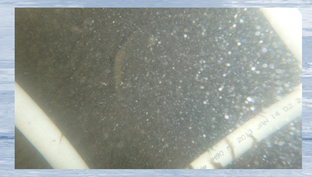
Cracking Down on Crumbling Concrete

A Project to Discover the Potential Life on the Harlem Sea Wall



Abstract

The Harlem River sea wall is in a state of disrepair. The wall is made of Portland cement, and with a pH of 13, it does not support healthy ecosystem development (Perkol-Finkel & Sella 2014). ECOncrete was made to be more supportive of a biodiverse ecosystem (Perkol-Finkel & Sella 2014). In order to see if ECOncrete would be a better building material to use when compared to the current sea wall, several ECOncrete disk were suspended on the Harlem River sea wall for a year. This experiment will be looking at the biodiversity of the intertidal zone on the Harlem River (Figure 01) of species on building materials, the sea wall, and ECOncrete disks were then compared. The disks were attached to structures designed to hold them against the current sea wall and deployed in the Harlem River (under the Words Island Bridge, E116th Street). The ECOncrete disks were photographed after, and the different species present were recorded. Then using Coral Point Count (Nova SouthEastern) It was found that the sea wall as it stands has an extreme lack of growth, with an average of 0.5 species per square foot found on the wall, compared to an average of 6.4 different species on the eight ECOncrete disks, each with a surface area of approximately 350 square inches. There were also seven species found only on the ECOncrete disks and not on the sea wall. These results demonstrate that ECOncrete supports a higher level of biodiversity when compared to the current Harlem River sea wall, and should therefore be considered as the primary building material in upcoming coastal architectural projects.

Introduction and Background

Humans have been augmenting the environment. One possible side effect is that biodiversity has dropped in cities and industrial rivers. (Curran, L., 2013)We don't know the full effects of turning rivers with beaches to industrial transportation with concrete walls lining the coastline (Lukens and Selberg, 2004; EBM, 2004) . Portland cement, when dissolved in water has a pH of 13.5-12 This is too high when you consider the species who live in the harbor are comfortable at a pH of 8, and the brackish waters natural pH is 8.5. ECOncrete's natural pH was designed to be more inviting to species having a pH of 9. Having these extra species will also allow the ECOncrete to become more durable. This Biologic build up protects the ECOncete from impacts (Chapman & Underwood, 2011) increasing the lifespan of the sea wall. ECOncrete was tested in the Mediterranean sea as flat tiles and, when compared to concrete, had dramatically more biological coverage. The study also found that the texture of the tile has a affect on the amount of growth on the tile, where the more complex side had more growth (Perkol-Finkel & Sella, 2014);(Abdo, 2015).

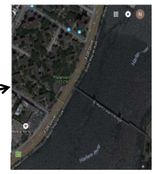
Problem and Hypothesis (table 01)

Category	Entry
Scientific Problem	Which substrate, ECOncrete or Portland Cement, supports a higher level of biodiversity.
Hypothesis	If we place ECOncrete disks in the Harlem River then ECOncrete will have a higher biodiversity when compared to the Harlem Sea wall.

Locality

Uptown Manhattan

Figure 01 : the location of site 1 and site 2 in comparison to the Harlem River



Site 1: Under the wards island bridge 40°786594'N, -73.938472'W

Site 2: E116st On FDR drive 40°47.641665'N, 73°55.863572'W

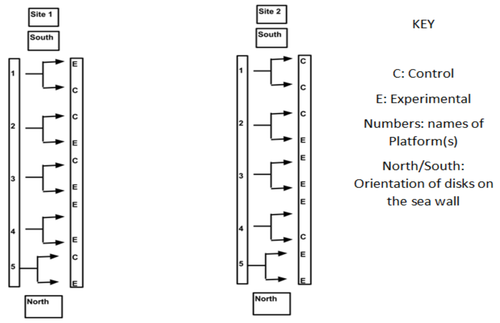


Figure 02: The orientation of Experimental (E), with an ECOncrete disks, and Control (C), without an ECOncrete disk, grids on Site 1 and Site 2

Results

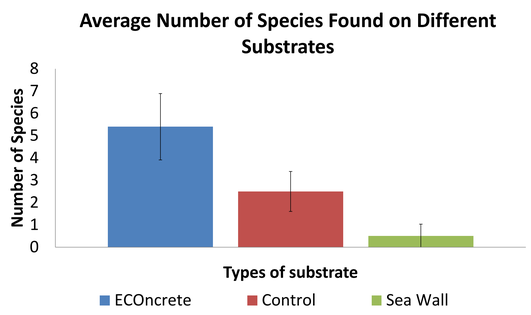


Figure 03. Average Number of Species Found on Substrates: The average number of species found on the different substrates tested (ECOncrete, Control, and Sea Wall) along with the standard deviation: the blue bar is the ECOncrete, the red bar is the control (grid), and the green is the sea wall.

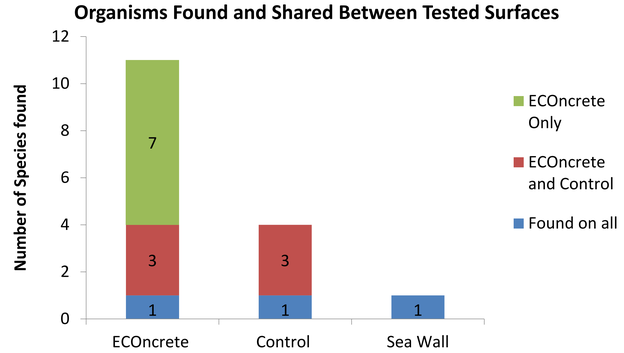


Figure 04. Organisms Found and Shared Between Tested Surfaces: This shows how many different organisms are found on the different substrates, the different colors show where the organisms were found: blue are the organisms found on all substrates, red are organisms found in the ECOncrete disk and control, and the green are organisms found only on the ECOncrete.

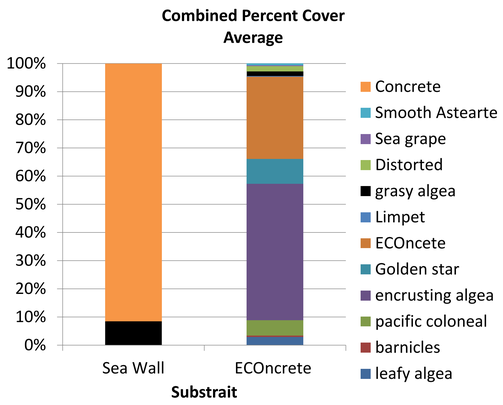


Figure 05: The overall average percent cover on ECOncrete disks and Photos of the sea wall on sites 1 and 2

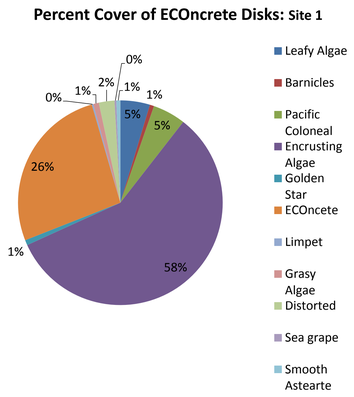


Figure 06: The average number percent cover of biodiversity on all ECOncrete disks found on site one. All but 2 disks have all 10 pictures, 2 of the disks have 9/10 pictures.

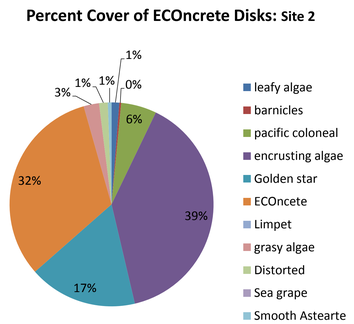


Figure 07: The average number percent cover of biodiversity on all ECOncrete disks found on site two. Only 2 out of 6 disks were recovered and able to be observed

Methods

Wall platforms

This platform was used to support and protect the ECOncrete disks wile they were suspended in the water, this was done using 2 lengths of wire rope to hang a 2x4x10 wooden plank to the sea wall. After labeling each side of the plank (North and South) a metal grid with a rubber coating was attached, using heavy duty zip ties to secure the disk to the grid. To insure that the plank stayed in place the wire rope continued through the plank and was then tied around a cinder block.

Sampling the Biodiversity on the ECOncrete Disks

After a year left on the sea wall, platforms were removed and the disks were then cut off the grids. Presents data was then taken off the disks and recorded on data sheets. Then, pictures were taken of all sides of the disk (accept the flat bottom).

Sampling the Biodiversity on the Harlem sea wall

After a custom PVC frame was built that could support the weight of a hand held underwater camera with a built in timer. The camera timer was set to take 5 pictures over the course of 15 seconds, after 5 seconds to allow the PVC frame to drop to the right height.

Analyzing pictures using Coral Point Count (CPCe)

All pictures were used to find percent cover using Coral Point Count, a 10x10 grid was generated on top of each picture so that was only the portion of the ECOncete disk in the grid, then at the intersection of the lines record what specie is their.

Discussion

- Seven species found only on the ECOncrete disk showing that ECOncrete is able to sustain a more biodiverse ecosystem.
- The least number of species found on one disk is much greater then the most number of species found on the sea wall.
- The large presence of the invasive and biofouling Golden Star Tunicate could be responsible for the comparatively large percent coverage of raw ECOncrete.
- Results are similar to those found by Perkol-Finkel & Sella (2014) that ECOncrete can support a more biodiverse ecosystem in comparison to Portland cement.
- Site 1 may be influenced by 2 disks having nine out of ten pictures to collect data off of.
- Site 2 may be influenced by four out of six disks falling off of the platforms.
- Although there were unrelated oyster cages directly above the ECOncrete disks there was no oyster spat found on the ECOncrete disks or the oysters.
- The different species found were similar to those found in the governors island reef. (Abdo, 2015)
- Research should be done on the biodiversity and ecology of ecosystems on ECOncrete and Concrete substrates in a controlled environment.
- According to the data gathered both future Sea walls and any rebuilt sea walls should utilize ECOncrete due to its ability to sustain higher biodiversity then a concrete sea wall.

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Abdo, T. (n.d.). 150527_econceteresearchpaper_tahirah_abdo.pdf. Retrieved October 02, 2017, fromhttps://docs.google.com/viewerng/viewer?url=http%3A%2F%2Fharborseals.org%F ● Chapman, M. G. & Underwood, A. J. (2011) Evaluation of ecological engineering of "armored" shorelines to improve their value as habitat. Journal of Experimental MarineBiology and Ecology, 400, 302-313. ●Curran, L. (2013). Invasive Tunicates in the Pacific Northwest [PDF]. Oregon State University ● Ido, S., & Shimrit, P. (2015). Blue is the new green – Ecological enhancement of concrete based coastal and marine infrastructure. Ecological Engineering, 84, 260-272. kdoi:10.1016/j.ecoleng.2015.09.016 ● Lukens, R. R. & Selberg., C. (2004) Guidelines for Marine Artificial Reef Materials. Joint Publication of the Gulf and Atlantic States Marine Fisheries Commissions.