

Subject: Revised Margara ER Monitoring Plan
From: Craig Lilyestrom <craig.lilyestrom@drna.gobierno.pr>
Date: Wed, 07 Feb 2007 14:00:31 -0400
To: David Smith <dsmith@independentmaritime.com>, "Graham, Bruce"
<bgraham@conshelf.com>
CC: Kevin Kirsch <Kevin.Kirsch@noaa.gov>, Tom Moore <Tom.Moore@noaa.gov>

Dear David:

Attached you will find a revised Emergency Restoration Monitoring Plan, which resulted from revisions of the original draft submitted by CSA. We are confident that this Plan will achieve objectives of interest to all parties.

We look forward to continued cooperation with you and hope we can initiate work described in this Plan shortly.

The file is in pdf (Acrobat Reader) format. Please let me know if you have any trouble opening it.

For the Trustees,

Craig

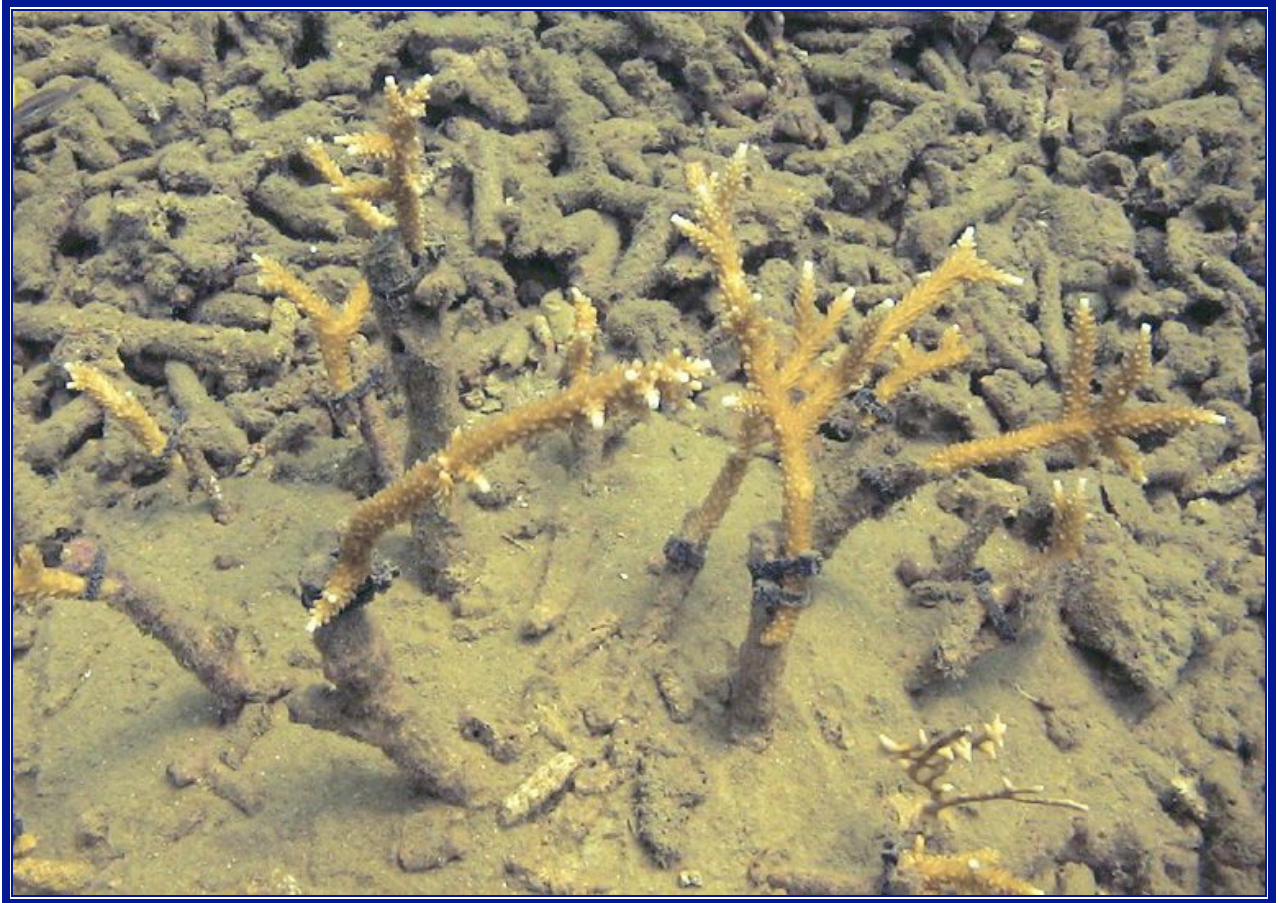
Craig G. Lilyestrom, Ph.D.
Director
Marine Resources Division
Department of Natural and Environmental Resources
Edif. de Agencias Ambientales
Sector el 5, Carr. 8838, Km. 6.3
Rio Piedras, PR 00926
Voice: 787-999-2200 ext. 2615
Fax: 787-999-2266

Mailing address:
.
Dept. of Natural and Environmental Resources
Marine Resources Division
P.O. Box 366147
San Juan, Puerto Rico 00936

Margara ER Monitoring Plan.pdf

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**Proposed Monitoring Plan
For Emergency Restoration at the
M/T Margara Restoration Site**



February 2007

Prepared for:

David H. Smith
Independent Maritime Consulting, Ltd.
10 Spruce Street
Southport, Connecticut 06890

Prepared by:

Continental Shelf Associates, Inc.
759 Parkway Street
Jupiter, Florida 33477
Telephone: (561) 746-7946

PROPOSED MONITORING PLAN

1.0 INTRODUCTION AND PROJECT OBJECTIVES

Continental Shelf Associates, Inc. (CSA) is pleased to present this draft monitoring plan for emergency restoration conducted at the *M/T Margara* grounding site. The proposed monitoring plan is based on the elements discussed during the project meeting of Responsible Party (RP) and Trustee representatives in San Juan, Puerto Rico on 3 October 2006. The monitoring plan relies on the establishment of experimental and reference stations during an initial baseline survey and the completion of approved monitoring tasks during the baseline survey and subsequent surveys.

The overall goal of this draft monitoring plan is to determine the relative success of coral/substrate reattachment as a suitable means of emergency restoration at the *M/T Margara* grounding site. The proposed monitoring plan will permit the detection of, and response to, significant changes in overall habitat characteristics, hard coral/substrate reattachment status, and relative health. Monitoring study objectives are as follows:

- To evaluate the temporal stability of reattached biota and natural substrate; and
- To evaluate the relative health of reattached hard corals.

2.0 PROJECT DESIGN OVERVIEW

2.1 Monitoring Station Selection and Establishment

Monitoring stations will include both biota/substrate groupings and staghorn coral (*Acropora cervicornis*) groupings. Stations will be established within the restored impact areas and adjacent non-impact areas. Monitoring is designed to evaluate relative changes in sampling parameters within and between experimental (i.e., restored impact area) and reference (i.e., adjacent non-impact areas) groups.

Four monitoring sites in the southern impact area (Figure 1) and 9 monitoring sites in the northern impact area (Figure 2) have been selected for monitoring to obtain an understanding of the success of the Emergency Restoration (ER). The location of the sites is meant to give a spatial representation of the entire grounding area and ER efforts covering all types of impacted areas (pinnacles, berms, scours, large and small footprints, etc.). This will allow for comparisons not only within sites but between different sites.

The four sites at the southern impact area were selected based on the criteria that ER activities reattached at least 60 colonies of hard coral and 60 colonies of soft corals at each site (Table 1). The number of colonies reattached at each site was obtained from the ER Master Tracking sheet provided by NOAA.

Table 1: Number of colonies of hard and soft corals reattached by the ER at each of the proposed monitoring sites in the Southern Impact area. Hard coral fragments were included in the number of hard corals.

Monitoring Sites	Reference Markers	# of Hard Corals	# of Soft Corals
1	150, 151	128	155
2	145, 147, 148, 149	79	182
3	144	60	131
4	143	61	68

The 10 sites in the northern impact area all had over 160 colonies of hard corals and 180 soft corals. There was a much larger ER effort in the northern area which allowed for selection of areas with more reattached colonies.

Table 2: Number of colonies of hard and soft corals reattached by the ER at each of the proposed monitoring sites in the Northern Impact area. Hard coral fragments were included in the number of hard corals.

Monitoring Sites	Reference Markers	# of Hard Corals	# of Soft Corals
5	132	340	468
6	131	358	552
7	116	163	183
8	121	205	339
9	122, 128, 142	518	580
10	152 - 155	587	676
11	117, 123	644	702
12	124, 125, 127	256	290

Within each monitoring site 10 permanent 1m² quadrats will be set up and permanently marked to determine the condition of the reattached corals. These will be randomly selected from 20 quadrats to give a representative sampling from the ER activities. Selection criteria for the location of a potential quadrat will be that there are at least 5 colonies of reattached hard and soft corals found within 1m². Random selection will be performed by placing red or blue washers blindly taken from a bag and selecting the quadrats that have the red washers.

Permanent quadrats will be set up adjacent to each monitoring site to allow for comparison between the ER and unimpacted reef. 10 quadrats will be set up by running a transect line and placing quadrats every other meter. The same selection criteria for ER quadrats will be used for the reference samples (at least 5 colonies of hard and soft coral in 1m²). A rebar stake will be put in the reef at the beginning and end of each transect line to assist in relocation of permanently marked quadrats.

The *Acropora cervicornis* that was reattached during the ER will be monitored at the 4 main *A. cervicornis* reattachment sites (Figure 2). Techniques included the reattachment of *A. cervicornis* fragments to 1) stainless steel bolts projecting outward from pooled cement, 2) natural coral rubble extending outward from pooled cement, and 3) secured frames of plastic coated wire mesh. In all three reattachment techniques, fragments of *Acropora cervicornis* were secured using plastic cable ties. Clustered fragments (one “puddle”) within an individual

reattachment location will constitute an experimental *A. cervicornis* monitoring station. Three replicates for each technique from each site will be monitored resulting 36 monitored clusters (3 replicates for each of the 3 methods at 4 stations). Four *A. cervicornis* reference sites will be selected. Possible location for 3 of the reference sites to be determined through additional discussion with the RP and trustees. A fourth site will be selected in the field. Within each reference site, there will be three 1 m² replicates.

Experimental and reference biota/substrate stations will each encompass an area of 1 m². Much of the biota/substrate reattached during emergency restoration of the site was tightly clustered into large, complex groupings and often with abutting attachment points. Corners and/or boundaries of the selected 1 m² grouping will be permanently marked to facilitate their relocation during subsequent surveys. The selected experimental and reference groupings of biota/substrate and *A. cervicornis* will be marked with a unique numeric tag and mapped relative to reference benchmarks. Each group will be mapped by determining the distance and bearing (compass heading) relative to one or more of the thirty-five geo-referenced benchmarks established during the site restoration. Due to the spatial distribution of the groupings, multiple benchmarks will be required for mapping. The navigational coordinates will be recorded for each benchmark. Numeric tags will be positioned within the established boundaries of the grouping to ensure the tag is visible in video images collected as part of the monitoring program. Mapping and tagging of monitoring stations will be conducted during the baseline survey.

2.2 *In Situ* Data Collection

The specific objectives of this draft monitoring plan are to evaluate the stability (i.e., integrity of reattachment) and relative health of selected biota/substrate groupings and *Acropora cervicornis* groupings. Tactile censuses and direct observations will be conducted to assess the stability of the biota/substrate at experimental monitoring stations. *In-situ* tactile census, including observations of scouring, will be used to determine stability of cement bond for biota/substrate groupings.

To compare the health and stability of hard and soft corals reattached by ER activities, data will be collected following a modified sampling protocol as described by AGRRA (http://www.agrra.org/method/data_revised.html). The modified protocol will include soft corals as well as hard corals. Data that will be recorded will include species, size, old mortality, recent mortality, disease, bleaching, damsel fish gardens, presence of damselfish, overgrowth, competition, injury, or any other cause of mortality, in addition to stability evaluations and observations on any biota-cement interactions. This will provide a measurement of the density of corals present, size distribution and condition of the colonies. Within each 1m² quadrat, the percent cover of coral, algae, sand, rubble, bare substrate, other invertebrates, etc. will be recorded. Additionally, specific data describing condition of coral attachment shall be collected. This data includes:

- Is coral secure to cement?
- Is cement secure to substrate?
- Type of growth on cement?
- Is mortality localized near attachment point?

- Is there any new settlement?

Observations will be performed by experienced coral reef scientists.

The success of the different *A. cervicornis* reattachment techniques will be determined by recording the condition of each fragment. Size, presence of disease, bleaching, mortality (% recent or old), branching, overgrowth of *A. cervicornis* over plastic ties and attachment by *A. cervicornis* to the different structures will be recorded. Successive data collection will allow for calculation of growth by *A. cervicornis* fragments. Presence of algae and other invertebrates on the reattachment structures and *A. cervicornis* fragments will be recorded. To allow for comparison of reattached fragments to “unimpacted” thickets of *A. cervicornis*, the presence of disease, bleaching, recent and old mortality will be recorded in the reference samples consisting of 1 m² quadrats.

Qualitative digital still photography, supplemented by video imagery will be utilized to augment direct observations for each of the monitored parameters and to provide a reference for subsequent observations. Stability and relative health of experimental and reference groups will be compared between groups and between monitoring surveys. Such imagery should be collected using high resolution cameras equipped with strobes to insure accurate image capture.

3.0 FIELD SURVEY LOGISTICS AND SCHEDULE

3.1 Survey Vessel and Navigation

Monitoring activities will be conducted utilizing a contracted vessel with sufficient deck space to accommodate safe SCUBA and surface supply dive operations with essential sampling equipment. Navigation during transit to and from the project site will be achieved using an on-board differential global positioning system (DGPS).

3.2 Field Survey Team

A four-person survey team of consisting of Responsible Party and Trustee representatives would be the optimal staffing required to conduct field operations associated with the proposed draft monitoring plan. Two-person dive teams will conduct dive operations and underwater data collection.

3.2 Field Operations and Schedule

Survey I (baseline) will be conducted during early 2007 (February or March). The first portion of Survey I will involve station identification and selection, mapping, and tagging. The remaining survey efforts will be utilized to complete data collection. Subsequent surveys for monitoring of emergency restoration would be conducted approximately every 6 months for the first two years and annually for years 3-5 following the completion of Survey I (Baseline) and

include data collection as described in **Section 2.2**. Data collection sheets will be reviewed by all parties prior to their use.

4.0 DATA ANALYSES

4.1 Biota/Substrate Stations

The number and relative health of coral colonies within each of the monitored groupings (experimental and reference) will be established during the baseline survey using the methodologies described in **Section 2.2**. During subsequent surveys, the number of attached and healthy biota per station and per survey and the relative health of hard and soft corals will be compared to determine spatial and temporal change of each monitored parameter. Proportional difference in attachment status of reattached biota/substrate and relative health of experimental and reference biota, expressed as a percentage, will be utilized to assess the success of biota/substrate reattachment as a suitable means of long-term restoration at the *M/T Margara* site. Evidence of catastrophic events (e.g., mass bleaching, coral disease(s), and storm damage) will be noted and referenced with adjacent habitat that was not impacted during the grounding event.

This plan will not account for mortality that has occurred since the completion of ER activities. Transects were performed in October, 2006 after cessation of the ER. These transects were run both outside the impact area and in the impacted areas where ER was performed. The purpose of these transects was to get a preliminary idea of the size structure, density, species diversity and condition of the corals that were reattached compared with the surrounding unimpacted area. When the first surveys are performed for this monitoring plan, the transects that were run in October, 2006 can be redone to try and account for any changes that have occurred between cessation of ER activities and the start of the monitoring program.

4.2 *Acropora cervicornis* Stations

The reattachment status and relative health of each *A. cervicornis* fragment within experimental stations will be recorded and compared with reference stations. In addition, the proportional differences in stability and relative health of *A. cervicornis* fragments for each of the three reattachment techniques will be used to assess relative success of the various techniques.

5.0 REPORTS

Results from each survey will be incorporated into Draft and Final Reports. Report copies will be submitted within 30 days of each survey to Independent Maritime Consulting, Ltd. and to PRDNER and NOAA. A Final Report will be submitted within 45 days of receipt of comments concerning the Draft Report. Reports will include a detailed description of methods for sampling and analyses, station maps, including a GIS of baseline monitoring activities, and treatment of sampling results and digital images. Future survey report will present a comparative analysis of

data collected between surveys and summarize temporal and spatial data comparisons and present an assessment of the relative success of the site restoration.

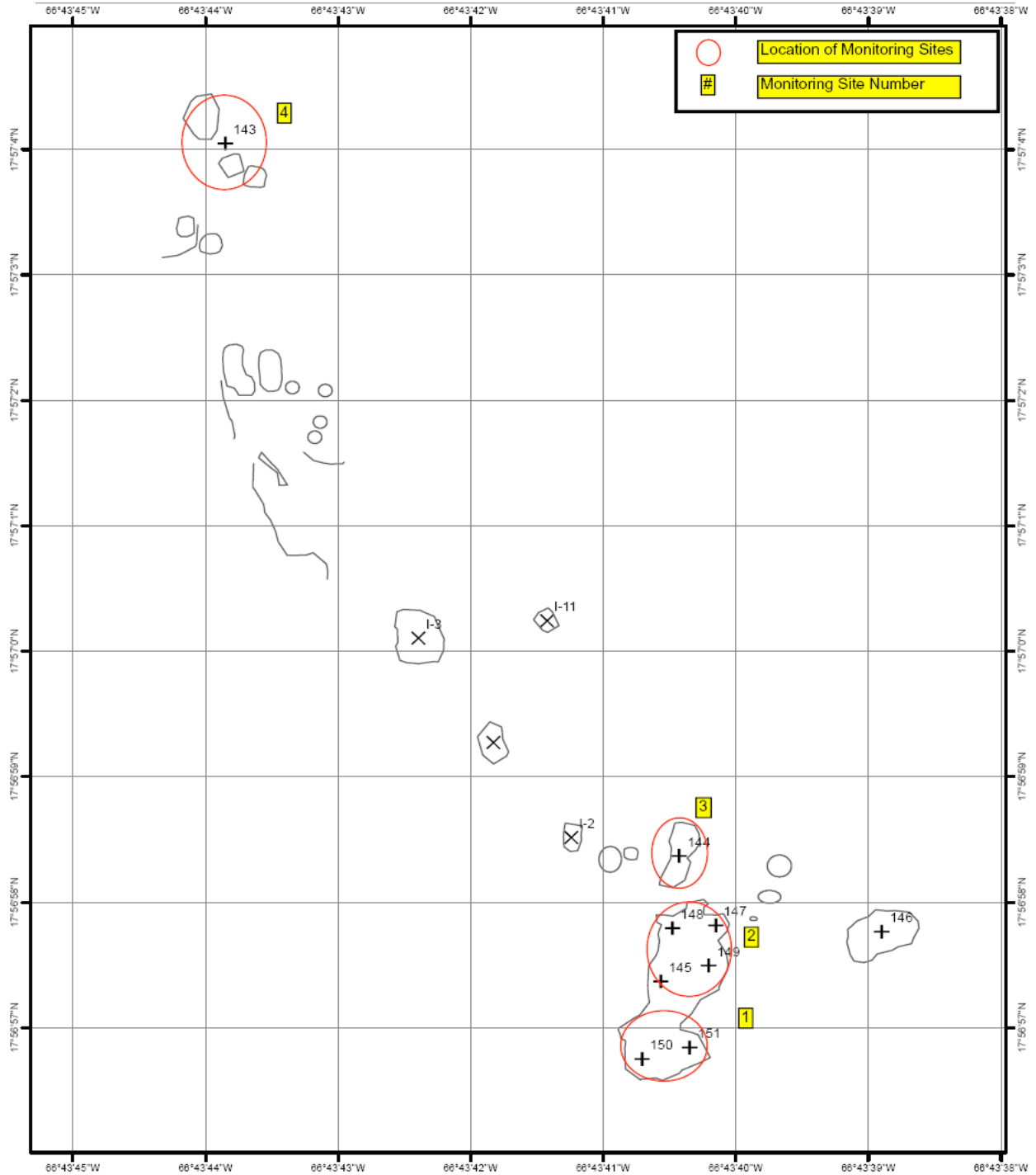


Figure 1: Location of Monitoring Sites in the southern impact area.

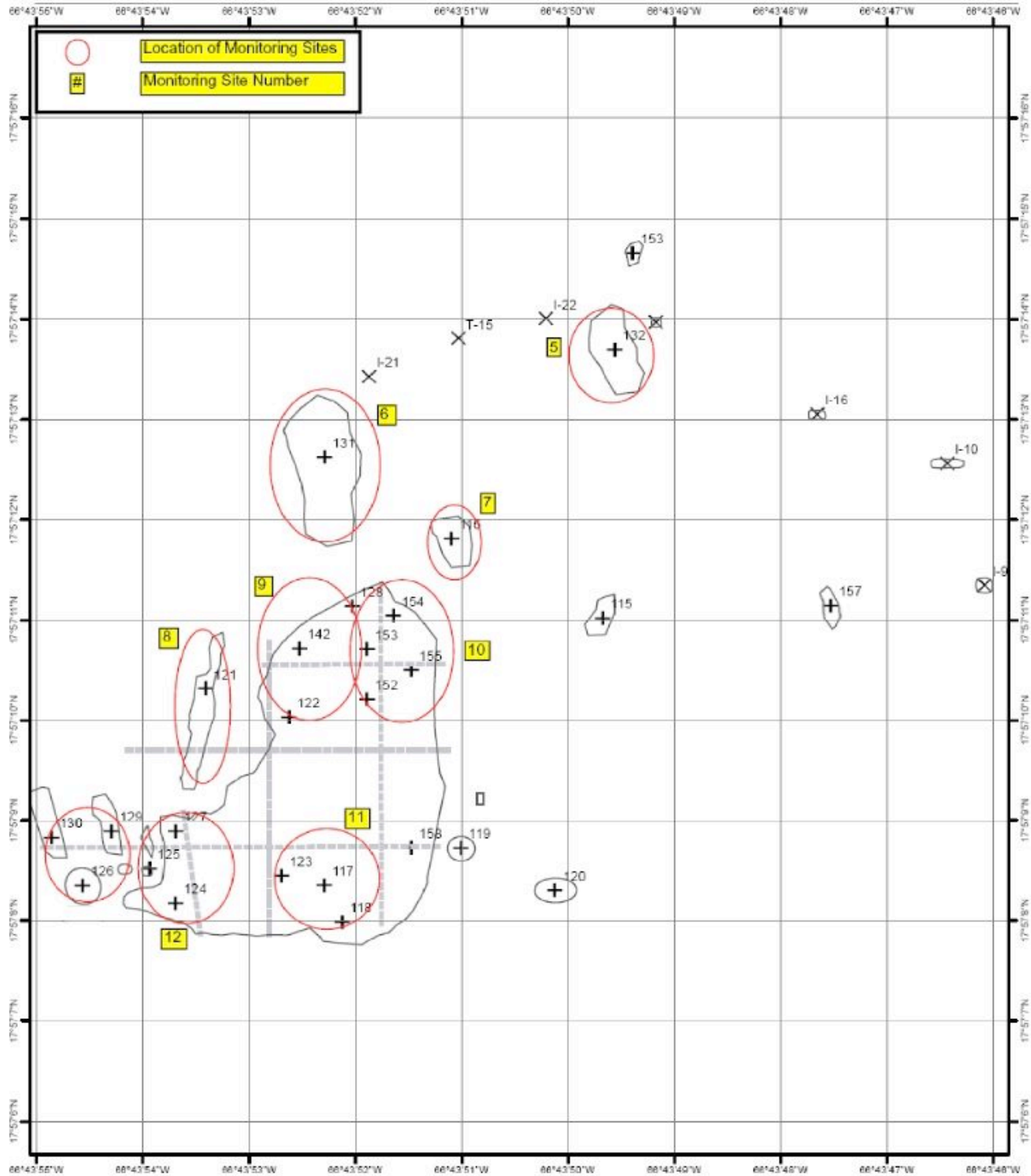


Figure 2: Location of Monitoring Sites in the northern impact area.

