Product Review: ReeFi's Uno LED Luminaire

By Dana Riddle

Once, light-emitting diodes (LEDs) were merely the off/off indicator of coffee pots and other appliances. How times have changed. Light-emitting diode (LED) lighting is the preferred method of lighting aquaria by many aquarists. Their advantages are many – low power consumption, minimal heat generation, ramping of light intensity, spectral tuning, programmable photoperiod and so on. In addition, the price of a LED luminaire has dropped considerably from the first commercial models introduced 15 years ago.

This article will review the ReeFi Uno LED luminaire. This company is located in Seattle, Washington.

Specifications

Dimensions: 7.25" x 5.68" x 1.73"
Number of LEDs: 72 LEDS ranging from UV-A/violet to Warm White.
Spectral Qualities: 16 400nm; 16-420; 16 violet; 10 royal blue; 6 blue; 2 Lime; 1 Amber; 4 Cool Whites; 1 Warm White. LEDs are manufactured by Cree (2nd Generation XP-E2) and Lumileds (Luxeon Rebel).
Maximum Wattage: 214 (180W LEDs, ~15W loss in 9.5ft DC cord, ~19W loss in 92% efficient power rectifier).
Cord Lengths - Plug to rectifier: 75" (~6 feet); Rectifier to Luminaire: 115" (9.5 feet); Total: 190" (15.5 feet)
Approximate Weight (luminaire only): Two pounds.

Spectral Quality

There are nine individually-controlled LED channels in the ReeFi Uno (400, 420, violet, Royal Blue, blue, lime, amber, warm white and cool white). All LEDs are within a nanometer or two of advertised peak output.

All Channels at 100% Power

Peak spectral output is at 420nm, with shoulders at approximately 400, 440, and 470nm. Phosphors in the lime, amber, and warm & cool whites extend the spectrum into the green through red bandwidth.

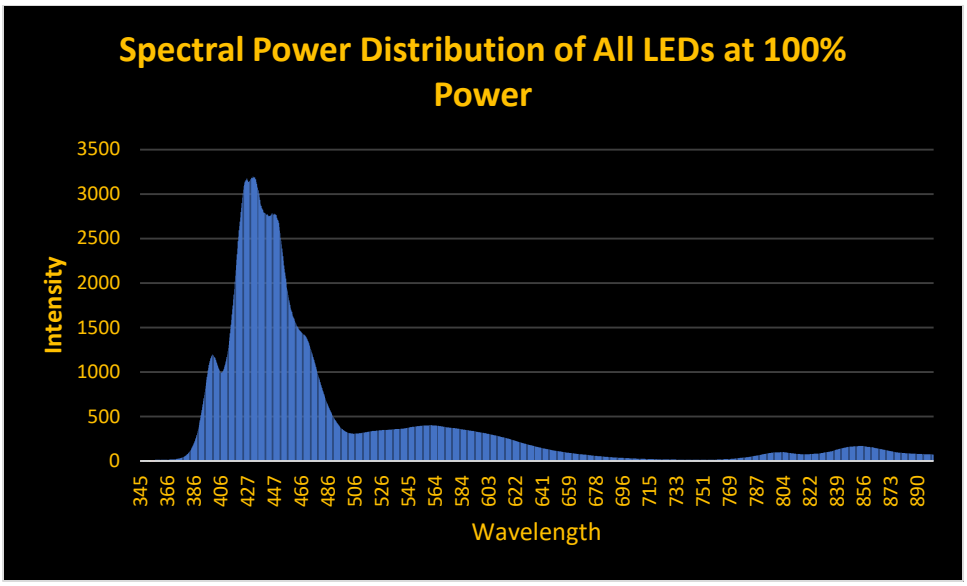

Figure X. Spectral quality – all LEDs at 100$ power.

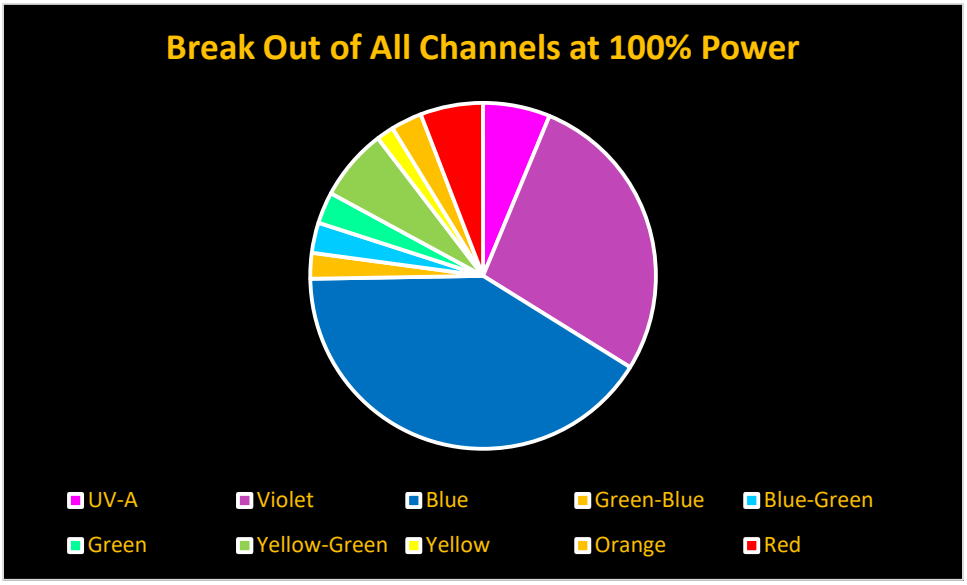

Figure X. Violet and Blue light are predominant at full power.

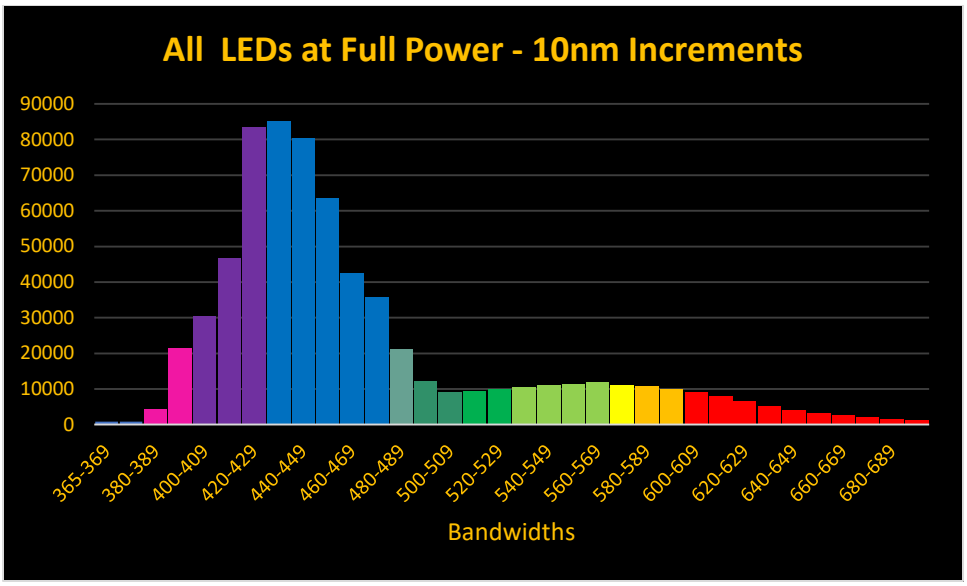

Figure X. Spectral quality in 10nm increments of all LEDs at full power.

400nm LED

Actual peak output is at 398nm, indicating top shelf binning.

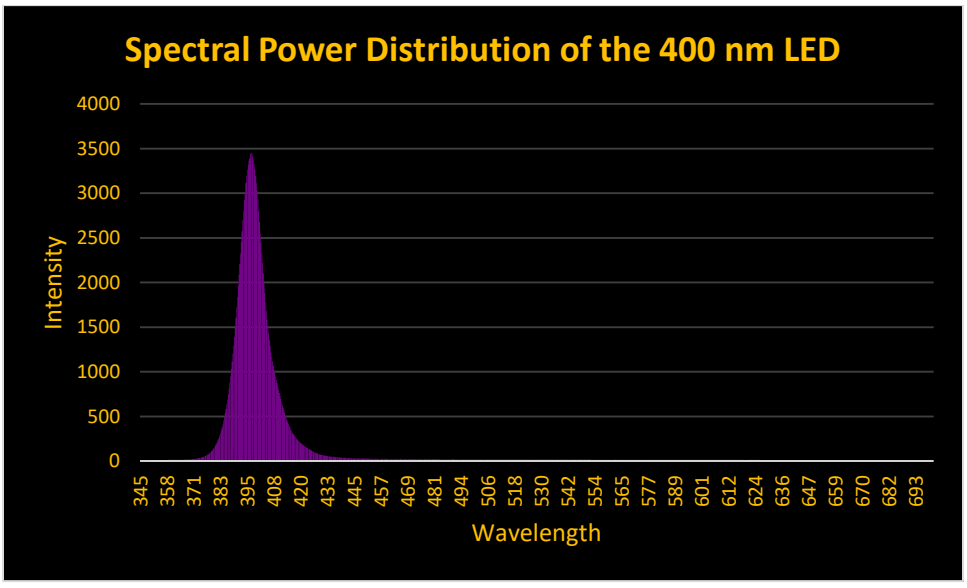

Figure X. SPD of the 400nm LED.

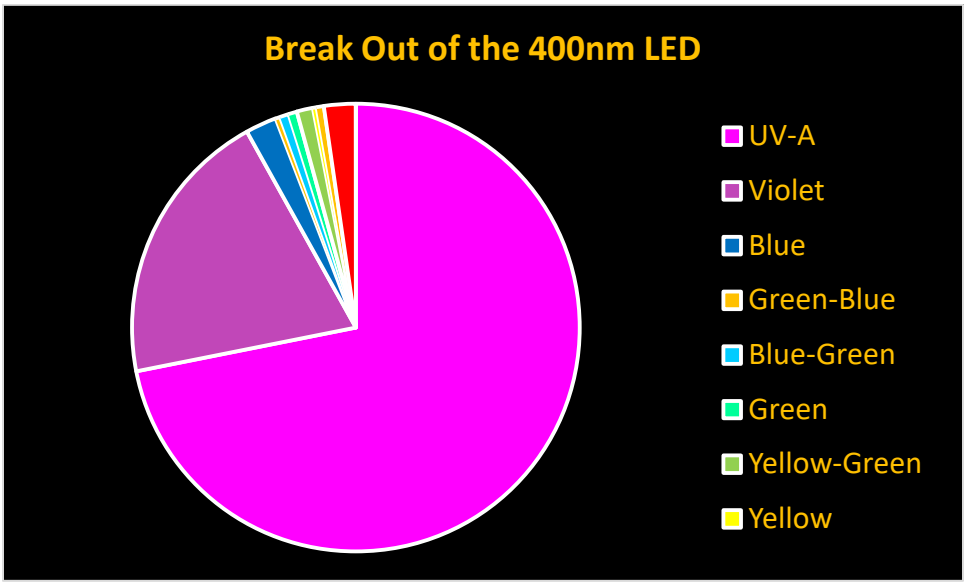

Figure X. Near UV and violet light compose most of the 400nm LED's spectral quality.

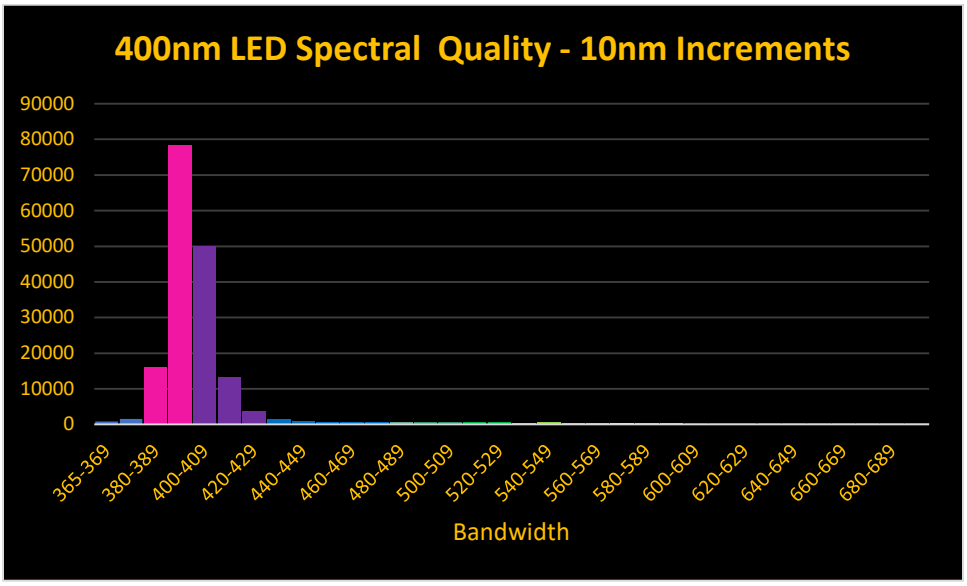

Figure X. The 400nm LED's 10nm bandwidths.

420nm LED

Peak spectral output is right on the money – 420nm.

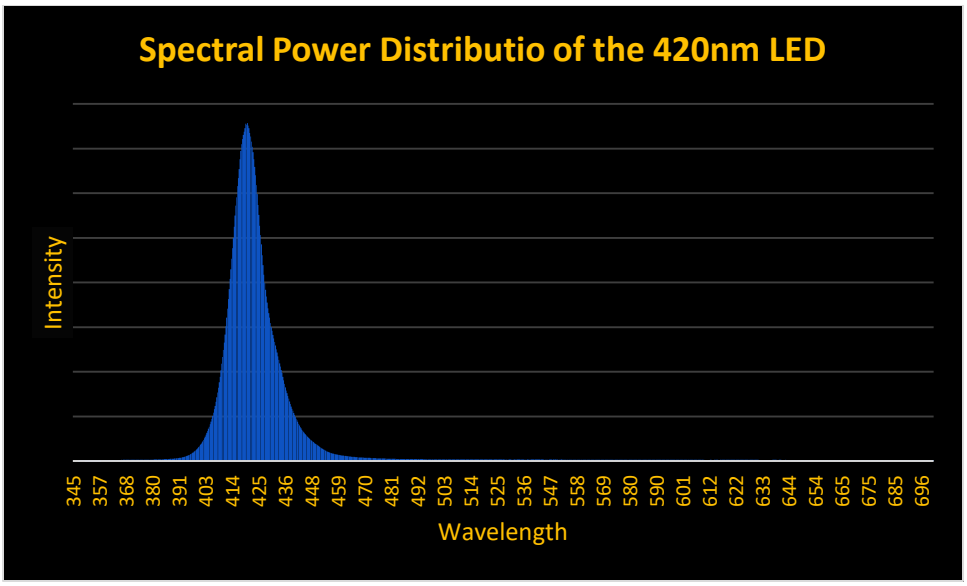

Figure X. The 420nm Led produces mostly violet radiation.

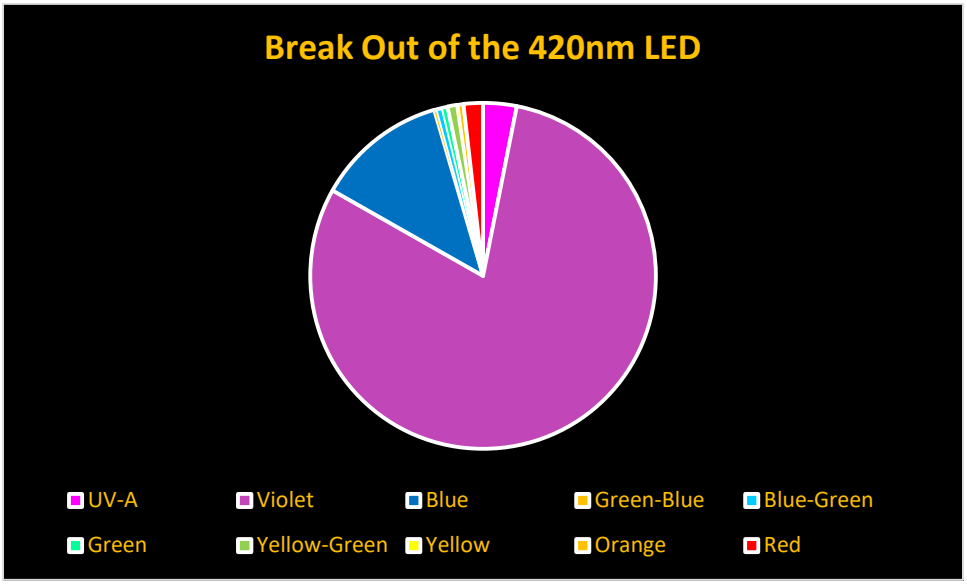

Figure X. Violet light is about 80% of the 420's output.

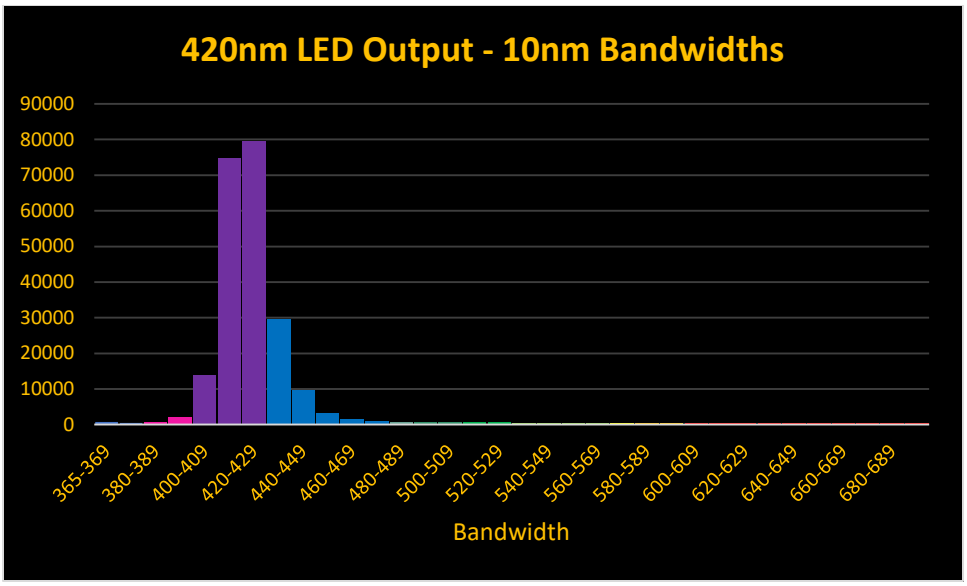

Figure X. Some blue light is produced by the 420nm LED.

Violet LED

Peak output is at 430nm.

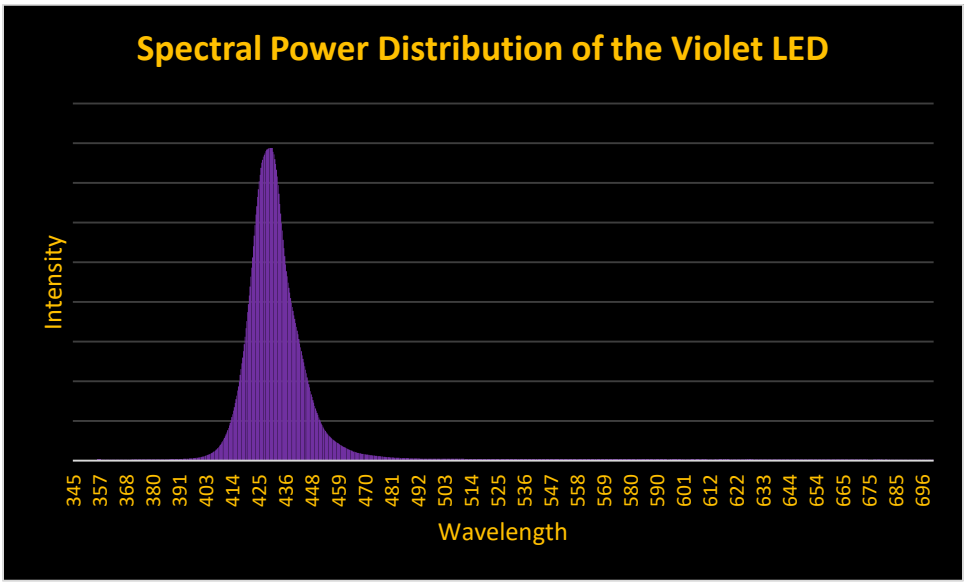

Figure X. The violet LED is aptly named.

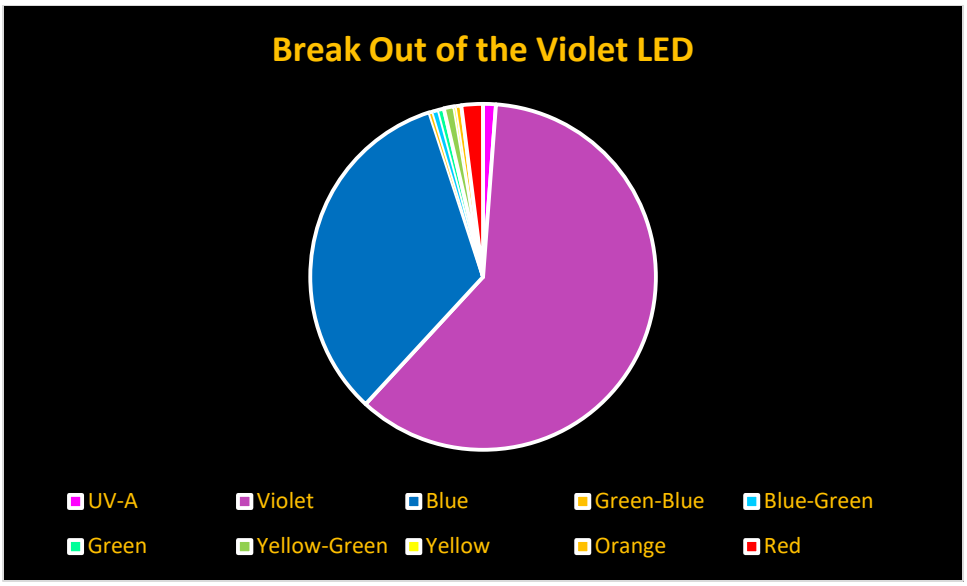

Figure X. Violet and blue light are the major bandwidths produced by this LED.

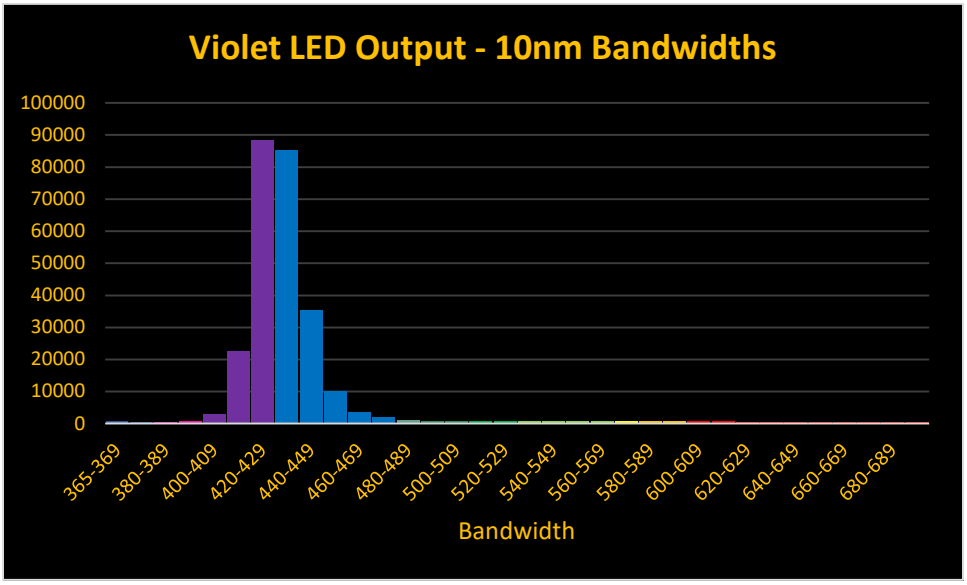

Figure X. Ten nanometer bandwidths of the violet LED.

Royal Blue LED

Peak output is 448nm.

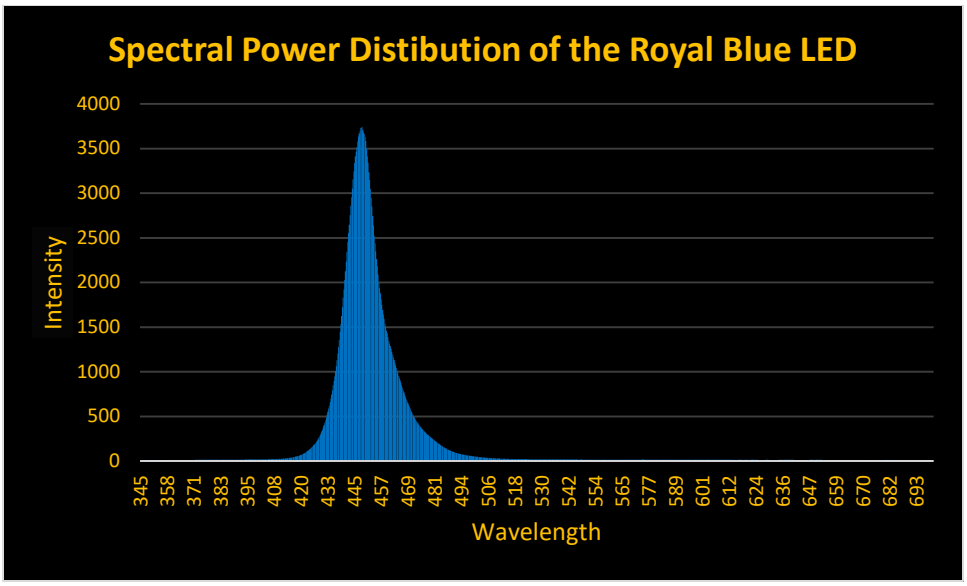

Figure X. The Royal Blue LED peaks at 450nm.

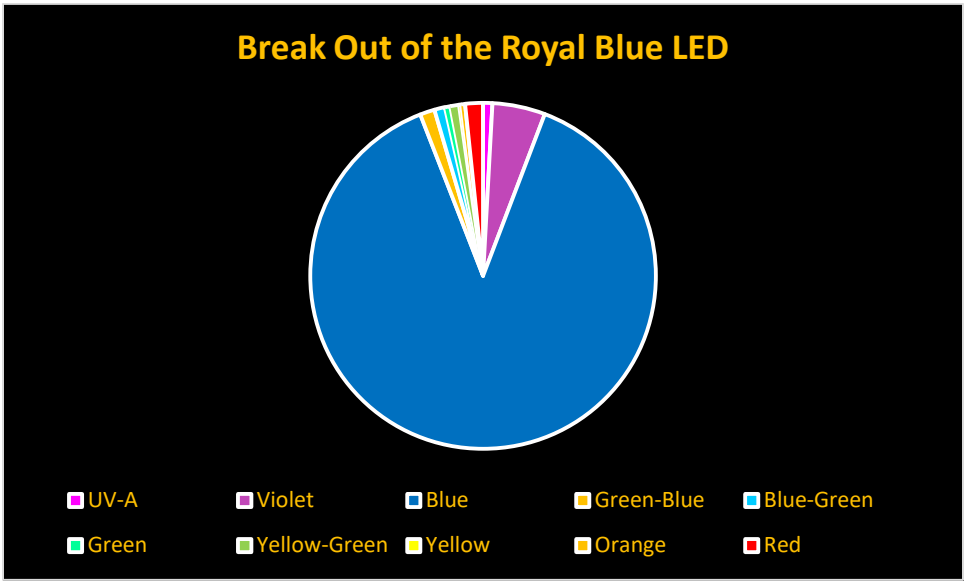

Figure X. The Royal Blue LED really is blue.

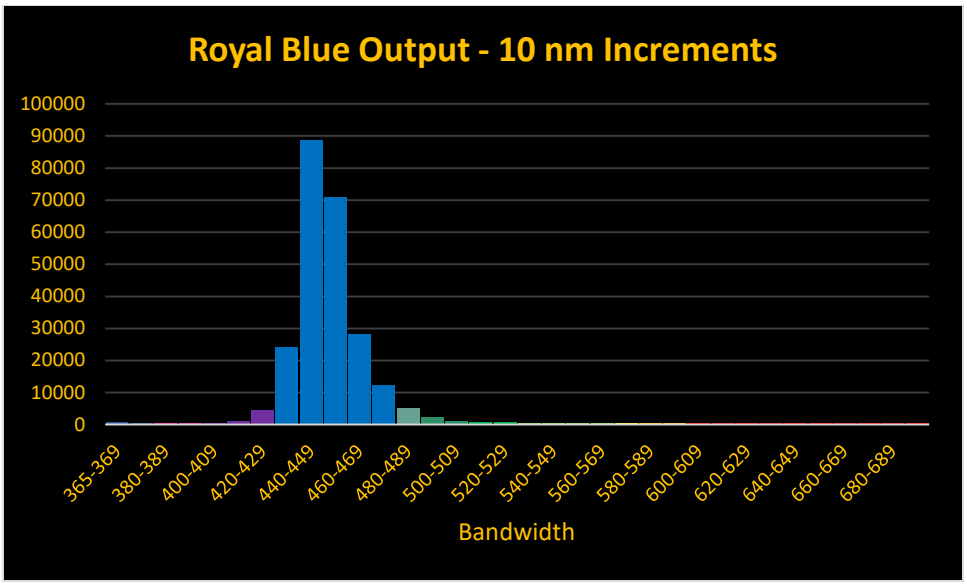

Figure X. Bandwidths of the Royal Blue LED.

Blue LEDs

Peak out is at 471nm.

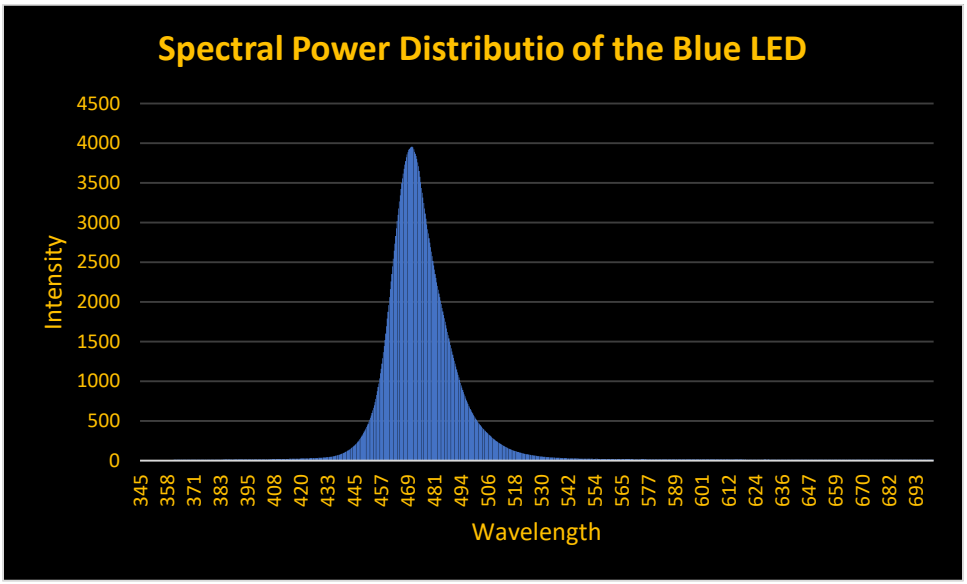

Figure X. Peal output of the blue LED is about 470nm.

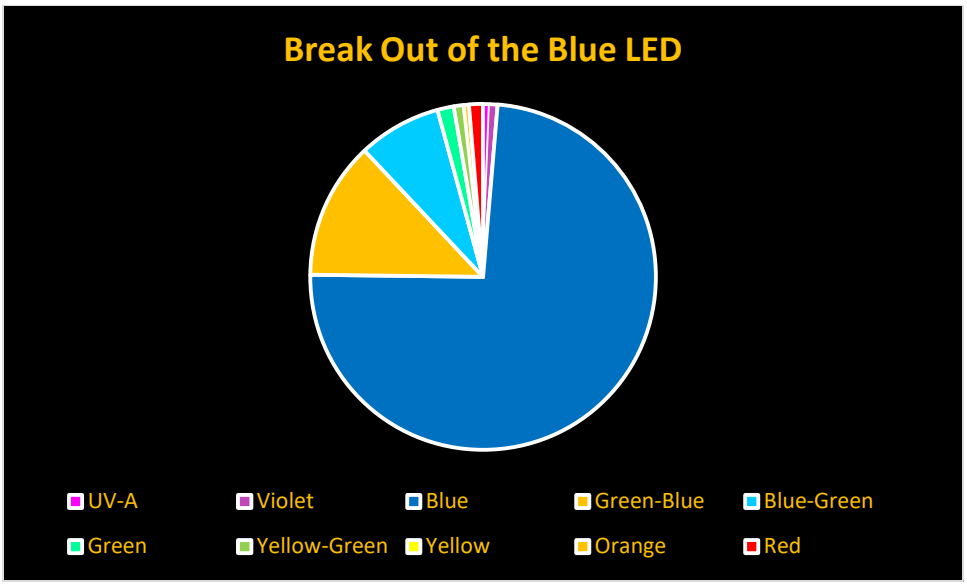

Figure X. Not all radiation produced by the LED is blue.

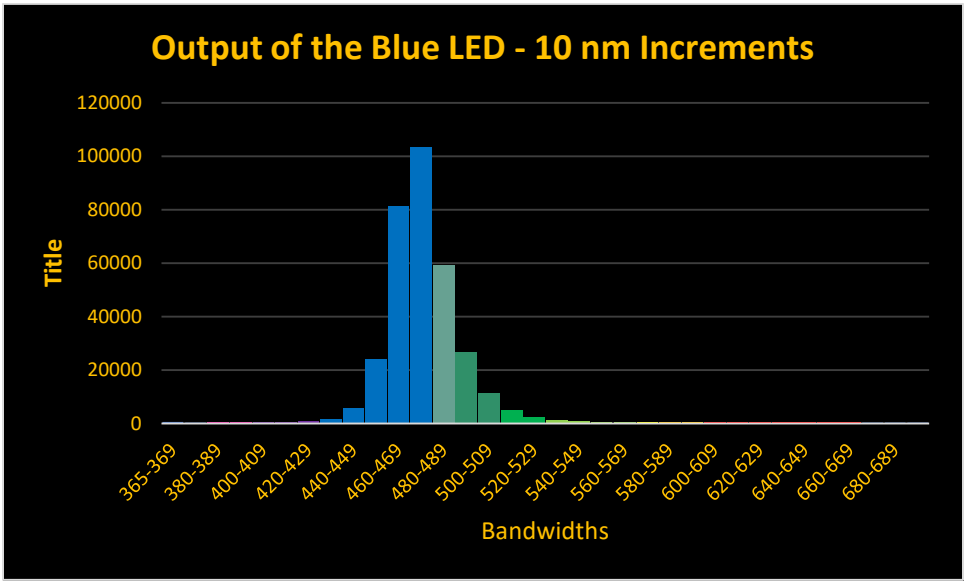

Figure X. The aqua and green output of the blue LED is useful in zooxanthellae photosynthesis.

Lime LEDs

These LEDs have a broadband output, peaking at 549nm.

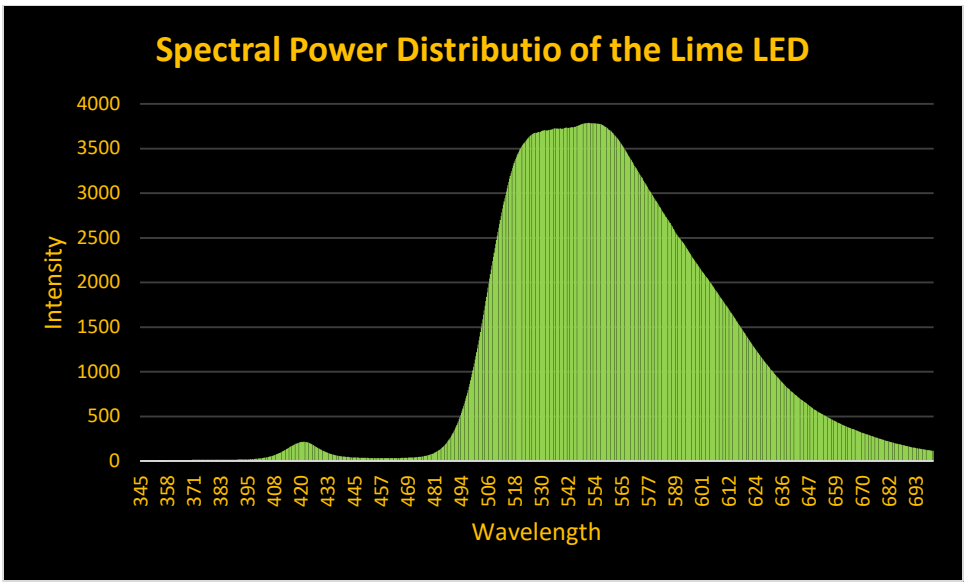

Figure X. The accessory pigment peridinin absorbs light up to about 550nm.

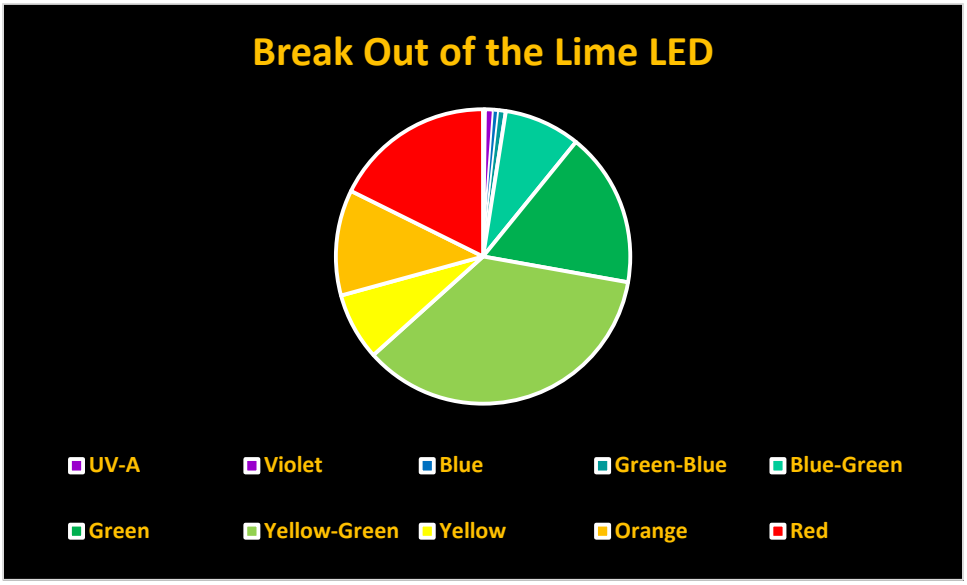

Figure X. Although difficult to determine visually, spectroscopy reveal the lime LED is full spectrum.

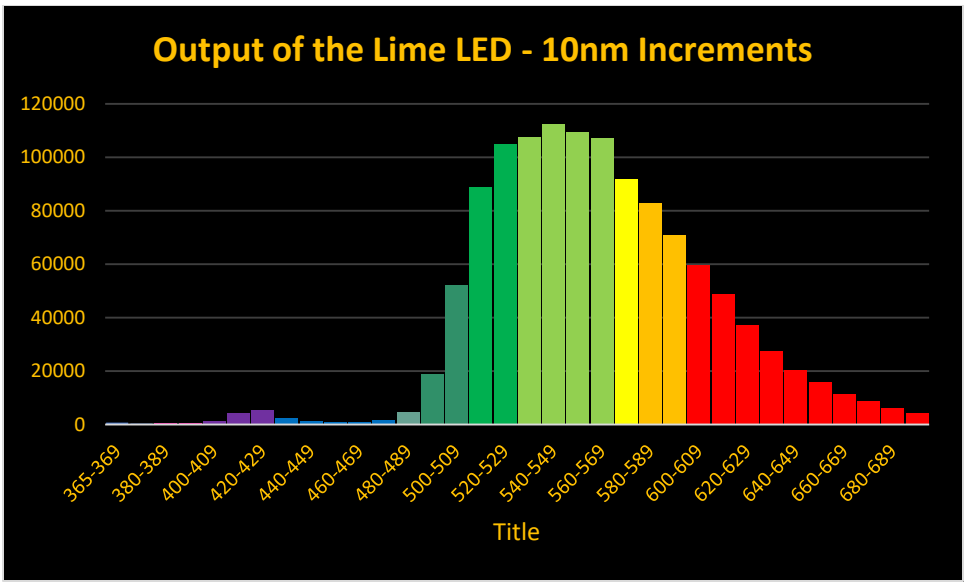

Figure X. Output of the lime LED in 10nm increments.

Amber

These LEDs have a broadband output, with a peak at 593nm.

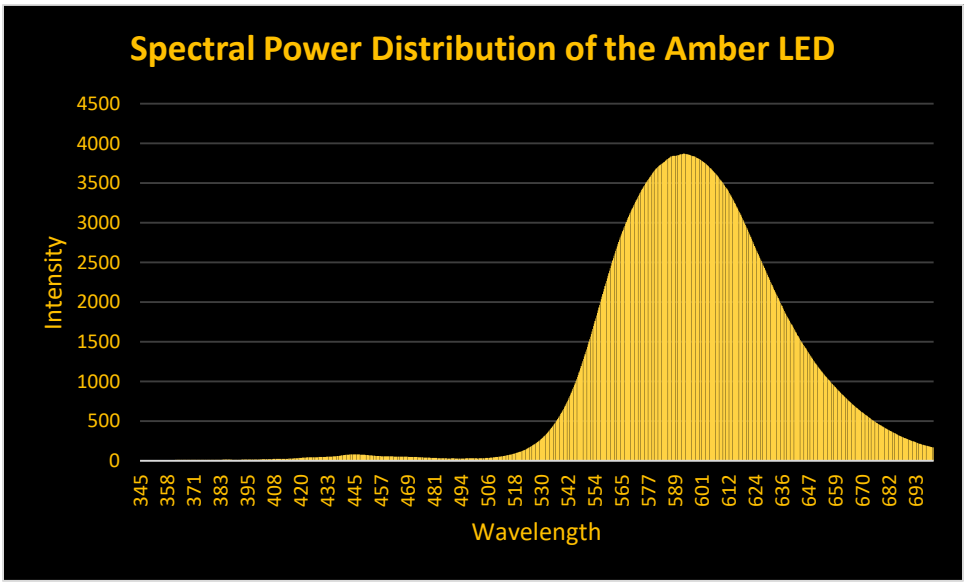

Figure X. Some of the amber LED's output is into the red portion of the spectrum.

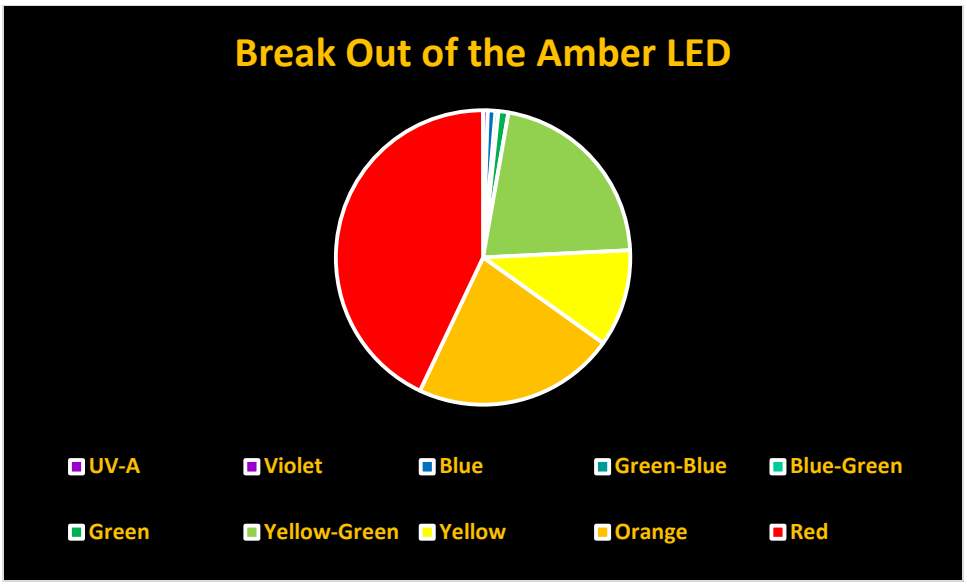

Figure X. The amber LED has about 21% of its output in the yellow-green portion of the spectrum.

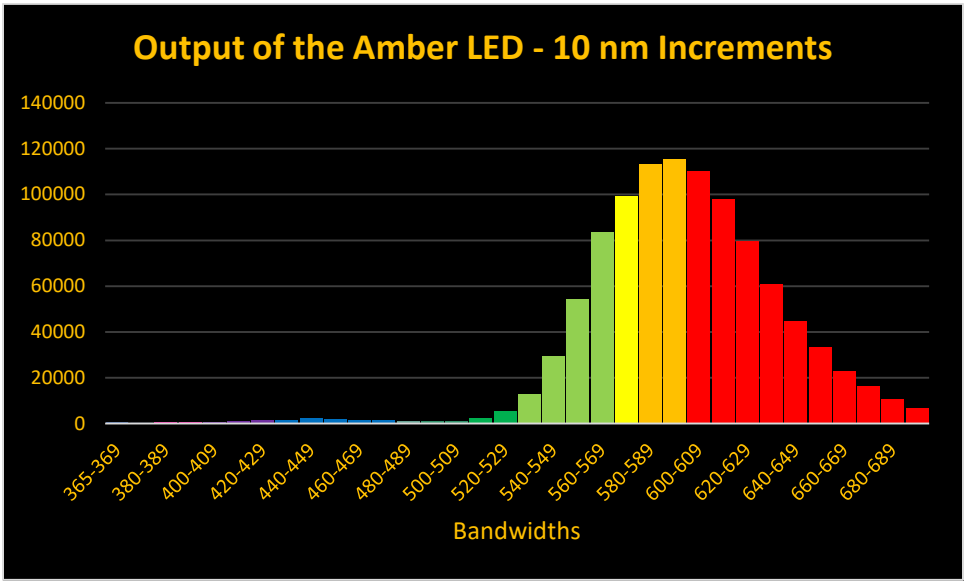

Figure X. Amber LED output in 10nm increments.

Warm White

These LEDs are actually blue LEDs (peaking at 450nm) and are doped with phosphors to create full spectrum light.

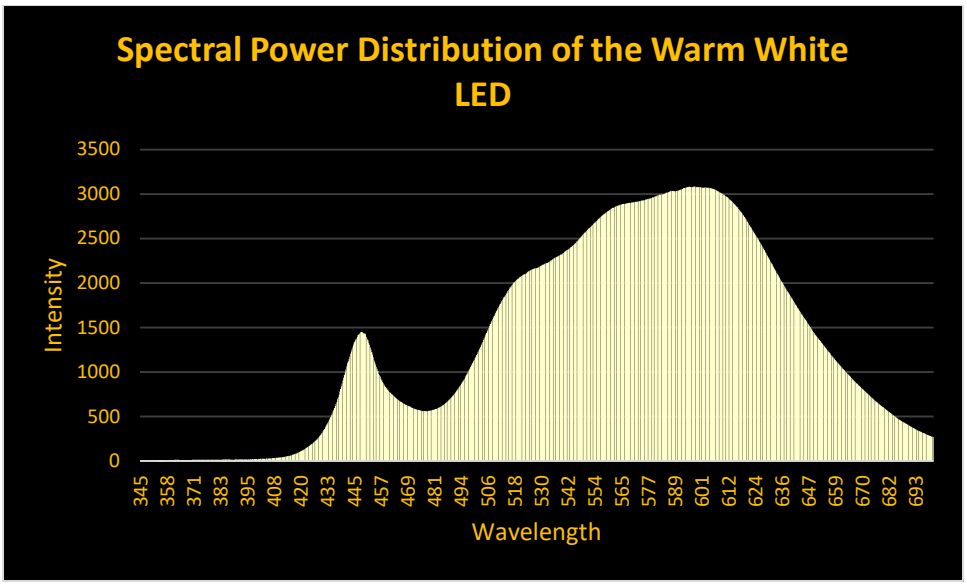

Figure X. Phosphors make this LED produce full spectrum light.

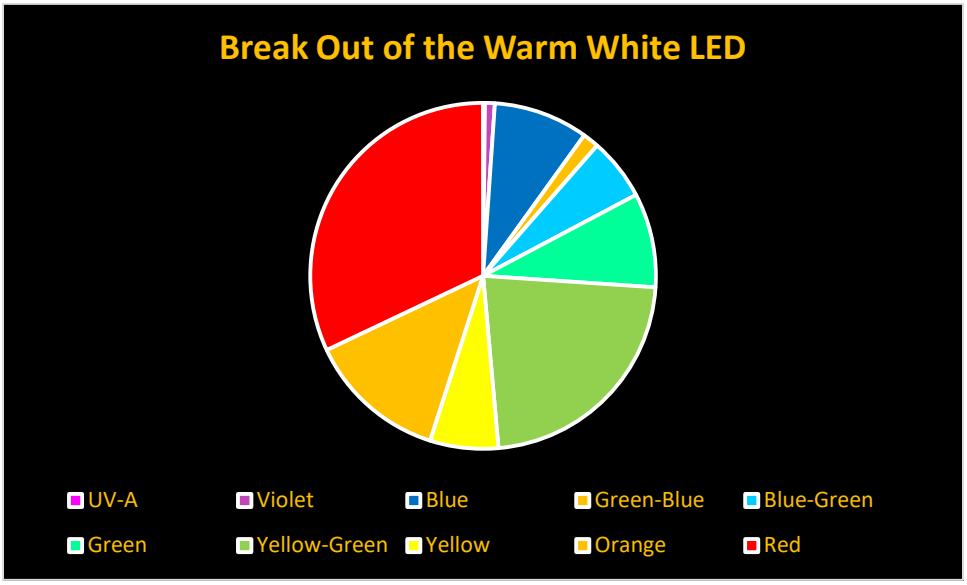

Figure X. Yellow, orange and red light make the output of this LED appear 'warm.'

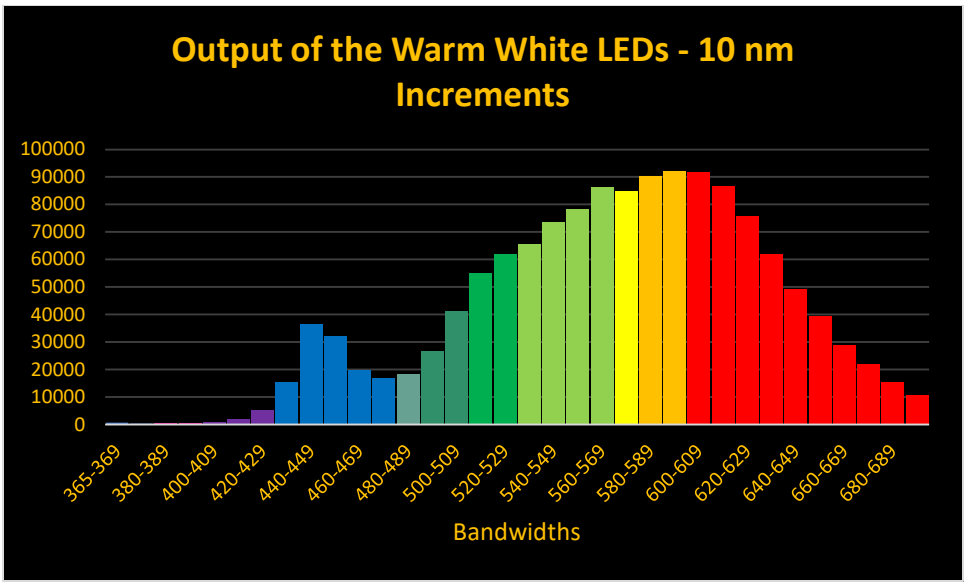

Figure X. Warm White LED output in 10nm increments.

Cool White

As with Warm White LEDs, these are actually blue LEDs (peaking at 450nm) and are doped with phosphors to create full spectrum light.

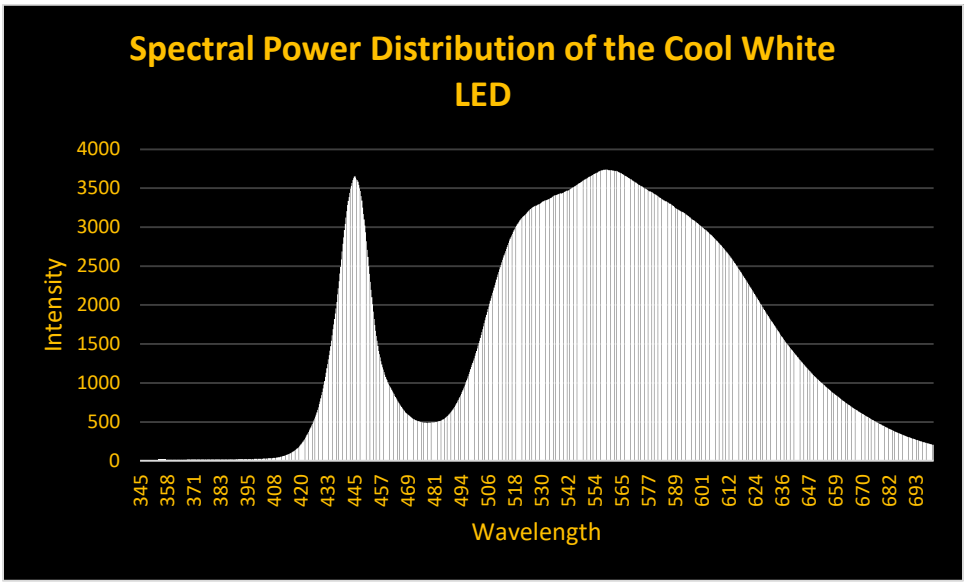

Figure X. The Cool White LED is not as 'warm' as the Warm White LED.

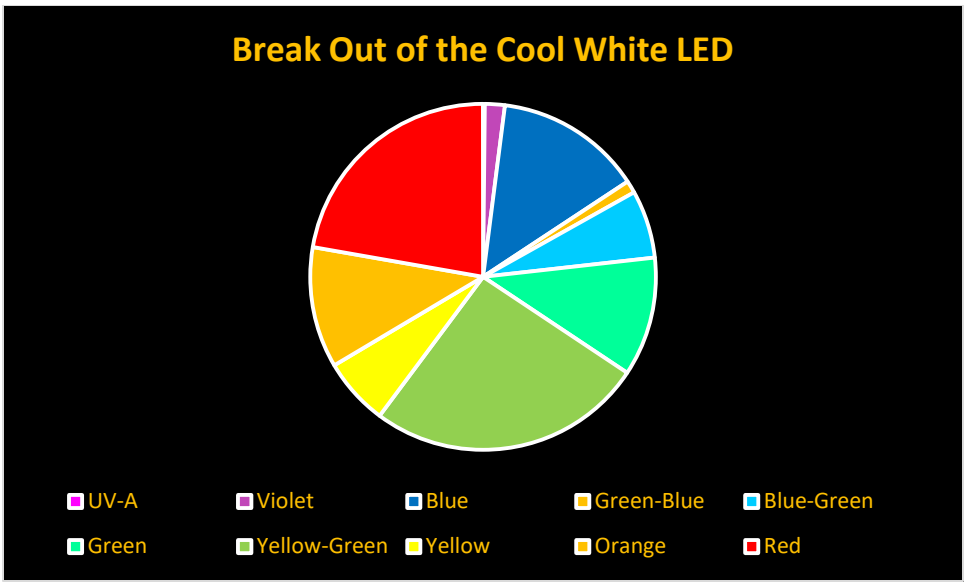

Figure X. The Cool White LED is truly full spectrum.

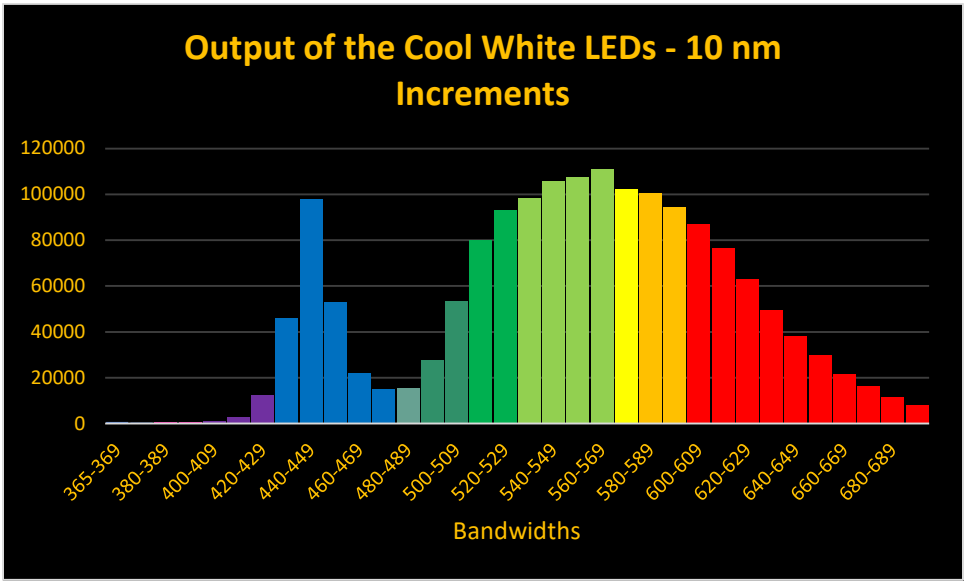

Figure X. Output in 10nm increments.

Photosynthetically Usable Radiation (PUR)

Photosynthetically Usable Radiation (PUR) is the portion of Photosynthetically Active Radiation (PAR) that is beneficial in the promotion of photosynthesis. Here, it is expressed as a percentage.

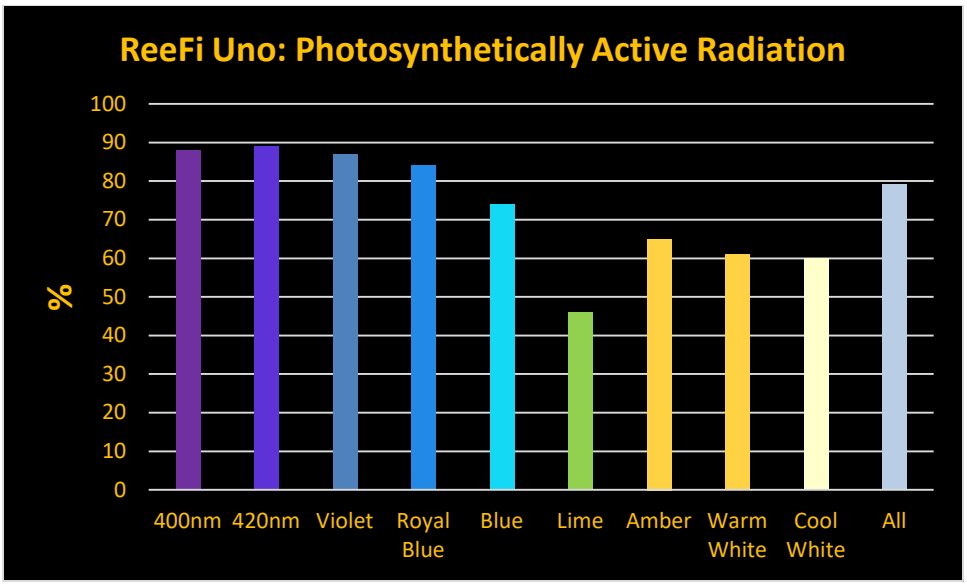

Figure X. An estimate of light usable in photosynthesis in per cent.

Light Distribution

Corals, algae, plants and other photosynthetic organisms require varying amounts of light, hence it is important to understand have a given light source illuminates an aquarium. Figures x to x illustrate these patters at various depth when the Uno (at full power) is suspended 9.5” above the water’s surface.

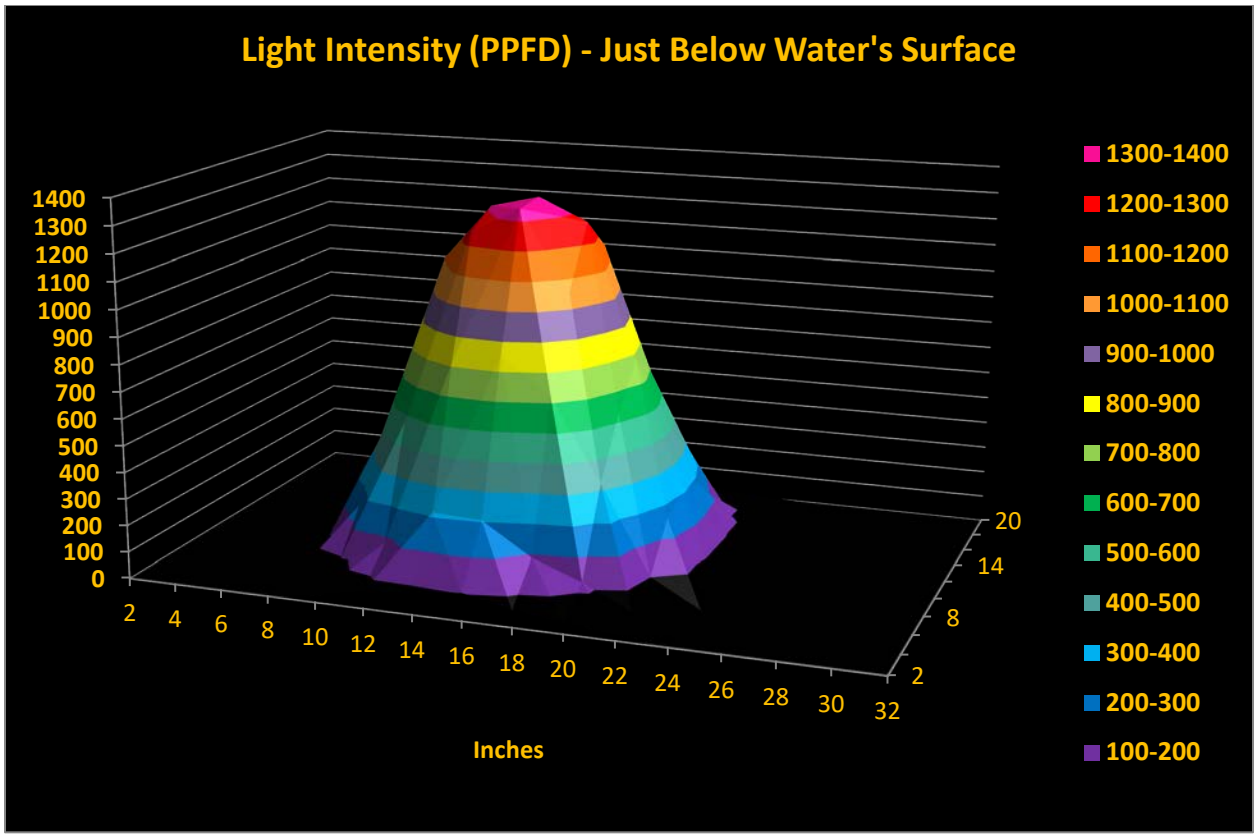

Figure X. Full strength sunlight in the tropics is about 2,000 µmol·m²·second. Compare this to the output of the Uno.

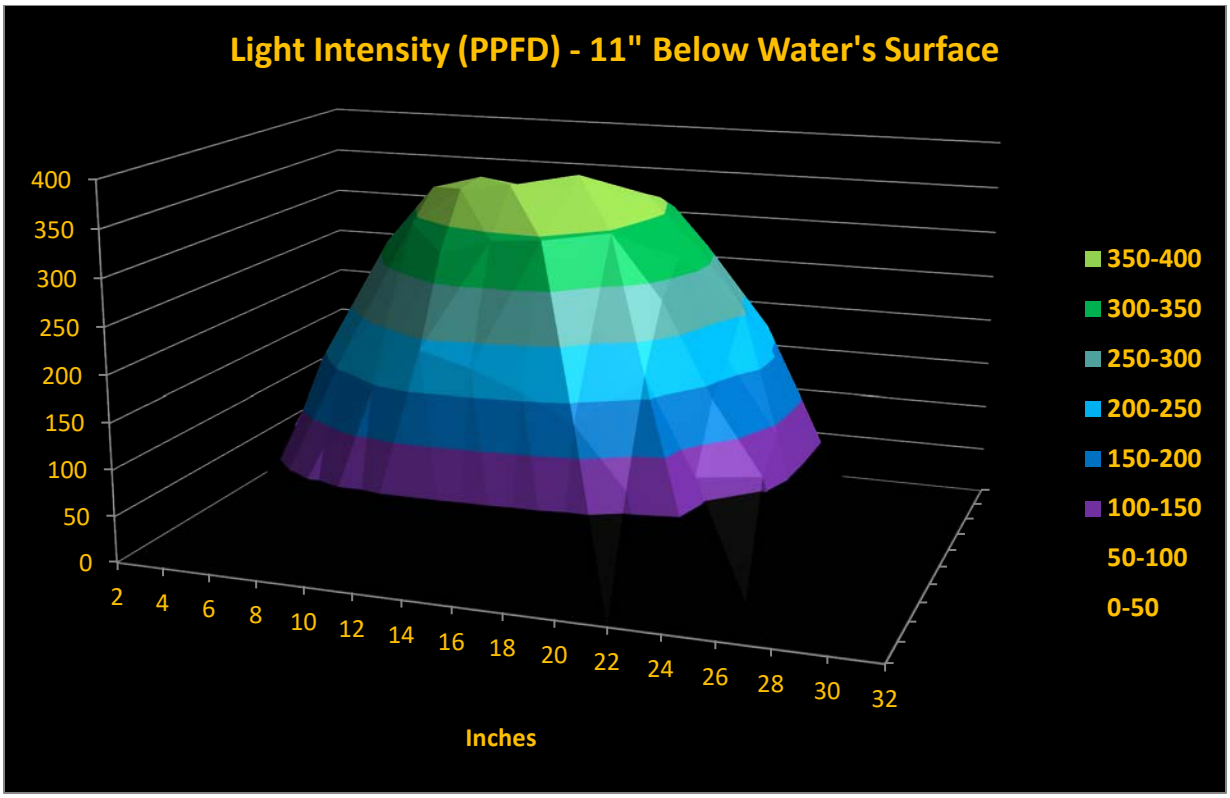

Figure X. Light intensity and distribution of the Uno at 11 inches below the water's surface.

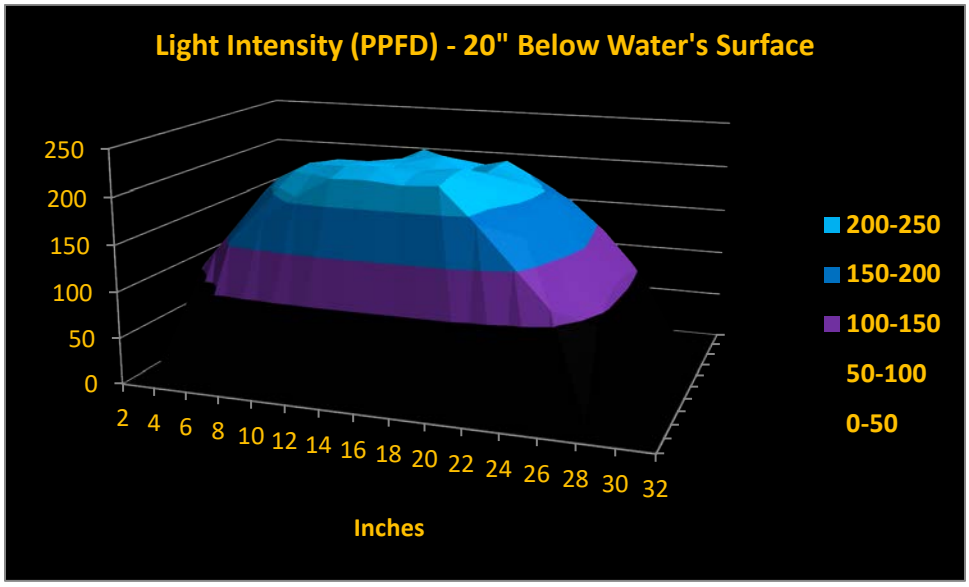

Figure X. Light intensity and distribution at 20 inches below the water's surface.

Programming

It was a breath of fresh air to program the ReeFi luminaries. It was done simply by accessing the IP address of the luminaire, using slide bars to control PPFD and light quality, and then saving the program.

As an aquarium hobbyist since the 1960's, I grew up with simple lighting systems activated by simply plugging them in, or, if advanced, using a timing device. This worked well with all lighting systems. Then enter the era of the internet and advanced lighting systems with online programming. I found it tiresome to learn how to program LED lights with each model and iteration. Frankly, some control software were garbage. In my opinion, ReeFi's approach to programming is the gold standard for aquarium lighting.

There are several pre-set programs including those for SPS corals, LPS corals, night view, and so on.

Firmware updates are available online and can be downloaded in just a few minutes.

Moonlight
Automatic moon phasing is included with the cloud-based software and its spectral quality can be selected by the end user.

Reflectors ('ReeFlectors')
ReeFi LED luminaries use conical light-focusing devices for light and color blending. See Figure X.

Cooling/Heat Exchanger
Heat is the enemy of LED lighting systems. Some luminaires use monstrous heat sinks to control temperature. Small units use fins to dissipate heat. The ReeFi uses **f**our-phase copper vapor chambers and micro–zipper heat sinks - these are often used in controlling temps in computers. If the Uno is mounted within a hood, it is recommended that it be well-ventilated. Do not use in an enclosed hoods.

Splash Guard
A iron-free glass plate protects the LEDs from water splashes. This might seem trivial, but glass does not degrade as plastics will when exposed to ultraviolet, violet, and blue radiation.

Power Consumption
ReeFi advertises the Uno luminaire will use 180 watts at full power.

Price
At the time of this writing, the Uno is available for $350 on a pre-order basis.

Mounting Options
An adjustable mounting device is available for $55 (pre-order price.)

Warranty
The Uno is warrantied for a period of 3 years.

Discussion
A plethora of LED luminaires are currently available on the aquarium market and many offer the same characteristics, such as programming of photoperiod, light intensity, and spectral qualities. The latter is constrained by the relatively few number of spectrally distinct light-emitting diodes. Hence, it is attention to detail that makes a difference among various makes and models. If we use 100 $\mu mol \cdot m^2 \cdot sec$

as the minimum light intensity for a mixed reef aquarium, the ReeFi Uno, at full power, generates enough light to adequately illuminate an aquarium up to 30 inches long, 20 inches wide and 20 inches deep. If the minimum light required is 200 µmol·m²·sec (as with many SPS tanks), one Uno is sufficient for every 20 inches or so of aquarium length up to widths of 18 inches or so of width and depth. Of course lowering the luminaire slightly from the 9.5 inch mounting height above the aquarium will increase light intensity at the bottom of the tank. Although I found the light output of the Uno at full power to be a crisp white light, this might not be the choice of many hobbyists desiring a light weighted towards the violet/blue portion of the spectrum which showcases the fluorescence of many captive corals. Of course, the answer is simple – program the light for full intensity (and photosynthesis) for times you're away and 'bluer' light for your viewing pleasure. I highly recommend the use of a quantum meter to measure light intensity in the aquarium. As mentioned previously, programming of any ReeFi luminaire is a breeze and presents no challenges to those technically-challenged.

Testing Protocols

Spectral qualities of the LEDs were determined by an Ocean Optics USB2000 spectrometer, and data were exported to an Excel worksheet where refinement was made by proprietary program. Light intensity (Photosynthetic Photon Flux Density, or PPFD) was determined through use of an Apogee Instruments' MQ-510 quantum meter. Underwater light intensities were made in a 100-gallon RubberMaid tub filled with freshwater. The tub is made of a gray plastic which minimizes reflection of light and overcame problems of reflected light influencing light measurements in testing done in glass aquaria. PPFD measurements were made every 2 inches on center using three grids made of egg crate material, which were supported at various depths (just below the water's surface, 11 inches and 20 inches. by PVC pipes. See Photo X. The luminaire was suspended 9.5 inches above the water's surface. Photosynthetically Usable Radiation (PUR) and Kelvin were estimated by a Seneye device. Power consumption was reported by a Kill-A-Watt power meter.

Contact and Further Information

See www.reefi-lab.com for further details.