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Sand Bar
• CORAL FARMS •

The Sand Dollar Standard

OUR SOLUTION FOR SETTING A STANDARD IN GRADING AND PRICING FOR PROPAGATION IN THE CORAL AQUACULTURE

SAND BAR CORAL FARMS | San Clemente, CA

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Introduction

The coral aquaculture industry lacks any standardization for grading and pricing. This problem affects everyone from wholesalers to the hobbyists shopping on e-commerce platforms. Left unsolved, these problems will continue to cause a negative impact on sales and in the confidence customers have in the industry. We would like to share our data-driven concept for scoring, grading, and pricing of aquarium coral. This paradigm change creates new industry standards for measurement and a descriptive language called the Sand Dollar Standard (SDS). This solution allows our customers to buy corals that meet the specifications they want and at a fair market price.

Problems in the Industry

Nomenclature

There are no accepted naming standards in the coral aquaculture industry. Names like Bling Bling, Tickle Monster, Grizzly Adams, Oompa Loompa, and Blueberry Blast abound on e-commerce sites. These names serve only marketing purposes and cause confusion. In addition, some wholesalers and entrepreneurs use name recognition such as JasonFoxSignatureCorals.com to brand their coral.

A survey of several coral e-commerce sites for the brain coral *Trachyphyllia* spp. reveals the names shown in Table 1. This summary shows that the rainbow/ultra/master designation is the rating scale used most often by retailers. But mostly, the e-commerce names used for coral genera vary widely.

Table 1 - Names used for brain coral (*Trachyphyllia* spp.) on several e-commerce sites.

Website	Name Used
SaltwaterFish.com	*Trachy Rainbow Rim*
WorldwideCorals.com	*Ultra Christmas Trachyphyllia*
	Ultra Double Head Trachyphyllia
FreshMarine.com	*Green Open Brain Coral*
VividAquariums.com	*Green Trachyphyllia Brain Coral*
TidalGardens.com	*Ultra Trachyphyllia Brain, Paint Splatter Trachyphyllia Brain*
LiveAquaria.com	*Brain Coral, Trachyphyllia*
UltraRainbowCorals.com	*Green Trachy*
BlueZooAquatics.com	*Welsophyllia Brain Coral-Metallic Green*
*Animal-World.com**	*Open Brain Coral, Folded Brain Coral, Crater Coral, Green Open Brain Coral*
ThatPetPlace.com	*Ultra Red & Green Open Brain*

Market Structure

The US aquaculture supply chain begins with trans shippers who sell to wholesalers who, in turn, sell to retailers like Sand Bar Coral Farms. We grow, cut, propagate, harvest, and sell living coral to hobbyists and businesses through a brick and mortar retail store and the e-commerce website SandBarCoralFarms.com.

Many coral hobbyists are also entrepreneurs who skip the retail level and buy directly from other hobbyists. However, for these hobbyists the only options for commercial sale are swaps and selling on eBay and Craigslist.

*Animal-World is an informational site only, but it shows the variations in coral naming even outside the industry.

SaltyUnderground.com	*Nucular Infusion Trachy Coral, Bright Trachy*
AquariumIllusions.com	*Trachyphyllia Green*

When there is no naming standardization, it forces customers to rely more on photos to make sure they are buying the coral they want. Of course, high-quality photos that reflect the true appearance of corals are essential for customer decision-making and their ultimate satisfaction. It is our opinion, however, that by standardizing coral names in our brick and mortar and e-commerce outlets there will be no question in the customers' mind they are getting exactly what they want. Further, high-quality corals that are accurately portrayed sell themselves because customers have trust and confidence in the retailer. This eliminates the need for any additional naming conventions for branding and/or marketing purposes.

Grading

Another gap in the coral aquaculture business is the absence of a quality rating/grading system or method. Photos and descriptions of coral only go so far to give the customer confidence in their purchase. This gap also makes it hard to compare two similar pieces of coral.

To solve this problem, we have taken cues from the 4Cs grading system used in the diamond industry. SDS uses the 3Ps: palette, pattern, and presentation to give a piece of coral an aesthetic grade. The cut and size are taken into consideration for coral destined for the commercial market. This grading system clarifies the similarities and differences between pieces within a genus and will also stabilize prices in the market.

Pricing

Strikingly different prices for identical pieces of coral are often found on e-commerce sites. This volatile pricing creates confusing, frustrating and sometimes unfair situations for the customer and the retailer. Tables 2 shows several examples of this problem.

Table 2 - Regular retail prices (not sales or markdowns) for identical coral genera on several e-commerce sites as of February 27, 2018.

Key Players

Based on annual revenue from Owler.com, the three largest e-commerce sites for coral are LiveAquaria.com ($10.5 million), SaltwaterFish.com ($9.1 million), and CoralConnectionSarasota.com ($6.2 million).

SimilarWeb.com shows LiveAquaria's website had over 1.3 million visitors in the last month and ranks #1 in the Pets and Animals > Fish and Aquaria category. By comparison, SaltwaterFish.com ranks #20 with just over 450,000 site visitors in the last month.

Site	*Psammocora*	*Sympodium*	*Rhodactis*	*Stylophora*	Trachyphyllia
Saltwater Fish.com	None	$142.99 to $113.99	$138.99 to $91.99	None	$168.97
WorldwideCorals.com	$40.00 to $69.00	None	$69.00 to $49.00	5-pack $225	$129.00 to $399.00
FreshMarine.com	None	None	$49.99	None	$33.98 to $69.98
VividAquariums.com	None	$24.99	$44.99 to $24.99	$29.99	$99.99 to $249.00

TidalGardens.com	$35.00	None	$30.00	$30.00 to $35.00	$160.00 to $225.00
LiveAquaria.com	$29.99 to $34.99	69.99	$49.99 to $29.99	$29.99 to $69.99	$44.99 to $149.99
UltraRainbowCorals.com	None	None	$29.99	None	$39.99
BlueZooAquatics.com	None	None	None	$29.95 to $69.95	None
ThatPetPlace.com	$21.99 to $49.99	$34.99 to $89.99	$19.99 to $89.99	$19.99 to $79.99	$49.99-$169.99
SaltyUnderground.com	$69.99	$29.99	$79.99-$39.99	$45.99	$69.99
AquariumIllusions.com	none	none	C$100.00 -C$20.00	none	C$85.00

Our Solution: The Sand Dollar Standard (SDS)

Overview

In response to the issues outlined above, we have created the following SDS calculation model using a point-based and weighted scoring system. This, along with the genus, common name and price gives the official SDS designation for a piece of coral.

The first output of the SDS is a genus-specific aesthetic grade for the coral calculated from its scores for Palette (color), Pattern, and Presentation. Taken together, these characteristics are called the 3Ps. Scores come from corresponding ratings for attributes for each of these three characteristics. The aesthetic grade for a piece of coral is the sum of the 3Ps. We explain this in more detail in the sections below.

The aesthetic price calculation uses an aesthetic pricing factors for each score of the 3Ps of the coral. The sum of the aesthetic pricing factors for palette, pattern, and presentation to four decimal places results in the aesthetic grade price multiplier for the piece of coral.

For commercial market coral, we encourage retailers to add genus-specific commercial pricing factors for size, cut, and availability to the recommended aesthetic retail price for the coral. Figures 1 and 2 show how the components of the 3Ps and commercial factors come together.

The Recommend Retail Price of the coral is calculated as follows:

The average wholesale price multiplied by 1 plus the sum of the aesthetic pricing factors plus the sum of the commercial pricing factors. The formula is:

(Average Wholesale Price * (1 + Aesthetic Price Multiplier + Commercial Price Multiplier))

Putting this information together, the SDS designation for a piece of coral looks like this:

SDS - Score, *Genus*, Common Name, Price

Examples:
SDS - 14.2, *Trachyphyllia*, Brain, $700.00
SDS - 11.1, *Sympodium*, $350.00

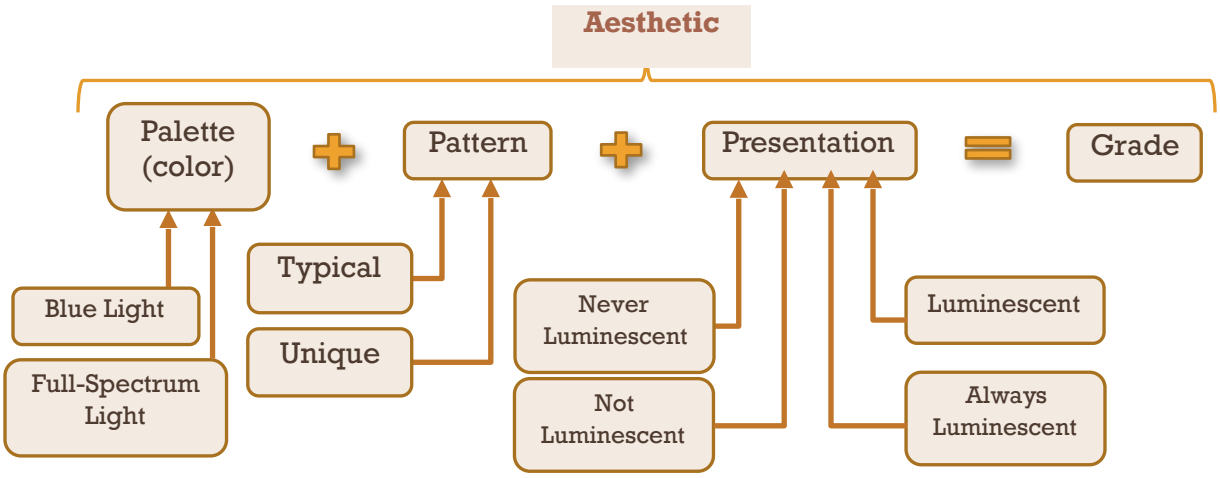

Figure 1 – A visual representation of the aesthetic components of the Sand Dollar

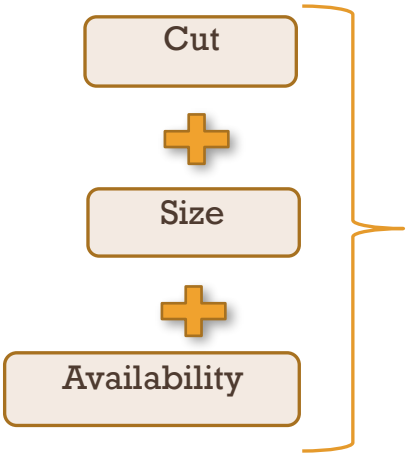

Figure 2 - A visual representation of the market-driven commercial factors of the Sand Dollar Standard.

Accuracy of Coral Common Names

Behind the Sand Dollar Standard are databases specific to the most common genera in the coral propagation industry. We confirmed the taxonomic rank of each coral by comparing them to the information in the World Register of Marine Species (WoRMS), www.MarineSpecies.org. Also, we used the classic book *Aquarium Corals*[1] by Eric H. Borneman to identify visually the corals and add a second level of confidence to the nomenclature we chose[2].

How the SDS Works

Determining the Aesthetic Grade

As described in the section above, we calculate the aesthetic grade of a piece of coral by adding together its scores for the 3Ps. Briefly, here is how those individual scores are determined by the database based on the ratings that are chosen.

The Palette

Our strategy for creating a basic color palette for the SDS began with extensive searches of the literature and other online scholarly work and expert opinions. We found several comprehensive review papers and books that discuss the current knowledge in the field of coral pigments and color. Overall, researchers have discovered only a fraction of what is thought to be an astounding array of pigments in corals.

The information we found shows that there are hundreds and possibly thousands of pigments in Cnidarians like coral[5]. Complicating this fact is that one pigment can express different colors depending on the wavelength/intensity of the light used. In addition, certain environmental factors can influence color such as the color of the water, the presence of molecular oxygen, iodide and other halides, water pH, and temperature[3]. To create the SDS color palette and rating system, we devised a method for counting the main colors in corals polyps and established measurement parameters for light.

Types of Pigments

Experts categorize coral pigments into four categories[1]: fluorescent proteins, non-fluorescent proteins (reflective chromoproteins), photosynthetic pigments and kindling proteins.

Fluorescent proteins (FP) absorb light at one wavelength and emit (fluoresce) light at a lower energy wavelength. Close to 90 fluorescent proteins have been identified in corals[5] and they represent 9 color categories: green, red, cyan, yellow, blue, violet, purple, orange, and pink. At first glance, cyan may seem just a variation of blue. However, experts recognize it as a distinct color in coral due to its evolution via positive natural selection[4].

Over 50% of FPs are “greenish” in color and therefore called green fluorescent proteins, or GFPs[5]. The existence of GFPs has been known since before the 1960s. The interest in this fluorescent pigment exploded in the early 1990s when scientists discovered how to use it as a marker for gene expression[6].

The non-fluorescent chromoproteins (CP) reflect light at certain wavelengths which gives them their color. Their colors are usually purple-blue although other colors exist such as violet, blue-red and pink-red[7]. Brown and blue corals are included in the CP category[8]. Brown corals display yellow, red, orange, and green colors while blue corals exhibit blue, pink, purple, and grey.

Photosynthetic pigments such as chlorophyll are the most common pigments found in corals[5]. Zooxanthellaes are single-celled organisms that contain chlorophyll and live in symbiosis with the corals[9]. Chlorophyll absorbs red and blue light, giving the organisms their characteristic green color. Some of these pigments are fluorescent such as the phycoerythrin in red algae and cyanobacteria that infects coral tissues. A non-fluorescent yet highly reflective pigment called Marienne is found in algae that live in coral tissues.

The term kindling describes the ability of a pigment protein to change from a non-fluorescent chromoprotein to a fluorescent one. An example of this is CP-580 found in *Goniopora tenuidens* which is purple-red but changes to fluorescent green through a chemical oxidation reaction[10] and is, therefore, light-independent.

The designation 'black' coral (antipatharians) comes from the coral's black skeleton not the color of the tissues[11]. Although their skeletons play a critical role in the ecology and evolution of coral[12], the color of the skeleton is not counted when using the SDS. However, there are a few corals that have black polyps due to the presence of melanin pigments. Also, the pigment astaxanthin results white polyps on black corals.

The SDS Coral Pigment Palette

Based on the information above, we have chosen the following palette of 13 colors for aquarium corals for use in the SDS: green, red, cyan, yellow, blue, violet, purple, orange, pink, brown, black, grey, and white.

In the SDS, the overall color rating for the coral is determined by the average of the total number of *palette colors* it displays under blue and full-spectrum light. A color is counted only once even if it appears under both types of light. Shades of a color or colors created by the blending of two or more colors are counted as the primary color.

Figure 3 – The baby blue color of this *Trachyphyllia* counts as only 1 color (blue) according to the SDS even though it is a combination of blue and white pigments.

For example, a baby blue sections of the *Trachyphyllia* shown in Figure 3 are the result of blending blue and white pigments. Although the color is the result of its white and blue pigments, blue is the main palette pigment it displays so the coral would score 1 for blue and 1 for red. Figures 4 and 5 show *Micromussa* corals which have 3 and 4 colors, respectively.

Corals with colors in between the main palette colors are evaluated based on the main color. For example, a yellowish-orange coral is orange and an orangish-yellow coral is yellow.

The SDS controls for the wavelength and color temperature of light used when viewing a coral along with the water depth. To count the number of colors in a coral, we use specific light color temperatures as measured on the Kelvin (K) scale[13] for the full-spectrum and the Nanometer (nm) scale for blue light. Our lighting equipment is the Radion XR30W G4 PRO.

Figure 4 - This *Micromussa* coral has 3 colors: Red, blue, and purple.

Lighting for Figures 3-5:
Radion XR30W G4 PRO
Blue Light – 420 nm
Full Spectrum – 20,000 K

In addition, to control for the effect of water depth on the expression of colors, we assess corals at a standard water depth of 8 inches.

Calculating the Palette Score

In the SDS system, corals can have palette score of 1 to 13 based on the thirteen palette colors. This rating is done under both blue and full spectrum lighting with separate ratings generated for each light type. The palette grade is the simple average of the

number of colors presented under blue light and the number of colors presented under full spectrum lighting.

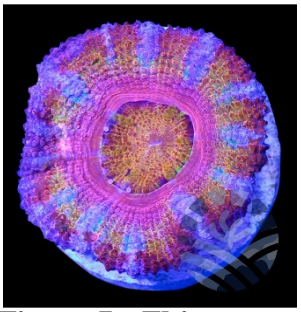

Figure 5 – This *Micromussa* coral displays 4 colors according to the SDS: pink, purple, blue, and yellow.

The Pattern

Under the SDS, the pattern of a coral is either typical or unique. This aspect of the grade is driven by the luminescence in the presentation discussed in the next main section.

Calculating the Pattern Score

The pattern grade is either 1 for a typical specimen or 2 for one that is unique.

The Presentation

The presentation of a coral is based on its luminescence; its ability to give off light without being heated. The SDS recognizes 4 states of luminescence used to evaluate how a coral presents itself:

- Never Luminescent – Corals that are not luminescent in nature.
- Not Luminescent – Corals that are capable of luminescence but are not expressing it.
- Luminescent – Corals displaying luminescence.
- Always Luminescent – Corals that are always luminescent in nature.

Figure 6 - Image of a coral that is normally

Figure 7 - Image of the same coral in Figure 6 but not displaying luminescence.

Luminescence adds to the presentation score of a coral. Higher scores are earned by corals that always luminescent and luminescent. The SDS does not penalize species that are not luminescent in nature, but corals that have luminescent capability but not expressing it receive a lower score.

Figures 6 and 7 show the difference when a coral has its 'lights tuned off.' These images show why luminescence is a highly desirable quality in corals and why such species command a higher price.

Calculating the Presentation Score

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Calculating the Grade

The grade for a piece of coral is the sum of its scores for the 3Ps to one decimal place. This grading makes it easier to quantify and compare the visual quality of similar pieces

of coral. Grades range from 3.0 to 17.0 in 0.5 increments. Not all coral is capable of achieving the minimum or maximum grade. Therefore, ranges showing the minimum and maximum SDS grade for each genus have been established to aid the consumer.

Aesthetic Price

The SDS establishes a standardized recommended aesthetic price for each coral genus at a unit of measure specific to each. It does this by using the SDS grade, an average wholesale price obtained from selected coral wholesalers, and a proprietary algorithm.

The aesthetic price establishes the recommended basis for commercial coral pricing. It also provides the consumer with a guide for weighing differences in retail pricing due to service, reputation, and other commercial factors discussed below, and is separate from the aesthetic value of the coral.

Sand Bar Coral Farms sets the prices used in the SDS aesthetic pricing database. Price adjustments occur quarterly after surveying selected coral wholesalers who are chosen by looking at their overall impressions, revenue, and domestic reach.

Generally, the more colors present up to 13, the greater the score for the coral and its subsequent value. The databases behind the SDS recognize that some coral genera have limited colors yet are very desirable and/or rare in the market and adjusts the aesthetic prices accordingly.

Commercial Retail Price

Retailers are expected to establish their own retail prices. It is recommended they start with the aesthetic price as a base and adjust up or down from there. Below are some factors that the SDS recommends retailers consider when setting retail prices.

The Size

There are 8 sizes the SDS recommends for pricing consideration. They are extra small (XS), small (S), small-medium (S-M), medium (M), medium-large (M-L), large (L), extra-large (XL), and extra-extra-large (XXL). The SDS databases provide guidelines to size by coral genera to help retailers be consistent in their sizing. Retailers are encouraged to apply a commercial price factor for size to the aesthetic pricing recommendation. They should also provide consumers with a description of the size of the item being offered.

The SDS uses three sizes of plugs/plates that give the customer a reference scale for visualizing the size of the coral they are buying. These standard sizes are:

- ¾” plug for sizes XS, S, and S-M
- 1.25” plug for sizes S-M, M, and M-L
- 3.0” plate or per (unit) for sizes S, M, L, and XL

The Cut

The SDS recommends identifying specimens with one of three cuts: encrusting, fresh, or scrap. Retailers may want to apply a commercial price factor to adjust their pricing based on the type of cut.

Fresh – No encrusting or damage (Figure 10).
Encrusting – A coral that grows out along the surface of the mount (Figure 11).
Scrap – A Coral exhibiting damage that distracts from the aesthetics (Figure 12).

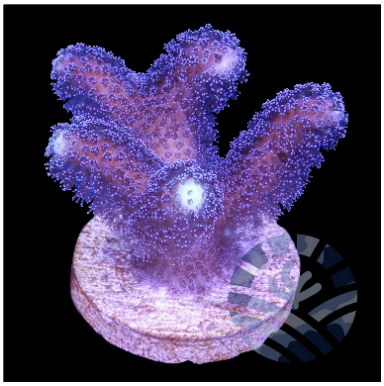

Figure 10 - Image showing a fresh coral on a plug.

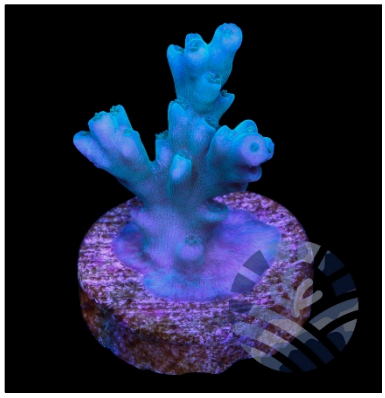

Figure 11 - Image showing a coral encrusting on a plug.

Figure 12 - Image showing a scrap piece of coral on a plug.

The Availability

Retailers should stay abreast of changes to availability of coral both locally, nationally, and worldwide. While the use of an average wholesale price in the recommended aesthetic price attempts to adjust for changes in the national and world markets, these adjustments may lag or be missing. Retailers should consider using a commercial price factor along with the recommended aesthetic price to adjust for the rarity of a specimen or changes in supply.

Conclusion

We created the SDS database system to standardize descriptions and quality measurements in the coral aquaculture industry. This will increase the confidence and trust our customers have in us and assure them they are getting exactly what they ordered and at a fair market price. In addition, we believe the SDS will stabilize pricing in the coral aquaculture market by allowing everyone to speak the same language.

The SDS will alleviate many of the current problems we and our customers experience in the industry. There will also be many opportunities to learn and make refinements in the system after the rollout. We welcome comments and suggestions on the Sand Dollar Standard from hobbyists and other members of the coral aquaculture community.

About Sand Bar Coral Farms

Sand Bar Coral Farms is a family owned and operated business located in Mission Viejo, CA, specializing in rare, hard-to-source corals as well as the familiar favorites. Their stock of happy, healthy, and sustainably sourced corals, clams, and invertebrates are meticulously cared for using automated monitoring systems and protocols that allow them to produce consistent stock and set up safe quarantines when needed.

Owners Eric and Darby Perry are proud of their efforts to educate people about reef aquarium husbandry at Sand Bar Coral Farms and through their online forum on Reef2Reef. The farm offers a wide range of free educational workshops to suit beginners and experts. The Sand Bar Coral Farms forum on Reef2Reef is home to helpful dedicated fraggers and enthusiastic noobs who share their knowledge, experiences, and of course, photos of their beloved polyps.

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