

Reef Weave

A nature-based solution

John Oliver Ph.D. & Kamille Hammerstrom M.S.

Global warming, especially peaks in warming over recent decades, causes bleaching events that kill coral and severely stress coral reef ecosystems. The worst impacts are in shallow water, where ocean warming is highest and bleaching can be widespread. Although as much as a billion dollars has already been spent to restore coral populations and reefs, the area of recovered coral is minuscule compared to natural coral recruitment. After a bleaching disturbance, the dead coal structures provide habitat for many marine organisms, in particular fish that feed primarily on zooplankton plankton living in the waters that bathe the reefs. They use the dead reef as refuge from predators as they venture into open water and dart back to cover. Reef structures provide hiding places that can be entered through a range of door sizes like mesh openings in safety nets. Bigger fish can't get through a door or mesh that is too small, and smaller fish avoid being eaten.

We are exploring the use of weaved structures to provide reef-like habitats with a range of door openings to protect different sizes of fish. We plan to deploy these basket habitats on dock pilings in the Maldives, wrapping around a piling like flowers around a central stem. Plankton-feeding fish should use the hiding places in the reef weaves, while invertebrates and algae settle on the weave material itself. Some corals may settle as well, but this habitat is primarily for fish and other reef associates, and secondarily for corals. However, it might be reshaped to attract more coral species. If the first reef weaves function as expected, they can be modified in many ways to increase food web complexity and thus diversity. We can alter the reef weaves to explore a wide variety of structural components like diameter and shape of weave material; opening sizes and shapes; sizes and shapes of the weaved baskets; and attaching overhangs, branches, and so on. This ecosystem could mature into important alternate habitat for many fish and invertebrates living in the stressed natural reefs. Docks could be converted into unique, diverse, and highly desirable reef ecosystems. A boon for conservation and eco-tourism.

Reef Weave Interdisciplinary Team:



Easa Waheed
Baa.Kihaadhoo Weaver



Hussain Shaafiu
Baa.Kihaadhoo Council President



Ibrahim Mohamed (Ph.D.)
Specialist in Environmental Sciences

Coastal Conservation & Research, Inc.

Coastal Conservation & Research, Inc. seeks to protect, restore, and understand marine, estuarine, freshwater, and upland habitats through environmental planning, scientific research, habitat restoration and education.



Kamille Hammerstrom (M.S.)
Moss Landing Marine Laboratories, Research Faculty.
Associate, Coastal Conservation and Research. Weaver



John Oliver (Ph.D.)
Moss Landing Marine Laboratories, Research Faculty.
Founder, Coastal Conservation and Research

CCA ARCHITECTURE / ARCHITECTURAL ECOLOGIES LAB



Margaret Ikeda
Founder / Associate Professor of
Architecture, CCA. Co-Director AEL



Evan Jones
Founder / Architect, Sr. Adjunct of
Architecture, CCA. Co-Director AEL

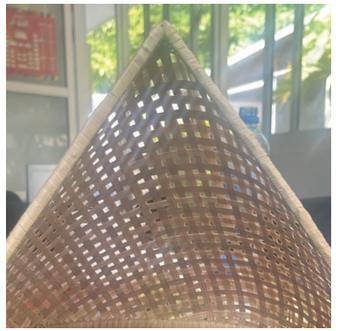
Background

Independent traditional weavers across the Maldives create functional objects and panels from locally sourced palm leaves. By selling these handwoven items to local families and supplying resorts with thatch roofing panels, they **secure a vital source of income for their households**.















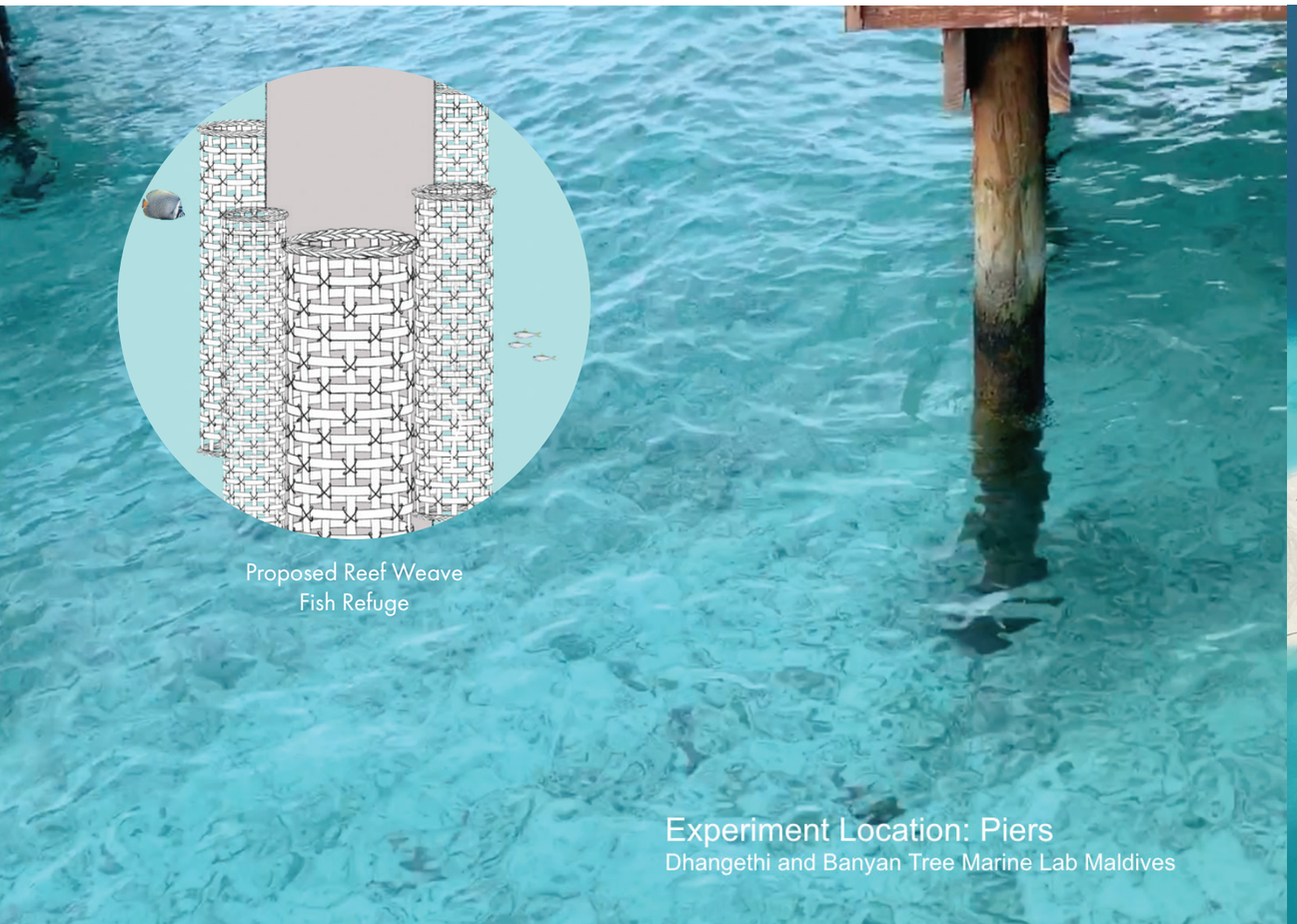
Problem

The Maldives, a low-lying island nation heavily reliant on healthy coral reefs, is experiencing the impacts of climate change firsthand. Rising ocean temperatures due to global warming, combined with more frequent and intense El Niño events, have led to repeated coral bleaching and widespread coral death across the globe. **The Maldives has been particularly hard hit, with multiple mass bleaching events causing severe damage to its reefs.**

Coral reefs struggle to recover from these heat-related disturbances, and many other anthropogenic impacts such as dredging and reclamation. Consequently, many species are unable to bounce back and recover. To rebuild, reefs depend on coral larvae surviving and settling, but the increasing frequency of these heat waves is making this increasingly difficult. As coral reefs decline at an alarming rate, **scientists and conservationists are working to restore these vital ecosystems.**







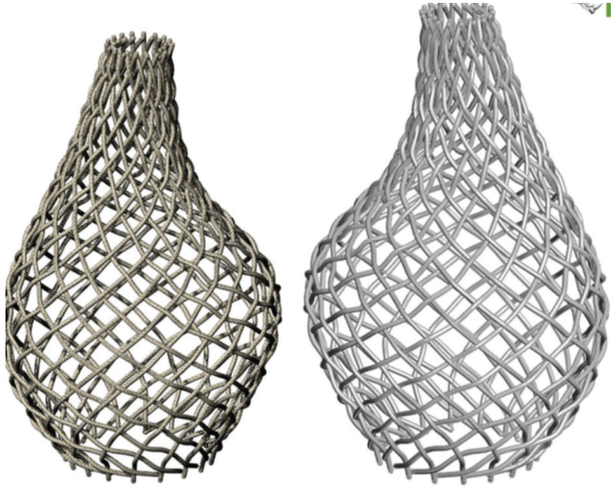
Proposed Reef Weave
Fish Refuge

Experiment Location: Piers
Dhangethi and Banyan Tree Marine Lab Maldives



Design Solutions

The ReefWeave project recognizes an approach to **intertwine climate adaptive strategies into a community-based solution lead by traditional skills of local weavers** to produce novel woven structures that protect and restore their ecosystems. This approach can contribute to the regional economy and catalyze a demand and interest for **locally sourced bio-based material structures whose life-cycle has no negative impact on the health of the ecosystem.**







Plan of Action

In the Maldives, **ReefWeaves can wrap around pilings as habitat for plankton-feeding fish and other coral reef associates.** ReefWeaves are basket-like, and the nature of weaving allows for an amazing variety of potential habitat structures. **They provide spaces for fish and invertebrates to hide from predators**, while sessile invertebrates settle on the actual weave.





Woven Research & Education

Leveraging habitat restoration research developed. deployed, and tested in California by marine biologists and designers in the San Francisco Bay, the ReefWeave project in the Maldives will operate in conjunction with a local divers with experience in monitoring and deploying coral restoration prototypes. **Spatial parameters and speculative forms will be translated through local skills and embedded material knowledge.**



Local weaving materials used by Native Americans in California (Native Willow, left; Creek Dogwood, right)



curved cylinder

Goals for Prototype 1:

Weave spacing: Varying from 3cm, 6cm, 9cm. Gradients are good.

Diameter: 30-50 cm

Length: Varying around 60cm. Could be longer too. Looking to create a module that can be repeated.

Weaving Form Type: Variations from flat cylinders to a curved cylinders.

Materials: Plant based and locally sourced.

Securing the Future of a Local Craft

Easa Waheed, local Baa.Kihaadhoo Weaver **teaches local students how to harvest and process palm tree leaf stems,** transforming them into functional tools for the home



