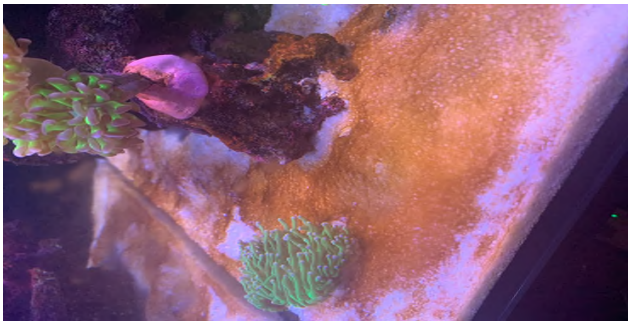
DEFEATING DINOS

WHY DO WE GET DINOFLAGELLATES & HOW DO WE RID THEM FROM OUR REEF TANKS

A complete step-by-step guide from ID to removing them from our systems

Rev E – April 2021



June 2020

ABSTRACT

"Thanks Jason for all your help from ending my worst nightmare. From being completely clueless to actually starting now to understand how a reef tank is meant to function at a microscopic level, your help with everything has been amazing. Literally there with me at every step which is exactly what I needed. Now I'm armed with the all the knowledge you have passed on, I'm convinced my reefing adventure will successfully continue for many, many years to come."

Written in Conjunction with -
Jason Mack, Steph Chartier and Alistair Logan,

Dec 2020

Contents Page

1.0 Overview and What to do if you Think you May Have dinos?

First of all, join us on Facebook. There is a group called "Mack's reef… Dinoflagellates support" group. Post microscope images for help with IDs and general updates. And most importantly, tell us all when you have finally beat them. We all love to see those posts.

Dinos occur when the right conditions favour them. Usually this is in tanks where nitrates (N03) and phosphates (P04) have been at 0 or there is an imbalance where one or the other has been at 0 for a period of time. This creates an environment in which dinoflagellates thrive and, unfortunately, our desired microbiology doesn't. This ultimately causes it to die off, allowing dinos to dominate without any other organisms to compete with them ☹… so yes, you guessed it: We need to build up our microfauna within the system to beat them back again.

Certain trace elements (halogens and metals), when in balance, help inhibit the growth of fast-growing algae (like hair algae), bacteria (cyano), dinos, and pathogens. These elements include iodine, zinc, nickel, boron, bromine, molybdenum, and vanadium. When these are out of balance, either lacking or overdosed, we start to see issues with reef systems. This is where ICP laboratory testing comes into play as it gives us a peek under the hood, so to speak.

High or low levels or imbalances between trace elements / pollutants are generally underlying problems. They are not proven to be the cause of dinos becoming dominant, but there are discussions it helps keep them dominant in systems. Always remember that 0 nutrients are generally the trigger, so keep those No3 and P04 levels above 0.

If you have found this guide useful and its helped you in your battle to defeating dinos when nothing else has worked, we do accept donations with a twist, We have decided that ALL donations that are made will be used to fund giveaways on the macks reef dinos support group.

YES you heard that right, We are giving it all right back too you guys

The below link can be used to donate.

www.Paypal.me/jmack15

2.0 General Introduction and Key Reading

One thing you should always do as a reefer is do your own research on what you're putting into your tank. Try and get an understanding of what its purpose is and what the positives and also negatives can be. Don't just do it because someone on Facebook told you it worked for them. Chemicals should be dosed into the system to fix an issue as a last resort only. If you don't resolve the underlying issue, it will just come back and usually with a bang the 2nd time around. Every tank is different and what works for one tank may not work on another.

You will read time and time again in this document that you should make any changes within the tank SLOWLY. Nothing good happens fast in a reef tank, so make sure any corrections are made steadily and slowly or you risk a sudden swing in parameters. Reefs, corals, and fish do not like sudden changes. Think to yourself what happens in the oceans when there is a sudden swing. I can tell you that it's nothing good.

Any sudden changes can have a major impact and cause the system to crash, so always remember slow and steady. Patience is key in this hobby or you will learn this the hard way. Always try natural approaches first. If these don't work, then consider another approach. You will not see instant changes using natural approaches, so be patient. If you're not a patient person, then I'm sorry to say this hobby is probably not for you.

It's taken a while for your tank to get into this position, so it may take a while for you to get out of it. With some dino types, we can see successes in as little as a week. With other types it can take months. But the good news is you can beat them.

Finally, the information contained within this document is a guide only and, as above, we EXPECT you to do your own research. Honestly, we would be offended if you didn't. As always, if you have any questions on any element of what's detailed below, please ask.

3.0 Initial Reefing, Good Practice, and What Can be Done Before Microscope ID

The following can be implemented and is generally good practice on reef tanks:

Allowing for the ID of the type of dino using a microscope. (Further information on this is below. The current list can be completed before an ID has been confirmed.) Without an ID, it's all just guesswork.

1. Correcting NO3 and PO4 to within range of:

- **Mixed Reef System**
    - NO3 - 5-10ppm
    - P04 - 0.05-0.1ppm (preferably around 0.1 for po4)
    - There is a section within this document specifically addressing the raising of NO3 and PO4 levels, so please refer to this for tips on getting them within the recommended parameters.
- **SPS Dominant System**
    - NO3 - 3 – 5 ppm
    - P04 - 0.03 - 0.05 ppm (preferably around 0.05 for po4)
    - There is a section within this document specifically addressing the raising of NO3 and PO4 levels, so please refer to this for tips on getting them within the recommended parameters.
    - We would recommend that the mixed reef parameters are implemented as these give you a bit of a buffer if the levels start to drop.

    - If the above SPS dominant levels are adopted we would recommend that you ensure you test daily using accurate test kits with minimal +/- accuracy variances to ensure you don't bottom out your parameters, there are many many successful SPS systems that run No3 and Po4 at the mixed reef levels and sometimes above this.
2. Reduce (don't stop) any carbon dosing (eg. Nopox, vodka, vinegar) as this can feed dinos, also if you stop carbon dosing suddenly this can result in a large dying off of bacteria which will adversely affect the system. If you are dosing products such as amino acids or Red Sea AB+, we suggest stopping this as it can cause the dinos to explode in many systems. It should be noted that AB+, in our experience, does not cause dinos but will 100% feed them. The stuff is like rocket fuel.
3. Support / boost the microbiology of your tank by dosing live phytoplankton and copepods. Adding bacteria will also help. All these organisms help battle all the nasties at a microscopic level.
4. Reducing your lighting schedule for a peak time of 5-6 hrs max. Reduce whites, greens, and reds while running more blues.
5. Broadcast dosing hydrogen peroxide (H2O2). More info on this below within section 17.
6. Add some activated carbon into a high flow area within your sump or in a reactor to help remove some of the toxins dinos let off. (Some types are extremely toxic.)
7. Lots of systems nowadays are started by using artificial dry rock. Add a decent piece of live rock into the system (into the sump is fine). This will help boost your system with some healthy and mature bacteria and other beneficial organisms.
8. If you don't already start looking into making your own RODI water for auto top up and for salt water mixing, our experience is on every level you should know that what your putting into you're tank is clean and not full of contaminants.. if you have your own 4 stage RODI make sure you change out the filters as soon as the TDS goes above 0 and also the DI resin

All of the above can be done before you've had an ID on which type of dinos you have, and we recommend adopting the majority of the above as it will help keep your reef tank nice and healthy. ☺

4.0 Types of Dinos & Methods for Removal

The full dinos fact / crib sheets can be found at the rear of this document.

4.1 Amphidiniums (large-cell and small-cell) and Prorocentrum

These are the most difficult types of dinos to remove from systems once they're in there. Generally these types of dinos, unlike Ostreopsis and Coolia, go into the sand bed / rocks at night, so UV has very little effect against them. Dealing with these can be a long and drawn out process. But just remember they didn't become the dominant species in your tank overnight, so it's going to take a while to build your microbiology to outcompete them again

For the above types, we recommend all of what has been explained above along with dosing waterglass / sodium silicate. This is to introduce a diatom bloom to outcompete the dinos. So basically we're going to need to overdose silicates (SI) to achieve this. More detailed information is contained below on silicate dosing along with recommended dosing amounts / methods.

Silicates are used up fast in a reef tank, so the majority of what you had today will be gone tomorrow, but every tank's silicate consumption is different. For instance, sponges feed off SI, so if you have a lot of sponges, it will take more to get the level up. We also recommend taking samples

from various places within the tank weekly to view under the microscope. Over the course of treatment, you should see an increase in diatoms and a decrease in dinos. Below are a few snapshots of Prorocentrum, small-cell Amphidiniums, and large-cell Amphidiniums.

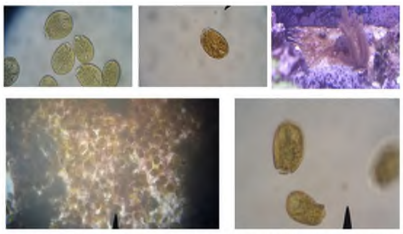
Prorocentrum

Left: Prorocentrum. Right: Prorocentrum with Ostreopsis cells

Video1
Video2

Size:~30-60µm	Mucus: High	Tank Position: Middle to Low
Toxin: Med/High	Strands: Short or none	Cysts: Yes
Night Migration: Into Water (less willing)	Bubbles: Med	Surfaces: Macros, Any Surface
Armor: Yes	Flow: Medium	
Similar Described Species: Prorocentrum Lima	Perfectly left/right symmetric ovals with small indentation at the front. Circular structure in center of cell (pyrenoid). Theca not usually visible unless it's been shed. Movement style like amphidinium, but less. Most likely dino to be motionless.	

Amphidinium (Large-Cell)

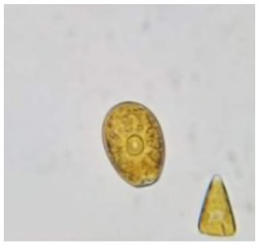


Top left and center & bottom right: Large Cell Amphidinium. Top right: outbreak on sandbed. Bottom left: Large Cell Amphidinium colonizing a cyano mat.

Videos (Author)
Video (AlgaeID)

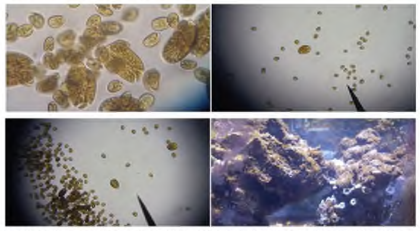
Size:~30-60µm	Mucus: Low	Tank Position: Bottom
Toxin: No/Low	Strands: None	Cysts: None
Night Migration: Into Sand	Bubbles: Low	Surfaces: Sand, Rock,
Armor: No	Flow: Low	Cyano Mats
Similar Described Species: A. operculatum(?) A. mootonorum(?)	Oval shape with a "beak" at the front. In some populations, beak tilts left / right. No armor, and cells can be slightly flexible in shape. Moves "like a roomba" -Jason_1982	

Large Cell – One side more loop sided, Beak has two slits and is more defined



Prorocentrum – Very symmetrical side to side and the beak is small with a small v shaped indent

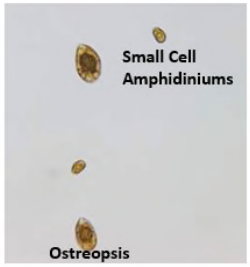
Amphidinium (Small Cell)



Top left & right: Small Cell Amphidinium with Large Cell Amphidinium. Bottom left: Small Cell Amphidinium with Ostreopsis cell center and Large Cell Amphidinium upper right. Bottom right: Mixed Small/Large Cell Amphidinium outbreak on rocks.

Pics and Vids (author)
Video (author)

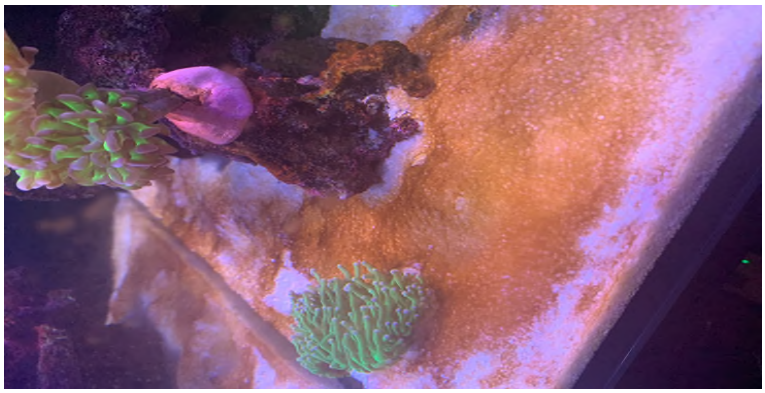
Size:~10-15µm	Mucus: Low	Tank Position: All
Toxin: Low-Medium	Strands: Short	Cysts: No
Night Migration: Into Water	Bubbles: Low	Surfaces: Rock, Any
Armor: No	Flow: Medium	
Similar Described Species: Amphidinium Carterae	Appears like the more common Large-Cell Amphidinium, except roughly a third or fifth of the size, and much faster and more active swimmer. Beak always with a sideways bend.	



Difference between Ostreopsis and small cell Amphidiniums

Amphidiniums (Large and small cell) to the naked eye within the tank are not mats but more of a dusting on the sandbed.

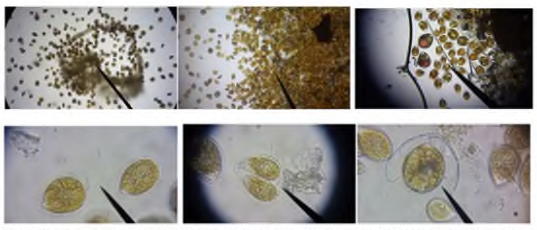
Prorocentrum to the naked eye tend to create a kind of thick mat on the sand or lower rocks only.



4.2 Ostreopsis & Coolia

Generally we find that dealing with Ostreopsis and Coolia can be quicker than with Amphidiniums / Prorocentrum; however, it's not always straightforward. This is due to these types going into the water column after the lights have been out. This makes them more susceptible to being "removed" by a high quality, oversized UV unit (please see UV section for placement and flow rate requirements). Ostreopsis specifically are the most toxic kind of dinos, and it is recommended to introduce activated carbon into your tank ASAP and not to add any additional cleanup crew. The dinos will ultimately kill anything that eats them. (More information about activated carbon is available further on within this document.) In regards to toxicity, please ensure you wash your hands thoroughly if they have been in the tank. Generally we find that if the above pre-ID process is completed and maintained in conjunction with running a high quality, oversized UV on your system, these will normally clear up within one to two weeks; however, we all know every tank's different. But in our experience, this is the best option for removing these types from reef tanks.

Ostreopsis

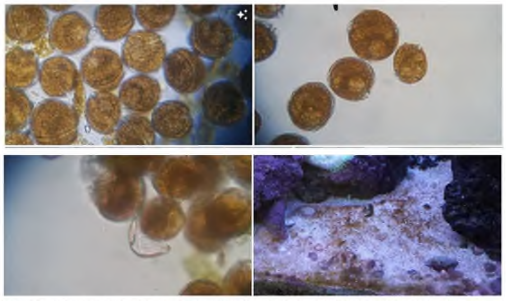


Top left and center: Ostreopsis populations. Top right: abnormal cells with red accumulation bodies compared to normal cells. Bottom Left: normal cells. Bottom center: cell division taking place within theca. Bottom right: cell either shedding theca to enter cyst state, or shedding short term cyst to resume normal growth.

Videos (AlgaeID)
Videos (Author)

Size:~40-80µm	Mucus: Medium	Tank Position: High
Toxin: High	Strands: Long >1" (microfibers)	Cysts: 2 kinds
Night Migration: Into Water	Bubbles: High	Surfaces: Rock, Macros,
Armor: Yes	Flow: High	Coral skeleton, rough etc
Similar Described Species: Ostreopsis Ovata	Sesame seed shape with lighter colored pointed end. Often spins in circle with point toward the center of spin. Clear cellulose shell (theca) often visible as outline of the cell.	

Coolia

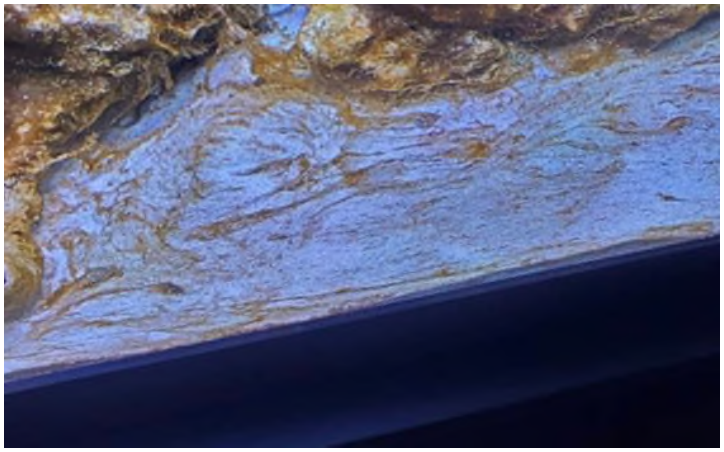


Top left & right: Coolia cells. Bottom left: theca being separated from cell. Bottom right: Coolia outbreak on sand in a tank.

Pics and vids

Size:~30-50µm	Mucus: Medium	Tank Position: Low
Toxin: Low-Med	Strands: Short	Cysts: Yes(?)
Night Migration: Into Water	Bubbles: Low	Surfaces: Rock, Algae,
Armor: Yes	Flow: Low	Sand
Similar Described Species: Coolia Monotis	Almost spherical, strong grooves cut across the cell. Theca (armor) is apparent. Moves in short bursts with change in direction. Overall effect is moving in small circles.	

Ostreopsis to the naked eye are long strands and found everywhere in the tank on glass ,rocks and corals .



Coolia to the naked eye are short strands and only found usually on the sand bed

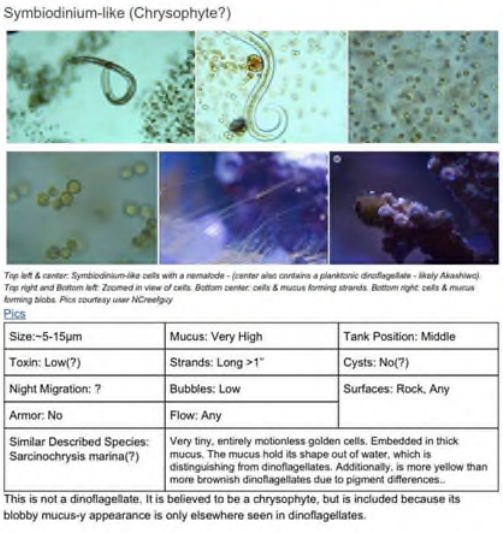
4.3 Chrysophytes

Chrysophytes are also called the ‘golden algae’ as the algae tends to show as a golden colour to the naked eye in the system, although these are not classed as a dinoflagellate they are often mistaken as them. Chrysophytes tend to show up when there are excess silicates present in the system, if you

are not dosing silicates into your system then the source of input must be found and stopped. The first step in correcting the issue is to cut off the input source of silicates into the system, generally silicates are inputted into the system via RODI water (top up water). Its very common for you still have 0 tds and the di resin to be depleted. One of the first things that is leached back when it the DI resin is depleted is silicates. Silicates don't register on the TDS so this may very well show 0. We have tested this scenario via an ICP test on the RODI water. TDS reading 0, DI exhausted, silicates read high. Our advice is to make sure you use the colour changing DI resin and to change that out as necessary rather than depending on the tds reading completely.

If your RODI water is sourced from a LFS or another source we would advice you invest in an RODI unit as we should always be aware exactly what we are putting into our tanks.

Once the source has been found and cut off this should slow the issue, however what were going to have to do now is basically scrub the rockwork and help remove the Chrysophytes ideally this would be done by removing the rockwork from the tank scrubbing it then returning it back to the tank.



4.4 Diatoms

Below are a few images of what Diatoms look like under the microscope. To be clear these are not dinos but included so the user can tell the difference between dinos and diatoms. They can look very, very similar in appearance in the tank. While dosing silicates, as explained above, you should start to see an increase in diatoms and a decrease in dinos. Also, as you start to increase your nitrate and phosphate levels, adding copepods, etc., you will see an increase in other organisms within the sand bed / rockwork. There are far too many different types of organisms to try and mention them all here, but this is positive as it's showing an increase in your system's microbiology and will help out complete the dinos.

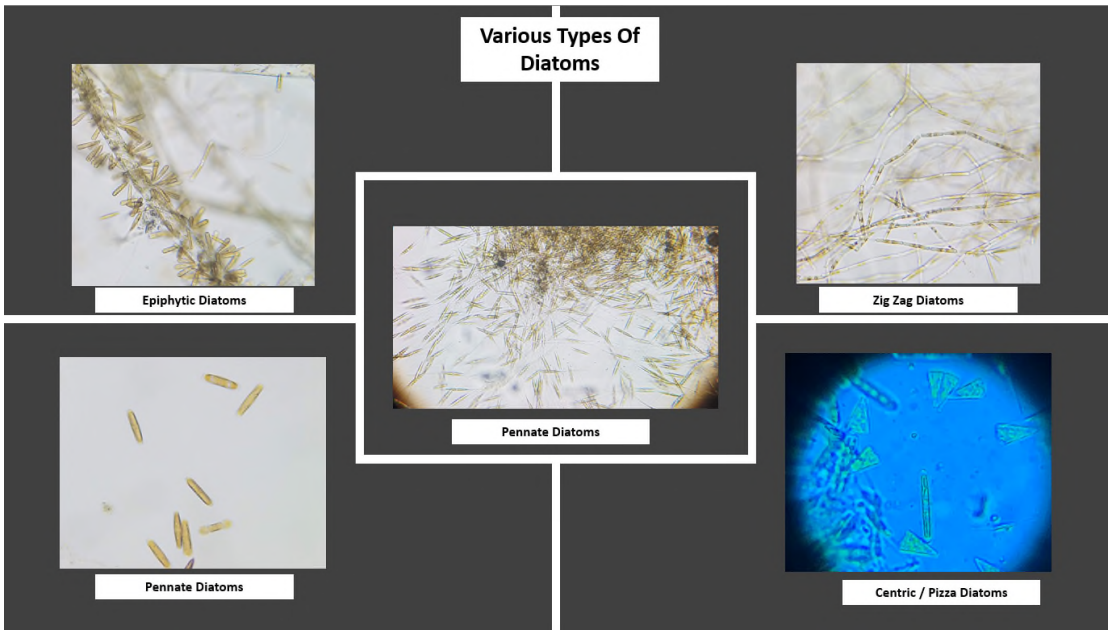
However as explained above diatoms and dinos can look very similar to the naked eye, this seems to be a very common issue where people "think" they had dinos and they will advise they cleared them by doing x, y and z, however if they didn't put a sample under a microscope there issue could have just been a diatom bloom in the tank.

Once you have put a sample under a microscope and confirmed you have a diatom bloom in your tank and not dinos. The first step in correcting the issue is to cut off the input source of silicates into the system, generally silicates are inputted into the system via RODI water (top up water). Its very

common for you still have 0 tds and the di resin to be depleted. One of the first things that is leached back when it the DI resin is depleted is silicates. Silicates don't register on the TDS so this may very well show 0. We have tested this scenario via an ICP test on the RODI water. TDS reading 0, DI exhausted, silicates read high. Our advice is to make sure you use the colour changing DI resin and to change that out as necessary rather than depending on the tds reading completely.

Once the source of silicates is removed from the system the diatoms over time will consume the remaining silicates and burn themselves out, you can syphon the sandbed to speed up the removal.

It should also be noted that diatoms are very very common in new systems this is due to silicates being present in new sand and rocks, our advice is simple just leave them be and they will burn themselves out over time.



5.0 Microscopes

This piece of equipment is key to helping us help you beat the nasty brown algae in your tank. Without an ID, it's just guesswork. Could it be dinos?? Could it be diatoms?? Could it be chrysophytes? They all look very similar to the eye but different under a microscope. Even if if we know for sure that it's dinos, different methods have to be adopted to beat certain types of dinos. So to help us help you, please ensure you get a microscope so we can help you ID them and beat the buggers. If not, then it's all just guessing.

I'm sure you have seen many, many posts about "I had dinos and I beat them by doing X, Y, and Z." The issue is that they never ID'ed what was in their tank, so it was more than likely NOT dinos and potentially diatoms or maybe cyano.

For a microscope, the minimum recommended magnification is 400x. **Don't get the electronic kind** as these wont give you the magnification required. As with everything in this hobby, you get what you pay for. A traditional microscope works much better for what we need. The ones with a phone holder will also help with images and videos to help us ID them for you.

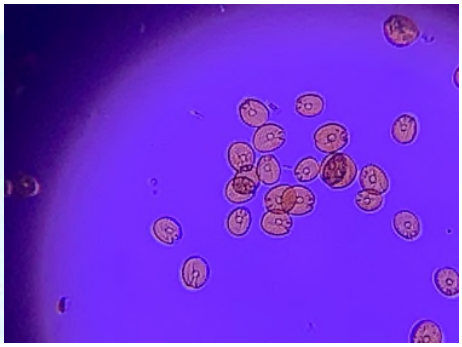
To get the 400x magnification, you will need a 40x lens + 10x eyepiece. This will help you get images like below. It's key we are able to see the cell structure so that we can make an accurate ID or, again,

we're just guessing. A video of them is also good because different dinos move in different ways (e.g. Ostreopsis generally spin in circles on their own axis).

If you live in Holland or Belgium and don't want to buy a microscope, you can contact Jason Mack and send him a sample. If you're within the UK, then you can contact Alistair Logan to send a sample.

I will say that it will be more beneficial for you to get your own microscope because we recommend taking regular samples and viewing them under the microscope. Over a period of time you should see a reduction in the amount of dinos and an increase in other organisms such as diatoms.

To collect a sample it's as simple as scooping up some of the alage from your tank and either putting it in a glass testing vial (giving is a good shake) then putting some of the sample on a slide or putting some of the sample directly from the tank onto a slide and viewing this under the microscope.



6.0 Water Testing & Recommended Testing Kits

Testing, testing, testing. Generally the main cause of dinos is when we bottom out nitrates and phosphates; however, it's not unknown for them to take over with extremely high levels.

It's crucial that we test and understand all parameters on a minimum of a weekly basis. If you have low nitrates and phosphates and you are dosing solutions to raise these, I would suggest testing these either daily or every other day. Once the required level has been hit, stop dosing, but continue testing so you can pick up when the levels start to drop again.

We would recommend the following test kits due to better accuracy:

Nitrate – Salifert / Red Sea / Hanna checker

Phosphate – Hanna checker (phosphate ULR or phosphorus) / Red Sea Pro / Salifert

**** If you're dosing silicates, it's been known for the Hanna ULR checker results to be falsely elevated due to interference with the silicate levels in the tank. Iif dosing silicates, it's recommended NOT to use the hanna checker to monitor phosphates. The Red Sea and Sailfert test results do not appear to be affected by the tank's silicate levels. ****

Alkalinity – Hanna checker (DKH or PPM checker) / Red Sea / Salifert

Calcium – Red Sea / Salifert

Magnesium – Salifert

Silicate – Columbia or Seachem seem to be the most accurate, but regular ICP's tests will give you a more accurate view of silicate levels

For us, testing is the most important part of owning a reef aquarium and accuracy is literally everything when it comes to this. At some point (probably now) you are going to react to those test results, whether that be dosing products to raise nitrates / phosphates or dosing to raise your alkalinity, calcium, and magnesium. Confidence that these results are accurate is going to be key to your success.

If a result comes back showing something that is out of the ordinary, re-test because it may be user error or *a defective batch if using say hanna sachets.*

It's completely understandable that this hobby is expensive enough; however, as I've mentioned above, the accuracy of your test kits can be the difference between success and failure in this hobby, so don't let yourself down by investing in testing kits that aren't accurate. Bulk Reef Supply (BRS) has done some amazing videos on test kits, looking at each parameter, so give these a watch before making your mind up.

Trace element testing

Any hobby grade test kits for trace elements, in our experience, is **NOT ACCURATE**. Our advice would be to **NEVER** blind dose trace elements into your system because you just don't know if what you're dosing is elevating those levels too high. You're just dropping them in your tank and hoping it will be okay. One method to accurately (as accurately as you can) get a view of trace elements is sending in an ICP test.

7.0 ICP Testing

There is lots of evidence that points to a relation of a lack or imbalance of certain trace elements (halogens/metals) and dinos. It really is worth having an ICP test completed as it gives you a detailed peek under the hood of your tank. As stated in the previous section, hobby-grade test kits for trace elements are not accurate, so please don't blindly dose these or rely on home test kits for these. For example, I was dosing a drop of lugols iodine into my tank and testing daily. The level always came back at 0 with a hobby-grade test kit. I had an ICP test done. See below.

Iodine	539.6	60.67	478.9

Luckily there was no ill effect on any of my corals or fish, but as you can see, the level is nearly 10 times higher than natural sea water levels.

We are currently logging people's ICP results and trying to record as much data as possible from tanks with dinos and then after dinos have been beaten so we can look for common trends.

The lack of or from overdosing trace elements such as Iodine, Fluorine, Bromine, Boron Molybdenum, Strontium, Vanadium, Zinc seem to be lacking in the majority of tanks that have dinos present.

These elements have shown to inhibit the growth of fast-growing algae (hair algae etc), dinos, bacteria (cyano) pathogens.

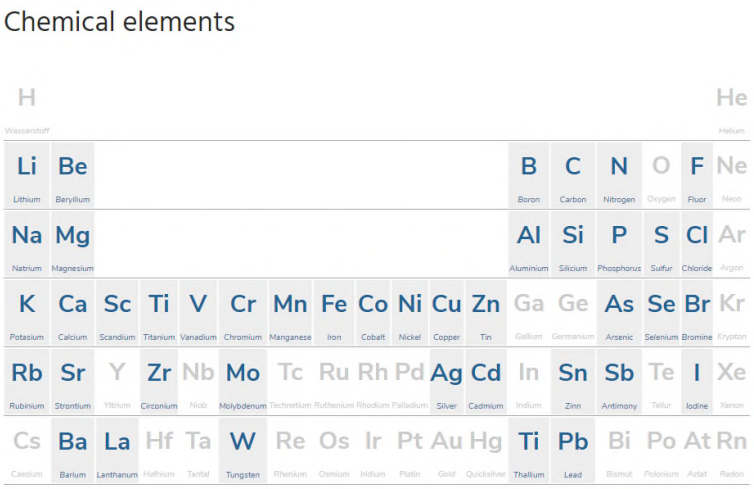
There are various ICP tests available such as ATI and Fauna Marin. What becomes a major benefit, and also an expensive one, is that you can dose individual trace elements to raise their levels; however, pick one brand and stick with it because they each have their own line of trace elements which will differ in concentrations from other brands. So, for example, if you have an ATI ICP completed and their "help / dosing" guidelines try to raise a specific trace element, if you use a

Triton trace element, you're either going to be adding too much or too little due to differences in concentrations.

Kourtney Roberts has very kindly created an excel sheet that will allow you to input specifics on your tank (volume) ICP results, baseline target levels (safe range of levels are also shown) you can then select specific trace element brands to enable you to dose these as some will be more cost effective than other due to them being a higher concentration. The sheet will then advise on corrections required. This sheet can be found within the mack reef dino group within the files sections its titled "Tank supplement dosage calculator".

Fauna Marin has created the below portal to help people start to expand their knowledge of trace elements and how they link together. It is, I must say, an amazing piece of work.

https://www.faunamarin.de/en/knowledge-base/



8.0 Recommended Water Parameters

With regard to thek recommended levels for nitrates and phosphates, we recommend the below levels. It should also be noted that 0 nitrate and 0 phosphate is not good for any reef aquarium. All life within the tank, including corals, depend on a certain level of nitrates and phosphates to survive.

- Recommended levels - mixed reef:
  - Nitrates – 5ppm to 10ppm
  - Phosphates – 0.05ppm to 0.1ppm
- Recommended levels - SPS dominant:
  - Nitrates – 2ppm to 5ppm
  - Phosphates – 0.02ppm to 0.05ppm
- So were looking generally for a ratio of:
  - 1/100 N03 to P04
  - So for every 1ppm of N03 we should have 0.01ppm of P04
  - For example 10ppm of N03 the range were looking for is 0.10 P04, again these do not have to be exact we're just looking for them to be within range. If you try and chase these numbers exactly you will no doubt cause yourself to overshoot.
  - Don't chase the exact number too much you're just looking at getting them within range of each other. If you chase the number you will no doubt end up overdosing. For example if your Po4 is 0.10 and your No3 is 8ppm that's okay.

    - If you get major differences in No3 and Po4 this can lead to cyano within the aquarium (see section 20 for more info on dealing with cyano)
- We would recommend that the mixed reef parameters are implemented as these give you a bit of a buffer if the levels start to drop.
- If the above SPS dominant levels are adopted we would recommend that you ensure you test daily using accurate test kits with minimal +/- accuracy variances to ensure you don't bottom out your parameters, there are many many successful SPS systems that run No3 and Po4 at the mixed reef levels and sometimes above this, stability is the key to success.

Targeting the above levels initially allows for a bit of a buffer. If the levels begin to drop as they are being consumed, they are not going to drop to 0 within 24 – 48 hours, which means if we keep up our routine testing, we will catch them before they hit 0. It's also going to promote other types of algae to grow in the tank, which helps boost your microbiology. Green hair algae (GHA) is also going to help outcompete the dinos.

With regards to the remainder of other parameters to target, we would suggest that ALK, CAL and MAG are maintained as close as possible to the salt mix you're using. In doing so, you're not going to see any mini swings in parameters when doing water changes. If you know the brand of salt you're using, it's easy enough to find the levels of your salt mix online. If you have other levels in mind and you know the salt mix levels, this its okay, but we would suggest not completing any water changes over 20%.

If you have an ICP test completed, the recommended levels within the report will be as close to natural seawater levels as possible. It may say you have high nitrates and phosphates, but you should ignore these for now as we want to get this up.

Ammonia and nitrite should always be 0. If these start to rise at any time, then water changes will be needed to lower them and additional bacteria should be dosed to help facilitate the conversion from ammonia to nitrite to nitrate.

9.0 Methods for raising Nitrate and Phosphate Levels

There are a number of ways to try and raise your NO3 and P04 levels. Accurate testing of your water parameters is very important and can be achieved at home using specific test kits. There is a section further down within this document where advice is given on which test kits are accurate enough for home testing.

9.1 Nitrates

If your nitrates are low, first of all, we need to understand why as the nitrification cycle should be providing us with a constant supply of nitrates into our system. So ask yourself the following questions:

- Have I got enough bioload in my system (fish)
- Is my equipment removing any available nitrates from the system
- Am I dosing / using any products that are stripping my system of available nitrates, always try to understand what the pros and cons are of anything your using in your tank.

Usually by correcting one of the above (e.g. turning skimmer down, adding additional fish if there is a low bioload in your system) it should help raise the nitrates in our system. Please note, with regards to volume of fish being added, do this slowly. Remember slow and steady. Also add additional bacteria into the system periodically and test ammonia after adding new fish to make sure

the bacteria are doing its job. Another option is to feed a little more, which again, will help create waste for the bacteria to convert.

If after, say, a week of trying the above we're still getting a 0 reading on our test kits, then it's time to dose some nitrates into the system.

A product most people use for dosing nitrates is Brightwell's Neo-Nitro. There are loads of different brands / products on the market, so do your research before picking one. My advice would be to dose 25% of what is recommended on the bottle initially as we don't want a massive swing of nitrates. Slow and steady. Dose one day; test the next. If the level is still below the target level, then dose again. **READ & FOLLOW THE INSTRUCTIONS** provided on the bottle at all times. Also, don't forget to give the bottle a good shake before using every time.

It would be best to test nitrates daily or as a minimum every other day initially. If you're dosing nitrates, test the day after dosing. Once you hit your target level, stop dosing. Dose test dose test.

Keep testing. If the level drops, dose a little to boost it back up again. After a while of dosing and testing, you will get a feel for what appropriate amount is to dose. If the level gets too high, then consider a water change to lower. Eventually you and your equipment should become tuned in with waste production / removal, which will allow for more stability.

The calculation for dosing neo-nitro is

- Tank vol (in gallons) x parameter increase x 3.785 = amount to dose
- Example 48 x 3 x 0.1261 = 18.16ml
- We would suggest not trying to raise level by 3ppm per day.

Further information on brightwells neo-nitro can be found here:

https://www.brightwellaquatics.com/products/neonitrot.php

9.2 Phosphates

If phosphate levels are at 0, the process should be fairly similar to raising nitrates. Initially, you can try to over feed and/or remove anything that is stripping phosphates from the system (e.g. Rowaphos, GFO).

Similar to nitrates, if after a week your test kit is still showing 0, then it's time to dose some phosphates into the system.

Another product by Brightwell is called Neo-Phos. This is what the majority of people use for dosing phosphates. There are loads of different brands / products on the market, though, so do your research before picking one. My advice would be to dose 25% of what is recommended on the bottle in order to prevent a massive swing of phosphates. Slow and steady. Bring the levels up over the course of a week. Dose one day and test the next. If the level is still below the targeted level, then dose again. **READ & FOLLOW THE INSTRUCTIONS**. Don't forget to shake the bottle before using.

It would be best to test phosphates daily or as a minimum every other day initially. If you're dosing phosphates, test daily. Once you hit your target level, stop dosing. Keep testing and if the level drops, dose a little to boost it back up again. If it gets too high, then consider a water change to lower. Eventually you and your equipment should become tuned in with the waste production, which will allow for more stability.

The calculation for dosing neo-phos is

- Tank vol (in gallons) x parameter increase x = amount to dose
- Example 48 x 0.03 x 3.785 = 5.45ml

We would suggest not trying to raise level by 0.03ppm per day

Further info on Brightwells neo-phos can be found here:

https://www.brightwellaquatics.com/products/neophost.php

10.0 Activated Carbon

As part of the pre-ID section we mention running some activated carbon in your tank or sump. This is due to the majority of dinos being toxic (some more than others Ostreopsis & Prorecentrum).

Also be sure to soak / rinse out the carbon before putting it into your system as it will release a significant amount of carbon dust / particles that you do not want in your tank.

Rinsing in tap water is okay, but be sure to rinse in RO afterwards before putting it into your tank. Running Carbon will be key before hitting Ostreopsis too hard as they are the most toxic dino, especially when they start dying off. Carbon may need to be changed out weekly as it becomes exhausted.

In a bag is okay or in a reactor is even better, just remember that if it's in a reactor, you don't want the carbon to tumble as it will grind together and turn into dust that will then get all over your sump and display. If it's placed in a bag in the sump, make sure it's located in a high flow area and give it a mix up every now and again.

It should also be noted that overusing carbon can have an adverse effect on fish, specifically on tangs, so please ensure you read and follow the instructions. Don't overdose and change it as required. In many cases half the manufacturer's recommended amount of carbon is more appropriate than using the full amount.

As an example if you use Red Sea's Activated Carbon they recommend 50 grams per 200 litres of volume, however please check your carbons manufacturers guidance on dosing.

11.0 Dosing Bacteria

Bacteria is constantly consumed by other organisms within the home reef system, and it's a constant battleground for dominance at the microscopic level. It's best to ensure that the right types of bacteria stay dominant in your reef system. We suggest topping up your bacteria on a weekly basis. Three are various different types of bacteria on the market from Dr.Tims, ATM Colony that are generally used as part of the initial nitrogen cycle, a good bacterial type is Dr.Tims Eco balance as this product is though to add good bacteria into the tank and block out the bad.

Whichever one you pick, do some research online before making the purchase. Looking specifically at MicroBacter7, it can reduce your nitrates and phosphates. By the end of this document, you will get the gist that testing these parameters for the foreseeable future should almost be completed daily. So before starting to dose certain products that can reduce N03 and P04, it's a good idea to get these levels elevated first.

Dose as per the instructions on the bottle. Before dosing each time, give the bottle a good shake.

The calculation for dosing MicroBacter7 is as follows:

Initial dosing, we would suggest adopting the medium- to High-nutrient Systems, or to seed Biological Filtration in new aquaria method which means dosing daily for 2 weeks (UV and Skimmers off for 4 hours after dosing, also keep an eye on No3 and Po4 levels as MB7 can consume these.

- Tank vol (in gallons) / 25 gallons x 5ml
- 48 / 25 * 5 = 9.6ml

Following the initial seeding method we would then recommend adopting the Stable, Low-nutrient Systems method which advises to dose bacteria weekly as part of your general maintenance

- Tank vol (in gallons) / 50 gallons x 5ml
- 48 / 50 * 5 = 4.8ml

Further info on Brightwells microbacter7 can be found here

- https://www.brightwellaquatics.com/products/microbacter7t.php

Further info on Dr.Tims Eco balance can be found here

- https://www.drtimsaquatics.com/products/eco-balance/

12.0 Dosing Phytoplankton / Zooplankton

Dosing Phytoplankton / zooplankton is incredibly important to the aquatic food chain within our tanks. They utilize nutrients in the water along with carbon dioxide to reproduce and, in the process, create essential fatty acids (EFAs) critical to the health and development of most marine organisms. Dosing a highly concentrated batch of live phytoplankton is only going to benefit your tank.

Phytoplankton utilize nitrates, phosphates, iron, and other trace elements to produce proteins and essential fatty acids. The phytoplankton, in turn, are consumed by filter feeders and aquatic bugs like copepods, rotifers, etc., which pass these essential fatty acids on to fish and corals that manage to grab them.

Many of the aquatic bugs generally eat detritus, thereby keeping the tank cleaner naturally. Live phytoplankton are used in aquaculture to absorb and bind heavy metals. In this case the use of live phytoplankton will clean the water and lead to healthier corals and fish even if it is not used as a food source directly.

Live Phytoplankton will also remove nitrates and phosphates, consume carbon dioxide (stabilize pH), and oxygenate the water during the day part of the light cycle. Watch that your NO3 and P04 levels don't drop too quickly when dosing. It's a good idea to get these levels above 0 before dosing and don't dose too much.

Conservative advice is to start off with the addition of a minimal dose once per week and build up to several times per week. The gradual increase in feeding phytoplankton gives your system time to adjust to the phyto's presence. Remember to go SLOW AND STEADY with any changes in your system.

It is hard to say definitively that one should add a set amount to a set water volume. Trying to mimic nature with the exact amount of phytoplankton found in nature is not practical from a cost standpoint. The dose amount you decide upon will vary based on which organisms are in the tank,

how many organisms are in the tank, the aquatic environment you are trying to emulate, skimming, water changes, etc.

Live Phytoplankton needs to be stored in the fridge, and make sure to give it a good mix up daily even if not dosing any.

There are many places to purchase phytoplankton however generally the darker colour the higher concentration (this is what were looking for) If you're located within the UK a company called Reef Boost has offered our users a 10% discount on all there products, so if your looking for a high quality Phytoplankton give them a try. (Below prices will of course be subject to change) check out the post regarding this within the pages announcements section.

If you're interested in culturing your own Phytoplankton Reef Boost sell the required kits along with all the information you'll need to get you going.

We are also pleased to announce that we are now sponsored by Algae barn, you will be able to get 15% off on there site by using discount code **MACKSREEF15**, this offer is open to both US and international members. However please note international delivery costs will apply

	Description	Sizes	Direct Price
	**Nanno Uno** Freshly harvested Nannochloropsis phytoplankton. A smaller cell size and contains substantial amounts of the omega-3 fatty acid and high levels of polyunsaturated fatty acids. Very high lipid levels, and is ideal for feeding corals & culturing rotifers	275ml 500ml 1500ml	£6 £9 £20
	**Tetra Uno** Freshly harvested Tetraselmis Phytoplankton. A larger motile cell and contains substantial amounts of the omega-3 fatty acid and high levels of polyunsaturated fatty acids. Very high lipid levels and is ideal for feeding corals & culturing copepods	275ml 500ml 1500ml	£6 £9 £20
	**Phyto Trio** Blend of Nannochloropsis, Tetraselmis and Chlorella. The best of all the phytoplankton species in one bottle. Chlorella is very high in proteins and compliments the omega-3 and polyunsaturated fatty acids of the nannochloropsis & tetraselmis	275ml 500ml 1500ml	£6 £9 £20

13.0 Dosing Copepods

There is never a bad time to seed your reef with pods; however, the best time to seed is when the nitrogen cycle has stabilized in a newly set up system. At this time, nitrate build-ups have very likely resulted in the growth of undesirable algae. Algae provides a great food source for copepods (e.g. Tigriopus and Tisbe). These unsightly algal growths will decline as the pod population grows. The pod population size will stabilize after nitrate levels (and thus the algal growth rate) have levelled off.

It should be noted that Tigriopus copepods are not known for eating dinos, but they will help you outcompete them, so it's definitely worth adding them into your tank. They will only have positive effects on your reef's ecosystem. Tisbe pods is another discussion. These have been seen, through a microscope, eating dinos; however, in certain parts of the world (UK & Europe), these can be difficult and expensive to get hold of. If you can, it's worth adding these to your system also.

There is a process to adding these into your system, which is explained below:

If you order a few bags and you're not going to use them on the day you get home, then store these in the fridge. They should be okay in there for a few days.

Like all marine creatures, we need to make sure we temperature acclimate them to our tank's water temperature. If they are removed from the fridge and just added to the tank, chances are they will

mostly die due to temperature shock. Float them within the sealed container in either your sump or in the main display for around 30 minutes before they're added into the display.

The temperatures of the tank water and copepod container now match. The best time to add copepods into the tank is going to be after the main display lights have been off for 1-2 hours. If they're added in the middle of the day, expect your fish to go into a feeding frenzy. After the lights have been off for a couple of hours, the fish go into a kind of sleep / zombie mode, so the majority of what you add will survive.

As a general rule, you shouldn't add any water into your aquarium that has come from another tank as it could have anything in there, so the next step is going to be to use a copepod sieve to take the copepods out of the bag they came in and disregard the bag water. Before doing this, have a small amount of tank water in a small plastic container.

To give the copepods the best chance of survival, do the following when adding them to the system:

Ensure as above lights have been off for 1-2 hours

Just prior to adding, turn all flow off in the tank (return and wavemakers)

Use a long coral feeder to remove the copepods from the container and squirt them into the rock work and sand bed. This gives them the best chance of hiding away and eventually repopulating in the system.

Leave the return pump and wavemakers off for 30 mins after adding the copepods

From experience of adding a fair few of these, also leave the skimmer and UV off and filter socks out overnight. Once the flow goes back on, a lot of what's been added could end up in the filter socks or sump the next morning.

After 30 mins, turn all the flow back on and then get yourself off to bed 😊.

Just remember to TURN YOUR FLOW BACK ON.

As with the Phytoplankton Reef boost has offered our UK members a 10% discount on there products below is a package of copepods and rotifers (Below prices will of course be subject to change) check out the post regarding this within the pages announcements section. Algae barn also offers 15% off using code MACKSREEF15.

If you're interested in culturing your own copepods or rotifers, reef boost also sells packs that enable you to start these, the pack will also include all the information you need to get you going.

	**Mandarin Mix** Freshly harvested Copepods & Rotifers. There are adult male and female copepods along with juveniles making this an excellent starter culture or an essential feed for Mandarins, Copperbands and other fussy eaters	275ml 500ml	£9 £13	

<u>14.0 Live Rock vs Artificial Rock / Dry Rock</u>

I'm sure all reefers have read many, many posts / articles about the benefits of using artificial rock/dry (dead) rock vs using matured live rock. The main benefit of starting your tank off with artificial rock / dry rock is that no pests are present within the system on day one. This, for reefers of all experience levels, in theory, is a huge benefit since battling crabs / fire worms / aiptasia can be

painful. But the question is: Is it as painful as battling dinos for 6 months? With every positive there are of course negatives. Live rock is literally teeming with life, including matured bacteria and also lots and lots of microbiology.

One of the main issues with not starting a system off using live rock is that you're pretty much starting your tank off with 0 bacteria and 0 microfauna in your system. To build these and fully establish them in your tank takes time. Always remember that nothing good happens fast in a reef tank.

Yes, we can add bacteria such as ATM Colony early on for the nitrification cycle, but don't be fooled. This is only the first stage of cycling a reef tank. So when we start adding large amounts of fish / corals quickly (within a month of getting the tank wet) along with equipment (skimmer, phosphate removers, NO-POX etc.) to remove excess nutrients, we see massive swings in nitrates and phosphate levels in new tanks because the system is not yet stable. More often than not, this results in us bottoming out nitrates and phosphates.

Also, you will see many videos about maintaining super low nutrients on tanks and dosing things such as vibrant as a prevention of the ugly stage, etc. Just leave the tank alone to do its thing. Getting green hair algae in a new reef tank is completely normal.

Another battle that many people face is trying to maintain the magic 3ppm nitrate and 0.03ppm phosphates levels in early reef systems, which can be extremely difficult and will require testing these levels almost daily. You're also giving yourself no margin for movement. If there is any slight swing, then, boom, you've hit 0. Our advice: Give yourself some flexibility and target these a little higher, especially over the first 12 months of the life of your reef.

The key here is stability and not overloading your tank with fish and corals too soon and too quickly. Slow and steady. "Nothing good happens fast in a reef tank". If we do this too soon and too quickly before your system has matured enough to be able to deal with the large bioloads naturally without excess equipment to strip nutrients out the water, then chances are you are going to encounter issues with constant swings in levels.

My advice would be to allow your tank to cycle slowly early on and to seed your system early on with coralline algae. When you start seeing these spots in your tank, then your system is ready to support additional life (corals). Yes, we all want to have these established reefs full of corals early on. In reality, having tanks like the ones you see in shops and online literally takes years to establish.

Using artificial rock / dry rock is beneficial, but we need to make sure we are allowing our tanks and our rockwork to mature enough. This will take longer than if using actual live rock.

15.0 UV, Placement & Flow Rates

For the types of dinos that go into the water column at night (Osteoporosis and Coolia), the best and quickest way to deal with them is to install a high quality, oversized UV as per the following guidelines:

The recommended UV size is a minimum of 1 watt per 3 gallons / 12 litres. The higher the wattage the better. This is essential to ensure maximum contact time for any water that passes through the UV. We would not recommend Green Killing Machine UV units as these have high pre-set flow rates. People appear to get poor to no results from using them. A high quality UV, such as D-D are great. If you are in the United States, Jebao UVs are very well priced and work well for dinos.

Flow through the UV should be very slow. The general rule of thumb is 1 to 3x gph/lph for the tank's volume. This is usually about 65-100gph (250-400lph) on smaller tanks or 90-200gph (350-750lph) on bigger tanks (Pathogen flow rate).

UV should be temporarily set up above your tank / at the side of your tank, pulling and returning water from your display. Run at least 12 hrs during lights out (can be run 24/7, just remember to turn off for an hour when dosing phytoplankton). The UV intake pump should be located as close to the sand bed as possible. Running the UV in the sump, in our experience, is nowhere near as effective. You can also run multiple UV's connected together if you have a large system.

UV should be turned off for an hour after dosing phytoplankton / copepods / bacteria because the UV will zap anything that goes through it.

16.0 Dosing Waterglass / Seahorse Breeder Silicates

We recommend dosing waterglass to initiate a diatom bloom for certain types of dinos. Other silicate options can be very expensive in the long run, such as dosing Brightwell's SpongExcel (it generally takes a large volume to hit the 2-3ppm sweet spot).

- Recommend 36 - 41% liquid sodium silicate (Waterglass)
  - For the above concentration, we recommend dosing 0.1mL per 15 gallons (55 liters) of tank volume for 1ppm of silicate.
  - Aim for 2-3ppm.
  - For example, on a tank that's 60 gallons:
  - 60 gallons / 15 gallons = 4
  - 4 x 0.1mL = 0.4mL - This gives you the dosage to get to 1ppm silicate
  - 0.4mL x 2= 0.8mL – this amount should give you 2ppm silicate

Do not directly dose waterglass into the aquarium as it generally just turns into a solid. It should be mixed in with around 250ml of RO water and given a good shake, then poured slowly into a high flow area (return pump area / wave maker).

Some precipitation from silicate dosing is normal. It is magnesium being precipitated out. It should all almost completely dissolve back eventually and does not typically affect your magnesium any noticeable amount.

Test kits are not usually reliable when it comes to SI, especially salifert; however, Colombo's SI test kit seems to be reliable.

Test and once you hit the 2-3ppm sweet spot, stop dosing and only then re-dose once the level falls below the above. Silicate is used up very rapidly and most people will need to dose daily, especially at the beginning.

Although 2-3ppm is the target, in our experience and others there is no effect on livestock in the tank when levels have been accidentally dosed and maintained significantly higher (we have seen 16ppm and higher)

It should be noted that while dosing waterglass / silicates, a decrease in alkalinity uptake can occur. We recommend regular testing and adjustment of dosing in relation to alkalinity, calcium and magnesium. To start, you should be testing these daily to catch any change in levels.

We are also currently exploring adding a mix of silicates into systems to see if this is more effective at out-completing the dinos e.g. waterglass, seahorse breeder and brightwells sponcExcel, the thought process here is that this should input a mix of diatoms into your system therefore accelerating the diatoms outcompeting the dinos, I tested this method personally using waterglas sand seahorse breeder silicates (only available in UK / Europe) and saw a much quicker and diverse diatom bloom.

17.0 Hydrogen Peroxide (H202 Dosing)

Dosing hydrogen peroxide (H2O2) can help. In small amounts, it is generally safe to dose 3% H202 @ 1ml per 10gal/ 37 litres every 24 hours, just make sure it's food safe and you should be good to go. You can get a higher % h202 you will just need to adjust dosing to suit, there are a couple of examples below:

- 3% h202 – 48 gallons / 10 gallons * 1ml = 4.8ml
- 6% h202– 48 gallons / 10 gallons * 0.5ml = 2.4ml
- 12% h202 – 48 gallons / 10 gallons * 0.33ml = 1.58ml

Dosing h202 can be very beneficial for your aquarium in terms of keeping algae at bay and with regards to gas exchange. It can be dosed by broadcasting (dose into a high flow area) or spot treating onto problem areas (make sure all flow is turned off)

If there is just a patch of dinos in one area, a small amount can be dosed directly onto this area with all flow in the tank turned off. Watch it bubble away.

We recommended using H202 at a strength of 3% that is **food-grade**. Dose this into a high-flow area within your system (directly into wave maker / return pump area). It is also recommended that you dose some nitrifying bacteria on a weekly basis while dosing H202.

12% food grade H202 can be used; however, the dosing amounts mentioned would need to be divided by four for the correct amount.

While dosing H2O2 is overall safe for livestock Lysmata shrimp (cleaners, fire, and peppermint) are more sensitive to it. While many people experience no ill effect to their shrimp when dosing the recommended amount, it is possible that it could harm those particular shrimp.

We also advise to dose H202 after the lights have been off for an hour of so as again it has been known on occasion to irritate anemones and other corals. So in our experience it is best to dose into

a high flow area (return pump chamber) an hour after the lights have been off as the majority of corals will have closed up by then.

18.0 Cleaning of the Rockwork / Sandbed

18.1 Cleaning of the Sandbed

Another good method of removing a large amount of dinos quickly from the system is to syphon them off the sand bed. Generally (in the UK) we would recommend a product called Aqua-one Vac-A-Tank gravel cleaner. This product tumbles the sand and removes very little from the system. A standard cleaner can be used but expect large amounts of sand to also be removed also

As we don't want to be removing large volumes of water from the system (if your levels are already super low), we recommend placing a filter sock into your sump and basically re-circulating the water around the system instead of removing large amounts of water. The filter sock will remove the dinos and any rubbish in the sand.

Recommend 5 -10 micron-sized filter socks

Dinos range from 13- 85 microns hence the 5-10 micron filter sock.

Anything larger than 5 to 10 micron filter socks will just allow the dinos to recirculate in your system, and we don't want to do that.

Make sure you clip the tube coming from the sand vac into the filter sock so it doesn't unexpectedly flick out of the sock and spray water everywhere (yes, I learnt that the hard way).

18.2 Cleaning of the Rockwork

Depending on the type of dinos you have and if they are on the rockwork too, you should use a type of baster (turkey baster) to give your rockwork a good blast every night to make sure they are removed from the rockwork and enter the water column so they can either be removed by your filtration or go through the UV and get zapped by that. As part of your weekly maintenance, you should give you rockwork a good blast just to make sure any detritus doesn't build up within the rockwork because it will cause issues further down the line when it is eventually released into the water column. If you are seeing large amounts of waste build-up in your rockwork, then this would, no doubt, be an issue caused by lack of flow within your tank so you may need to look at adding a wave maker or two or turning up the ones you already have in your tank.

19.0 Blackouts

So do blackouts actually work, in our experience the answer to this is no and we don't recommend them especially if you have SPS within your system as this can really stress them out and cause bleaching. There is evidence out their that suggests that long blackout (7-9 weeks) can cause certain strains of dinos to disappear completely, this isn't really applicable for most of us as we have corals within our systems, a blackout duration like this would causes extreme stress and most likely death of all corals within the system not to mention the adverse effect on the tanks micro-biology.

However generally most reefers will look at 3 day blackouts the tricky thing with short blackouts and dinos is this can force them into protocysist (type of hibernation) and they can then lie dormant for weeks even months just waiting for the right conditions to return. So initially it will look like they have cleared but in reality they will be back in a few days when light hits the system again, which is why generally unless the underlying issues are resolved then they will come back generally with a bang the second time around.

20.0 Dino-X Dosing

This method can be very harsh on corals, we generally don't recommend this as our methods described above do work, the advice throughout this document is about slow and steady approaches to allow for the balance to be slowly corrected in favour of the good micro-biology. Dino-X will cause a sudden die off of the dinos with nothing there to take there place so in the majority of cases the dinos return.

DinoX can be used as a last resort, however we would advise that any corals cac be temporally moved into another system then this should be completed as a precaution, some people see zero losses but sadly others see significant losses. It should be noted that DinoX does not work on all types of dinos, for many people who have used this method initially the dinos appear to have cleared only for them to return a couple of weeks later.

21.0 Completing Water Changes

Okay so with water changes the general consensus is don't do them if dinos are dominant with the system as the dinos will thrive when new water is added into the system.

What we recommend is only do water changes if your no3 / po4 levels (too high), you use water changes to keep Alk, cal and mag in check or based on ICP results / advise due to pollutants being present in the system.

If water changes are required we would recommend using a high quality salt mix that does not contain high levels of iron, one of our team recently had an ICP completed based on a clean salt mix using Tropic Marin pro, the snapshot below shows the results elevated levels of iron, manganese, Lithium Barium, it is believed it's the high iron content within fresh salt water mixes causes the dino population to increase.

We also recommended that within a 24hr period only 10% - 15% water changes are completed. If you need to do more then spread them out over a few days. The elevated levels in tropic marin pro detailed above and below if completed on 10% water changes won't cause a major swing in levels and have an impact on your tanks corals, however complete a 50% water change in one setting then it could cause a big swing in the above levels, corals, inverts, micro-biology wont react well to a sudden swing in parameters including trace elements.

We would recommend currently doing water changes using red seas blue bucket salt as the general consensus is this doesn't have high iron levels, the below link is to a post on Reef to reef where

Jason2459 has put together a number tests based on fresh salt mixes and posted the relevant ICP results of these.

https://www.reef2reef.com/threads/saltmix-parameters-bring-on-the-test-results.233233/

Trace Element	ICP Reading	ATI Baseline Level	Difference
Lithium	184.4 µg/l	165.0 µg/l	+19.42 µg/l
Silicon	81.63 µg/l	97.03 µg/l	-15.40 µg/l
Iodine	44.57 µg/l	63.07 µg/l	-18.50 µg/l
Barium	21.97 µg/l	9.70 µg/l	+12.27 µg/l
Molybdenum	7.78 µg/l	11.64 µg/l	-3.86 µg/l
Nickel	u.	0.49 µg/l	-0.49 µg/l
Manganese	180.1 µg/l	0.97 µg/l	+179.1 µg/l
Arsenic	u.	1.46 µg/l	-1.46 µg/l
Beryllium	u.	0.10 µg/l	-0.10 µg/l
Chrome	0.28 µg/l	0.49 µg/l	-0.21 µg/l
Cobalt	u.	0.10 µg/l	-0.10 µg/l
Iron	20.89 µg/l	0.49 µg/l	+20.40 µg/l
Copper	u.	0.49 µg/l	-0.49 µg/l
Selenium	u.	0.49 µg/l	-0.49 µg/l
Silver	u.	0.10 µg/l	-0.10 µg/l
Vanadium	1.03 µg/l	1.46 µg/l	-0.43 µg/l
Zinc	1.25 µg/l	1.94 µg/l	-0.69 µg/l

22.0 Removal of the Sand Bed

A possible option (shouldn't be the first option) for aiding in removal of dinos from the system is to progressively remove the substrate / sand bed from the tank, however this option can simply force specific types of dinos onto the rockwork as appose to the sandbed. We understand the frustration with some types of dinos staying dominant in systems in some take for weeks or even months. We would advise to use this option as a last resort as the sand in your system houses a lot of the good bacteria and microbiology, remove the sand and your removing there home. Stick with our methods they DO WORK it just takes time, allow for things to happen naturally and over time. Nothing good happens fast in a reef system.

Either way correct the underlying issues in your system – lack of bacteria, Low / depleted No3 / Po4, high / low / imbalance in trace elements, lack of micro-biology or removing the sand bed wont make any difference the dinos will remain dominant but just find another surface to dominate.

As an Alternative option the sand can be removed from the tank in sections and treated in hydrogen peroxide then rinsed in RODI water and returned into the tank, target a section of the tank each day the sand will need to be treated at a higher concentration of H202 per litre than explained within section 17.

23.0 Future updates / Areas of further exploration

- Raising temperature – metabolic reaction generally not proven to work.
- Adding clean up crew - This is not advised as a solution to dealing with dinos, the main issue here is the toxins that are released by the dinos once eaten, this will result in the death of majority of clean up crew that each any alage with dinos in it. Adding a sand sifting goby again is not advised as it will most likely suffer the same fate as the clean up crew.

- Vibrant dosing – can strip your system of Nitrates and Phosphates quickly, dosing vibrant is generally the cause of a lot of people bottoming out their NO3 and PO4 and opening the door for dinos.
- Bubble scrubbing – can be productive if you have Ostreopsis or coolia, generally best completed after the lights have been out a few hours and the dinos have entered the water column.
- Raising PH / methods of keeping PH stable – Only positive benefits will be seen in a reef system by keeping your PH stable and even more positives can be seen if you can hit the magic 8.3 to 8.5 number and keep it stable. Drawing fresh outside air into your skimmer can help, or attaching a CO2 scrubber onto your skimmers air-intake as this will remove the CO2 from the air before it goes into the skimmer. More surface agitation etc etc
- Water changes – water changes using salt with high iron content thought to cause issues.
- Feeding – adding iron via feeding Mysis shrimp?
- Further detail on trace element / pollutant corrections
- Why do we tend to get Cyano during treatments – While trying to get your nutrients up it can be a bit of a balancing act but over time using the methods detailed above it will enable you to stabilise them, you will get cyano in your reef tank if your nitrates and phosphates are out of balance e.g. nitrates 25ppm Phosphates 0.03ppm, the good news is the cyano will help outcompete the dinos so don't be too quick to dose products such as chemiclean to clear them quickly as you could just be giving the dinos the space to re-colonise in. Our advice would be to increase flow via wavemakers, get your no3 and po4 back in balance as we have described within section 9.0 and even syphon it out using the method in section 18.1 and the cyano should go away on its own. If it persists and starts impacting on corals then it may be time to resort to chemicals to clear.

22.0 Appendices

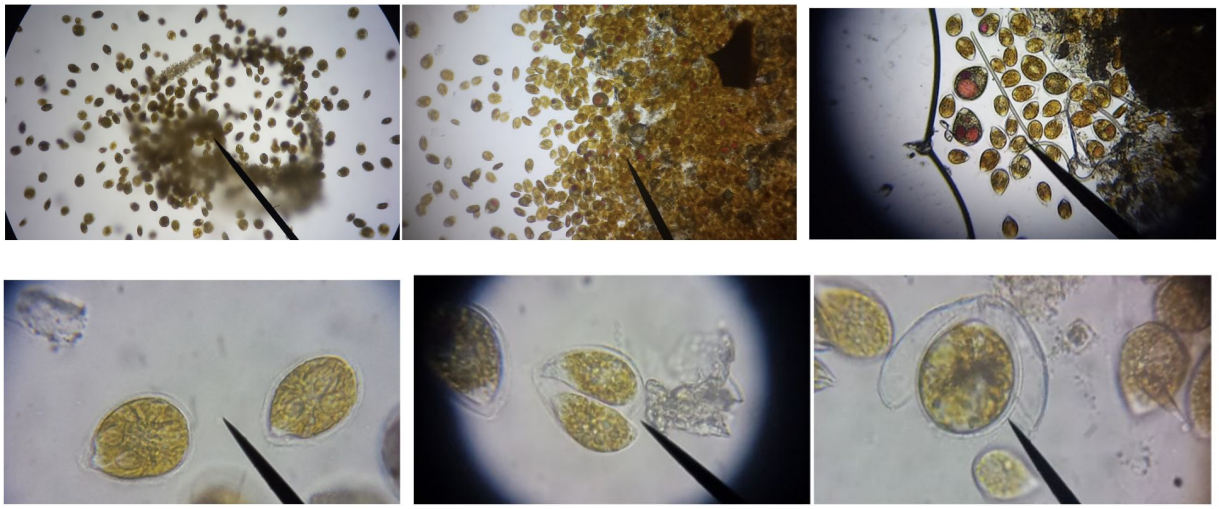
- **Full Dino ID extracts as produced by Taricha on Reef to Reef**

A Guide to Dinoflagellate Identification in Reef Aquaria

By Jonathan Begnaud (taricha)
Version: 12/12/2019

The Big 3

Ostreopsis



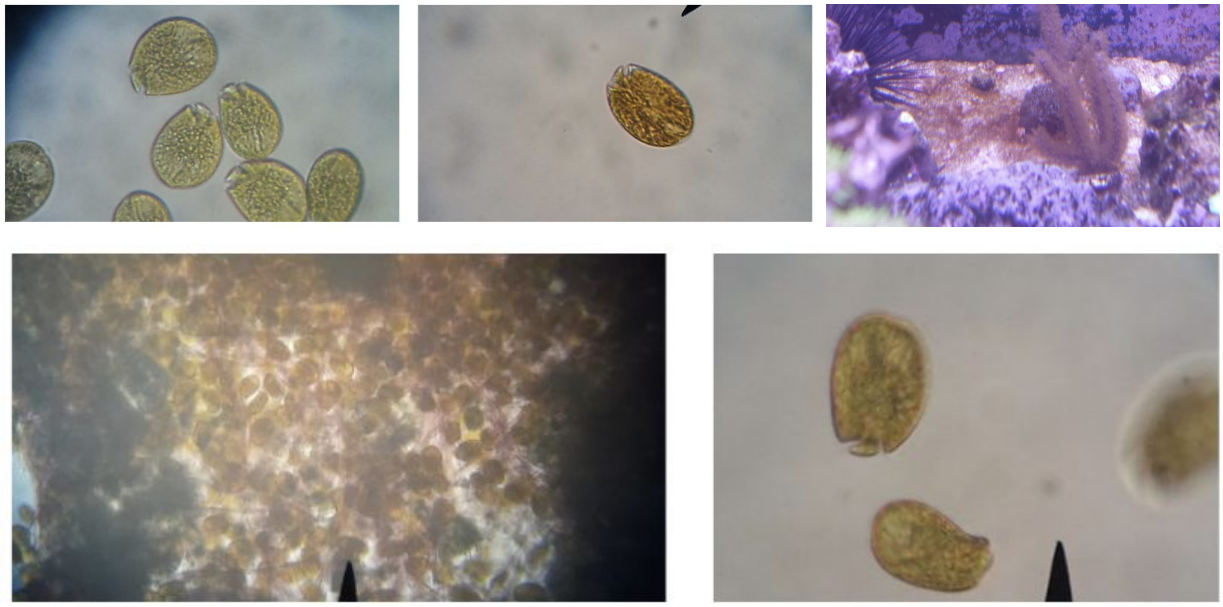
Top left and center: Ostreopsis populations. Top right: abnormal cells with red accumulation bodies compared to normal cells. Bottom Left: normal cells. Bottom center: cell division taking place within theca. Bottom right: cell either shedding theca to enter cyst state, or shedding short term cyst to resume normal growth.

Videos (AlgaeID)
Videos (Author)

Size:~40-80µm	Mucus: Medium	Tank Position: High
Toxin: High	Strands: Long >1” (microfibers)	Cysts: 2 kinds
Night Migration: Into Water	Bubbles: High	Surfaces: Rock, Macros,
Armor: Yes	Flow: High	Coral skeleton, rough etc
Similar Described Species: Ostreopsis Ovata	Sesame seed shape with lighter colored pointed end. Often spins in circle with point toward the center of spin. Clear cellulose shell (theca) often visible as outline of the cell.	

The most common bloom culprit and accounts for the majority of tank losses due to dinos, can make long strands by combination of microfibers and mucus. Two types of cysts: short term - hours to days, or long term - months until warmth and nutrients are favorable. In wild, forms huge blooms covering macroalgae.

Amphidinium (Large-Cell)



Top left and center & bottom right: Large Cell Amphidinium. Top right: outbreak on sandbed. Bottom left: Large Cell Amphidinium colonizing a cyano mat.

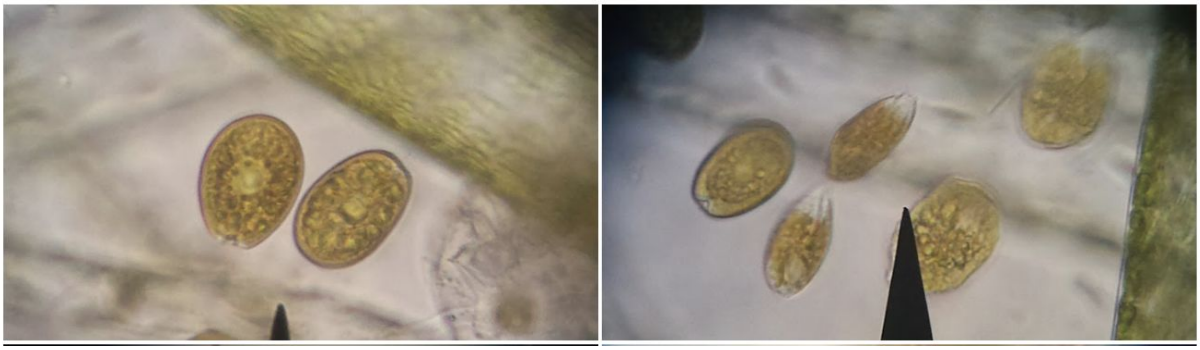
Videos (Author)
Video (AlgaeID)

Size:~30-60µm	Mucus: Low	Tank Position: Bottom
Toxin: No/Low	Strands: None	Cysts: None
Night Migration: Into Sand	Bubbles: Low	Surfaces: Sand, Rock, Cyano Mats
Armor: No	Flow: Low	
Similar Described Species: A. operculatum(?) A. mootonorum(?)	Oval shape with a “beak” at the front. In some populations, beak tilts left / right. No armor, and cells can be slightly flexible in shape. Moves “like a roomba” -Jason_1982	

Brown dusty appearance resembles diatoms to the eye. Due to staying in/under sand, less susceptible to chemical kill methods than other species, and cannot be targeted by UV or other water filtration methods. Unharmed by extended darkness and metronidazole (antibiotic that affects chloroplast). May be susceptible to grazing (snails, amphipods etc) due to low toxins. Least harmful type of dino, so aggressive “treatments” kill much more livestock than the dinos.

.

Prorocentrum



Left: Prorocentrum. Right: Prorocentrum with Ostreopsis cells

Video1

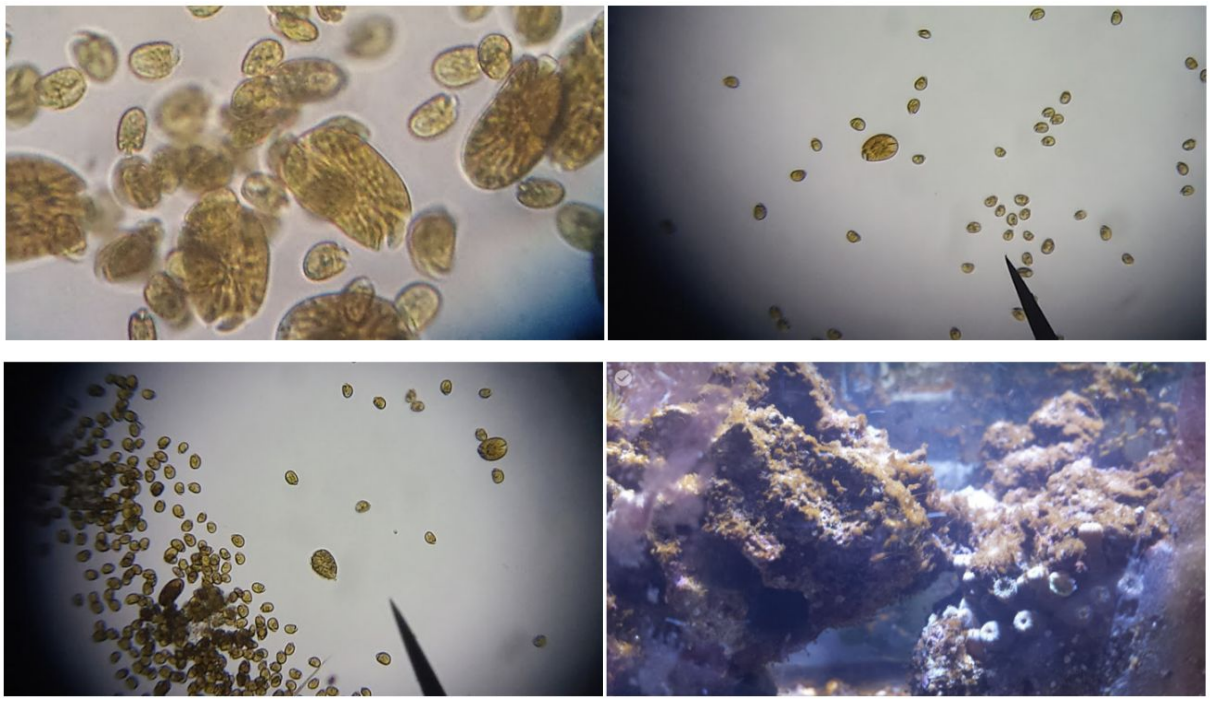
Video2

Size:~30-60µm	Mucus: High	Tank Position: Middle to Low
Toxin: Med/High	Strands: Short or none	Cysts: Yes
Night Migration: Into Water (less willing)	Bubbles: Med	Surfaces: Macros, Any Surface
Armor: Yes	Flow: Medium	
Similar Described Species: Prorocentrum Lima	Perfectly left/right symmetric ovals with small indentation at the front. Circular structure in center of cell (pyrenoid). Theca not usually visible unless it's been shed. Movement style like amphidinium, but less. Most likely dino to be motionless.	

Least common of the "common" varieties. Can colonize any surface - even live copepods - by heavy mucus production. Swims almost identically to Large Cell Amphidinium, though frequently seen motionless in mucus. Goes into water but needs some change in conditions (like short blackout) to trigger large nightly migration into UV.

Others Rarely Found in Aquaria

Amphidinium (Small Cell)



Top left & right: Small Cell Amphidinium with Large Cell Amphidinium. Bottom left: Small Cell Amphidinium with Ostreopsis cell center and Large Cell Amphidinium upper right. Bottom right: Mixed Small/Large Cell Amphidinium outbreak on rocks.

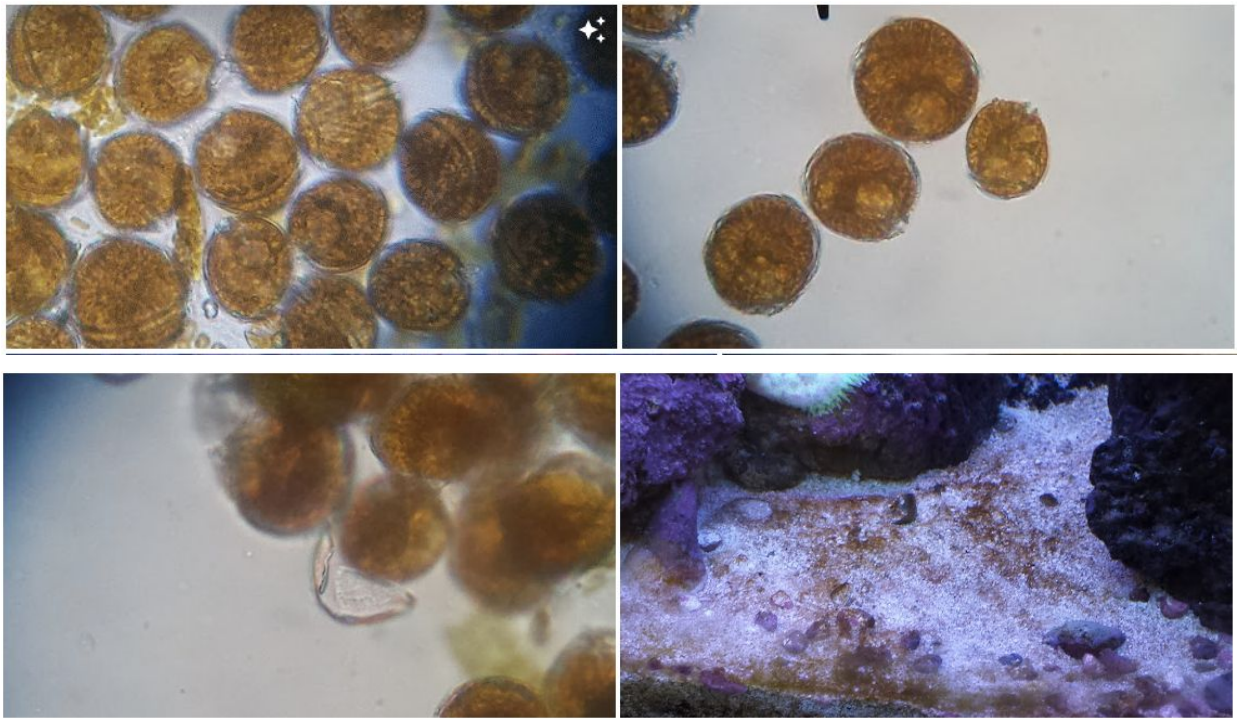
Pics and Vids (author)

Video (author)

Size:~10-15µm	Mucus: Low	Tank Position: All
Toxin: Low-Medium	Strands: Short	Cysts: No
Night Migration: Into Water	Bubbles: Low	Surfaces: Rock, Any
Armor: No	Flow: Medium	
Similar Described Species: Amphidinium Carterae	Appears like the more common Large-Cell Amphidinium, except roughly a third or fifth of the size, and much faster and more active swimmer. Beak always with a sideways bend.	

Most active, fastest swimmer of our dinos and spreads easily to all surfaces. Due to movement into the water and its toxins, should be treated as similar to all other dinos and not like the large cell amphidinium cousins. Has been reported to self-destruct by 9th day of darkness.

Coolia



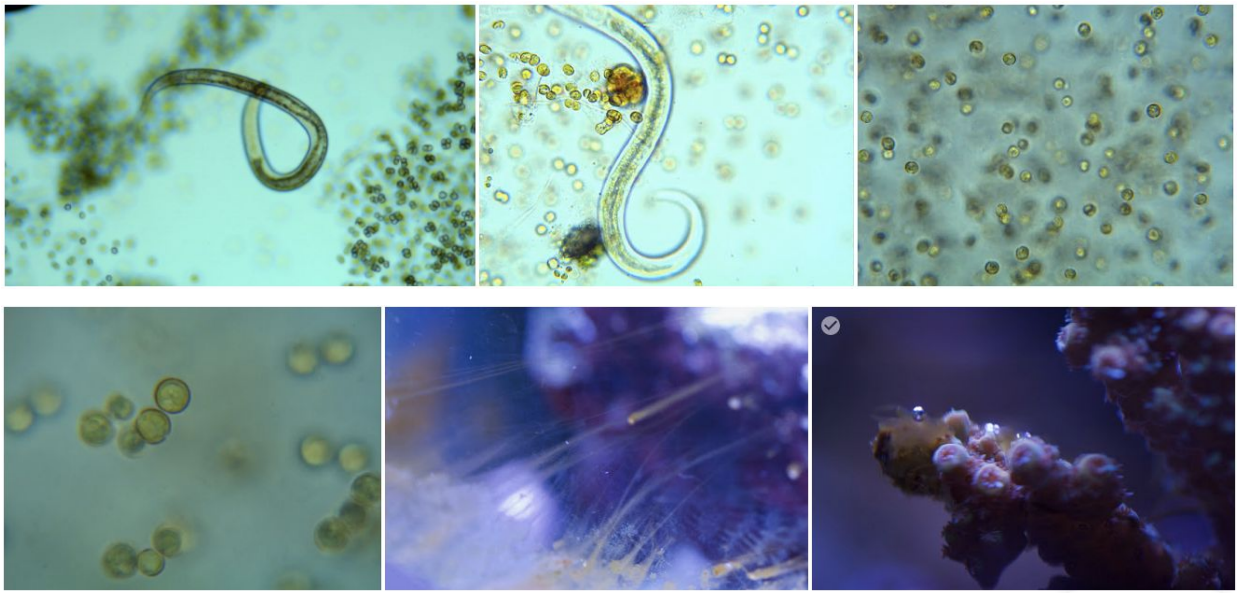
Top left & right: Coolia cells. Bottom left: theca being separated from cell. Bottom right: Coolia outbreak on sand in a tank.

Pics and vids

Size:~30-50µm	Mucus: Medium	Tank Position: Low
Toxin: Low-Med	Strands: Short	Cysts: Yes(?)
Night Migration: Into Water	Bubbles: Low	Surfaces: Rock, Algae, Sand
Armor: Yes	Flow: Low	
Similar Described Species: Coolia Monotis	Almost spherical, strong grooves cut across the cell. Theca (armor) is apparent. Moves in short bursts with change in direction. Overall effect is moving in small circles.	

Very closely related to ostreopsis, and should be treated similarly, but is much more likely to be found on the sand. Like prorocentrum, may need additional changes to force into the water to be UV susceptible.

Symbiodinium-like (Chrysophyte?)



Top left & center: Symbiodinium-like cells with a nematode - (center also contains a planktonic dinoflagellate - likely Akashiwo). Top right and Bottom left: Zoomed in view of cells. Bottom center: cells & mucus forming strands. Bottom right: cells & mucus forming blobs. Pics courtesy user NCreefguy

Pics

Size:~5-15µm	Mucus: Very High	Tank Position: Middle
Toxin: Low(?)	Strands: Long >1”	Cysts: No(?)
Night Migration: ?	Bubbles: Low	Surfaces: Rock, Any
Armor: No	Flow: Any	
Similar Described Species: Sarcinochrysis marina(?)	Very tiny, entirely motionless golden cells. Embedded in thick mucus. The mucus hold its shape out of water, which is distinguishing from dinoflagellates. Additionally, is more yellow than more brownish dinoflagellates due to pigment differences..	

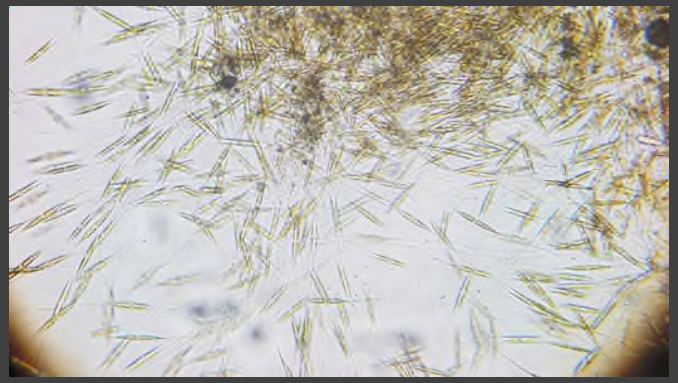
This is not a dinoflagellate. It is believed to be a chrysophyte, but is included because its blobby mucus-y appearance is only elsewhere seen in dinoflagellates.

Others

There are 2000+ species of dinos so many different species could be present in an aquarium, but people’s reef tanks all seem to create similar conditions that allow only the same few species to bloom. If, however you have a non-standard system like no skimmer, then your tank will be habitable by a much wider, totally different population of dinos than those discussed here.

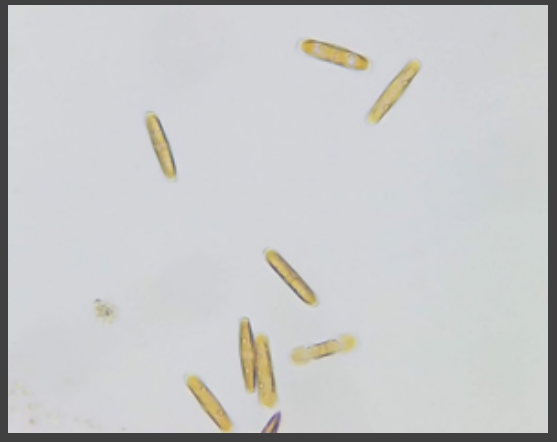
Various Types Of Diatoms

Epiphytic Diatoms

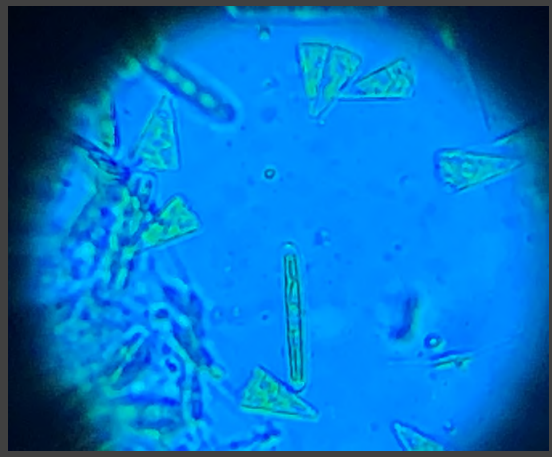


Pennate Diatoms

Zig Zag Diatoms



Pennate Diatoms



Pizza Diatoms