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-Todd Barber

Thursday, July 05, 2007

**Biological Monitoring Report on Reef Balls Used as
Submerged Breakwaters in Bayahibe, Dominican
Republic *For*
Reef Ball Foundation Records
July 5, 2007**

Submitted to



(A

Reef Beach Company Authorized Contractor)

**For Use By
Iberostar, Gran Dominicus, Oasis Coral Canoa & Cadques Caribe
&
Dominican Republic Regulatory & Environmental Authorities**

By The



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With Contributions From

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Introduction

Antilia invited Reef Ball Chairman, Todd Barber to do a biological survey of the Reef Balls in Bayhibe at the same time that Dr. Lee Harris, Consulting Coastal Engineer, from Florida Institute of Technology, monitored the installed Reef Balls and beach profiles.

The Gran Canola supported the monitoring efforts by providing rooms and accommodation, and Cadques Caribe provided logistical support in the form of a helicopter charter to perform aerial survey work. Antilia provided survey equipment logistics, Dr. Lee Harris's fees, and support expenses. Reef Ball Foundation provided Mr. Barber's fees to ensure the projects meet Reef Ball's environmental standards providing high quality reef habitat in a form that benefits the oceanic ecosystem.

The primary goals of the biological monitoring were:

- 1) To determine if the engineered movement of the Reef Balls further offshore did any harm to the corals and fouling community already developed on the Reef Balls. (The movement was done to accommodate Gran Dominicus's need for more swimming space because the Reef Balls were so effective at creating a beach that the swimming area because too small for hotel goals.)
- 2) To monitor a demonstration project conducted by the Reef Ball Coral Team in 2004 which test planted 2 asexually reproduce *Acropora Palmata* (Elkhorn Coral) to see if this endangered species could adapt to the water conditions with frequent sedimentation and touristic pressures.
- 3) To monitor the natural fouling community and corals growing on the various reef balls planted at different times.
- 4) To make recommendations about future design or management practices involving the Reef Balls that would benefit the marine environment.

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Executive Summary (Report Conclusions)

- 1) Moving the Reef Balls did not substantially alter the fouling community on Reef Balls. [However, Reef Balls with planted endangered corals where not moved and would be ill advised].
- 2) Two planted endangered Acropora Palmata (Elkhorn Corals) survived and grew by more than (from asexually produced fragments approximately 2 square inches to approximately 2 square feet colonies)



- 3) Consistently, the older the Reef Ball the more coral cover and more diverse marine fouling community. Because changes in the biological community's are still significantly different, it can be assumed that non-planted Reef Balls have not reached the climax community state yet even though some have been in the water since 1996.
- 4) In Bayhipe, we recommend asexually reproducing and planting endangered Acropora Palmata (Elkhorn Coral) and the testing of threatened Acropora Cervicornis [Staghorn Coral] and other important reef building species on any new Reef Balls built (such as Cadques Caribe), or on any Reef Balls that are young enough to clear the fouling community in the immediate planting area of the coral plug (Such as the newer Reef Balls at the Oasis Coral Canoa or Gran Dominicus Phase II). [Note: asexual coral reproduction and planting on Reef Balls must be performed by a certified Coral Team overseen by at least a Level IV Coral Propagation and Planting Expert.] We do NOT recommend planting corals on the original Reef Balls at Gran Dominicus or Iberostar as the fouling community is establish enough that it would be difficult for corals to be planted due to competition for space and carnivorous predators (primarily snails and fire worms).

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Effect of Moving Reef Balls on Associated Marine Communities

The scope of this report includes only the **biological impacts** of Reef Balls moved after a significant time and after the establishment of a marine ecosystem. The movement of the Reef Balls to deeper water clearly reduced their effectiveness for wave attenuation but that is being addressed by a separate engineering report by Dr. Lee Harris. Please refer to that report to answer beach erosion impacts, stability impacts, and anchoring changes.

The Reef Ball Foundation does not, as a general policy, recommend moving Reef Balls after they have been deployed for a significant amount of time because a marine ecosystem develops around them and becomes dependent on the newly created reef habitat. However, an advantage of a modular designed artificial reef is it's ability to be moved when project goals change or in the event the Reef Balls need to be re-configured.

At Gran Dominicus Resort, initially there was no beach at all and the Reef Balls were placed about 175 feet offshore. As the Reef Balls developed the beach wide, the swimming distance to the beach was reduced...in some cases to less than 75 feet. Because many guests enjoy swimming in the protected area of the Reef Balls, the resort elected to move their Reef Balls further offshore even at the cost of reduced protection from beach erosion. Because this move was only a foot or two deeper and in the same general biological zone, it was suspected that the marine life attached to the Reef Balls would survive the move and associated fish would simply swim to the relocated site.

Because the corals on the Reef Balls were primarily "massive" corals and not branching varieties, handling them did not present a major obstetrical in terms of avoiding physical damage. Even so, The Reef Ball Foundation recommended against moving the Reef Balls.

However, project goals for Gran Dominicus dictated the move be undertaken and the move was undertaken in the 2004/5 time frame.

Todd Barber conducted monitoring in May 2007 and conditions for the monitoring were not ideal as visibility was about 6 feet. Therefore the results of this monitoring can be best classified as "expert opinion" not scientifically verifiable results. That would require a much more formal monitoring program which has not been a priority for the resorts.

Monitoring photographs for this project are found at
<http://www.reefball.org/album/dominicanrepublic/bayahibe/regionalreefballunderwaterbiologicalmonitoring/may2007/index.html>

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We could find no visual or obvious differences in the assemblages and communities of fish and marine life on the Reef Balls if similar age whether moved or not moved. However, there were significant differences in Reef Balls of different ages. The longer the Reef Balls were in the water, the more diverse and abundant the assemblages and communities where. This would be expected as an established designed artificial reef pattern.

Therefore, should it be a desire of the resorts to move their Reef Balls in the future, it is possible to do so with minimal disruption of the biological communities. However, the move must be done without exposing the Reef Balls to air for more than 15 minutes (unless misted with fresh water or covered in salt water soaked blankets in which case up to 6 hours is possible if temperature is controlled).

Reef Balls that have planted *Acropora palmata* (Elkhorn coral), or *Acropora cervicornis* (Staghorn coral) CAN NOT be moved (except by a level V certified coral team). Therefore, there are 2 Reef Ball off Gran Dominicas that should be identified before any construction activities and guarded against perils.

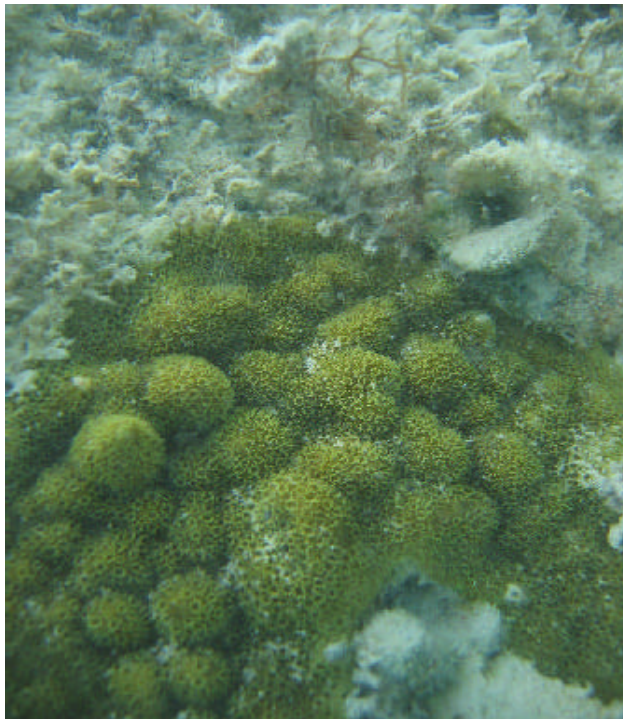
At this time, we are not away of any resorts that plant to move their existing Reef Balls. However, The Oasis Coral Canoa is considering an asexual coral propagation and planting program to help save the endangered *Acroporas*. This must be undertaken with the understanding that any Reef Balls planted with these species should be considered non-movable from an environmental perspective unless special transport methods are undertaken..

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Biological Monitoring Photos

A selection of some of the more important reef building coral species found growing by natural recruitment to the Reef Balls include:



Mustard Hill Coral (*Porites Astreoides*)



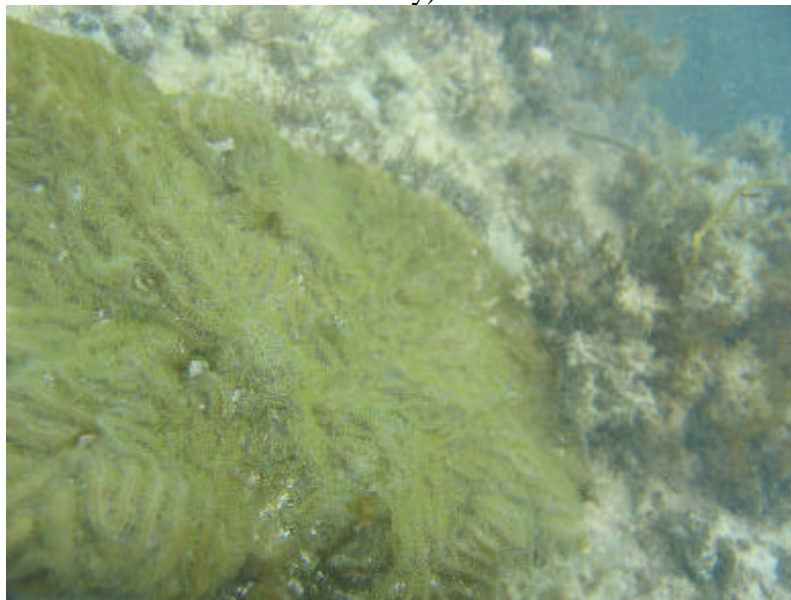
Blade Fire Coral (*Millepora complanata*)

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Maze Coral (*Meandrina meandrites*)
(Visual ID
only)



Brain Coral (*Diploria cívosa*...encrusting variation)

Massive Starlet Coral (*Siderastrea siderea*)
(*Siderea* identified by corallite detail)
[In this case growing in the inside of Reef Ball]

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Other interesting finds...



Sabellariid worm rock (A rare reef building worm species growing directly in a whirlpool creating hole of a single Reef Ball off Gran Dominicas)

Finding this worm rock aside heathy *Acropora Palmata* (Elkhorn Coral, pictured below) means the site has a very rare combination of high water quality and coastal sediments. [Elkhorn requires the highest water quality and typically non-turbid sediments unless the grain size is large enough not to impair feeding. Worm rock requires sediments to be pulled from the water to build the hard skeleton it mixes with a kind of biological glue. Neither of these species would be likely to survive in this area with the assistance of the Reef Balls.]



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Monitoring Conclusions

The Reef Balls in Bayhipe are doing quite well biologically and have established active coral reef communities. The longer they are in place, the more diverse and populated the

Reef Balls are becoming.

(Left: Newer Reef Ball showing algae dominated community).

Left: Intermediate aged Reef Ball showing change to sponges and some coral

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Left: Older Reef Ball
encrusted with coral.

Left: Oldest (and moved)
Reef Ball showing slower
growing massive corals
beginning to take over
the community.

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Diadema populations (long spiny sea urchins) were excellent and many were using the special plug holes built into the Reef Ball to help shelter these important animals. Long spiny sea urchins are critical to encouraging future natural coral settlement on the Reef Balls.



(Picture not representative of fish present as conditions were difficult for photographs, however fish were observed in high numbers within the rocks)

Reef Balls that are partially filled with rock have an even larger carrying capacity in this region due to the higher percentage of juvenile fish in the shallow water that require small complex void spaces. Tourism impacts have been relatively small even though the reefs are snorkeled and used often. This is partially due to good water quality in the area.

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and partially due to the higher general wave conditions that keep tourists from standing on the Reef Balls and damaging their surface biological communities.

Recommendations

- ????Add rocks to the interior of Reef Balls filling up about 10% to 1/3rd of the void space. Ideally, get these rocks from the sea floor around the Reef Balls to reduce the damage smaller rocks could do in a future hurricane.
- ????Do NOT plant Reef Balls that may be moved in the future or that already have too much growth on them for effective planting.
- ????Continue annual biological monitoring to keep an eye out for future pollution source problems.
How is it Actually Accomplished? (this is an abbreviated section, please refer to our manual "Reef Restoration" which is being published next month for a highly detailed explanation).
- ????Undertake an Acropora Palmata asexual coral reproduction project and plant all of the newly laid reef balls or any future reef balls with at least one colony on each reef ball. Propagation as many different genetic colonies as possible for the most conservation results. [Some photos of this process below]

-Creation of new coral colonies via [Propagation](#), and attaching coral colonies to Reef Balls or prepared (by drilling a small hole) natural rock already in shallow water habitat The team uses an efficient and inexpensive [attachment adapter system](#) to create "plugs" for a diverse selection of hard and soft coral species.

[Click to see underwater propagation photos](#)

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Plugs for attachment adapter system method for fragments

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[Click to see rescue photos](#)



Click photo above to see a reef being planted

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Appendix A:

Proposal for Oasis Coral Canoa Reef Ball Coral Team Offers Volunteer Coral Team Activation

[Note: Coral Team activations are by invitation only and require conditions conducive self supported volunteer ecotourism. If your hotel is interested in a project please contact us to find out if this type of a project is possible for your resort]

The Reef Ball Foundation has a Division called the “Coral Team” which works to assist resorts in performing coral reproduction and planting projects on their Reef Balls using volunteers to minimize resort costs.

Organized using paying volunteers, the Coral Teams can utilize non-occupied hotel room space to “sell” to volunteers to support the coral transplant supplies and equipment required to undertake these projects. The volunteers also form the backbone of the labor to collect the corals, asexually reproduce them and then plant them on the hotel's Reef Balls but are supervised by experts to insure success. On average, a typical hotel would have to pay around \$75,000 for the same service from commercial reef rehabilitation services. The benefits to the hotels are numerous from having better guest snorkeling opportunities, additional beach protection and promotional and press opportunities.

In the special case of the Oasis Coral Canoa, there exists an opportunity to work with an endangered species of coral, that although it is very sensitive, can provide rapid growth and fast conversion from an artificial reef into a natural fringing coral reef. As this report has demonstrated, a test of this coral was successful from 2004-2007.

The Reef Ball Coral Team would provide to the Oasis Coral Canoa two coral experts (John Walch, Coral Team Division President and Todd Barber, Reef Ball Foundation Chairman) to lead a team of 12 volunteers. Each volunteer would pay to the Reef Ball Foundation \$1,000/double occupancy or \$1500/single occupancy to participate and their payments are tax deductible in the US. These funds would be used to fund the airfare/fees of the experts, coral transplanting supplies, project t-shirts, etc.

If participating, The Oasis Coral Canoa we would need to supply 8-12 all inclusive rooms (depending on volunteers signing up for single or double occupancy room), scuba tanks, weights and belts for the week, internet usage, boat support (likely needed for a couple of hours each day to aid in the collection of stock corals and movement of corals).

Volunteer trips usually conclude in a wine & cheese party where we need some space in either a conference room, restaurant or outdoor area. Hotel management is invited to this party for awards and recognition and the event can also be appropriate for inviting the press if the hotel desires publicity for the event. Although the teams typically bring

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enough wine and cheese for the team members, the hotel may need to supply additional refreshments if attendance is beyond the number of volunteers.

Depending upon the supply of imperiled stock corals, a team will typically plant around 500 corals in a weeks time. Projects in the Caribbean are usually 7 days in duration. Project leaders usually arrive 1-2 days early to set up the coral propagation table so 2 extra rooms will be needed a day or two prior to the formal project. There is no guarantee about the number of corals that can be planted, but in our previous projects Coral Teams have always meet their leader's goals. From a Reef Ball Foundation perspective, our goal would be to have at least one Elkhorn coral planted on every Reef Ball at the Canola resort.

In order to initiate a project, we need a formal commitment to the block of rooms and on site logistical support at least 2 months prior to the project commencing. Because corals should be planted in cooler waters due to heat stresses, September is the earliest possible date with October being a better choice. Project dates are typically selected by the host hotel to insure they are can use unoccupied rooms to minimize the project cost for the hotel. Therefore low tourist season is ideal.

We encourage hotels sponsoring volunteer projects to provide any low cost extras they can to help us attract qualified and motivated volunteers. Examples include expedited check in, use of boat for extra pleasure dives, or discounted rooms in the case volunteers want to stay longer/or arrive early to relax outside the project work requirements. If the resort has outside activities such as sailing, golf or excursions we only encourage this if scheduling is possible outside of the volunteers normal work hours or in the event of bad weather days.

Reef Ball Coral Teams come to work, the team meets for breakfast when the restaurants first open and will work typically until sundown, weather permitting. Hotel guests and staff are welcomed to join in the activities and therefore increasing the number of corals the teams can plant. Most hotel guests get very excited to see corals being asexually reproduced a the beach. Many hotels advertise or promote our visit beforehand to encourage higher occupancy rates. Some make our work part of the formal guest activities for that week and we are happy to accommodate.

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Because our activities will be on the beach, we ask the hotel to provide an appropriate banner to be displayed above the coral propagation table as shown on the picture below. Our coral table will require that we borrow 2 umbrellas from the resort for the week also as shown.



(Pictured, Todd Barber, left in sunglasses and John Walch, right with beard, lead a Reef Ball Coral Team Volunteer Project at the Cayman Island Beach Resort Marriott)

For references, The Reef Ball Coral Team has performed volunteer projects at:

The Four Seasons Resort, Maldives Islands
Beach Resort Marrriot, Cayman Islands
The Racha Resort (5 stars), Puckett Thailand
Porto Mari Beach, Curocao
Playa Duz Hal, Cozumel Mexico
Maiden Island, Antigua
Friends of the Environment, Abaco, Bahamas
Royal Caribbean Cruise Lines, Coco Cay, Berry Islands, Bahamas
UAE President's Residence, Dubai, United Arab Emirates
Reef Dive Resort, Matakang Island, Malaysia
and many other governmental and private coral rehabilitation projects.

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