

**Qualitative Assessment Surveys of World War II Ordinance Sites
in Coral Reef Habitats at the Island of Rota: A Historical Record**

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PREFACE

The following reports document the observations of Division of Fish and Wildlife (DFW) personnel pertaining to the detonation and/or planned detonation of World War II ordinance located in the nearshore coral reefs of the Island of Rota, Commonwealth of the Northern Mariana Islands (CNMI).

World War II ordinance are common in the nearshore coral reefs of the CNMI, as well as throughout Micronesia. The CNMI Emergency Management Office (EMO) began detonation of ordinance on Rota beginning in May 1996, with the first two detonations occurring without any in-water assessment surveys. Subsequently, surveys were undertaken with varying degrees of planning. The initial Coral Garden and Wedding Cake pre-detonation surveys were required by agreement between the National Marine Fisheries Service, the United States Navy, and various branches of the CNMI government headed by the CNMI EMO. Personnel from the CNMI Division of Fish and Wildlife were instructed to perform both pre- and post-detonation surveys of these two sites without adequate time to plan a comprehensive survey that would collect quantitative data. The subsequent revisitation of the Coral Garden site was accomplished during the time period allocated for the Sub-Chaser #3 assessment.

The Sub-Chaser #3 survey was more comprehensively planned, but also lacked adequate time for inter-agency coordination to conduct a more efficient survey that would record quantitative data. Instead, CNMI government agencies acted independently in the collection and dissemination of data.

These reports are qualitative in nature and are presented here as both a historical record of events, and to provide a baseline template for future management purposes. A general conclusion addressing the ordinance detonations is presented at the end of the last report.

ASSESSMENT SUMMARY
Coral Gardens & Wedding Cake Ordinance Detonation Sites, Rota Island

This summary report documents the observations of the ordinance detonations in Rota, Commonwealth of the Northern Mariana Islands, by Division of Fish and Wildlife (DFW) personnel for the period June 13 through June 14, 1996.

Personnel from the DFW were notified the afternoon of June 12 that they would be needed in Rota the next day to dive on ordinance sites before and after planned detonations. The ordinate sites on Rota were identified as the 'Coral Garden Dive Spot' and the 'Southern tip of Wedding Cake Mountain' (Figures 1 & 2).

Coral Garden Pre-Detonation Assessment

Date: June 13, 1996.
Biologist/Technician: Michael Trianni & Stan Taisacan; DFW Saipan and Rota, respectively.
Bottom Time: Dive 25 minutes.

The transport vessel was operated by U.S. Navy Explosive Ordinance Detachment (E.O.D.), Guam. Allotted bottom time for DFW personnel by U.S. Navy E.O.D. was 20 minutes.

Personnel from the Division of Fish and Wildlife dove on the 'Coral Gardens Dive Spot' (CGDS) site prior to detonation. We were transported on the boat operated by EOD personnel, and were told that we would have to conform to their dive plan, described as a 90/20 (Depth-90 feet, Bottom Time-20 minutes). We dove for approximately 30 minutes, with a bottom time of about 25 minutes. A transect was laid due east from 90 feet, near ground zero, to 26 feet. Along the transect eight stations at 10 meter intervals were identified by tying man-made structures or coral heads with red plastic surveying tape. The following observations were made along the transect;

<u>Station</u>	<u>Depth(ft)</u>	<u>Notes</u>
1	90	Tape tied to isolated part of shipwreck. No fish present. Encrusting corals present on wreck. Bottom otherwise homogeneous sandy bottom.
2	82	Tape tied to <i>Porites rus</i> coral. Six species of Chaetodontidae, <i>Acanthurus olivaceus</i> in immediate proximity of station.

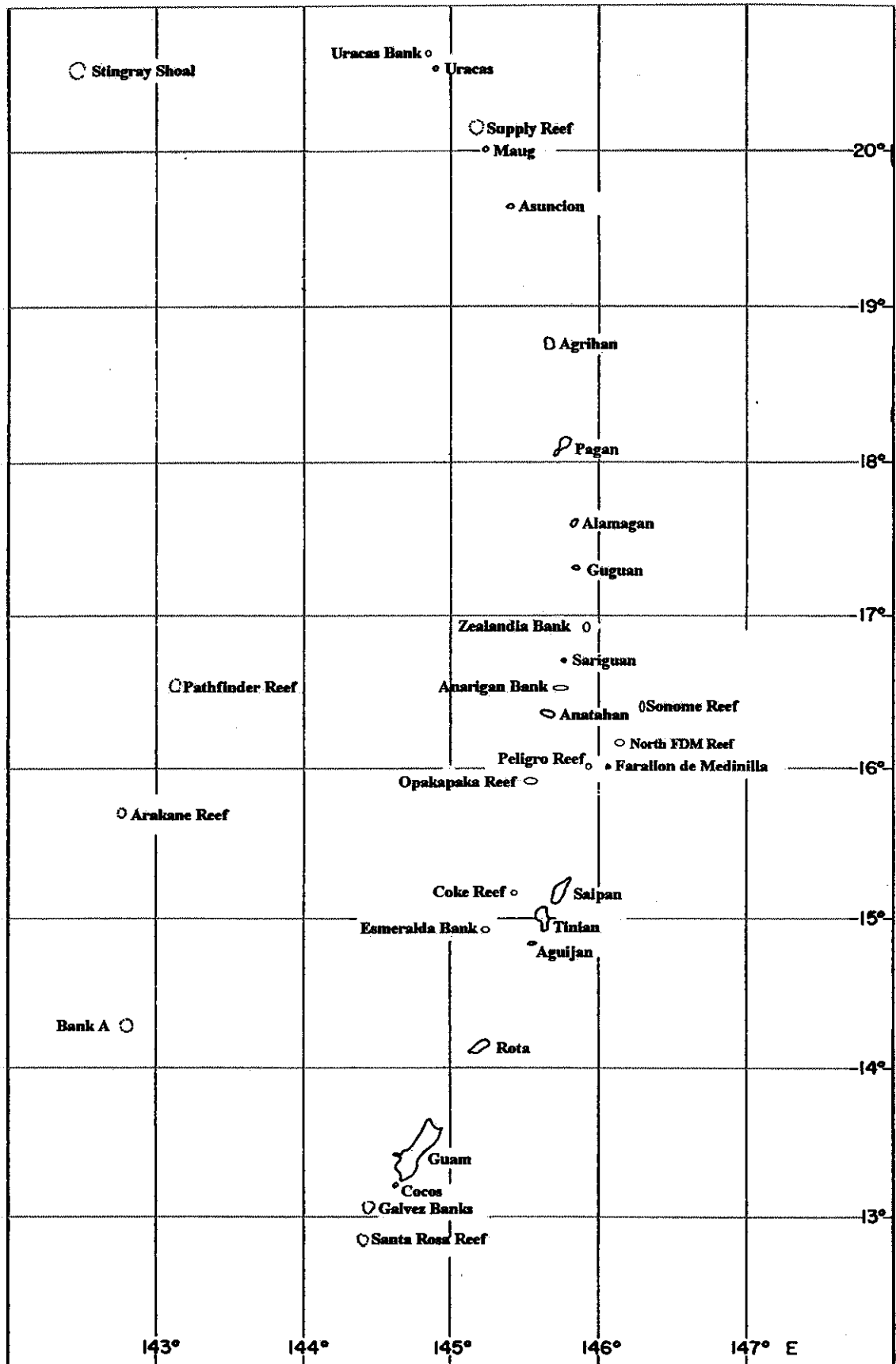


Figure 1. The Mariana Archipelago.

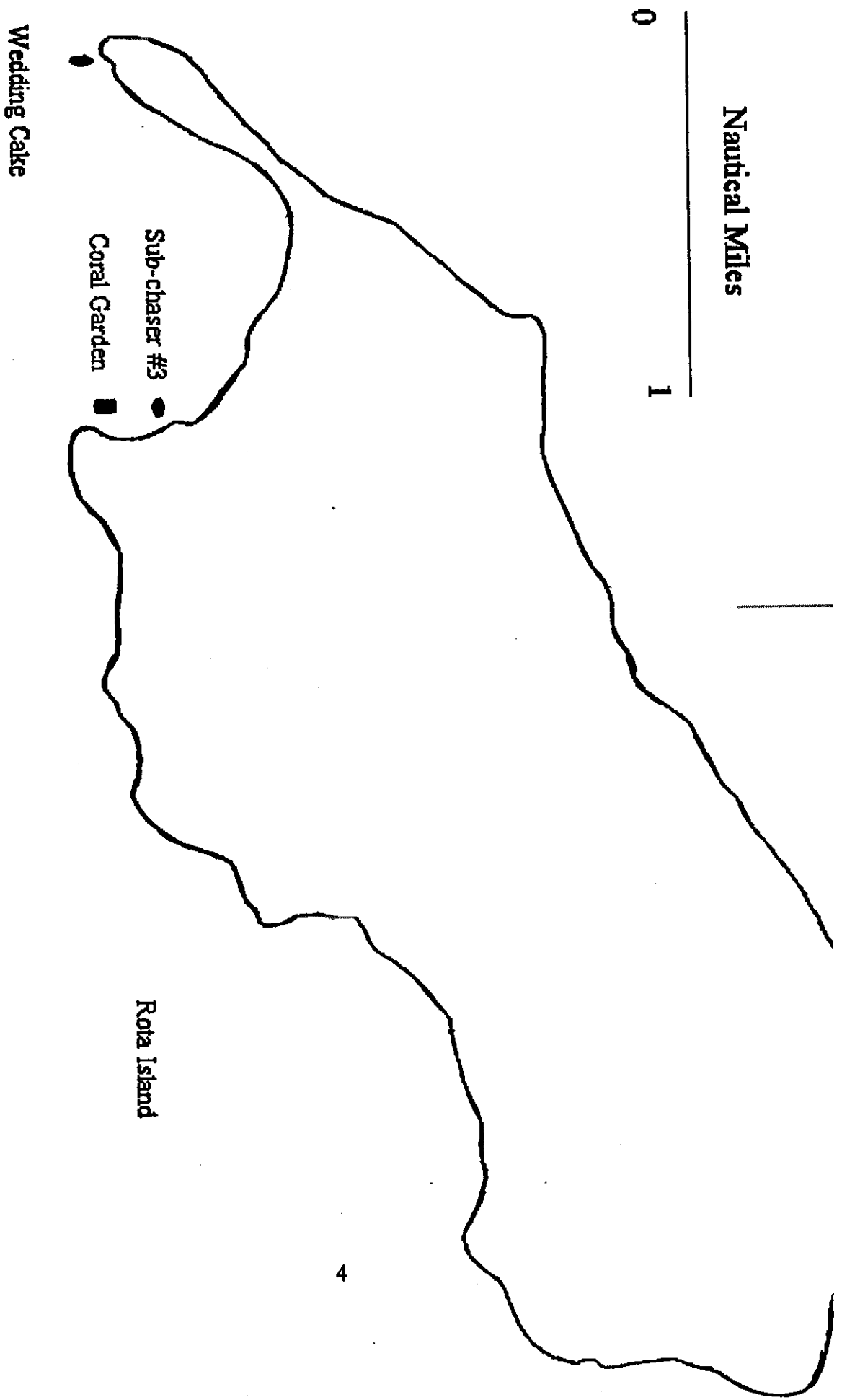


Figure 2. The island of Rota showing the location of ordinance sites.

3	70	Tape tied to <i>Porites rus</i> coral. Two species of Labridae, six species of Chaetodontidae, three species of Pomacentridae.
4	59	Tape tied to <i>Porites rus</i> coral. Encrusting coral present. Three species of Labridae, four species of Chaetodontidae, two species of Pomacentridae.
5	47	Tape tied to <i>Porites rus</i> coral. Four species Labridae, three species Acanthuridae, five species Pomacentridae, six species Chaetodontidae.
6	41	Tape tied to <i>Porites rus</i> coral. Three species Labridae plus <i>Gomphosus varius</i> , five species Pomacentridae.
7	31	Tape tied to <i>Porites rus</i> coral. Five species of Pomacentridae, six species Chaetodontidae. Trenches alongside coral mounds with <i>Myripristis spp.</i> sighted.
8	26	Tape tied to <i>Porites rus</i> coral. Trenches alongside coral mounds. Several species of Serranidae, Acanthuridae.

From the last transect point we dove west back along the transect at 30 feet. Schools of *Pterocaesio tile* were encountered above stations 1-4. The total number of fish in all schools appeared to exceed 100.

Coral Garden Detonation

Date: June 13, 1996.

The explosion was observed from the helicopter with Rufus Crowe, the pilot, Donald Flores of Emergency Management Office (EMO), and the Public Relations official from EMO, Richard Relyea. The charge was pulled at 1555 and exploded at 1600. The initial explosion resulted in a white plume of water which appeared to rise over 20 feet, followed by a plume of dark brown water which appeared to also rise over 20 feet (more precise estimates are available from EMO, which filmed the entire explosion sequence). The sediment dispersed from the blast center concentrically, eventually covering a significant portion of the Coral Gardens preserve (an estimate of the extent of coverage will be available from EMO). Dead fish were observed floating in and outside of this sediment plume, appearing to number near 100. At 1611 a sea turtle was observed approximately 30-40 yards south of the debris plume. It was flapping frantically on it's back at the surface, appearing to attempt to dive.

Approximately three minutes after the initial observation, the turtle was again observed on its back, flapping frantically. It appeared to be severely disoriented, and EMO personnel inquired if it should be retrieved. Because of the abnormal behavior it was exhibiting DFW personnel responded that it should be collected for examination. It was retrieved and returned to dock by a DPS boat. It was dead upon arrival. Carapace length was 46.3 centimeters, and width was 37.5 centimeters. It weighed approximately 30 pounds. No evidence of external damage was present, although blood was observed trickling from its mouth and nasal area. The identification of the turtle was verified by DFW staff in Saipan as a Hawksbill turtle, *Eretmochelys imbricata*.

Wedding Cake Mountain Pre – Detonation Assessment

Date: June 14, 1996

The Department of Public Safety(DPS) provided transport.

DFW personnel arrived at the Command Post at 1010 to ascertain the status of the planned detonation south of Wedding Cake. EMO personnel informed that the explosives were currently being fixed, with the detonation set for 1200. It was decided to only snorkel the site rather than attempt a short dive close to the one-hour clearance time. The site was observed for approximately 10 minutes in large seas. It did not appear that significant benthic damage would occur from the detonation, as the bottom was composed of large slabs of relatively uniform smooth rock sloping from approximately 40 feet to the bomb site at 80 feet, over about 50 yards. Few fish were observed, including Acanthuridae, Scaridae, and a large school of unidentified juvenile fish near the surface.

Wedding Cake Mountain Post – Detonation Assessment

Date: June 14, 1996

The DPS provided transport to this site. The explosion observed from the chopper produced a white plume of water that rose about 15 feet. No sediment was disturbed. Six fish were retrieved following the detonation at this site. These included one *Naso lituratus*, four *Naso unicornis*, and one *Scarus rubroviolaceus*.

Coral Garden Post – Detonation Assessment

Date: June 14, 1996

Transportation to the dive site for post detonation evaluation was provided by the DPS. No restrictions on bottom time were imposed by the DPS for this dive.

After entering the water focus was centered on locating the transect stations. Two of the eight transect stations were located. These stations were determined to be numbers 6 & 7.

An effort to locate station number 8, as well as stations below number 6, was unsuccessful. The coral reef community below station 6 was observed to be completely devastated. This corresponds to a radius of destruction of over 196 feet from the blast site.

<u>Station</u>	<u>Depth(ft)</u>	<u>Notes</u>
6	41	Tape tied to <i>Porites rus</i> coral. Surrounding coral devastated. Very few live fish remaining around station, Chaetodontidae, Pomacentridae present.
7	31	Tape tied to <i>Porites rus</i> coral. Surrounding coral devastated. One species of Chaetodontidae, and numerous(10-20) <i>Gomphosus varius</i> present.

Below station 6 only a few fish in the families Chaetodontidae and Pomacentridae were observed. The environment was very still compared to the previous day, with visibility much reduced from 100 plus feet prior to detonation to 50 feet post-detonation nearly 24 hours later. The reef slope was totally devastated by the blast. Massive mounds of coral rubble were observed around 68 feet. Small mounds of white debris were observed on the sand bottom. This debris was probably the remains of benthic infauna pulverized by the blast. Gray colored debris covered coral and exposed benthos throughout the reef slope. In the shallow area of Coral Gardens, above 30 feet, extensive broken corals were observed. Evidence of sediment fallout was evident up to, and north of the Coral Gardens mooring buoy. Very few fish were observed. This shallow area was snorkeled.

We dove over the reef slope to the immediate north and south of the transect line, obtaining an impression of the damage. Dead fish were found scattered over exposed benthos, as well as on, and under the extensive coral rubble. A rough estimation of the number of fish killed by the blast along the transect line was 500-800.

Fish observed killed included but were not limited to the following classifications;

Scarus spp.
Scarus sordidus
Scarus rubroviolaceus
 Labridae
Gomphosus varius
Pempheris oualensis
Myripristis spp.
Sargocentron spp.
 Chaetodontidae
Pseudanthias spp.

Pseudanthias pascalus
Epinephalus fasciatus
Epinephalus spp.
Lutjanus bohar
Lutjanus gibbus
Parupeneus spp.
Priacanthus hamrur
Naso literatus
Pterocaesio tile(school of 20-30)

Sea cucumbers
Thelenota ananas
Holothuria nobilis

Conclusion

The results of the Coral Garden detonation resulted in a complete destruction of the coral reef community below station 6. Community structure was severely altered, resulting in a dramatic change in the species composition of the fish community. An extensive pre-detonation assessment would have resulted in a more accurate observation of the magnitude of change that had occurred, as well as generating a realistic estimate of recovery time.

The detonation off Wedding Cake Mountain occurred in a less structurally heterogeneous environment, that is an environment less susceptible to long term community alteration.

SITE RE-VISITATION
Coral Gardens Ordinance Detonation Site, Rota Island

Date: Wednesday August 7, 1996

Personnel: Michael Trianni & Patrick Bryan, CNMI Division of Fish and Wildlife

Transportation: CNMI Department of Public Safety

We entered the water over ground zero and descended to 90 feet. The visibility was estimated to be 60-70 feet. From ground zero I moved up the reef slope toward the reef flat, generally following the direction of the transect laid prior to the detonation June 13. Massive mounds of coral rubble comprised the habitat at 80 feet, with no evidence that fish had recruited back to the area. The strata had not changed since the detonation, and as documented in the pre- and post-detonation reports the coral community was devastated. At approximately 65 feet three species of fish were encountered; *Gomphosus varius*, *Thalassoma lutescens*, and *Chaetodon auriga*. *G. varius* was the most abundant species, as was noted in the post-detonation report. Near 50 feet *C. quadrimaculata* was observed. A more diverse array of fish were encountered near 40 feet including *G. varius*, *T. lutescens* plus other members of the family Labridae, *Acanthurus literatus*, *A. olivaceus*, and *Pterocaesio tile*.

Above 40 feet *C. ornatissimus*, three more species of Chaetodon, *Balistapus undulatus*, two more species of balistidae, and numerous *Gomphosus varius*, a species now abundant throughout the physically impacted area. Foliose corals were observed to be broken throughout this area. Sediment from the post-detonation plume was observed to be everywhere, extending up to the mooring buoy at 15 feet. Sedimentation of the benthic environment on the reef flat was observed to be highly significant.

At approximately 35 feet I began to generally swim around the coral gardens area, moving up and down slope in a non-directional fashion recording fish species upon encounter. As stated in the post-detonation report, all coral below approximately 40 feet was completely devastated. This coral consisted mainly of *Porites* (*Synaraea*) *rus*. Trenches and overhangs were extensively damaged, being strewn with rock and coral rubble. Only *C. ornatissimus* was observed to be using corraline structure as a refuge, and only in a couple of sites between 30 and 40 feet on the upper reef slope. All other species observed were in a non-physical association with the coral. No juvenile fish were observed in or around broken or standing coral heads. No members of the family Pomacentridae were observed.

Date: Wednesday August 10, 1996

Personnel: Michael Trianni, CNMI Division of Fish and Wildlife

Transportation: Dive Rota

I entered in approximately 25 feet of water just west of coral gardens mooring buoy, almost directly east of ground zero. I headed down slope in a westerly direction toward ground zero. In the vicinity of the entry point were observed 10-15 fish comprised of four species including *G. varius*, and *N. literatus*, *C. auriga*, and *Zebrastoma flavescens*.

As I approached 60 feet no additional species of fish were encountered, except a small school(10-15), of *P. tile* at approximately 50 feet. As stated previously, the reef slope that was comprised of significant growth of *Porites rus* was completely devastated. No fish were observed using the shattered coral as a food source or refuge.

At 80 feet I once again encountered the extensive rubble field comprised of mounds of coral 10-20 feet high. One species of Pomacentridae, a Pomacanthid, and the wrasse *T. lutescens* were observed amid the coral rubble. Moving up to 50 feet in a SSE direction a few *N. literatus* and a *Scarus* spp. were observed, along with a *Lutjanus bohar* and *Balistoides viridescens*.

Swimming in a SSW I encountered high ridges covered with encrusting corals (*Porities* spp.) and large heads of *Diploastrea heliopora*. In approaching this area more species of fish were encountered including *Pterois volitans*, *C. auriga*, *C. ornatisimus*, and *Balistipus undulatus*. South of these ridges the reef becomes less steep with numerous overhangs. In one overhang *Neoniphron sammara* was observed along with *Ctenochaetus striatus* and *Acanthurus* spp.

This area was mostly protected from the blast percussion by distance from ground zero and the high ridges with encrusting coral. In this area observed fish species included *S. schlegeli* (terminal phase), *N. literatus*, *Pempheris oualensis*, *Myripristis* spp., Syngnathidae, *S. altipinnis* (immature phase), *Chysptera* spp., *Parupeneus bifasciatus*, and *C. auriga*. Numerous unidentified juvenile damselfish were observed using coralline heads for refuge. Numerous other species were present but unidentified. This area appeared to be very diverse faunistically.

ASSESSMENT SUMMARY

Sub-Chaser #3 Ordinance Site, Rota Island

This report documents observations from ordinate site 'Sub-Chaser #3' in Rota, Commonwealth of the Northern Mariana Islands (CNMI), by CNMI Division of Fish and Wildlife (DFW) biologists for the period August 7-8, 1996 (Figures 1 & 2). The findings here provide a brief description of the sub-chaser and associated ordinance, the surrounding benthic habitat with observations of the following; coral species with percent coral cover, prominent invertebrate species, and a general description of the coral reef fish community.

Transport from Saipan to Rota was provided by the CNMI Challenger, which provided sleeping quarters and service to dive platforms during site assessment operations.

Dates: Wednesday August 7, Thursday August 8, 1996.

Location: Sub-Chaser #3 ordinate site.

Biologists: Patrick Bryan and Michael Trianni.

Bottom Time: Dive #1 approximately 50 minutes, Dive #2 approximately 48 minutes.

Sub-Chaser - Immediate Site Description

DFW Fisheries Biologists dove on site for approximately 50 minutes the afternoon of August 7, and 48 minutes the morning of August 8. Visibility was approximated to be 70-80 feet for both dives. The depth at site center where the vessel shaft is located was documented at 55 feet. Depth charges were in depths from 55 to 58 feet deep, with four lying at the base of the seaward reef slope. The shaft, propeller, and engine remains lie in a sand flat surrounded by rock and coral outcroppings, with the group of four depth charges situated up-slope in an easterly direction about 25 feet from the shaft. These drums were partially submerged in sand and several were dented. One charge had a hole in it about one foot in diameter. Approximately 25 feet down slope and west of the shaft was the other depth charge. It was partially submerged in sand and also had about a one foot diameter hole in it. Continuing approximately 165 feet from the shaft, the ribs of the hull protrude from the sand flat. The area around the sub-chaser and ordinance was composed of a reef slope separated by trenches and dominated by *Porities* spp. to the East, or shore side, with the remaining area composed of isolated coral outcroppings surrounded by white sand flats.

Sub-Chaser - Surrounding Area and Coral Cover

The area around the shaft and charges was composed of sand and coral rubble. Three large heads of *Diploastrea heliophora* lie oriented around the charges; each roughly 15 to 20 feet away. Wreckage from the sub-chaser was scattered around the site. There were limestone mounds or buttresses on the sand with live corals including *Porities* spp., *Porities (Synaraea)*,

Pocillopora, *Favia*, and *Fungia* growing on the tops and sides. These buttresses ranged in diameter from several feet to over 30. They rose prominently from the sand bottom and had live coral coverage from 5 to 10 percent, with live coverage decreasing with depth.

Reef Slope Description and Coral Cover

The reef slope rises to a depth of 20 feet approximately 163.5 feet from the site center. The slope was formed of high coral ridges comprised mostly of *Porities* spp., *Porities* (*Synaraea*), *Pavona* spp., with sand bottom trenches descending from near the surface to depths of 50-60 feet where the sand flat begins. Large, massive heads of *Diploastrea heliopora* are also common on the slope. From the shaft 50 meters up slope to 20 feet was covered by 20-25 percent live coral.

Invertebrates - General Description

Invertebrates observed within a 50 meter radius of the charges include: Various sponges, echinoderms (*Culcita*, *Acanthaster*, and several other starfishes and urchins), crinoids, bivalves (*Tridacna*, *crocea*, *T. maxima*). Sea cucumbers were also observed including *Holothuria nobilis* and *Thelenotia ananas*.

Fishes - General Description

During the first dive, observations of fish life were made from 16-65 feet concentrically from the site center, at depths from 45-70 feet. The purpose of these observations was to identify diversity within a Family group, specifying species when possible. Observation results are listed in Table 1.

During the second dive observations of fish life were made along 50 meter (163 foot) transects in East, West, and Southerly directions from the site center (55 feet deep). Approximately three meters to each side of the transect line was observed. The east directed transect inclined up the reef slope to a depth of 20 feet. Along this transect sand-bottomed trenches ran down to the sand flat. The west directed transect declined along the sand flat to a depth of 70 feet. Along this, and the south directed transect, the habitat was comprised of sand flat interspersed with coral covered limestone buttresses of varying height. The south directed transect declined to a depth of 65 feet. The purpose of these observations was to identify diversity within a Family group, specifying species when possible. The results of these observations are listed in Table 2.

Recommendation

The detonation from the Coral Gardens site shattered the coral community up to 196 feet from ground zero, up the adjacent reef slope to a depth of 40 feet. A similar result can be expected from a detonation at the Sub-Chaser #3 site. The transects measured 163 feet from the Sub-Chaser #3 site center can be used to realistically estimate the radial extent of damage that can be expected. The east directed transect rose to a depth of 20 feet, documenting the slope at this site as being at a steeper incline than the one destroyed at the Coral Gardens site.

Due to the following;

- The severe extent of damage resulting from the Coral Gardens detonation,
 - The proximity and relief of a reef slope similar to that impacted at Coral Gardens,
 - The presence of holes in two of the depth charges,
- and
- That the charges have been in place for over fifty years,

it is advised that a detonation in the manner conducted at Coral Gardens be avoided. It is therefore recommended the charges be left in their present location rather than severely compromise the integrity of the coral reef community.

GENERAL CONCLUSION

The igniting of World War II ordinance located near coral reef habitat on the island of Rota caused severe damage to the only marine preserve in the CNMI, Coral Gardens. The action can only be considered excessive, and not in the best interests of the people or natural resources of the Commonwealth.

The detonation at Coral Gardens caused a public outcry not only in the CNMI, but also in the international dive community. Consequently, a high degree of media attention and public pressure was placed on the U.S. Navy, the National Marine Fisheries Service, and the natural resource agencies of the CNMI.

In part due to the debacle at Coral Gardens, a more comprehensive assessment was undertaken at the Sub-Chaser #3 ordinance site. In addition to the DFW recommendation, other natural resource agencies in the CNMI that assessed the Sub-Chaser #3 site recommended that the ordinance not be detonated. Subsequent to these assessments a meeting of all participating CNMI agencies, as well as U.S. Navy representatives, was held on August 13, 1996 at the CNMI Emergency Management Office. From the information presented it was concluded that the reasoning behind the detonations of World War II ordinance in Rota waters, that the public was in immediate danger by the presence of the ordinance, was not valid. It was thus agreed that the private sector be contacted to explore other options for removal.

It can be concluded that detonation of World War II ordinance located near coral reef habitats should not take place, unless it can be proven beyond reasonable doubt that real danger exists.

Table 1. Observations of fish families and species present from Sub-Chaser #3 Site. Dive #1.

FAMILY	# SPECIES	SPECIES
HOLOCENTRIDAE (Soldierfishes and Squirrelfishes)	3	<i>Myripristis berndti</i> <i>Sargocentron spp.</i> <i>Neoniphon sammara</i>
SERRANIDAE(Fairy Basslets, Groupers)	4	<i>Cephalopholis urodeta</i> <i>C. argus</i>
AULOSTOMIDAE(Trumpetfishes)	1	<i>Aulostomus chinensis</i>
LUTJANIDAE(Snappers)	2	<i>Aphareus furca</i> <i>Lutjanus bohar</i>
CAESIONIDAE(Fusiliers)	1	<i>Pterocaesio tile</i>
LETHRINIDAE(Emperors)	2	<i>Monotaxis grandoculus</i> <i>Gnathodentex aurolineatus</i>
MULLIDAE	4	<i>Parupeneus bifasciatus</i> <i>Parupeneus spp.</i> <i>Mulloides spp.</i>
CHAETODONTIDAE(Butterflyfishes)	6	<i>Chaetodon auriga</i> <i>C. ornatissimus</i> <i>C. trifasciatus</i>
POMACANTHIDAE(Angelfishes)	3	<i>Centropyge shepardi</i>
POMACENTRIDAE(Damselfishes)	12	<i>Chromis viridis</i> (school of 30-40 fish) <i>Dascyllus reticulatus</i> <i>D. trimaculatus</i> <i>Chrysiptera spp.</i> <i>Pomacentrus spp.</i>

LABRIDAE(Wrasses)	10	<i>Gomphosus varius</i> <i>Thalassoma lutescens</i> <i>Labriodes dimidiatus</i> <i>Coris gaimard</i> <i>Labriodes bicolor</i> <i>Hemigymnus fasciatus</i>
SCARIDAE(Scaridae)	5	<i>Scarus altipinnis(I)</i> <i>S. globiceps(I,T)</i> <i>S. schlegeli(I)</i>
I = Immature Phase T = Terminal Phase		
MICRODESMIDAE	1	<i>Ptereleotris evides</i>
ACANTHURIDAE(Surgeonfishes)	6	<i>Acanthurus blochii</i> <i>A. nigricauda</i> <i>A. olivaceus</i> <i>Ctenchaetus striatus</i> <i>C. strigosus</i>
ZANCLIDAE(Moorish Idol)	1	<i>Zanclus cornutus</i>
BALISTIDAE(Triggerfishes)	3	<i>Balistapus undulatus</i>
TETRAODONTIDAE(Puffers)	1	<i>Arothron nigropunctatus</i>

Table 2. Observations of fish families and species present from Sub-Chaser #3 Site. Dive #2.

FAMILY	# SPECIES	SPECIES
HOLOCENTRIDAE (Soldierfishes and Squirrelfishes)	2	<i>Myripristis berndti</i> <i>Neoniphon sammara</i>
SERRANIDAE (Fairy Basslets, Groupers)	4	<i>Cephalopholis urodeta</i> <i>C. argus</i>
CAESIONIDAE (Fusiliers)	2	<i>Pterocaesio tile</i> <i>P. marri</i>
LETHRINIDAE (Emperors)	2	<i>Monotaxis grandoculus</i> <i>Gnathodentex aurolineatus</i>
MULLIDAE	2	<i>Parupeneus bifasciatus</i> <i>Mulloidichthys vanicolensis.</i>
CHAETODONTIDAE (Butterflyfishes)	6	<i>Chaetodon auriga</i> <i>C. ornatissimus</i> <i>C. trifasciatus</i>
POMACANTHIDAE (Angelfishes)	3	<i>Centropyge shepardi</i>
POMACENTRIDAE (Damsel fishes)	10	<i>Chromis viridis</i> <i>Dascyllus reticulatus</i> <i>D. trimaculatus</i>
LABRIDAE (Wrasses)	8	<i>Gomphosus varius</i> <i>Thalassoma lutescens</i> <i>Labriodes dimidiatus</i> <i>Coris gaimard</i> <i>Labriodes bicolor</i>
SCARIDAE (Scaridae)	3	<i>Scarus altipinnis</i> (I) <i>S. globiceps</i> (I) <i>S. forsteni</i> (T)

I = Immature Phase

T = Terminal Phase

ACANTHURIDAE(Surgeonfishes)	6	<i>Acanthurus blochii</i> <i>A. lineatus</i> <i>A. nigricauda</i> <i>A. olivaceus</i> <i>A. xanthopterus</i> <i>Ctenchaetus striatus</i> <i>C. strigosus</i>
BALISTIDAE(Triggerfishes)	2	<i>Balistoides conspicillum</i> <i>Melichthys niger</i>
MONACANTHIDAE	2	<i>Paraluteres prionurus</i>

