



UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration

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MEMORANDUM TO: David Bernhart
NOAA/NMFS F/SER3

FROM: Tom Moore 
NOAA/NMFS F/HC3

SUBJECT: Emergency Coral Reef Restoration Actions Following the
Grounding of the *M/T Margara*

The NOAA Restoration Center (RC) is requesting emergency consultation pursuant to section 7 of the Endangered Species Act for the salvage and restoration of staghorn coral (*Acropora cervicornis*) due to the grounding of the *M/T MARGARA* in Puerto Rico. The urgency of this project is a result of the necessity to prevent the further mortality of the recently listed threatened species.

The *M/T MARGARA*, a 228-m (748-ft) tanker went aground on a hard bottom formation 3 miles south of Guayanilla, PR on 27 April 2006. The freighter was reportedly under its own power when it grounded in a water depth of approximately 10.5 m (34 ft). The *M/T MARGARA* was removed from the grounding location the following morning on 28 May 2006. The impacted hard bottom formation is located along the outer portion of the relatively narrow insular shelf south of Bahia de Tallaboa. The hard bottom bank feature is designated as reef habitat (U.S. National Oceanic and Atmospheric Administration, 2001¹) and supports an epifaunal assemblage visually dominated by soft corals, sponges, and hard corals. A unique feature of grounding location was the presence of a relatively large thicket of staghorn coral (*Acropora cervicornis*) in addition to number of smaller thickets. The grounding physically approximately impacted 8500m² of coral reef including the large thicket of *A. cervicornis*. Coral salvage and triage actions to date have resulted in the salvage of more than 2500 hard corals, an unknown number of soft corals, and approximately 800 fragments of *A. cervicornis*.

Emergency restoration actions to permanently secure the dislodged corals to the bottom are to begin as soon as possible and be ongoing for approximately 3-4 months. These actions will include reattachment of dislodged corals and the stabilization of damaged reef areas. A specific plan to address *Acropora cervicornis* at the site is attached and an overall restoration strategy will be provided to your office as soon as complete.

¹ Morelock, J., W. R. Ramirez, A. W. Bruckner, M. Carlo. 2001. Status of coral reefs southwest Puerto Rico. *Carib. J. Sci. Special Publication*. Vol. 4.



We have determined that under the ESA that the subject project “may affect” the threatened staghorn coral, at the site of the grounding. However, the actions at the site will be solely beneficial because without the planned emergency restoration effort the majority of corals would likely die due to abrasion and additional breakage. Therefore, we are requesting concurrence with our determination that the proposed project will not jeopardize the continued existence of the species.

At this time we are requesting an emergency consultation and will continue to consult with your staff to provide for the conservation of staghorn coral.

Should you have any questions or concerns please do not hesitate to contact me at (727) 647-6538 or Tom.Moore@noaa.gov

M/T Margara Grounding

Acropora Cervicornis Reattachment Strategy

DRAFT

Overall Philosophy:

Acropora cervicornis (staghorn coral) has been designated by NOAA Fisheries Service as Threatened under the Endangered Species Act of 1972 due to dramatic declines in population throughout its range in the last 30 years. While it is increasingly rare to find abundant healthy stands of *A. cervicornis* in the Caribbean, the site of the M/T Margara grounding supported a relatively healthy and dense population.

The grounding resulted in widespread fragmentation, burial and crushing of *A. cervicornis* colonies at the site. To date there are approximately 600-800 fragments cached or staged in temporary holding areas awaiting final reattachment. Because there is little precedence and experience to draw upon for an *A. cervicornis* reattachment effort of this magnitude, the co-trustees are developing a reattachment strategy that utilizes various techniques at multiple locations in order to maximize the probability of success.

Reattachment Locations:

Three spatially distinct locations for reattachment will be established in the Northern Grounding Area¹. The locations will be jointly selected by the Responsible Party's (RP) consultant and the Trustee team meeting the following characteristics:

- Stable Impact Area
- Free of Anti-Fouling Paint
- Little or no Loose Rubble at or Around the Site
- No Reef Framework Damage
- Healthy stands of *A. cervicornis* adjacent to but not at the site
- Areas not directly adjacent to other restoration/reattachment activities
- Capable of supporting the implementation of the techniques listed below

Reattachment Techniques

¹ Currently the majority of cached *A. cervicornis* has been located at the Northern Grounding Area, if a significant amount of *A. cervicornis* is available in the Southern Grounding Area a fourth site will be established.

A suite of reattachment techniques are being proposed in order to maximize the chances of survival *A. cervicornis* fragments. Multiple techniques will be utilized at each reattachment site. If field teams determine that additional reattachment techniques are likely to be successful based on site specific conditions, then those additional techniques will be implemented at multiple locations and a subsequent description of the reattachment technique will be documented.

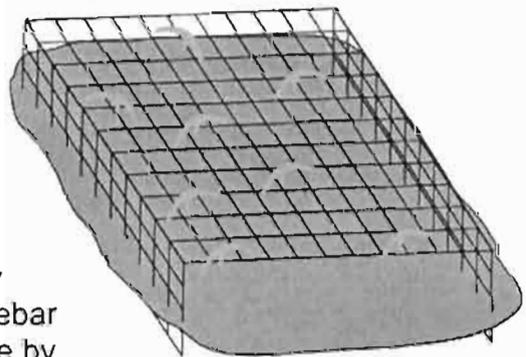
Reattachment to EcoReefs

EcoReefs™ are interlocking ceramic artificial reef modules that mimic the growth form of branching corals. EcoReefs™ branches provide a reattachment surface sufficient for the size *A. cervicornis* fragments found at the *Margara* grounding site. Individual modules would be secured to the bottom using a combination of manta and/or duckbill anchors and cement. An array of EcoReefs™ will be constructed of 4-6 interlocking modules and each module will have approximately 10-15 fragments of *A. cervicornis* attached to it. A two-part epoxy ("all-fix" is the recommended brand) will be used to adhere the individual *A. cervicornis* fragments to the ceramic modules (cable ties may be used as well but are not preferred).



Reattachment to Low Relief Frames

This method is designed to quickly provide a large area to attach the fragments while allowing the positioning of those fragments close enough to the concrete base to promote rapid attachment to the base. The frame is constructed from pieces of plastic coated wire mesh. The frame is formed by putting a 90 degree bend 4 inches in along both sides of the length of the wire mesh. The four inch uprights that are formed by these bends will allow the frame "tops" to be supported 2 inches above the concrete base with 2 inches embedded in the concrete. The base should be formed by pouring cement over 2-3 inch tips of #5 rebar previously sunk 1-2 feet into the substrate by hand (sledgehammer) or with mechanical means (pneumatic jackhammer).



Once the frame is secure in the concrete and the base has cured, the fragments can then be attached utilizing two-part epoxy and/or cable ties. *A. cervicornis* should be secured so that a small portion is below the mesh and placed at various degree angles ranging from less than 90 degrees to

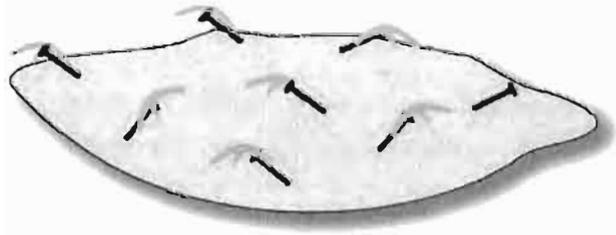
greater than 30 degrees. Fragments should be placed with the majority of growing tips facing downward and spaced approximately 12 inches from and no closer than 10 inches from other fragments.

A critical factor to consider in the construction of these frames is to ensure that the tensile strength of frame can resist flexing so as to prevent the fragments from being pulled away from the concrete base once they naturally attach themselves. Possibly small cement balls could be placed strategically under the frame work to help anchor the frame and prevent collapse. The benefit of this method is that it allows for the creation of a large attachment area without exposing the fragments to the wet cement or the cement plume created during the initial construction. The possible disadvantage is the increased surface area for epiphytic colonization.

Reattachment to Stainless Rod

This method would be implemented by pouring a concrete base (as described above) and inserting stainless nails or rod into the wet cement base on 30-60 degree angles. Approximately 6 inches should remain above the concrete. Once the base is dry and the nails secure the

A. cervicornis would then be attached along the nails or rod using two-part epoxy and/or cable ties. Fragments would be placed ½ inch up the nail with the majority of growing tips facing downward and spaced approximately 12



inches from and no closer than 10 inches from other fragments. In cases where larger fragments of *A. cervicornis* with multiple branches are present they may be situated so as to be attached to allow for multiple points of attachment.

Reattachment in Pools of Cement

Natural depressions in the limestone reef framework or depressions created by the grounding will be used as sites of opportunity to contain pools of cement which will serve as *A. cervicornis* "planting" sites. Alternatively, pools of cement can be formed by pouring cement into a circular form. In both scenarios, the cement will be poured over 2-3 inch tips of #5 rebar previously sunk 1-2 feet into the substrate by hand (sledgehammer) or with mechanical means (pneumatic jackhammer).. It is anticipated that each pool will contain approximately 5 gallons of cement. Once the plume of cement clears the area, individual fragments of *A. cervicornis* can be planted 1 inch deep at various degree angles ranging from less than 90 degrees to greater than 30 degrees

Fragments should be planted with the majority of growing tips facing downward and spaced approximately 12 inches from and no closer than 10 inches from other fragments. In cases where larger fragments of *A. cervicornis* with multiple branches are present they will be situated into the pool of cement to allow for multiple points of attachment.

NOTE: Researchers in PR that have studied various techniques indicate that do to the small amount of die-back that occurs where the coral makes contact with the cement that often algae re-colonizes the area and out competes the coral. Therefore Trustee's feel this is a low priority technique for implementation.

Other Methodologies

The on-site Trustee/RP team may develop alternate or additional methodologies provided that at a minimum two different approaches are applied and that they are applied consistently throughout the site. New techniques should be proposed to the full Trustee/RP team before full scale implementation.

General Considerations

The following general considerations are provided for the reattachment of *A. cervicornis* at the site of the M/T *Margara* grounding.

Removing Fragments from Coral Caches – Currently, approximately 600 fragments are cached on wire mesh and PVC pipe. The remaining fragments (approx. 200) have been piled together and cached within the traditional coral caches.

Because *A. cervicornis* is a quick growing species it is possible that piled fragments may have naturally fused together or fused to the bottom. If the fragments have fused together, NOAA oversight personnel will photo document those fragments. Fused fragments will be treated as a single fragment and reattached. If the fragment has secured itself to the bottom naturally it will not be moved from the coral cache location unless it is in danger for another reason (e.g., shifting rubble). The attached fragment will be left in place and the Trustee team consulted as to what protective measures may be necessary.

Fragment Placement – Individual fragments should always be placed in a horizontal orientation or plane. If the fragment has viable buds growing they should be placed so that they will grow in the direction of the substrate. The horizontal placement will promote the growth of multiple shoots and the orientation of the buds in the direction of the substrate will promote multiple points of attachment.

Presence of Disease or Algae – If visible disease or algae is present on the fragment its introduction into the reattachment site could compromise the integrity of the other corals at the site. Such fragments should have the questionable area clipped and discarded underwater and the remaining portion of the fragment can be reattached provided it is not placed in direct contact with other *A. cervicornis*.

***Acropora* sp. Spawn** – The annual coral spawning event for *Acropora cervicornis* and *Acropora palmata* is expected to occur on or around August 12th 2006. Because of the nature of coral spawning, the following special precautions will be required at the site between August XX and August XX.

- Still working out the details but likely that due to the amount of energy required in the days prior to spawning and the weak state the coral will be in the days following the spawn that all activities in the vicinity of *A. cervicornis* (fragments and unimpacted thickets) will be limited.

Endangered Species Act (ESA) Requirements

A. cervicornis has recently been listed as threatened under the ESA and therefore is subject to additional protections. In order to insure compliance with the ESA, the NOAA Restoration Center has initiated emergency consultation activities pursuant to section 7 of the ESA with the NOAA Fisheries Service Protected Resources Division (PRD). Once this document is completed, NOAA will submit it as part this consultation. During the emergency consultation process PRD has indicated that the following conservation measures will be required to be in place for our activities to move forward.

- A plan to minimize the impact of repetitive boat anchoring at the site during operations. This will be accomplished through the installation of approximately 15 mooring buoys. Additionally, the location of known *A. cervicornis* thickets and caches will be marked with surface buoys.
- Training of all personnel working on the site in the identification of *A. cervicornis* and briefing them on precautions that should be implemented when working around the species.
- The presence of an authorized agency representative during all operations that have the potential to affect *A. cervicornis*. NOAA staff providing on-site support and oversight for the project will serve as the authorized agency representative.

In addition to ESA Section 7 requirements, NOAA Fisheries PRD has also recommended that the Trustees and Responsible Party consider providing a small amount (<50) of impacted fragments to selected researchers who would otherwise be impacting wild healthy colonies in order to obtain their samples.

"Fragments of Opportunity" is the preferred method for coral researchers to obtain samples. During the injury assessment and compensatory restoration scaling the RP would not be penalized for the loss of this coral tissue from the site.

Monitoring Plan and Site Maintenance

A detailed monitoring plan will need to be developed and implemented specific to the *A. cervicornis* reattachment. Additionally experience with *A. cervicornis* nurseries has shown that maintenance is one of the keys to success. A maintenance protocol will be developed that include items such as algae removal, predator control (snail removal), and re-securing dislodged fragments.

Nursery Potential

The Trustees and the Responsible Party should also consider the possibility of maintaining sections of the *A. cervicornis* restoration sites as on-site nurseries. After growth occurs fragments would be clipped and out planted at other sections of the site. This could be considered additional primary restoration helping return more of the site to baseline quicker..