July 2021

Environmental Biodegradation Evaluation and Time-Lapse Video: New WinCup Holdings, Inc., Phade® PHA Marine Biodegradable Straws

Purpose

Keypoint Intelligence was commissioned by New WinCup Holdings, Inc., to establish marine tanks and then monitor and evaluate the biodegradation of Wincup's proprietary phade® PHA Marine Biodegradable straws in saltwater environments optimally designed to sustain marine life. The primary objective of the project was to create a time-lapse video of a phade PHA Marine Biodegradable straw biodegrading in two unique marine environments: one at a warmer temperature of 80°F-84°F and the other at a cooler temperature of 72°F-76°F. It was critical that both environments (tanks) were properly set to first support marine life. Project procedures included the use of two saltwater-filled fish tanks set to controlled temperature and lighting conditions to support marine life as well as photographic equipment to capture photos in both tanks at five-minute intervals.

Summary

After 58 days (Tank 1, average temperature of 76°F) and 54 days (Tank 2, average temperature 83°F) of exposure inside the established tank conditions, Keypoint Intelligence technicians and analysts saw no visible signs of the two phade PHA straws in either tank, with the straw in Tank 2 deteriorating in four fewer days than the straw in Tank 1. Photos and videos were taken during the entire project. The photos for Tank 1 were used to develop a time-lapse video of the biodegradation of the straw in a marine environment, while similar photos were also collected for Tank 2.

Methodology

The primary objective of the project was to capture photographic assets showing the biodegradation of the phade PHA Marine Biodegradable straw in a marine environment. Prior to commencing the project, WinCup provided Keypoint Intelligence with the ASTM 6691 Marine Biodegradation standards, which were used as a reference to set up the tanks but were not adhered to in full. Temperatures in each tank were reduced from the ASTM 6691 standard of 89F° to 74°F for Tank 1 (range of 72°F -76°F) and at 84°F for Tank 2 (range of 80°F-84°F).

Each tank was installed and configured by a Marine Tank Specialist from Seaphoria, which also provided 40 gallons of premixed salt water specifically for marine aquariums. Optimal tank conditions were set—configured with all necessary elements such as rocks and sand—to ensure both tanks would fully support and sustain marine life. While bacterial levels were not measured, they were deemed optimal for support of marine life by measuring other elements in the water affected by naturally occurring beneficial bacteria. Optimal levels for pH and temperature were created to meet this objective.

Keypoint Intelligence received a case containing 375 phade PHA Marine Biodegradable straws. Several were open and used by Keypoint staff to confirm the straws were viable for the project. Ten Jumbo straws (7.75" in length) were chosen at random and then removed from the packaged paper sleeves and individually weighed (all weighed a consistent 0.7 grams). From those ten straws, two were randomly selected for testing.

Setup

Beginning on March 16, Keypoint Intelligence technicians began facilitating proper tank conditions. Upon the establishment of proper conditions within each tank (temperature, pH, bacteria levels, etc.), two clownfish were added to each tank on March 30.

On April 2 the first of the randomly selected phade straws was placed on top of the water in Tank 2, after which it immediately sank to the bottom (unlike other traditionally manufactured straws). The straw was then placed on the rocks by Keypoint Intelligence technicians.

Keypoint Intelligence and the Marine Tank Specialist delayed the start of the project in Tank 1 because it was not showing optimal conditions to sustain marine life. On April 6, the second of the randomly selected phade straws was placed on top of the water in Tank 1, after which the straw also sank to the bottom right away and was placed on the rocks by Keypoint Intelligence technicians. Unfortunately, one of the clownfish was lost within the first 24 hours.

The positioning on each rock was done for two reasons. First, to enable as much water to engage with the surface of the straw as possible and to provide waterflow over the straw (note that ASTM 6691 calls for consistent agitation of the item in water to represent motion in the marine environment). Secondly, to provide the best environment to document the photos showing the biodegradation of the straw.

Keypoint Intelligence technicians monitored and recorded tank conditions each day for the duration of the test, along with manual feeding of the fish. On weekends, fish were fed as needed. Video and photos were also collected throughout the test for each tank, with a time-lapse video created to visualize the degradation of the straws over time. Testing was considered complete upon seeing no visible evidence of the test straws in any part of either tank.

Results

By April 12-13, the first signs of biodegradation on both straws (see Supporting Test Data for all photos) had already become evident, roughly seven days following the straws being added to the tanks. By April 22, technicians observed a buildup of algae beginning to form in both tanks, represented by a bright mustard yellow and rust coloring on the rocks as well as the sand on the bottom of the tank and even on the phade straw itself. This rapid buildup was likely caused from the consistent lighting that was required to capture photos of both tanks every five minutes, 24 hours a day, seven days a week (the presence of consistent light can foster rapid algae growth in a marine tank). Once observed, technicians notified WinCup of the issue and recommended adding two marine snails to Tank 2, and one to Tank 1. The snails consumed the algae and allowed the rocks and sand to regain their original color (their presence can be seen in the video). It should also be noted that the disappearance of the algae on the phade straw came from the biodegradation process (bacteria consuming the straw as well as the algae on the straw) and not from the snails. While the snails did occasionally bump the straws in both tanks, they did not attempt to eat the algae off the straw. Aside from the use of a magnetic aquarium glass cleaner to minimize any contamination in the tank's front glass, no chemicals or other water clarifiers were added to the tank.

On May 20, the straw in Tank 1 broke into two pieces as a result of the biodegradation process (bacteria consuming the phade straw). Upon falling to the floor of the tank, the current in the tank from the pumps pushed the straw under one of the rocks in the back of the tank, which caused the view of the straw to be almost completely blocked from the camera. Keypoint Intelligence and WinCup decided the rock in the front left of the tank should be removed (May 24) so that a better view could be established of the straw completing biodegradation. As the rock was removed, the team changed the timing on the photography from one shot every five minutes to one shot every five

seconds to capture the action—at no point in this process was the straw touched. A technician simply removed the rock and the photography was adjusted back to one shot every five minutes, enabling a much better and cleaner view of the final states of biodegradation and allowing for irrefutable evidence of the complete biodegradation of the phade PHA Marine Biodegradable straw on Day 58.

The project was initially slated for a period of 90 days. The straws broke down fully with 33.3% of allotted test time remaining.

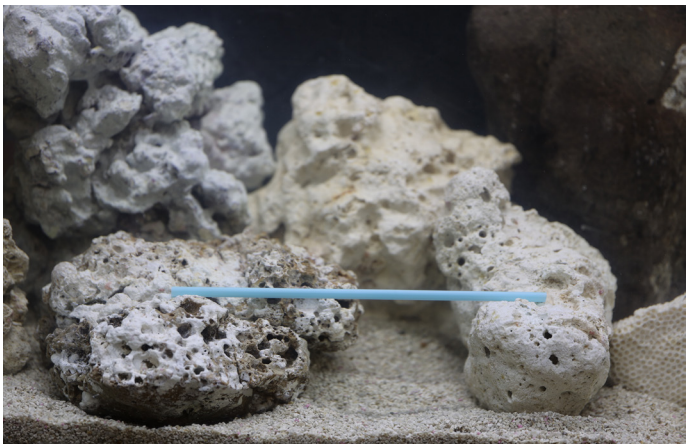
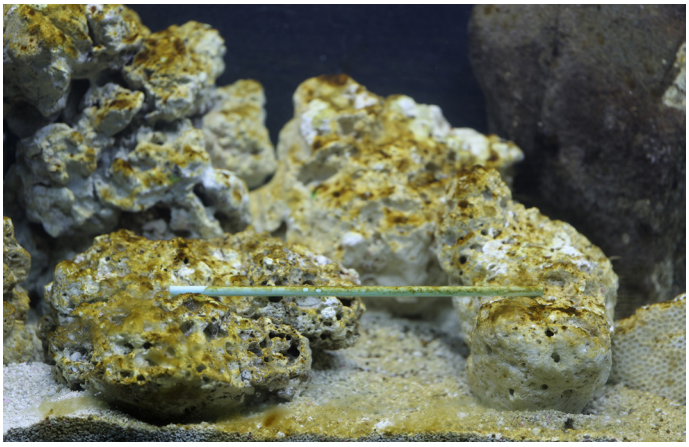
Keypoint Intelligence technicians noted that Tank 2, which was maintained at a higher temperature than Tank 1, saw a faster biodegradation of the phade straw, but only four days faster (54 days in Tank 2 vs. 58 days in Tank 1).

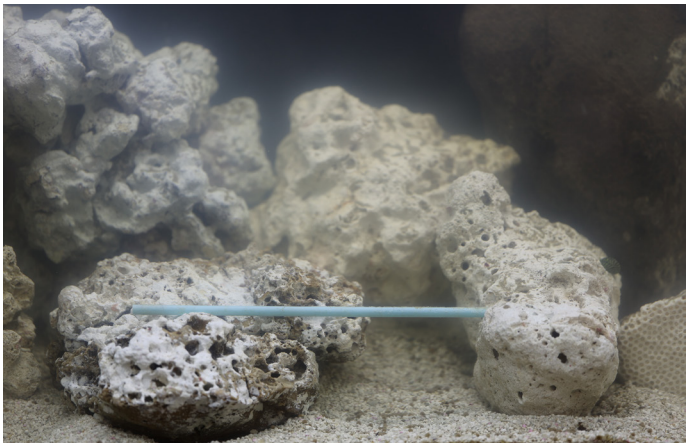
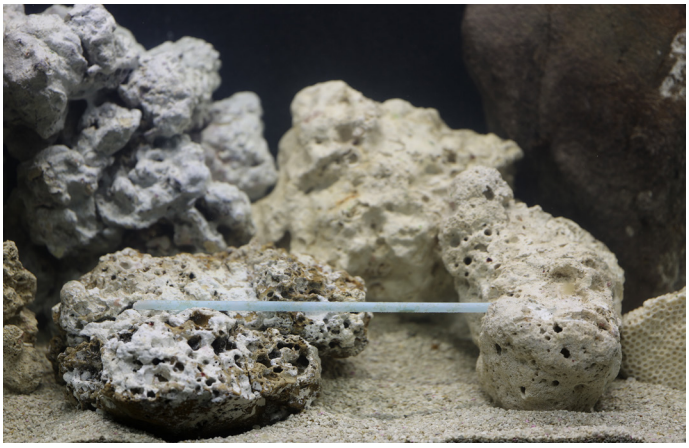
This project was designed to develop a time-lapse video of the Phade PHA Marine Biodegradable straw biodegrading in a Marine environment and is not meant to represent any form of testing or certification. The certifications obtained by phade can be found on the phade website and the landing page hosting the time-lapse video. Biodegradation and biodegradation of PHA in any environment is completely dependent on the amount and presence of bacteria in the environment. Therefore, conditions and results of phade PHA straws biodegrading and biodegrading will vary. This project was executed to provide visual proof of the biodegradation process for a phade straw.

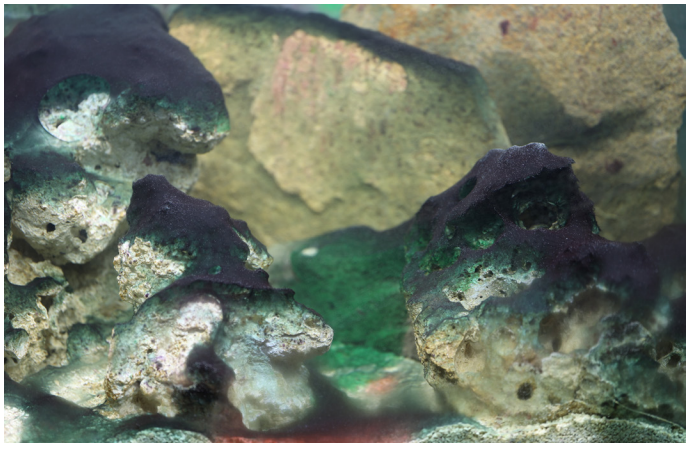
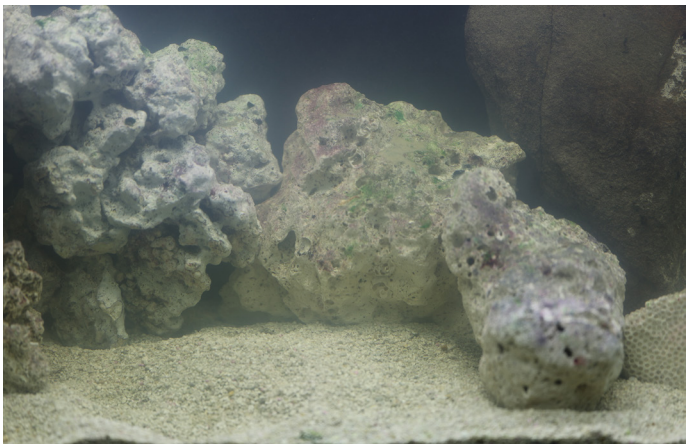
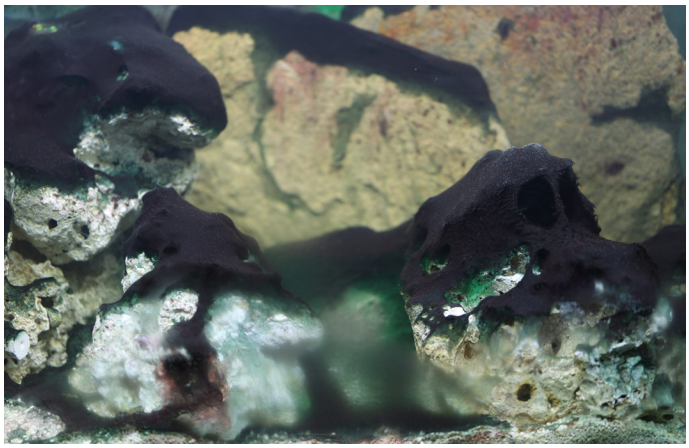
Supporting Test Data

Test Setup

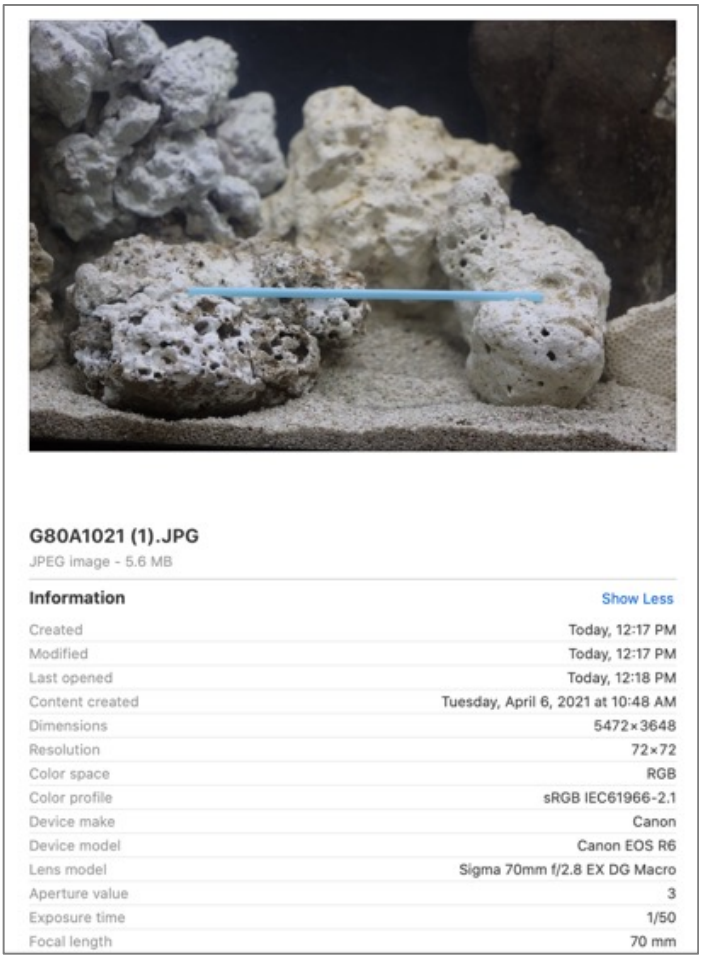
Straw Degradation Images

Tank 1	Tank 2
4/6/21  First day of the straw in the tank.	**4/2/21**  First day of the straw in the tank.
4/16/21  The straw exhibited some degradation, and algae began forming along the rocks.	**4/16/21**  The straw exhibited some degradation, and algae began forming along the rocks.

4/30/21	**4/30/21**
	
Algae was now under control, with the straw visibly intact but continuing to degrade at a steady pace.	Algae was now under control, with the straw visibly intact but continuing to degrade at a steady pace.
5/14/21	**5/14/21**
	
The color of the straw was now visibly faint compared to the start of the test as degradation continued.	The straw is barely intact, with very evident degradation.

5/28/21	**5/28/21**
	
The straw had now collapsed from the rocks it was mounted on, and remnants can be seen just beneath the rock in the center of the frame.	No visible remains of the straw.
6/7/21	**6/7/21**
	
The straw had now completely broken down.	No remnants of the straw are visible.

Tank 1 Photos



G80A1021 (1).JPG
JPEG image - 5.6 MB

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Modified	Today, 12:17 PM
Last opened	Today, 12:18 PM
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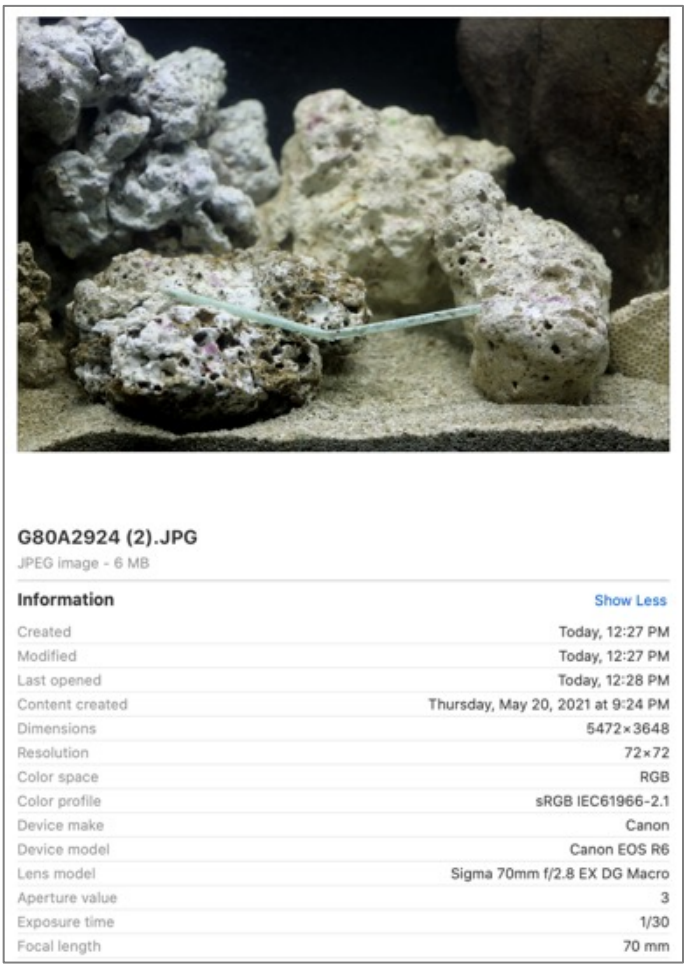
Dimensions	5472×3648
Resolution	72×72
Color space	RGB
Color profile	sRGB IEC61966-2.1
Device make	Canon
Device model	Canon EOS R6
Lens model	Sigma 70mm f/2.8 EX DG Macro
Aperture value	3
Exposure time	1/50
Focal length	70 mm

Day 1, April 6, 2021:
Straw put in tank.



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Last opened	Today, 12:28 PM
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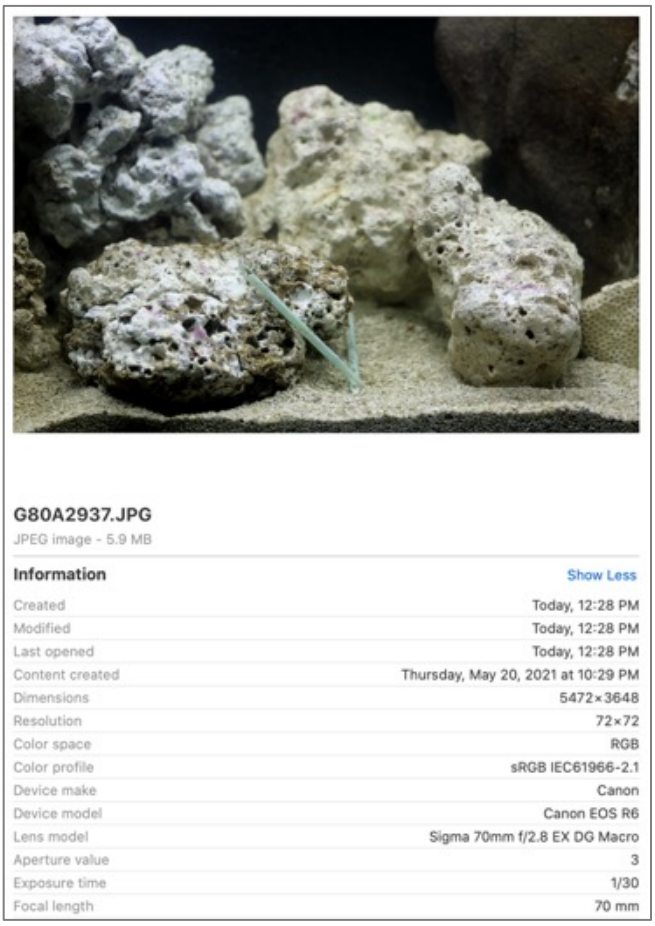
Device make	Canon
Device model	Canon EOS R6
Lens model	Sigma 70mm f/2.8 EX DG Macro
Aperture value	3
Exposure time	1/30
Focal length	70 mm

Day 45, May 20, 2021, 9:24 pm:
First break in straw.



G80A2937.JPG
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Created	Today, 12:28 PM
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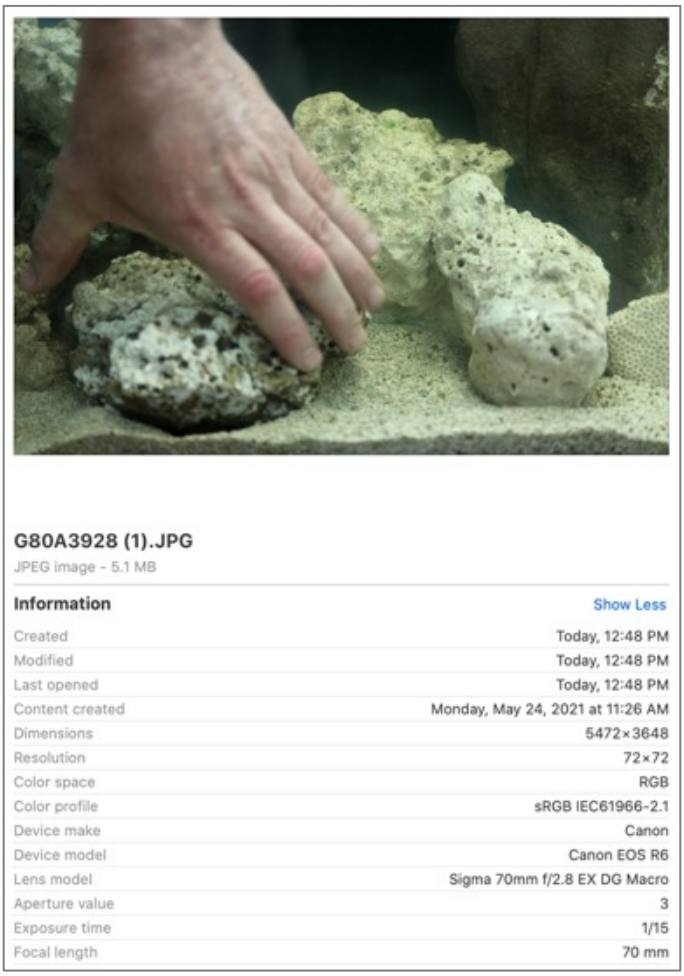
Device make	Canon
Device model	Canon EOS R6
Lens model	Sigma 70mm f/2.8 EX DG Macro
Aperture value	3
Exposure time	1/30
Focal length	70 mm

Day 45: May 20, 2021, 10:29 pm:
Complete break of straw



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Created	Today, 12:48 PM
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Dimensions	5472×3648
Resolution	72×72
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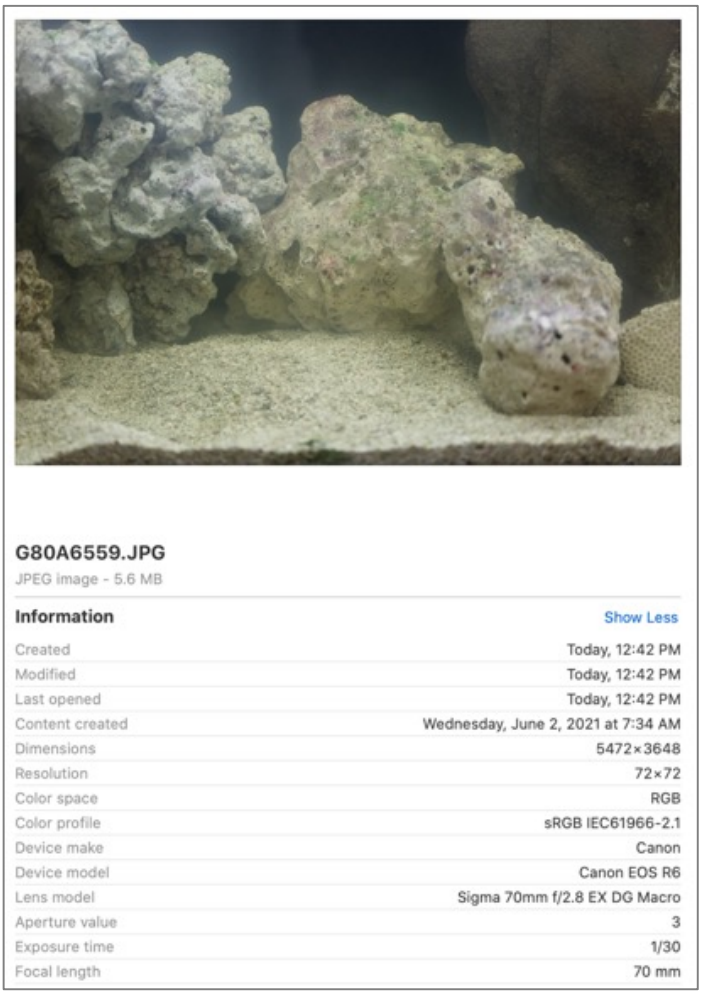
Color profile	sRGB IEC61966-2.1
Device make	Canon
Device model	Canon EOS R6
Lens model	Sigma 70mm f/2.8 EX DG Macro
Aperture value	3
Exposure time	1/15
Focal length	70 mm

Day 51: May 24, 2021, 11:26 am:
A rock is removed.



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JPEG image - 5.6 MB

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Created	Today, 12:42 PM
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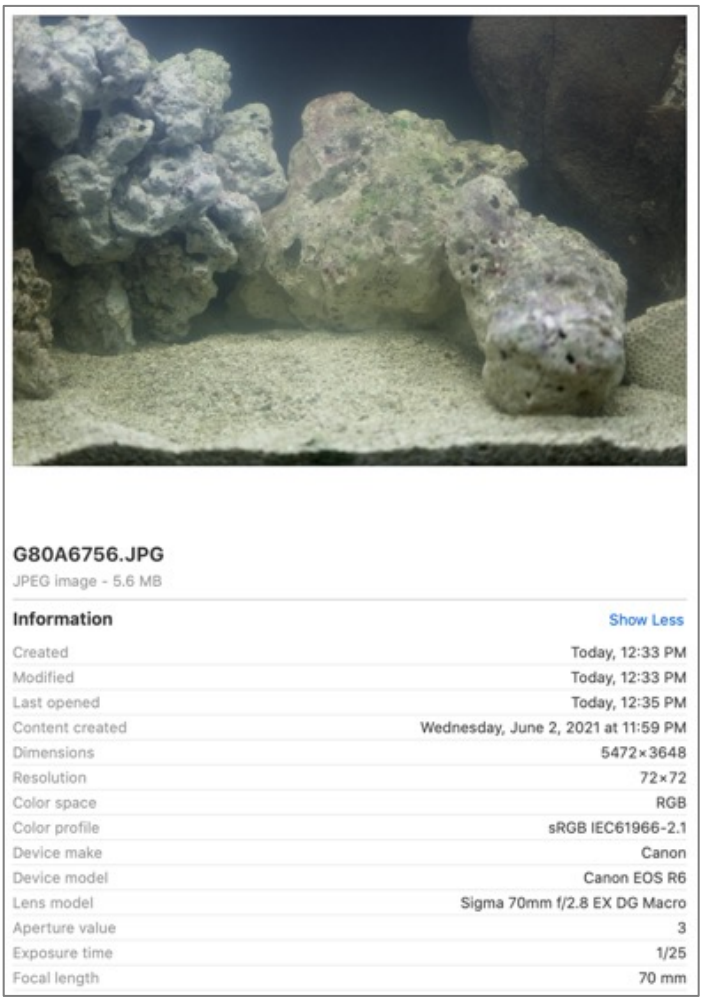
Content created	Wednesday, June 2, 2021 at 7:34 AM
Dimensions	5472×3648
Resolution	72×72
Color space	RGB
Color profile	sRGB IEC61966-2.1
Device make	Canon
Device model	Canon EOS R6
Lens model	Sigma 70mm f/2.8 EX DG Macro
Aperture value	3
Exposure time	1/30
Focal length	70 mm

Day 58: June 2, 2021, 7:34 am:
Straw is completely gone.



G80A6756.JPG
JPEG image - 5.6 MB

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Created	Today, 12:33 PM
Modified	Today, 12:33 PM
Last opened	Today, 12:35 PM
Content created	Wednesday, June 2, 2021 at 11:59 PM
Dimensions	5472×3648
Resolution	72×72
Color space	RGB
Color profile	sRGB IEC61966-2.1
Device make	Canon
Device model	Canon EOS R6
Lens model	Sigma 70mm f/2.8 EX DG Macro
Aperture value	3
Exposure time	1/25
Focal length	70 mm

Day 58, June 2, 2021, 11:59 pm:
Final frame.

Temperature Log

Tank 1				Tank 2			
Date	Time	Tank Temperature (°F)	Lab Temperature (°F)	Date	Time	Tank Temperature (°F)	Lab Temper-ature (°F)
4/2/2021	8:30 am	75.6	72.9	4/2/2021	8:35 am	83.0	72.9
4/3/2021	8:15 am	77.4	73.8	4/3/2021	8:20 am	82.4	73.8
4/5/2021	8:35 am	76.2	72.8	4/5/2021	8:40 am	83.1	72.8
4/6/2021	8:10 am	76.2	72.9	4/6/2021	8:15 am	82.4	72.9
4/7/2021	9:05 am	75.8	74.1	4/7/2021	9:10 am	82.3	74.1
4/8/2021	8:00 am	75.7	73.9	4/8/2021	8:00 am	83.6	73.9
4/9/2021	8:17 am	75.0	73.7	4/9/2021	8:20 am	82.7	73.6
4/10/2021	12:30 pm	75.8	73.6	4/10/2021	12:35 pm	83.4	73.6
4/12/2021	9:00 am	75.7	72.8	4/12/2021	9:05 am	83.2	72.8
4/13/2021	8:15 am	76.1	73.4	4/13/2021	8:25 am	83.1	73.4
4/14/2021	8:30 am	75.9	74.0	4/14/2021	8:35 am	82.7	74.0
4/15/2021	8:35 am	76.2	72.1	4/15/2021	8:40 am	83.6	72.1
4/16/2021	8:11 am	77.0	73.6	4/16/2021	8:20 am	83.0	73.6
4/18/2021	11:37 am	75.9	72.7	4/18/2021	11:45 am	82.8	72.7
4/19/2021	9:00 am	76.1	74.2	4/19/2021	9:00 am	82.6	74.2
4/20/2021	8:45 am	76.2	73.4	4/20/2021	8:50 am	82.7	73.4
4/21/2021	8:30 am	75.9	73.1	4/21/2021	8:35 am	82.6	73.1
4/22/2021	9:15 am	76.2	74.2	4/22/2021	9:25 am	83.3	74.2
4/23/2021	9:10 am	76.1	73.7	4/23/2021	9:15 am	83.0	73.7
4/25/2021	9:15 am	77.3	72.9	4/25/2021	9:20 am	83.1	72.9
4/26/2021	10:05 am	77.1	73.4	4/26/2021	10:00 am	83.4	73.4
4/27/2021	10:00 am	77.0	73.2	4/27/2021	10:05 am	83.2	73.2
4/28/2021	10:05 am	76.8	73.2	4/28/2021	10:00 am	83.6	73.2
4/29/2021	9:17 am	76.4	73.1	4/29/2021	9:20 am	83.5	73.2
4/30/2021	10:15 am	77.0	73.0	4/30/2021	10:15 am	83.7	73.0
5/2/2021	11:20 am	77.1	72.1	5/2/2021	11:25 am	83.5	72.6
5/3/2021	9:25 am	77.8	72.6	5/3/2021	9:25 am	83.7	72.6
5/4/2021	9:05 am	77.1	72.1	5/4/2021	9:05 am	82.9	72.1
5/5/2021	9:25 am	76.3	73.1	5/5/2021	9:25 am	83.2	73.1
5/6/2021	9:00 am	76.2	73.4	5/6/2021	9:00 am	83.1	73.4
5/7/2021	9:00 am	76.4	73.6	5/7/2021	9:00 am	83.2	73.1
5/8/2021	9:25 am	76.3	73.5	5/8/2021	9:25 am	83.3	73.5
5/10/2021	9:25 am	76.2	73.8	5/10/2021	9:25 am	83.1	73.8
5/11/2021	4:00 pm	76.3	72.7	5/11/2021	4:00 pm	83.1	72.7

5/12/2021	3:00 pm	76.4	72.7	5/12/2021	3:00 pm	83.0	72.7
5/13/2021	9:15 am	76.5	72.8	5/13/2021	9:15 am	83.2	72.8
5/14/2021	9:30 am	76.1	73.2	5/14/2021	9:30 am	83.3	73.2
5/16/2021	3:30 pm	75.7	72.8	5/16/2021	3:30 pm	83.0	72.8
5/17/2021	10:15 am	75.8	73.1	5/17/2021	10:15 am	83.1	73.1
5/18/2021	9:30 am	76.2	73.1	5/18/2021	9:30 am	83.1	73.1
5/19/2021	9:05 am	75.9	72.9	5/19/2021	9:05 am	83.0	72.9
5/20/2021	9:30 am	75.8	72.9	5/20/2021	9:30 am	82.9	72.9
5/21/2021	9:00 am	76.0	73.0	5/21/2021	9:00 am	83.1	73.0
5/22/2021	3:00 pm	75.8	72.7	5/22/2021	3:00 pm	82.9	72.7
5/24/2021	10:00 am	76.1	72.6	5/24/2021	10:00 am	83.1	72.6
5/25/2021	9:00 am	76.1	72.6	5/25/2021	9:00 am	83.1	72.6
5/26/2021	9:00 am	75.9	72.7	5/26/2021	9:00 am	83.0	72.7
5/28/2021	8:45 am	76.1	72.7	5/28/2021	8:45 am	83.0	72.7
5/29/2021	7:30 pm	76.0	72.7	5/29/2021	7:30 pm	82.8	72.7
5/30/2021	2:30 pm	75.8	72.6	5/30/2021	2:30 pm	83.0	72.6
5/31/2021	9:00 am	76.0	72.7	5/31/2021	9:00 am	82.8	72.7
6/1/2021	9:30 am	75.8	72.4	6/1/2021	9:30 am	83.0	72.4
6/2/2021	9:50 am	76.1	72.7	6/2/2021	9:50 am	82.7	72.7
6/3/2021	9:30 am	75.7	72.6	6/3/2021	9:30 am	83.1	72.6
6/4/2021	9:00 am	75.8	72.7	6/4/2021	9:00 am	82.8	72.7
Average Temperature		76.2	73.1	**Average Temperature**		83.1	73.1

Initial Water Test Readings

Test	Tank 1	Tank 2
pH	7.800	7.800
Ammonia	0.000	0.000
Nitrite	0.000	0.000
Nitrate	1.000	1.000
Salinity	1.023	1.020
Phosphate	2.200	1.900
Calcium	482.000	402.000
Magnesium	1,072.000	929.000
Alkalinity	9.000	9.000

API Saltwater Master Test Kit Results

Test	API Master Test Kit	Aquarium Supplier Test
pH level	X	X
Ammonia	X	X
Nitrite	X	X
Nitrate	X	X
Salinity	Coralife Hydro	X
Phosphate		X
Calcium		X
Magnesium		X
Alkalinity		X

Test Environment: Testing was conducted under ambient conditions of Keypoint Intelligences quality-controlled test lab, which is operated in a stable environment of 72°F (+/-5°F) and 45% RH (+/-10%) and monitored daily by an Extech digital temperature/humidity recorder. US-sourced supplies were tested in Keypoint Intelligence's US lab, and stable lighting was maintained throughout the test to eliminate fluctuation in lighting for video capture.

Conditioning: Each tank was set up with rocks and saltwater for an estimated two to three weeks to achieve optimal environmental conditions before the introduction of the straws and fish.

Test equipment:

Saltwater Test Materials

- 20-gallon rectangle glass tank (24"W x 12.5"D x 16.75"H)
- BioPellet Reactor; Phosban Reactor 150
- Eheim pump for reactor
- Tank hood with LED lighting
- 15 lbs. marine gravel
- 60 lbs. marine rock
- Tetra Whisper 20 tank filter
- Ehiem TruTemp 100 adjustable heater

Camera/Video equipment

- 2 Canon EOS R6 Digital cameras
- 2 Sigma F2 85MM Macro lenses
- GoPro Hero 4 camera
- 2 MacBook Air PCs
- 5 tripods
- 12 256-GB Pro Extreme SD cards
- AC adapters for cameras
- 2 2-TB SSD drives
- 2 Ethernet cables
- Canon EOS software for control of Canon cameras and time-lapse capture
- 2-TB Lacie external USB hard drives for image storage
- Battery backup system for Cameras and PCs
- TeamViewer software to enable continuous remote monitoring of cameras, PCs, and tank conditions

Lab Equipment

- Sartorius Lab Scale
- CoraLife Hydrometer (specific gravity salinity measurement)
- Extech temp/humidity meter
- MasterTherm tank water temperature meter

About Keypoint Intelligence

For almost 60 years, clients in the digital imaging industry have relied on Keypoint Intelligence for independent hands-on testing, lab data, and extensive market research to drive their product and sales success. Keypoint Intelligence has been recognized as the industry's most trusted resource for unbiased information, analysis, and awards due to decades of analyst experience. Customers have harnessed this mission-critical knowledge for strategic decision-making, daily sales enablement, and operational excellence—improving business goals and increasing bottom lines. With a central focus on clients, Keypoint Intelligence continues to evolve as the industry changes by expanding offerings and updating methods, while intimately understanding and serving manufacturers', channels', and their customers' transformation in the digital printing and imaging sector.

For more information on Keypoint Intelligence, please call (973) 797-2100, visit www.keypointintelligence.com, or email info@keypointintelligence.com.