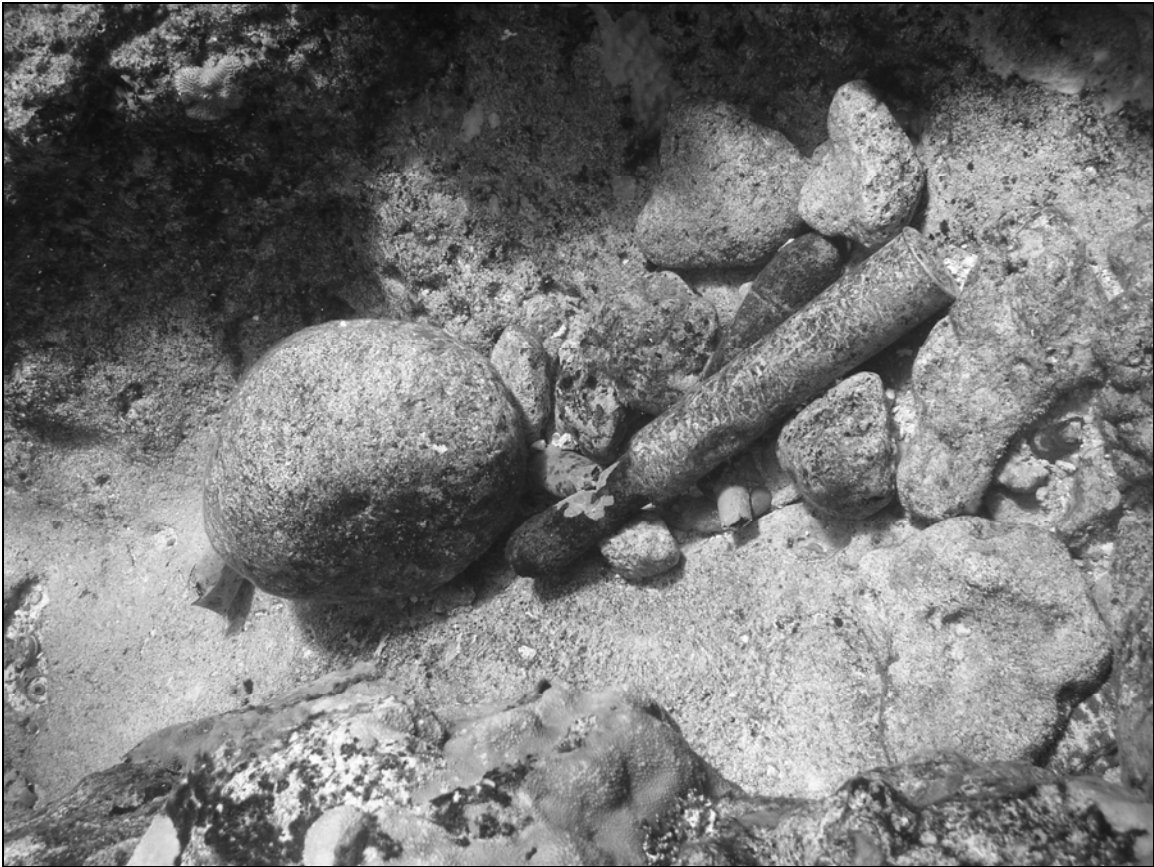


Survey of the submerged ordnance at Camel Rock and
War in the Pacific NHP, Guam

Conducted by

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Survey Purpose

Following World War II, an estimated 64 tons of unexploded Japanese and American ordnance were disposed of into the waters off Camel Rock in Asan Bay Guam. The location of the ordnance was last surveyed in 1978 by the Department of the Navy (Dept. of Navy 1978). Recent concerns over the possible spread of these ordnance, particularly toward the reef flat and beaches within War in the Pacific NHP, has prompted this survey to ascertain the current distribution of the Camel Rock ordnance.

Methodology

Visual surveys, using SCUBA or snorkel, were conducted by the Natural Resources staff of War in the Pacific NHP, National Park Service to determine the spatial extent of submerged ordnance in Asan Bay, between Camel Rock and Asan Cut. All surveys (Table 1) were conducted in the morning hours from either land (snorkel) or boat (SCUBA/snorkel) and in accordance with the regulations and safety requirements of the National Park Service Dive Management Program and RM-4.

Table 1. Survey Schedule and personnel

Date	Location	Personnel	Transects Surveyed
8 Feb. 2006	Reef Slope	D. Minton, A. Pakenham, A. Palmer	RS-1
9 Feb. 2006	Reef Flat	D. Minton, A. Palmer, J. Drake	T1 through T6
13 Feb. 2006	Reef Flat	D. Minton, A. Palmer	T7 through T10
17 Feb. 2006	Reef Slope	D. Minton, A. Palmer, J. Drake	RS-2, RS-3, RS-4

Reef Flat

Reef flats were surveyed using transect lines running approximately perpendicular to shore. The lines started near the beach at approximately the low tide mark and extended toward the reef crest for as far as conditions would allow. Ocean conditions, including high surf and strong current, did not allow for surveys to extend to the reef crest. The first transect was started immediately east of the old outfall pipe on Asan Point (Figure 1). Transects lines were placed such that transect areas were non-overlapping, and extended eastward until no ordnance were found on three consecutive transect lines. Time did not permit surveys to the west of the old outfall pipe.

Along each transect two or three swimmers, spaced approximately 10 m apart, visually surveyed the bottom for any ordnance using mask, fins and snorkels. When

ordnance was located, the position was marked using a Garmin GPS unit in a water tight bag and photographed using a digital Olympus 5050 camera in a Light and Motion underwater housing (no flash).

The survey area was shallow (0-1 m) high energy reef flat with low coral cover and conspicuous macro-algae (“seaweed”). Near shore, the reef has a deeper “lagoon” area where the water is calmer, and a swimming area that has been protected from wind driven currents using a basalt rock breakwater. The near shore areas tends to have more sand and broken coral rubble. An old outfall pipe extends from the tip of Asan Point out to the reef crest. The pipe is held above mean high tide by a series of concrete pilings constructed on the reef flat. The concrete pilings are in good condition, but the pipe is not; many sections are broken and pieces of the pipe litter the shore and bottom.

Reef Slope

The reef slope was surveyed by divers using SCUBA accompanied by surface swimmer on snorkel. The primary goal of this effort was to map the spatial extent of ordnance; therefore, transects were not systemically placed. Divers descended to a target depth and swam in a pre-determined direction stopping periodically to take photographs with a digital Olympus 5050 camera in a Light and Motion underwater housing (no flash) and to collect GPS points. To take a GPS point, divers signaled the surface swimmer by knocking two metal pipes or “clangers” together and the surface swimmer marked the position directly above the divers using a Garmin GPS unit in a water tight bag. Divers took notes using an underwater slate.

Survey line depth and direction were based upon the results of previous transects and/or previous familiarity with the survey area and ordnance. For example, the start of the first survey line (RS-1) was based on a known position of submerged ordnance in 20 m deep water. To find the eastern most boundary of the ordnance field, divers swam east from this position at depth, obtaining photographs and GPS points as ordnance were located (Figure 1). As ordnance were still found at the end of the first survey line, the second line (RS-2) resumed where the first ended, continuing east until no further ordnance were found after two minutes of searching. At this time, the survey line was turned south to locate the shoreward extent of the ordnance field. Survey lines continued in this manner until the spatial extent of the ordnance was mapped.

Areas Not Surveyed

Several areas could not be surveyed during the course of this project. Rough ocean conditions on three of the four survey days precluded comprehensive examination of the reef crest area. On 17 Feb 2006, conditions allowed personnel to enter shallow water (~3 m depth) near the reef crest to the east of Camel Rock. Strong current near Camel Rock did not allow for surveys to the north or west of the islet. Surveys could not be conducted deeper than 40 m. National Park Service diving regulations do permit operations beyond this depth.

Post Processing: GIS and Photographs

GPS points were downloaded into ArcGIS 9.0 and overlain on satellite imagery of Asan Bay. Other available GIS data (e.g., park boundary, etc) was added to the GIS output. The four ordnance zones (A-D) described in 1978 Dept. of Navy survey were transferred onto the final figures by hand. The zones approximate those described in the USN text and appearing in the accompanying hand drawn figure (Dept. Navy 1978).

Photographs were downloaded and labeled to correspond with their GIS photo-point. Adobe Photoshop 9.0 was used on some digital images to improve color balance and/or contrast, otherwise images are entirely unaltered.

Results

Submerged ordnance were found at 39 of 43 sites surveyed and extended from deeper than 40 meters to near the low tide mark on the reef flat (Table 2 and see photos).

On the reef flat, ordnance tended to occur closer to the reef crest (Figure 2), however, a small concentration of ordnance was located at site UXO 19, which is near shore and in or near the designated swimming area for War in the Pacific NHP. The ordnance found on the reef flat during this survey was exclusively small arms ammunition, but larger ordnance have been found on the reef flat on at least one occasion. The EPA located a large shell near the outfall pipe in August 2005. Based on the photograph, taken at low tide, the position of the ordnance is just to the east of the outfall pipe nearer to the reef crest than to the shore. Attempts to relocate this specific ordnance during this survey were unsuccessful.

On the reef slope (Figure 3), ordnance were observed deeper than 40 meters at two locations, UXO 1 and UXO 20. Ordnance were found at high concentrations in shallow water (UXO 38-44). The shallow (<6 m) fore reef in this area is limestone pavement incised with 1 meter crevices running approximately perpendicular to the reef crest. In nearly every crevice in this area, at least one large ordnance was found, and, in many instances, numerous shells were found in a crevice (e.g., see UXO 38 or UXO 39). Ordnance were generally loose and varied in condition from whole unexploded shells to ones that were broken open. In some crevices, along with the ordnance were 1 lb. fishing weights. This area is just inside the Piti Bay Marine Protected Area (MPA) and is often poached by fisherman standing on the outfall pipe, which serves as the eastern boundary of the MPA.

Ordnance in deeper water (between 10-40 m) do not appear to have spread laterally along the reef slope since 1978 (Figure 3). The Department of Navy found the highest concentrations of ordnance in zones B & C, which matches the results reported here. Ordnance were not present in zone D in 1978 and do not appear to have spread into that reef area at this time as no ordnance were found east of UXO 22. Due to hazardous conditions, the western extent of the ordnance was not adequately defined in this survey, but National Park Service divers have conducted extensive work between 10-20 meters north and west of Camel Rock and have never previously encounter ordnance in this area.

The Department of Navy limited its survey to between 10-40 meters and it is unknown if ordnance were found deeper or shallower at that time. In this survey, ordnance were found at all depths north and east of Asan Point.

Table 2. Sites surveyed in Asan Bay and War in the Pacific NHP for ordnance. Sites correspond to those in Figures 2 & 3 and in the photographs.

Site Code	Depth (ft.)	Date	Notes
UXO1	130	8-Feb-06	Ordnance extended into the sand at least 140 ft. Location gently sloped into deeper water.
UXO2	75	8-Feb-06	
UXO3	70	8-Feb-06	Large (500 lb) bomb on site; heavily encrusted. Photos did not come out.
UXO4	70	8-Feb-06	Ordnance extends into deeper water.
UXO5	70	8-Feb-06	Ordnance extends into deeper water.
UXO6	75	8-Feb-06	Ordnance extends into deeper water.
UXO7	75	8-Feb-06	Ordnance extends into deeper water.
UXO11	Reef Flat	9-Feb-06	Single small arms shell.
UXO14	Reef Flat	13-Feb-06	Single small arms shell.
UXO15	Reef Flat	9-Feb-06	Single small arms shell.
UXO16	Reef Flat	9-Feb-06	Single small arms shell.
UXO17	Reef Flat	9-Feb-06	Single small arms shell.
UXO18	Reef Flat	9-Feb-06	>6 pieces of small arms ordnance located.
UXO19	Reef Flat	9-Feb-06	Single small arms shell.
UXO20	130	14-Feb-06	Ordnance observed deeper. Bottom dropped quickly in this area, bottom limit unknown
UXO21	70	14-Feb-06	No ordnance found.
UXO22	70	14-Feb-06	Eastern most extent of ordnance located.
UXO23	20	14-Feb-06	No ordnance found.
UXO24	25	14-Feb-06	
UXO25	17	14-Feb-06	No ordnance found.
UXO26	22	14-Feb-06	
UXO27	77	14-Feb-06	
UXO28	90	14-Feb-06	
UXO29	93	14-Feb-06	
UXO30	92	14-Feb-06	
UXO31	69	14-Feb-06	
UXO32	66	14-Feb-06	
UXO33	78	14-Feb-06	
UXO34	69	14-Feb-06	

Table 2 (continued). Sites surveyed in Asan Bay and War in the Pacific NHP for ordnance. Sites correspond to those in Figures 2 & 3 and in the photographs.

Site Code	Depth (ft.)	Date	Notes
UXO35	40	14-Feb-06	No ordnance found.
UXO36	25	14-Feb-06	
UXO37	30	14-Feb-06	
UXO38	18	14-Feb-06	1 lb. fishing weight found in same crevice as ordnance
UXO39	20	14-Feb-06	Fishing weights found in same crevice as ordnance
UXO40	20	14-Feb-06	
UXO41	15	14-Feb-06	
UXO42	12	14-Feb-06	Multiple shells are loose and mixed with coral rubble.
UXO43	12	14-Feb-06	Multiple shells are loose and mixed with coral rubble.
UXO44	18	14-Feb-06	
UXO45	25	14-Feb-06	
UXO46	30	14-Feb-06	
UXO47	28	14-Feb-06	
UXO48	30	14-Feb-06	

Recommended Future Surveys

Due to time limitations and ocean conditions two areas did not receive adequate inspection. The reef flat to the west of the old outfall pipe was not surveyed, and its proximity to a high concentrations of ordnance just over the reef crest suggest it is a likely site at which to find migrating ordnance. Additionally, the shallow fore reef near the reef crest to the east of the outfall pipe was not adequately surveyed and should receive more attention in the future

Reference

Department of the Navy, Explosive Ordnance Disposal Group One, Detachment Guam, M.I., letter 8027 Ser 53 (R. Darling, Officer in Charge). August 23, 1978.

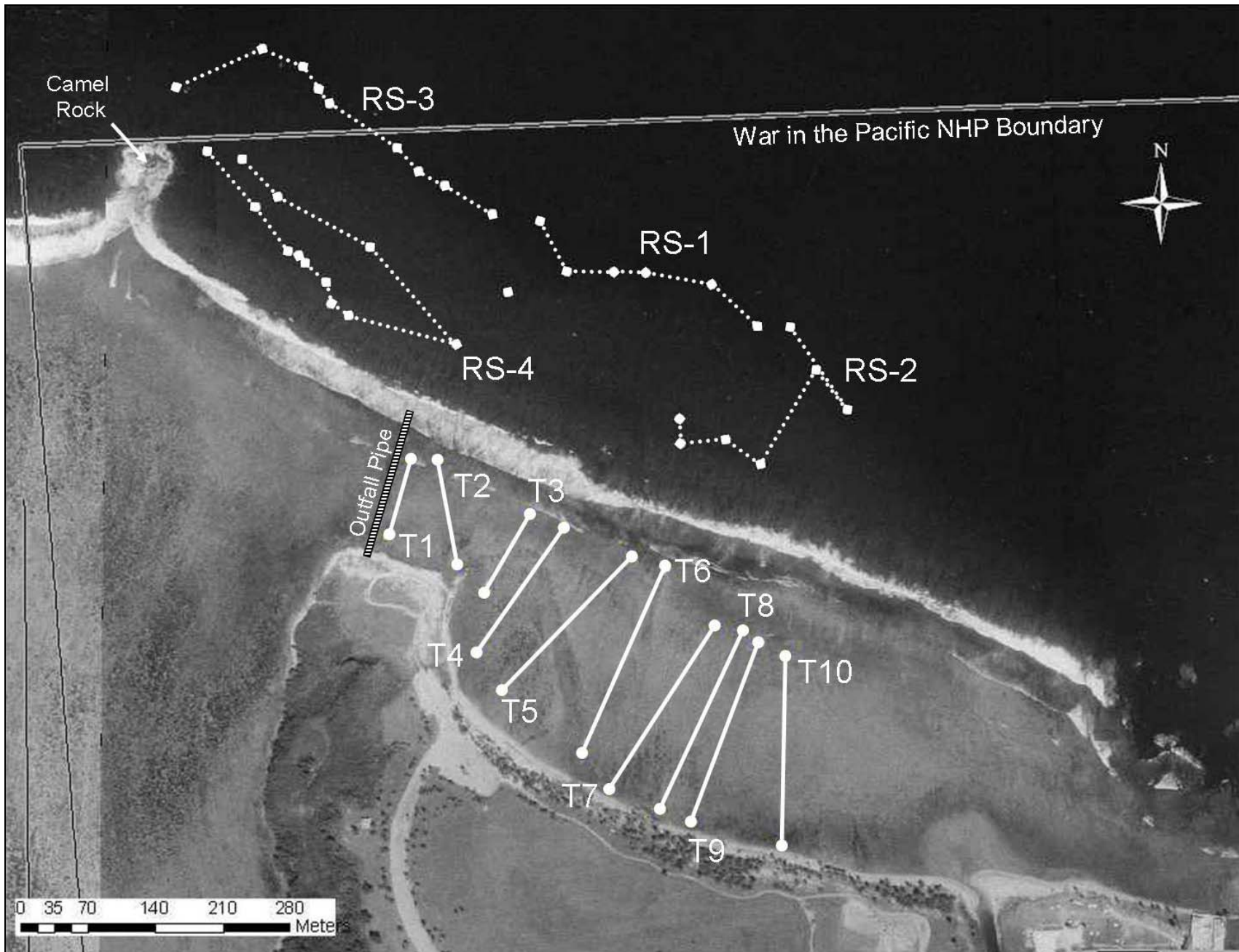


Figure 1. Location of reef flat transects and reef slope survey lines.

Survey of submerged ordnance at Camel Rock



Figure 2. Locations of UXO found on the reef flat at War in the Pacific NHP. Dotted line marks the approximate perimeter of the reef flat search area.

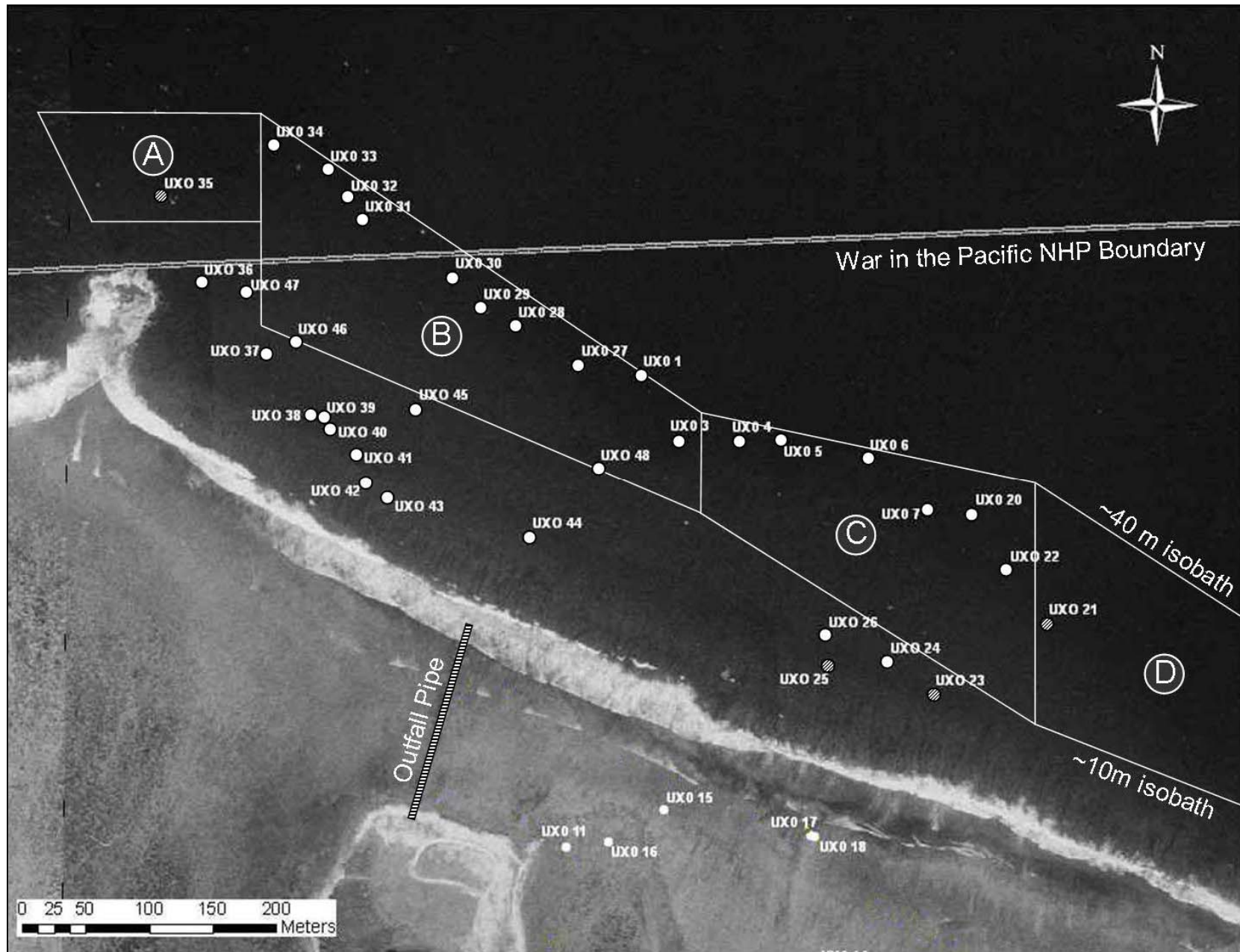


Figure 3. Locations of UXO found on the reef slope near Camel Rock. Areas A-D correspond to zones surveyed by the Department of Navy (1978). Hatched points (UXO 21, UXO 23, UXO 25, and UXO 35) are sites where no UXO were located.