Mangrove Restoration Impact Assessment Report

in the Bay of Jiquilisco

Feb 2023

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www.mangroveactionproject.org

www.asociacionmangle.org

“ For us, the importance of the Bay and the mangrove forest is that it is home to many of the species that we depend on to survive. The mangrove forests also purify our air. That’s important for us, for my family and the community, that we have a healthy forest, and a healthy life. It’s essential to keep conserving the forest as a living buffer. ”

Giovanni Díaz, *Community Leader, Montecristo Island*

Introduction

Mangroves play a fundamental role in the Bay of Jiquilisco by providing coastal protection, supporting fisheries and maintaining the overall health and productivity of coastal waters, yet since the 1950s there has been an unprecedented loss of mangroves in the region. Mangrove Action Project's visit in 2011, and their training on ecological mangrove restoration techniques, helped to kickstart the successful restoration of mangroves around the bay.

This report focuses on assessing the approaches and techniques employed in mangrove restoration projects around the bay. By evaluating a range of sites across the bay and interviewing local community members and restoration practitioners, this report provides data on the successful outcomes of these projects. By assessing ecological parameters such as species diversity and abundance, sediment type, salinity and pH, we can gain insights into the overall success and effectiveness of these initiatives. Additionally, by speaking with community members, we explore the socio-economic benefits of mangrove restoration, including improved livelihoods, and enhanced coastal protection.

By examining these restoration approaches, outcomes, and challenges, we can gather valuable insights and lessons learned that can guide future restoration initiatives. With a collaborative and science-based approach, we can strive towards restoring the resilience and functionality of mangrove forests, ensuring their sustained benefits for both the environment and the communities that depend on them.

José Maria Argueta, *Asociación Mangle, Executive Director*

The Mangrove Ecosystem

The Bay of Jiquilisco, located on the Pacific coast of El Salvador, is home to one of the largest and most diverse mangrove forests in Central America. The mangroves in the bay cover approximately 25,000 hectares and are critical to the health of the bay's ecosystem, as well as the well-being of the local communities.

The mangroves provide numerous benefits to the environment. They act as a natural barrier against coastal erosion, helping to protect the shorelines from storms and waves. The root systems of the mangroves filter pollutants and sediment from the water, improving water quality and creating a healthy environment for marine species. The bay's mangrove-lined inlets host the largest abundance of coastal-marine birds in El Salvador, many of which are threatened or endangered. The bay is also an important breeding ground for sea turtles, and the mangroves provide a safe nesting site for these endangered animals.

In addition to their ecological importance, the mangroves in the Bay of Jiquilisco are also essential to the local communities. Many people in the area rely on fishing and agriculture for their livelihoods, and the mangroves play a vital role in supporting these industries. The mangroves provide a habitat for fish and shrimp, which are important sources of food and income for local families. The leaves and wood of the mangroves are also used for firewood, construction, and crafts.

Despite their importance, the mangroves in the Bay of Jiquilisco are under threat. Like many mangrove forests around the world, they are facing pressure from human activities such as deforestation, pollution, and overfishing. Various threats to the bay come from upstream in the Lempa River, mainly due to the Cerrón Grande Hydroelectric Dam, urban development and large-scale agricultural activities. The overflow, or mass release, of water from the dam causes flooding as well as sedimentation in the mangroves, which blocks channels, reduces hydrology and stops tidal waters from flowing out of the mangroves. Climate change is also a concern, as rising sea levels and changes in rainfall patterns could affect the health of the mangroves and the ecosystem they support.

The bay is designated as both a Ramsar Wetland of International Importance and a UNESCO Biosphere Reserve.

Kickstarting Mangrove Recovery

In 2011 an Ecological Mangrove Restoration (EMR) training workshop undertaken by Asociación Mangle (AM), the Fund for the Initiative of the Americas (FIAES), EcoViva and Mangrove Action Project (MAP) helped train mangrove restoration practitioners in the art of mangrove restoration via the "best practices" approach promoted by MAP.

This follow-up provided an opportunity to offer advice in advanced techniques to former workshop participants and basic effective practices to those new recruits needing training. Improved monitoring and assessment techniques will also add substance to longer term commitment to the mangroves.

MAP had the opportunity to learn from the successful work done by AM and those affiliated local communities and offer advice for making improvements where needed.

An additional aim of this renewed collaboration between AM and MAP will be to establish the Jiquilisco Bay' past, present and future work of conservation and restoration as a "best practices" regional working model for promulgating the benefits of the overall CBEMR process.

In July 2011, MAP, alongside Asociación Mangle, FIAES, and EcoViva, introduced EMR to El Salvador, organising the first national forum on EMR. This forum was followed by a four-day EMR workshop geared toward local community Wetland Rangers, environmental organisations and government officials. The forum attracted national attention to the ecological problems facing the mangrove forests of the Bay of Jiquilisco, and similar areas being adversely affected by uncontrolled inland development. Due in great part to the success of this training, officials at El Salvador's Ministry of Environment and Natural Resources (MARN) asked Asociación Mangle to lead the charge in demonstrating an ecological approach to mangrove restoration in El Salvador. FIAES, the largest environmental fund and Grantmaker dedicated to coastal conservation and wetland protection in El Salvador, identified EMR as the primary method for its mangrove restoration work going forward.

After this training session, EcoViva and its local partners began to restore the degraded mangrove ecosystem in El Llorón.

This work contributed to real conservation results that propelled ecological restoration to the forefront of El Salvador's national mangrove conservation strategy.

The El Salvador EMR training was so successful that authorities at MARN, including the Minister of the Environment himself, decided to incorporate key components of EMR into the permitting process for mangrove restoration, setting a potential precedent for all mangrove ecosystem restoration throughout El Salvador and across Latin America.

Since 2011, efforts have been underway to protect and restore the mangroves in the Bay of Jiquilisco. Local communities, government agencies, and NGOs are working together to improve hydrology, implement sustainable management practices, and educate people about the importance of the mangroves.

This work has contributed to results that have put ecological restoration at the forefront of El Salvador's national mangrove conservation strategy.

A Shift in Restoration

“ There has been a shift in philosophy of working with the communities. Starting with the restoration projects, we have been able to generate employment, and a job is better than average agricultural day labor wages. This has helped to create a vision for the future for the inhabitants, who are involved in the restoration projects. ”

Jorge Oviedo, *FIAES, Executive Director*

“ The 2011 workshop was so important because as we tried to recover the mangroves through planting, we were actually going backward. If it wasn’t for the new technique, we would be repeating the same mistake. ”

Manuel González, *Wetland Ranger, Las Mesitas*

“ The EMR technique taught us that to save the forest, to intervene and recover a site, we had to understand it. It takes more work and more effort and needs more investment. But the results are more effective.”

Giovanni Díaz, *Community Leader, Montecristo Island*

Project Highlights

Restoration

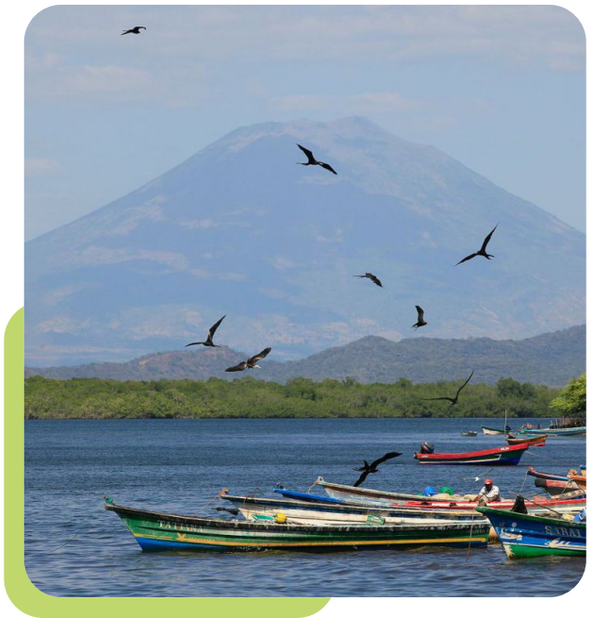
Over 70km

of channels dug across El Salvador using MAP's CBEMR method to restore over a hundred hectares of mangrove.

Community

Over 1000 people

in El Salvador have been taught the principles of CBEMR and are using the methods to restore mangroves.



Policy

Incorporation

of the principles of CBEMR as the national policy by the Authorities at the Ministry of Environment & National Resources for best practices in mangrove restoration.

Collaboration

10 Organisations

including the government, local NGOs and community leaders across El Salvador have requested future trainings to build on the success they have already seen and to monitor that success.

NOTE: MAP adopted 'Ecological Mangrove Restoration' (EMR) as developed by Robin Lewis of Florida and incorporated the Community-Based (CB) approach to support community stewardship in restoration projects.

MAP's Follow-up Visit

In February 2023, MAP visited El Salvador to follow-up on the 2011 workshop and to see the success on the mangrove restoration work happening in the Bahía de Jiquilisco. The MAP team were hosted by José María Argueta, Executive Director at Asociación Mangle. MAP conducted research, collected data and filmed to assess and monitor the successful restoration work around the Bahía de Jiquilisco. The data collected includes an assessment of variables described below, and data sheets can be found here, showing the research undertaken.

MAP staff visit FIAES office during Feb 2023 to discuss mangrove restoration across the country.

Assessing a mangrove restoration site involves evaluating the site's ecological and social conditions to determine the success of the restoration effort. Here are the key factors considered during this assessment:

ECOLOGICAL FACTORS

SOIL QUALITY

HYDROLOGICAL CONDITIONS

SOCIAL FACTORS

MONITORING & EVALUATION

Mangrove Restoration Assessment

The ecological factors to consider include the survival and growth of the planted mangrove seedlings, the overall health and diversity of the mangrove ecosystem, and the presence of other species such as fish, crabs, and birds. A healthy mangrove ecosystem should be able to support a wide range of biodiversity and provide important ecosystem services.

The quality of the soil is critical for the survival and growth of mangroves. The soil should be rich in nutrients, have good water retention capacity, and be free of toxins or pollutants.

Mangroves require specific hydrological conditions, including a certain salinity level, to survive and grow. The water level should be high enough to provide adequate moisture for the mangroves but not so high that it leads to waterlogging or other problems.

The social factors to consider include the involvement & participation of local communities in the restoration effort, the extent to which the restoration project has contributed to the livelihoods & well-being of the local community, and the effectiveness of any outreach & education efforts to raise awareness about the importance of mangrove conservation.

Ongoing monitoring and evaluation are essential to assess the success of the restoration effort over time. This should include regular assessments of the ecological and social conditions at the site, as well as the use of appropriate indicators to measure progress towards restoration goals.

In summary, assessing a mangrove restoration site involves evaluating a range of ecological and social factors to determine the success of the restoration effort and identify areas for improvement. It requires a collaborative and participatory approach that involves local communities, restoration practitioners, and relevant stakeholders.

Project Areas

Extent and change of vegetation cover in the project areas

Full Ecosystem Impact

An estimated 62ha of mangroves across the project sites have been restored through natural regeneration and without any planting. The benefits of restoration using this methodology is that it brings back a full mangrove ecosystem. Across the whole Bay, the EMR approach has been used to restore over 100ha of mangrove forests, and hundreds more across El Salvador.

Since the mangroves have been restored and the overall health of the ecosystem has improved, the bay has seen an increase in the number of animal species that are dependent on these habitats. There has been a rise in the number of migratory and wading birds, as well as an increase in mammals, crabs and fish. When the restoration work first started there were hardly any 'punche' crabs, *Ucides occidentalis*, and now those numbers have seen a significant increase with the improved mangrove conditions.

" Following the EMR technique and opening the channels changed everything.... the color of the leaves, the roots of the trees, and the return of wildlife including coyotes, racoons, lizards, migratory birds and crabs. "

Manuel González, *Wetland Ranger, Las Mesitas*

" I have children, and I have grandchildren, too. We all do the same thing: fishing, clamming, harvesting shellfish. Since the mangroves recovered, the numbers of fish have recovered. "

Elizabeth Rivas de Carranza, *Community Member, Puerto Parada*

El Lloron

SITUATION

When MAP visited in 2011, a large area of mangrove had been lost at El Lloron, and the health of the remaining mangroves was in decline. Strong storms such as Hurricane Mitch, poor hydrology caused by land-use change, sedimentation, and the annual flooding of the River Lempa all contributed to the mangroves' degradation.

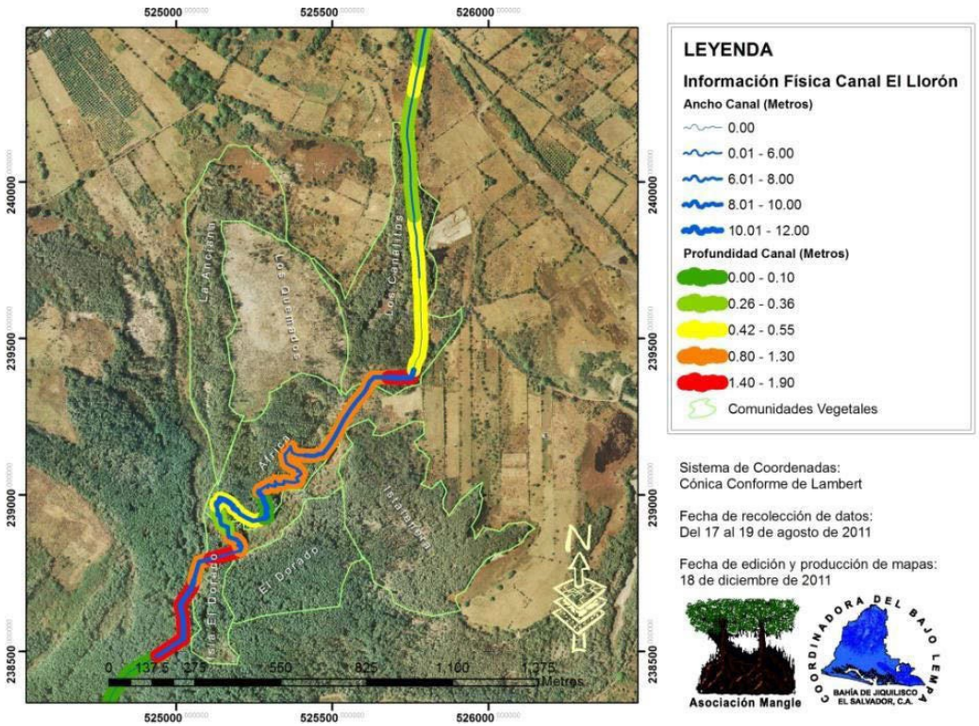
AIMS

The aim at El Lloron was to start by understanding the site history and the ecology of the different species of mangrove tree. Speaking to community members and Mangrove Rangers helped to determine where the original channels were, what the hydrology should look like, and how the site had been degraded. The next step was to select where restoration should occur and how to restore or recreate good hydrology and remove or reduce stressors.

Restoration Overview

The mangrove restoration area, referred to as "El Llorón" was the first site the Asociación Mangle chose to restore. The CBEMR process includes a diagnostic of each mangrove site, along with a restoration plan.

The restoration team measured the channel (width, length and depth) and collected biophysical data, such as salinity, and pH, along the El Llorón channel. They also collected information about the plant and animal communities.



Map showing the data collected for the El Lloron canal, including channel width (ancho) and depth (profundidad)

ACTIVITIES & RESULTS

Since 2011 the restoration team have implemented restoration activities to:

- open channels to allow water to flow
- remove dead trees, roots & excess sediment from channels
- monitor site to see which plant & animal species return
- maintain & monitor channels to support good hydrology

Asociación Mangle and local community members dug over 2 km of channels to improve hydrology at El Lloron and the results have been fantastic. Through natural regeneration, and without planting any trees, all three original tree species have returned to El Lloron, red mangrove (*Rhizophora racemosa*), black mangrove (*Avicennia germinans*), and white mangrove (*Laguncularia racemosa*).

Community Engagement

After the initial training provided by MAP, AM conducted restoration training for nearby community members and brought the communities to the forefront of the restoration efforts. Community engagement and involvement is an essential part of mangrove restoration. The communities living near the mangroves in the bay have traditional knowledge about the ecosystem that has been passed down from generation to generation, which is invaluable in guiding restoration efforts and ensuring that they are effective.

The seven communities involved in the training were Isla Montecristo, Las Mesitas, La Chacastera, La Canoita, Los Calix, Los Lotes, and La Babilonia. These communities then became integral to the restoration at El Lloron, with FIAES and MARN providing funds to the communities to provide an income whilst they conducted restoration work.

Many of these communities are still involved in the restoration work today which demonstrates the long-term commitment of communities to mangrove restoration.

Community members like Wendy Ramos from La Chacastera dig and collect mud to maintain the channels in El Llorón channel. Half the restoration team are made up of women.

" Clearing the channels helps the mangroves stay healthy. For me and my family, it puts food on the table. It's important for the animals and for the environment, too. If this didn't exist, we wouldn't exist either. "

Wendy Ramos, *Community Member, Las Chacastera*

FIAES took the EMR work outside of the Bay of Jiquilisco, into Xirihualtique, Barra de Santiago, Jaltapeque and La Unión Bay. For the Jaltepeque project, for example, the community earnt an average of $350 per month for 18 months. People, including women who accounted for most of the participants, worked within restoration, clearing channels and other related activities.

ACTIVITIES & RESULTS

7 communities engaged in restoration & conservation activities

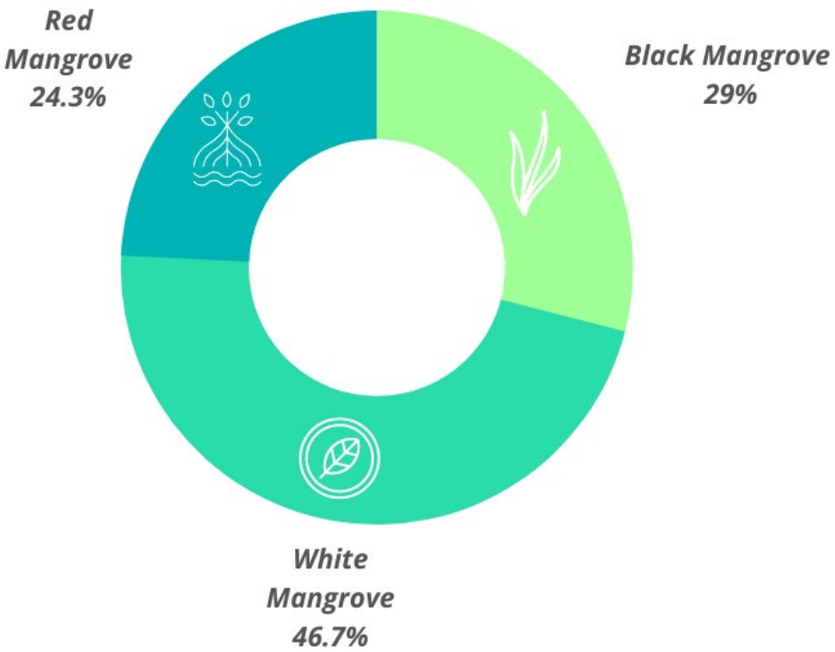
Recovery From Above

Aerial images showing the restoration of 'El Lloron' mangrove area using Ecological Mangrove Restoration techniques.

By looking at historical and current mangrove presence on Google Earth Pro, the area of mangrove trees around the channels at El Lloron has increased by 18.7 hectares.

Dr Laura Michie led the mangrove assessments for the sites at El Lloron, El Rico and El Copante.

Restored Mangrove Species



Soil type: **Clay**

Salinity: **21 ppt**

pH: **7**

Average tree height: **8.7 m**

The hydrology has improved which has seen an increase in tidal flushing and there are no longer deep areas of standing water. Environmental conditions were collected (salinity, pH and soil type) which all point to healthy restored ecosystems. significant increase.

BLACK MANGROVE

AVICENNIA GERMINANS

WHITE MANGROVE

LAGUNCULARIA RACEMOSA

RED MANGROVE

RHIZOPHORA MANGLE

CHINAMPAS*

The MAP team met with Alejandra from HALO Trust and heard about the work they are doing at El Lloron to build chinampas. The chinampas are islands of mud, reed grass and bamboo, which allows mangroves to grow where the substrate elevation is too low to support mangrove growth. This area is permanently inundated.. The project provides employment for community members and at-risk youth to work alongside HALO's team.

There are 300 chinampas, made with four bamboo stakes and woven reed grass, which is then filled in with sediment from the surrounding area. All chinampas have been planted with 4 – 5 seedlings, a mixture of the three existing species – red mangrove, black mangrove, and white mangrove. They are being monitored every two months to see which species survive, to check for elevation changes, and to record environmental conditions.

*Terminology update - Azteca chinampas are floating organic farming systems. Tarquinas would be the appropriate name for these structures built into the soil.

" These chinampas are made with local materials that local people can source here from this area. They can be made from bamboo, a plant that is found locally, or with bullrush, mixed with mud. This helps the mangroves to grow and flourish. We are monitoring the project to see how many plants survive, and how many don't. "

Alejandra Ríos, *HALO Trust*

MARN Mangrove Rangers cut areas of grass to prevent fires and maintain the health of mangroves.

El Rico

SITUATION

In 2011, a large extent of mangroves at El Rico had been lost or degraded. Like at El Lloron, strong storms, poor hydrology and sedimentation has all contributed to the mangroves' degradation. There was an added pressure at El Rico due to the population of mud crabs at the landward edge of the mangroves and on the terrestrial grassland. There was, and still is, frequent burning of the grasses to clear the area and find the crab burrows which causes devastation to the plant life at El Rico.

AIMS

The aim at El Rico was to start by understanding the site history and the issues that caused the mangrove loss. Speaking to community members and Mangrove Rangers helped to determine some of the issues and where the channels had been blocked. The next step was to select where restoration should occur and how to restore or recreate good hydrology and remove or reduce stressors.

Restoration Overview

The uncontrolled fires at El Rico are now managed by the Mangrove Rangers through cutting and controlled burning which has contributed to a much healthier ecosystem. With new channels dug and waterways cleared there have been some great results.

One of the tallest Rhizophora trees we surveyed in El Rico.

ACTIVITIES & RESULTS

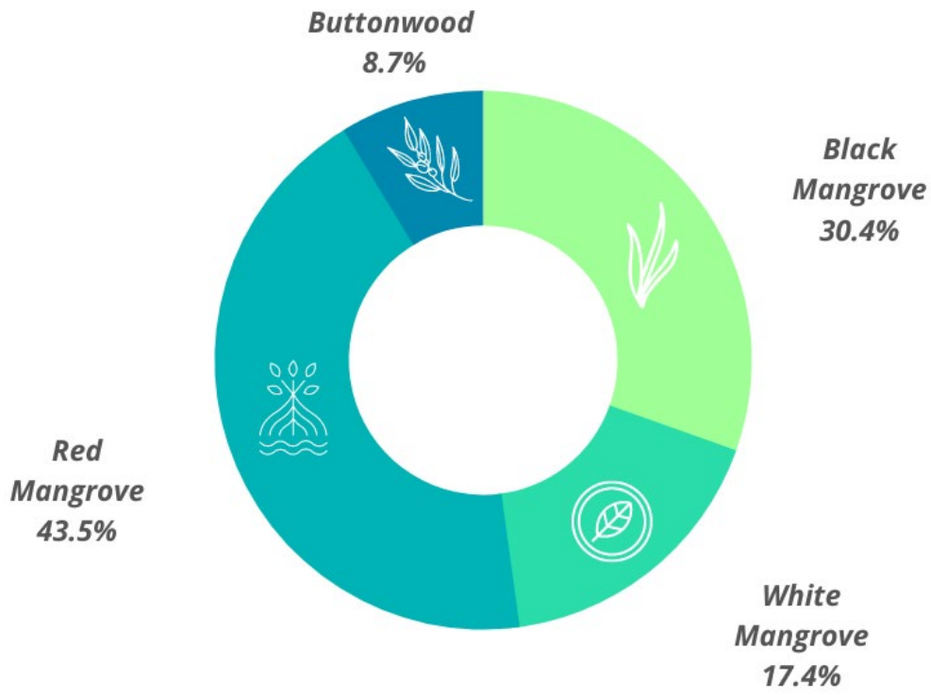
Since 2011 the restoration team have implemented restoration activities to:

- open channels & dig new ones to improve hydrology & enable standing water to drain from the site
- reduce the amount of uncontrolled fires at the site
- monitor site to see which plant & animal species return
- maintain & monitor channels to support good hydrology

The four original tree species have returned to El Rico, red mangrove (*Rhizophora racemosa*), black mangrove (*Avicennia germinans*), white mangrove (*Laguncularia racemosa*), and buttonwood mangrove (*Conocarpus erectus*) a mangrove associated species. The hydrology has improved and there are no longer areas of standing water. The areas of restored mangrove are of relatively high elevation, on the landward edge of the mangroves, and some of the quadrats included terrestrial grasses. Environmental conditions were collected (salinity, pH and soil type) which all point to healthy restored ecosystems.

Whilst visiting El Rico, the team met with MARN's Mangrove Rangers who play a vital role in the restoration efforts and monitoring in the Bay of Jiquilisco.

Restored Mangrove Species



Soil type: **Sand/Clay**

Salinity: **34 ppt**

pH: **7**

Average tree height: **8.1 m**

BLACK MANGROVE

AVICENNIA GERMINANS

WHITE MANGROVE

LAGUNCULARIA RACEMOSA

RED MANGROVE

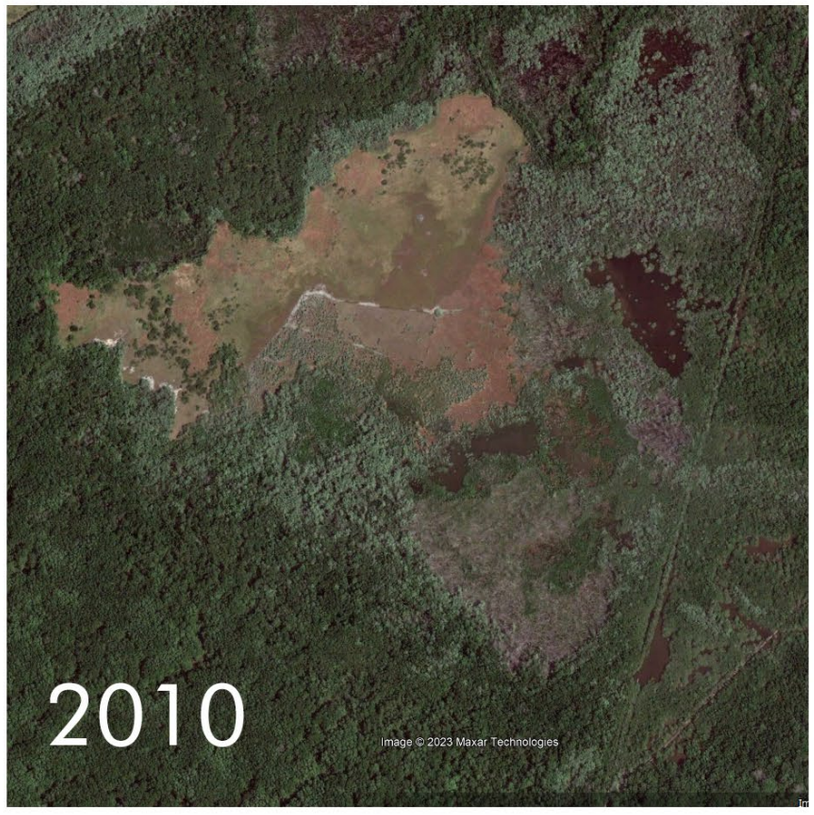
RHIZOPHORA MANGLE

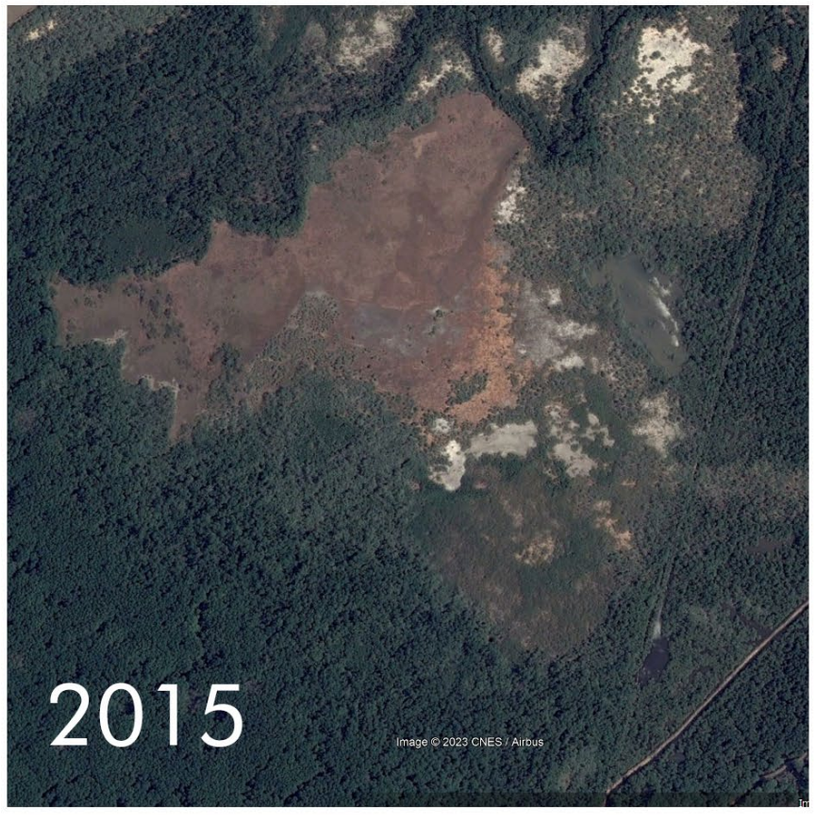
BUTTONWOOD

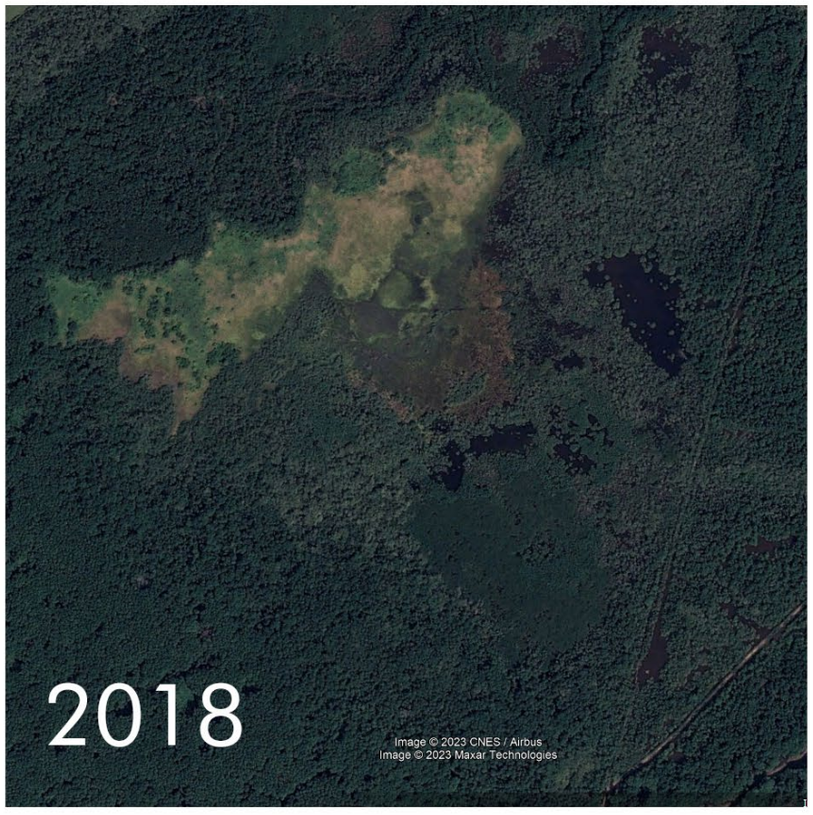
CONOCARPUS ERECTUS

Recovery From Above

Aerial images showing the restoration of 'El Rico' mangrove area using Ecological Mangrove Restoration techniques.







By looking at historical and current mangrove presence on Google Earth Pro, the area of mangrove trees around the channels at El Rico has increased by 34.2 hectares.

El Copante

SITUATION

In 2011, a large area of mangroves at El Copante had been lost and the health of the remaining mangroves was in decline. Poor hydrology and sedimentation have contributed to the mangroves degradation and there were large areas of standing water. Some areas of mangrove were no longer connected to the main channels and remained flooded for many years. Some previous planting efforts had occurred at El Copante - mostly Red Mangrove saplings planted in the late 90s and early 00s.

AIMS

The aim at El Copante was to start by understanding the site history and the issues that caused the mangrove loss. Speaking to community members and Mangrove Rangers helped to determine some of the issues and where the channels had been blocked or had disappeared completely. The next step was to select where restoration should occur and how to restore or recreate good hydrology and remove or reduce stressors.

Restoration Overview

A new 2 km channel was excavated to connect the site to existing canals, which allowed the standing water to drain from the area. Once connected to the tidal cycle, the movement of water brought many mangrove seeds and natural regeneration occurred.

When Jim Enright and Alfredo Quarto last visited this site in 2011, the mangroves were extremely stressed with standing water.

ACTIVITIES & RESULTS

Since 2011 the restoration team have implemented restoration activities to:

- dig a new channel to improve hydrology and enable standing water to drain from the site
- monitor site to see which plant & animal species return
- maintain & monitor channels to support good hydrology

The three original tree species have returned to El Copante, red mangrove (*Rhizophora racemosa*), black mangrove (*Avicennia germinans*), and white mangrove (*Laguncularia racemosa*). The majority of the restored area surrounds the new channel and has a high density of trees, the majority of which are white mangrove (58.2%). The mangrove area at the highest elevation is rarely covered by the tide and floods in the rainy season, this area is home to Jaguarundi, racoons and mangrove terrapins. Environmental conditions were collected (salinity, pH and soil type) which all point to healthy restored ecosystems.

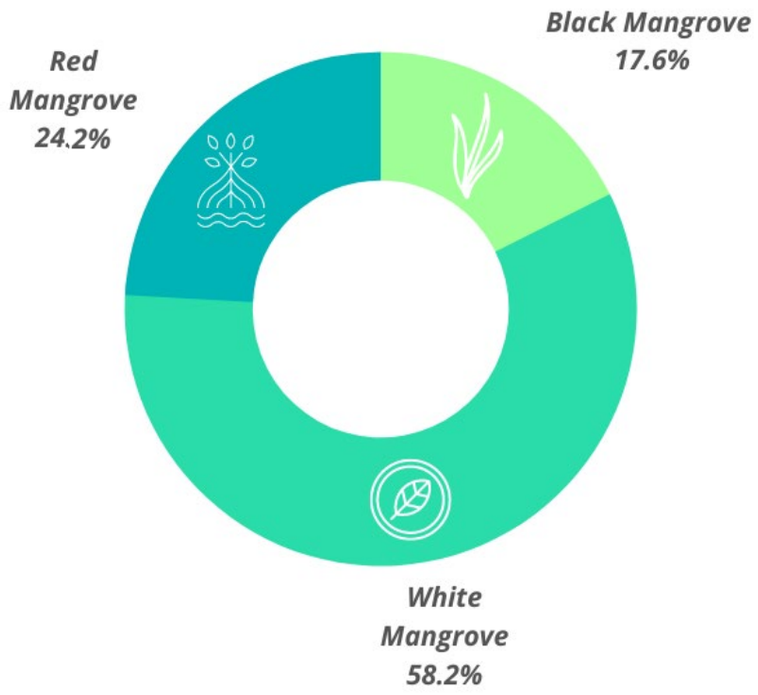
Recovery From Above

Aerial images showing the restoration of 'El Copante' mangrove area using Ecological Mangrove Restoration techniques.

By looking at historical and current mangrove presence on Google Earth Pro, the area of mangrove trees around the channels at El Copante has increased by 8.7 hectares.

Data was gathered along the 2km channel that helped to restore the mangroves at El Copante.

Restored Mangrove Species



BLACK MANGROVE

AVICENNIA GERMINANS

WHITE MANGROVE

LAGUNCULARIA RACEMOSA

RED MANGROVE

RHIZOPHORA MANGLE

Soil type: **Clay**

Salinity: **37 ppt**

pH: **7**

Average tree height: **7.2 m**

Recommendations & Future Work

RESTORATION ACTIVITIES

Run training workshops on Community-Based Ecological Mangrove Restoration (CBEMR) for community members, community groups, non-profits and government staff, including advanced CBEMR workshops for current restoration practitioners to train in addition techniques such as monitoring and shrimp pond restoration.

Many of the channels around the Bay of Jiquilisco have blockages caused by fallen trees. If they are not moved quickly enough, sediment begins to accumulate adjacent to the tree and further blocks the canal. The Mangrove Rangers work effectively to clear these fallen trees, however the frequency of which the trees fall can overwhelm their capacity. Therefore, a method to monitor fallen trees and some assistance or increased capacity to clear them would be beneficial.

Suggestions at El Copante include some thinning of the trees. The density of trees is high and they are all the same age. The forest will naturally thin itself over time, with more dominant trees growing and reaching the light and the smaller trees dying, but some cutting could be beneficial. If the trees die and fall they will create debris and may block the channels, and thinning will speed up the growth process of the surviving/dominant trees. The thinning process should be decided by a forestry expert and either the Mangrove Rangers or a foresty professional should come and mark the trees that can be cut for poles. A small pruning saw (or small chainsaw) would be better than a machete or a large chain saw as the trees are close together.

Suggestions for the chinampas include making some larger ones to see if/how size alters success rates. Try building some 2-3 m wide, at different elevations. Plant some with all three species and leave others to observe natural regeneration. Wait a couple of years to see if there is success. It will take some time for the trees to grow and to determine if they will be restricted by the size of the chinampas, or if they might 'outgrow' them and become unstable in the surrounding water. If sedimentation occurs around the chinampas then thise will increase the area available for growth. HALO trust are removing sediment from the channels at El Lloron to maintain depth, and another suggestion is to use this sediment to build the chinampas. This will mean the sediment doesn't need to be taken from the area around the chinampas which subsequently lowers to elevation.

MONITORING ACTIVITIES

These would be dependent on the specific needs of each mangrove forest and restored area. Continued monitoring of restored sites is advised, including data collection of tree species, size of trees, environmental conditions (such as salinity, pH, soil type and saturation). Continued monitoring of waterways to maintain hydrology - measuring channel width and depth, and checking for debris and sedimentation.

Mangrove Challenges

CONTINUE BUILDING & STRENGTHEN

Through examining these restoration outcomes, we can see the great success of the initiatives in the Bay of Jiquilisco and the benefits these are providing to community members. This work demonstrates the positive impact of full ecosystem restoration, and the successful technique that has spread across the region and throughout El Salvador.

The data collected here provides valuable insights into the restoration work and highlights the challenges that can guide future restoration initiatives. By acknowledging these challenges, we can identify strategies to overcome them and improve the efficiency and effectiveness of future restoration efforts. Monitoring of the restoration work generates valuable data and knowledge that can be shared with other restoration practitioners, researchers, and policymakers.

" We believe that the greatest challenge is to slow the encroachment of the agricultural border, mainly driven by sugarcane crops and widespread ranching, as well as indiscriminate logging and other abuses or activities within the mangrove forest, such as extending salt fields without the appropriate environmental permits. "

Jorge Oviedo, *FIAES, Executive Director*

" We have moved past the initial learning phase, as we know more about mangrove restoration in the short term. But we do need more work to be able to restore the mangroves fully to see our mangrove forests healthy. "

Daysi Herrera, *FIAES, Local Coordinator*

" It is important for us to stay current. We could have workshops in several phases: initial workshops for beginners, advanced workshops for technical staff and people who are knowledgeable and implementing initiatives on this issue, and maybe a workshop on GIS systems, or other components that can help to strengthen and document ecological mangrove restoration efforts. "

José Maria Argueta, *Asociación Mangle, Executive*

Conclusion

By using the CBEMR technique the communities are seeing huge successes in restoring the mangroves in the Bay of Jiquilisco, and the technique has spread across the region and throughout El Salvador. It is great to see so many groups active in the management and conservation of the Bay of Jiquilisco's mangroves and estuaries, many mangrove areas that were lost have now returned due to the fantastic joint work of the NGOs, non-profits, community members and government, and with continued work and collaboration this success can keep building.

The organisations behind the mangrove recovery

Mangrove Action Project (MAP) is a US-registered 501 c (3), which has advocated for the conservation and restoration of global mangrove forests since 1992. MAP personnel, now based on several continents, have conducted mangrove workshops in more than 20 countries, teaching best practices for mangrove conservation, restoration, and education. MAP works with a variety of mangrove stakeholders, including coastal communities, NGOs, scientists, and governments to improve mangrove practices globally. More information on MAP can be found at www.mangroveactionproject.org.

Asociación Mangle is a grassroots community organization that works to strengthen capacities, build skills, and advance agricultural practices to improve the quality of life of the population in the Bay of Jiquilisco, El Salvador. They focus on community organization, food security, youth engagement, environmental conservation, and gender equality.

The Stages of CBEMR

Community-Based Ecological Mangrove Restoration (CBEMR)

An alternative mangrove restoration technique developed to overcome the high rate of planting failure. CBEMR is a holistic rehabilitation technique which combines decades of field experience and published science to encourage project teams to work with local people **to facilitate the natural regeneration of mangroves by restoring and improving the local hydrology and topography, and removing or reducing stressors to mangroves**. This avoids the time and expense of building a nursery and planting nursery-raised seedlings or propagules, increases site biodiversity and helps bring back the full complement of mangrove ecosystem services. **Key to the process is getting the participation of local people from the outset and resolving the issues which caused the initial mangrove loss**. The phrase 'community-based' emphasizes the importance of local stakeholder participation but does not mean that the community owns the mangrove. All stakeholders must be involved including government, NGOs, CBOs, community members and private businesses if adjacent to the site. Gender balanced participation is also key to ensure long-term success.

The principle stages of the CBEMR process are:

With the local people, develop an understanding of the species that are living or should live on the proposed site, their ecology, preferences, tolerances, method of reproduction etc. The team should also understand the site's relevant features, salinity and hydrology (depth, duration and frequency of inundation), and collect data on site history, previous use, seed/propagule availability, and what is currently preventing natural regeneration. There should be a clear understanding of what has changed on the site or the site's context, and therefore, what needs to be remedied, as well as social issues that affect site restoration. To aid this research a concurrent study of a benchmark natural reference mangrove is encouraged of similar topography and salinity, to gain a better understanding of species abundance, tolerances, species elevation relative to sea level, soil types, and other site features.

Assuming the restoration site chosen is appropriate, the next stage is **to develop a restoration plan with the local community, including maps and diagrams, paying particular attention to removing natural regeneration inhibitors and restoring or improving the hydrology**, within the restrictions of budget, local labour skills and availability, and other issues identified during the research. Then execute the plan and implement the activities necessary, if possible to facilitate natural regeneration. Activities could include social agreements about changes in behaviour, restrictions on cutting or livestock movements. Activity might also include alternative livelihoods and capacity building.

Monitor the project and intervention from the start for at least 5 years after the work is completed. Correct faults and adapt intervention as necessary, such as channels and hydrology and fencing which might require maintenance. Unless the objective is something other than full ecosystem restoration, planting is normally not necessary unless the site is 'propagule-limited'. If this is the case, other methods can be used to introduce more propagules, for example, by broadcasting propagules onto an incoming neap tide.

CBEMR's assumed objective is full ecosystem restoration. This means that all possible species of flora are expected to naturally regenerate over time if conditions and elevation are suitable. It is hoped that with improved hydrology and a full complement of flora, all the expected fauna would also return as well as the expected ecosystem goods and services.