

Glass Reefs Nourish the Marine Environment

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Abstract

Glass is made with soda, lime and silica and is colored and clarified with minerals. The glass dissolves in water, especially salt water, releasing the minerals and forming the basis of a food chain. Terracotta shards, being earthenware that is also colored with minerals, also leach out minerals. Microfauna and flora, tiny shrimp, insects and isopods thrive between the shards, further enhancing the food chain. Fort Bragg, California's, world famous glass beaches have created the richest marine environment in at least northern California and provide an excellent opportunity to study the beneficial effects of the glass and terracotta shards. With landfills moving farther from the municipalities they serve, it is becoming far more economically and environmentally sound to locally recycle, and for communities near the coast to create glass and terracotta reefs to nourish the marine environment, instead of sending their glass and terracotta to landfills.

Introduction

The author established and operates what is now the world-famous Sea Glass Museum in Fort Bragg, California, home to the highest concentration of “sea glass” in the world situated on 3 separate beaches and their auxiliary coves.

He is not a marine biologist but learned the basis of this paper from a marine biologist he met at the beach one day shortly after beginning his sea glass jewelry business in 2005 or 2006. As he did not understand the importance of what he was being told at the time, he failed to get her name or contact information and has been unable to locate her at any state university in California, Oregon or Washington. He cannot, therefore, provide a reference for that research.

Comments from marine biologists on a Georgia-Pacific “scientists’ notebook” page about Fort Bragg are also noted, but the page was taken down in 2013.

Any biologist, however, understands the importance of minerals to the food chain and the concept should be clear. Fort Bragg’s uniquely rich marine environment and the beautiful patina of its sea glass is the proof.

The author envisions a permanent research facility in Fort Bragg, including an aquarium highlighting the rich diversity of local marine life, to study and document the beneficial effects of the glass in order to promote the creation of glass reefs worldwide to assist environmentally stressed marine environments, while also reducing the environmental and economic stresses associated with transporting the heavy glass and terracotta to increasingly distant landfills

As Fort Bragg already has a high tourism rate based on not just the glass beaches, but natural beauty and other attractions, the aquarium/gift shop profits should be more than adequate to fund the entire facility. Due to the Georgia-Pacific mill closure, there are large, prime, tracts of land available for development along the headlands downtown west of Main Street and adjacent to the glass beaches complex. The city is also desperate to attract new businesses since the mill closed, especially highly reputable ones like this that have a low negative impact and offer a high year-round attraction value and good jobs.

Fort Bragg's Sea Glass Beaches

Fort Bragg, California, has unique coastal rock formations that set up wave patterns that keep things from washing away. What is placed on its beaches, stays on its beaches.



Photo: Capt. Joseph Forrington

ABOVE: The bay at Fort Bragg Site #1



Photo: Capt. Joseph Forrington

ABOVE: The bay at Fort Bragg Site #2

Like all water communities, Fort Bragg had an ocean dump site. Unlike other communities, nothing washed away in Fort Bragg, so the sites filled and had to be moved twice over the decades from 1906 until 1967. Over time the biodegradables nourished the environment as they were degraded and metals were salvaged and sold as scrap or used in art. This process has left the glass and terracotta shards for last, but the locals have been harvesting the glass since the dumps were active as recycled glass and terracotta shards have a thousand uses.

Instead of trucking their glass to landfills, Austin, Tx, and other communities now tumble the glass to remove the sharp edges and then put it out for people to take for free, which they do since, as proven in Fort Bragg, it has so many uses: pathways, gardens, fish tanks, driveways, patios, art, etc.



Photo: Capt. Joseph Forrington

ABOVE: Glass covering Fort Bragg's Site #1



Photo: Capt. Joseph Forrington

ABOVE: Glass covering Fort Bragg Site #2

Glass is made with soda, lime and silica and is colored and clarified with minerals. The glass dissolves in water, especially salt water, releasing the minerals, forming the basis of a food chain. Terracotta shards, being earthenware that is also colored with minerals, also leach out nutritional minerals.

The following table provides a list of some of the minerals used to color and clarify (“decolor”) glass.

MINERALS USED TO COLOR GLASS

Cadmium Sulfide	Yellow
Gold Chloride	Red
Cobalt Oxide	Blue-Violet
Manganese Dioxide	Purple
Nickel Oxide	Violet
Sulfur	Yellow-Amber
Chromic Oxide	Emerald Green
Uranium Oxide	Fluorescent Yellow, Green
Iron Oxide	Greens and Browns
Selenium Oxide	Reds
Carbon Oxides	Amber Brown
Antimony Oxides	White
Copper Compounds	Blue, Green, Red
Tin Compounds	White
Lead Compounds	Yellow
Manganese Dioxide	A "decoloring" agent
Sodium Nitrate	A "decoloring" agent

The ratio of minerals added to Fort Bragg's marine environment can be roughly derived from the color rarity.

SEA GLASS COLOR RARITY

ORANGE	
GRAPE PURPLE	1:10,000
DARK LAVENDER	
RED	
TURQUOISE	1:5,000
YELLOW	
PINK	1:3,000
BLACK	
TEAL	1:2,500
GRAY	
ICE BLUE	1:2,000
AQUAMARINE	
LIME	1:1,000
LAVENDER	
CITRON	
CORNFLOWER BLUE	1:500
COBALT BLUE	1:300
HONEY AMBER	
SOFT GREEN	1:200
AQUA	
SEAFOAM	1:100
FOREST GREEN	1:50
KELLY GREEN	
ROOT BEER BROWN	3:10
WHITE	4:10

Microfauna and flora, tiny shrimp, insects and isopods thrive between the shards, further enhancing the food chain.



Photo: David Littschwager

ABOVE: Microfauna



Photo: Capt. Joseph Forrington

ABOVE: Shrimp



Photo: Capt. Joseph Forrington

ABOVE: Unidentified Creature and Bone Fragment

Fort Bragg has 48 variety of chiton, more than anywhere else in California, and the other species are healthier and more plentiful than in the surrounding areas.

During the Georgia-Pacific (GP) mill site cleanup after the mill closed, GP had marine biologists dive the sea caves behind the GP property to see if the groundwater seeping out of them was contaminated. They found no contamination, but on their scientists' notebook page they had a large section, with photos, dedicated to what they called the "striking array and abundance" of life in and around the caves. The page was taken down in 2013 but the address was <http://project.bbl-inc.com/fortbraggmillsite/index2.cfm?module=scientistsnotebook> should anyone want to try to find a cached copy.



Photo: Prof. Douglas Eernisse

ABOVE: Gumboot Chiton



Photo: Hans Hillewaert

ABOVE: Chitons (“Chinese Abalone”)

Nick-named “Chinese Abalone”, the variety of chiton pictured above tastes just like the highly prized local Red Abalone.



Photo: Capt. Joseph Forrington

ABOVE: Fort Bragg’s lush underwater garden

Conclusions

1. Local recycling of glass and terracotta is a proven, far more economical and environmentally sound practice than trucking it to landfills.
2. Fort Bragg, California, offers excellent research opportunities to document the additional marine environmental benefits of glass reefs for communities near coastlines worldwide.