GB

REEF CARE PROGRAM

Algae Control

Testing and Supplementing

Red Sea

Red Sea's Reef Care Program

The complete Reef Care program is the result of years of research into the physiological demands of SPS, LPS & Soft Corals in the reef aquarium. The complete program has been divided into 4 distinct but complimentary sub-programs according to the various biological processes that take place.

In addition to the Algae Control program, which is fully described below, the complete Reef Care program also includes the following:

Reef Foundation – Provides biologically balanced levels of the foundation elements (calcium, carbonates and magnesium) that ensure the optimal water conditions for a sustainable, vibrant coral reef.

Reef Colors – Provide the essential minor and trace elements that are part of the coral skeleton and soft tissue and are specifically important for SPS corals to display their natural pigments.

Reef Energy – Provides the carbohydrates, vitamins and amino acids that fuel all metabolic processes of corals.

For optimal results you should implement the complete program.

Algae Nutrient control

Micro-biological reduction of algae nutrients (nitrates & phosphates) occur naturally in all anoxic areas of the aquarium (inside live rocks, porous filter media and substrates). This bacterial activity is limited by the availability of suitable carbon sources and mineral co-factors and under normal conditions is unable to reduce all of the algae nutrients generated on a regular basis. Supporting the natural processes by regular dosing of a suitable carbon source and mineral co-factors provides an easy and reliable method of incremental control of the algae nutrient levels to safely control both the presence of nuisance algae and the population of the symbiotic Zooxanthellae. Incremental control is most important with stony corals, allowing the corals to gradually adjust themselves to the subsequent changes in exposure to UV radiation, increase in required energy production and decreased rates of coral skeleton growth (skeletogenisis).

Coral's Symbiotic Zooxanthellae Algae

Understanding the role played by the symbiotic Zooxanthellae algae and their relationship with the coral is essential for successful implementation of the algae control program.

In nature corals host Zooxanthellae populations at densities of 0.5 - 5 million/cm2 that are located inside the coral soft tissue. The corals derive approx 85% of their energy from the Zooxanthellae and produce the remaining 15% in their soft tissue by metabolizing coral nutrients (Carbohydrates, Amino and Fatty acids) that are available in the surrounding water. This energy fuels all of the corals' metabolic processes such as protein production and skeletogenisis.

The Zooxanthellae use the strong sunlight on the tropical reef as their primary energy source and pass on up to 95% of their photosynthesis products (Carbohydrates, Amino and Fatty acids) to their coral host, utilizing the balance for their own metabolic processes. The coral host provides the Zooxanthellae with nutrients, nitrogenous compounds,

phosphates and CO_2. It is this symbiotic relationship, involving the recycling of nutrients, that is the key to the ecological success.

Another aspect of this symbiosis relates to photo-protection from strong radiation. In nature, the Zooxanthellae protect the corals from intense UV radiation by absorbing the light energy and shading the delicate inner layers of the coral soft tissues.

In nature the Zooxanthellae population density is controlled by the algae nutrients (nitrates and phosphates) excreted by the coral, however in an artificial reef aquarium the amount of algae nutrients accumulate rapidly and if left uncontrolled will induce an over-density of the Zooxanthellae populations.

The high nutrient induced over-density of the Zooxanthellae population disturbs the natural balance causing competition between the Zooxanthellae and the coral for the available resources such that without additional nutrition the coral may become undernourished. Furthermore the increase in Zooxanthellae population causes the corals to become darker with a deep brown tint that obscures the natural vivid pigments of the coral. Higher Zooxanthellae population densities within the acceptable range will however provide the coral with the energy required for accelerated coral growth.

Reducing the algae nutrients in the water will reduce the Zooxanthellae population to the level that can only be supported by the algae nutrients supplied directly by the coral. Under these conditions the coral will receive less energy from the Zooxanthellae and will have less protection from the UV radiation. In this situation, if suitable coral nutrients (Carbohydrates, Amino acids and Vitamins) are readily available in the water, the soft tissue of the coral can increase its internal production of energy and assuming the necessary trace elements are available in the water, the coral will increase its natural UV protection by enhancing pigmentation of the soft tissue which is seen as enhanced coloration.

Enhanced Coloration or Accelerated Growth

Enhanced coloration and accelerated growth require different water conditions. It is relatively easy to maintain the conditions for accelerated coral growth. Maintaining the conditions for enhanced coloration is more demanding in that it requires a higher level of attention to the water parameters. It is theoretically possible but not recommended to achieve both accelerated growth and advanced coloration simultaneously as the system will always be on the edge of instability.

Accelerated coral growth

To achieve accelerated coral growth set the algae nutrient levels to maintain a relatively high population of Zooxanthellae that will provide enough energy to the corals for growth. For this to work properly it is necessary to ensure:

- Algae nutrient levels of 1 – 2 ppm nitrate and 0.1 ppm phosphate
- Boosted and balanced levels of the Foundation Elements [Alkalinity 12.6dKH / 4.5meq/L, Ca 465ppm, Mg 1390ppm] to properly utilize all of the extra energy
- Availability of the minor and trace elements (Reef Colors) taken up by the corals during growth [I2 0.06ppm, K 410ppm, Fe 0.15ppm]
- Sufficient coral nutrients (Reef Energy) to supplement the energy supplied by the Zooxanthellae [2ml of Reef Energy A & B per 110Liter/25gal]

Note: During periods of accelerated growth, coral will display a brownish tint

Enhanced coral coloration

To achieve enhanced coloration set the algae nutrient levels to maintain a reduced level of Zooxanthellae, reducing the brownish tint of the corals and inducing the protection response of enhanced coloration. For this to work properly it is necessary to ensure:

- Algae nutrient levels of 0.25 ppm nitrate and 0.02 ppm phosphate
- Reduced levels of the Foundation Elements [Alkalinity 8.2dKH / 2.9meq/L, Ca 430ppm, Mg 1310ppm] to lower the energy demand from coral growth
- Availability of the minor and trace elements (Reef Colors) used in the soft tissue for increased coloration [I2 0.06ppm, K 380ppm, Fe 0.15ppm]
- Increased coral nutrients (Reef Energy) to provide the additional energy that the coral needs to receive from the environment [4ml of Reef Energy A & B per 110Liter/25gal]

NO_3:PO_4-X

NO_3:PO_4-X is a unique complex of carbons that are used by nutrient reducing bacteria. Each carbon in the complex is utilized by different strains of microorganisms while ensuring the specific Carbon:Nitrogen:Phosphorus ratio required for each stage. The complex includes other organic bonded elements that are important stimulators in each stage of the reduction process. These metal and non-metals elements ensure steady bacterial propagation and complete nitrate reduction to nitrogen gas and the absorption and utilization of phosphate by the bacteria.

The fine control of the nitrate and phosphate levels provided by monitored dosing of NO_3:PO_4-X guarantees the gradual changes and accurate maintenance of the nutrient levels preventing destruction of the Zooxanthellae population that can cause UV shock and starvation of the corals.

Unlike some other low-nutrient regimes, correct use of NO_3:PO_4-X will maintain all of the micro fauna that are beneficial for the reef.

NO_3:PO_4-X is recommended as a complete carbon source for use with carbon based de-nitrators.

Do not use NO_3:PO_4-X in conjunction with sulphur based de-nitrators or phosphate and nitrate removers as the different methods for nitrate and phosphate reduction will cause interference.

The Algae Control Test Kits

Nitrate Pro test kit is an advanced colorimetric comparator test, measuring the level of nitrate to an exceptionally high resolution of 0.25 ppm.

Phosphate Pro test kit is an advanced colorimetric comparator test, measuring the level of phosphate to an exceptionally high resolution of 0.02 ppm.

General instructions for testing NO_3 & PO_4 and dosing NO_3:PO_4-X

1. Only use NO_3:PO_4-X according to the enclosed instructions.
2. Test only with high resolution test kits such as Red Sea's Nitrate & Phosphate colorimetric comparator Pro Kits.
3. The NO_3:PO_4-X dosing chart (on back of product) is based on treating 100 liters / 25 gallons of water. Estimate your total volume of water (aquarium & sump less volume of live rocks etc) to calculate the correct dosage for your system.
4. NO_3:PO_4-X should be added to the sump. If you do not have a sump, add NO_3:PO_4-X slowly to an area with high water flow to prevent direct contact with the corals.
5. Efficient protein skimming is essential to provide the necessary oxygenation of the aquarium and to remove bacterial flocks from the water.
6. NO_3:PO_4-X must be added consistently on a daily basis to prevent starvation and destruction of the nitrate and phosphate reducing bacteria. If you miss one or more days of using NO_3:PO_4-X do not add the amount that you have missed and resume the dosing at the current daily dose.
7. For optimal results It is recommended to add NO_3:PO_4-X with a dosing pump.

NO_3:PO_4-X - Directions for use

Controlled nitrate and phosphate reduction

In biological nitrate and phosphate reduction there is direct relationship between the reduction of nitrate and phosphate, the reduction rate of nitrate being higher than that for phosphate. The dosing of NO_3:PO_4-X is therefore regulated by measured levels of nitrate however in lower nutrient systems is important also to monitor the levels of phosphate.

Prevention of nuisance algae in Marine fish and Soft Coral aquariums / Accelerated growth – LPS and SPS corals

Before starting to use NO_3:PO_4-X measure and record the level of Nitrate in the aquarium

Start with the recommended daily dosage, test the nitrate every week and adjust the dosage until the nitrate level is stable between 1 and 2.5 ppm.

Measured Level (ppm)	Daily Dosage ml / 100 l (25 gal)
NO_3 above 10	3
NO_3 above 2.5 but less than10	2
NO_3 above 1 but less than 2.5	1

In the event that the nitrate level drops below 1ppm cut the daily dose by 50%. Test nitrate 2 times per week and adjust the dosage accordingly until it stabilizes between 1 and 2.5 ppm.

Enhanced coloration – LPS and SPS corals

Before starting to use NO_3:PO_4-X measure and record the level of Nitrate and Phosphate in the aquarium

Start with the recommended daily dosage, test the nitrate every week and adjust the dosage until the nitrate level has been reduced to approximately 1ppm.

Continue daily dosing as recommended, test both nitrate and phosphate at least 2 times per week to make sure that that nitrate and phosphate levels do not drop below the desired levels of NO_3 = 0.25; PO_4 = 0.02

Once the desired levels have been reached continue dosing daily and monitoring both nitrate and phosphate weekly.

Measured Level (ppm)	Daily Dosage ml / 100 l (25 gal)
NO_3 above 10	3
NO_3 above 1 but less than10	2
NO_3 above 0.25 but less than 1; PO_4 above 0.04	2
NO_3 above 0.25 but less than 1; PO_4 above 0.02 but less than 0.04	1

In the event that the nitrate level drops below 0.25ppm or the phosphate drops below 0.02 immediately cut the daily dose by 50%. Test nitrate and phosphate 2 times per week and adjust the dosage accordingly until they stabilize at the desired levels.

Important notes for using the Algae Control Colorimetric Comparator Test Kits

- Before testing clean the glass vials and the large syringe by rinsing with the water to be tested.
- After testing rinse all syringes and vials with RO or distilled water before storing. If vials are left unwashed a residue can form that will affect the results of future tests. Use a slightly acidic solution such as vinegar to remove the residue.
- Close all reagents tightly immediately after use.
- The test reagents are stable up to the date stated on the pack when stored closed between 15 – 25°C.
- Store the reagents and color card in the plastic box to prevent damage from prolonged exposure to light.

N-NO_3: Table below gives the values for N-NO3 the Nitrogen content of Nitrate

Low range (ppm)	NO_3	0.25	0.50	0.75	1.00	2.00	4.00
	N-NO_3	0.06	0.11	0.17	0.23	0.45	0.91
High Range (ppm)	NO_3	4.00	8.00	12.00	16.00	32.00	64.00
	N-NO_3	0.91	1.82	2.73	3.64	7.27	14.55

P-PO_4: Table below gives the values for P-PO4 the Phosphorus content of Phosphate.

Low range (ppm)	PO_4	0.02	0.04	0.08	0.16	0.36	0.64
	P-PO_4	0.007	0.013	0.027	0.053	0.120	0.213
High Range (ppm)	PO4	0.17	0.34	0.68	1.36	3.06	5.44
	P-PO_4	0.06	0.11	0.23	0.45	1.02	1.81

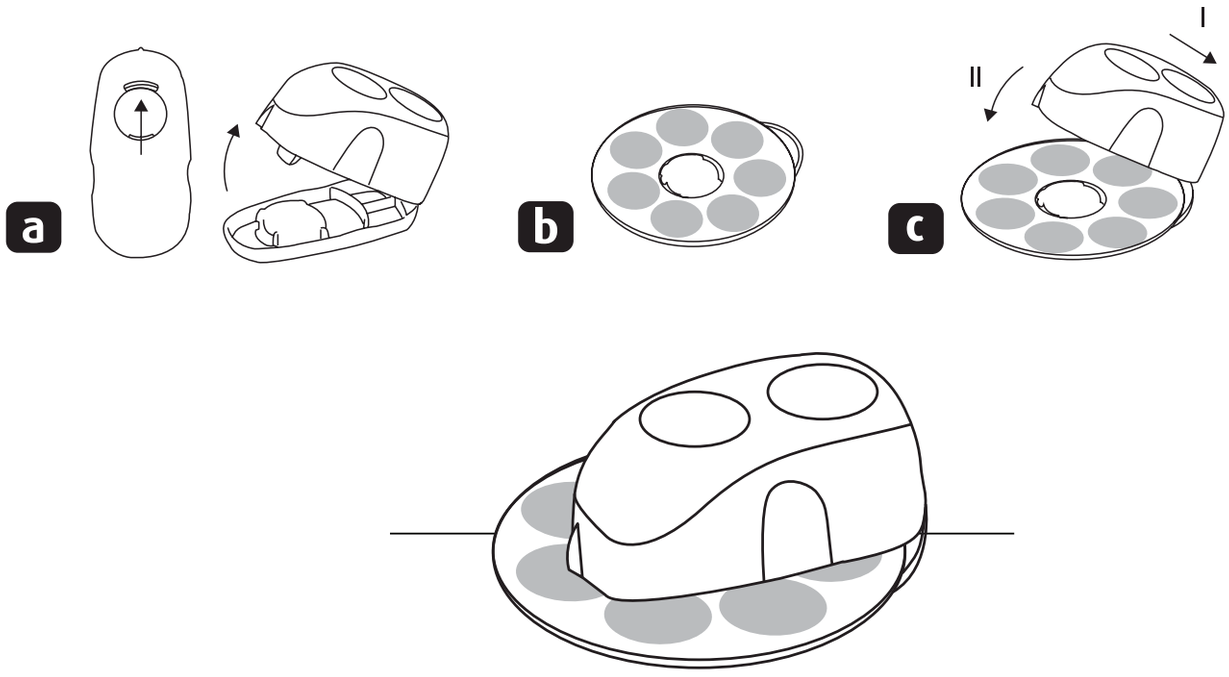
Assembling the Colorimetric comparator

a. Press the catch in the recess of the base outwards and raise the body of the comparator from the base.

b. Place the color disc onto the base so that the white surface on the base is in the center of the disc.

c. Replace the body of the comparator by hinging it to the base at the back and pushing the catch through the center of the disc. The color disc should rotate freely in the comparator.

NOTE: In order to maintain the high accuracy of Red Sea's colorimetric comparator Pro Tests they are supplied with special optically clear glass vials that have a slightly smaller diameter than the regular glass vials supplied with all other kits. To prevent mistakes the regular glass vials do not fit in the comparator.



Directions for Nitrate Pro Test Kit

1. Using the syringe provided, place exactly 16 ml of the water to be tested into both of the glass vials.
2. Insert one of the vials (control vial) into the outer hole of the comparator.
3. Vigorously shake the bottle of Nitrate Pro Reagent A for 30 seconds and add 8 drops to the second vial (reaction vial). Close the vial with the cap and shake for 15 seconds.
4. Add 5 drops of Nitrate Pro Reagent B, close the vial with the cap and shake for 15 seconds.
5. Add 5 drops of Nitrate Pro Reagent C, close the vial with the cap and mix gently for 15 seconds.
6. Remove the cap from the reaction vial and insert the vial into the center hole of the comparator.
7. Wait 9 minutes for the color in the reaction vial to stabilize at the end point.
8. When the end point of the test reaction has been reached look into both vials from above and rotate the color disc until the closest color match possible is achieved between the vials. Note: Turbidity or severe coloration of the water sample (high organic load) may distort the colors.
9. The nitrate level corresponding to the color selected is printed on the color disc as indicated by the pointer on the side of the comparator body. If necessary, estimate an intermediate value.
10. The color in the reaction vial will remain stable for 5 minutes. Do not relate to the color in the reaction vial after this time.

High Range: For levels of nitrate above 4ppm dilute 1ml of the water to be tested with 15ml of RO water.

Directions for Phosphate Pro Test Kit

1. Using the syringe provided, place exactly 17 ml of the water to be tested into both of the glass vials.
2. Insert one of the vials (control vial) into the outer hole of the comparator.
3. Add 10 drops of Phosphate Pro Reagent A to the other vial (reaction vial), close the vial with the cap and shake for a few seconds.
4. Add 2 drops of Phosphate Pro Reagent B, close the vial with the cap and shake for a few seconds.
5. Remove the cap from the reaction vial and insert the vial into the center hole of the comparator.
6. Wait 6 minutes for the color in the reaction vial to stabilize.
7. When the end point of the test reaction has been reached look into both vials from above and rotate the color disc until the closest color match possible is achieved between the vials. Note: Turbidity or severe coloration of the water sample may distort the colors.
8. The phosphate level corresponding to the color selected is printed on the color disc as indicated by the pointer on the side of the comparator body. If necessary, estimate an intermediate value.
9. The color in the reaction vial will remain stable for 5 minutes. Do not relate to the color in the reaction vial after this time.

High Range: For levels of phosphate above 1 ppm dilute 2ml of the water to be tested with 15ml of RO water.

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