

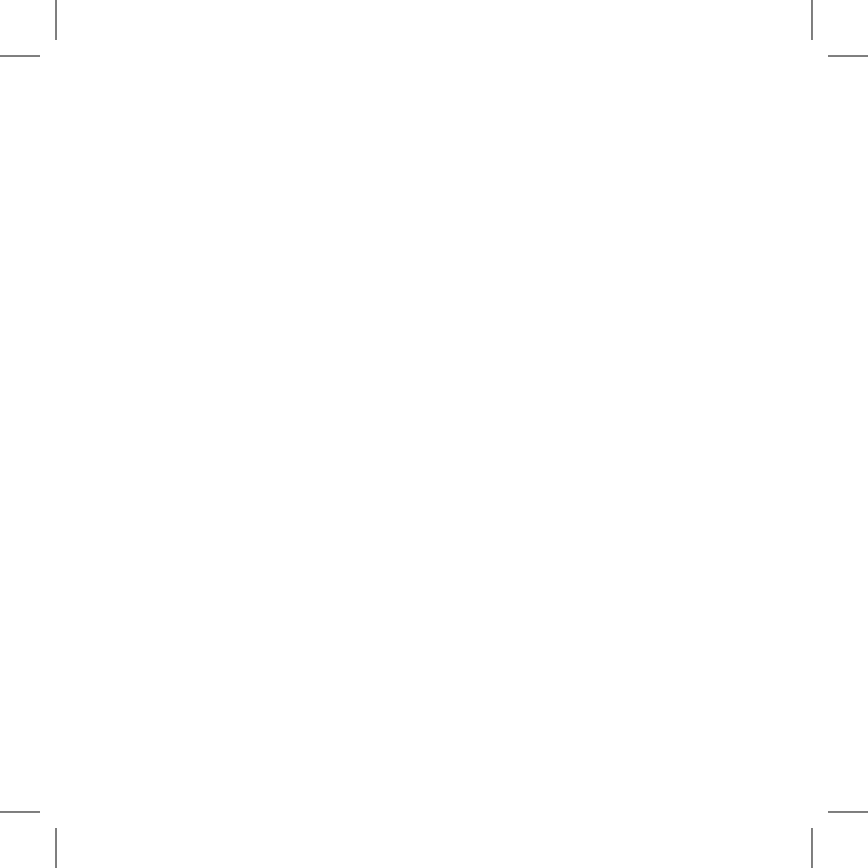
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REEF CARE PROGRAM

Reef Colors

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 Reef Colors 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.

Algae Control Program – Controlled nitrate & phosphate reduction that prevents nuisance algae and provides the fine control of Zooxanthellae populations that significantly affect coral growth rates and coloration.

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.

Reef Colors

Red Sea's research into the metabolic demand of SPS, LPS & soft corals has identified 27 minor and trace elements that in addition to the foundation elements are present in the skeleton and soft tissue of all corals. These elements are known as important bio-catalysts in thousands of metabolic processes in marine organisms and therefore must be readily available in all reef aquariums. Many of them however become toxic in concentrations above the levels found in natural sea water and therefore their correct dosage is crucial to the long term success of any reef aquarium.

Our research has identified 4 distinct groups of elements with similar biological functions as well as a direct connection to specific coral pigments that enabled the division of the 27 elements into the 4 supplements Reef Colors A, B, C & D. Reef Colors supplements have been formulated such that the ratio of the elements in each supplement are the same as are found in the combined coral skeleton and soft tissue.

All of the Reef Colors should be supplemented regularly to all LPS and SPS aquariums without connection to the colors of the specific corals or whether the water parameters (levels of foundation elements and algae nutrients) are set for enhanced coloration or accelerated growth.

Enhanced Coloration

In reef aquariums corals often have higher than natural populations of Zooxanthellae algae that give a deep brown tint obscuring the natural vivid pigments of the corals. Lowering the Zooxanthellae populations by fine control of algae nutrients (such as with Red Sea's $\text{NO}_3\text{:PO}_4\text{-X}$) will remove the brownish tint and induce the production of pigments (chromoproteins) that protect the delicate inner layers of the coral soft tissue from intense UV radiation, similar to the tanning of human skin when exposed to direct sunlight.

Our research has shown that the pigments can only be produced by the soft tissue of the coral if the specific elements required for the bio-chemical process are available in the correct concentration. Each of the natural pink, red, green/yellow & blue/purple pigments are connected with specific elements that correlate with the elemental grouping of the Reef Colors A, B, C & D.

Dosing by total elemental demand

Reef Colors A, B & C each contain a leading element (Iodine, Potassium & Iron) that is accurately measurable with Red Sea's unique Reef Colors Pro test kits enabling the replenishment of each of these supplements according to the total demand of the reef.

Dosing by calcium (coral growth) demand

Our research also identified a constant ratio between each of the Reef Colors and the overall consumption of calcium, which is proportional to coral growth and metabolic activity. Therefore, by measuring the uptake of calcium by the corals we are able to replenish all of the elements that have definitely been depleted from the water by the corals, without the danger of reaching toxic levels. This method of dosing should be used for supplementing Reef Color D and can be applied successfully to Reef Colors A, B, & C.

The Reef Colors Supplements

Reef Color A	Complex of halogen elements
Main elements	Iodine, Bromine and Fluorine
Test for dosing	Iodine
Function	The halogens act both as antioxidants and oxidative agents within the soft tissue and mucus layer of corals, reducing the possibilities for coral bleaching. In active reef systems these elements are depleted very quickly due to their high oxidative abilities and reactivity with organic materials.
Coloration	Iodine and bromine are related to the pink chromo-protein (pocloporin)
Level in NSW	Iodine 0.06 ppm; Bromine 65 ppm; Fluorine 1.3 ppm
Overdose	Halogens can have adverse effects on the soft tissues of corals and all micro-fauna. Common indication of overdose is a severe regression of the soft tissues of hard corals and pale colors in soft corals. In case of over dosing change 50% of the water and reduce the supplementing dosage by 50%.

Reef Color B	Complex of Potassium and Boron
Main elements	Potassium and Boron
Test for dosing	Potassium
Function	Potassium has an essential role in the transportation of coral nutrients within the soft tissue including the nutrients provided by the Zooxanthellae. Potassium and boron have a significant effect on the alkalinity inside the coral soft tissue and play a role in the formation of aragonite in the coral skeleton.
Coloration	Potassium is related to the red chromo-proteins (peridinin, neo-peridinin)
Level in NSW	Potassium 400 ppm; Boron 4.6 ppm
Overdose	Common indication of overdose is a darkening of the corals due to excessive Zooxanthellae growth and the outbreak of nuisance algae. In case of over dosing change 25 % of the water and reduce the supplementing dosage by 50%.

Reef Color C	Complex of 11 "light" metals
Main elements	Iron, Manganese, Cobalt, Copper, Aluminum, Zinc, Chrome and Nickel
Test for dosing	Iron
Function	Essential micro-elements with fundamental roles in many biochemical metabolic processes including respiration and production of energy, chlorophyll and photosynthetic catalysts. These elements precipitate into the coral skeleton which act as a reservoir for their use in the soft tissue.
Coloration	C elements are related to the green/yellow chromo-proteins (GFP)
Optimal level	0.15 ppm of total iron (chelated and non-chelated) in an artificial reef aquarium
Overdose	Toxic to all invertebrates above recommended levels. Common indication of overdose is a darkening of the corals due to excessive Zooxanthellae growth and the outbreak of nuisance algae. Can cause regression of the soft tissues in SPS corals. In case of over dosing change 50 % of the water and reduce the supplementing dosage by 50%.

Reef Color D	Complex of 18 trace elements
Main elements	Silver, Gold, Vanadium and Tungsten
Test for dosing	Calcium
Function	These 18 elements (out of all the trace elements in NSW) participate in different metabolic processes inside coral skeleton and soft tissue.
Coloration	D elements are related to the blue/purple chromo-proteins (pociliporin , diadinoxanthin and dinoxanthin)
Overdose	Can cause severe regression of the soft tissues of corals and stress to crustaceans. Common indication of overdose is a darkening of the corals. In case of over dosing change 50 % of the water and reduce the supplementing dosage by 50%.

Testing and Supplementing

Test either Calcium or the Color Elements every week.

SPS corals have a relatively high uptake of calcium and therefore of all the Reef Color elements. Since the stability of the water parameters is essential for their health and vitality supplementing of the Color Elements should be done daily. At lower nutrient levels for enhanced coral coloration it is preferable to test the individual color elements.

LPS corals have a lower uptake of calcium and therefore they can tolerate the Color Elements being supplemented weekly. They will however benefit from a daily supplementing regime. Choose which of these supplementing options is best for you and your aquarium.

Soft corals only need Colors A & B and should be supplemented weekly. To promote coralline algae in a soft coral aquarium use Reef Color C.

Dosing by calcium (coral growth) demand

Calculate the daily or weekly dose of each supplement according to the dosage of Red Sea's Reef Foundation supplements or to a known uptake of calcium. (Add 1ml of Color supplement for every 20ppm of Calcium added per 100 liters (25 gal) of aquarium water or for every 2g of calcium uptake.)

Dosing by total elemental demand

Initial adjustment of Color Elements to optimal levels

When first using the Reef Colors products or after a water-change, test the levels of the Color Elements and supplement as necessary to achieve the optimal levels.

Weekly dosing - Soft Corals

Test the Color Elements every week and dose each supplement to replenish back to the optimal levels.

Daily dosing - SPS corals

Ensure that all of the Color Elements are at optimal values and run the aquarium for 4 days at a stable salinity (compensate for evaporation daily) without adding any supplements. At the end of the 4 days test the Color Elements and calculate the "4 day dosage" of each supplement to replenish back to the optimal levels. Add the "4 day dosage" to the system. Divide this "4 day dosage" by 4 and use as the daily dosage for the next week.

After a week of adding the daily dosage, test the Color Elements and calculate the adjusting dosage of each supplement to replenish back to the optimal levels.

- If the adjusting dosage is significantly different from the previous daily dosage amend (increase/decrease) the daily dosage as appropriate.
- If the measured level of a specific element is above the optimal level wait for the excess of the element to be depleted before restarting the daily supplementation with the amended daily dosage.

Continue testing all of the elements every week and make adjustments to the daily dosages as required. As your corals grow or you add or remove livestock the uptake of the elements in your aquarium will gradually change. It is recommended to keep a log book of the weekly measurements and dosages.

If you miss one or more days of supplementing add the complete amount that you have missed but do not exceed the maximum recommended daily increase for any of the elements.

General instructions for testing and supplementing:

1. Before carrying out any water testing always check the salinity and make adjustments as necessary. If you have made adjustments to the water wait 10 minutes for the water parameters to stabilize (e.g. 1ppt increase in salinity due to evaporation of fresh water will result in an approximate increase of 13ppm Ca).
2. All of the Red Sea Reef Care Program supplements have dosing charts (on back of product) 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.
3. Supplements should be added to the sump. If you do not have a sump, add the supplements slowly to an area with high water flow to prevent direct contact with the corals.
4. To prevent stress to the corals the maximum daily increases of each of the elements are as follows: Iodine 0.03ppm; Potassium 10ppm; Iron 0.05ppm. Larger adjustments should be spread over a few days according to the daily maximum.

The Reef Colors Test Kits

Red Sea's Iodine Pro test kit is an advanced colorimetric test, measuring the level of total Iodine as Iodide (I^-) & Iodate (IO_3^-) to an exceptionally high resolution of 0.03 ppm. This test kit enables the accurate dosing of Reef Colors A supplement.

Red Sea's Potassium Pro test kit is an advanced titration test, measuring the level of potassium to an exceptionally high resolution of 3 ppm. This test kit enables the accurate dosing of Reef Colors B supplement.

Red Sea's Iron Pro test kit is an advanced colorimetric test, measuring the level of total Iron (chelated and non-chelated iron) to an exceptionally high resolution of 0.05 ppm. This test kit enables the accurate dosing of Reef Colors B supplement.

Important notes for using the Reef Colors 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 cards in the plastic box to prevent damage from prolonged exposure to light.

Directions for Iodine Pro Test Kit

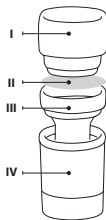
1. Rinse the vial marked "standard" & syringe with RO or distilled water and dry thoroughly.
2. Using the syringe provided, place exactly 5 ml of RO water into the standard vial, close the vial firmly with the cap and place the vial into the aquarium for 10 minutes to allow the water in the vial to reach the temperature of the aquarium water.
3. After 10 min. take the standard vial out of the aquarium and add 1 level measuring spoon of Iodine standard 0.06 ppm powder. Close the vial with the cap and shake until the powder is fully dissolved.
4. Using the syringe provided, place exactly 5 ml of the water to be tested into the other vial (sample vial).
5. Add 5 drops of Iodine Pro Reagent A to both the sample and standard vials.
6. Add 8 drops of Iodine Pro Reagent B to both the sample and standard vials.
7. Stand both of the vials in their designated positions on the color card.
8. The standard vial acts as a timer for the reaction. Check the color of the water in the standard vial by looking into the vial from above and watch to see when the color in the standard vial matches the color of 0.06 ppm on the color card. This is the end point of the test reaction, which will take approximately 5 - 15 minutes for an aquarium at 25°C (77°F). The warmer the water the quicker the reaction.
9. When the end point of the test reaction has been reached look into the sample vial from above and compare the color in the vial to the colors on the card and choose the Iodine level that gives the closest color match. If necessary, estimate an intermediate value.
10. The color in the sample vial will remain stable for 5 minutes. Do not relate to the color in the sample vial after this time.

Directions for Iron Pro Test Kit

1. Using the syringe provided, place exactly 17 ml of the water to be tested into the glass vial.
2. Add a leveled measuring spoon of Iron Pro Reagent A, close the vial with the cap and shake for 15 seconds.
3. Add 6 drops of Iron Pro Reagent B, close the vial with the cap and shake for 15 seconds.
4. Wait 15 minutes for the color in the vial to stabilize.
5. Move the vial between the designated positions on the color card, look into the vial from above and compare the color in the vial to the colors on the card. Choose the Iron level that gives the closest color match and if necessary estimate an intermediate value.
6. 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.

Directions for Potassium Pro Test Kit

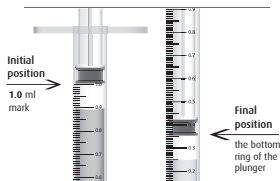
1. Prepare the filtration kit as follows:
 - a. Lay a clean dry filter paper (II) above the funnel (III)
 - b. Place the top cylinder (I) on the filter paper and push down, trapping the filter paper between the cylinder and the funnel
 - c. Place the assembled filter onto the filter cup (IV)
2. Using the large syringe provided, place exactly 2 ml of the water to be tested into one of the glass vials.
3. Add exactly 3ml of RO or distilled water to the 2 ml water sample.
4. Add 4 drops of Potassium Pro Reagent A, close the vial with the cap and shake for 15 seconds.
5. Add 11 drops of Potassium Pro Reagent B, close the vial with the cap and shake for 15 seconds.
6. Wait for 10 minutes (use a stopwatch) and then pour all of liquid from the glass vial into the top of the filter.
7. Wait (approx 7 minutes) until at least 3ml of clear liquid has collected in the filter cup (above the line), remove the filter and dispose of any remaining liquid. Using the 5ml syringe take exactly 3ml of the filtered clear liquid from the filter cup and put it into the 2nd glass vial.
8. Ensure that the dispensing tip is on the 1 ml titration syringe and fill with 0.5 ml of Potassium Pro Titrant (D).



Note for filling the 1ml titration syringe: Raise the plunger of the syringe until the bottom ring of the plunger (see arrow in diagram) is at the 1.0 ml mark. The surface of the liquid will be approximately 0.1 – 0.15 ml below the plunger. Do not try to remove

the air trapped between the liquid and the plunger. This small volume of air corresponds to the liquid held inside the plastic tip.]

9. Insert the syringe into the center of the Titrator so that the volumetric scale on the side of the syringe is visible. The graduations of the volumetric scale are 0.01 ml, equivalent to 3 ppm of potassium.
 10. Add 2 drops of Potassium Pro Reagent C and mix gently. The test sample will now have the titration start color as shown on the instruction card.
 11. Screw the glass vial onto the bottom of the Titrator.
 12. Add one drop at a time of Potassium Pro Titrant (D) by pressing the plunger of the syringe and gently swirling after each drop, until the end color is achieved. Pay careful attention to the color of the test sample from the addition of the first drop.
- Note:** The amount of titrant used is inversely proportional to the level of potassium in the aquarium water sample. If you reach the end color on adding the first drop the potassium level is 467 ppm or above.
13. Note the amount of titrant used (according to the initial and final position of the plunger not the liquid surface) and use the table to calculate the level of potassium in the water sample.
 14. Dispose of any unused quantity of titrant. Rinse all syringes, glass vials and filter kit with RO or distilled water before storing. Filter papers are for single use only and cannot be reused.





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