Chuck Di Perri,
De Palm Tours
DRAFT REPORT

Subject: Seatrek Reef Ball Project Site Evaluation

Hi Chuck,

Larry and I enjoyed our visit to Aruba to survey the Sea Trek site, De Palm Island snorkeling site, and other potential shallow water sites to help recover damages from the hurricane. For purposes of discussion, this report is divided into five parts 1) Background, 2) Sea Trek Site 3) De Palm Coral Reef Island Snorkeling Reef, 4) Island Wide Opportunities (Boca Catalina, Arashi, and Antilla Shipwreck), 5) Reef Ball Foundation Grant Requirements and 6) Next Steps.

Background

Hurricane Lenny described by veteran meteorologist John Tewey on San Juan's WOSO-AM radio as, "a once-in-a-lifetime event." pounded the shallow water reefs of the normally protected south side of Aruba with 6-8 foot seas in November of 1999. Aruba is outside of the normal belt of hurricanes and therefore these protected reefs have not experienced this type of event in recorded history. The author of this report has seen coral heads on nearby Curocao which were estimated to be 1,000 to 1,500 years old overturned by Lenny. On the DePalm Island site, the author witnessed coral heads at least 200 years old that had been overturned.

Because waves loose about 20% of their energy for each depth interval equal to the maximum wave height, there is fortunately little wave damage past 18-24 feet. However, due to the slope of the reef, many areas experienced physical damages and "sand slides" that damaged reef heads further down. Off Depalm Island, we witnessed sand slide damages down to about 55 feet.

Corals propagate both sexually and asexually. After storm events, broken corals that stabilize themselves on hard bottom reattach and grow into new colonies. Those that find sand or soft bottom initially die on the side facing the seafloor because they need current and light to survive. Without a hard bottom to attach to, they will eventually get moved again in future storms

and with each turn more of the corals die, leading to an eventual death of the coral "fragment."

Scientific efforts in recent years have developed techniques to gather these dying fragments, stabilize them artificially and then re-seed damaged reef sites to create a dramatically faster recovery from storm events. The ideal time to undertake fragment stabilization is either immediately following the storm, or after one full season (to allow the natural stabilization of the fragments first) avoiding the hottest summer months which can stress corals when oxygen levels are low due to high water temperature.

Sea Trek Site

You have asked us to survey a bayside side on De Palm Island to develop an underwater attraction for the Sea Trek installation being planned for the site.

Bottom Survey Results:

1) The site consists of silt/sand on the surface going to hard packed sands at depths of 4-12 inches. Hard bottom is found about 4 inches below the sand in several areas which are presently covered with calcareous algae species. This depth to hard bottom is conducive to artificial reef placement, however it is reasonable to expect subsidence (settlement) of heavy materials by 4-12 inches.

1a) Stability: Stability is not an issue for this site since you are in a protected bay outside the normal range of hurricanes. Reef Balls could be stacked if desired (two high without additional supports, higher with center pilings if desired). You could potentially save budget by making the Reef Balls for this site lighter than standard sizes by inflating the central bladder more when casting or by adding additional side holes.

2) **The silt in the upper layers of sand is extensive**, **this will be the biggest treat to the guest experience and maintenance of corals transplanted** to the site. We **highly** recommend that the walking trail be at least 12 inches above the seafloor and that disturbances to the bottom by the guests be minimized at all costs to avoid a significant loss of visibility.

3) Observations of natural settlement species:

Hard Corals: Only three species of hard corals where found with 25 meters of the site, all in the encrusting family likely in the lettuce coral group. Within 200 meters (but still on the bay side) we found an knobby coral, likely in the star coral family.

Soft Coral: We found few common sea whips

Anemones: One of the most strikingly color invertebrates found in the area where pinkish purple Condylactis gigantea Anemones. We noted 8 individuals within 50 meters. These would make an idea "point" attraction during the walk but would need to be artificia lly concentrated to make a striking visual impact. We also noted brown curly cue anemones in abundance.

Feather Dusters & Tube Worms: The site had a wide variety of feather dusters and tube worms (mostly non-calcareous) however most were in the brown color ranges. They are in indicator of a high siltation loading in the water and will most likely be a dominant natural settler of artificial reefs.

Algaes: There were a wide variety of both calcareous, non--calcareous, macro and micro algaes including some cyno-bacter algaes indicating a possible nitrate/ammonia/silicate or phosphate source within the bay. Levels were not too high to prevent corals from surviving, but probably too high to keep them from settling and or thriving.

Fish: Many species of tropical fish were seen in the area, but abundance was concentrated on the existing structures such as the dock, floating barge, and the natural slope.

4) Recommendations: In order to create a reef of high visual impact, we recommend the propagation and transplantation of coral fragments destined to die which were damaged by Lenny.

In accordance with our discussion on Island, we recommend (given budget constraints) that a plastic crate walkway is created with various "attractions" along the way including the sunken airplane, a "wall" of Reef Balls, a scattered field of fragment propagated Reef Balls, a Reef Ball Column heavily transplanted with large corals and bubbled with air, a Reef Ball with

a high concentration of Condylactus anemones in the center of the trail and a fish feeding program at the end of the trail.

A special care program of coral feeding and siltation removal may be necessary to maintain the health of the larger coral colonies transplanted from offshore sites where the water quality is higher.

Due to construction constraints on De Palm Island, we would recommend limiting the size of Reef Balls to no larger than our Pallet Ball sized modules utilizing stacking techniques to build larger visual attractions. We also recommend a mixture of sizes to provide a variety of visual changes.

De Palm Coral Reef Island Snorkeling Reef

We dived the Snorkeling Reef and the wall located on the ocean side of Palm island. The entire area has natural hard bottom below a thin layer of sand. It was evident that this was (and actually still is) one of the most beautiful snorkeling destinations in Aruba. It was also apparent that Lenny uprooted a very high percentage of the initial corals that were present before the storm. The author of this report has spent over ten years surveying reefs after storms and this site offered more potential for re-growth and as a source of coral fragments than any site ever surveyed before. However there exists a greater challenge than most restoration sites due to the larger sizes of the coral fragments. In order to make a complete restoration, the normal process of gathering fragments for processing on-land needs to be expanded to placing Reef Balls next to the larger fragments so that repairs can be made in situ.

We also observed a significant amount of additional damage occurring to the reef by the guests that were not guided by instructors and including fresh coral breaks from people stepping on the Reef. We recommend instructor guidance for snorkelers or at a minimum the construction of a snorkeling trail with clear underwater signs instructing guests not to touch or especially step on the corals. On land warning signs would be helpful too to prevent further damage to this natural treasure.

Recommendations:

Complete coral restoration program and installation of snorkeling trail along with increase guest education programs including signing a pledge on the ferry ride over not to touch or molest the corals. (See Island Wide Opportunities and Reef Ball Foundation Requirements Sections for more specific recommendations)

Island Wide Opportunities (Boca Catalina, Arashi, and Antilla Shipwreck),

We surveyed three additional sites during our stay on Island.

-The Boca Catalina site has a significant number of small brain corals that is in need of stabilization. The site from 7-12 feet deep represents an excellent opportunity for Reef Ball restoration work to not only restore additional species to the area which are no longer present but also to widen the area available for snorkeling so that the tourist pressure is spread out. This represents an excellent opportunity for Reef Ball development.

However, the inshore area (less than 7 feet) appears to have undergone a shift do to shoreline changes from the storm and is now showing species growth accustomed to higher siltation areas. The structure is adequate in this area to support high fish populations but it is unlikely that visually striking corals will repopulate the area even with transplant work do to the shoreline changes. We do not recommend any work in this area.

-The Arashi site was characterized by the convergence of waves from a variety of angles due to the shape of the island. As such, the corals in the area were adapted to higher wave energies than other sites and therefore did not experience as much damage as other shallow reefs in Aruba. However, it was apparent that after the storm, coral diseases struck some of the large stands of elk-horn coral because large areas were intact but the coral tissues were dead. This is often the result of infection after an area is damaged.

In this area, additional structure, like Reef Balls are not needed. However, the stands of dead elk-horn can be rejuvenated more quickly by tying pieced of live elk-horn fragment to these areas to foster new growth.

-The Antilla Shipwreck was in relatively good shape after the storm, loosing corals mostly on the sides and at the base due to scouring effects that are to be expected on high profile materials. No restoration effort is suggested for this site nor is the site a potential source of fragments since the surrounding sands have buried any fragments that might have been present after the storm. Reef Balls might be used on any of the island wreck for trails and underwater navigation aids or to connect the wrecks with each other or natural reefs in the area.

Big Picture...

There are precious few shallow water reefs to enjoy in Aruba after Lenny and an Island wide effort to capitalize on the treasures of coral fragments left by the storm is a once in a lifetime opportunity just as Lenny was a once in a lifetime storm. The Reef Ball Foundation would like to assist Aruba to restore the above mentioned shallow water reefs and if desired to create additional ones to match the tourists demand. The Foundation is willing to donate the use of Reef Ball molds and to donate the time of trainers to teach local residents and volunteers how to perform this restoration work provided that Aruba can organize itself well enough to support an intensive 5-6 week project to build and deploy 300-1000 Reef Balls transplanted with coral fragments, coral colonies and coral heads that are destined to die if they are not stabilized.

We have created a checklist of items that would need to be donated to complete such a project. Obviously, the more support by the local community, the more Reef Balls that can be built and the larger an area that can be restored. Additionally, a larger project would attract much more positive media attention than a smaller project and one goal of this project could be to increase tourism on the island. The Reef Ball Foundation will add it's support on a matching basis, the more that others provide, the more the Reef Ball Foundation will provide. The Reef Ball Foundation is also willing to provide project management expertise for this project. Once per year, the Reef Ball Foundation picks a project most suited to our assistance, last year, with the Foundation's assistance two high schools in North East Florida (Jacksonville and St. Augustine) deployed almost 1,000 Reef Balls. This year, we hope our project will be to assist Aruba in its shallow water restoration efforts.

In order to organize and execute such a project in the timeframe needed (we hope to start the project in late March/early April 2001 and finish before the June Bonaire Dive Festival sponsored by CORAL). We would need strong support from:

-The Aruba Watersports Association (Initial meetings indicate support)
-The Aruba Hotel Association (TBD)
-The Aruba Government (permission and duty free import/export of the molds only) (Initial meetings were encouraging)
-The Aruba Tourism Board (initial meetings showed support)
-The NGO community of Aruba (Initial meetings were encouraging)
-The Reef Ball Foundation (already in support)

Additional support, while not required has been offered or is expected by:

-CORAL (already in support)
-CORL (pledged support)
-Save the Oceans Project (already offered support)
-Eternal Reefs (offered concrete costs for 100 memorial Reef Balls)
-Reef Innovations (already offered support)
-Florida Institute of Technology scientist (volunteered time)
-Reef Ball Curacao PortoMari Plantation Project information/cost sharing (possibilities are being explored)
-Lago Alumn of Aruba (offered support of individual members)

For Chuck's meeting on Monday, The major items that would facilitate the project are as follows:

? Concrete for 300-1000 Reef Balls (50-300 yards) (About US$6,000-$35,000 @ $115/yard, estimated high)
    -Eternal Reefs has pledged the concrete for 100 units

? Shipping of molds to Aruba from Sarasota
    -Approximately

? Shipping of molds from Aruba to Sarasota

? Providing a place to build the Reef Balls

? Forklift or front end loader for 4 weeks to move Reef Balls at construction area and to load them.

? Transportation from construction area to water entry locations (truck or flatbed truck) and unloading equipment at water entry

? Boats for floating units out to sea (any size)

? Boats for support of coral fragment gathering, survey work
(not needed when fragments are in snorkeling range)

? kid pools and salt water aquarium pumps for doing fragment work
(Optional but desirable)

? Hotel Rooms for trainers/staff (preferably at all inclusives to keep down food costs)
? Hotel Rooms for volunteers (a good block of rooms could be sold to volunteers to help finance the other costs in the project)

? Donations of airfare (another way to save costs or could be resold to volunteers to help finance the other costs in the project)

? Donations of admixtures
(Possible that Reef Ball can get W.R. Grace to donate)

? Donation of hydraulic cement (for the coral transplant plugs and cementing large coral heads underwater)

? Donation of rental cars during the project (for staff, trainers, and potentially volunteers)

We envision the possibility that De Palm Tours could be the coordinating force to facilitate this vision and in doing so De Palm tours would be given additional discounts on the De Palm Sea Trek Project.

Reef Ball Foundation Grant Requirements

The Sea Trek site does not on it's own right qualify for a Reef Ball Foundation grant due to it's commercial nature. However, the educational component is a benefit, particularly the documentation of the procedures used for the coral transplants. Additionally, the molds could be used for some offshore work such as creation of the De Palm Island snorkeling reef which have true environmental benefits. Therefore...

The Reef Ball Foundation has approved De Palm Tours for a Reefs Around the World Grant (40% off of retail plus other benefits such as reduced costs for training etc.) for the Sea Trek site given the following conditions:

1) All corals transplanted must be documented by photograph along with propagation/transplant notes or observations that might be useful to others propagating the same coral species. This process should include note updates at least twice per year for 3 years.

2) For every 2 Reef Balls used in the Sea Trek site, at least one Reef Ball must be placed offshore and transplanted with corals rescued from offshore. (These can be Reef Balls done only by De Palm Tours or they can be Reef Balls that are made by the island wide project since De Palm was a leader in getting this project potentially started).

3) If the island wide project is undertaken, De Palm would also be given the option of contracting directly with Reef Innovations, Inc. to build the Reef Balls for De Palm without the need to purchase molds at all. (Chuck, you would need to contact Larry directly about how he would work this out with you but I suspect he could just come a week early or stay a week late and the whole De Palm Island project could be completed very quickly).

Next Steps

We have obviously given lots of options to think about and we are very willing to be flexable to meet your needs. We understand that the Sea Trek project needs to proceed quickly and that the island wide project may or may not be doable and may or may not meet your timeframe expectations for Sea Trek. Therefore we will need to take our next step directions from you. Curacao has already sent

the check for molds to be produced and they plan on starting the project ether before Feb 26 or after March 6th depending upon Larry and my schedule. I must go to DEMA from Jan 23-27 and then have Malaysian clients in town from the 27-Feb 11th followed by a 10 day trip to Malaysia for a Reef Ball project. I am available so far for all other dates. Larry has another project in a separate part of Malaysia tentatively planed for early Feb. but subject to change. Thank you for giving us the opportunity to assist you in this exciting project, we look forward to working closely with you to accomplish your project goals.

Sincerely,

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