Biomimicry LivingLabs® & Green Harbors Project®: Applying Nature’s Solutions

Anamarija Frankić
Univ. of Zadar, Croatia
Umass Boston
Biomimicry New England
anamarija@biomimicryne.org

Students:
L. Greber, S. Sheldon, Ch. McIntire, A. Cataldo, K. Starbuck, Sh. Edmundson, Z. Popovic, D. Bertuna, S. Sears, S. Norris, A. Winnett, M. Riccio, T. Maguire
www.umb.edu/ghp

Photo: A. Frankić
In urban harbors, the human built environment replaces the natural environment (like the only remaining natural salt marsh in Boston Harbor, in the photo). As a result, we are losing important ecological functions and services necessary to adapt to env. changes. How can we build human environments that will support both human and ecological needs and functions?
Why Care?

Globally, estuaries have been scientifically monitored and assessed to be highly eutrophic and labeled with a dead fish sign (http://www.vims.edu/research/topics/dead_zones/). We know that they would perform better and healthier if we restore their shellfish beds (specifically oysters), salt marshes and eel grass beds together, in collaboration and not separately in competition!
Our solution:
Biomimicry LivingLabs®
Green Harbors Project®: Biomimicry LivingLabs®

www.umb.edu/ghp

Making urban harbors healthy, wealthy and resilient, here and now;

Applied science, research and technology on local level in collaboration with local communities and businesses.
Coastal Keystone Habitats in NE

- Salt Marsh
- Shellfish beds
- Eel grass beds

Biomimicry approach is to restore the three coastal keystone habitats together (mutually) (Frankic et al, 2011):

What is the ratio between those three systems in nature? How can we apply it in built environments?
We know what are the missing Ecological Functions & Services without salt marshes and oyster reefs:

<table>
<thead>
<tr>
<th>Ecological Functions &amp; Services</th>
<th>How can harbors replace and support missing eco. services?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nutrients/total nitrogen take</td>
<td>~21gN/m²/y</td>
</tr>
<tr>
<td></td>
<td>~1.0 – 2.0 gN/y</td>
</tr>
<tr>
<td>Carbon Sequestration &amp; pH buffer</td>
<td>Oyster reefs &amp; living shorelines</td>
</tr>
<tr>
<td></td>
<td>~210gCO₂/m²/y</td>
</tr>
<tr>
<td></td>
<td>42% dry weight soft tissue; and 11% in shell mass (CaCO₃)</td>
</tr>
<tr>
<td>Sediment accretion and oxygenation</td>
<td>Oyster reefs, Green cement, Recycled shells, salt marsh</td>
</tr>
<tr>
<td></td>
<td>~1.3 cm/y (vertical accretion)</td>
</tr>
<tr>
<td></td>
<td>Bioturbation;</td>
</tr>
<tr>
<td>Water storage, Filtration, Bioremediation,</td>
<td>Oyster reefs, Salt marshes</td>
</tr>
<tr>
<td></td>
<td>1 acre = 1mill gallons of water</td>
</tr>
<tr>
<td></td>
<td>30-50 gallons/day Natural coastal engineers</td>
</tr>
</tbody>
</table>

Data Source: Feagin et al. 2010; Shepard et al, 2011; Beck et al, 2011, Frankic et al, 2011; Carmichael et al. 2012; Kellogg et al. 2013; Rose et al. 2014; (Note: eel grass beds are the third keystone coastal habitat that is missing)

One-acre wetland can on average store about three-acre feet of water, or one million gallons (EPA, 2006)

www.Shellshocked.com
### Example: Water Quality Issue in Savin Hill Cove

<table>
<thead>
<tr>
<th>Date</th>
<th>Dock Fox Point (MPN)</th>
<th>Wet Sample (MPN)</th>
<th>CSO Patten Cove (MPN)</th>
<th>Wet Sample (MPN)</th>
</tr>
</thead>
<tbody>
<tr>
<td>10/22/14</td>
<td>10</td>
<td>10</td>
<td>&lt;10</td>
<td>&lt;10</td>
</tr>
<tr>
<td>10/24/14</td>
<td>&gt;200.5</td>
<td>&gt;200.5</td>
<td>&gt;200.5</td>
<td>&gt;200.5</td>
</tr>
<tr>
<td>10/31/14</td>
<td>31</td>
<td>31</td>
<td>560</td>
<td>560</td>
</tr>
<tr>
<td>11/10/14</td>
<td>&lt;10</td>
<td>20</td>
<td>20</td>
<td>20</td>
</tr>
<tr>
<td>11/24/14</td>
<td>31</td>
<td>31</td>
<td>885</td>
<td>885</td>
</tr>
<tr>
<td>11/25/14</td>
<td>53</td>
<td>53</td>
<td>87</td>
<td>87</td>
</tr>
<tr>
<td>12/15/14</td>
<td>192</td>
<td>192</td>
<td>164</td>
<td>164</td>
</tr>
</tbody>
</table>
http://media.umb.edu/sfecoasts
Free Open Course Coasts & Communities

Proposal for Boston living with watercompetition
https://www.youtube.com/watch?v=xr9vzhHA

Savin Hill Cove, Biomimicry LivingLabs:
Floating Island without vegetation and planting cord grass
First oyster reef restoration in Boston Harbor

Established 10K native oysters (C. virginica) naturally in 4 years
Oyster reef and salt marsh = living shorelines in urban harbors

After
Water around oyster project is higher in nitrogen ranging from fair to severe degradation.

Source: Amy Costa and Anamarija Frankic (PI)
Oyster habitat restoration in Duck Creek, Wellfleet Harbor, Images: A. Frankic

2 acres, 3 years = 5.8 mill oysters
Biomimicry Class Presents: Floating Classroom Proposal

How would nature design and build a Floating Classroom?
Classroom Design Proposal

15 sq feet per person x 20 students = 300 sq feet

Floating classroom area ~ 400 sq feet

Depends on water depth
1000s of students were introduced to biomimicry, from K-12 to graduate degrees;

GHP won the President’s higher education community service award, and Citi of Boston award;

www.biomimicryNE.org

GHP has been funded by EPA, NOAA, the MIT Sea Grant, local community, and

www.biomimicryNE.org
Adopt a student for a green job!

Green Harbors Project (GHP)

THANK YOU!