

The Southeast Florida Marine Debris Reporting and Removal Program

Southeast Florida Coral Reef Initiative
Fishing, Diving and Other Uses
Local Action Strategy Projects 29, 30 and 32



Southeast
Florida
Coral Reef
Initiative

Acting above to protect what's below.

The Southeast Florida Marine Debris Reporting and Removal Program

3rd Annual Southeast Florida Reef Cleanup Summary

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Coral Reef Conservation Program

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Table of Contents

INTRODUCTION	3
METHODOLOGY	4
<i>Dive Charter Boat Participants</i>	4
<i>Site Selection</i>	4
<i>Cleanup Logistics.....</i>	6
<i>Data Collection.....</i>	7
<i>Post-Dives and Debris Disposal.....</i>	8
RESULTS	9
<i>Type of Debris - By Material</i>	11
<i>Type of Debris – By Source</i>	13
<i>Spatial Distribution of Debris.....</i>	14
DISCUSSION	16
<i>Reef Cleanup Recommendations.....</i>	16
<i>Other Marine Debris Management Strategies.....</i>	16
<i>Conclusion</i>	17
REFERENCES.....	18

Table 1. Diver participation and debris removed from Miami-Dade, Broward, and Palm Beach counties during the 3rd Annual Southeast Florida Reef Cleanup, as compared to totals from previous years. 9

Figure 1. Divers aboard Dolphin Sun Dive Charters in Palm Beach County pose with debris they collected during the 3rd Annual Southeast Florida Reef Cleanup..... 3

Figure 2. The 3rd Annual Southeast Florida Reef Cleanup was organized through SEFCRI’s Marine Debris Reporting and Removal Program, in conjunction with the Southeast Florida Action Network (SEAFAN). 4

Figure 3. Dive sites in Miami-Dade, Broward, and Palm Beach counties visited during the 3rd Annual Southeast Florida Reef Cleanup..... 5

Figure 4. Cleanup kits loaned to divers participating in the 3rd Annual Southeast Florida Reef Cleanup. 6

Figure 5. Divers sort and record marine debris collected aboard Narcosis Dive Charters. .. 7

Figure 6. IKEA-brand large tote bag with marine debris. 8

Figure 7. Debris removed by South Florida Diving Headquarters and Southern Scuba School as part of the 3rd Annual Southeast Florida Reef Cleanup. 11

Figure 8. Percentage of total debris items collected during the 3rd Annual Southeast Florida Reef Cleanup, by material..... 12

Figure 9. Percentage of total debris items collected during the 3rd Annual Southeast Florida Reef Cleanup, by source. 13

Figure 10. The high relief and ledge structure at Barracuda Reef in Broward County may contribute to debris accumulation..... 15

INTRODUCTION

This summer, divers across southeast Florida had fun underwater while actively contributing to coral reef conservation during the 3rd Annual Southeast Florida Reef Cleanup, hosted by the Florida Department of Environmental Protection Coral Reef Conservation Program (FDEP CRCP) and the Southeast Florida Coral Reef Initiative (SEFCRI). In partnership with twelve local dive charter boats, reef cleanups were held in Miami-Dade, Broward, and Palm Beach counties on July 20th, June 29th, and August 3rd, respectively, where a total of 146 divers helped to remove marine debris from the local coral reefs (Figure 1). In Martin County, FDEP CRCP and SEFCRI supported the Pecks Lake Reef Dive Cleanup on July 27th. This event was coordinated by the Marine Industries Association of the Treasure Coast and the Port Salerno Commercial Fishing Dock Authority in conjunction with the 6th Annual Treasure Coast Waterway Cleanup, and included participation by over 60 additional divers (April Price & Associates, 2013). For more information about the 6th Annual Treasure Coast Waterway Cleanup and the Peck's Lake Reef Dive Cleanup, please visit www.twaterwaycleanup.com.



Figure 1. Divers aboard Dolphin Sun Dive Charters in Palm Beach County pose with debris they collected during the 3rd Annual Southeast Florida Reef Cleanup.
Photo Credit: FDEP CRCP

The 3rd Annual Southeast Florida Reef Cleanup was coordinated through SEFCRI's Marine Debris Reporting and Removal Program, which seeks to raise awareness about the causes and consequences of marine debris, minimize its impacts through cleanup efforts, and develop strategies to reduce the amount of debris entering the marine environment (Bohnsack & Monty,

2012). In addition to organizing yearly reef cleanups throughout southeast Florida, this program asks local divers to remove small debris on a regular basis and, as part of the Southeast Florida Action Network (SEAFAN) marine incident reporting system, encourages them to report all debris encountered or removed from southeast Florida's reefs by calling the SEAFAN hotline at (866) 770-SEFL or filling out an online form at www.SEAFAN.net (Bohnsack & Monty, 2012).



Figure 2. The 3rd Annual Southeast Florida Reef Cleanup was organized through SEFCRI's Marine Debris Reporting and Removal Program, in conjunction with the Southeast Florida Action Network (SEAFAN).

METHODOLOGY

Dive Charter Boat Participants

The 3rd Annual Southeast Florida Reef Cleanup took place exclusively aboard local dive charter boats and, to the extent possible, all dive operators within Miami-Dade, Broward, and Palm Beach counties were invited to participate. Twelve local dive charter boats participated in the 2013 event, including two in Miami-Dade County (R.J. Diving Ventures and Latitude 305, Diving & Charters), four in Broward County (American Dream Dive Charters, Brownie's YachtDiver Stores, Lady Go Diver, and South Florida Diving Headquarters in partnership with Southern Scuba School), and six in Palm Beach County (Sunstar Aquatic Services, Splashdown Divers, Dolphin Sun Dive Charters, Pura Vida Divers, Narcosis Dive Charters, and Jupiter Dive Center).

Site Selection

Dive sites for the 3rd Annual Southeast Florida Reef Cleanup were chosen by each of the local dive operators, and to some extent informed by previously successful reef cleanup locations. A total of 22 sites were visited throughout Miami-Dade, Broward, and Palm Beach counties (Figure 3). In Miami-Dade County, participants aboard charter boats visited four sites, including Keys Canyon, Jose Cuervo Reef, the Mathew Lawrence Barge, and the Pillars. Seven sites were targeted during the Broward County cleanup, including Barracuda Reef, Sunrise Reef, Moe's Reef, Grouper Bend,

RSB-1 Wreck, Razzle Dazzle, and Lighthouse Ledge. Finally, during the Palm Beach County portion of the reef cleanup, debris was removed from eleven dive sites, including Hillsboro Ledge, Separated Rocks, Boynton Reef, Horseshoe Reef, Paul’s Reef, Bath & Tennis Reef, Breaker’s Reef, Mid Reef, Shark Canyon, Loggerhead Reef, and Julie’s Reef. Some locations, especially those known to accumulate debris, were targeted over the course of several dives, including repetitive dives from the same boat and by different boats within the region.

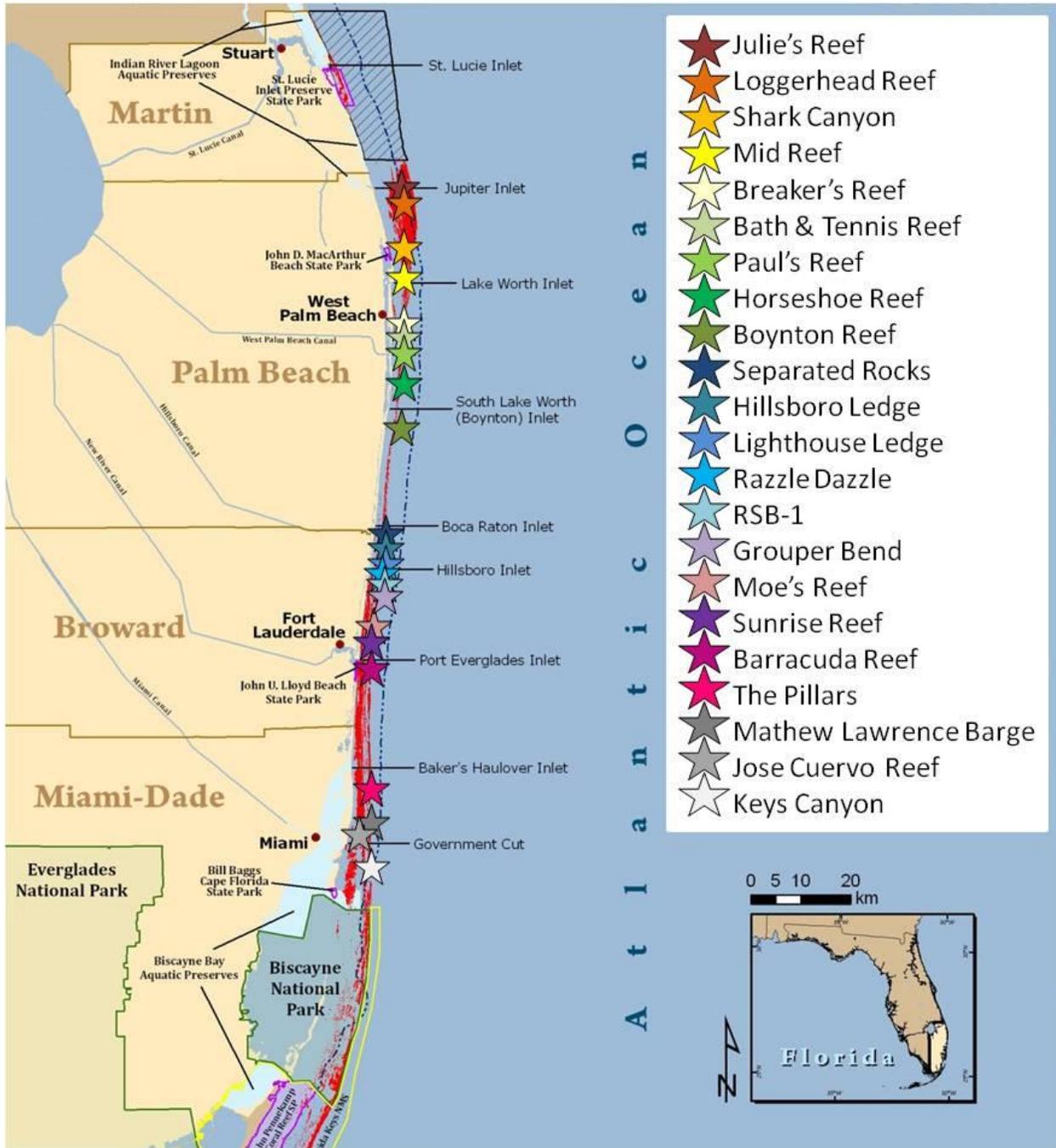


Figure 3. Dive sites in Miami-Dade, Broward, and Palm Beach counties visited during the 3rd Annual Southeast Florida Reef Cleanup.

Cleanup Logistics

Registration and execution of the reef cleanup dives occurred according to the standard practice maintained by each dive company; divers signed-up, rented scuba gear and paid for a 2-tank dive trip directly through the individual dive charters, and also adhered to the established diving procedures and safety standards maintained aboard each dive boat. To conduct the reef cleanup, FDEP CRCP prepared and loaned all supplies necessary, which included a marine debris dive cleanup briefing, guidelines for administering the cleanup, gloves, catch bags, cutting shears, clipboards, data sheets, trash bags, a waterproof scale (as available), small promotional giveaways, and informational packets for all participants. For each boat, one to two site coordinators were designated to liaise with FDEP CRCP staff and to oversee the actual cleanup event, which included providing a marine debris dive cleanup briefing to all participants, loaning ‘cleanup kits’ consisting of gloves, cutting shears, and catch bags to remove debris (Figure 4), and overseeing the proper documentation and disposal of debris.



Figure 4. Cleanup kits loaned to divers participating in the 3rd Annual Southeast Florida Reef Cleanup.

Photo Credit: FDEP CRCP

Site coordinators during the 3rd Annual Southeast Florida Reef Cleanup consisted of FDEP CRCP staff, members of the SEFCRI Marine Debris Program Project Team (including staff from The Florida Fish and Wildlife Conservation Commission, Palm Beach County Reef Rescue, Miami-Dade County Department of Environmental Resources Management, and Palm Beach County Department of Environmental Resources Management), students from local universities (Nova Southeastern University and the University of Miami’s Rosenstiel School of Marine and Atmospheric Sciences) and in some cases staff or partners of the participating dive boats (Jupiter Dive Center, Pura Vida Divers, Brownies YachtDiver Stores, and Southern Scuba School).

The reef cleanup consisted of one dive trip (two dives) aboard each of the dive boats, with the exception of Pura Vida Divers, which participated in the reef cleanup during both the morning and afternoon trips for a total of 4 dives, Splashdown Divers, which ended the trip midway through the first dive due to deteriorating weather conditions, and Narcosis Dive Charters, which contributed to the cleanup effort during 3 dives, including one in the morning and two in the afternoon. Thus, all debris removed during the 3rd Annual Southeast Florida Reef Cleanup occurred over the course of 26 dive opportunities across Miami-Dade, Broward, and Palm Beach counties.

Data Collection

During each dive, participants collected debris and then returned to the boat to sort and record their findings onto the Marine Debris Program's Reef Dive Cleanup Data Card (Figure 5). These data cards were newly designed for this year's event, based on the Dive Against Debris data sheets produced by the Project Aware Foundation specifically for underwater cleanup activities (Project AWARE Foundation, 2013). Using these data sheets, divers recorded the debris they collected based on its material of construction: plastic, glass & ceramic, wood, metal, cloth, rubber, paper/cardboard, or other/mixed materials. Rather than having a list of pre-defined debris items as appears in the Dive Against Debris data sheets, the SEAFAN Reef Dive Cleanup Data Cards provide blank spaces within each debris category for divers to record specifically what they find. This method was developed by the SEFCRI Marine Debris Project Team to streamline the debris recording process for participating divers, while still maintaining compatibility with Project Aware so that these cleanup results can easily be reported on the Dive Against Debris website.



Figure 5. Divers sort and record marine debris collected aboard Narcosis Dive Charters. Photo Credit: Nikole Ordway.

Post-Dives and Debris Disposal

At the conclusion of the cleanup dives, volunteers turned in their completed data sheets and the loaned cleanup kits, and were given small giveaway items and informational handouts from FDEP CRCP and SEFCRI. The collected debris was recycled or disposed of in trash cans or dumpsters at each location. To the extent possible, clean monofilament was separated out for recycling through the Florida Fish and Wildlife Conservation Commission's Monofilament Recovery and Recycling Program, while heavily encrusted line was cut up before disposal to reduce the likelihood of additional entanglement in the landfill (Florida Fish and Wildlife Conservation Commission, 2011).

During the Palm Beach County portion of this year's event, efforts were made to begin trying to decrease the use of disposable plastic trash bags. Instead, IKEA-brand large tote bags were tested as an alternative, reusable method of containing debris aboard the dive boats before it was disposed of in dumpsters and recycling bins (Figure 6). Beyond reducing plastic waste, this strategy had a number of benefits. These bags are free-standing, which allowed debris to be more easily transferred from divers' catch bags, and are easily cleaned and stored for reuse. They are also safer because they are more resistant to puncture by broken bottles, fish hooks, and other sharp objects, have handles to more easily transport debris from the boat to the disposal location, and are capable of holding up to 55 lbs. of weight (IKEA, 2013). This and similar efforts to reduce the cleanups' plastic footprint will continue in the future.



Figure 6. IKEA-brand large tote bag with marine debris.
Photo Credit: FDEP CRCP

RESULTS

Following the reef cleanup, all data sheets submitted from each boat in each county were compiled and analyzed. Across the three counties, divers collectively spent 210.6 hours underwater cleaning up approximately 140.2 linear miles of southeast Florida's reefs. They succeeded in removing an estimated 1568 pieces of debris, which weighed over 1070 pounds, and totaled almost 850 gallons. This effort represents an increase in both participation and the amount of debris removed compared to the previous cleanup events held in 2011 and 2012 (Table 1).

County	Number of Participants	Dive Time (hours)	Distance Covered (linear miles)	Pieces of Debris Removed	Weight of Debris (pounds)	Volume of Debris (gallons)
Miami-Dade	16	19	9.6	256	184	67.5
Broward	62	90.2	55	840	599	636
Palm Beach	68	101.4	75.6	642	289	146.2
2013 Total	146	210.6	140.2	1568	1072	849.7
2012 Total	76	93.6	36.4	485	356.5	165.5
2011 Total	17	18	3.24	60	110	30

Table 1. Diver participation and debris removed from Miami-Dade, Broward, and Palm Beach counties during the 3rd Annual Southeast Florida Reef Cleanup, as compared to totals from previous years.

The numbers presented in Figure 7 were calculated as follows:

- *'Number of Participants'* - divers who entered the water with the intent of participating in the reef cleanup, whether or not any debris was recovered.
- *'Dive Time'* - the total amount of time that cleanup participants spent underwater participating in the cleanup, calculated based on the bottom time recorded by each dive team multiplied by the number of members participating in that dive team.
- *'Distance Covered'* - determined based on diver estimates and, where available, calculated based on GPS coordinates recorded at the beginning and end of drift dives, with distance proportional to the dive time (Palm Beach and Broward counties only).

- *'Pieces of Debris Removed'* - the tally of items recorded on data sheets by cleanup participants. Some items, such as fishing line are inherently difficult to quantify. In these instances, divers determined a numerical tally based on the number of bundles or discrete pieces collected. Therefore, a piece of line that is 0.5 feet is tallied as 1 item, as is a single piece of fishing line that is 100 feet in length. On a few data sheets, however, an estimated total length of line collected was provided instead of a total count. Although little literature is available on quantifying marine debris items such as fishing line, a study on the spatial distribution of lost fishing gear in the Florida Keys by Chiappone et al. provides both a quantity of 'hook-and-line' debris items removed (e.g., monofilament and fishing wire, both with and without hooks, sinkers, and leaders), and a measurement of their total linear length (Chiappone, Swanson, Miller, & Dienes, 2004). Although the actual lengths of debris recorded during this study varied from <0.5 m to >5 m, the average length was approximately 1.4 m, or 4.5 ft. (Chiappone, Swanson, Miller, & Dienes, 2004). In an effort to most accurately reflect the amount of fishing line recovered during the cleanup dives, when only a total length of line was provided, these numbers were converted to quantity by dividing the estimated linear length by five (4.5 ft. average length, rounded to the nearest whole number). Thus, when only an estimated length was provided on the data sheets, each five feet of length was considered to be one discrete item. In a few instances where neither a quantity nor a length estimation was provided for an item, the minimum number was assumed. For example, a singular item recorded on the data sheet, such as 'fishing line,' was counted as one item, and plural items such as 'hooks' were considered two items.
- *'Weight of Debris'* - combination of estimated and measured amounts, as scales were not available for all boats. Weight was measured or estimated immediately following each dive when debris was still wet. As such, the total weight collected is higher than it would be for dry debris, as some items (e.g., foam mattress pads) retained water that was then included in the aggregate weight. While this makes it difficult to compare these data with the weight of dry debris collected from beach cleanups, it still represents the amount of effort contributed by volunteers, who lifted the heavier, wet debris items from the water during the event.
- *'Volume of Debris'* - estimated by comparing the amount of debris collected against the holding capacity of containers with a known volume (laundry baskets with a volume of 44L or ~11.6 gallons, IKEA large tote bags with a volume of 19 gallons, etc.).

The increase in debris removed during the 2013 cleanup event is largely attributed to the greater number of dive boats and participants. In particular, the weight and volume of debris removed were much larger primarily due to the efforts of divers participating with South Florida Diving Headquarters and Southern Scuba School in Broward County. This particular trip included experienced divers who used lift bags to retrieve larger and heavier debris, such as tires and large quantities of rope. The debris removed solely from this effort nearly filled a Bagster dumpster bag, which is 2.5' H x 4' W x 8' L (Figure 7). This accounted for approximately 500 lbs. and 505 gallons of the total debris removed across all three counties, or 47% and 59% of those totals, respectively.



Figure 7. Debris removed by South Florida Diving Headquarters and Southern Scuba School as part of the 3rd Annual Southeast Florida Reef Cleanup.

Photo Credit: Alfred Townsend

The data collected during this cleanup event is inherently uncertain as tallies and calculations were recorded at the discretion of the individual divers and site coordinators, including the number of debris items and categorization by type. In some cases, measurements such as distance covered, volume, and weight are estimates. Guidance on recording and quantifying data was provided to standardize data collection as much as possible, although individual judgment likely still varied between participants and the accuracy of all data cannot be confirmed. While such uncertainty is a common occurrence in community data collection efforts, these data still provide some means of assessing and quantifying the amount of marine debris present along southeast Florida's reefs.

Type of Debris - By Material

Of the total debris collected across Miami-Dade, Broward, and Palm Beach counties, plastic items were the most prevalent, with 43.5% or 682 pieces of debris made out of plastic (**Error! Reference source not found.**). Items within this category included beverage bottles, monofilament fishing line, grocery store bags, PVC pipes, dive equipment, food wrappers, and nylon rope, among others. Metal debris, consisting of items such as aluminum beverage cans, fishing hooks, sinkers, leader line, boat anchor and chain, and dive weights were second most common, comprising 31.1% (488 pieces) of the total debris. The remaining debris items recovered were composed of glass & ceramic (8.9% - glass beverage bottles), cloth (7.5% - rope, cloth bags), wood (4.4% - wood slats, processed wood fragments), other or mixed materials (3.1% - clothing, fiberglass boat pieces, fishing poles, shoes, golf balls), rubber (1.1% - tires, rubber gloves, rubber bands), and paper/cardboard (0.3% - paper fragments).

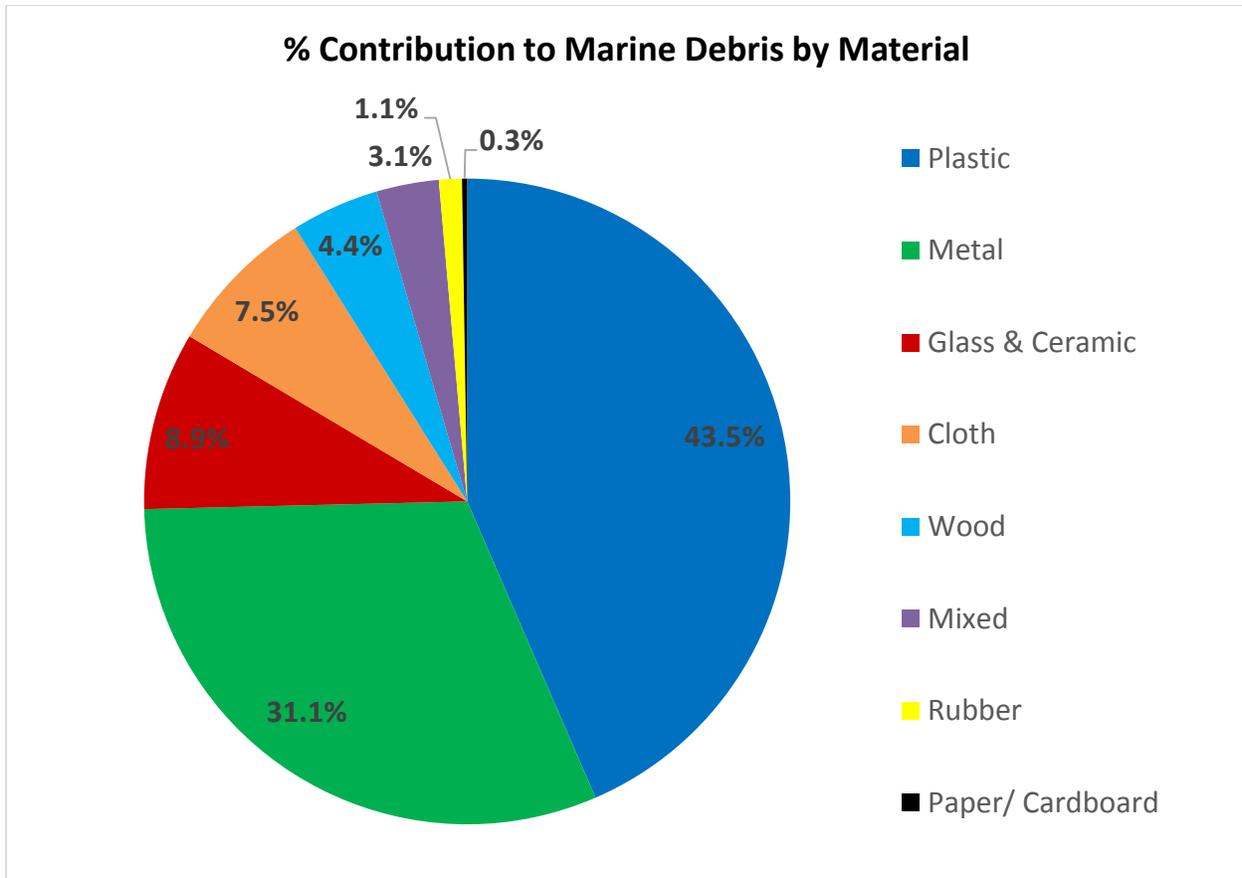


Figure 8. Percentage of total debris items collected during the 3rd Annual Southeast Florida Reef Cleanup, by material.

In addition to being the most prevalent type of debris, the majority of direct impacts on marine life by debris that were observed during the cleanup dives involved plastics, specifically monofilament fishing line wrapped around sponges and coral. Other impacts involved entanglement by plastic bags, rope, and metal fishing wire. All types of debris have the potential to impact the coral reef ecosystem and marine life, whether by entanglement, ingestion, abrasion or other physical damage, although plastic is often considered the most troubling.

Globally, plastics are estimated to comprise 60% to 80% of marine debris, due to their popular use in consumer products and slow rate of decomposition (Derraik, 2002). Little is known about the amount of time it takes for plastics to biodegrade completely, although there is a general consensus that they are highly persistent in the marine environment (Moore, 2008). Monofilament fishing line, for example, may last up to 600 years (Florida Fish and Wildlife Conservation Commission, 2011). Many plastics are now designed to disintegrate more quickly in the water, which does not eliminate the plastic problem, but instead reduces it into thousands of tiny plastic particles (Moore, 2008). Such plastics are easily mistaken as food, which can accumulate and lead to starvation in marine animals, and also introduce polychlorinated biphenyls (PCBs) into marine food webs (Derraik, 2002). Many plastics also contain bioactive additives such as UV stabilizers, softeners, flame retardants, non-stick compounds and colorants, which may have adverse effects on marine organisms (Moore, 2008).

Type of Debris – By Source

Following the cleanup dives, the collected debris was further analyzed and categorized into five main groups, based on their most likely source:

- Fishing debris – Monofilament, leader line, hooks, sinkers, lures, fishing rods, etc.
- Boating debris – Lines, anchor chain, boat parts (trim tab, intake cover, hull pieces), etc.
- Diving debris – Dive masks, snorkels, dive weights, weight belts, etc.
- Trash – Bottles, cans, food wrappers, plastic bags, miscellaneous plastic, etc.
- Household debris – Sunglasses, golf balls, clothing, mattress pads, furniture, etc.

Among the debris categories, fishing and trash were the most common, comprising 43% and 41% of the total debris collected in southeast Florida, respectively (Figure 9). The remainder was composed of boating, household, and diving debris, which contributed 8%, 7%, and 1%, respectively, to the total. This ratio is very similar to the composition of debris found during the 2012 cleanup event, in which 43.7% was fishing-related, and 39% was trash. Of the fishing debris, the majority was composed of monofilament fishing line, while aluminum cans, followed by glass and plastic beverage bottles, were the most prevalent items within the trash category. Within these categories, fishing, boating, and diving debris are considered to be ocean-based sources, while trash and household debris are characterized as land-based. As such, 52% of the debris collected appears to have come from water-based activities, whereas 48% originated on land. This proportion is also consistent with debris recovered during the 2012 cleanup event.

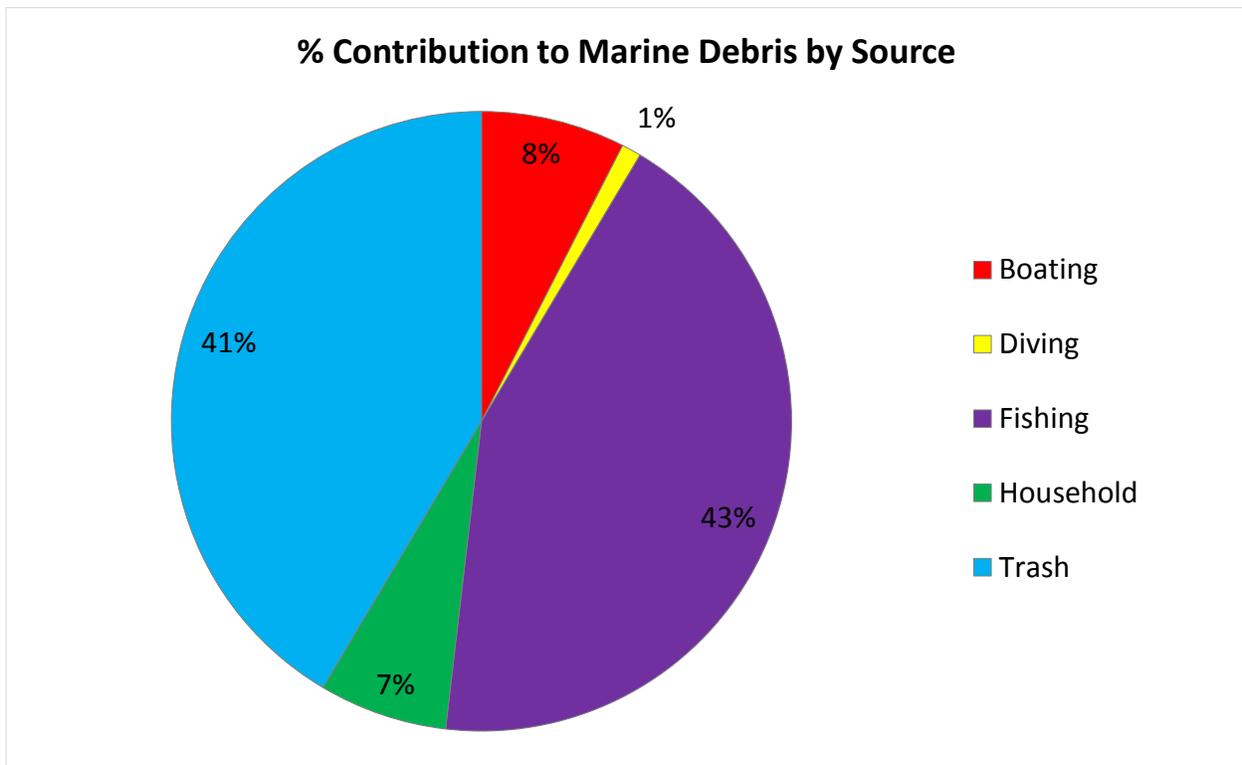


Figure 9. Percentage of total debris items collected during the 3rd Annual Southeast Florida Reef Cleanup, by source.

There is some uncertainty in classifying marine debris by source. In particular, there is a great deal of overlap between the types of products used on land and on the water, which makes determining the origin of debris items very difficult. For example, for the purposes of this analysis, all trash has been categorized as land-based, although some may have been accidentally lost while boating, or even intentionally disposed of at sea. The same holds true for some household items, such as sunglasses and money, both of which were discovered during the 2013 reef cleanup. These items may have come from upland users, or may have been associated with boating, fishing, or diving activities. Similarly, lost fishing gear is considered an ocean-based debris item, although some may have washed into the ocean from shore fishing activities. Despite these shortcomings, this classification system provides a simple representation of the types and quantities of debris on southeast Florida's reefs.

The percent contribution to marine debris is calculated based on the number of items found, as opposed to the contribution to the total weight or volume of debris (Figure 8, Figure 9). Although outside the scope of these cleanup events, further analysis of the debris collected to determine the percent contribution by weight or volume would likely yield different results. For example, boating debris comprises only 8% of the total debris removed when calculated based on the quantity of items. However, boating debris includes items such as anchors, chain, rope, and pieces of boat, all of which tend to be larger and heavier overall. Thus, boating debris could be considered a larger contributor to marine debris if calculated by weight or volume. This may also be true when analyzing the percent contribution of the various materials of construction. In particular, while only 1.1% of the total marine debris items found consisted of rubber, several of these items were tires, which together contributed a great deal to both the total weight and volume of debris removed. As the extent of damage to coral reef habitat is likely influenced by both the size and prevalence of marine debris items, both of these factors should be accounted for in determining the true amount and impacts associated with marine debris in southeast Florida.

Spatial Distribution of Debris

The debris recovered during the 3rd Annual Southeast Florida Reef Cleanup was not uniformly distributed across all dive sites. Of the 22 cleanup sites, 62% of the collected debris was recovered at only 3 sites. These sites included Jose Cuervo Reef in Miami-Dade County (14% of total debris), Barracuda Reef in Broward County (26% of total debris), and Horseshoe Reef in Palm Beach County (22% of total debris).

- *Jose Cuervo Reef* – A total of 220 pieces of debris were recovered at Jose Cuervo Reef, which was targeted during one dive by RJ Diving Ventures. During this dive, participants recovered an average of 27.5 pieces of trash each, and 27.8 pieces per hour of effort.
- *Barracuda Reef* – Barracuda Reef was targeted during both of the dives aboard American Dream Dive Charters. In total, 414 pieces of debris were removed, which amounted to an average of 25.9 pieces per diver and 16.9 pieces per hour of effort.
- *Horseshoe Reef* – A total of three dives occurred on Horseshoe Reef during the cleanup, including both dives with Dolphin Sun Dive Charters and one aboard Narcosis Dive Charters, during which 345 pieces of debris were removed. An average of 18.2 pieces of trash were collected per diver, and 14.5 pieces per hour of effort.

In contrast, at several reefs very little to no trash was found during the cleanup, including Moe's Reef, Matthew Lawrence Barge, Mid Reef and RSB 1. Only 11 pieces of debris were recovered across these four sites over the course of four dives, which amounted to less than 1% of the total.

A number of factors may influence the spatial distribution and abundance of marine debris at different dive sites throughout southeast Florida, including the popularity of any given site among boaters, divers, and fishermen, proximity to popular beaches, ocean currents, and the physiographic characteristics of the reef itself (Bauer, Kendall, & Jeffrey, 2008). In particular, areas prone to concentrated recreational fishing activity are often associated with greater amounts of fishing debris, including hook and line gear (Bauer, Kendall, & Jeffrey, 2008). Bauer et al. also discovered a positive association between boat density and both the presence and abundance of marine debris (2008).

At some reef sites, debris abundance may also be influenced by proximity to shore and the extent of human activity at those locations (National Research Council, 2008). This may be the case at Jose Cuervo Reef, which is located less than 0.2 miles off of the heavily-visited Miami Beach. At this site, 204 of the 220 pieces of debris collected (93%) were household or trash items that are classified as land-based in origin. This deviates greatly from the average composition of marine debris found across southeast Florida, in which terrestrial (household and trash) sources account for only 48% (**Error! Reference source not found.**).

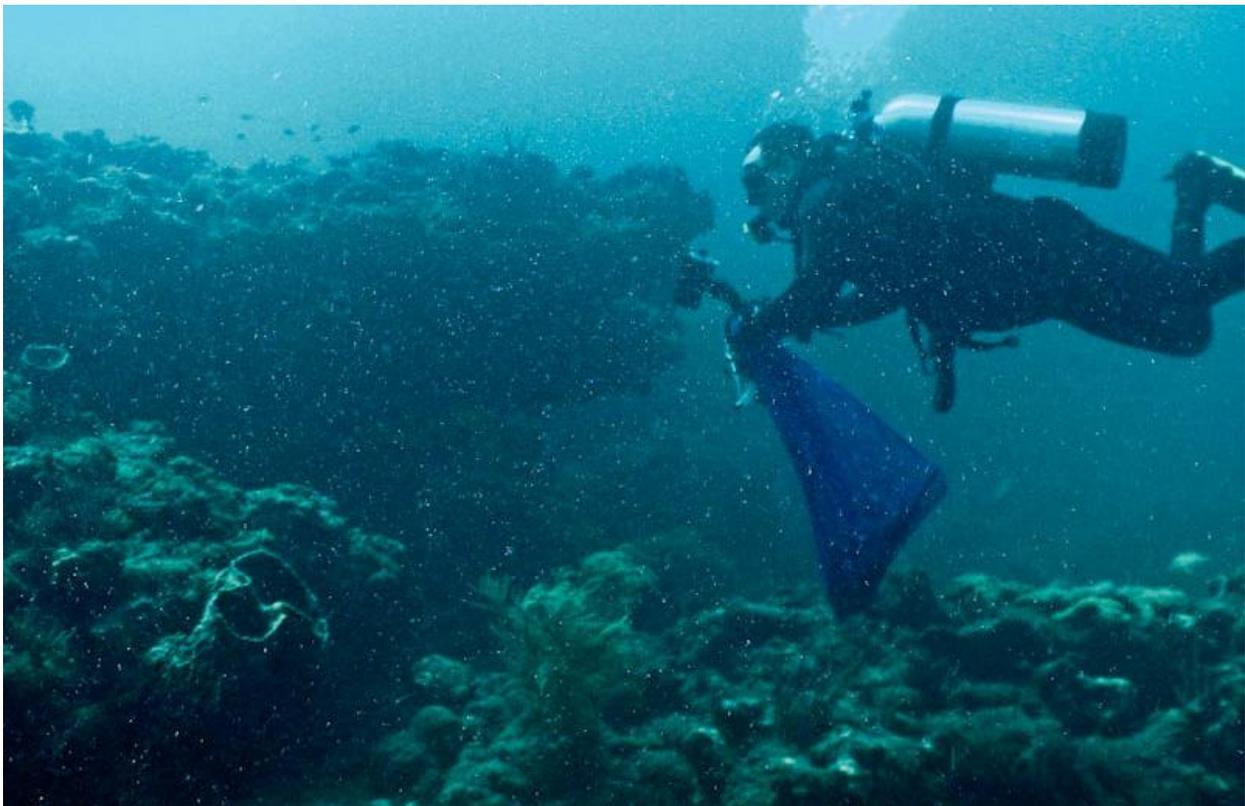


Figure 10. The high relief and ledge structure at Barracuda Reef in Broward County may contribute to debris accumulation.

Photo Credit: Heather S. Flint

The physiographic characteristics and the flow of ocean currents may also influence debris distribution and abundance along southeast Florida's reefs. In particular, a positive correlation has been shown between debris accumulation and the presence of ledges, as well as the height and area of relief (Kendall, Bauer, & Jeffrey, 2007). Currents may also influence the distribution and accumulation of debris, especially those that flow perpendicular to the reef's orientation (Kendall, Bauer, & Jeffrey, 2007). Both Horseshoe and Barracuda reefs have relatively high relief and ledges, which may contribute to the greater abundance of marine debris observed at those sites (**Error! Reference source not found.**). Contributing factors may also include the strong currents that often flow perpendicular to Horseshoe reef and cause debris to become caught along the reef structure, and the heavy boat traffic and easy accessibility of Barracuda Reef due to its proximity to Port Everglades Inlet and abundance of mooring buoys.

DISCUSSION

Reef Cleanup Recommendations

The 3rd Annual Southeast Florida Reef Cleanup was the most successful cleanup event hosted by SEFCRI and FDEP CRCP to date, both in terms of participation and the amount of debris removed. Providing the necessary cleanup supplies and training site coordinators from the local dive operators to manage the event proved a successful means of increasing participation despite the limited capacity of FDEP CRCP staff and SEFCRI Marine Debris Project Team members. A goal for next year is to generate even more interest in the event within the local community of divers, and to increase participation among the dive operators. As further expansion of this event is limited only by the availability of supplies and staff, more dive boats who are able to supply their own site coordinators will be particularly important.

Due to the extreme variation in the amount and distribution of marine debris along southeast Florida's coral reefs, site selection is an important consideration in planning future cleanup events. To maximize the productivity of the cleanup and the subsequent benefit to the marine environment, sites which have a greater accumulation of debris should be prioritized over sites that have historically had very little debris. Data from the 3rd Annual Southeast Florida Reef Cleanup will help to inform site selection during the 2014 cleanup event. Reef users are also encouraged to report their individual marine debris sightings and removal efforts on a regular basis to SEAFAN, which will provide additional insight about marine debris in the region and facilitate a more targeted approach. An improved understanding about the types, amounts, and distribution of debris in southeast Florida will enhance future cleanup efforts.

Other Marine Debris Management Strategies

Beyond reef cleanups, other management strategies exist to reduce marine debris in southeast Florida, particularly by reducing the amount of debris that enters the marine environment in the first place. Efforts to reduce trash and fishing debris may have the greatest impact, as these types of debris accounted for 84% of the marine debris collected during the 2013 reef cleanups.

Improved waste management, including a greater availability of trash and recycling bins, especially at locations with direct access to the ocean, can help prevent waste from becoming

marine debris. Of the trash collected, 69% was composed of aluminum cans, plastic beverage bottles, and glass beverage bottles, all of which are easily recycled. Thus, a greater emphasis on recycling will help prevent marine debris by turning excess waste into a resource. Public awareness campaigns against littering and promoting increased recycling efforts, as well as greater enforcement of anti-littering laws would support improved waste management efforts and help to reduce the amount of trash that ends up in the marine environment.

The fishing debris collected during the 3rd Annual Southeast Florida Reef Cleanup was overwhelmingly hook-and-line gear from recreational users, which is commonly lost when it snags on the bottom structure and breaks (National Research Council, 2008). Damaged line can also accidentally become lost from the boat or even intentionally discarded. Education and outreach efforts can increase awareness among fishermen of the impacts associated with lost gear, encourage greater participation in monofilament recycling programs, and provide recommendations for reducing gear loss. Although not recovered during this particular event, abandoned or lost commercial fishing gear, including nets and traps, are also a conspicuous source of marine debris, which has the potential to impact coral reefs and their associated marine life. As such, it is important to include commercial fishers in education and outreach campaigns, develop partnerships, and encourage their active contribution to achieve the shared goal of protecting marine resources by both preventing and recovering lost gear.

Given the variation in the types and distribution of debris, a combination of several strategies may be necessary to effectively reduce marine debris in southeast Florida.

Conclusion

Much remains to be learned about the prevalence, distribution, sources, and impacts of marine debris, both in southeast Florida and worldwide. The results from each site visited during the 3rd Annual Southeast Florida Reef Cleanup were reported to PADI Project Aware in order to contribute to the larger global effort against marine debris. This data, along with information from marine debris reports submitted to www.SEAFAAN.net, and other marine debris research throughout the region will be an important first step for informing possible strategies for reducing, preventing, and abating marine debris in southeast Florida.

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