one has focused on PO_4 .

Now we have a way to selectively remove PO_4 and so have a much greater degree of control over the fundamental nutrients in the pond.

Why not just change water?

Why not just change water as is the custom?

Why bother to manage PO_4 ?

Water exchange is usually the cheapest and safest way to control blooms

Managing PO_4 is more difficult: it must be measured,
then product needs to be applied.

In some circumstances water exchange may not be the best option

Limited water exchange may be useful

For example, persistent blue green blooms such as *Oscillatoria* can not be controlled with water exchange, Application of Phoslock allows the farmer to selectively remove excess PO_4 and at the same time allow beneficial algae to grow.

Many farmers try to limit their water exchange because of the risk of introducing diseases. Some farmers have reservoirs used for recirculating water back to their ponds. Phoslock is ideal for these situations where PO_4 can build to very high levels

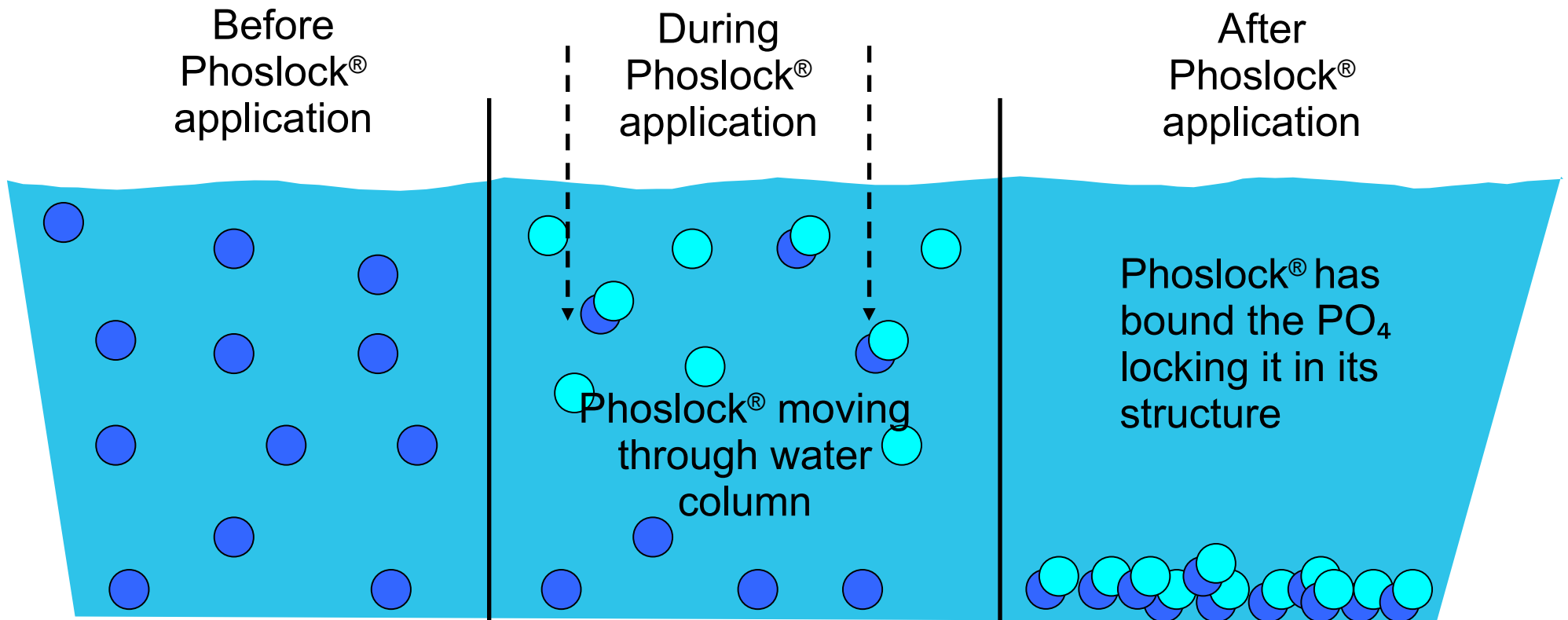
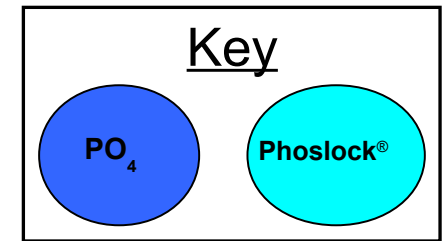
How does Phoslock work?

Phoslock contains an active natural mineral, Lanthanum, that selectively binds with PO_4 and locks it up permanently as a harmless mineral.

Once it is locked up it can no longer be used by algae and so farmers now have the ability to control how much PO_4 is in their ponds.

How does Phoslock[®] work?

Phoslock[®] contains the natural Rare Earth mineral, Lanthanum, that selectively binds with PO_4 and locks it up permanently as a harmless mineral compound and settles out.



How do we know it works ?

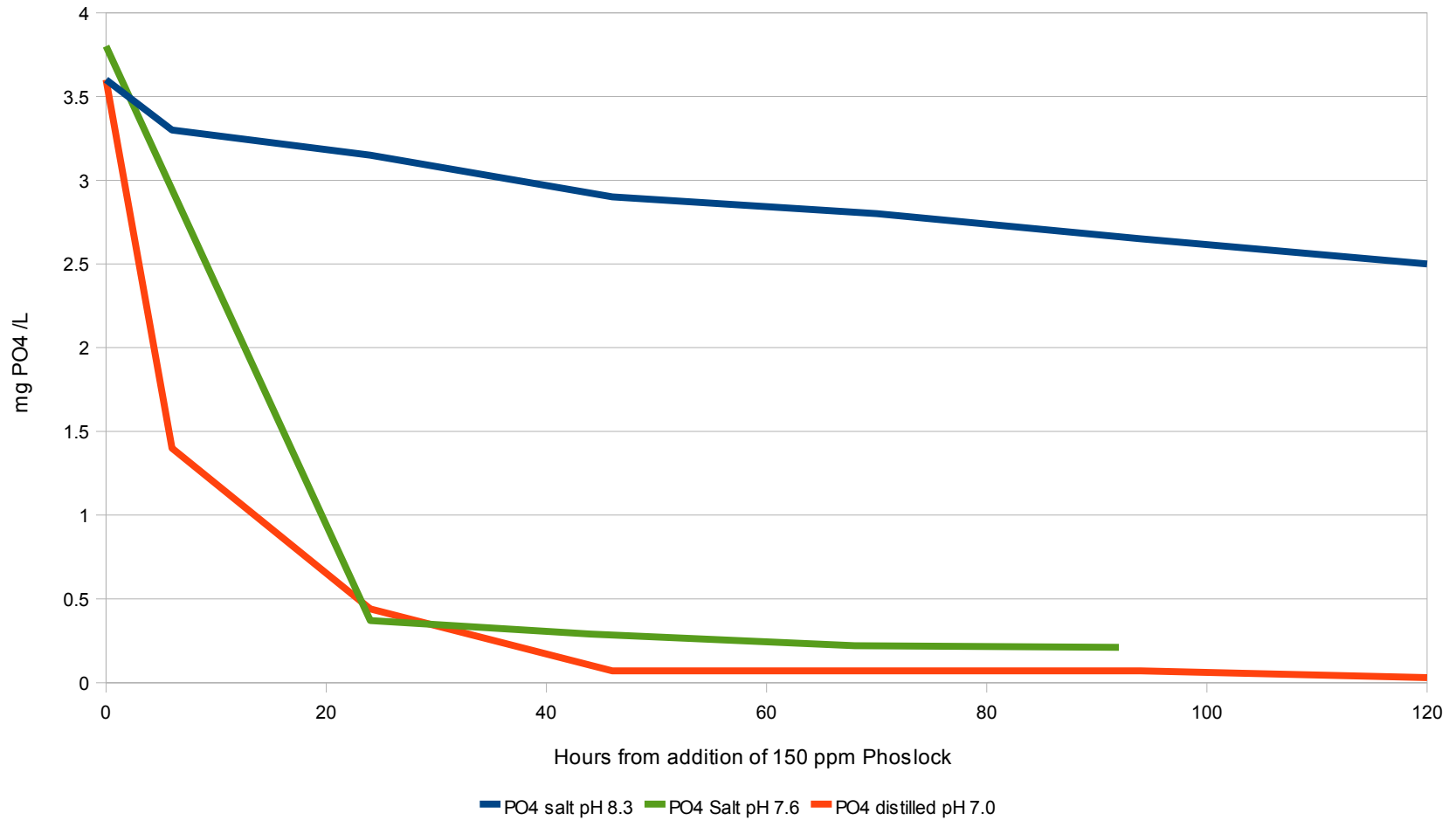
We can show very quickly that it works to remove PO_4 permanently from the pond

Measuring PO_4 followed by application then measurement of PO_4 again the following day will show this.

Bench tests can be done also to show that Phoslock removes PO_4

Figure 1

Effectiveness of Phoslock in different conditions



Phoslock removes PO₄ faster in seawater with reduced pH

How do we know its working?

What will the farmer notice?

The farmer will notice his ponds are much easier to manage

Daytime DO will not go so high

Daytime pH will not go so high

Nighttime DO will not go so low

Better Pond Outcomes

Less “boom and bust” of the algal bloom: more stable bloom

Potential to save on power costs: less aeration required

Less organic material in the water due to less “leakage” by algae

Photosynthesis slows down - less bubbles and pond froth – cleaner water

Blooms will gradually change away from BGA and brown flagellates to green chlorella blooms

How long does it take to see these changes?

Depends on the state of the pond at the beginning of application: normally can expect changes to be seen within 2 – 3 weeks

PO_4 measurements however will show that PO_4 is being reduced within one or two days of application

Reduction of pH to less than 7.7 will help to speed up improvement

Is it possible to remove too much PO_4 ?

Surely phosphate is essential for a healthy bloom?

PO_4 is essential but too much is dangerous.

Research has shown conclusively that in aquaculture ponds when PO_4 is removed by Phoslock the pond responds by producing alkaline phosphatase enzyme that liberates PO_4 from organic molecules.

Phoslock must be applied at intervals to mop up the excess PO_4 produced in this way

The issue in aquaculture is often too much PO_4 , which generates increased risk for the farmer.

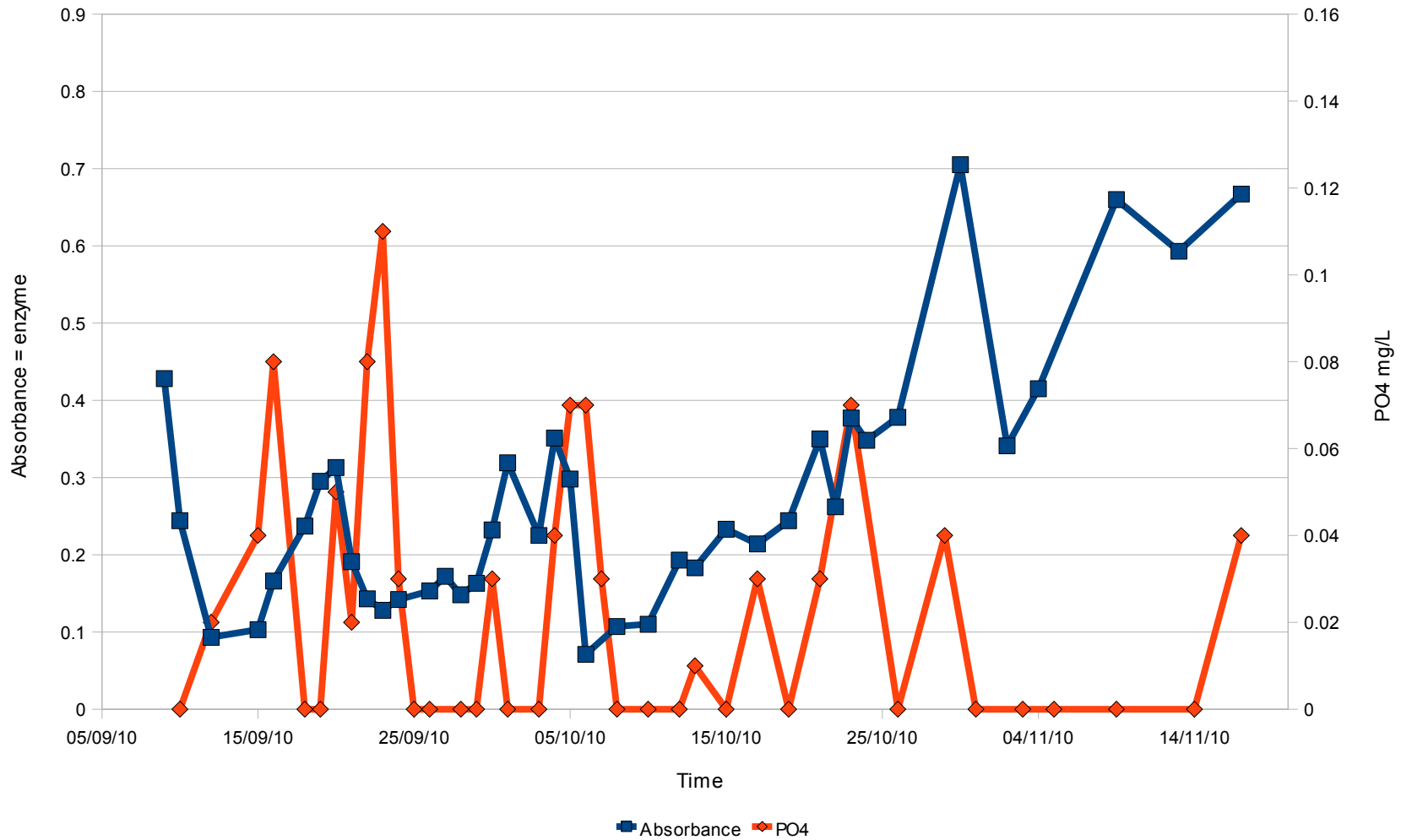
Alkaline Phosphatase enzyme

When Phoslock is applied to the pond, it binds with and removes free phosphate

When PO_4 is removed the algae respond by producing an enzyme – Alkaline Phosphatase (APase) that liberates PO_4 from organic molecules

The following slide shows this

Enzyme and PO4: Pond 4



Relationship between APase enzyme and PO₄. Absorbance is a measure of the amount of enzyme in the pond. In these trials, PO₄ was removed when it exceeded 0.03 mg/L

About APase

APase enzyme is produced in very large quantities in the pond.

Production of APase ensures that the algae have access to PO_4 .

If there was no PO_4 at all then the algae could not grow

APase also helps the pond in other ways

It speeds up the decomposition of organic molecules

It does this by breaking off the PO_4 .

Decomposition of organic molecules in the pond is often a problem

If this decomposition is too slow then sludge can build up

Bacterial additives, if applied correctly, can help speed up the decomposition of organic molecules

Removing PO_4 using Phoslock does this by causing production of APase

Are there any negative side effects?

Phoslock is widely used in environmental applications to remove phosphate and remediate eutrophied waterbodies.

These types of applications are very strictly monitored and application is only approved after the most rigid tests have been applied. There have been no reports of negative side effects and use of the product in environmental applications continues to grow in Europe, Canada, USA, Australia and Asia.

In aquaculture, there have been no reports of negative side effects

How is Phoslock used?

Determine the PO_4 in the pond

If this is more than 0.1 mg/litre then PO_4 may be a problem

Add Phoslock to remove the excess PO_4

Measure PO_4 again in 3-4 days

Apply more Phoslock again if required

Repeat this until the PO_4 level is at the desired level

What is the optimum level of Phosphate?

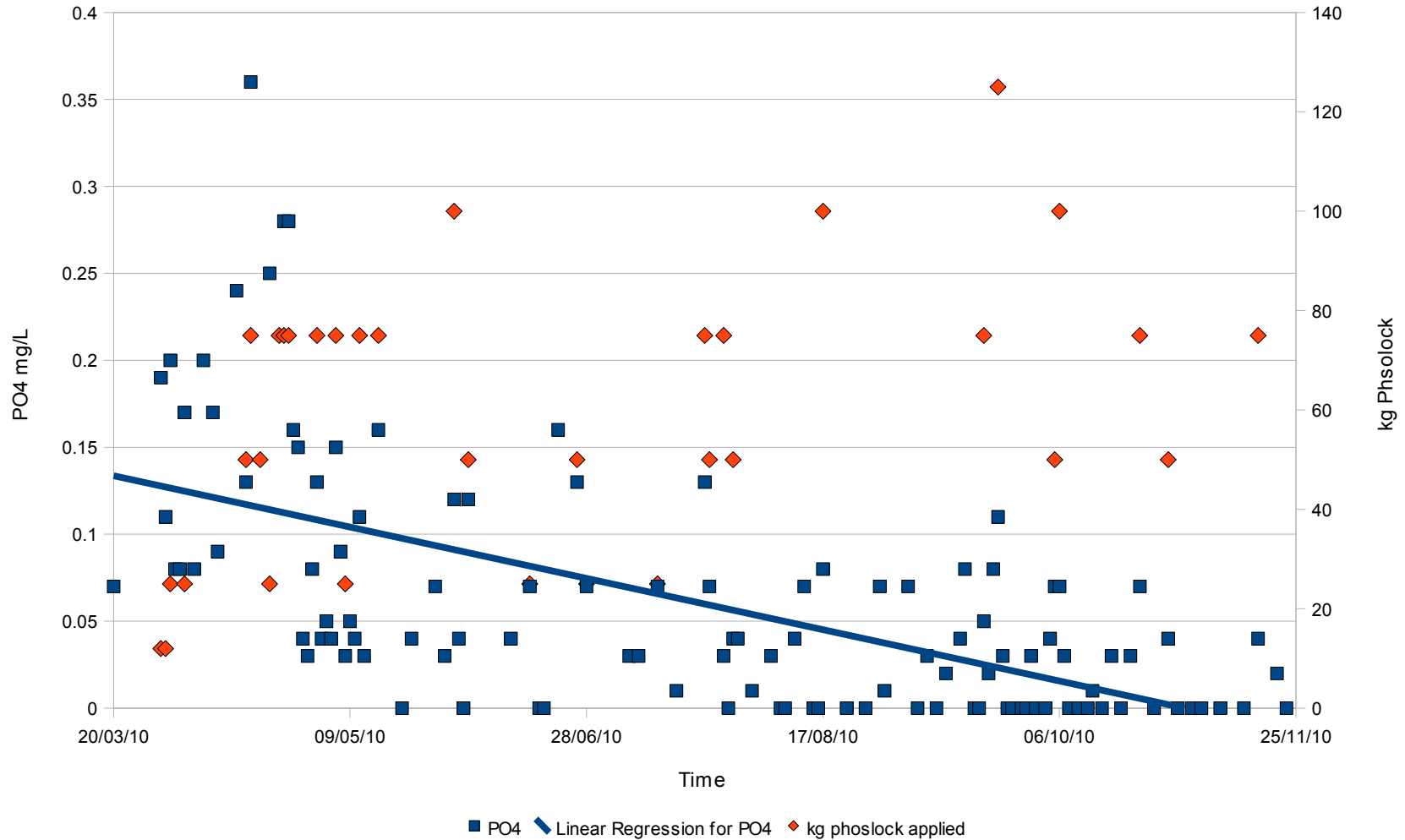
The desired level will depend on the farm

For example, a farm using formulated feed will have different PO_4 requirements to a farm relying on the algal bloom as the feed source for the animals e.g. tilapia

In general, if formulated feed is being used, then it is generally preferable to hold PO_4 at close to 0 mg/L

The following slide is an example of Phoslock application in a
30 ML saltwater pond growing Barramundi and receiving
250 – 300 kg of 50% protein feed per day

PO4 response to Phoslock Application: Pond 4



Excess Phosphate is removed by Phoslock as shown here: this pond received 150 kg feed per ha per day

Calculating how much Phoslock to add

Firstly, measure the PO_4

This is easy. A PO_4 test kit can do this within 10 minutes or so

Once the PO_4 is known, calculate how many kg of

PO_4 needs to be removed

For example: the pond is 1 ML, the PO_4 is 0.5 mg/L, and we want to reduce this to 0.05 mg/L.

Therefore we want to remove 0.45 mg/L from 1 ML, which is a total of 0.45 kg that requires removal.

Calculating how much Phoslock to add

We know that 30 kg of Phoslock is required to remove 1 kg of PO_4 ,
so we need to apply about 14 kg Phoslock. We would apply this
then check the pond again 3 days later, and apply further Phoslock
as required. Further checks are needed because there are always
some other sources of PO_4 and usually further applications
are required to get the PO_4 under control.

How is the product applied and how often?

The product is simply spread over the surface of the pond

It can be applied as a slurry or as dry granules

It is important to spread over the pond it as much as possible

Frequency of application depends on the PO_4 status of the pond and
of the incoming water

As a general rule, PO_4 should be removed gradually.

The following are guidelines and will vary from farm to farm and from application to application

Guidelines

DO NOT OVER-APPLY: Apply only enough Phoslock to remove the free PO_4

Apply up to 50 kg per ha per day

Apply 30 kg product for every kg PO_4 to be removed

Until PO_4 reaches the value desired, measure PO_4 every 2nd day

Remember PO_4 is very dynamic and changes from day to day

though this volatility will decrease as PO_4 is removed

General Guidelines for application of Phoslock and molasses

General guidelines for semi intensive and intensive fish and prawn ponds

For pH control: For fish and prawns: apply 35 kg molasses/ha 2 times a week from date of stocking

For PO₄ control:

For prawns, from day 30 post stocking, apply twice a week at the rate of 1 kg Phoslock for every 20 kg feed added to the pond

For fish, from stocking, apply twice a week at the rate of 1 kg Phoslock for every 20 kg feed added to the pond

What other management is required?

On farm research has shown that holding pond pH under 7.7 is very beneficial. This reduced pH enhances the effectiveness of Phoslock

The types of bloom that occur in low pH - low PO_4 ponds are stable, safe and predictable

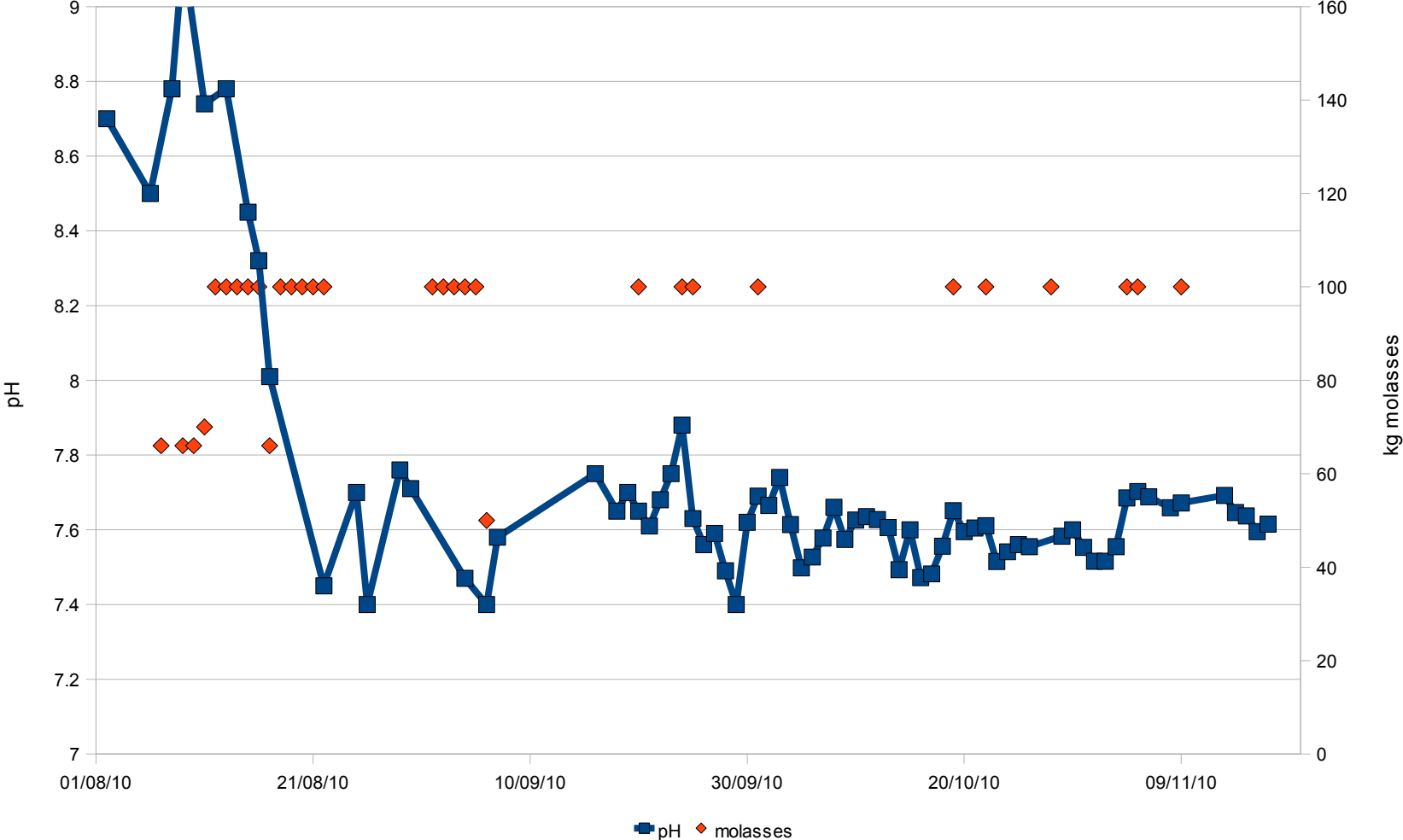
In these ponds the dangerous and nuisance algae are in very low numbers or are absent

How can pH be managed?

Application of a soluble organic carbon source such as molasses will reduce and maintain pH

The organic carbon source causes the pond microbes to produce a weak acid – CO_2 – and this is what allows management of pH

pH response to molasses: Pond 4



Application of molasses reduces then maintains pH in a 30 ML pond

What other benefits does low pH - low PO₄ have for pond management?

Apart from stable and safe blooms:

Low PO₄ causes the pond algae and other microbes to produce large amounts of enzyme, in particular alkaline phosphatase, and this helps break down organic matter in the pond

Low PO₄ - low pH reduces cyanobacteria so helping to reduce the amount of N in the pond – cyanobacteria “fix” N

Low PO₄ - low pH seems to speed up the nitrogen cycle, including denitrification, in the pond: this helps in low water exchange systems

Low PO₄ - low pH seems to reduce or eliminate barnacles and other calcium shelled fauna in the ponds

Some reasons other than bloom management to consider Phoslock

Phoslock has application in farms with low or zero water exchange where PO_4 can build up to very high levels

Phoslock can allow farms to move to less water exchange

Phoslock can help improve environmental credentials by limiting discharge of phosphate into the environment

BAP is enhanced when phosphate emissions are reduced

How much does the product cost?

In ponds receiving 100 – 200 kg feed per ha per day about 100 kg Phoslock per ha per month is required. Less feed, less Phoslock required

In brackish water ponds about 200 - 300 kg molasses per ha per month is required to maintain pH under 7.7

Phoslock attacks the cause, not the symptoms

Farmers are able to reduce or eliminate use of other types of pond additives, because Phoslock attacks the cause of the problems, namely excessive PO_4 , not the symptoms, so many of the symptoms of poor pond water quality will disappear.

Stable blooms, less stress

More stable blooms will means less stress on the fish or prawns.

No BGA will means less chance of chronic stress
caused by these harmful types of blooms

Questions?

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More Information

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