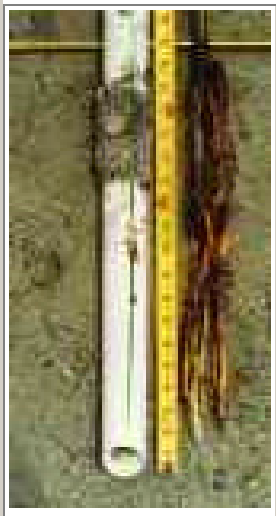
Riley Encased Methodology (REM) for Mangrove Restoration

Stage I



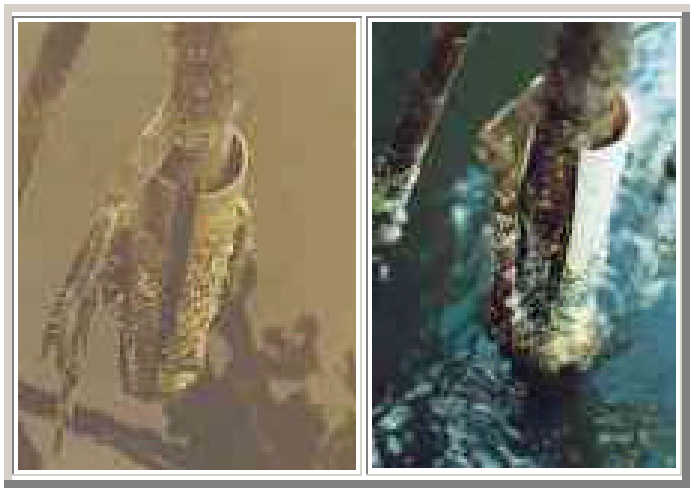
Riley encased methodology (REM) was developed for the purpose of establishing mangroves along high-energy shorelines where natural recruitment no longer occurs and where conventional planting methods are ineffective. The principles of REM are based on individual seedling isolation and a spontaneous adaptation process. By isolating individual propagules from the external environment within tubular encasements at the planting site, an artificial environment is created favorable to early plant development: plants are protected from wrack, debris, wind, wave activity, and unintentional damage from human interaction.

Not obvious from casual observation, the early stage of development produces an efficacious root system anchoring the plant inside the encasement. This anchoring phenomenon is so strong that after the first three months, the physical body of the seedling will actually break if an attempt is made to pull it from the encasement.

The photograph on the right reveals the roots of two seedlings that have been encased for 24 months. The encasement of the first seedling has been cut away and the other has had its encasement completely removed to provide an inside look at root development. As is evident from these examples, the mangrove root system has readily adapted to the encasing PVC tube.

In both cases, the seedlings have sprouted prop roots that occupy the majority of the inside volume immediately below the body of the seedling. As the seedling grows, the root bundles will follow the encasement penetrating the natural substrate.

As the plant grows and expands to fill the inside of the encasement, typically a single root will begin to venture through the longitudinal split. This initial egression of a root segment occurs as the growth inside the encasement pushes outward with sufficient force to cleave the split in the encasement. A comparison of the developing root system and egression through the widening split are exhibited in the photo on the left. The proliferating root system ensures stability of the tree and provides essential nutrients for accelerated growth inside this isolated environment.



Roots first emerge from the encasement, as shown in the two photos above, as the longitudinal split is forced open by the increasing cross-sectional area of the developing tree. Over the next several years the split will continue to enlarge and the root system will extend beyond the confines of the protective encasement. As the plant develops, growth in the main stem and root bundles pushes outward against the walls of the encasement expanding the longitudinal split. On the right, two photos of the same plant demonstrate over time how the split will continue to enlarge. The first photo was taken in February 1995 and the other in February 1997. It is this progressive widening of the longitudinal split that facilitates the principle of spontaneous adaptation in REM methodology.

Stage II

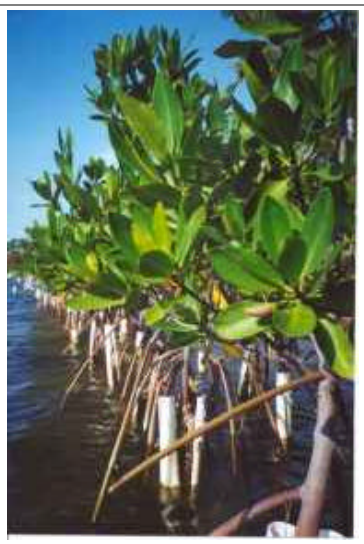
The development of aerial roots provide substantial support, stablize the tree, and enable it to ultimately gain complete independence from the encasement. When the first aerial root firmly implants itself into the sediment, the added stability will enable the tree to resist forces of the wrack line, withstanding a formidable physical influence that has demonstrated the ability to overwhelm free standing seedlings at every prior stage of development.

Implementation of REM concludes with the mangrove achieving reproductive maturity. The red mangrove species in Florida, Rhizophora mangle, is vivaparous; the seeds germinate while still

attached to the parent tree and grow to a length of 12 inches before dropping into the water in early autumn. The seedlings float, which provides an effective dispersal mechanism for mangroves living in estuaries and tidal waters. The photographs below show the progressive development of propagules on encased red mangrove.

Stage III

The photos on this page show plants that are in various stages of the adaptation process. Adaptation is a principle of Encased Methodology. The photos below show trees that have completed the adaptation process and are no longer dependent on the encasement for protection. The trees have well-developed foliage, prop and aerial roots, are reproductively mature and self-supporting.



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