

**Artificial Reef Development, Nourishment and Monitoring**

**F-10 U.S. Virgin Islands**

**Study 3. Monitoring Artificial Reefs.**

**Results of St. Thomas/St. John, U.S. Virgin Islands  
Artificial Reef Monitoring Surveys  
(October 1, 2000 to September 30, 2005)**

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## **INTRODUCTION**

The practice of placing foreign structures into aquatic environments for the purpose of attracting and increasing catches of fish has been long standing. Traditionally, man has been creating artificial reefs unintentionally or intentionally for centuries to enhance fishing or to improve the environment (Carstairs 1988). More recent applications of artificial reefs include the protection of existing natural reefs, restoration or enhancement of water and habitat quality, mitigation of habitat damage, environmental and eco-tourism enhancement, shoreline stabilization, and enhancement of fishery production and harvest (Seaman 2000).

Despite their popular uses, their value has long been a topic of hot debate. It has been suggested that artificial reefs enhance underwater habitat and fish production while alleviating pressure on the area's natural reefs (Polovina 1994). On the other hand, it has also been suggested that artificial reefs simply aggregate fish, which can lead to over-exploitation of fish populations (Polovina 1994).

If habitat is limited, artificial reefs may increase fish production by: (1) increasing foraging habitat for adult and juvenile fishes; (2) increasing the nesting habitat for adult fishes; and (3) increasing the amount of resting habitat and refuges from predators (Grossman et al 1997). As a result, stock sizes of economically important species may increase resulting in benefits to both recreational and commercial fishers.

Artificial reefs almost certainly increase accessibility of fish to fishers, and perhaps even increase fishing efforts (McGlennon and Brandon 1994 cited in Grossman et al 1997). If new reefs are attracting fishers who previously did not fish an area, over-exploitation can occur. Additionally, artificial reefs may increase catch rates (Buckely et al 1989; Polovina and Sakai 1989; and Friedlander et al 1994). Despite the controversy and differences in the rationale for deployment, it is important that artificial reefs be monitored to assess changes in the fauna over time.

In the U.S. Virgin Islands, artificial reef construction, deployment, and monitoring have existed for many years. USVI offshore artificial reef deployment was initially permitted in 1974 on the island of St. Croix (Uwate and Tobias 2001). By 1996, there were three major permitted artificial reef sites in St. Thomas and St. John (Beets 1992). To-date, a number of structures have been added to these designated reef sites and monitoring programs have been undertaken at two of these sites, one on St. Croix and one on St. Thomas (Uwate and Tobias 2001).

The primary objective of DFW Recreational Fishery Enhancement Program is to enhance recreational fishing opportunities in the USVI by using artificial reefs. Expected results of this project are enhanced catch and harvest opportunities of recreationally targeted fish species at artificial reef sites.

This report documents dive survey results from October 1, 2000 to September 30, 2005 that were completed as part of the monitoring program of St. Thomas, U.S. Virgin Islands artificial reefs. The artificial reef site surveyed during this period was southeast of Saba Island, St. Thomas.

## **METHODOLOGY**

In FY2001, divers attempted to identify artificial reef structures at the artificial reef site southeast of Saba Island, St. Thomas (Figure 1). The originally permitted artificial reef site was one square nautical mile. The area permitted in 2005 was about 0.2 square nautical mile. The specifications for the locations of the artificial reef structures at this site were extremely poor. Many were line of sight triangulations or very rough latitude and longitude records. As such, these early diver investigations were not very successful. Divers, more often than not, were not able to locate underwater structures in the area. Water depth in the artificial reef area southeast of Saba Island, St. Thomas is between 25 and 30 m. During most dive trips, water clarity to those depths was limited. Divers were not able to see the bottom from the surface.

In February 2002, the artificial reef site southeast of Saba Island was surveyed with side scan sonar in a collaborative effort with the EPA's vessel *PW Anderson*. A side scan sonar mosaic of the artificial reef site was created using Delph Map imaging software (Figure 2). A preliminary geo-referenced map of targets in the site was created from the side scan sonar images. Within the mosaic, potential targets were labeled 1 to 165. Many of these targets were rather small (less than a few square meters in size) and were considered isolated debris or an isolated rock. These were not considered major artificial reef sites, and were not further explored. In addition, some of these sites were from different side scan sonar lines. When side scan sonar lines were overlayed in the mosaic, a single target might be in slightly different locations on different lines. The single target would show up as two different targets on the mosaic. Diver investigations (see below) resolved these issues for major artificial reef sites. With the sides scan mosaic of the artificial reef site, objects were easily located.

Between April and July 2002, most objects in the artificial reef site were surveyed and documented. The protocol used for locating a submerged structure was as follows:

1. A SCUBA diver was dropped into the water at the appropriate GPS location of the structure.
2. The SCUBA diver swam at a depth of 10 to 15 m (midwater) until the target was located at the bottom (25 to 30 m). At a depth of 10 to 15 m, a SCUBA diver could see the bottom at 25 to 30 m and any structures on it.
3. Once the target was found, the diver dropped down to the structure and attached a surface marker to the target.
4. New GPS coordinates were taken from the boat at the surface marker using a hand held WAAS GPS.
5. After the surface marker was attached, a team of divers surveyed the target.

During these initial FY2002 surveys, qualitative visual censuses were conducted by SCUBA divers. At each artificial reef structure, fish and invertebrate species were recorded. For comparison, divers also identified and recorded species away from the artificial reef structure. Divers also noted the depth, size, material type, and possible movement of each target. Digital video and photos were taken at each site as well.

During these initial surveys, all targets were located and surveyed. In subsequent years (FY2003, FY2004, and FY2005), budget limitations allowed only repeat dive surveys on about one-third of the targets per year.

In FY2004, quantitative random swim surveys were employed. This was possible because DFW staff had become certified in NITROX, which allowed greater bottom time. The extended bottom dive time allowed divers to conduct more thorough surveys. These surveys started at a random location on the selected reef site. A ten to 20 minute timed search was conducted in FY2004 and a 20 minute timed search was conducted in FY2005. During these surveys, fish species were identified and counted. One timed dive survey was completed for each target.

During the timed survey, a second diver recorded invertebrates and algae on the artificial reef and away from the artificial reef structure. No transect line was used during these timed diver surveys. Photo and video documentation were taken during the surveys and later reviewed to help compile species list.

The state of the structure and diversity of associated species at the site and away from the site (including fish, coral and algae) were noted during artificial reef surveys for each sample year. Site GPS coordinates, wreck size, conditions, and year of survey are presented in Table 1. Detailed species list for all artificial reef structures over the survey years (FY2001 to FY2005) are presented in the Appendix Tables. Results of timed swim surveys which provided fish counts (abundance) were available for respected year only (FY2004 and FY2005).

In FY2004, a GIS database and an ArcView map were created for St. Thomas artificial reefs. The side scan sonar mosaic of the artificial reef site with new artificial reef boundary and some of the artificial reef structures are included in the GIS database. These are geo-referenced to underwater photographs and relevant monitoring report.

In FY2005, four trips were completed at the artificial reef site southeast of Saba Island, St. Thomas. A total of eight artificial reef structures were surveyed during that period.

## RESULTS

Results of the southeast Saba Island, St. Thomas surveys were as follows.

Target 2 (18°17.014`N, 64°58.593`W) – This decomposed barge wreckage (Figure 3) was first surveyed in 2002. This wreckage appears to have been submerged for a substantial period of time and has fallen in on itself. Dimensions for this structure were 17 m x 6 m. It is in 28 m of water. No signs of movement of this structure could be detected.

The barge wreckage was colonized by encrusting invertebrates and algae. Large colonies of encrusting sponges and tunicates dominate. Numerous tube worms, *Sabellastarte magnifica*, inhabit the wreckage as do several corkscrew anemones, *Bartholome annulata* and various hydroids. Hard corals colonizing the wreckage include *Diploria* sp., *Millepora alcicornis*, and *Agaricia* sp. Nineteen invertebrate species of 17 genera were encountered (Table 2). Numerous



fish are associated with the barge. The most abundant species is *Haemulon aurolineatum*. A large cubera snapper, *Lutjanus cyanopterus*, and red hind, *Epinephelus guttatus*, were also encountered. There were 19 fish species of 16 genera and 19 invertebrate species of 17 genera (Table 2).

The surrounding area was predominately a rodolith and *Lobophora variegata* community with low relief. Solitary invertebrates, mostly erect rope sponges and barrel sponges, were present within the rodolith community.

Target 20 (18°17.995`N, 64°58.752`W) – Target 20 is an upside down sailboat (Figure 4). It was surveyed in 2002 and 2004. This target is in 26.5 m of water. The sailboat is fairly broken up but does not show signs of movement.

Numerous fishes and lobsters were encountered on this wreck. A diver conducted a fish survey in 2004 during which all fish encountered with the wreck were recorded. A total of 269 individuals were observed by the diver representing 14 families. The number of fish minute<sup>-1</sup> varied by species but the most abundant species was *Haemulon aurolineatum* with 5.33 fish minute<sup>-1</sup>. In 2002 fish were not enumerated but species richness was greater in 2002 than in 2004 (Table 3).

Invertebrates and algae were also recorded. In 2004, 16 invertebrate species from the same number of genera were recorded while in 2002 only 14 from 14 genera were recorded (Table 3). Algal richness increased slightly in 2004 from 2002 (Table 3).

Target 22 (18°17.945`N, 64°58.708`W) – Target 22 is a pile of steel debris (Figure 5). It was surveyed in 2002 and 2004. The same GPS coordinates were used to locate the debris both years indicating that there has been no significant movement. There was no evidence of the objects moving after being scuttled. The debris is in 26.5 m of water. The dimensions of the pile were roughly 15.5 m by 9.8 m (area = 151.9 m<sup>2</sup>).

Several fish species use the debris pile as cover. A 10-minute timed search survey in 2004 was conducted for fish associated with the artificial reef. The most abundant species recorded was *Holocentrus adscensionis* with 50 individuals and 2.50 fish minute<sup>-1</sup>. A total of 246 individuals representing 11 families, 18 genera, and 20 species were recorded. In 2002 species richness and genera were greater, with 30 species and 24 genera reported, than 2004 (Table 4). Species richness was greater in 2004 for both invertebrates and algae than it was in 2002 (Table 4).

Target 25 (18°17.811`N, 64°59.501`W) – Target 25 is a large steel barge (Figures 6 and 7). It was surveyed in 2002, 2004 and 2005. The steel barge has dimensions of 42 m x 11 m (area = 462 m<sup>2</sup>). The barge is in 26.5 m of water and is in good condition. There were no signs of movement over the years. The hull of the barge has several panels missing which allows fish access to the interior (Figure 6). There were also several barge tires in the same position as observed in previous years (Figure 7).

Many fish species were encountered on and near the barge. A total of 273 fishes from 10 families were observed in 2005. This is slightly greater than the cumulative fish count in 2004

(264 fishes). A 20 minute timed search was conducted in 2004 and in 2005. The timed search in 2005 yielded greater variation in number of fish minute<sup>-1</sup> (0.10 to 14.00 fish minute<sup>-1</sup> in 2005) compared to 2004 (0.05 to 2.50 fish minute<sup>-1</sup>). The number of genera and species in 2005 decreased compared to the previous sample years (Table 5).

The deck of the barge was encrusted with coralline algae, sponges, hydroids (Figure 8). *Halimeda* and *Sargassum* were prevalent on the deck, and large black coral colonies, *Antipathes atlantica*, colonize the stern of the barge (Figure 9). Species richness for invertebrates and algae was greater in 2005 than in 2004 and 2002 (Table 5). For example, in 2002 only two hard coral species were observed and reported (*Diploria* sp. and *Siderastrea* sp.). In 2005, five hard coral species were observed.

Target 30 (18°17.772`N, 64°59.460`W) – Target 30 is a debris pile containing steel grates (Figure 10). It was surveyed in 2002 and 2005. The reef size was approximately 12 m x 14 m and is in 26 m of water. The coordinates for this structure remained the same in 2005 as in 2002 indicating that the structure had not moved.

Numerous yellowtail snappers, *Ocyurus chrysurus*, were present in both survey years. A total of 374 fish were counted during the 2005 survey. The number of fish species decreased slightly from 2002 (Table 6). The number of invertebrate and algae species at the site remained relatively stagnant (Table 6). The number of fish minute<sup>-1</sup> varied in 2005 by species. The most abundant species was *Haemulon aurolineatum* with 6.00 fish minute<sup>-1</sup>.

The surrounding habitat was a rhodolith community with scattered erect sponges and low canopy algae. Few fishes were encountered away from the debris.

Target 32 (18°17.760`N, 64°59.565`W) – Target 32 is a fiberglass and wood hull boat with a short keel (Figure 11). Its dimensions were 10 m x 3 m. It was surveyed in 2002 and 2005. This target is in 28 m of water. The hull was moderately broken-up with a section of the stern and bow broken. There was little infrastructure but a few holes in the bottom of the boat that provided access to the interior and were heavily used by several fishes.

The hull of the boat was covered with the encrusting star sponge (*Halisarca* sp.) and other invertebrates. The number of fish species observed was the same in 2002 and 2005. Invertebrate and algae richness was fairly similar as well (Table 7).

The surrounding habitat around target 32 was predominately a rhodolith community, cf. *Lithothamnion ruptile*, with low cover algae. Only three fish species were encountered away from the wreckage in 2005 including a southern stingray, *Dasyatis americana*.

Target 38 (18°17.693`N, 64°58.227`W) – Target 38 was an antennae tower (Figure 12) broken into three sections. It was only surveyed in 2003. This structure was not identified in 2001 during the initial search for artificial reef targets, but was found with side scan sonar during the *OSV PW Anderson* survey in February 2002. The tower sections sit at a depth of 26.7 m in a predominately rhodolith algal plain with solitary erect sponges (Figure 13). The structures were in excellent condition and exhibited heavy growth by algae and sessile invertebrates.

A large green sea turtle, *Chelonia mydas*, was found among the towers as were numerous fishes (Figure 14). Figure 15 is a large southern stingray, *Dasyatis americana*, that was found among the structures. Additionally, the structures were heavily encrusted with sponges, corals, and algae. There were 19 fish species, 18 invertebrate species, and 2 algae species identified in 2003 (Table 8).

Target 42 (18°17.566`N, 64°58.658`W) – Target 42 is composed of concrete dock slabs. These were surveyed in 2002, 2004 and 2005. Approximately 19 large concrete dock slabs were at a depth of 26 m and in excellent condition. Two of the dock slabs were measured *in-situ* during 2002 and had dimensions of 12.6 m x 2.5 m and 10.5 m x 2 m (area = 31.5 m<sup>2</sup> and 21 m<sup>2</sup> respectively). The average area of each dock slab, based on the two slabs measured, was 26.25 m<sup>2</sup>. There was no evidence of movement after the slabs settled on the bottom.

Numerous fishes inhabited this artificial reef site. Fish were observed traveling between the scattered slabs. Over the years, large red hinds, *Epinephelus guttatus*, were often encountered on or under the dock slabs. In addition, several queen triggerfish, *Balistes vetula* (Figures 16), were routinely observed at this site. The results of the 2005 ten minute search yielded 328 fishes from 16 families, 25 genera, and 32 species. Fish richness was the same in 2005 as in 2004, but less than that in 2002 (Table 9).

The concrete dock slabs have been submerged for at least a decade, therefore there was significant hard and soft coral growth as well as other invertebrate growth. Several reef-building corals were found such as *Diploria* spp., *Montastraea cavernosa*, *Porites astreoides* (Figure 17), and numerous soft corals and sponges encrusted the concrete slabs.

Spiny lobsters, *Panulirus argus*, were observed every survey year at this site, except 2005. Several queen conch, *Strombus gigas*, were also found among the dock slabs over the years. Invertebrate richness increased with seven additional species recorded in 2005 (see Table 9). Algae also increased in 2005 from previous years (Table 9).

Target 45 (18°17.618`N, 64°59.839`W) – Target 45 is the Western Cites tug (Figure 18). It was surveyed in 2002, 2004 and 2005. This tug sits at a depth of 28 m. It is about 22 m x 5 m.

The hull and cabin were completely encrusted with sponges, encrusting tunicates, algae and some hard coral (Figures 19 and 20). Snapper species (*Lutjanus griseus* and *Lutjanus synagris*) dominate the site during the 2004 and 2005 surveys (Figure 21). Numerous inconspicuous fish found shelter and protection on this artificial reef. Gray snappers were also one of the most abundant fish encountered in 2005 at 10.00 fish minute<sup>-1</sup>. The abundance of other fish species varied over the years. There was even a nurse shark, *Ginglymostoma cirratum*, encountered in the deck of the barge in 2005 (Figure 22).

Species richness at this site increased significantly between 2002 and 2005 (Table 10). The number of fish species observed increased from 19 to 31 between these years. During this same time period, invertebrate richness more than doubled from S=11 to S=29. Alga richness has remained the same as previous sample years (Table 10).

The surrounding area was a patchy algae community. The same number of algae species were encountered this year as previous years (see Table 9). No large invertebrates were encountered adjacent to the wreck and no reef-building corals were noticed.

Target 51 (18°17.410`N, 64°58.408`W) – Target 51 is the WIT Islander steel barge (Figure 23). It was surveyed in 2001, 2002 and 2003. The dimensions of this barge are 55 m x 16 m x 4 m. The water depth at the bottom of this barge is 26 m and the top is at 22 m. Over the years there was no observable difference in the condition of the structure. There was a crack in the main deck that spanned the width of the barge. It was unclear if this was present in either 2001 or 2002. The artificial reef did not appear to have moved during the period surveyed.

A hawksbill turtle, *Eretmochelys imbricata*, was recorded using the barge in 2003 (Figure 24). Numerous fishes were associated with the structure and were observed using holes in the barge as refuge from predators. Species richness of fishes was greater in 2003 than 2001 (Table 11). A species list was not generated in 2002.

The hull and deck of the barge was encrusted with sessile invertebrates and algae. As with fish, invertebrate species richness was greater in 2003 than 2001 (Table 11). This may be due in part to the use of photographs to aid in identification of organisms.

The surrounding habitat was a rhodolith algal plain with scattered sponges. In some instances the rhodoliths form large mounds that were used by serranids like the chalk bass, *Serranus tortugarum*.

Target 52 (18°17.473`N, 64°58.684`W) – Target 52 consisted of scattered concrete slabs (Figure 25) that lie near target 42. It was surveyed in 2003 and 2005. Water depth at this target was 27 m. Numerous concrete slabs (8 counted) were scattered over a large area and were heavily colonized by algae, encrusting invertebrates and hard coral.

In 2003, seven hard coral species were identified. In 2005, however, twelve species were recorded. Some of the more common species of coral observed were *Agaricia agaricites*, *Montastraea cavernosa* and *Meandrina meandrites*. There was also a variety of sponges that colonized the slabs. Many of these sponges shelter and protect vulnerable marine crustacea such as shrimp and crabs from predators (Figures 26 and 27).

Several species of fish were associated with the structures; many of which were juveniles. During both survey years, the structures also attracted commercially important species such as *Epinephelus guttatus* (Figure 28). There were six red hinds observed in a 10 minute search in 2005.

An additional 10 fish and invertebrate species were identified since 2003. Algal richness also increased by 6 in 2005 (Table 12).

Identifying the surrounding habitat at this site was difficult. The scattered nature of the concrete slabs make it impossible to determine if the fish were moving between structures or preferred the habitat adjacent to the structures. The habitat between and around the concrete structures was a rhodolith algal plain with solitary erect sponges.

Target 57 (18°17.501`N, 64°59.139`W) – Target 57 (Figure 29) was the top section of a steel ferry upside down and moderately broken-up. It was surveyed in 2002 and 2005. There was no obvious movement of the main structure since 2002 as the coordinates for this structure have remained the same.

In 2002 it was reported that there were no gorgonians and little macroalgae. This still remains the case. However, a significant amount of hydroids, tunicates, encrusting sponges and hard coral inhabited the ferry in 2005 (Figure 30).

Large schools of tomtates (grunts), *Haemulon aurolineatum* and *Chromis multilineata* (Figure 31) were the most abundant species in all survey years. A couple lobsters were recorded at the site in 2002 and 2005 (Figure 32).

The relative abundance of species of fish encountered during the 2005 timed survey ranged from 0.10 to 10.00 fish minute<sup>-1</sup>. There were a total of 339 fishes counted at this site during the timed swim. Although there were no fish counts in 2002, a species list was generated. The number of fish species encountered in 2002 and 2005 was similar (Table 13).

Between 2002 and 2005, the number of invertebrate species observed increased. Fish genera observed also increased (Table 13). It was suggested in the annual performance report (Vasques and Tobias 2002) that perhaps this artificial reef was deployed right before 2002 because there was limited growth. Perhaps this explains the dramatic increase in the number of invertebrates encountered since then.

Target 58 (18°17.456`N, 64°59.618`W) – Target 58 is a steel barge with small holes along the sides (Figure 33). It was surveyed in 2002, 2004 and 2005. The coordinates for this structure remained the same between these years. This indicated that there was limited or no movement of the structure. The structure also did not appear to have broken apart anymore than it was in previous years. The barge sits at a depth of approximately 27.4 m.

A species list was generated for marine organisms that were both associated with the wreck and organisms found in the surrounding area. Fish species richness increased by eight species in 2005 compared to the 2002 and 2004 survey years. A roaming 10 minute swim was conducted in 2005. Abundance of individual fish species ranged from 0.10 to 15.00 fish minute<sup>-1</sup>. A total of 49.5 fish minute<sup>-1</sup> was recorded. There was also an increase in invertebrate and algae richness. The number of invertebrates observed more than doubled since 2004 (Table 14). The number of algae species increased as well (Table 14). This sudden increase in invertebrate richness may be due to inexperienced divers conducting the surveys in previous years.

The barge was colonized by encrusting invertebrates and algae. The deck of the barge was covered with *Sargassum* and *Halimeda* spp. which dominated this reef over the years. Several species of sponges were on the barge as well (Figure 34). Some hard corals, such as *Madracis decactis*, *Millepora alcicornis*, *Siderastrea* sp. had also colonized the deck and hull over the years.

The surrounding area was predominately rhodolith community with erect rope sponges. Other algae in the surrounding habitat included *Dictyota* sp., *Halimeda* sp. and *Sargassum hystrix*. No reef-building invertebrates were seen.

Target 59 (18°17.434`N, 64°59.877`W) – Target 59 is a twin engine Cessna plane (Figure 35). It was surveyed in 2002 and 2004. The plane did not appear to have moved over the last two survey years and the basic structure appeared to be in similar condition as when first identified in 2002. The depth of the wreck was 28.4 m.

A total of 142 fishes from ten species were encountered on the Cessna in 2004. Species richness for fish was similar in 2002 and 2004 (Table 15). A timed search was conducted for fish associated with the Cessna which varied by species from 4.0 minute<sup>-1</sup> for squirrel fish, *Holocentrus adscensionis*, to 0.07 fish minute<sup>-1</sup> for groupers (Appendix, Table 33). Despite the structure's relatively small size, several adult red hind, *Epinephilus guttatus*, were observed (eight in 2002 and ten in 2004). The number of Caribbean spiny lobster, *Panulirus argus*, declined from 19 reported in 2002 when the structure was first found, to six in 2004. The decline in adult *P. argus* may be related to dive operators which now may frequent the wreckage and may be harvesting the lobsters. Nevertheless, the structure provides an important haven for lobsters.

Species richness for invertebrates increased slightly from 2002 to 2004 (Table 15). In 2002 seven species from six genera were observed while in 2004 eleven species from nine genera were identified. Algal richness increased from two species of genera in 2002 to three each in 2004 (Table 15).

Target 62 (18°17.393`N, 64°58.665`W) – Target 62 is the bow of a fiberglass boat. It was surveyed in 2002 only. Target 62 sat at a depth of 26.7 m. The boat was measured *in-situ* as 8.7 m x 5.3 x 1.2 m, with total volume = 55.33 m<sup>3</sup>.

The boat bow was open allowing numerous fishes to swim in and around it. Significant overgrowth of gorgonians, sponges, and tunicates adhered to the artificial reef. There were few species of stony coral such as *Madracis decactis* and *Agaricia* sp. that were associated with the boat.

A survey of the surrounding area was conducted and verified that the habitat was a rhodolith community with random distribution of scattered rope sponges and sparse low canopy algae. The survey from this target yielded 14 fish, 17 invertebrate, and 4 algae species (Table 16).

Target 70 (18°17.051`N, 64°58.981`W) – Target 70 is the WIT Concrete, a large freighter (Figures 36 and 37). The WIT Concrete is a Liberty ship which was sunk in July 1997 (Vasques and Tobias 2002). It was first located and surveyed in 2001 and then resurveyed every year from 2002 to 2004. The WIT Concrete lies in 29 m of water. It does not appear to have moved through the years of surveys. The stern of the structure had broken off prior to being deployed on this artificial reef site. The open stern is broken-up allowing access to the ship's interior. It does not appear to have broken-up any further compared with 2002. There are no time counts of organisms for this wreck. Nevertheless, a species list was generated for fish, invertebrates, and algae.

This structure is very large and therefore attracts many fishes. In 2004, 34 species of fish from 27 genera and 16 families were recorded. This is less than that recorded in 2003 but more than that 2002 and approximately equivalent to 2001 (Table 17). There was even a Goliath grouper, *Epinephelus itajara*, encountered in 2004 (Figure 38). Goliath grouper are extremely rare in the US Virgin Islands, therefore, any sightings are noteworthy observations. Dive operators have also reported seeing Goliath grouper on this wreck.

The wreck was heavily colonized by sessile invertebrates including black coral, *Antipathes* spp. Species richness remains fairly constant for invertebrates from 2001 through 2004 (Table 17). The recorded algal species has fluctuated across years (Table 17).

Target 79 (18°16.986`N, 64°59.648`W) – Target 79 is an upside-down sailboat. It was surveyed in 2002 and 2004. The sailboat sits at a depth of approximately 30 m and is 9 m x 4.1 m. This wreck does not appear to have moved nor does it appear to have decomposed further.

Numerous fishes use the wreckage particularly tomtates, *Haemulon aurolineatum*, which surrounded the wreck by the hundreds (Figure 39). The same phenomenon was recorded for 2002. Species richness for fish in 2004 was similar to that recorded for 2002 (Table 18). Thirteen species of fish from 12 genera and 9 families were recorded on the wreck in 2004. Fish richness was slightly higher in 2002.

Sessile invertebrates and algae also colonized the hull of this sailboat. More invertebrate species were recorded in 2004 than in 2002 (Table 18). Conversely, fewer algal species were recorded in 2004 than in 2002 (Table 18). This was likely due to the inexperienced diver overlooking some species in 2004.

Target 165 (18°17.767`N, 64°59.433`W) – Target 165 (Figure 40) is a steel cargo ship with a large break mid-ship that allows divers and fishes access to the interior of the ship. There are also several doorways and broken or missing panels that provide access to the interior of the ship (Figures 41 and 42). This ship was surveyed in 2002 and 2003. This structure was 55 m x 10 m. Target 165 is in 27 m of water. The top of the structure is at 22 m. There was no obvious structural change between years and there did not appear to be any movement of the structure. WAAS GPS coordinates taken for the previous year were still accurate, suggesting the artificial reef has not moved.

This ship provides habitat for numerous species of fish such as barracuda and red hind. In addition to providing habitat for fish, the hull of the ship is encrusted by numerous invertebrates such as black corals, *Diploria* spp., and *Montastraea* spp. Species richness for fishes was lower in 2003 than in 2002 (Table 19). However, species richness was higher for invertebrates and algae (Table 19).

The surrounding habitat was a rhodolith, cf. *Lithothamnion ruptile*, community with numerous solitary erect sponges. There were no bioherms in the immediate area.

### **GIS Database Results**

GIS ArcView maps were created in order to graphically organize and represent artificial reef survey results over the years. Several representations can be created within the GIS program and can be cataloged over the years. Figures 43 and 44 represent fish species richness by survey year and invertebrate species richness by survey year, respectively.

In general, artificial reef sites increased in species richness (fish and invertebrate) or remained relatively stagnant over the survey years. The artificial reefs also provided a good substrate for filamentous algae, a primary food source for herbivorous fishes. It should be emphasized that methodology for the reef surveys evolved over the years. In addition, different divers were used for these field surveys each year. Therefore the estimates provided here may not be directly comparable or valid. As follow-up inspections continue in the future, methodology will be standardized increasing the validity of the results.

### **DISCUSSION AND RECOMMENDATIONS**

Presently, the objective of DFW's Recreational Fishery Enhancement Program is to enhance fishing opportunities in the USVI by using artificial reefs. Perhaps this objective should be modified or expanded to provide a framework for developing an understanding of artificial reefs. The Fish and Wildlife Commission, Division of Marine Fisheries in Florida, have developed specific program goals created by the Artificial Reef Advisory Board (FLAR Strategic Plan, 2003). Some of these project goals include: (1) assuring that long-term social, economic, and quality of life values of artificial reef benefit the local and regional economies of Florida, (2) utilizing artificial reefs in scientific research to obtain an understanding of how artificial reefs function ecologically and physically across spatial and temporal scales, and (3) using artificial reefs as a component of fisheries management. Program objectives such as these can help provide DFW with a model on how to structure our artificial reef program.

There are basic fundamental questions within the Recreational Fishery Enhancement Artificial Reef Program that still need to be addressed. For example, are the artificial reefs actually used by people? It is important for DFW to develop more accurate and thorough information to identify the target audiences and their use of these artificial reefs. Perhaps even integrating the social factors and impacts of growth, population development, and economics into the artificial reef process would be of value. It may also be useful to conduct standardized surveys to assess



resident and visitor reef use at local levels by measuring user value of artificial reefs and natural reefs but distinguishing the difference between the two.

Another question to address is whether or not artificial reefs really attract or enhance fish populations? If this question were to be addressed or incorporated in DFW's monitoring program, it is important to identify and agree to this specific objective, but still look at artificial reefs with a broad perspective. Modifying our artificial reef program to incorporate single species or multiple species management is noteworthy and appropriate in addressing such a question (Florida Fish and Wildlife Commission, 2003). DFW should consider only surveying targeted species to see if artificial reefs really increase commercially/recreationally important species. DFW should also consider identifying reef attributes that enhance survival, growth, and reproduction of various life stages of marine organisms.

Lastly, as future surveys continue, the GIS database should be up-dated to include all known artificial reef wrecks and survey data in the Virgin Islands. This is to ensure that scientific results from artificial reef research are meaningful, accessible to the public, and disseminated in useable formats.

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**Table 1.** St. Thomas artificial reefs located south, southeast Saba Island

DFW ID #	Latitude	Longitude	Depth (ft.) bottom/top *1	Object Size (ft.) *2	Description of Materials	Year surveyed
2 <sup>*3</sup>	18°17.014'N	64°58.593'W	93'	55' x 21'	steel barge, very decomposed	02'
20	18°17.995'N	64°58.752'W	85'	49' x 9'	upside down fiberglass sailboat, very broken-up	02',04'
22	18°17.945'N	64°58.708'W	87'	51' x 32'	steel debris and scrap metal	02',04'
25	18°17.811'N	64°59.501'W	87'	138' x 33'	steel barge w/ stern tires, good condition	02',04',05'
30	18°17.772'N	64°59.460'W	86'	40' x 45'	steel debris containing steel grates	02', 05'
32	18°17.760'N	64°59.565'W	92'	33'x10'	fiberglass and wood hull boat w/ short keel	02',05'
38	18°17.693'N	64°58.227'W	88'		antennae tower	03'
42	18°17.566'N	64°58.658'W	85'	34' x 6' each	scattered concrete slabs (~20 pieces)	02',04',05'
45	18°17.618'N	64°59.839'W	89'	73'x17'	steel hull tug	02',04'
51	18°17.410'N	64°58.408'W	86'/72'	180'x52'x14'	steel barge, good condition	01',03'
52	18°17.473'N	64°58.684'W	86'		concrete slabs	03',05'
57	18°17.501'N	64°59.139'W	89'	31' x 8'	appears to be the top section of a steel ferry upside down, broken-up	02',05'
58	18°17.456'N	64°59.618'W	88'	120'x26x10''	Steel barge w/ small holes along side, good condition	02',04',05'
59	18°17.434'N	64°59.877'W	96'	19'x31'	twin engine plane	02',04'
62 <sup>*3</sup>	18°17.393'N	64°58.665'W	88'	29' x 17'	bow section of fiberglass boat, very broken-up	02'
70 <sup>*3</sup>	18°17.051'N	64°58.981'W	95'	300'x56'x46'	large steel freighter	01',02',03' 04'
79	18°16.986'N	64°59.648'W	99'	30'x13.5'	upside down sailboat w/ keel broken off	02', 04'
165	18°17.767'N	64°59.433'W	89'/72'	180' x 33'	steel cargo ship with large collapse in main deck, moderately broken-up	02',03'

1. The depth for all objects is the depth to the bottom of the object, except, where two depths are given the first is to the bottom & the second is to the top of the object.
2. All object sizes are approximate, measured underwater with a 50 meter tape measure.
3. Material is inside the boundaries of the 0.2 square mile artificial reef site.

**Table 2.** Species richness (S) of organisms associated with target 2 (steel barge), by year. Only positively identified genera are included.

	2002	
	Genera	Species
<b>Fish</b>	(S = 16)	(S = 19)
<b>Invertebrates</b>	(S = 17)	(S = 19)
<b>Algae</b>	(S = 2)	(S = 3)

**Table 3.** Species richness (S) of organisms associated with target 20 (upside down fiberglass sailboat) by year. Only positively identified genera are included.

	2002		2004	
	Genera	Species	Genera	Species
<b>Fish</b>	(S = 20)	(S = 29)	(S = 22)	(S = 26)
<b>Invertebrates</b>	(S = 14)	(S = 14)	(S = 16)	(S = 16)
<b>Algae</b>	(S = 3)	(S = 3)	(S = 4)	(S = 4)

**Table 4.** Species richness (S) of organisms associated with the target 22 (steel debris) by year. Only positively identified genera are included.

	2002		2004	
	Genera	Species	Genera	Species
<b>Fish</b>	(S = 24)	(S = 30)	(S = 18)	(S = 20)
<b>Invertebrates</b>	(S = 13)	(S = 14)	(S = 18)	(S = 24)
<b>Algae</b>	(S = 2)	(S = 2)	(S = 5)	(S = 5)

**Table 5.** Species richness (S) of organisms associated with target 25 (concrete slabs) by year. Only positively identified genera are included.

	2002		2004		2005	
	Genera	Species	Genera	Species	Genera	Species
<b>Fish</b>	(S = 21)	(S = 30)	(S = 22)	(S = 25)	(S = 14)	(S = 15)
<b>Invertebrates</b>	(S = 10)	(S = 11)	(S = 18)	(S = 19)	(S = 21)	(S = 22)
<b>Algae</b>	(S = 4)	(S = 4)	(S = 6)	(S = 6)	(S = 5)	(S = 8)

**Table 6.** Species richness (S) of organisms associated with target 30 (steel debris) by year. Only positively identified genera are included.

	2002		2005	
	Genera	Species	Genera	Species
<b>Fish</b>	(S = 22)	(S = 31)	(S = 21)	(S = 29)
<b>Invertebrates</b>	(S = 18)	(S = 22)	(S = 19)	(S = 23)
<b>Algae</b>	(S = 6)	(S = 6)	(S = 6)	(S = 7)

**Table 7.** Species richness (S) of organisms associated with target 32 (fiberglass and wood hull boat) by year. Only positively identified genera are included.

	2002		2005	
	Genera	Species	Genera	Species
<b>Fish</b>	(S = 12)	(S = 15)	(S = 13)	(S = 15)
<b>Invertebrates</b>	(S = 13)	(S = 13)	(S = 10)	(S = 12)
<b>Algae</b>	(S = 2)	(S = 2)	(S = 3)	(S = 3)

**Table 8.** Species richness (S) of organisms associated with target 38 (antennae tower) by year. Only positively identified genera are included.

	2003	
	Genera	Species
<b>Fish</b>	(S = 16)	(S = 19)
<b>Invertebrates</b>	(S = 15)	(S = 18)
<b>Algae</b>	(S = 2)	(S = 2)

**Table 9.** Species richness (S) of organisms associated with target 42 (concrete slabs) by year. Only positively identified genera are included.

	2002		2004		2005	
	Genera	Species	Genera	Species	Genera	Species
<b>Fish</b>	(S = 24)	(S = 36)	(S = 28)	(S = 32)	(S = 25)	(S = 32)
<b>Invertebrates</b>	(S = 24)	(S = 29)	(S = 24)	(S = 29)	(S = 30)	(S = 36)
<b>Algae</b>	(S = 5)	(S = 5)	(S = 4)	(S = 4)	(S = 5)	(S = 9)

**Table 10.** Species richness (S) of organisms associated with target 45 (steel hull tug) by year. Only positively identified genera are included.

	2002		2004		2005	
	Genera	Species	Genera	Species	Genera	Species
<b>Fish</b>	(S = 14)	(S = 19)	(S = 19)	(S = 24)	(S = 24)	(S = 31)
<b>Invertebrates</b>	(S = 10)	(S = 11)	(S = 16)	(S = 21)	(S = 22)	(S = 29)
<b>Algae</b>	(S = 2)	(S = 3)	(S = 4)	(S = 4)	(S = 4)	(S = 4)

**Table 11.** Species richness (S) of organisms associated with target 51 (steel barge) by year. Only positively identified genera are included.

	2001		2003	
	Genera	Species	Genera	Species
<b>Fish</b>	(S = 19)	(S = 22)	(S = 21)	(S = 27)
<b>Invertebrates</b>	(S = 8)	(S = 9)	(S = 20)	(S = 20)
<b>Algae</b>	(S = 2)	(S = 2)	(S = 4)	(S = 5)
<b>Other</b>	(S = 1)	(S = 1)	(S = 1)	(S = 1)

**Table 12.** Species richness (S), of organisms associated with target 52 (concrete slabs) by year. Only positively identified genera are included.

	2003		2005	
	Genera	Species	Genera	Species
<b>Fish</b>	(S = 16)	(S = 20)	(S = 24)	(S = 30)
<b>Invertebrates</b>	(S = 16)	(S = 17)	(S = 22)	(S = 27)
<b>Algae</b>	(S = 2)	(S = 2)	(S = 6)	(S = 8)

**Table 13.** Species richness (S) of organisms associated with target 57 (steel ferry) by year. Only positively identified genera are included.

	2002		2005	
	Genera	Species	Genera	Species
<b>Fish</b>	(S = 23)	(S = 24)	(S = 20)	(S = 23)
<b>Invertebrates</b>	(S = 7)	(S = 8)	(S = 18)	(S = 21)
<b>Algae</b>	(S = 4)	(S = 4)	(S = 4)	(S = 5)

**Table 14.** Species richness (S) of organisms associated with target 58 (steel barge) by year. Only positively identified species are included.

	2002		2004		2005	
	Genera	Species	Genera	Species	Genera	Species
<b>Fish</b>	(S = 18)	(S = 22)	(S = 18)	(S = 22)	(S = 23)	(S = 30)
<b>Invertebrates</b>	(S = 13)	(S = 13)	(S = 11)	(S = 11)	(S = 20)	(S = 24)
<b>Algae</b>	(S = 4)	(S = 4)	(S = 4)	(S = 4)	(S = 3)	(S = 6)

**Table 15.** Species richness (S) of organisms associated with target 59 (twin engine plane) by year. Only positively identified genera are included.

	2002		2004	
	Genera	Species	Genera	Species
<b>Fish</b>	(S = 10)	(S = 10)	(S = 9)	(S = 10)
<b>Invertebrates</b>	(S = 6)	(S = 7)	(S = 9)	(S = 11)
<b>Algae</b>	(S = 2)	(S = 2)	(S = 3)	(S = 3)

**Table 16.** Species richness (S) of organisms associated with target 62 (bow section of fiberglass boat) by year. Only positively identified genera are included.

	2002	
	Genera	Species
<b>Fish</b>	(S = 11)	(S = 14)
<b>Invertebrates</b>	(S = 13)	(S = 17)
<b>Algae</b>	(S = 4)	(S = 4)

**Table 17.** Species richness (S) of organisms associated with the target 70 (WIT Concrete ship) by year. Only positively identified genera are included.

	2001		2002		2003		2004	
	Genera	Species	Genera	Species	Genera	Species	Genera	Species
<b>Fish</b>	(S = 26)	(S = 35)	(S = 20)	(S = 25)	(S = 31)	(S = 42)	(S = 27)	(S = 34)
<b>Invertebrates</b>	(S = 18)	(S = 18)	(S = 21)	(S = 23)	(S = 20)	(S = 24)	(S = 25)	(S = 26)
<b>Algae</b>	(S = 5)	(S = 5)	(S = 8)	(S = 8)	(S = 4)	(S = 4)	(S = 8)	(S = 8)

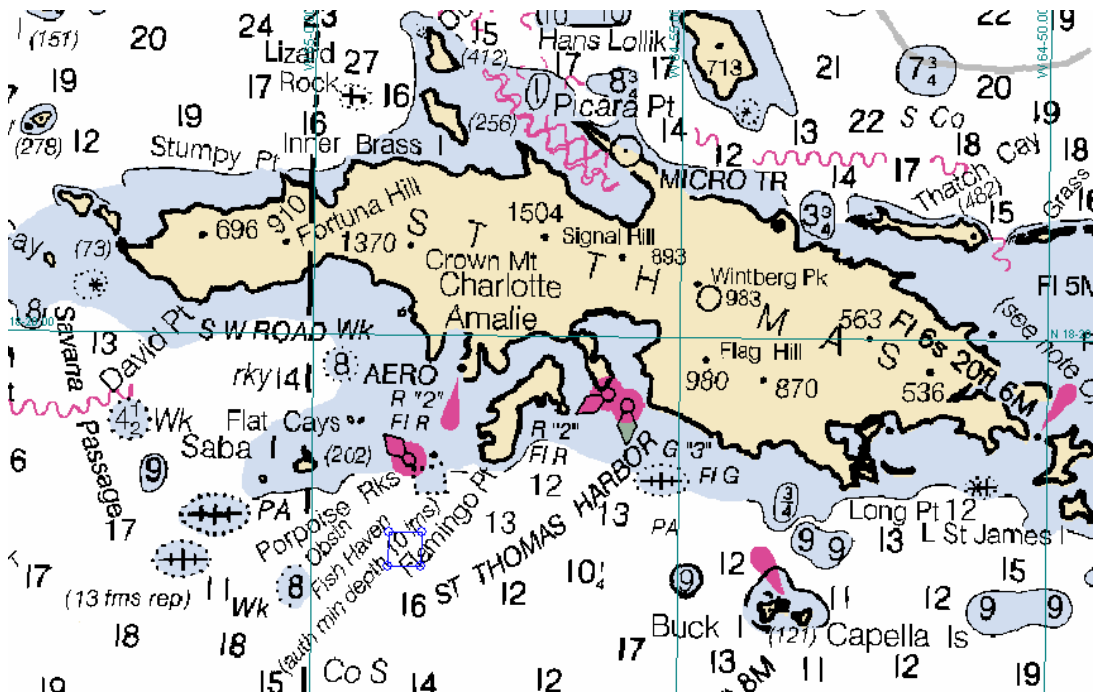
**Table 18.** Species richness (S) of organisms associated with target 79 (upside down sailboat) by year. Only positively identified genera are included.

	2002		2004	
	Genera	Species	Genera	Species
<b>Fish</b>	(S = 13)	(S = 15)	(S = 12)	(S = 13)
<b>Invertebrates</b>	(S = 5)	(S = 6)	(S = 9)	(S = 9)
<b>Algae</b>	(S = 4)	(S = 4)	(S = 3)	(S = 3)

**Table 19.** Species richness (S) of organisms associated with target 165 (steel cargo ship) by year. Only positively identified species are included.

	2002		2003	
	Genera	Species	Genera	Species
<b>Fish</b>	(S = 21)	(S = 28)	(S = 18)	(S = 24)
<b>Invertebrates</b>	(S = 11)	(S = 12)	(S = 15)	(S = 15)
<b>Algae</b>	(S = 3)	(S = 4)	(S = 4)	(S = 4)

Figure 1. St. Thomas artificial reef site, southeast Saba Island



**St. Thomas artificial reef site**

**Boundary coordinates:**

NE corner: 18°17.42' N, 64°58.50' W

SE corner: 18°16.97' N, 64°58.50' W

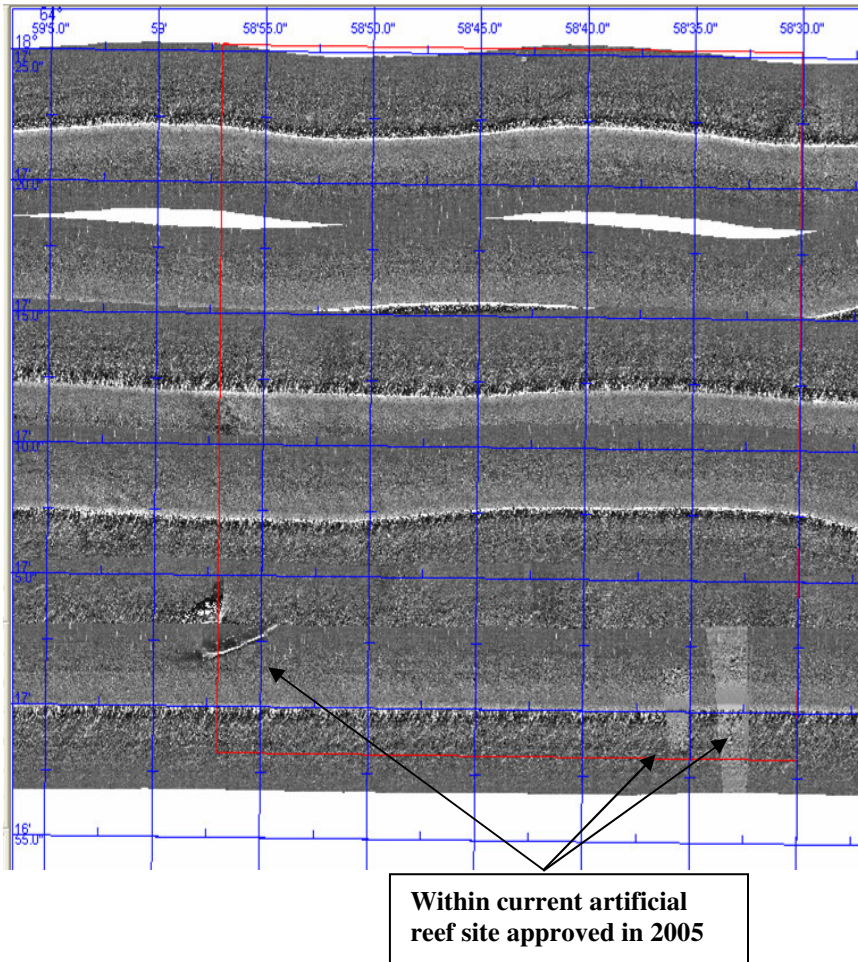
SW corner: 18°16.97' N, 64°58.95' W

NW corner: 18°17.42' N, 64°58.95' W

Total area = 0.2 sq. nautical miles



Figure 2. Benthic mosaic of the south Saba, St. Thomas artificial reef site  
Red line indicates proposed boundary



### St. Thomas Artificial Reef Site Boundary

#### Coordinates:

NE Corner: 18°17.42' N, 64°58.50' W

SE Corner: 18°16.97' N, 64°58.50' W

SW Corner: 18°16.97' N, 64°58.95' W

NW Corner: 18°17.42' N, 64°58.95' W

Total Area = 0.2 sq. nautical miles

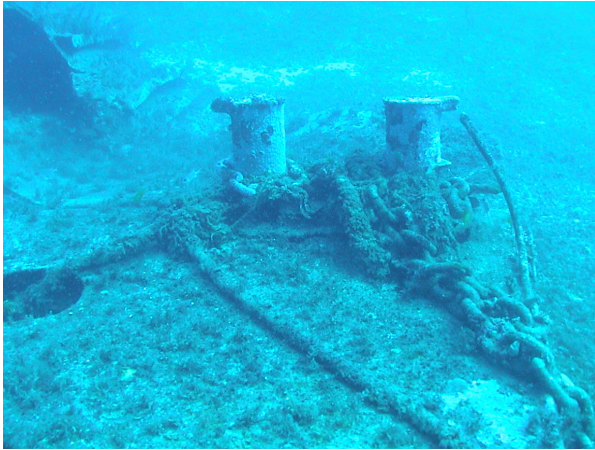


Figure 3. Target 2, decomposing barge wreckage.



Figure 4. Target 20, upside down sailboat.



Figure 5. Target 22, pile of steel debris.



Figure 6. Target 25, holes in the hull allow fish access to the interior.

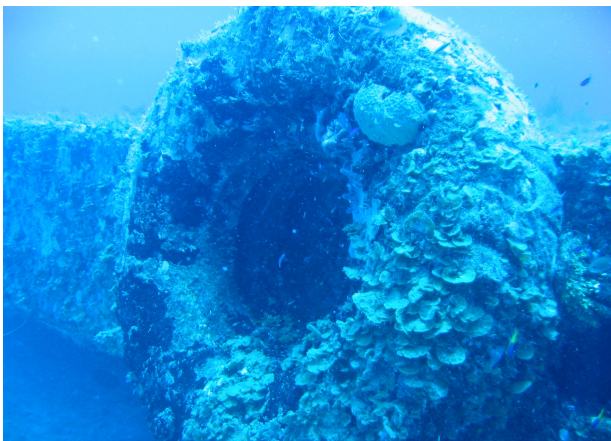


Figure 7. Target 25, stern of barge with tire as fender.



Figure 8. Target 25, hull of barge encrusted with sessile invertebrates and algae.



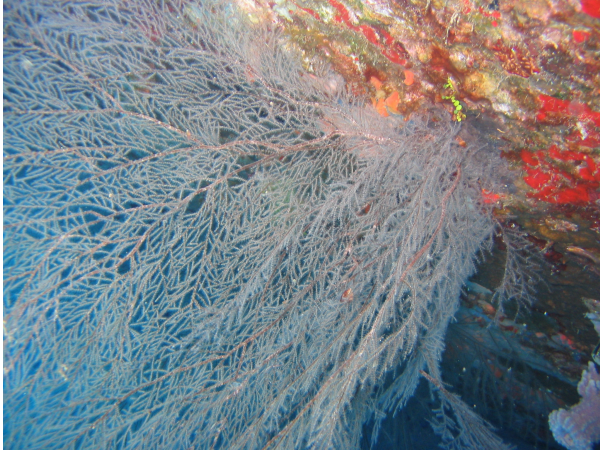


Figure 9. Target 25, black coral, *Antipathes atlantica*, growing under the stern.

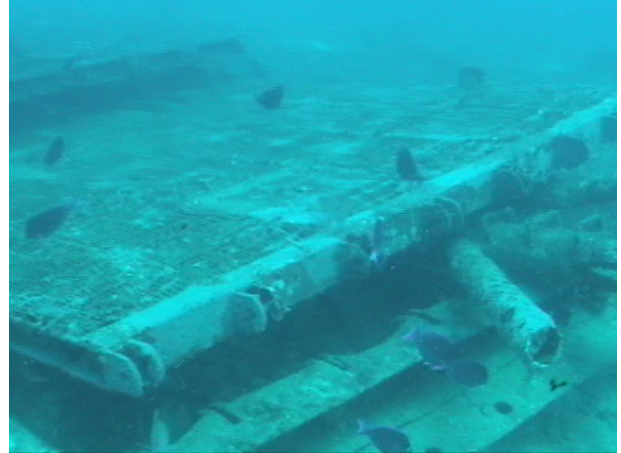


Figure 10. Target 30, cargo ramp.



Figure 11. Target 32, fiberglass boat with short keel.



Figure 12. Target 38, antennae tower.



Figure 13. Target 38, solitary erect sponges found on tower.



Figure 14. Target 38, large green turtle, *Chelonia mydas*, found at site.





Figure 15. Target 38, large southern stingray, *Dasyatis americana*, found at site.

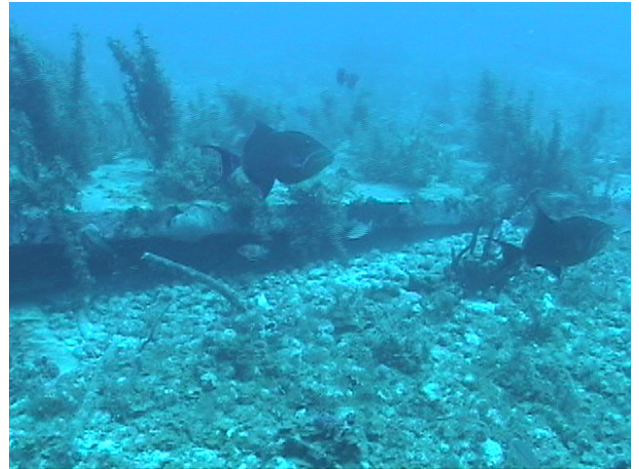


Figure 16. Target 42, *Balistes vetula* encountered around the dock slabs.



Figure 17. Target 42, reef-building corals attached to concrete slabs.



Figure 18. Target 45, Western Cites tug.

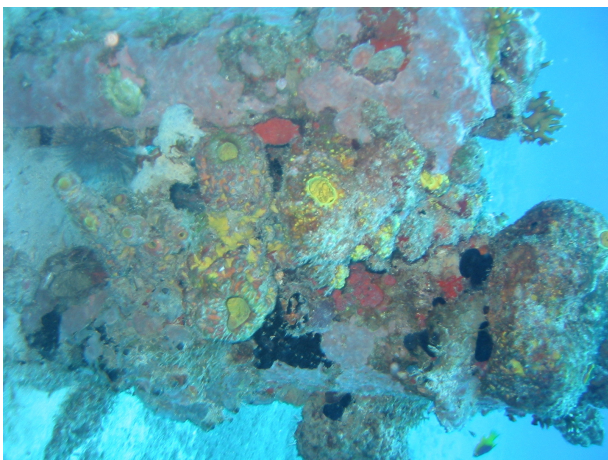


Figure 19. Target 45, sponge overgrowth on tug.

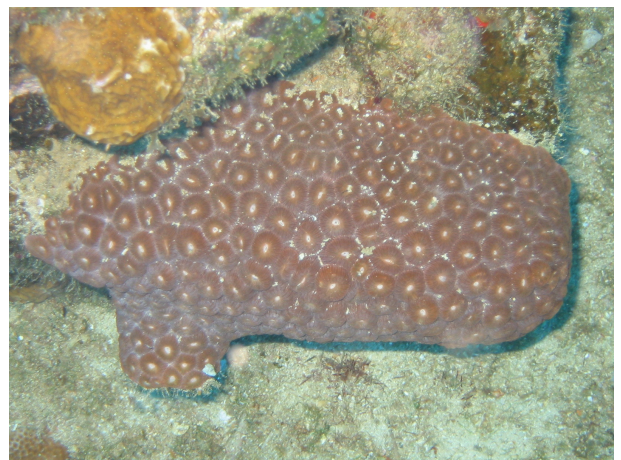


Figure 20. Target 45, hard coral, *Montastraea cavernosa*, found on tug.





Figure 21. Target 45, schooling gray snappers, *Lutjanus griseus*, found around barge.



Figure 22. Target 45, nurse shark, *Ginglymostoma cirratmu*, found at site.



Figure 23. Target 51, deck of the WIT Islander barge.

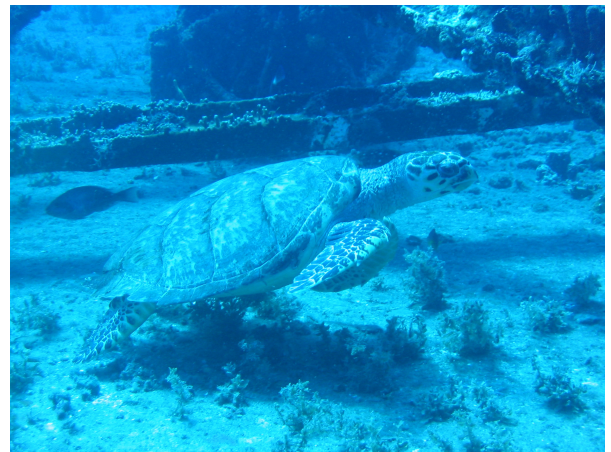


Figure 24. Target 51, hawksbill turtle, *Eretmochelys imbricata*, on deck of barge.



Figure 25. Target 52, concrete slabs with gorgonians and encrusting sponges, hydroids, and tunicates.



Figure 26. Target 52, *Niphates digitalis* houses banded coral shrimp.





Figure 27. Target 52, giant barrel sponge houses arrowhead crab.



Figure 28. Target 52, *Epinephelus guttatus* (red hind) under a concrete slab.



Figure 29. Target 57, top section of steel ferry.

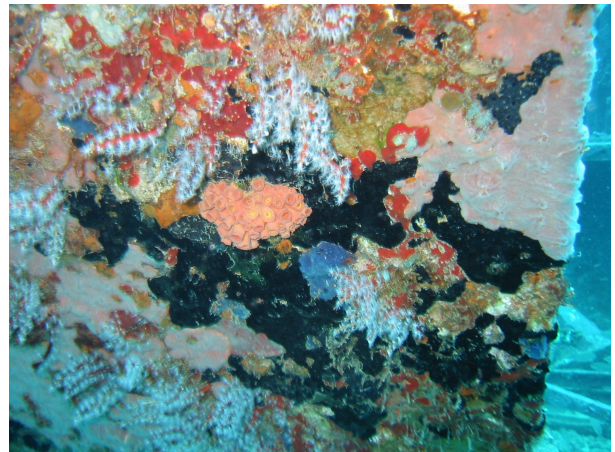


Figure 30. Target 57, encrusting hydroids, tunicates, sponges and hard coral.



Figure 31. Target 57, school of tomtates, *Haemulon aurolineatum*.



Figure 32. Target 57, juvenile Caribbean Spiny lobster, *Panulirus argus*.



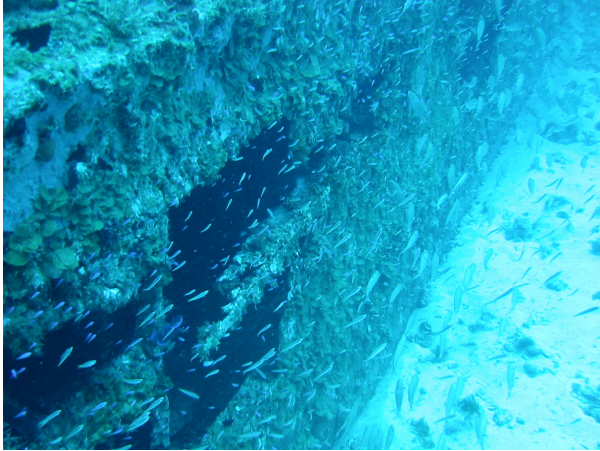


Figure 33. Target 58, holes along side the barge.

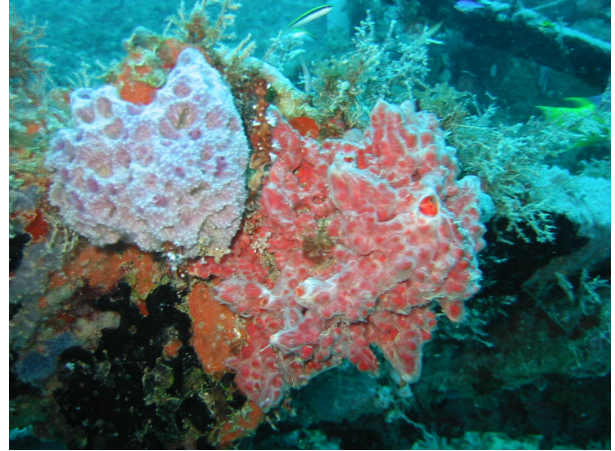


Figure 34. Target 58, a variety of sponges on barge.



Figure 35. Target 59, twin engine Cessna plane.

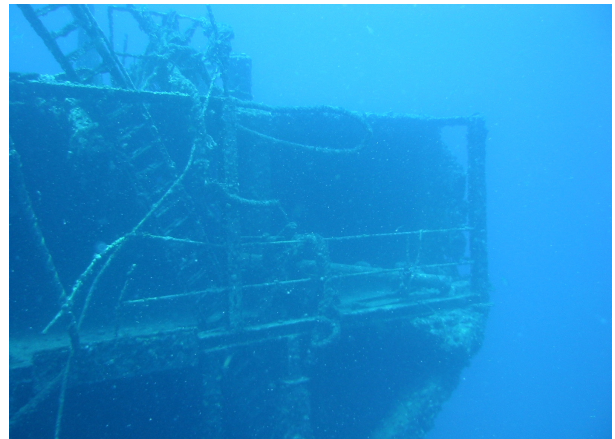


Figure 36. Target 70, stern of target showing infrastructure.

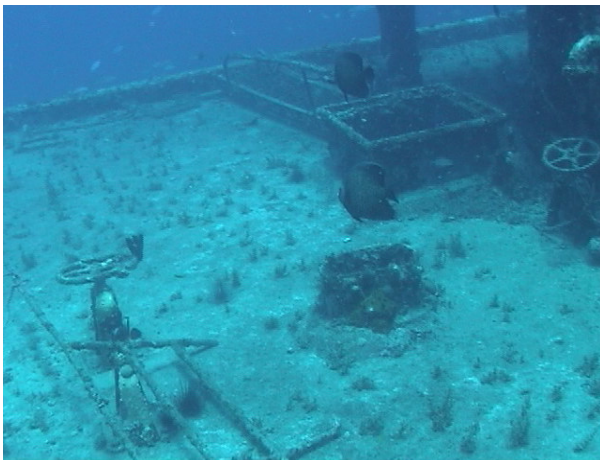


Figure 37. Target 70, main deck of target.



Figure 38. Target 70, *Epinephelus itajara*, approximately 100lbs., found in the wreck.



Figure 39. Target 79, large school of tomtates, *Haemulon aurolineatum*, surrounding wreck.



Figure 40. Target 165, steel cargo ship.



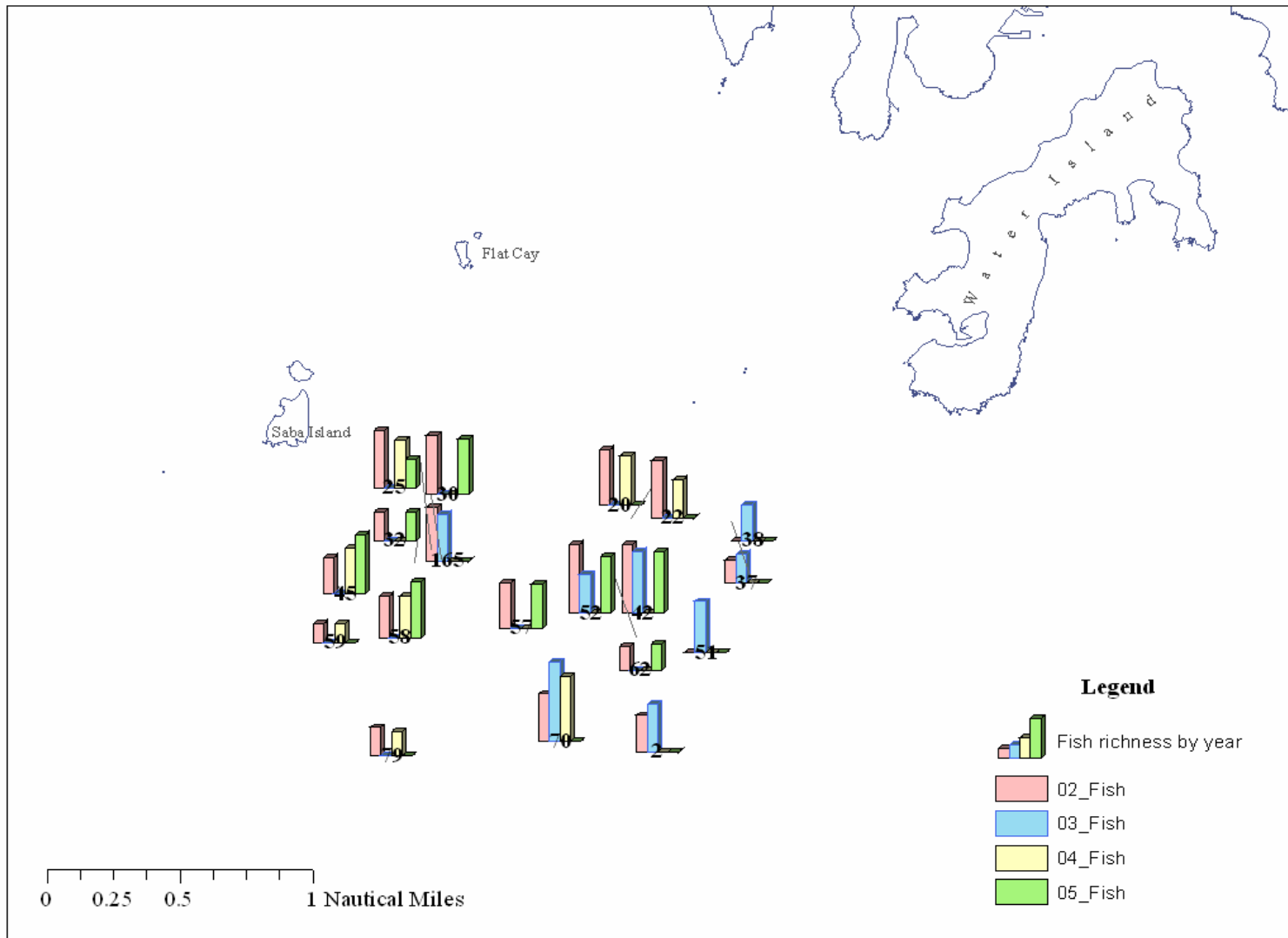
Figure 41. Target 165, a large break mid-ship.



Figure 42. Target 165, doorways that allow diver and fish access.

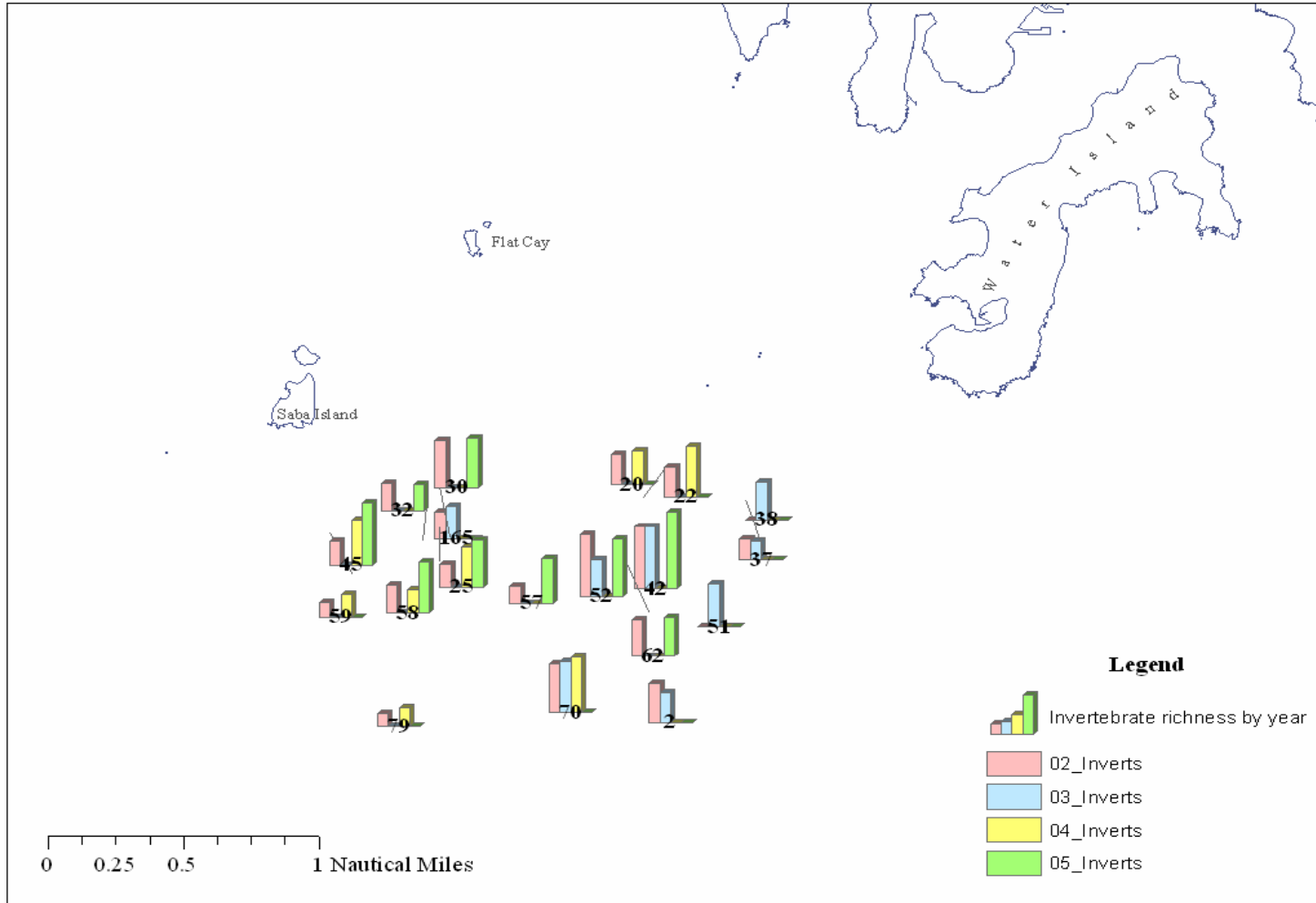


Figure 43. Fish species richness by year, southeast Saba, St. Thomas artificial reef site.



\*Note: Bar graphs are not scaled to map.

Figure 44. Invertebrate species richness by year, southeast Saba, St. Thomas artificial reef site



\*Note: Bar graphs are not scaled to map.

**APPENDIX**

**Table 1.** List of species that were associated with **Target 2** (steel barge) and those that were encountered in the surrounding area but not directly associated with the artificial reef, 2002.

<b>Associated with artificial reef</b>	<b>Surrounding area</b>
<b>Fish Species</b>	<b>Fish Species</b>
Bar jack, <i>Caranx ruber</i>	Barracuda, <i>Sphyraena barracuda</i>
Tomtate, <i>Haemulon aurolineatum</i>	Lizardfish, <i>Synodus</i> sp.
French grunt, <i>Haemulon flavolineatum</i>	Southern stingray, <i>Dasyatis americana</i>
Blue tang, <i>Acanthurus coeruleus</i>	
Blue chromis juv., <i>Chromis cyanea</i>	
Brown chromis, <i>Chromis multilineata</i>	
Bicolor damselfish, <i>Stegastes partitus</i>	
Red hind, <i>Epinephelus guttatus</i>	
Squirrelfish, <i>Holocentrus adscensionis</i>	
Spanish hogfish, <i>Bodianus rufus</i>	
Redband parrotfish, <i>Sparisoma aurofrenatum</i>	
Bluehead, <i>Thalassoma bifasciatum</i>	
Butter hamlet, <i>Hypoplectrus unicolor</i>	
Yellow goatfish, <i>Mulloidichthys martinicus</i>	
Spotted goatfish, <i>Pseudupeneus maculatus</i>	
Doctorfish, <i>Acanthurus chirurgus</i>	
Sharpnose puffer, <i>Canthigaster rostrata</i>	
Green moray, <i>Gymnothorax funebris</i>	
Green turtle, <i>Chelonia mydas</i>	
<b>Invertebrates</b>	<b>Invertebrates</b>
Fire coral, <i>Millepora</i> sp.	Row pore rope sponge, <i>Aplysina cauliformis</i>
Unidentified hydroids	Rope sponge, <i>Aplysina fulva</i>
Brain coral, <i>Diploria</i> sp.	Black-ball sponge, <i>Ircinia strobilina</i>
Maze coral, <i>Meandrina meandrites</i>	Barrel sponge, <i>Xestospongia muta</i>
Starlet coral, <i>Siderastrea siderea</i>	Pink vase sponge, <i>Niphates digitalis</i>
Encrusting gorgonian, <i>Erythropodium caribaeorum</i>	Spaghetti worm, <i>Eupolymnia crassicornis</i>
Pederson cleaner shrimp, <i>Periclimenes pedersoni</i>	
Large claw snapping shrimp, <i>Synalpheus</i> sp.	
Soldierfish isopod, <i>Anilocra laticaudata</i>	
Long spine urchin, <i>Diadema antillarum</i>	
Corkscrew anemone, <i>Bartholomea annulata</i>	
Giant anemone, <i>Condylactis gigantea</i>	
Feather duster, <i>Sabellastarte magnifica</i>	
Unidentified tunicates	
Unidentified bryozoans	
Star encrusting sponge, <i>Halisarca</i> sp.	
Black-ball sponge, <i>Ircinia strobilina</i>	
Stinker sponge, <i>Ircinia felix</i>	

**APPENDIX, Table 1. Continued.**

<b>Associated with artificial reef</b>	<b>Surrounding area</b>
<b>Invertebrates</b>	<b>Invertebrates</b>
Row pore rope sponge, <i>Aplysina cauliformis</i> Branching tube sponge, <i>Pseudoceratina</i> sp. <b>Arrow crab, <i>Stenorhynchus seticornis</i></b>	
<b>Algae</b>	<b>Algae</b>
<i>Sargassum hystrix</i> <i>Sargassum</i> sp. <i>Halimeda</i> sp.	<i>Lobophora variegata</i> <i>Dictyota</i> sp. Rhodoliths unidentified sp. <i>Halimeda</i> sp. <i>Penicillus pyriformis</i>

**Table 2.** List of species that were associated with **Target 20** (fiberglass sailboat) and those that were encountered in the surrounding area but not directly associated with the artificial reef, 2002.

<b>Associated with artificial reef</b>	<b>Surrounding area</b>
<p><b>Fish Species</b></p> <p>Gray angelfish, <i>Pomacanthus arcuatus</i>                      French angelfish, <i>Pomacanthus paru</i>                      Doctorfish, <i>Acanthurus chirurgus</i>                      Ocean surgeonfish, <i>Acanthurus bahianus</i>                      Bicolor damsel, <i>Stegastes partitus</i>                      Blue chromis, <i>Chromis cyanea</i>                      Brown chromis, <i>Chromis multilineata</i>                      Bar jack, <i>Caranx ruber</i>                      White margate, <i>Haemulon album</i>                      Tomtate, <i>Haemulon aurolineatum</i>                      Rock hind, <i>Epinephelus adscensionis</i>                      Red hind, <i>Epinephelus guttatus</i>                      Graysby, <i>Cephalopholis cruentatus</i>                      Coney, <i>Cephalopholis fulva</i>                      Dog snapper, <i>Lutjanus jocu</i>                      Mutton snapper, <i>Lutjanus analis</i>                      Yellowtail snapper, <i>Ocyurus chrysurus</i>                      Yellowhead wrasse, <i>Halichoeres garnoti</i>                      Bluehead, <i>Thalassoma bifasciatum</i>                      Rainbow wrasse juv., <i>Halichoeres pictus</i>                      Stoplight parrotfish, <i>Sparisoma viride</i>                      Redband parrotfish, <i>Sparisoma aurofrenatum</i>                      Squirrelfish, <i>Holocentrus adscensionis</i>                      Blackbar soldierfish, <i>Myripristis jacobus</i>                      Glasseye snapper, <i>Heteropriacanthus cruentatus</i>                      Barracuda, <i>Sphyraena barracuda</i>                      Yellow goatfish, <i>Mulloidichthys martinicus</i>                      Sharpnose puffer, <i>Canthigaster rostrata</i>                      Porcupinefish, <i>Diodon hystrix</i></p>	<p><b>Fish Species</b></p> <p>Sharpnose puffer, <i>Canthigaster rostrata</i>                      Slippery dick, <i>Halichoeres bivittatus</i></p>
<p><b>Invertebrates</b></p> <p>Atlantic triton's trumpet, <i>Charonia variegata</i>                      Flame scallop                      Pederson cleaner shrimp, <i>Periclimenes pedersoni</i>                      Arrow crab, <i>Stenorhynchus seticornis</i>                      Caribbean spiny lobster, <i>Panulirus argus</i>                      Fire coral, <i>Millepora</i> sp.                      Magnificent feather duster, <i>Sabellastarte magnifica</i>                      Unidentified hydroids                      Starlet coral, <i>Siderastrea siderea</i>                      Lettuce coral, <i>Agaricia</i> sp.</p>	<p><b>Invertebrates</b></p> <p>Rose coral, <i>Manicina areolata</i>                      Unidentified gorgonians                      Rope sponges, <i>Aplysina</i> sp.                      Black ball sponge, <i>Ircinia strobilina</i>                      Branching tube sponge, <i>Pseudoceratina crassa</i></p>

**Table 2. Continued.**

<b>Associated with artificial reef</b>	<b>Surrounding area</b>
<b>Invertebrates</b> Sea whip, <i>Pterogorgia</i> sp. White telesto, <i>Carijoa riisei</i> Unidentified tunicates Star encrusting sponge, <i>Halisarca</i> sp. Rope sponges, <i>Aplysina</i> sp. Branching vase sponge, <i>Callyspongia</i> sp. Black ball sponge, <i>Ircinia strobilina</i> <b>Unidentified sponges</b>	<b>Invertebrates</b>
<b>Algae</b> <i>Dictyota</i> sp. <i>Sargassum</i> sp. <i>Halimeda</i> sp.	<b>Algae</b> Rhodolith, cf. <i>Lithothamnion ruptile</i> <i>Halimeda</i> sp. <i>Sargassum</i> sp. <i>Udotea</i> sp. <i>Dictyota</i> sp. <i>Penicillus</i> sp.

**Table 3.** List of species that were associated with **Target 20** (fiberglass sailboat) and those that were encountered in the surrounding area but not directly associated with the artificial reef, 2004.

Associated with artificial reef			Surrounding area
Fish Species	Count	<sup>1</sup> fish/min (N=1)	Fish Species
<i>Pomacanthus arcuatus</i> <sup>2</sup>			<i>Stegastes partitus</i>
<i>Holacanthus ciliaris</i>	1	0.07	<i>Coryphopterus glaucofraenum</i>
<i>Amblycirrhitus pinos</i>	2	0.13	
<i>Balistes vetula</i>	1	0.07	
<i>Acanthurus chirurgus</i>	8	0.53	
<i>Acanthurus coeruleus</i>	20	1.33	
<i>Holocentrus adscensionis</i>	30	2.00	
<i>Myripristis jacobus</i> <sup>2</sup>			
<i>Lutjanus jocu</i>	1	0.07	
<i>Ocyurus chrysurus</i>	36	2.40	
<i>Haemulon album</i> <sup>2</sup>			
<i>Haemulon aurolineatum</i>	80	5.33	
<i>Haemulon parra</i>	2	0.13	
<i>Epinephelus guttatus</i>	6	0.40	
<i>Cephalopholis cruentatus</i> <sup>2</sup>			
<i>Cephalopholis fulva</i> <sup>2</sup>			
<i>Hypoplectrus unicolor</i>	1	0.07	
<i>Pseudupeneus maculatus</i>	12	0.80	
<i>Mulloidichthys martinicus</i> <sup>2</sup>			
<i>Chromis multilineata</i>	30	2.00	
<i>Thalassoma bifasciatum</i>	36	2.40	
<i>Bodianus rufus</i> <sup>2</sup>			
<i>Scarus taeniopterus</i>	1	0.07	
<i>Sparisoma aurofrenatum</i> <sup>2</sup>			
<i>Diodon hystrix</i>	2	0.13	
<i>Caranx ruber</i> <sup>2</sup>			
<b>Cumulative</b>	<b>269</b>	<b>17.93</b>	
<b>Invertebrates</b>			<b>Invertebrates</b>
<i>Millepora alcicornis</i>			<i>Pseudopterogorgia sp.</i>
<i>Siderastrea sp.</i>			<i>Aplysina cauliformis</i>
<i>Montastraea cavernosa</i>			<i>Amphimedon compressa</i>
<i>Porites astreoides</i>			<i>Pseudoceratina crassa</i>
<i>Diploria strigosa</i>			
<i>Carijoa riisei</i>			
<i>Pseudopterogorgia sp.</i>			
<i>Panulirus argus</i>	1		
<i>Stenorhynchus seticornis</i>			
<i>Spirobranchus giganteus</i>			

**Table 3. Continued.**

Associated with artificial reef	Surrounding area
<b>Invertebrates</b> unidentified sabellids <i>Lima scabra</i> <i>Aplysina cauliformis</i> <i>Amphimedon compressa</i> <i>Pseudoceratina crassa</i> <i>Ircinia felix</i> <i>Halisarca sp.</i> unidentified encrusting sponges	<b>Invertebrates</b>
<b>Algae</b> <i>Dictyota spp.</i> <i>Lobophora variegatta</i> <i>Sargassum hystrix</i> <i>Halimeda sp.</i>	<b>Algae</b> <i>Dictyota spp.</i> <i>Sargassum hystrix</i> <i>Lobophora variegatta</i> <i>Schizothrix calcicula</i> <i>Udotea cyathiformis</i> Rhodolith, <i>cf. Lithothamnion ruptile</i>

<sup>1</sup>Total search time for artificial reef was 20 minutes.

<sup>2</sup>Fish that were not recorded by the diver but were observed in the video or photos, so are not included in the timed search results.



**Table 4.** List of species that were associated with **Target 22** (steel debris) and those that were encountered in the surrounding area but not directly associated with the artificial reef, 2002.

Associated with artificial reef	Surrounding area
<p><b>Fish Species</b></p> <p>Bar jack, <i>Caranx ruber</i>                      Spotfin butterflyfish, <i>Chaetodon ocellatus</i>                      Gray angelfish, <i>Pomacanthus arcuatus</i>                      Queen angelfish, <i>Holacanthus ciliaris</i>                      Queen triggerfish, <i>Balistes vetula</i>                      Red hind, <i>Epinephelus guttatus</i>                      Graysby, <i>Cephalopholis cruentatus</i>                      Coney, <i>Cephalopholis fulva</i>                      Bluestriped grunt, <i>Haemulon sciurus</i>                      Lane snapper, <i>Lutjanus synagris</i>                      Gray snapper, <i>Lutjanus griseus</i>                      Blue tang, <i>Acanthurus coeruleus</i>                      Doctorfish, <i>Acanthurus chirurgus</i>                      Ocean surgeonfish, <i>Acanthurus bahianus</i>                      Blue chromis juv., <i>Chromis cyanea</i>                      Brown chromis, <i>Chromis multilineata</i>                      Bicolor damsselfish, <i>Stegastes partitus</i>                      Squirrelfish, <i>Holocentrus adscensionis</i>                      Glasseye snapper, <i>Heteropriacanthus cruentatus</i>                      Redband parrotfish, <i>Sparisoma aurofrenatum</i>                      Spanish hogfish, <i>Bodianus rufus</i>                      Clown wrasse, <i>Halichoeres maculipinna</i>                      Bluehead, <i>Thalassoma bifasciatum</i>                      Spotted goatfish, <i>Pseudupeneus maculatus</i>                      Yellow goatfish, <i>Mulloidichthys martinicus</i>                      Sharpnose puffer, <i>Canthigaster rostrata</i>                      Green moray, <i>Gymnothorax funebris</i>                      Spotted moray, <i>Gymnothorax moringa</i>                      Remora, <i>Echeneis naucrates</i>                      Nurse shark, <i>Ginglymostoma cirratum</i></p>	<p><b>Fish Species</b></p> <p>Bridled goby, <i>Coryphopterus glaucofraenum</i></p>
<p><b>Invertebrates</b></p> <p>Fire coral, <i>Millepora</i> sp.                      Unidentified hydroids                      Maze coral, <i>Meandrina meandrites</i>                      Starlet coral, <i>Siderastrea siderea</i>                      Finger coral, <i>Porites porites</i>                      Sea plume, <i>Pseudopterogorgia</i> sp.                      Queen conch, <i>Strombus gigas</i>                      Milk conch, <i>Strombus costatus</i>                      Long spine urchin, <i>Diadema antillarum</i></p>	<p><b>Invertebrates</b></p> <p>Unidentified hydroids                      Rope sponge, <i>Aplysina fulva</i></p>

**Table 4.** Continued.

Associated with artificial reef	Surrounding area
<b>Invertebrates</b> Feather duster, <i>Sabellastarte magnifica</i> Star encrusting sponge, <i>Halisarca</i> sp. Octopus sponge, <i>Ectyoplasia ferox</i> Branching tube sponge, <i>Pseudoceratina crassa</i> Stinker sponge, <i>Ircinia felix</i> Rope sponge, <i>Aplysina</i> sp. <b>Unidentified tunicates</b>	<b>Invertebrates</b>
<b>Algae</b> Encrusting coralline algae <i>Dictyota</i> sp. <i>Halimeda</i> sp.	<b>Algae</b> <i>Avrainvillea</i> sp. <i>Dictyota</i> sp. Rhodoliths, cf. <i>Lithothamnion reptile</i> <i>Halimeda tuna</i> <i>Halimeda</i> sp. <i>Udotea cyathiformis</i> <i>Penicillus pyriformis</i>
<b>Fish species found in the fish traps nearby</b>	
Ocean surgeonfish, <i>Acanthurus bahianus</i> Doctorfish, <i>Acanthurus chirurgus</i> Blue tang, <i>Acanthurus coeruleus</i> Queen triggerfish, <i>Balistes vetula</i> Queen angelfish, <i>Holocanthus ciliaris</i> Squirrelfish, <i>Holocentrus adscensionis</i>	

**Table 5.** List of species that were associated with **Target 22** (steel debris) and those that were encountered in the surrounding area but not directly associated with the artificial reef, 2004.

Associated with artificial reef			Surrounding area
Fish Species	Count	<sup>1</sup> fish/min (N=1)	Fish Species
<i>Pomacanthus arcuatus</i>	1	0.05	<i>Ocyurus chrysurus</i> <i>Lutjanus synagris</i> <i>Caranx latus</i>
<i>Holacanthus tricolor</i> <sup>2</sup>			
<i>Caranx ruber</i>	30	1.50	
<i>Balistes vetula</i>	3	0.15	
<i>Acanthurus chirurgus</i>	12	0.60	
<i>Acanthurus coeruleus</i>	10	0.50	
<i>Holocentrus adscensionis</i>	50	2.50	
<i>Anisotremus virginicus</i> <sup>2</sup>			
<i>Haemulon carbonarium</i>	8	0.40	
<i>Epinephelus guttatus</i>	2	0.10	
<i>Hypoplectrus puella</i>	3	0.15	
<i>Pseudupeneus maculatus</i>	10	0.50	
<i>Stegastes partitus</i> <sup>2</sup>			
<i>Chromis cyanea</i>	24	1.20	
<i>Chromis multilineata</i>	30	1.50	
<i>Thalassoma bifasciatum</i>	42	2.10	
<i>Halichoeres maculipinna</i>	2	0.10	
<i>Bodianus rufus</i>	3	0.15	
<i>Scarus taeniopterus</i>	11	0.55	
<i>Sparisoma iserti</i>	5	0.25	
<b>Cumulative</b>	<b>246</b>	<b>12.30</b>	
<b>Invertebrates</b>			<b>Invertebrates</b>
<i>Millepora alcicornis</i>			<i>Agelas conifera</i> <i>Ircinia felix</i> <i>Aplysina cauliformis</i> <i>Amphimedon compressa</i> <i>Ectyoplasia ferox</i>
<i>Siderastrea radians</i>			
<i>Montastraea cavernosa</i>			
<i>Montastraea annularis</i>			
<i>Diploria strigosa</i>			
<i>Madracis decactis</i>			
<i>Madracis mirabilis</i>			
<i>Porites astreoides</i>			
<i>Agaricia sp.</i>			
<i>Scolymia sp.</i>			
<i>Carijoa riisei</i>			
<i>Pseudopterogorgia americana</i>			
<i>Pseudopterogorgia sp.</i>			
<i>Strombus gigas</i>			
<i>Strombus costatus</i>			
<i>Spirobranchus giganteus</i>			

**Table 5. Continued.**

Associated with artificial reef	Surrounding area
<b>Invertebrates</b>	<b>Invertebrates</b>
<i>unidentified sabellids</i> <i>Aplysina fistularis</i> <i>Aplysina cauliformis</i> <i>Calyspongia vaginalis</i> <i>Monanchora unguifera</i> <i>Verongula gigantea</i> <i>Ircinia strobilina</i> <i>Ircinia felix</i> <i>Halisarca sp.</i> unidentified encrusting sponges	
<b>Algae</b>	<b>Algae</b>
<i>Dictyota spp.</i> <i>Lobophora variegatta</i> <i>Halimeda spp.</i> <i>Sargassum hystrix</i> <i>Schizothrix calcicula</i>	<i>Halimeda sp.</i> <i>Lobophora variegatta</i> <i>Schizothrix calcicula</i> <i>Udotea sp.</i> <i>Udotea cyathiformis</i> <i>Rhodolith, cf. Lithothamnion ruptile</i>

**Table 6.** List of species associated with **Target 25** (steel barge) and those found in the surrounding area adjacent to but not on the artificial reef, 2002.

<b>Associated with artificial reef</b>	<b>Surrounding area</b>
<p><b>Fish Species</b></p> <p>Bar jack, <i>Caranx ruber</i>                      White margate, <i>Haemulon album</i>                      Tomtate, <i>Haemulon aurolineatum</i>                      French grunt, <i>Haemulon flavolineatum</i>                      White grunt, <i>Haemulon plumieri</i>                      Cottonwick, <i>Haemulon melanurum</i>                      Vermilion snapper, <i>Rhomboplites aurorubens</i>                      Yellowtail snapper, <i>Ocyurus chrysurus</i>                      Saucereye porgy, <i>Calamus calamus</i>                      Rock hind, <i>Epinephelus adscensionis</i>                      Blue tang, <i>Acanthurus coeruleus</i>                      Ocean surgeon fish, <i>Acanthurus bahianus</i>                      Blue chromis, <i>Chromis cyanea</i>                      Brown chromis, <i>Chromis multilineata</i>                      Bicolor damselfish, <i>Stegastes partitus</i>                      Fairy basslet, <i>Gramma loreto</i>                      Squirrelfish, <i>Holocentrus adscensionis</i>                      Blackbar soldierfish, <i>Myripristis jacobus</i>                      Glassy sweeper, <i>Pempheris schomburgki</i>                      Queen parrotfish, <i>Scarus vetula</i>                      Blue parrotfish, <i>Scarus coeruleus</i>                      Redband parrotfish, <i>Sparisoma aurofrenatum</i>                      Stoplight parrotfish, <i>Sparisoma viride</i>                      Spanish hogfish, <i>Bodianus rufus</i>                      Bluehead, <i>Thalassoma bifasciatum</i>                      Yellowhead wrasse, <i>Halichoeres garnoti</i>                      French angelfish, <i>Pomacanthus paru</i>                      Gray angelfish, <i>Pomacanthus arcuatus</i>                      Yellow goatfish, <i>Mulloidichthys martinicus</i>                      Sharpnose puffer, <i>Canthigaster rostrata</i></p>	<p><b>Fish Species</b></p> <p>Bar jack, <i>Caranx ruber</i>                      Chalky bass, <i>Serranus tortugarum</i>                      Sand tilefish, <i>Malacanthus plumieri</i>                      Southern stingray, <i>Dasyatis americana</i></p>
<p><b>Invertebrates</b></p> <p>Fire coral, <i>Millepora</i> sp.                      Bush hydroid, <i>Dentitheca dendritica</i>                      Unidentified hydroids                      Brain coral, <i>Diploria</i> sp.                      Starlet coral, <i>Siderastrea</i> sp.                      Deepwater sea fan, cf. <i>Iciligorgia schrammi</i>                      Wire coral, <i>Cirrhopathes leutkeni</i>                      Unidentified tunicates                      Unidentified bryozoans                      Star encrusting sponge, <i>Halisarca</i> sp.</p>	<p><b>Invertebrates</b></p> <p>Rope sponge, <i>Aplysina fulva</i>                      Branching tube sponge, <i>Pseudoceratina</i> sp.</p>

**Table 6. Continued.**

<b>Associated with artificial reef</b>	<b>Surrounding area</b>
<b>Invertebrates</b>	<b>Invertebrates</b>
Row pore rope sponge, <i>Aplysina cauliformis</i> Scattered pore rope sponge, <i>Aplysina fulva</i> Branching tube sponge, <i>Pseudoceratina</i> sp. <b>West Indian sea egg, <i>Tripneustes ventricosus</i></b>	
<b>Algae</b>	<b>Algae</b>
Crustose coralline algae <i>Sargassum</i> sp. <i>Halimeda</i> sp. <i>Dictyota</i> sp. <i>Ventricaria ventricosa</i>	<i>Avrainvillea</i> sp. <i>Lobophora variegata</i> <i>Sargassum</i> sp. Rhodolith, cf. <i>Lithothamnion ruptile</i> <i>Penicillus pyriformis</i>

**Table 7.** List of species that were associated with **Target 25** (steel barge) and those that were encountered in the surrounding habitat but not directly associated with the artificial reef structure, 2004.

Associated with artificial reef			Surrounding area
Fish Species	Count	<sup>1</sup> fish/min (N=1)	Fish Species
<i>Pomacanthus arcuatus</i>	1	0.05	not surveyed
<i>Pomacanthus paru</i>	2	0.10	
<i>Holacanthus ciliaris</i>	1	0.05	
<i>Amblycirrhitus pinos</i> <sup>2</sup>			
<i>Coryphopterus sp.2</i>			
<i>Gramma loreto</i> <sup>2</sup>			
<i>Acanthurus bahianus</i>	4	0.20	
<i>Acanthurus coeruleus</i>	16	0.80	
<i>Holocentrus adscensionis</i>	25	1.25	
<i>Ocyurus chrysurus</i>	12	0.60	
<i>Haemulon aurolineatum</i>	25	1.25	
<i>Epinephelus guttatus</i>	1	0.05	
<i>Cephalopholis cruentatus</i> <sup>2</sup>			
<i>Cephalopholis fulva</i> <sup>2</sup>			
<i>Paranthias furcifer</i> <sup>2</sup>			
<i>Hypoplectrus sp.2</i>			
<i>Pseudupeneus maculatus</i>	12	0.60	
<i>Pempheris schomburgki</i>	50	2.50	
<i>Chromis multilineata</i>	30	1.50	
<i>Stegastes partitus</i>	30	1.50	
<i>Thalassoma bifasciatum</i>	50	2.50	
<i>Halichoeres radiatus</i> <sup>2</sup>			
<i>Bodianus rufus</i> <sup>2</sup>			
<i>Scarus iserti</i>	5	0.25	
<i>Caranx ruber</i> <sup>2</sup>			
Cumulative	<b>264</b>	<b>13.20</b>	
<b>Invertebrates</b>			<b>Invertebrates</b>
<i>Millepora alcicornis</i>			<i>Ircinia strobilina</i>
<i>Siderastrea sp.</i>			<i>Aplysina cauliformis</i>
<i>Manicina areolata</i>			<i>Aplysina fulva</i>
<i>Porites astreoides</i>			<i>Pseudoceratina crassa</i>
<i>Agaricia sp.</i>			<i>Amphimedon compressa</i>
<i>Cirripathes leutkeni</i>			<i>Strombus costatus</i>
<i>cf. Antipathes atlantica</i>			
<i>Carijoa riisei</i>			
<i>Pseudopterogorgia sp.</i>			
<i>Diodogorgia nodulifera</i>			
<i>Spirobranchus giganteus</i>			
unidentified sabellids			

**Table 7. Continued.**

Associated with artificial reef	Surrounding area
<b>Invertebrates</b> <i>Lima scabra</i> <i>Aplysina fulva</i> <i>Aplysina cauliformis</i> <i>Amphimedon compressa</i> <i>Holopsamma helwigi</i> <i>Pseudoceratina crassa</i> <i>Ircinia strobilina</i> <i>Halisarca sp.</i> unidentified encrusting sponges	<b>Invertebrates</b>
<b>Algae</b> <i>Dictyota spp.</i> <i>Lobophora variegatta</i> <i>Sargassum sp.</i> <i>Halimeda sp.</i> <i>Caulerpa racemosa</i> <i>Penicillus sp.</i> unidentified crustose coralline algae	<b>Algae</b> <i>Dictyota spp.</i> <i>Sargassum hystrix</i> <i>Lobophora variegatta</i> <i>Schizothrix calcicula</i> <i>Halimeda sp.</i> <i>Udotea cyathiformis</i> <i>Rhodolith, cf. Lithothamnion ruptile</i>

<sup>1</sup>Total search time for artificial reef was 20 minutes.

<sup>2</sup>Fish that were not recorded by the diver but were observed in the video or photos, so are not included in the timed search results.



**Table 8.** List of species that were associated with **Target 25** (steel barge) and those that were encountered in the surrounding habitat but not directly associated with the artificial reef structure, 2005.

Associated with artificial reef			Surrounding area
Fish Species	Count	<sup>1</sup> fish/min (N=1)	Fish Species
<i>Pomacanthus arcuatus</i>	2	0.20	<i>Pseudupeneus maculatus</i> <i>Stegastes partitus</i>
<i>Holacanthus tricolor</i>	2	0.20	
<i>Acanthurus chirurgus</i>	12	1.20	
<i>Holocentrus adscensionis</i>	34	3.40	
<i>Ocyurus chrysurus</i>	34	3.40	
<i>Haemulon aurolineatum</i>	6	0.60	
<i>Pseudupeneus maculatus</i>	15	1.50	
<i>Abudefduf saxatilis</i>	4	0.40	
<i>Chromis multilineata</i>	140	14.00	
<i>Thalassoma bifasciatum</i>	8	0.80	
<i>Bohiadus rufus</i>	5	0.50	
<i>Sparisoma viride</i>	1	0.10	
<i>Scarus iserti</i>	6	0.60	
<i>Sparisoma sp.</i>	2	0.20	
<i>Caranx ruber</i>	2	0.20	
<b>Cumulative</b>	<b>273</b>	<b>27.30</b>	
Invertebrates			Invertebrates
<i>Millepora alcicornis</i>			<i>Pseudopterogorgia americana</i> <i>Pseudopterogorgia sp.</i> <i>Aplysina cauliformis</i> <i>Aplysina fulva</i> <i>Amphimedon compressa</i>
<i>Cirripathes leutkeni</i>			
cf. <i>Antipathes atlantica</i>			
<i>Siderastrea siderea</i>			
<i>Rhizopsammia goesi</i>			
<i>Porites astreoides</i>			
<i>Pseudopterogorgia sp.</i>			
<i>Carijoa riisei</i>			
<i>Ellisella barbadensis</i>			
<i>Aplysina fulva</i>			
<i>Aplysina cauliformis</i>			
<i>Halisarca sp.</i>			
<i>Pseudoceratina crassa</i>			
<i>Amphimedon compressa</i>			
<i>Ircinia strobilina</i>			
<i>Monanchora barbadensis</i>			
<i>Agaricia sp.</i>			
<i>Manicina areolata</i>			
<i>Diodogorgia nodulifera</i>			
<i>Spirobranchus giganteus</i>			
<i>Spheciospongia cuspidifera</i>			
<i>Lima scabra</i>			

**Table 8. Continued.**

Associated with artificial reef	Surrounding area
<p><b>Algae</b></p> <p><i>Dictyota spp.</i>  <i>Lobophora variegatta</i>  <i>Halimeda goreau</i>  <i>Halimeda opuntia</i>  <i>Halimeda tuna</i>  <i>Halimeda discoidea</i>  <i>Codium isthmocladum</i>  <i>Sargassum hystrix</i></p>	<p><b>Algae</b></p> <p><i>Dictyota spp.</i>  <i>Sargassum hystrix</i>  <i>Lobophora variegatta</i>  <i>Schizothrix calcicula</i>  <i>Udotea cyathiformis</i>            Rhodolith, cf. <i>Lithothamnion ruptile</i></p>

<sup>1</sup> Total search time for artificial reef was 10 minutes

**Table 9.** List of organisms that were associated with **Target 30** (steel debris) and organisms that were found in the surrounding area but not directly associated with the steel debris, 2002.

<b>Associated with artificial reef</b>	<b>Surrounding area</b>
<p><b>Fish Species</b></p> <p>Bar jack, <i>Caranx ruber</i>            Queen triggerfish, <i>Balistes vetula</i>            Queen angelfish, <i>Holacanthus ciliaris</i>            Gray angelfish, <i>Pomacanthus arcuatus</i>            Spotfin butterflyfish, <i>Chaetodon ocellatus</i>            Tomtate, <i>Haemulon aurolineatum</i>            White grunt, <i>Haemulon plumierii</i>            Mutton snapper, <i>Lutjanus analis</i>            Gray snapper, <i>Lutjanus griseus</i>            Schoolmaster, <i>Lutjanus apodus</i>            Butter hamlet, <i>Hypoplectrus unicolor</i>            Rock hind, <i>Epinephelus adscensionis</i>            Red hind, <i>Epinephelus guttatus</i>            Ocean surgeon fish, <i>Acanthurus bahianus</i>            Doctorfish, <i>Acanthurus chirurgus</i>            Blue chromis, <i>Chromis cyanea</i>            Brown chromis, <i>Chromis multilineata</i>            Sergeant major, <i>Abudefduf saxatilis</i>            Cocoa damselfish, <i>Stegastes variabilis</i>            Beaugregory, <i>Stegastes leucostictus</i>            Bicolor damselfish, <i>Stegastes partitus</i>            Glasseye snapper, <i>Heteropriacanthus cruentatus</i>            Squirrelfish, <i>Holocentrus adscensionis</i>            Striped parrotfish, <i>Scarus iserti</i>            Redband parrotfish, <i>Sparisoma aurofrenatum</i>            Stoplight parrotfish, <i>Sparisoma viride</i>            Spanish hogfish, <i>Bodianus rufus</i>            Hogfish, <i>Lachnolaimus maximus</i>            Creole wrasse, <i>Clepticus parrae</i>            Spotted goatfish, <i>Pseudupeneus maculatus</i>            Masked goby, <i>Coryphopterus personatus</i></p>	<p><b>Fish Species</b></p> <p>Cesar grunt, <i>Haemulon carbonarium</i>            Coney, <i>Cephalopholis fulva</i>            Doctorfish, <i>Acanthurus chirurgus</i>            Sand tilefish, <i>Malacanthus plumieri</i>            Bicolor damselfish, <i>Stegastes partitus</i>            Yellow goatfish, <i>Mulloidichthys martinicus</i></p>
<p><b>Invertebrates</b></p>	<p><b>Invertebrates</b></p>
<p>Caribbean spiny lobster, <i>Panulirus argus</i>            Pederson's shrimp, <i>Periclimenes pedersoni</i>            Arrow crab, <i>Stenorhynchus seticornis</i>            Giant anemone, <i>Condylactis gigantea</i>            Magnificent feather duster, <i>Sabellastarte magnifica</i>            Fire coral, <i>Millepora</i> spp.            Bush hydroid, <i>Dentitheca dendritica</i>            Feather hydroid, <i>Gymnangium speciosum</i></p>	<p>Rope sponge, <i>Aplysina fulva</i>            Branching tube sponge, <i>Pseudoceratina</i> sp.</p>

**Table 9. Continued.**

Associated with artificial reef	Surrounding area
<p><b>Invertebrates</b></p> <p>Unidentified hydroids            Brain coral, <i>Diploria</i> spp.            Grooved brain coral, <i>Diploria labyrinthiformis</i>            Starlet coral, <i>Siderastrea siderea</i>            Lettuce/ sheet coral, <i>Agaricia</i> spp.            Maze coral, <i>Meandrina meandrites</i>            Flower coral, <i>Meandrina areolata</i>            Unidentified tunicates            Unidentified bryozoans            Star encrusting sponge, <i>Halisarca</i> sp.            Octopus sponge, <i>Ectyoplasia ferox</i>            Overgrowing sponge, <i>Holopsamma helwigi</i>            Stinker sponge, <i>Ircinia felix</i>            Vase sponge, <i>Callyspongia plicifera</i>            Row pore rope sponge, <i>Aplysina cauliformis</i>            Scattered pore rope sponge, <i>Aplysina fulva</i>            Convoluted barrel sponge, <i>Aplysina lacunosa</i></p>	<p><b>Invertebrates</b></p>
<p><b>Algae</b></p> <p>Crustose coralline algae  <i>Halimeda</i> spp.  <i>Dictyota</i> spp.  <i>Lobophora variegata</i>  <i>Ventricaria ventricosa</i>  <i>Schizothrix calcicola</i></p>	<p><b>Algae</b></p> <p><i>Avrainvillea</i> sp.  <i>Wrangelia penicillata</i>  <i>Schizothrix calcicola</i>  <i>Halimeda</i> spp.  <i>Lobophora variegata</i>            Rhodolith, cf. <i>Lithothamnion ruptile</i>  <i>Penicillus pyriformis</i></p>

**Table 10.** List of species that were associated with **Target 30** (steel debris) and those that were encountered in the surrounding habitat but not directly associated with the artificial reef structure, 2005.

Associated with artificial reef			Surrounding area
Fish Species	Count	<sup>1</sup> fish/min (N=1)	Fish Species
<i>Pomacanthus arcuatus</i>	1	0.10	<i>Heteroconger longissimus</i>
<i>Acanthurus chirurgus</i>	12	1.20	<i>Stegastes planifrons</i>
<i>Acanthurus bahianus</i>	6	0.60	<i>Stegastes partitus</i>
<i>Chaetodon capistratus</i>	3	0.30	
<i>Chaetodon striatus</i>	1	0.10	
<i>Holocentrus adscensionis</i>	26	2.60	
<i>Lutjanus analis</i>	2	0.20	
<i>Lutjanus jocu</i>	1	0.10	
<i>Lutjanus apodus</i>	4	0.40	
<i>Ocyurus chrysurus</i>	42	4.20	
<i>Anisotremus surinamensis</i>	1	0.10	
<i>Haemulon aurolineatum</i>	60	6.00	
<i>Cephalopholis fulva</i>	2	0.20	
<i>Pseudupeneus maculatus</i>	16	1.60	
<i>Chromis cyanea</i>	36	3.60	
<i>Chromis multilineata</i>	50	5.00	
<i>Stegastes partitus</i>	24	2.40	
<i>Halichoeres radiatus</i>	2	0.20	
<i>Thalassoma bifasciatum</i>	17	1.70	
<i>Bodianus rufus</i>	3	0.30	
<i>Halichoeres garnoti</i>	8	0.80	
<i>Scarus iserti</i>	22	2.20	
<i>Sparisoma sp.</i>	6	0.60	
<i>Sparisoma viride</i>	6	0.60	
<i>Caranx ruber</i>	2	0.20	
<i>Caranx latus</i>	10	1.00	
<i>Balistes capricus</i>	2	0.20	
<i>Scomberomorus regalis</i>	1	0.10	
<i>Heteropriacanthus cruentatus</i>	8	0.80	
<b>Cumulative</b>	<b>374</b>	<b>37.40</b>	
<b>Invertebrates</b>			<b>Invertebrates</b>
<i>Aplysina cauliformis</i>			<i>Aplysina cauliformis</i>
<i>Aplysina fulva</i>			<i>Ircinia strobilina</i>
<i>Callyspongia vaginialis</i>			
<i>Calyx podatypa</i>			
<i>Carijoa riisei</i>			
<i>Diplastrella sp.</i>			
<i>Diploria strigosa</i>			
<i>Eumilia fastigiana</i>			
<i>Eunicea sp.</i>			

**Table 10. Continued.**

Associated with artificial reef	Surrounding area
<b>Invertebrates</b>	<b>Invertebrates</b>
<i>Holopsamma helwigi</i> <i>Ircinia felix</i> <i>Millepora alcicornis</i> <i>Millepora complanata</i> <i>Montastrea annularis</i> <i>Montastrea cavernosa</i> <i>Mycetophyllia sp.</i> <i>Niphates digitalis</i> <i>Panulirus argus</i> 2 <i>Porites astreoides</i> <i>Porites porites</i> <i>Pseudoceratina crassa</i> <i>Siderastrea radians</i> <i>Strombus gigas</i> 12	
<b>Algae</b>	<b>Algae</b>
<i>Dictyota spp.</i> <i>Halimeda tuna</i> <i>Halimeda discoidea</i> <i>Sargassum sp.</i> <i>Lobophora variegatta</i> <i>Halisarca sp.</i> <i>Padina jamaicensis</i>	<i>Halimeda sp.</i> <i>Padina jamaicensis</i> <i>Lobophora variegatta</i> <i>Avrainvillea sp.</i> <i>Sargassum sp.</i> <i>Udotea sp.</i>

<sup>1</sup> Total search time for artificial reef was 10 minutes

**Table 11.** List of species that were associated with **Target 32** (fiberglass and wood hull boat) and those that were encountered in the surrounding area but not directly associated with the artificial reef, 2002.

Associated with artificial reef	Surrounding area
<p><b>Fish Species</b></p> <p>Barracuda, <i>Sphyraena barracuda</i>            Mutton snapper, <i>Lutjanus analis</i>            Rock hind, <i>Epinephelus adscensionis</i>            Tomtate, <i>Haemulon aurolineatum</i>            White margate, <i>Haemulon album</i>            Ocean surgeonfish, <i>Acanthurus bahianus</i>            Blue chromis, <i>Chromis cyanea</i>            Brown chromis, <i>Chromis multilineata</i>            Cocoa damsel, <i>Stegastes variabilis</i>            Bicolor damselfish, <i>Stegastes partitus</i>            Bluehead, <i>Thalassoma bifasciatum</i>            Blackbar soldierfish, <i>Myripristis jacobus</i>            Squirrelfish, <i>Holocentrus adscensionis</i>            Queen triggerfish, <i>Balistes vetula</i>            Yellow goatfish, <i>Mulloidichthys martinicus</i>            Green turtle, <i>Chelonia mydas</i></p>	<p><b>Fish Species</b></p> <p>Bridled goby, <i>Coryphopterus glaucofraenum</i>            Yellowhead jawfish, <i>Opistognathus aurifrons</i>            Tobaccofish, <i>Serranus tabacarius</i>            Yellowhead wrasse, <i>Halichoeres garnoti</i></p>
<p><b>Invertebrates</b></p> <p>Fire coral, <i>Millepora alcicornis</i>            Unidentified hydroids            Feather hydroid, <i>Gymnangium</i> sp.            Algae hydroid, <i>Thyrosocyphus ramosus</i>            Brain coral, <i>Diploria</i> sp.            Starlet coral, <i>Siderastrea siderea</i>            Unidentified bryozoans            Star encrusting sponge, <i>Halisarca</i> sp.            Row pore rope sponge, <i>Aplysina cauliformis</i>            Branching tube sponge, <i>Pseudoceratina</i> sp.            Queen conch, <i>Strombus gigas</i>            Spiny lobster, <i>Panulirus argus</i>            Pederson cleaner shrimp, <i>Periclimenes pedersoni</i>            Corkscrew anemone, <i>Bartholomea annulata</i>            Arrow crab, <i>Stenorhynchus seticornis</i></p>	<p><b>Invertebrates</b></p> <p>Rope sponge, <i>Aplysina fulva</i>            Branching vase sponge, <i>Callyspongia vaginalis</i>            Branching tube sponge, <i>Pseudoceratina crassa</i>            Barrel sponge, <i>Xestospongia muta</i></p>
<p><b>Algae</b></p> <p><i>Wrangelia penicillata</i>  <i>Dictyota</i> sp.</p>	<p><b>Algae</b></p> <p>Rhodolith, cf. <i>Lithothamnion ruptile</i>  <i>Avrainvillea</i> sp.  <i>Wrangelia penicillata</i>            cf. <i>Amphiroa rigida</i>  <i>Halimeda</i> sp.  <i>Penicillus pyriformis</i></p>

**Table 12.** List of species that were associated with **Target 32** (fiberglass and wood hull boat) and those that were encountered in the surrounding area but not directly associated with the artificial reef, 2005.

Associated with artificial reef			Surrounding area
Fish Species	Count	<sup>1</sup> fish/min (N=1)	Fish Species
<i>Balistes vetula</i>	2	0.20	<i>Stegastes partitus</i> <i>Caranx ruber</i> <i>Dasyatis americana</i>
<i>Acanthurus chirurgus</i>	8	0.80	
<i>Acanthurus bahianus</i>	10	1.00	
<i>Holocentrus adscensionis</i>	26	2.60	
<i>Haemulon carbonarium</i>	14	1.40	
<i>Haemulon aurolineatum</i>	100	10.00	
<i>Serranus tigrinus</i>	1	0.10	
<i>Pseudupeneus maculatus</i>	12	1.20	
<i>Chromis cyanea</i>	24	2.40	
<i>Stegastes partitus</i>	12	1.20	
<i>Thalassoma bifasciatum</i>	8	0.80	
<i>Lachnolaimus maximus</i>	1	0.10	
<i>Scarus iserti</i>	8	0.80	
<i>Caranx ruber</i>	18	1.80	
<i>Gramma loreto</i>	8	0.80	
<b>Cumulative</b>	<b>252</b>	<b>25.20</b>	
<b>Invertebrates</b>			<b>Invertebrates</b>
<i>Agelas conifera</i>			<i>Montastraea annularis</i> <i>Aplysina cauliformis</i> <i>Aplysina fulva</i>
<i>Aplysina fistularis</i>			
<i>Aplysina fulva</i>			
<i>Callyspongia vaginalis</i>			
<i>Calyx podatypa</i>			
<i>Halisarca sp.</i>			
<i>Ircinia felix</i>			
<i>Ircinia strobilina</i>			
<i>Millepora alcicornis</i>			
<i>Porites astreoides</i>			
<i>Siderastrea radians</i>			
<b>Algae</b>			<b>Algae</b>
<i>Dictyota spp.</i>			<i>Dictyota spp.</i> <i>Sargassum hystrix</i> <i>Lobophora variegatta</i> <i>Udotea cyathiformis</i> Rhodolith, cf. <i>Lithothamnion</i> <i>ruptile</i>
<i>Halimeda sp.</i>			
<i>Udotea sp.</i>			

<sup>1</sup> Total search time for artificial reef was 10 minutes



**Table 13.** List of species that were associated with **Target 38** (antennae tower) and those that were encountered in the surrounding area but not directly associated with the artificial reef, 2003.

<b>Associated with artificial reef</b>	<b>Surrounding area</b>
<p><b>Fish species</b></p> <p>Blue tang, <i>Acanthurus coeruleus</i>                      Doctorfish, <i>Acanthurus chirurgus</i>                      Caesar grunt, <i>Haemulon carbonarium</i>                      White margate, <i>Haemulon album</i>                      Tomtate, <i>Haemulon aurolineatum</i>                      Bluestriped grunt, <i>Haemulon sciurus</i>                      Bicolor damselfish, <i>Stegastes partitus</i>                      Blue chromis, <i>Chromis cyanea</i>                      Graysby, <i>Cephalopholis cruentatus</i>                      Yellowmouth grouper, <i>Mycteroperca interstitialis</i>                      Squirrelfish, <i>Holocentrus adscensionis</i>                      Bluehead wrasse, <i>Thalassoma bifasciatum</i>                      Stoplight parrotfish, <i>Sparisoma viride</i>                      Queen angelfish, <i>Holacanthus ciliaris</i>                      Gray angelfish, <i>Pomacanthus arcuatus</i>                      Sharpnose puffer, <i>Canthigaster rostrata</i>                      Spotfin butterflyfish, <i>Chaetodon ocellatus</i>                      Sharknose goby, <i>Elacatinus evelynae</i>                      Southern stingray, <i>Dasyatis Americana</i>                      Green sea turtle, <i>Chelonia mydas</i></p>	<p><b>Fish species</b></p> <p>Yellowtail snapper, <i>Ocyurus chrysurus</i>                      White margate, <i>Haemulon album</i>                      Blue tang, <i>Acanthurus coeruleus</i>                      Yellowhead jawfish, <i>Opistognathus aurifrons</i></p>
<p><b>Invertebrates</b></p> <p><i>Porites porites</i>  <i>Porites astreoides</i>  <i>Madracis decactis</i>  <i>Montastraea annularis</i>  <i>Montastraea cavernosa</i>  <i>Millepora alcicornis</i>  <i>Meandrina meandrites</i>  <i>Diploria strigosa</i>                      Agaricia sp.  <i>Rhizopsammia goesi</i>  <i>Ircinia felix</i>  <i>Ircinia strobilina</i>                      Cinachyra sp.                      Halisarca sp.  <i>Aplysina cauliformis</i>  <i>Agelas conifera</i>  <i>Monanchora unguifera</i>  <i>Amphimedon compressa</i></p>	<p><b>Invertebrates</b></p> <p>Rhodoliths, cf. <i>Lithothamnion ruptile</i>  <i>Ircinia felix</i>  <i>Aplysina cauliformis</i></p>

**Table 13. Continued.**

<b>Associated with artificial reef</b>	<b>Surrounding area</b>
<b>Invertebrates</b>	<b>Invertebrates</b>
Unidentified hydroids Unidentified tunicates	
<b>Algae</b>	<b>Algae</b>
<i>Dictyota</i> sp. <i>Lobophora variegata</i>	<i>Udotea cyathiformis</i> <i>Halimeda opuntia</i> <i>Halimeda tuna</i> <i>Halimeda discoidea</i> <i>Sargassum</i> sp.

**Table 14.** List of species that were associated with **Target 42** (concrete slabs) and those that were encountered in the surrounding area but not directly associated with the artificial reef, 2002.

Associated with artificial reef	Surrounding area
<p><b>Fish Species</b></p> <p>Bar jack, <i>Caranx ruber</i>                      Queen triggerfish, <i>Balistes vetula</i>                      White margate, <i>Haemulon album</i>                      Tomtate, <i>Haemulon aurolineatum</i>                      French grunt, <i>Haemulon flavolineatum</i>                      White grunt, <i>Haemulon plumieri</i>                      Caesar grunt, <i>Haemulon carbonarium</i>                      Spanish grunt, <i>Haemulon macrostomum</i>                      Dog snapper, <i>Lutjanus jocu</i>                      Gray snapper, <i>Lutjanus griseus</i>                      Rock hind, <i>Epinephelus adscensionis</i>                      Red hind, <i>Epinephelus guttatus</i>                      Coney, <i>Cephalopholis fulva</i>                      Foureye butterflyfish, <i>Chaetodon capistratus</i>                      Blue tang, <i>Acanthurus coeruleus</i>                      Ocean surgeon fish, <i>Acanthurus bahianus</i>                      Doctorfish, <i>Acanthurus chirurgus</i>                      Blue chromis, <i>Chromis cyanea</i>                      Brown chromis, <i>Chromis multilineata</i>                      Bicolor damselfish, <i>Stegastes partitus</i>                      Glasseye snapper, <i>Heteropriacanthus cruentatus</i>                      Squirrelfish, <i>Holocentrus adscensionis</i>                      Blackbar soldierfish, <i>Myripristis jacobus</i>                      Striped parrotfish, <i>Scarus iserti</i>                      Redband parrotfish, <i>Sparisoma aurofrenatum</i>                      Stoplight parrotfish, <i>Sparisoma viride</i>                      Spanish hogfish, <i>Bodianus rufus</i>                      Bluehead, <i>Thalassoma bifasciatum</i>                      Yellowhead wrasse, <i>Halichoeres garnoti</i>                      Slippery dick, <i>Halichoeres bivittatus</i>                      French angelfish, <i>Pomacanthus paru</i>                      Yellow goatfish, <i>Mulloidichthys martinicus</i>                      Masked goby, <i>Coryphopterus personatus</i>                      Bluestriped lizardfish, <i>Synodus saurus</i>                      Sharpnose puffer, <i>Canthigaster rostrata</i>                      Trumpetfish, <i>Aulostomus maculatus</i></p>	<p><b>Fish Species</b></p> <p>Yellowtail snapper, <i>Ocyurus chrysurus</i>                      Yellowhead jawfish, <i>Opistognathus aurifrons</i>                      Queen triggerfish, <i>Balistes vetula</i>                      Hogfish, <i>Lachnolaimus maximus</i>                      Sand tilefish, <i>Malacanthus plumieri</i>                      Puddingwife, <i>Halichoeres radiatus</i>                      Bicolor damselfish, <i>Stegastes partitus</i></p>

**Table 14. Continued.**

Associated with artificial reef	Surrounding area
<p><b>Invertebrates</b></p> <p>Caribbean spiny lobster, <i>Panulirus argus</i>            Arrow crab, <i>Stenorhynchus seticornis</i>            Queen conch, <i>Strombus gigas</i>            Milk conch, <i>Strombus costatus</i>            Unidentified crinoids            Fire coral, <i>Millepora</i> sp.            Bush hydroid, <i>Dentitheca dendritica</i>            Feather hydroid, <i>Gymnangium speciosum</i>            Unidentified hydroids            Brain coral, <i>Diploria</i> spp.            Grooved brain coral, <i>Diploria labyrinthiformis</i>            Starlet coral, <i>Siderastrea siderea</i>            Great star coral, <i>Montastraea cavernosa</i>            Maze coral, <i>Meandrina meandrites</i>            Flower coral, <i>Meandrina areolata</i>            Finger coral, <i>Porites porites</i>            Tube coral, <i>Cladocora arbuscula</i>            Grooved-blade sea whip, <i>Pterogorgia guadalupensis</i>            Sea rod, <i>Plexaurella</i> spp.            Porous sea rod, <i>Pseudoplexaura</i> spp.            Common sea fan, <i>Gorgonia ventalina</i>            Blue bell tunicate, <i>Clavelina puerto-secensis</i>            Encrusting social tunicates, <i>Symplegma viride</i>            Unidentified tunicates            Unidentified bryozoans            Star encrusting sponge, <i>Halisarca</i> sp.            Overgrowing sponge, <i>Holopsamma helwigi</i>            Stinker sponge, <i>Ircinia felix</i>            Vase sponge, <i>Callyspongia plicifera</i>            Black ball sponge, <i>Ircinia strobilina</i>            Row pore rope sponge, <i>Aplysina cauliformis</i>            Scattered pore rope sponge, <i>Aplysina fulva</i>            Branching tube sponge, <i>Pseudoceratina</i> sp.</p>	<p><b>Invertebrates</b></p> <p>Rope sponge, <i>Aplysina fulva</i>            Black ball sponge, <i>Ircinia strobilina</i>            Stinker sponge, <i>Ircinia felix</i></p>
<p><b>Algae</b></p> <p><i>Schizothrix calcicola</i>            Crustose coralline algae  <i>Sargassum</i> sp.  <i>Halimeda</i> sp.  <i>Dictyota</i> spp.  <i>Ventricaria ventricosa</i></p>	<p><b>Algae</b></p> <p><i>Schizothrix calcicola</i>  <i>Avrainvillea</i> spp.  <i>Padina</i> spp.            Rhodolith, cf. <i>Lithothamnion ruptile</i>  <i>Penicillus pyriformis</i>  <i>Penicillus dumetosus</i></p>

**Table 15.** List of species that were associated with **Target 42** (concrete slabs) and those that were encountered in the surrounding area but not directly associated with the artificial reef, 2004.

Associated with artificial reef			Surrounding area
Fish Species	Count	<sup>1</sup> fish/min (N=1)	Fish Species
<i>Pomacanthus arcuatus</i>	3	0.15	<i>Stegastes partitus</i>
<i>Holacanthus tricolor</i>	1	0.05	<i>Opistognathus aurifrons</i>
<i>Chaetodon capistratus</i>	4	0.20	<i>Coryphopterus glaucofraenum</i>
<i>Balistes vetula</i>	2	0.10	
<i>Acanthurus chirurgus</i>	50	2.50	
<i>Acanthurus coeruleus</i>	20	1.00	
<i>Holocentrus adscensionis</i>	30	1.50	
<i>Lutjanus synagris</i>	2	0.10	
<i>Ocyurus chrysurus</i>	20	1.00	
<i>Haemulon plumierii</i>	10	0.50	
<i>Epinephelus guttatus</i>	2	0.10	
<i>Cephalopholis cruentatus</i>	1	0.05	
<i>Serranus tabacarius</i>	2	0.10	
<i>Hypoplectrus sp.</i>	1	0.05	
<i>Hypoplectrus nigricans</i>	10	0.50	
<i>Heteropriacanthus cruentatus</i>	2	0.10	
<i>Pseudupeneus maculatus</i>	5	0.25	
<i>Equetus lanceolatus</i>	2	0.10	
<i>Stegastes partitus</i>	15	0.75	
<i>Stegastes leucostictus</i> 2			
<i>Chromis cyanea</i>	40	2.00	
<i>Chromis multilineata</i> 2			
<i>Thalassoma bifasciatum</i>	2	0.10	
<i>Halichoeres garnoti</i>	5	0.25	
<i>Clepticus parrae</i>	1	0.05	
<i>Scarus taeniopterus</i>	4	0.20	
<i>Sparisoma viride</i>	8	0.40	
<i>Calamus calamus</i>	1	0.05	
<i>Aulostomus maculatus</i>	2	0.10	
<i>Canthigaster rostrata</i> 2			
<i>Synodus intermedius</i>	1	0.05	
<i>Coryphopterus sp.</i> 2			
<b>Cumulative</b>	<b>246</b>	<b>12.30</b>	
<b>Invertebrates</b>			<b>Invertebrates</b>
<i>Millepora alcicornis</i>			<i>Pseudopterogorgia americana</i>
<i>Siderastrea sp.</i>			<i>Pseudopterogorgia sp.</i>
<i>Montastraea cavernosa</i>			<i>Aplysina cauliformis</i>
<i>Mycetophyllia sp.</i>			<i>Amphimedon compressa</i>
<i>Diploria labyrinthiformis</i>			

**Table 15. Continued.**

Associated with artificial reef	Surrounding area
<p><b>Invertebrates</b></p> <p><i>Diploria sp.</i>  <i>Madracis sp.</i>  <i>Gorgonia mariae</i>  <i>Gorgonia ventalina</i>  <i>Pseudopterogorgia americana</i>  <i>Pseudopterogorgia sp.</i>  <i>Pterogorgia spp.</i>  <i>Pseudoplexaura spp.</i>  <i>Muricea sp.</i>            unidentified gorgonian  <i>Panulirus argus</i>  <i>Periclimenes pedersoni</i>  <i>Strombus costatus</i>  <i>Davidaster rubiginosa</i>  <i>Condylactis gigantea</i>  <i>Bartholomea annulata</i>  <i>Sabellastarte magnifica</i>  <i>Spirobranchus giganteus</i>            unidentified sabellids  <i>Aplysina cauliformis</i>  <i>Aplysina fistularis</i>  <i>Calyspongia sp.</i>  <i>Pseudoceratina crassa</i>  <i>Ircinia strobilina</i>  <i>Ircinia felix</i>  <i>Halisarca sp.</i>            unidentified encrusting sponges</p>	<p><b>Invertebrates</b></p>
<p><b>Algae</b></p>	<p><b>Algae</b></p>
<p><i>Dictyota spp.</i>  <i>Lobophora variegatta</i>  <i>Halimeda spp.</i>  <i>Sargassum hystrix</i></p>	<p><i>Dictyota spp.</i>  <i>Sargassum hystrix</i>  <i>Lobophora variegatta</i>  <i>Schizothrix calcicula</i>  <i>Udotea cyathiformis</i>            Rhodolith, cf. <i>Lithothamnion ruptile</i></p>

<sup>1</sup>Total search time for fish artificial reef was 20 minutes.

<sup>2</sup>Fish that were not recorded by the diver but were observed in the video or photos, so are not included in the timed search results.

**Table 16.** List of species that were associated with **Target 42** (concrete slabs) and those that were encountered in the surrounding area but not directly associated with the artificial reef, 2005.

Associated with artificial reef			Surrounding area
Fish Species	Count	<sup>1</sup> fish/min (N=1)	Fish Species
<i>Pomacanthus arcuatus</i>	6	0.60	<i>Stegastes partitus</i>
<i>Chaetodon capistratus</i>	6	0.60	<i>Opistognathus aurifrons</i>
<i>Balistes vetula</i>	1	0.10	<i>Coryphopterus glaucofraenum</i>
<i>Acanthurus chirurgus</i>	24	2.40	
<i>Acanthurus coeruleus</i>	12	1.20	
<i>Acanthurus bahianus</i>	36	3.60	
<i>Holocentrus adscensionis</i>	24	2.40	
<i>Lutjanus griseus</i>	24	2.40	
<i>Lutjanus apodus</i>	6	0.60	
<i>Ocyurus chrysurus</i>	28	2.80	
<i>Anisotremus surinamensis</i>	8	0.80	
<i>Haemulon parra</i>	2	0.20	
<i>Haemulon carbonarium</i>	36	3.60	
<i>Haemulon aurolineatum</i>	36	3.60	
<i>Epinephelus guttatus</i>	4	0.40	
<i>Cephalopholis cruentatus</i>	1	0.10	
<i>Hypoplectrus puella</i>	1	0.10	
<i>Heteropriacanthus cruentatus</i>	10	1.00	
<i>Milloidichthys martinicus</i>	6	0.60	
<i>Pseudupeneus maculatus</i>	9	0.90	
<i>Stegastes partitus</i>	2	0.20	
<i>Thalassoma bifasciatum</i>	12	1.20	
<i>Halichoeres garnoti</i>	4	0.40	
<i>Lachnolaimus maximus</i>	1	0.10	
<i>Scarus taeniopterus</i>	2	0.20	
<i>Sparisoma viride</i>	10	1.00	
<i>Scarus iserti</i>	4	0.40	
<i>Sparisoma sp.</i>	1	0.10	
<i>Caranx ruber</i>	8	0.80	
<i>Trachinotus falcatus</i>	1	0.10	
<i>Equetus lanceolatus</i>	1	0.10	
<i>Aulostomus maculatus</i>	2	0.20	
<b>Cumulative</b>	<b>328</b>	<b>32.80</b>	
<b>Invertebrates</b>			<b>Invertebrates</b>
<i>Millepora alcicornis</i>			<i>Pseudopterogorgia americana</i>
<i>Millepora complanata</i>			<i>Pseudopterogorgia sp.</i>
<i>Millepora squarrosa</i>			<i>Aplysina cauliformis</i>
<i>Siderastrea radians</i>			<i>Aplysina fulva</i>
<i>Montastraea cavernosa</i>			<i>Amphimedon compressa</i>

**Table 16. Continued.**

Associated with artificial reef		Surrounding area
<b>Invertebrates</b>		<b>Invertebrates</b>
<i>Porites astreoides</i> <i>Diploria labyrinthiformis</i>		
<i>Diploria strigosa</i> <i>Eunicae sp.</i> <i>Gorgonia mariae</i> <i>Plexaurella nutans</i> <i>Pseudoplexaura spp.</i> <i>Plexaura flexuosa</i> <i>Pterogorgia guadalupensis</i> <i>Anthosigmella varians</i> <i>Muricea sp.</i> <i>Tubastraea coccinea</i> <i>Manicina areolata</i> <i>Periclimenes pedersoni</i> <i>Strombus gigas</i> <i>Davidaster rubiginosa</i> <i>Condylactis gigantea</i> <i>Bartholomea annulata</i> <i>Sabellastarte magnifica</i> <i>Spirobranchus giganteus</i> <i>Aplysina fulva</i> <i>Aplysina cauliformis</i> <i>Aplysina fistularis</i> <i>Niphates digitalis</i> <i>Cribrochalina vasculum</i> <i>Myrmekioderma styx</i> <i>Calyspongia sp.</i> <i>Pseudoceratina crassa</i> <i>Ircinia strobilina</i> <i>Ircinia felix</i> <i>Halisarca sp.</i>		
<b>Algae</b>		<b>Algae</b>
<i>Dictyota spp.</i> <i>Lobophora variegatta</i> <i>Halimeda goreau</i> <i>Halimeda opuntia</i> <i>Halimeda tuna</i> <i>Halimeda discoidea</i> <i>Halimeda variegata</i> <i>Codium isthmocladum</i> <i>Sargassum hystrix</i>		<i>Dictyota spp.</i> <i>Sargassum hystrix</i> <i>Lobophora variegatta</i> <i>Schizothrix calcicula</i> <i>Udotea cyathiformis</i> Rhodolith, cf. <i>Lithothamnion ruptile</i>

<sup>1</sup> Total search time for artificial reef was 10 minutes



**Table 17.** List of species that were associated with **Target 45** (steel hull tug) and those that were encountered in the surrounding area but not directly associated with the artificial reef, 2002.

<b>Associated with artificial reef</b>	<b>Surrounding area</b>
<p><b>Fish Species</b></p> <p>Blue Tang, <i>Acanthurus coeruleus</i>                      French angelfish, <i>Pomacanthus paru</i>                      Squirrelfish, <i>Holocentrus adscensionis</i>                      Rock beauty, <i>Holacanthus tricolor</i>                      Coney, <i>Epinephelus fulvus</i>                      Bar jack, <i>Caranx ruber</i>                      Horse-eye jack, <i>Caranx latus</i>                      Tomtate, <i>Haemulon aurolineatum</i>                      French grunt, <i>Haemulon flavolineatum</i>                      Margate, <i>Haemulon album</i>                      Spanish Hogfish, <i>Bodianus rufus</i>                      Dog snapper, <i>Lutjanus jocu</i>                      School master, <i>Lutjanus apodus</i>                      Gray snapper, <i>Lutjanus griseus</i>                      Yellow goatfish, <i>Mulloidichthys martinicus</i>                      Bluehead Wrasse, <i>Thalassoma bifasciatum</i>                      Redband Parrotfish, <i>Sparisoma aurofrenatum</i>                      Queen Triggerfish, <i>Balistes vetula</i>                      Whitespotted Filefish, <i>Cantherhines macrocerus</i></p>	<p><b>Fish Species</b></p> <p>Dash Goby, <i>Gobionellus saepepallens</i>                      Yellowhead jaw fish, <i>Opistognathus aurifrons</i></p>
<p><b>Invertebrates</b></p> <p>Milk Conch, <i>Strombus costatus</i>                      Feather duster worms, various species                      Christmas tree worms, <i>Spirobranchus giganteus</i>                      Red Rope Sponge (also purple variety), <i>Aplysina cauliformis</i>                      Giant Barrel Sponge, <i>Xestospongia muta</i>                      Convoluted Barrel Sponge, <i>Aplysina lacunose</i>                      Black-ball sponge, <i>Ircinia strobilina</i>                      Encrusting sponges and tunicates, various species                      Painted tunicates, <i>Claveline picta</i>                      White telesto, <i>Carijoa riisei</i>                      Symmetrical Brain Coral (encrusting plate variety), <i>Diplora strigosa</i>                      Massive Starlet Coral, <i>Siderastrea siderea</i>                      Fire coral, <i>Millepora alicornis</i></p>	<p><b>Invertebrates</b></p> <p>None encountered</p>
<p><b>Algae</b></p> <p>Bristle Bush, <i>Penicillus</i> spp.                      Stalked Lettuce Leaf Alga, <i>Halimeda tuna</i>                      Large-leaf Hanging Vine, <i>Halimeda copiosa</i>                      Encrusting corallines, various species</p>	<p><b>Algae</b></p> <p>Encrusting Fan-Leaf Alga, <i>Lobophora variegata</i>                      Stalked Lettuce Leaf Alga, <i>Halimeda tuna</i></p>

**APPENDIX, Table 17. Continued.**

<b>Associated with artificial reef</b>	<b>Surrounding area</b>
<b>Algae</b>	<b>Algae</b>
	Mermaid's Tea Cup, <i>Udotea cyathiformis</i> White Scroll Alga, <i>Padina jamaicensis</i> Rhodoliths unidentified sp.

**Table 18.** List of species that were associated with **Target 45** (steel hull tug) and those that were encountered in the surrounding area but not directly associated with the artificial reef, 2004.

Associated with artificial reef			Surrounding area
Fish Species	Count	<sup>1</sup> fish/min (N=1)	Fish Species
<i>Pomacanthus arcuatus</i>	5	0.33	<i>Stegastes partitus</i>
<i>Holacanthus tricolor</i>	1	0.07	<i>Stegastes planifrons</i>
<i>Balistes vetula</i>	4	0.27	<i>Gnatholepis thompsoni</i>
<i>Acanthurus chirurgus</i>	50	3.33	<i>Coryphopterus glaucofraenum</i>
<i>Acanthurus coeruleus</i>	5	0.33	<i>Serranus tortugarum</i>
<i>Holocentrus adscensionis</i>	25	1.67	<i>Halichoeres bivittatus</i>
<i>Trachinotus falcatus</i>	1	0.07	
<i>Caranx ruber</i>	15	1.00	
<i>Lutjanus mahogoni</i>	1	0.07	
<i>Lutjanus synagris</i>	100	6.67	
<i>Lutjanus jocu</i>	1	0.07	
<i>Lutjanus griseus</i>	50	3.33	
<i>Cephalopholis fulva</i>	4	0.27	
<i>Pseudupeneus maculatus</i>	8	0.53	
<i>Stegastes leucostictus</i>	3	0.20	
<i>Stegastes partitus</i>	20	1.33	
<i>Chromis cyanea</i> 2			
<i>Thalassoma bifasciatum</i>	1	0.07	
<i>Halichoeres garnoti</i>	10	0.67	
<i>Bodianus rufus</i> 2			
<i>Scarus taeniopterus</i>	1	0.07	
<i>Amblycirrhitus pinos</i> 2			
<i>Coryphopterus sp.2</i>			
<i>Gobiosoma chancei</i> 2			
<b>Cumulative</b>	<b>305</b>	<b>20.33</b>	
<b>Invertebrates</b>			<b>Invertebrates</b>
<i>Millepora alcicornis</i>			<i>Aplysina cauliformis</i>
<i>Siderastrea siderea</i>			
<i>Siderastrea radians</i>			
<i>Montastraea cavernosa</i>			
<i>Montastraea annularis</i>			
<i>Diploria strigosa</i>			
<i>Diploria clivosa</i>			
<i>Madracis sp.</i>			
<i>Porites astreoides</i>			
<i>Lima scabra</i>			
<i>Carijoa riisei</i>			

**Table 18. Continued.**

Associated with artificial reef	Surrounding area
<p><b>Invertebrates</b></p> <p><i>Claveline picta</i>  <i>Condylactis gigantea</i>  <i>Sabellastarte magnifica</i>  <i>Spirobranchus giganteus</i>                      unidentified sabellids                      unidentified gorgonian  <i>Aplysina cauliformis</i>  <i>Aplysina fistularis</i>  <i>Pseudoceratina crassa</i>  <i>Ircinia strobilina</i>  <i>Ircinia felix</i>  <i>Halisarca sp.</i></p>	<p><b>Invertebrates</b></p>
<p><b>Algae</b></p> <p><i>Dictyota spp.</i>  <i>Lobophora variegatta</i>  <i>Halimeda spp.</i>  <i>Penicillus sp.</i></p>	<p><b>Algae</b></p> <p><i>Padina jamaicensis</i>  <i>Lobophora variegatta</i>  <i>Halimeda spp.</i>  <i>Udotea cyathiformis</i>                      Rhodolith, cf. <i>Lithothamnion ruptile</i></p>

<sup>1</sup>Total search time for the artificial reef was 20 minutes.

<sup>2</sup>Fish that were not recorded by the diver but were observed in the video or photos, so are not included in the timed search results.

**Table 19.** List of species that were associated with **Target 45** (steel hull tug) and those that were encountered in the surrounding area but not directly associated with the artificial reef, 2005.

Associated with artificial reef			Surrounding area
Fish Species	Count	<sup>1</sup> fish/min (N=1)	Fish Species
<i>Pomacanthus arcuatus</i>	2	0.20	<i>Opistognathus aurifrons</i>
<i>Pomacanthus tricolor</i>	3	0.30	<i>Stegastes partitus</i>
<i>Holacanthus ciliaris</i>	1	0.10	<i>Halichoeres bivittatus</i>
<i>Balistes vetula</i>	1	0.10	<i>Serranus tortugarum</i>
<i>Acanthurus chirurgus</i>	10	1.00	<i>Stegastes planifrons</i>
<i>Acanthurus coeruleus</i>	6	0.60	<i>Heteroconger longissimus</i>
<i>Acanthurus bahianus</i>	12	1.20	
<i>Holocentrus adscensionis</i>	50	5.00	
<i>Lutjanus apodus</i>	10	1.00	
<i>Lutjanus griseus</i>	100	10.00	
<i>Lutjanus synagris</i>	6	0.60	
<i>Ocyurus chrysurus</i>	25	2.50	
<i>Anisotremus surinamensis</i>	11	1.10	
<i>Haemulon aurolineatum</i>	74	7.40	
<i>Epinephelus guttatus</i>	4	0.40	
<i>Milloidichthys martinicus</i>	24	2.40	
<i>Pseudupeneus maculatus</i>	15	1.50	
<i>Chromis multilineata</i>	100	10.00	
<i>Thalassoma bifasciatum</i>	8	0.80	
<i>Bodianus rufus</i>	6	0.60	
<i>Halichoeres garnoti</i>	24	2.40	
<i>Halichoeres radiatus</i>	4	0.40	
<i>Scarus iserti</i>	38	3.80	
<i>Sparisoma sp.</i>	2	0.20	
<i>Caranx ruber</i>	12	1.20	
<i>Caranx latus</i>	4	0.40	
<i>Sphyraena barracuda</i>	1	0.10	
<i>Heteropriacanthus cruentatus</i>	1	0.10	
<i>Apogon maculatus</i>	100	10.00	
<i>Ginglymostoma cirratum</i>	1	0.10	
<i>Synodus intermedius</i>	2	0.20	
<b>Cumulative</b>	<b>657</b>	<b>65.70</b>	
<b>Invertebrates</b>			<b>Invertebrates</b>
<i>Agaricia fragilis</i>			<i>Aplysina fulva</i>
<i>Aplysina cauliformis</i>			<i>Aplysina cauliformis</i>
<i>Aplysina fistularis</i>			
<i>Aplysina fulva</i>			
<i>Bartholomea annulata</i>			
<i>Callyspongia vaginalis</i>			

**Table 19. Continued**

Associated with artificial reef	Surrounding area
<p><b>Invertebrates</b></p> <p><i>Carijoa riisei</i>  <i>Claveline picta</i>  <i>Condylactis gigantea</i>  <i>Diploria clivosa</i>  <i>Diploria strigosa</i>  <i>Halisarca sp.</i>  <i>Holopsamma helwigi</i>  <i>Ircinia felix</i>  <i>Ircinia strobilina</i>  <i>Lima scabra</i>  <i>Madracis decactis</i>  <i>Millepora alcicornis</i>  <i>Millepora complanata</i>  <i>Montastraea annularis</i>  <i>Montastraea cavernosa</i>  <i>Mycetophyllia aliciae</i>  <i>Porites astreoides</i>  <i>Pseudoceratina crassa</i>  <i>Sabellastarte magnifica</i>  <i>Siderastrea radians</i>  <i>Siderastrea siderea</i>  <i>Spirobranchus giganteus</i>  <i>Tubastraea coccinea</i></p>	<p><b>Invertebrates</b></p>
<p><b>Algae</b></p> <p><i>Dictyota spp.</i>  <i>Halimeda spp.</i>  <i>Lobophora variegatta</i>    <i>Sargassum hystrix</i></p>	<p><b>Algae</b></p> <p><i>Dictyota spp.</i>  <i>Sargassum hystrix</i>  <i>Penicillus dumetosus</i>  Rhodolith, cf. <i>Lithothamnion</i>  <i>ruptile</i>  <i>Padina jamaicensis</i>  <i>Caulerpa prolifera</i></p>

<sup>1</sup> Total search time for artificial reef was 10 minutes

**Table 20.** List of species that were associated with **Target 51** (steel barge) and those that were encountered in the surrounding area but not directly associated with the artificial reef, 2001.

<b>Associated with artificial reef</b>	<b>Surrounding area</b>
<p><b>Fish Species</b></p> <p>Tomtate, <i>Haemulon aurolineatum</i>                      Fairy Basset, <i>Gramma loreto</i>                      Blue tang, <i>Acanthurus coeruleus</i>                      Bicolor damselfish, <i>Stegastes partitus</i>                      Red hind, <i>Epinephelus guttatus</i>                      Squirrelfish, <i>Holocentrus adscensionis</i>                      Bigeye, <i>Priacanthus arenatus</i>                      Spanish hogfish, <i>Bodianus rufus</i>                      Queen parrotfish, <i>Sparisoma vetula</i>                      Stoplight parrotfish, <i>Sparisoma viride</i>                      Redband parrotfish, <i>Sparisoma aurofrenatum</i>                      Bluehead, <i>Thalassoma bifasciatum</i>                      Puddingwife, <i>Halichoeres radiatus</i>                      Creole Wrasse, <i>Clepticus parrae</i>                      Doctorfish, <i>Acanthurus chirurgus</i>                      Sharpnose puffer, <i>Canthigaster rostrata</i>                      Gray Angelfish, <i>Balistes capriscus</i>                      French Angelfish, <i>Pomacanthus paru</i>                      Sand Diver, <i>Synodus intermedius</i>                      Yellowtail Snapper, <i>Ocyurus chrysurus</i></p>	<p><b>Fish Species</b></p> <p>Barracuda, <i>Sphyraena barracuda</i>                      Bar jack, <i>Caranx ruber</i>                      Spotted goatfish, <i>Pseudupeneus maculatus</i>                      Yellow goatfish, <i>Mulloidichthys martinicus</i>                      Blue chromis juv., <i>Chromis cyanea</i>                      Brown chromis, <i>Chromis multilineata</i>                      Hawksbill Turtle, <i>Erectmochelys imbricata</i></p>
<p><b>Invertebrates</b></p> <p>Atlantic Triton, <i>Charonia variegata</i>                      Hydroids, Hydroida                      Brain coral, <i>Diploria labyrinthiformis</i>                      Painted Tunicate, <i>Clavelina picta</i>                      Starlet coral, <i>Siderastrea siderea</i>                      Branching coral, <i>Madracis</i> spp.                      Flower coral, <i>Eusmilia</i> spp.                      Black-ball sponge, <i>Ircinia strobilina</i>                      Stinker sponge, <i>Ircinia felix</i>                      Yellow tube sponge, <i>Aplysina fistularis</i></p>	<p><b>Invertebrates</b></p> <p>Row pore rope sponge, <i>Aplysina cauliformis</i>                      Queen conch, <i>Strombus gigas</i></p>
<p><b>Algae</b></p>	<p><b>Algae</b></p>
<p>Leaf algae, <i>Halimeda</i> spp.                      Sea Pearl, <i>Ventricaria ventricosa</i></p>	<p>Fan-leaf Alga, <i>Lobophora variegata</i>                      Blade Alga, <i>Halimeda opuntia</i>                      Bristle Bush, <i>Penicillus pyriformis</i></p>

**Table 21.** List of species that were associated with **Target 51** (steel barge) and those that were encountered in the surrounding area but not directly associated with the artificial reef, 2003.

<b>Associated with artificial reef</b>	<b>Surrounding area</b>
<b>Fish species</b>	<b>Fish species</b>
Permit, <i>Trachinotus falcatus</i> Bar jack, <i>Caranx ruber</i> Barracuda, <i>Sphyraena barracuda</i> Coney, <i>Cephalopholis fulva</i> Red hind, <i>Epinephelus guttatus</i> Tomtate, <i>Haemulon aurolineatum</i> Striped grunt, <i>Haemulon striatum</i> Lane snapper, <i>Lutjanus synagris</i> Yellowtail snapper, <i>Ocyurus chrysurus</i> Gray angelfish, <i>Pomacanthus arcuatus</i> Queen angelfish, <i>Holacanthus ciliaris</i> Rock beauty, <i>Holacanthus tricolor</i> Blue tang, <i>Acanthurus coeruleus</i> Ocean surgeonfish, <i>Acanthurus bahianus</i> Blue chromis, <i>Chromis cyanea</i> Brown chromis, <i>Chromis multilineata</i> Bluehead, <i>Thalassoma bifasciatum</i> Creole wrasse, <i>Clepticus parrae</i> Spanish hogfish, <i>Bodianus rufus</i> Puddingwife, <i>Halichoeres radiatus</i> Striped parrotfish, <i>Scarus iserti</i> Princess parrotfish, <i>Scarus taeniopterus</i> Bicolor damselfish, <i>Stegastes partitus</i> Cocoa damselfish, <i>Stegastes variabilis</i> Sergeant major, <i>Abudefduf saxatilis</i> Spotted goatfish, <i>Pseudupeneus maculatus</i> Bridled goby, <i>Coryphopterus glaucofraenum</i> Hawksbill turtle, <i>Eretmochelys imbricata</i>	Yellowhead jawfish, <i>Opistognathus aurifrons</i> Bar jack, <i>Caranx ruber</i> Bridled goby, <i>Coryphopterus glaucofraenum</i> Sand tilefish, <i>Malacanthus plumieri</i> Queen triggerfish, <i>Balistes vetula</i> Chalk bass, <i>Serranus tortugarum</i>
<b>Invertebrates</b>	<b>Invertebrates</b>
<i>Montastraea cavernosa</i> <i>Diploria strigosa</i> <i>Porites astreoides</i> <i>Madracis decactis</i> <i>Siderastrea radians</i> Agaricia sp. <i>Millepora alcicornis</i> <i>Meandrina meandrites</i> <i>Rhizopsammia goesi</i> <i>Eusmilia fastigiana</i> <i>Cirrhopathes leutkeni</i>	<i>Aplysina</i> sp. Unidentified rope sponges

**Table 21. Continued**



<b>Associated with artificial reef</b>	<b>Surrounding area</b>
<p><b>Invertebrates</b></p> <p><i>Pseudopterogorgia</i> sp.  <i>Carijoa riisei</i>  <i>Callyspongia vaginalis</i>  <i>Halisarca</i> sp.  <i>Clathria</i> sp.  <i>Cinachyra</i> sp.  <i>Ircinia felix</i>            Unidentified encrusting sponges            Unidentified rope sponges  <i>Sertularella speciosa</i>  <i>Thyroscyphus ramosus</i>            Unidentified hydroids            Unidentified tunicates            Unidentified sabellids</p>	<p><b>Invertebrates</b></p>
<p><b>Algae</b></p> <p><i>Dictyota</i> sp.  <i>Sargassum</i> sp.  <i>Lobophora variegata</i>  <i>Halimeda copiosa</i>  <i>Halimeda tuna</i>            Crustose coralline algae</p>	<p><b>Algae</b></p> <p><i>Penicillus pyriformis</i>  <i>Lobophora variegata</i>  <i>Sargassum</i> sp.            Rhodolith, cf. <i>Lithothamnion ruptile</i></p>

**Table 22.** List of species that were associated with **Target 52** (concrete slabs) and those that were encountered in the surrounding area but not directly associated with the artificial reef, 2003.

<b>Associated with artificial reef</b>	<b>Surrounding area</b>
<p><b>Fish Species</b></p> <p>Blue tang, <i>Acanthurus coeruleus</i>                      Ocean surgeonfish, <i>Acanthurus bahianus</i>                      Blue runner, <i>Caranx crysos</i>                      Jolthead porgy, <i>Calamus bajonado</i>                      Caesar grunt, <i>Haemulon carbonarium</i>                      White margate, <i>Haemulon album</i>                      Tomtate, <i>Haemulon aurolineatum</i>                      Yellowtail snapper, <i>Ocyurus chrysurus</i>                      Bicolor damselfish, <i>Stegastes partitus</i>                      Blue chromis, <i>Chromis cyanea</i>                      Graysby, <i>Cephalopholis cruentatus</i>                      Red Hind, <i>Epinephelus guttatus</i>                      Spanish hogfish, <i>Bodianus rufus</i>                      Puddingwife, <i>Halichoeres radiatus</i>                      Yellowhead wrasse, <i>Halichoeres garnoti</i>                      Bluehead, <i>Thalassoma bifasciatum</i>                      Squirrelfish, <i>Holocentrus adscensionis</i>                      Glasseye snapper, <i>Heteropriacanthus cruentatus</i>                      Spotted goatfish, <i>Pseudupeneus maculatus</i>                      Queen triggerfish, <i>Balistes vetula</i></p>	<p><b>Fish Species</b></p> <p>Blue tang, <i>Acanthurus coeruleus</i>                      Ocean surgeonfish, <i>Acanthurus bahianus</i>                      White margate, <i>Haemulon album</i>                      Tomtate, <i>Haemulon aurolineatum</i>                      Queen triggerfish, <i>Balistes vetula</i>                      Chalk bass, <i>Serranus tortugarum</i>                      Spotted goatfish, <i>Pseudupeneus maculatus</i>  <i>Malacoctenus</i> sp.</p> <p>*Note: these fish were probably attracted to the area by the artificial reefs and may have been moving between structures</p>
<p><b>Invertebrates</b></p> <p><i>Millepora alcicornis</i>  <i>Montastraea annularis</i>  <i>Siderastrea radians</i>  <i>Diploria strigosa</i>  <i>Meandrina meandrites</i>  <i>Porites porites</i>  <i>Eusmilia fastigiana</i>  <i>Pterogorgia guadalupensis</i>  <i>Halisarca</i> sp.  <i>Verongula rigida</i>  <i>Ircinia strobilina</i>  <i>Callyspongia vaginalis</i>  <i>Aplysina cauliformis</i>  <i>Xestospongia muta</i>  <i>Didemnum vanderhorsti</i>  <i>Strombus gigas</i>  <i>Strombus costatus</i></p>	<p><b>Invertebrates</b></p> <p><i>Aplysina cauliformis</i>  <i>Ircinia felix</i>  <i>Aplysina</i> sp.</p>

**Table 22. Continued.**

<b>Associated with artificial reef</b>	<b>Surrounding area</b>
<b>Algae</b>	<b>Algae</b>
<i>Sargassum</i> sp. – one slab had ~70% coverage <i>Lobophora variegata</i>	<i>Halimeda discoidea</i> <i>Udotea cyathiformis</i> <i>Lobophora variegata</i> Rhodolith, cf. <i>Lithothamnion ruptile</i>

**Table 23.** List of species that were associated with **Target 52** (concrete slabs) and those that were encountered in the surrounding area but not directly associated with the artificial reef, 2005.

Associated with artificial reef			Surrounding area
Fish Species	Count	<sup>1</sup> fish/min (N=1)	Fish Species
<i>Pomacanthus arcuatus</i>	3	0.30	<i>Stegastes partitus</i>
<i>Holocanthus tricolor</i>	7	0.70	<i>Chromis multilineata</i>
<i>Holocanthus ciliaris</i>	1	0.10	<i>Pseudupeneus maculatus</i>
<i>Balistes vetula</i>	1	0.10	<i>Acanthurus bahianus</i>
<i>Acanthurus chirurgus</i>	34	3.40	<i>Acanthurus coeruleus</i>
<i>Acanthurus coeruleus</i>	6	0.60	<i>Thalassoma bifasciatum</i>
<i>Acanthurus bahianus</i>	8	0.80	<i>Caranx ruber</i>
<i>Holocentrus adscensionis</i>	10	1.00	
<i>Myripristis jacobus</i>	10	1.00	
<i>Lutjanus analis</i>	1	0.10	
<i>Lutjanus apodus</i>	6	0.60	
<i>Ocyurus chrysurus</i>	4	0.40	
<i>Anisotremus surinamensis</i>	4	0.40	
<i>Haemulon carbonarium</i>	7	0.70	
<i>Haemulon aurolineatum</i>	15	1.50	
<i>Epinephelus guttatus</i>	6	0.60	
<i>Pseudupeneus maculatus</i>	16	1.60	
<i>Chromis cyanea</i>	24	2.40	
<i>Chromis multilineata</i>	36	3.60	
<i>Microspathodon chrysurus</i>	2	0.20	
<i>Stegastes partitus</i>	50	5.00	
<i>Thalassoma bifasciatum</i>	3	0.30	
<i>Bodianus rufus</i>	4	0.40	
<i>Scarus taeniopterus</i>	2	0.20	
<i>Sparisoma viride</i>	6	0.60	
<i>Scarus iserti</i>	4	0.40	
<i>Caranx ruber</i>	6	0.60	
<i>Seriola rivoliana</i>	1	0.10	
<i>Gramma loreto</i>	5	0.50	
<i>Malacanthus plumieri</i>	1	0.10	
<b>Cumulative</b>	<b>283</b>	<b>28.30</b>	
<b>Invertebrates</b>			<b>Invertebrates</b>
<i>Agaricia agaricites</i>			<i>Aplysina cauliformis</i>
<i>Aplysina fulva</i>			<i>Aplysina fulva</i>
<i>Callyspongia vaginalis</i>			
<i>Cribrochalina vasculum</i>			
<i>Diplastrella megastrellata</i>			
<i>Diploria labyrinthiformis</i>			
<i>Diploria strigosa</i>			

**Table 23. Continued**

Associated with artificial reef	Surrounding area
<b>Invertebrates</b> <i>Ectyoplasia ferox</i> <i>Erythropodium caribaeorum</i>	<b>Invertebrates</b>
<i>Eunicea sp.</i> <i>Halisarca sp.</i> <i>Ircinia felix</i> <i>Ircinia strobilina</i> <i>Madracis decactis</i> <i>Meandrina meandrites</i> <i>Millepora alcicornis</i> <i>Millepora complanata</i> <i>Montastraea annularis</i> <i>Montastraea cavernosa</i> <i>Mycectophyllia sp.</i> <i>Niphates digitalis</i> <i>Pseudoceratina crassa</i> <i>Ptilocaulis sp.</i> <i>Siderastrea radians</i> <i>Siderastrea siderea</i> <i>Sphaciospongia cuspidifera</i> <i>Xestospongia muta</i>	
<b>Algae</b>	<b>Algae</b>
<i>Dictyota spp.</i> <i>Halimeda goreau</i> <i>Halimeda opuntia</i> <i>Halimeda tuna</i>	<i>Dictyota spp.</i> <i>Sargassum hystrix</i> <i>Lobophora variegatta</i> <i>Halimeda sp.</i>
<i>Lobophora variegatta</i> <i>Padina jamaicensis</i> <i>Sargassum hystrix</i> <i>Ventricaria ventricosa</i>	<i>Halimeda tuna</i> Rhodolith, cf. <i>Lithothamnion ruptile</i>

<sup>1</sup> Total search time for artificial reef was 10 minutes

**Table 24.** List of species that were associated with **Target 57** (steel ferry) and those that were encountered in the surrounding area but not directly associated with the artificial reef, 2002.

<b>Associated with artificial reef</b>	<b>Surrounding area</b>
<p><b>Fish Species</b></p> <p>Rock beauty, <i>Holacanthus tricolor</i>                      Gray angelfish, <i>Pomacanthus arcuatus</i>                      Blue tang, <i>Acanthurus coeruleus</i>                      Ocean surgeonfish, <i>Acanthurus bahianus</i>                      Bicolor damsel, <i>Stegastes partitus</i>                      Beaugregory, <i>Stegastes leucostictus</i>                      Sergeant major, <i>Abudefduf saxatilis</i>                      Blue chromis, <i>Chromis cyanea</i>                      Brown chromis, <i>Chromis multilineata</i>                      Fairy basslet, <i>Gramma loreto</i>                      Bar jack, <i>Caranx ruber</i>                      Tomtate, <i>Haemulon aurolineatum</i>                      French grunt, <i>Haemulon flavolineatum</i>                      White grunt, <i>Haemulon plumierii</i>                      Rock hind, <i>Epinephelus adscensionis</i>                      Graysby, <i>Cephalopholis cruentatus</i>                      Coney, <i>Cephalopholis fulva</i>                      Yellowtail snapper, <i>Ocyurus chrysurus</i>                      Yellowhead wrasse, <i>Halichoeres garnoti</i>                      Bluehead, <i>Thalassoma bifasciatum</i>                      Spanish hogfish, <i>Bodianus rufus</i>                      Stoplight parrotfish, <i>Sparisoma viride</i>                      Redband parrotfish, <i>Sparisoma aurofrenatum</i>                      Sand diver, <i>Synodus intermedius</i>                      Squirrelfish, <i>Holocentrus adscensionis</i>                      Glasseye snapper, <i>Heteropriacanthus cruentatus</i>                      Yellow goatfish, <i>Mulloidichthys martinicus</i>                      Sharpnose puffer, <i>Canthigaster rostrata</i></p>	<p><b>Fish Species</b></p> <p>Stoplight parrotfish, <i>Sparisoma viride</i></p>
<p><b>Invertebrates</b></p> <p>Atlantic thorny oyster, <i>Spondylus americanus</i>                      Giant hermit, <i>Petrochirus diogenes</i>                      Fire coral, <i>Millepora</i> sp.                      Starlet coral, <i>Siderastrea siderea</i>                      Maze coral, <i>Meandrina meandrites</i>                      Finger coral, <i>Porites porites</i>                      Sheet coral, <i>Agaricia</i> sp.                      Sea whip, <i>Pterogorgia</i> sp.                      Unidentified tunicates                      Star encrusting sponge, <i>Halisarca</i> sp.</p>	<p><b>Invertebrates</b></p> <p>Rope sponges, <i>Aplysina</i> sp.                      Black ball sponge, <i>Ircinia strobilina</i>                      Branching tube sponge, <i>Pseudoceratina crassa</i>                      Orange ball sponge, <i>Cinachyra</i> sp.</p>

**Table 24.** List of species that were associated with **Target 57** (steel ferry) and those that were encountered in the surrounding area but not directly associated with the artificial reef, 2002.

Associated with artificial reef	Surrounding area
<b>Invertebrates</b>	<b>Invertebrates</b>
Rope sponges, <i>Aplysina</i> sp. Black ball sponge, <i>Ircinia strobilina</i> Stinker sponge, <i>Ircinia felix</i>	
<b>Algae</b>	<b>Algae</b>
<i>Lobophora variegata</i> <i>Dictyota</i> sp. <i>Halimeda tuna</i> <i>Halimeda discoidea</i>	Rhodolith, cf. <i>Lithothamnion ruptile</i> <i>Lobophora variegata</i> <i>Udotea</i> sp. <i>Dictyota</i> sp.

**Table 25.** List of species that were associated with **Target 57** (steel ferry) and those that were encountered in the surrounding area but not directly associated with the artificial reef, 2005.

Associated with artificial reef			Surrounding area
Fish Species	Count	<sup>1</sup> fish/min (N=1)	Fish Species
<i>Pomacanthus tricolor</i>	1	0.10	<i>Heteroconger longissimus</i>
<i>Acanthurus chirurgus</i>	5	0.50	<i>Stegastes planifrons</i>
<i>Acanthurus bahianus</i>	7	0.70	<i>Stegastes partitus</i>
<i>Holocentrus adscensionis</i>	15	1.50	
<i>Lutjanus analis</i>	1	0.10	
<i>Ocyurus chrysurus</i>	15	1.50	
<i>Haemulon macrostomum</i>	1	0.10	
<i>Anisotremus surinamensis</i>	2	0.20	
<i>Haemulon aurolineatum</i>	100	10.00	
<i>Epinephelus guttatus</i>	2	0.20	
<i>Milloidichthys martinicus</i>	15	1.50	
<i>Pseudupeneus maculatus</i>	26	2.60	
<i>Chromis multilineata</i>	100	10.00	
<i>Stegastes partitus</i>	8	0.80	
<i>Halichoeres radiatus</i>	1	0.10	
<i>Thalassoma bifasciatum</i>	6	0.60	
<i>Bodianus rufus</i>	6	0.60	
<i>Halichoeres garnoti</i>	8	0.80	
<i>Scarus iserti</i>	4	0.40	
<i>Sparisoma viride</i>	7	0.70	
<i>Caranx ruber</i>	5	0.50	
<i>Canthigaster rostrata</i>	2	0.20	
<i>Gramma brasiliensis</i>	2	0.20	
<b>Cumulative</b>	<b>339</b>	<b>33.90</b>	
<b>Invertebrates</b>			<b>Invertebrates</b>
<i>Agaricia sp.</i>			<i>Aplysina fulva</i>
<i>Aplysina cauliformis</i>			<i>Aplysina cauliformis</i>
<i>Aplysina fulva</i>			<i>Xestospongia muta</i>
<i>Clathria sp.</i>			<i>Ircinia strobilina</i>
<i>Callyspongia vaginalis</i>			
<i>Diplastrella sp.</i>			
<i>Halisarca sp.</i>			
<i>Holopsamma helwigi</i>			
<i>Ircinia felix</i>			
<i>Ircinia strobilina</i>			
<i>Millepora alcicornis</i>			
<i>Millepora complanata</i>			
<i>Madracis mirabilis</i>			
<i>Manicina areolata</i>			

**Table 25. Continued.**



Associated with artificial reef		Surrounding area
Invertebrates	Count	Invertebrates
<i>Myrmekioderma styx</i>		
<i>Pseudoceratina crassa</i>		
<i>Xestospongia muta</i>		
<i>Siderastrea radians</i>		
<i>Panulirus argus</i>	2	
<i>Mithrax spinosissimus</i>	1	
<i>Carijoa riisei</i>		
Algae		Algae
<i>Dictyota spp.</i>		<i>Halimeda tuna</i>
<i>Halimeda tuna</i>		<i>Halimeda discoidea</i>
<i>Halimeda discoidea</i>		Rhodolith, cf. <i>Lithothamnion ruptile</i>
<i>Sargassum hystrix</i>		<i>Padina jamaicensis</i>
<i>Lobophora variegatta</i>		<i>Lobophora variegatta</i>
		<i>Avrainvillea sp.</i>
		<i>Udotea cyathiformis</i>
		<i>Udotea sp.</i>

<sup>1</sup> Total search time for artificial reef was 10 minutes

**Table 26.** List of species that were associated with **Target 58** (steel barge) and those that were encountered in the surrounding area but not directly associated with the artificial reef, 2002.

<b>Associated with artificial reef</b>	<b>Surrounding area</b>
<p><b>Fish Species</b></p> <p>Tomtate, <i>Haemulon aurolineatum</i>                      French grunt, <i>Haemulon flavolineatum</i>                      White grunt, <i>Haemulon plumieri</i>                      Lane snapper, <i>Lutjanus synagris</i>                      Red hind, <i>Epinephelus guttatus</i>                      Fairy basslet, <i>Gramma loreto</i>                      Bar jack, <i>Caranx</i> <math>\square</math> <i>acula</i>                      Gray angelfish, <i>Pomacanthus arcuatus</i>                      Squirrelfish, <i>Holocentrus ascensionis</i>                      Blackbar soldierfish, <i>Myripristis jacobus</i>                      Stoplight parrotfish, <i>Sparisoma viride</i>                      Unidentified parrotfish                      Spanish hogfish, <i>Bodianus rufus</i>                      Unidentified wrasse                      Queen triggerfish, <i>Balistes vetula</i>                      Yellow goatfish, <i>Mulloidichthys martinicus</i>                      Spotted goatfish, <i>Pseudupeneus</i> <math>\square</math> <i>aculates</i>                      Blue tang, <i>Acanthurus coeruleus</i>                      Ocean surgeonfish, <i>Acanthurus bahianus</i>                      Coco damselfish, <i>Stegastes variabilis</i>                      Doctorfish, <i>Acanthurus chirurgus</i>                      Blue chromis, <i>Chromis cyanea</i>                      Sharpnose puffer, <i>Canthigaster rostrata</i>                      Lizardfish, <i>Synodus</i> sp.                      Green turtle, <i>Chelonia mydas</i></p>	<p><b>Fish Species</b></p> <p>Yellowtail snapper, <i>Ocyurus chrysurus</i>                      Dog snapper, <i>Lutjanus jocu</i></p>
<b>Invertebrates</b>	<b>Invertebrates</b>
<p>Fire coral, <i>Millepora alcicornis</i>                      Unidentified hydroids  <i>Madracis</i> sp.                      Starlet coral, <i>Siderastrea</i> sp.                      Sea whip, <i>Ellisella barbadensis</i>                      Common sea fan, <i>Gorgonia ventalina</i>                      Sea plume, <i>Pseudopterogorgia</i> sp.                      Unidentified zoanths                      Corkscrew anemone, <i>Bartholomea annulata</i>                      Unidentified tunicates                      Unidentified bryozoans                      Star encrusting sponge, <i>Halisarca</i> sp.                      Black-ball sponge, <i>Ircinia strobilina</i>                      Row pore rope sponge, <i>Aplysina cauliformis</i></p>	<p>Row pore rope sponge, <i>Aplysina cauliformis</i>                      Unidentified rope sponges</p>

**Table 26. Continued.**

<b>Associated with artificial reef</b>	<b>Surrounding area</b>
<b>Invertebrates</b> Branching vase sponge, unidentified Branching tube sponge, unidentified Arrow crab, <i>Stenorhynchus seticornis</i> True tulip, <i>Fasciolaria tulipa</i> Thorny oyster, <i>Spondylus americanus</i>	<b>Invertebrates</b>
<b>Algae</b> <i>Ventricaria ventricosa</i> <i>Sargassum sp.</i> <i>Dictyota sp.</i> <i>Padina jamaicensis</i>	<b>Algae</b> <i>Codium sp.</i> <i>Avrainvillea asarifolia</i> Rhodoliths unidentified sp.

**Table 27.** List of species that were associated with **Target 58** (steel barge) and those that were encountered in the surrounding area but not directly associated with the artificial reef, 2004.

<b>Associated with artificial reef</b>	<b>Surrounding area</b>
<p><b>Fish Species</b></p> <p><i>Balistes vetula</i>  <i>Acanthurus bahianus</i>  <i>Acanthurus coeruleus</i>  <i>Holocentrus adscensionis</i>  <i>Lutjanus jocu</i>  <i>Lutjanus synagris</i>  <i>Ocyurus chrysurus</i>  <i>Haemulon aurolineatum</i>  <i>Anisotremus virginicus</i>  <i>Serranus tigrinus</i>  <i>Hypoplectrus unicolor</i>  <i>Hypoplectrus chlorurus</i>  <i>Hypoplectrus sp.</i>  <i>Chromis cyanea</i>  <i>Stegastes partitus</i>  <i>Thalassoma bifasciatum</i>  <i>Bodianus rufus</i>  <i>Sparisoma viride</i>  <i>Synodus intermedius</i>  <i>Sphyraena barracuda</i>  <i>Canthigaster rostrata</i>  <i>Caranx ruber</i></p>	<p><b>Fish Species</b></p> <p><i>Opistognathus aurifrons</i>  <i>Coryphopterus glaucofraenum</i>  <i>Lutjanus mahogoni</i></p>
<p><b>Invertebrates</b></p>	<p><b>Invertebrates</b></p>
<p><i>Millepora alcicornis</i>  <i>Madracis decactis</i>  <i>Agaricia fragilis</i>  <i>Scolymia sp.</i>  <i>Dendrogyra cylindrus</i>  <i>Carijoa riisei</i>  <i>Ellisella barbadensis</i>  <i>Spirobranchus giganteus</i>                      unidentified sabellids  <i>Holopsamma helwigi</i>  <i>Ircinia felix</i>  <i>Halisarca sp.</i>                      unidentified encrusting sponges</p>	<p><i>Aplysina lacunosa</i>  <i>Amphimedon compressa</i></p>

**Table 27. Continued.**

<b>Associated with artificial reef</b>	<b>Surrounding area</b>
<b>Algae</b>	<b>Algae</b>
<i>Dictyota spp.</i> <i>Lobophora variegata</i> <i>Sargassum hystrix</i> <i>Halimeda sp.</i>	<i>Dictyota spp.</i> <i>Sargassum hystrix</i> <i>Lobophora variegata</i> <i>Udotea cyathiformis</i> <i>Rhodolith, cf. Lithothamnion ruptile</i>

**Table 28.** List of species that were associated with **Target 58** (steel barge) and those that were encountered in the surrounding area but not directly associated with the artificial reef, 2005.

Associated with artificial reef			Surrounding area
Fish Species	Count	<sup>1</sup> fish/min (N=1)	Fish Species
<i>Pomacanthus arcuatus</i>	3	0.30	<i>Opistognathus aurifrons</i>
<i>Pomacanthus paru</i>	3	0.30	<i>Coryphopterus glaucofraenum</i>
<i>Holacanthus ciliaris</i>	1	0.10	<i>Serranus tortugarum</i>
<i>Balistes vetula</i>	2	0.20	<i>Serranus tabacarius</i>
<i>Acanthurus chirurgus</i>	12	1.20	
<i>Acanthurus coeruleus</i>	6	0.60	
<i>Acanthurus bahianus</i>	15	1.50	
<i>Holocentrus adscensionis</i>	42	4.20	
<i>Lutjanus synagris</i>	32	3.20	
<i>Lutjanus analis</i>	1	0.10	
<i>Ocyurus chrysurus</i>	6	0.60	
<i>Haemulon carbonarium</i>	6	0.60	
<i>Haemulon aurolineatum</i>	150	15.00	
<i>Epinephelus guttatus</i>	3	0.30	
<i>Cephalopholis fulvus</i>	3	0.30	
<i>Serranus tigrinus</i>	1	0.10	
<i>Milloidichthys martinicus</i>	12	1.20	
<i>Pseudupeneus maculatus</i>	10	1.00	
<i>Chromis multilineata</i>	120	12.00	
<i>Stegastes partitus</i>	6	0.60	
<i>Thalassoma bifasciatum</i>	7	0.70	
<i>Bodianus rufus</i>	6	0.60	
<i>Halichoeres garnoti</i>	24	2.40	
<i>Halichoeres radiatus</i>	2	0.20	
<i>Scarus taeniopterus</i>	3	0.30	
<i>Sparisoma viride</i>	2	0.20	
<i>Caranx ruber</i>	12	1.20	
<i>Caranx latus</i>	2	0.20	
<i>Synodus intermedius</i>	2	0.20	
<i>Canthigaster rostrata</i>	1	0.10	
<b>Cumulative</b>	<b>495</b>	<b>49.50</b>	
<b>Invertebrates</b>			<b>Invertebrates</b>
<i>Agaricia fragilis</i>			<i>Aplysina fulva</i>
<i>Aplysina cauliformis</i>			<i>Ircinia strobilina</i>
<i>Aplysina fistularis</i>			<i>Aplysina lacunosa</i>
<i>Aplysina fulva</i>			<i>Amphimedon compressa</i>
<i>Carijoa riisei</i>			
<i>Cinachyra sp.</i>			
<i>Condylactis gigantea</i>			

**Table 28. Continued.**

<b>Associated with artificial reef</b>	<b>Surrounding area</b>
<p><b><i>Invertebrates</i></b>  <i>Diplosoma glandulosum</i>  <i>Holopsamma helwigi</i>  <i>Ircinia felix</i>  <i>Ircinia strobilina</i>  <i>Millepora alcicornis</i>  <i>Millepora complanata</i>  <i>Madracis decactis</i>  <i>Monanchora urguifera</i>  <i>Pseudoceratina crassa</i>  <i>Pterogorgia guadalupensis</i>  <i>Rhopalaea abdominalis</i>  <i>Sabellastarte magnifica</i>  <i>Scolymia sp.</i>  <i>Siderastrea radians</i>  <i>Spirobranchus giganteus</i>  <i>Tubastraea coccinea</i>  <i>Verongula gigantea</i></p>	<p><b><i>Invertebrates</i></b></p>
<p><b><i>Algae</i></b>  <i>Dictyota spp.</i>  <i>Lobophora variegatta</i>  <i>Halimeda goreau</i>  <i>Halimeda opuntia</i>  <i>Halimeda discoidea</i>  <i>Halimeda variegata</i>  <i>Sargassum hystrix</i></p>	<p><b><i>Algae</i></b>  <i>Dictyota spp.</i>  <i>Sargassum hystrix</i>  <i>Lobophora variegatta</i>  <i>Udotea cyathiformis</i>                      Rhodolith, cf. <i>Lithothamnion reptile</i> (90%)</p>

<sup>1</sup> Total search time for artificial reef was 10 minutes

**Table 29.** List of species that were associated with **Target 59** (twin engine plane) and those that were encountered in the surrounding area but not directly associated with the artificial reef, 2002.

Associated with artificial reef	Surrounding area
<b>Fish Species</b> Blue Tang, <i>Acanthurus coeruleus</i> Yellowtail Snapper, <i>Ocyurus chrysurus</i> Red Hind, <i>Epinephelus guttatus</i> Coney, <i>Epinephelus fulvus</i> Squirrelfish, <i>Holocentrus adscensionis</i> Blue Chromis, <i>Chromis cyanea</i> Bluehead Wrasse, <i>Thalassoma bifasciatum</i> Redband Parrotfish, <i>Sparisoma aurofrenatum</i> Green Moray, <i>Gymnothorax funebris</i> Sharpnose Puffer, <i>Canthigaster rostrata</i>	<b>Fish Species</b> French Grunt, <i>Haemulon flavolineatum</i>
<b>Invertebrates</b> Caribbean spiny lobster, <i>Panulirus argus</i> *(19 observed, 6 to 8 adult/legal size) Pederson cleaner shrimp, <i>Periclimenes pedersoni</i> Variegated Feather Duster, <i>Bispira variegata</i> Corkscrew anemone, <i>Bartholomea annulata</i> Convoluted Barrel Sponge, <i>Aplysina lacunose</i> Red Rope Sponge, <i>Aplysina cauliformis</i> Encrusting sponges and colonial tunicates Solitary ascidians, unknown sp. Fire coral, <i>Millepora alicornis</i> Encrusting star coral, unknown spp. Cup corals, unknown spp.	<b>Invertebrates</b> None encountered
<b>Algae</b> Encrusting Fan-Leaf Alga, <i>Lobophora variegata</i> Stalked Lettuce Leaf Alga, <i>Halimeda tuna</i> Red Encrusting Algae, unknown spp. Encrusting Algae, unknown spp.	<b>Algae</b> Encrusting Fan-Leaf Alga, <i>Lobophora variegata</i> Stalked Lettuce Leaf Alga, <i>Halimeda tuna</i> Large Leaf Watercress Alga, <i>Halimeda discoidea</i> Mermaid Tea Cup, <i>Udotea cyathiformis</i> Blade Alga, <i>Avrainvillea</i> spp. <i>Rhodoliths</i> unidentified sp.



**Table 30.** List of species that were associated with **Target 59** (twin engine plane) and those that were encountered in the surrounding area but not directly associated with the artificial reef, 2004.

Associated with artificial reef			Surrounding area
Fish Species	Count	<sup>1</sup> fish/min (N=1)	Fish Species
<i>Pomacanthus arcuatus</i>	4	0.27	<i>Pseudupeneus maculatus</i> <i>Ocyurus chrysurus</i>
<i>Acanthurus coeruleus</i>	15	1.00	
<i>Chromis cyanea</i>	24	1.60	
<i>Chromis multilineata</i>	24	1.60	
<i>Epinephelus guttatus</i>	10	0.67	
<i>Cephalopholis fulva</i>	1	0.07	
<i>Mycteroperca venenosa</i>	1	0.07	
<i>Scarus iserti</i>	3	0.20	
<i>Holocentrus adscensionis</i>	60	4.00	
<i>Caranx ruber</i> <sup>2</sup>			
<b>Cumulative</b>	<b>142</b>	<b>9.47</b>	
Invertebrates	Count		Invertebrates
<i>Panulirus argus</i>	6		<i>Aplysina cauliformis</i>
<i>Condylactis gigantea</i>			
<i>Millepora alcicornis</i>			
<i>Siderastrea siderea</i>			
<i>Siderastrea radians</i>			
<i>Agaricia fragilis</i>			
<i>Aplysina fistularis</i>			
<i>Callyspongia vaginalis</i>			
<i>Ircinia strobilina</i>			
<i>Ircinia felix</i>			
<i>Halisarca sp.</i>			
Algae			
<i>Dictyota spp.</i>			<i>Schizothrix calcicula</i> <i>Lobophora variegatta</i> <i>Halimeda spp.</i> <i>Udotea cyathiformis</i> <i>Avrainvillea asarifolia</i>
<i>Lobophora variegatta</i>			
<i>Halimeda spp.</i>			
unidentified cyanophyta			

<sup>1</sup> Total search time for artificial reef was 15 minutes

<sup>2</sup> *Caranx ruber* was not recorded by the diver but was observed in the video and is not included

**Table 31.** List of species that were associated with **Target 62** (fiberglass boat) and those that were encountered in the surrounding area but not directly associated with the artificial reef, 2002.

Associated with artificial reef	Surrounding area
<p><b>Fish species</b></p> <p>Doctordfish, <i>Acanthurus chirurgus</i>                      Ocean surgeonfish, <i>Acanthurus bahianus</i>                      Blue tang, <i>Acanthurus coeruleus</i>                      Blue chromis, <i>Chromis cyanea</i>                      Brown chromis, <i>Chromis multilineata</i>                      Bicolor damselfish, <i>Stegastes partitus</i>                      Masked goby, <i>Coryphopterus personatus</i>                      Spotted goatfish, <i>Pseudupeneus maculatus</i>                      Unidentified juvenile grunts, Haemulidae                      Yellowhead wrasse, <i>Halchoeres garnoti</i>                      Bluehead wrasse, <i>Thalassoma bifasciatum</i>                      Sharpnose puffer, <i>Canthigaster rostrata</i>                      Smoth trunkfish, <i>Lactophrys triqueter</i>                      Cardinalfish, <i>Apogon</i> sp.                      Redspotted hawkfish, <i>Amblycirrhitus pinos</i></p>	<p><b>Fish species</b></p> <p>Bluehead wrasse, <i>Thalassoma bifasciatum</i>                      Slippery dick, <i>Halichoeres bivittatus</i>                      Tobaccofish, <i>Serranus tabacarius</i>                      Yellowhead jawfish, <i>Opistognathus aurifrons</i>                      Bluestriped lizardfish, <i>Synodus saurus</i></p>
<p><b>Invertebrates</b></p> <p>Rope sponge, <i>Aplysina fulva</i>                      Black ball sponge, <i>Ircinia strobilina</i>                      Stinker sponge, <i>Ircinia felix</i>                      Unidentified hydroids                      White telesto, <i>Carijoa riisei</i>                      Star encrusting sponge, <i>Halisarca</i> sp.                      Overgrowing tunicates, Ascidiacea                      Unidentified encrusting tunicates                      Pederson cleaner shrimp, <i>Periclimenes pedersoni</i>                      Spotted moray, <i>Gymnothorax moringa</i>                      Branching tube sponge, <i>Pseudoceratina crassa</i>                      Warty sea rods, <i>Eunicea calyculata</i>                      Fire sponge, <i>Tedania ignis</i>                      Stove-top pipe sponge, <i>Aplysina archeri</i>                      Star coral, <i>Madracis decactis</i>                      Brown variable sponge, <i>Anthosigmella varians</i>                      Branching fire coral, <i>Millepora alcicornis</i>                      Blade fire coral, <i>Millepora complanata</i>                      Lettuce coral, <i>Agaricia</i> sp.</p>	<p><b>Invertebrates</b></p> <p>Rope sponge, <i>Aplysina fulva</i>                      Row pore rope sponge, <i>Aplysina cauliformis</i>                      Black ball sponge, <i>Ircinia strobilina</i></p>

**Table 31. Continued.**

Associated with artificial reef	Surrounding area
<b>Algae</b>	<b>Algae</b>
Crustose coralline algae <i>Schizothrix calcicola</i> <i>Halimeda discoidea</i> <i>Lobophora variegata</i>	Crustose coralline algae <i>Sargassum</i> sp. <i>Penicillus pyriformis</i> <i>Dictyota</i> spp. <i>Halimeda opuntia</i> <i>Padina</i> spp. Rhodolith, cf. <i>Lithothamnion ruptile</i>

**APPENDIX, Table 32.** List of species that were associated with **Target 70** (steel freighter) and those that were encountered in the surrounding area but not directly associated with the artificial reef, 2002.

Associated with artificial reef	Surrounding area
<p><b>Fish Species</b></p> <p>Bar jack, <i>Caranx ruber</i>                      Blue runner, <i>Caranx crysos</i>                      Rainbow runner, <i>Elagatis bipinnulata</i>                      Yellowtail snapper, <i>Ocyurus chrysurus</i>                      Lane snapper, <i>Lutjanus synagris</i>                      White grunt, <i>Haemulon plumieri</i>                      Tomtate, <i>Haemulon aurolineatum</i>                      Cesar grunt, <i>Haemulon carbonarium</i>                      Coney, <i>Cephalopholis fulva</i>                      Queen parrotfish, <i>Scarus vetula</i>                      Spanish hogfish, <i>Bodianus rufus</i>                      Bluehead, <i>Thalassoma bifasciatum</i>                      French angelfish, <i>Pomacanthus paru</i>                      Doctorfish, <i>Acanthurus chirurgus</i>                      Blue tang, <i>Acanthurus coeruleus</i>                      Blue chromis juv., <i>Chromis cyanea</i>                      Brown chromis, <i>Chromis multilineata</i>                      Squirrelfish, <i>Holocentrus adscensionis</i>                      Sergeant major, <i>Abudefduf saxatilis</i>                      Bicolor damselfish, <i>Stegastes partitus</i>                      Spotted goatfish, <i>Pseudupeneus maculatus</i>                      Yellow goatfish, <i>Mulloidichthys martinicus</i>                      Honeycomb cowfish, <i>Lactophrys polygona</i>                      Trumpetfish, <i>Aulostomus maculatus</i>                      Sharpnose puffer, <i>Canthigaster rostrata</i></p>	<p><b>Fish Species</b></p> <p>Barracuda, <i>Sphyraena barracuda</i>                      Bicolor Damselfish, <i>Stegastes partitus</i>                      Bluehead, <i>Thalassoma bifasciatum</i>                      Bridled goby, <i>Coryphopterus glaucofraenum</i></p>
<p><b>Invertebrates</b></p> <p>Bearded fireworm, <i>Hermodice carunculata</i>                      Unidentified sabellids                      Christmas tree worm, <i>Spirobranchus giganteus</i>                      Unidentified barnacles                      Long-spined urchin, <i>Diadema antillarum</i>                      Unidentified hydroids                      Unidentified tunicates                      Fire coral, <i>Millepora alcicornis</i> and <i>M. complanata</i>                      Encrusting gorgonian, <i>Erythropodium caribaeorum</i>                      Sea plume, <i>Pseudopterogorgia</i> sp.                      Sea whip, <i>Ellisella barbadensis</i>                      Wire coral, <i>Cirripathes leutkeni</i>                      Massive starlet coral, <i>Siderastrea siderea</i>  <i>Montastraea</i> spp.</p>	<p><b>Invertebrates</b></p> <p>Row pore rope sponge, <i>Aplysina cauliformis</i>                      Unidentified rope sponges                      Maze coral, <i>Meandrina meandrites</i></p>

**Table 32. Continued.**

Associated with artificial reef	Surrounding area
<p><b>Invertebrates</b></p> <p><i>Madracis</i> sp.            Brain coral, <i>Diploria</i> sp.            Maze coral, <i>Meandrina meandrites</i>            Rose coral, <i>Manicina areolata</i>            Tube coral, <i>Cladocora arbuscula</i>            Golden zoanthid, <i>Parazoanthus swiftii</i>            Star encrusting sponge, <i>Halisarca</i> sp.            Stinker sponge, <i>Ircinia felix</i>            Blackball sponge, <i>Ircinia strobilina</i>            Row pore rope sponge, <i>Aplysina cauliformis</i>            Branching tube sponge, <i>Pseudoceratina crassa</i>            Branching vase sponge, <i>Callyspongia vaginalis</i>            Unidentified encrusting sponges  <b>Unidentified tube sponge</b></p>	<p><b>Invertebrates</b></p>
<p><b>Algae</b></p> <p><i>Sargassum</i> sp.  <i>Dictyota</i> sp.  <i>Halimeda</i> sp.  <i>Padina</i> sp.  <i>Lobophora variegata</i>  <i>Ventricaria ventricosa</i>  <i>Wrangelia penicillata</i>            Unidentified crustose coralline algae</p>	<p><b>Algae</b></p> <p>Rhodolith unidentified sp.  <i>Avrainvillea longicaulis</i>  <i>Penicillus</i> spp.  <i>Udotea</i> spp.  <i>Dictyota</i> sp.  <i>Halimeda</i> sp.  <i>Lobophora variegata</i></p>

**Table 33.** List of species that were associated with **Target 70** (steel freighter) and those that were encountered in the surrounding area but not directly associated with the artificial reef, 2003.

Associated with artificial reef	Surrounding area
<p><b>Fish species</b>                      Longsnout butterflyfish, <i>Chaetodon aculeatus</i>                      Foureye butterflyfish, <i>Chaetodon capistratus</i>                      Coney, <i>Cephalopholis fulva</i>                      Grasby, <i>Cephalopholis cruentatus</i>                      Red hind, <i>Epinephelus guttatus</i>                      Permit, <i>Trachinotus falcatus</i>                      Bar jack, <i>Caranx ruber</i>                      Horse-eye jack, <i>Caranx latus</i>                      Creolfish, <i>Paranthias furcifer</i>                      Tomtate, <i>Haemulon aurolineatum</i>                      French grunt, <i>Haemulon flavolineatum</i>                      Striped grunt, <i>Haemulon striatum</i>                      Dog snapper, <i>Lutjanus jocu</i>                      Gray snapper, <i>Lutjanus griseus</i>                      Yellowtail snapper, <i>Ocyurus chrysurus</i>                      French angelfish, <i>Pomacanthus paru</i>                      Queen angelfish, <i>Holacanthus ciliaris</i>                      Queen triggerfish, <i>Balistes vetula</i>                      Spanish hogfish, <i>Bodianus rufus</i>                      Creole wrasse, <i>Clepticus parrae</i>                      Yellowhead wrasse, <i>Halichoeres garnoti</i>                      Puddingwife, <i>Halichoeres radiatus</i>                      Bluehead wrasse, <i>Thalassoma bifasciatum</i>                      Princess parrotfish, <i>Scarus taeniopterus</i>                      Stoplight parrotfish, <i>Sparisoma viride</i>                      Brown chromis, <i>Chromis multilineata</i>                      Blue chromis, <i>Chromis cyanea</i>                      Bi-color damselfish, <i>Stegastes partitus</i>                      Cocoa damselfish, <i>Stegastes variabilis</i>                      Sergeant major, <i>Abudefduf saxatilis</i>                      Ocean surgeonfish, <i>Acanthurus bahianus</i>                      Doctorfish, <i>Acanthurus chirurgus</i>                      Blue tang, <i>Acanthurus coeruleus</i>                      Squirrelfish, <i>Holocentrus adscensionis</i>                      Dusky squirrelfish, <i>Sargocentron vexillarium</i>                      Trumpetfish, <i>Aulostomus maculatus</i>                      Glasseye snapper, <i>Heteropriacanthus cruentatus</i>                      Smooth trunkfish, <i>Lactophrys triqueter</i>                      Sharpnose puffer, <i>Canthigaster rostrata</i>                      Spotted goatfish, <i>Pseudupeneus maculatus</i></p>	<p><b>Fish species</b>                      *Due to water depth and limited time a list was not generated of fishes not associated with the artificial reefs.</p>

**Table 33. Continued.**

Associated with artificial reef	Surrounding area
<b>Fish species</b>	<b>Fish species</b>
Yellow goatfish, <i>Mulloidichthys martinicus</i> Scorpionfish, <i>Scorpaena</i> sp.	
<b>Invertebrates</b>	<b>Invertebrates</b>
<i>Millepora alcicornis</i> <i>Dendrogyra cylindrus</i> <i>Siderastrea radians</i> <i>Porites porites</i> <i>Meandrina meandrites</i> <i>Manicina areolata</i> <i>Antipathes gracilis</i> <i>Antipathes</i> sp. <i>Carijoa riisei</i> <i>Cirripathes leutkeni</i> <i>Pterogorgia</i> sp. <i>Pseudopterogorgia</i> sp. <i>Pseudoplexaura</i> sp. <i>Aplysina cauliformis</i> <i>Aplysina fulva</i> <i>Aplysina fistularis</i> <i>Callyspongia vaginalis</i> <i>Pseudoceratina crassa</i> <i>Niphates digitalis</i> <i>Ectyoplasia ferox</i> <i>Holopsamma helwigi</i> <i>Halisarca</i> sp. <i>Ircinia strobilina</i> <i>Ircinia felix</i> Unidentified hydroids Unidentified encrusting sponges Unidentified tunicates Unidentified feather duster worms	<i>Aplysina cauliformis</i> <i>Ircinia felix</i> <i>Aplysina</i> sp.
<b>Algae</b>	<b>Algae</b>
<i>Sargassum</i> sp. <i>Lobophora variegata</i> <i>Halimeda</i> sp. <i>Turbinaria</i> sp.	Rhodolith, cf. <i>Lithothamnion ruptile</i> <i>Halimeda</i> sp. <i>Udotea</i> sp. <i>Lobophora variegata</i>

**Table 34.** List of species that were associated with **Target 70** (steel freighter), 2004 (associated with artificial reef).

<b>Fish species</b>	<b>Invertebrates*</b>
<p><i>Pomacanthus arcuatus</i>  <i>Chaetodon sedentarius</i>  <i>Chaetodon capistratus</i>  <i>Chaetodon aculeatus</i>  <i>Acanthurus bahianus</i>  <i>Acanthurus coeruleus</i>  <i>Holocentrus adscensionis</i>  <i>Lutjanus synagris</i>  <i>Ocyurus chrysurus</i>  <i>Haemulon aurolineatum</i>  <i>Epinephelus itajara</i>  <i>Epinephelus guttatus</i>  <i>Cephalopholis fulva</i>  <i>Hypoplectrus unicolor</i>  <i>Pseudupeneus maculatus</i>  <i>Mulloidichthys martinicus</i>  <i>Chromis multilineata</i>  <i>Chromis cyanea</i>  <i>Stegastes partitus</i>  <i>Abudefduf saxatilis</i>  <i>Thalassoma bifasciatum</i>  <i>Clepticus parrae</i>  <i>Bodianus rufus</i>  <i>Halichoeres radiatus</i>  <i>Scarus chrysopterus</i>  <i>Sparisoma viride</i>  <i>Melichthys niger</i>  <i>Acanthostracion polygonia</i>  <i>Lactophrys bicaudalis</i>  <i>Canthigaster rostrata</i>  <i>Sphyraena barracuda</i>  <i>Caranx crysos</i>  <i>Caranx latus</i>  <i>Caranx ruber</i></p>	<p><i>Millepora alcicornis</i>  <i>Siderastrea sp.</i>  <i>Montastraea cavernosa</i>  <i>Diploria strigosa</i>  <i>Meandrina meandrites</i>  <i>Mycetophyllia sp.</i>  <i>Antipathes sp.</i>  <i>Antipahtes pinnacea</i>  <i>Tuberastraea coccinea</i>  <i>Rhizopsammia goesi</i>  <i>Carijoa riisei</i>  <i>Ellisella barbadensis</i>  <i>Plexaura flexuosa</i>  <i>Eunicea spp.</i>  <i>Gorgonia ventalina</i>  <i>Diodogorgia nodulifera</i>  <i>Pseudopterogorgia sp.</i>  <i>Stenorhynchus seticornis</i>  <i>Spirobranchus giganteus</i>                      unidentified sabellids  <i>Lima scabra</i>  <i>Leucandra aspera</i>  <i>Aplysina fistularis</i>  <i>Amphimedon compressa</i>  <i>Pseudoceratina crassa</i>  <i>Ircinia felix</i>  <i>Halisarca sp.</i>                      unidentified encrusting sponges</p>
<b>Algae</b>	<b>Other species</b>
<p><i>Dictyota spp.</i>  <i>Lobophora variegata</i>  <i>Caulerpa racemosa</i>  <i>Ventricaria ventricosa</i>  <i>Valonia macrophysa</i>  <i>Udotea cyanthiformis</i>  <i>Sargassum sp.</i>  <i>Halimeda sp.</i></p>	<p><i>Eretmochelys imbricate</i></p> <p>*Note: No survey conducted at adjacent area during this year.</p>



**Table 35.** List of species that were associated with **Target 79** (sailboat) and those that were encountered in the surrounding area but not directly associated with the artificial reef, 2002.

<b>Associated with artificial reef</b>	<b>Surrounding area</b>
<p><b>Fish Species</b></p> <p>Tomtate, <i>Haemulon aurolineatum</i>                      Squirrelfish, <i>Holocentrus adscensionis</i>                      Slippery dick, <i>Halichoeres bivittatus</i>                      Yellowhead wrasse, <i>Halichoeres garnoti</i> Bluehead,  <i>Thalassoma bifasciatum</i>                      Blue parrotfish, <i>Scarus coeruleus</i>                      Queen triggerfish, <i>Balistes vetula</i>                      Yellow goatfish, <i>Mulloidichthys martinicus</i>                      Blue tang, <i>Acanthurus coeruleus</i>                      Ocean surgeonfish, <i>Acanthurus bahianus</i>                      Blue chromis, <i>Chromis cyanea</i>                      Beaugregory, <i>Stegastes leucostictus</i>                      Bridled goby, <i>Coryphopterus glaucofraenum</i>                      Spotted moray, <i>Gymnothorax moringa</i>                      Silversides, Fam. <i>Atherinidae</i></p>	<p><b>Fish Species</b></p> <p>None encountered</p>
<p><b>Invertebrates</b></p> <p>Massive starlet coral, <i>Siderastrea sidereal</i>                      Fire coral, <i>Millepora alcicornis</i>                      Unidentified octocorals                      Unidentified hydroids                      Star encrusting sponge, <i>Halisarca</i> sp.                      Stinker sponge, <i>Ircinia felix</i>                      Black-ball sponge, <i>Ircinia strobilina</i>                      Row pore rope sponge, <i>Aplysina cauliformis</i></p>	<p><b>Invertebrates</b></p> <p>Row pore rope sponge, <i>Aplysina cauliformis</i>                      Unidentified rope sponges                      Unidentified barrel sponges</p>
<p><b>Algae</b></p> <p><i>Lobophora variegata</i>  <i>Avrainvillea longicaulis</i>  <i>Udotea</i> sp.  <i>Acetabularia crenulata</i>                      Unidentified encrusting red algae</p>	<p><b>Algae</b></p> <p><i>Lobophora variegata</i>  <i>Avrainvillea longicaulis</i>  <i>Udotea</i> sp.  <i>Acetabularia crenulata</i>  <i>Rhodoliths</i> unidentified sp.</p>

**Table 36.** List of species that were associated with **Target 79** (sailboat) and those that were encountered in the surrounding area but not directly associated with the artificial reef, 2004.

<b>Associated with artificial reef</b>	<b>Surrounding area</b>
<b>Fish Species</b>	<b>Fish Species</b>
<i>Acanthurus bahianus</i> <i>Acanthurus coeruleus</i> <i>Holocentrus adscensionis</i> <i>Myripristis jacobus</i> <i>Ocyurus chrysurus</i> <i>Haemulon aurolineatum</i> <i>Cephalopholis fulva</i> <i>Stegastes partitus</i> <i>Chromis cyanea</i> <i>Thalassoma bifasciatum</i> <i>Halichoeres pictus</i> <i>Scarus taeniopterus</i> <i>Seriola rivoliana</i>	<i>Stegastes partitus</i> <i>Coryphopterus glaucofraenum</i> <i>Halichoeres garnoti</i>
<b>Invertebrates</b>	<b>Invertebrates</b>
<i>Millepora alcicornis</i> <i>Siderastrea sp.</i> <i>Montastraea cavernosa</i> <i>Porites astreoides</i> <i>Diploria strigosa</i> unidentified sabellids <i>Condylactus gigantea</i> <i>Amphimedon compressa</i> <i>Pseudoceratina crassa</i> <i>Halisarca sp.</i> unidentified encrusting sponges	<i>Aplysina cauliformis</i> <i>Amphimedon compressa</i> <i>Pseudoceratina crassa</i> <i>Manicina areolata</i>
<b>Algae</b>	<b>Algae</b>
<i>Lobophora variegatta</i> <i>Sargassum sp.</i> <i>Halimeda sp.</i>	<i>Lobophora variegatta</i> <i>Schizothrix calcicula</i> <i>Udotea sp.</i> Rhodolith, cf. <i>Lithothamnion ruptile</i>

**Table 37.** List of species that were associated with **Target 165** (steel cargo ship) and those that were encountered in the surrounding area but not directly associated with the artificial reef, 2002.

<b>Associated with artificial reef</b>	<b>Surrounding area</b>
<p><b>Fish Species</b></p> <p>Rock beauty, <i>Holacanthus tricolor</i>                      Gray angelfish, <i>Pomacanthus arcuatus</i>                      Blue tang, <i>Acanthurus coeruleus</i>                      Ocean surgeonfish, <i>Acanthurus bahianus</i>                      Bicolor damsel, <i>Stegastes partitus</i>                      Beaugregory, <i>Stegastes leucostictus</i>                      Sergeant major, <i>Abudefduf saxatilis</i>                      Blue chromis, <i>Chromis cyanea</i>                      Brown chromis, <i>Chromis multilineata</i>                      Fairy basslet, <i>Gramma loreto</i>                      Bar jack, <i>Caranx ruber</i>                      Tomtate, <i>Haemulon aurolineatum</i>                      French grunt, <i>Haemulon flavolineatum</i>                      White grunt, <i>Haemulon plumierii</i>                      Rock hind, <i>Epinephelus adscensionis</i>                      Graysby, <i>Cephalopholis cruentatus</i>                      Coney, <i>Cephalopholis fulva</i>                      Yellowtail snapper, <i>Ocyurus chrysurus</i>                      Yellowhead wrasse, <i>Halichoeres garnoti</i>                      Bluehead, <i>Thalassoma bifasciatum</i>                      Spanish hogfish, <i>Bodianus rufus</i>                      Stoplight parrotfish, <i>Sparisoma viride</i>                      Redband parrotfish, <i>Sparisoma aurofrenatum</i>                      Sand diver, <i>Synodus intermedius</i>                      Squirrelfish, <i>Holocentrus adscensionis</i>                      Glasseye snapper, <i>Heteropriacanthus cruentatus</i>                      Yellow goatfish, <i>Mulloidichthys martinicus</i>                      Sharpnose puffer, <i>Canthigaster rostrata</i></p>	<p><b>Fish Species</b></p> <p>Stoplight parrotfish, <i>Sparisoma viride</i></p>
<p><b>Invertebrates</b></p> <p>Atlantic thorny oyster, <i>Spondylus americanus</i>                      Giant hermit, <i>Petrochirus diogenes</i>                      Fire coral, <i>Millepora</i> sp.                      Starlet coral, <i>Siderastrea siderea</i>                      Maze coral, <i>Meandrina meandrites</i>                      Finger coral, <i>Porites porites</i>                      Sheet coral, <i>Agaricia</i> sp.                      Sea whip, <i>Pterogorgia</i> sp.                      Unidentified tunicates                      Star encrusting sponge, <i>Halisarca</i> sp.                      Rope sponges, <i>Aplysina</i> sp.</p>	<p><b>Invertebrates</b></p> <p>Rope sponges, <i>Aplysina</i> sp.                      Black ball sponge, <i>Ircinia strobilina</i>                      Branching tube sponge, <i>Pseudoceratina crassa</i>                      Orange ball sponge, <i>Cinachyra</i> sp.</p>

**Table 37. Continued.**

<b>Associated with artificial reef</b>	<b>Surrounding area</b>
<b>Invertebrates</b>	<b>Invertebrates</b>
Black ball sponge, <i>Ircinia strobilina</i> Stinker sponge, <i>Ircinia felix</i>	
<b>Algae</b>	<b>Algae</b>
<i>Lobophora variegata</i> <i>Dictyota</i> sp. <i>Halimeda tuna</i> <i>Halimeda discoidea</i>	Rhodolith, cf. <i>Lithothamnion ruptile</i> <i>Lobophora variegata</i> <i>Udotea</i> sp. <i>Dictyota</i> sp.

**Table 38.** List of species that were associated with **Target 165** (steel cargo ship) and those that were encountered in the surrounding area but not directly associated with the artificial reef, 2003.

Associated with artificial reef	Surrounding area
<p><b>Fish Species</b></p> <p>Masked goby, <i>Coryphopterus personatus</i>                      Blue tang, <i>Acanthurus coeruleus</i>                      Ocean surgeonfish, <i>Acanthurus bahianus</i>                      French angelfish, <i>Pomacanthus paru</i>                      Gray angelfish, <i>Pomacanthus arcuatus</i>                      Bar jack, <i>Caranx ruber</i>                      Barracuda, <i>Sphyraena barracuda</i>                      Striped grunt, <i>Haemulon striatum</i>                      French grunt, <i>Haemulon flavolineatum</i>                      Creolefish, <i>Paranthias furcifer</i>                      Stoplight parrotfish, <i>Sparisoma viride</i>                      Striped parrotfish, <i>Scarus iserti</i>                      Bluehead, <i>Thalassoma bifasciatum</i>                      Spanish hogfish, <i>Bodianus rufus</i>                      Cocoa damselfish, <i>Stegastes variabilis</i>                      Bicolor damselfish, <i>Stegastes partitus</i>                      Sergeant major, <i>Abudefduf saxatilis</i>                      Blue chromis, <i>Chromis cyanea</i>                      Brown chromis, <i>Chromis multilineata</i>                      Graysby, <i>Epinephelus cruentatus</i>                      Red Hind, <i>Epinephelus guttatus</i>                      Squirrelfish, <i>Holocentrus adscensionis</i>                      Sharpnose puffer, <i>Canthigaster rostrata</i>                      Queen triggerfish, <i>Balistes vetula</i></p>	<p><b>Fish Species</b></p> <p>Harlequin bass, <i>Serranus tigrinus</i>                      Sand tilefish, <i>Malacanthus plumieri</i>                      Stoplight parrotfish, <i>Sparisoma viride</i>                      Spotted goatfish, <i>Pseudupeneus maculatus</i>                      Clown wrasse, <i>Halichoeres maculipinna</i>                      Yellowhead jawfish, <i>Opistognathus aurifrons</i></p>
<p><b>Invertebrates</b></p> <p><i>Millepora alcicornis</i>  <i>Montastraea cavernosa</i>  <i>Siderastrea radians</i>  <i>Diploria labyrinthiformis</i>  <i>Meandrina meandrites</i>  <i>Porites astreoides</i>  <i>Ellisella barbadensis</i>  <i>Antipathes</i> sp.  <i>Halisarca</i> sp.  <i>Ircinia strobilina</i>  <i>Ectyoplasia ferox</i>  <i>Amphimedon compressa</i>  <i>Aplysina cauliformis</i>  <i>Halocordyle disticha</i>                      Unidentified hydroids</p>	<p><b>Invertebrates</b></p> <p><i>Aplysina cauliformis</i>  <i>Aplysina</i> sp.  <i>Ectyoplasia ferox</i></p>

**APPENDIX, Table 38. Continued.**

<b>Associated with artificial reef</b>	<b>Surrounding area</b>
<b>Invertebrates</b> Unidentified encrusting sponges Unidentified tunicates <i>Hermodice carunculata</i> Unidentified feather duster worms	<b>Invertebrates</b>
<b>Algae</b> <i>Sargassum</i> sp. <i>Lobophora variegata</i> <i>Halimeda</i> sp. <i>Dictyota</i> sp. Crustose coralline algae	<b>Algae</b> <i>Penicillus pyriformis</i> <i>Udotea cyathiformis</i> <i>Lobophora variegata</i> Rhodolith, cf. <i>Lithothamnion ruptile</i>