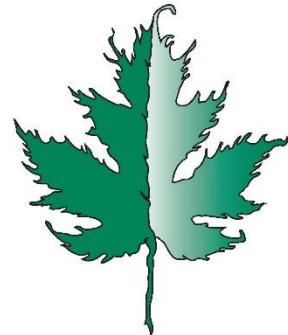


HABITUBES & HABI-MATS AS STREAM RESTORATION TECHNIQUES

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Stream Restoration Mantra:

**If You Build It,
They Will Come!**

(but you have to build all of it)





**For the last 20 years ... why
has stream restoration not
worked more effectively
for aquatic biology?**

Stream restoration work has historically focused on channel structures and bank stabilization.





Stream restoration has focused on the “Superstructure of a Living Habitat” but none of the living areas or habitats that are needed by living organisms.

What has been omitted?

- **Variable Types of Habitat**
- **‘Micro’ Habitat**
- **Food for Organisms**

**As science of restoration
continues to grow.**

**“..... habitat restoration and
ecological lift have become
integral parts of every
design.”**

Wood Structures



Woody Structures



Woody Riffles



Past & Present

Stream Restoration Projects & Bugs

- Habitat and microhabitat is minimal for organisms.
- When habitat is available, there is little to no material that is available or cultured to provide food for organisms.
- Little or no available food.
- Source of food is absent (eg., leaves, twigs, etc.).
- Usable organics are absent.
- Few to no organisms are available to repopulate the area.
- Hyporheic Zone/substrate has little or no source of microbes, fungi or organic material.
- If a refugium (source) is available, the restoration area has no habitat and food source available to hold species in place.
- Macroenthic organisms do not move upstream very readily during aquatic stages.

Biological Monitoring of Stream Projects in North Carolina

Submitted to the Ecosystem Enhancement Program

December 2008

- **This study set out to assess the ecological recovery of stream restoration projects**
- **Biology of restored streams is limited.**
- **Biological recovery is going to take longer than most monitoring periods are currently designed.**
- **Preconstruction integrity will affect success.**
- **Most of the streams in the study had not met required levels of restoration for macrobenthic organisms after five years.**
- **Estimated that restoration process will take 30 to 50 years for benthic macroinvertebrates to return to many streams.**

Present & Future

Stream Restoration Projects & Bugs Solutions

- **Restore Leaf Pack**
- **Restore Woody Debris**
- **Restore Usable Woody Debris**
- **Create Habitat**
- **Create Microhabitat**
- **Add the Right Kind of Usable Organics**
- **Provide Food for Organisms**
- **Promote Fungi Growth**
- **Promote Bacterial Growth**

How did we get here?

- **We have been working on this for 5+ years;**
- **We have tested numerous techniques and materials;**
- **This is in response to trends we are seeing;**
- **Regulatory requirements;**
- **Need for a way to relocate organisms from one stream to another;**
- **Need for Ecological Lift;**
- **Provide a way to speed up the restoration process;**
- **Need for a Cost Effective Solution.**

HabiTubes

For Leaf Pack Restoration



Goals of HabiTubes are:

- **Habitat Creation**
- **'Micro' Habitat Creation**
- **Semi-Permanent Food & Habitat Source**
- **Ability to Move Organisms**
- **Create Ecological Lift**
- **Speed up the Restoration Process**
- **Affordable Alternative**



HabiTubes

For Stream Restoration

- Artificial and natural way to keep leaf pack and woody debris in place for extended time.
- A way to move organisms from one stream to another.
- Can be used to enhance a struggling system.
- Can be refilled.
- If left in a stream, the material still offers habitat for organisms.
- Place for organisms to hang on in streams with flashy high flows.
- Can be a way to add and hold the proper type of organics in a stream.
- A way to stop the peak and drop of macrobenthic organisms after a restoration effort.











HabiTubes

For Leaf Pack Restoration

- **Recreates Leaf Pack**
- **Recreates Woody Debris**
- **Provides a Food Source for many MBO's**
- **Provides Growth Medium for MBO's**
- **Provides Habitat for MBO's**
- **Provides stable platform in flashy high flows**
- **Provides Microhabitat for MBO's**
- **Provides Ecological Lift**
- **Relocation Method for MBO's**
- **Natural Product**
- **Environmentally Friendly**

MBO's = Macroinvertebrate Organisms











Eastern U.S. Materials:

- **Maples**
- **Gums**
- **Ashes**
- **Birch**
- **Sycamore**
- **Oaks**
- **Woody Materials**
- **Fish Food**





Types of Woody Debris

- Small sticks.
- Larger sticks cut into 6 inch sections or smaller.
- Rotting wood.
- Wood Chips.
- Wood Shavings.
- Can be shaped into logs.
- Can be utilized for brush toes.





Installation Guidelines

- **HabiTubes are installed in riffles and glides of streams.**
- **Install at least one HabiTube per riffle.**
- **What is the average width and depth of stream riffles?**
- **Can be refilled every 6 to 8 weeks. In the fall and winter the reduction of the leaf material slows.**
- **HabiTubes are staked to the bottom or attached to rocks or wood in streams.**
- **Install in locations where water levels will inundate at least one-third the width of the HabiTubes**
- **Can be made to any size that is needed for a project.**





Installation Guidelines

Bank Full Width	Sample Bag		Small Tube		Medium Tube		Large Tube	
0 to 10 Feet	1		1					
10 to 20 Feet	2		2					
20 to 30 Feet	3		3	or	1			
30 to 40 Feet	4		4/6	and	2/1			
40 to 50 Feet	6		6/8	and	4/2	or	2	
* Installation guidelines are general guidelines.								
Each project will have specific guidelines and goals that become part of the design.								

Relocation Guidelines

- **Water Quality has to be similar between donor and receiver stream systems.**
- **Utilize similar stream orders for donor and receiver streams (1 to 5th order streams have useable assemblages of MBO's).**
- **Roughness of the stream.**
- **Relocation of usable organic material.**
- **Useable woody material.**
- **Stream average width and depth at riffles.**
- **Anchor points.**
- **Add additional HabiTubes downstream to receive displaced organisms.**

Findings

- The longer the HabiTubes stay in the water the more organisms utilize them.
- During spring and summer the HabiTubes have to be refilled every 6 to 8 weeks.
- During the fall and winter materials in the HabiTubes will be consumed at a slower rate.
- HabiTubes create a “micro” ecosystem that attracts organisms to their general location.
- Early on the May flies tend to stay on the outside of the HabiTubes. If algae is allowed to establish on the HabiTubes, the May fly numbers increase.
- Organisms like to nest in the HabiTubes.
- Salamanders, crayfish & newts utilize the HabiTubes.
- When the HabiTubes are added to a typical Qual IV Sampling Technique the number of taxa found in the sample increases by 30 to 50 percent.

Findings (continued)

- Relocations can best occur every 6 to 8 weeks.
- HabiTubes placed in a donor stream in the late fall can be relocated in the early spring.
- Relocations can occur during any time of year.
- Provide ecological lift for mitigation projects.
- Provide biotic restoration for delisting streams from 303(d) listings.
- Restore biotics as required by litigation.

Restoration Results

- **Energy Company, Mid-Atlantic**
 - Raised score from poor to good/fair.
 - Missed a good score by 6 points.
- **Greensboro, NC**
 - Worked on two stream segments (Kersey and Peoples Creeks).
 - Score dropped on Kersey Creek because stream dried up two times during the year.
 - Score stayed the same on second stream. Traditional sampling efforts added four new species and one new EPT.
 - Non-traditional sampling methods added another EPT.
 - EPT went from 3 to 5 species.

Advantages

- **HabiTubes and assist with replacement of biological components on 303(d) listed streams.**
- **HabiTubes can provide ecological lift to streams adding additional mitigation credits to new and existing mitigation projects.**
- **HabiTubes can assist with meeting mitigation performance standards.**
- **HabiTubes can provide assistance with monitoring of MBO's.**
- **Cost effective restoration technique.**



HabiTubes Sizes

- Sample/Extra Small Bag 8"x12"
 - Small Bag 8"x39"
 - Medium Bag 12"x39"
 - Large Bag 24"x39"
 - Extra Large Bag 2'x8'
-
- HabiTubes can be made to the size needed for the project.

HABI-MATS

“AN AQUATIC HABITAT PLATFORM”

- Provides habitat but not raise water levels.
- Adds woody habitat to stream in a cost effective way.
- Creates habitat for Aquatic Organisms.
- Recreates woody riffle habitat.
- Creates places for Benthic Macroinvertebrates to nest and hang on during high flows.
- Traps leaves & small sticks (i.e., useable organics) for organisms that can be used for food.
- Provides additional habitat types when combined with HabiTubes.
- Simulates root-wad habitat.
- Uses wood less than 3 inches in diameter.

HABI-MATS

“AN AQUATIC HABITAT PLATFORM”

- Provides additional habitat and places for benthic macroinvertebrates and fish to hold on and nest.
- Can be placed on the bottom or floated to support organisms.
- Attaches to the bottom of smaller streams.
- Can be floated in larger streams to imitate floating woody habitat.
- Recreates root wads for fish habitat.
- Restores urban watershed habitat in a cost effective way n when construction is not an alternative.
- Patent Pending.

Large Habi-Mat



Center Window in Habi-Mat for Tying and Weaving Wood



Side Windows in Habi-Mat for Tying and Weaving Wood



End Tassels for Tying Wood



HabiTubes Attached to Habi-Mat



Various Sizes of Habi-Mats



Pre-Installation



Pre-Installation



Installation



One-Month Post Installation



Installation



Installation



Two Months Post Installation



Two Months Post Installation



Platform Sizes

- **Extra Small – 1 Meter X 0.5 Meter**
- **Small - 1 Meter X 1.5 Meter**
- **Medium - 1 Meter X 2 Meter**
- **Large - 1 Meter X 3 Meter**
- **Built to any size**
- **Add HabiTubes stuffed with leaves or wood.**

Installed Platform Cost

Cost per Structure

- Extra Small \$500.00/platform installed
- Small: \$700.00/platform installed
- Medium: \$1,000.00/platform installed
- Large: \$1,500.00/platform installed

Advantages of HabiTubes & Habi-Mats

- Assist with replacement of biological components on 303(d) listed streams.
- Provide habitat and place for MBOs to hang on during high flows.
- Provide ecological lift to streams adding additional mitigation credits to new and existing mitigation projects.
- Assist with meeting mitigation performance standards.
- Provide assistance with monitoring of MBO's.
- Cost effective restoration technique.

HabiTubes & Habi-Mats

- **Tools for aquatic habitat restoration.**
 - **Simple Designs.**
 - **All natural materials.**
 - **Patent Pending.**











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