STRANDED TAR ON FLORIDA BEACHES: SEPTEMBER 1979 - OCTOBER 1980[1]

G. C. ROMERO, G. R. HARVEY AND D. K. ATWOOD

National Oceanic and Atmospheric Administration
Atlantic Oceanographic and Meteorological Laboratory
4301 Rickenbacker Causeway
Miami, Florida 33149 USA

ABSTRACT

Amounts of tar stranded on Florida beaches were determined periodically over one year (September 1979 - October 1980). Results show that tar fouling of southeast Florida beaches is an order of magnitude greater than the rest of the state. This may result from the extensive ship traffic in the Straits of Florida. There is no evidence that any Florida beaches received increased amounts of tar as a result of the 1979 Ixtoc-1 blowout in the southern Bay of Campeche. There is also no evidence that the amounts of tar on southeast Florida beaches have increased over amounts measured in API studies conducted in 1958 and 1971

INTRODUCTION

In September 1979 a program was instituted for monitoring stranded tar on Florida beaches. This program was started as part of an international monitoring program for petroleum pollution in the Caribbean Sea and Gulf of Mexico area called CARIPOL. This international effort is coordinated through the Intergovernmental Oceanographic Commission Regional Association for the Caribbean and Adjacent Regions (IOCARIBE) and includes cooperative monitoring efforts conducted by eighteen regional governments. The effort implemented in Florida was also part of the NOAA response to the Ixtoc-1 oil well blowout in the southern Bay of Campeche which occurred on 3 June 1979. This blowout had an output flow of between 1,000 and 30,000 barrels of oil per day from that date through the early spring of 1980. In September 1979 various research cruises and U.S. Coast Guard overflights had established that oil from this blowout was still confined to the southern Bay of Campeche and the southwestern Gulf of Mexico. However, beaches as far north as Corpus Christi, Texas, had been impacted in August 1979 and there was some concern that the oil could move into the Gulf Loop Intrusion (which extended all the way to the Mississippi Delta at that time) and eventually impact Florida's beaches. The intent of this study was to establish a baseline as to the amounts of tar present on Florida beaches at that time and then monitor for any changes that might occur for at least one year.

MATERIALS AND METHODS

The methods used in the sampling and analysis are those described in the intergovernmental Oceanographic Commission and World Meteorological Organization (IOC/WMO) manuals and guides Number 7 (UNESCO, 1976) and in the CARIPOL Manual for Petroleum Pollution Monitoring (IOCARIBE, 1980). The method consists of laying out a 1-2 m wide sampling strip at each location which extends from the water line to the backshore. Backshore is defined

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as the point where stable vegetation begins growing. This strip is then sampled carefully for tar. In sandy areas the upper 1-2 cm is broken up by the observer's fingers, or a rake, to find tar disguised by the sand. Where pebbles exist they are turned over. The collected tar is then weighed directly, or the weight is determined by a volume displacement technique using an average density of 0.85 g ml^{-1}. In cases where extensive amounts of sand or shell are incorporated in the tar the whole mass is weighed, the tar dissolved in a suitable solvent, and the remaining debris weighed to allow a difference calculation of the tar weight.

There are inherent problems with this method which result from the dynamic nature of most beaches and make it a semi-quantitative method rather than a quantitative one. Frequent sampling conducted at a site in Cape Florida State Park (near Miami) demonstrated two things: (1) tar found in the intertidal portion of the beach represents that deposited during the last tidal cycle and not a cumulative amount; and (2) the amount of tar found on the supratidal portion of the beach depends on recent wind which constantly shifts the sand so that it covers and uncovers tar.

Thus, intertidal areas would have to be sampled after every tidal cycle in order to determine total amounts of tar arriving on a beach. Since this is normally not logistically possible for any extensive area program, samples collected can only be considered as the amount of surface tar present at the time of sampling. This amount will be quite variable for any beach depending on when it is sampled during a tidal cycle, on recent prevailing winds, etc. In tact, our observation is that the mean value for the amounts of tar found during "N" occupations of a given sample site usually has a standard deviation of the same magnitude as the mean. Thus, differences between beaches, or changes on any one beach, are not significant unless they are close to an order of magnitude difference. Still, the method can be used to detect "hot spots" of stranded tar and will show gross changes in tar contamination which might result from such events as movement of large amounts of Ixtoc-1 tar into the eastern Gulf of Mexico.

RESULTS

Figure 1 shows the location of the Florida beach stations sampled and Table 1 is a listing of their position starting from the northeast coast of Florida (Fernandina Beach) south along the east coast and Florida Keys to Key West (Smather's Beach) and then northward along the west coast to the Florida Panhandle and west to the Alabama border (Santa Rosa Island National Sea Shore). A brief description of each site is given in Table 2 and the various dates when each site was sampled are given in Table 3. Table 4 shows the number of times each site was occupied, the mean amount of tar found at that site, the standard deviation of that mean, and the coefficient of variation. The magnitudes of the mean values are also represented in Figure 1. As stated above, standard deviations are about the same magnitude as the means. However, it is quite clear from the data that beaches in southeast Florida (south of 27°30'N) and in the Florida Keys contain at least an order of magnitude more stranded tar than the other beaches sampled (a mean of 9.8 gm^{-2}) for beaches on the east coast south of 27°30'N down to Key West with a standard deviation of 22.3 gm^{-2}, and a mean of 0.6 gm^{-2} for all other beaches sampled with a standard deviation of 1.7 gm^{-2}. In fact, the beaches of the northeast coast and entire west coast are quite pristine with many of them having no observable tar at all. The higher incidence of tar on southeast Florida and Florida Keys beaches probably results, at least in part, from the extensive ship traffic funneled through the Straits of Florida and prevalent winds which force tar resulting from bilge washings, etc. onto Florida shores. It could also result from the Gulf Loop Current sweeping tar out of the Gulf of Mexico and into the Straits of Florida where these same winds would act on it. In fact, if contamination of Florida beaches did result from Ixtoc-1 oil, it would very likely come ashore in the Keys and the southeast coast. However, there is no evidence that this occurred. Table 5 shows the monthly means for tar found stranded on beaches of the east coast of Florida south of 27°30'N and the Florida Keys. These data do not show a significant increase in tar stranded on southeast Florida beaches during the year September 1979-October 1980. In fact, the largest mean occurred in September 1979 when separate observations showed that floating Ixtoc-1 oil was confined to the southwestern Gulf of Mexico (see above). It also is obvious from Figure 1 and Table 4 that the beaches of the northeast Florida coast and the west Florida coast were not fouled to any extent during the period of this study by oil, including Ixtoc-1 oil.

Discussion

Although this study shows that there are significantly greater amounts of stranded tar on southeast Florida beaches, as compared to the rest of the state, there is no evidence that these amounts have increased in recent years. Previous studies of tar on southeast Florida beaches were conducted by the American Petroleum Institute (API) in 1958 and 1971-1972 (Dennis, 1959, 1974). The API studies consisted of a local, but much more intensive, sampling program than that described herein. Southeast Florida beaches were sampled daily, at low tide, along 300 m strips between the low tide and high tide lines. The results showed that the amounts of stranded tar were about the same in 1971-1972 as they were thirteen years earlier in 1958. It is difficult to compare the results of our 1979-1980 study to the API results due to the different sampling strategies used; however, when reasonable accumulation times are assumed for the tar found in our study, the accumulations are about the same as that which Dennis (1959, 1974) observed, i.e., 2-3 gm^{-1} of shoreline per day for beaches such as Golden Beach (see Table 1 for location).

Literature Cited

Dennis, J. V. 1959. Oil pollution survey of the United States' Atlantic coast with special reference to southeast Florida coast conditions. American Petroleum Institute, Division of Transportation, 1625 K Street N. W., Washington, D.C.

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Table 1, – Beach sampling sites: September 1979-1980.

Beach name	Latitude (N)	Longitude (W)
Fernandina Beach	30°38’	81°26’
Flagler Beach	29°30’	81°11’
Cañaveral National Seashore	28°45’	80°45’
Ambersand Beach	27°52’	80°27’
Jupiter Beach	26°55’	80°05’
Highland Beach	26°30’	80°05’
Lloyd State Park	26°06’	80°07’
Golden Beach	26°00’	80°10’
Haulover Beach	25°59’	80°10’
Cape Florida State Park	25°40’	80°10’
Tannihills/Elliott Key	25°25’	80°10’
Mile Marker 75	24°50’	80°55’
Cocoplum Beach	24°42’	81°03’
Bahia Honda State Park	24°40’	81°15’
Martin’s/Sugarloaf Key	24°35’	81°35’
Smather’s/Key West	24°33’	81°48’
East Cape/Cape Sable	25°07’	81°05’
Marco Island	25°57’	81°45’
Tarpon Road Beach	26°28’	82°08’
Redfish Pass	26°44’	82°13’
Dunedin Beach	28°03’	82°50’
Keaton Beach	29°55’	83°38’
Carrabelle	29°43’	85°02’
St. Joe State Park	29°40’	85°23’
St. Andrews State Park	30°07’	85°45’
Santa Rosa Island	30°20’	87°06’

TABLE 2. – Description of CARIPOL Florida beach sampling sites.

Beach name	East coast
Fernandina Beach	Wide beach of beige sand. Washed up oyster shells and sargassum. Backshore of sand, dunes, vines, and seaoats.
Flagler Beach	Wide beach of coarse reddish (iron) sand. Highway marks the backshore. Would naturally be dunes, vines, and seaoats.
Cañaveral National Seashore	Beige sand beach. Backshore of dunes, saw palmettos and cabbage palms.
Ambersand Beach	Beige sand beach, pounding surf. Washed up sargassum and syringodium and turkey wing shells. Backshore and bluff with sea grapes and cabagge palms.
Jupiter Beach	Beige sand beach, wide. Backshore, dunes, saw palmettos, cabbage palms and highway.
Highland Beach	Beige sand beach. Backshore in parking lot. Would naturally be dunes with vines and seaoats.
Lloyd State Park	Coarse gray sand beach. Washed up oyster shells and coral fragments. Backshore, Cassurinas. Very wide beach.
Golden Beach	Sand and coral fragments. Washed up sargassum and quantity of shell types. Backshore is chain link fence with dune vines.
Haulover Beach Pier	Coarse sand. The backshore is a traffic intersection.
Cape Florida	Wide sand beach. Backshore is Cassurina, but measurements taken 16 m from water line at lifeguard station. Washed up sargassum and thalassia.
Tannihills'	Private residence on Elliot Key, located on remote beach within Biscayne National Park boundaries. Short sandy beach, backshore Cassurinas.
Mile Marker 75	Lower Matecumbe Key. Short coarse sand beach with coral fragments and thalassia. Backshore wind poinsettias, vines, and succulents.
East Cape	Remote beach, within boundaries of Everglades National Park. Coarse sand and shell beach. Backshore salicornia and glasswort succulents. Coastal prairie ecosystem.
Marco Island	Wide, shallow, very white shell and sand beach. Backshore condominium patio. Under undisturbed circumstances the shoreline would be mangroves, *Rizophora mangle*.
Tarpon Road Beach	Sanibel Island. Wide, very white shell and sand beach. Backshore Cassurinas and seagrape.
Redfish Pass	Captivas Island. Steep slope about 20°. Coarse shell beach. Backshore, beach cottage patio.
Dunedin Beach	North of Tarpon Springs. Depending on the season and current, sometimes there is a very wide sand beach. Sometimes there is a narrow rocky sandy beach. Backshore is dirt ledge and parking lot.
Keaton Beach	Small natural sand deposit with saltmarsh on either side. At low tide the bottom is muddy sand. Wide and shallow sloping coarse sand. Backshore is picnic hut. Natural ecosystem of backshore is sawgrass.
Carrabelle	Wide white sand beach. Shallow slope and very wide (~ 50m) at low tide. Backshore is dunes and seaoats. Interesting sand shift. Coarse of feeder stream sometimes altered or completely closed, over four surveys in a year's time.
St. Joe State Park	Cape San Blas. Wide, very white sugar-like sand. Backshore 10 m high, dunes and seaoats.
St. Andrews State Park	Wide, very white sugar-like sand. Backshore dunes and cedars.
Santa Rosa Island	Gulf Coast National Seashore. Very white sugar-like sand. Washed up shells. Backshore dunes and seaoats.
Cocoplum Beach	Crawl Key. Very wide (~ 60 m) shallow slope beach, when the tide is out. Coarse white sand. Backshore Cassurinas. Sand shift, altering stream from mangrove runoff.
Bahía Honda State Park	Short sand beach. Backshore dunes and vines,
Martin's	Private residence. Wide sand beach. House built on the beach with sand going behind it to intertidal mangroves. Large quantities of thalassia,
Smather's Beach	Key West. Wide sand beach with coral chunks. There is no backshore. It goes up to a seawall.

TABLE 3.—Sampling dates for CARIPOL Florida beach sampling sites.

Name of Beach	Sept 79	Oct 79	Nov 79	Dec 79	Jan 80	Feb 80	Mar 80	Apr 80	May 80	June 80	July 80	Aug 80	Sept 80	Oct 80
Fernandina	—	14	—	—	—	6	—	—	—	14	—	—	—	17
Flagler	—	15	—	—	—	6	—	—	—	14	—	—	—	17
Cañaveral National Seashore	—	—	—	—	—	6	—	—	—	14	—	—	—	16
Ambersand	—	15	—	—	—	7	—	—	—	15	—	—	—	16
Jupiter	—	24	—	17	24	26	28	—	6	16	29	25	—	15
Highland	27	24	—	17	24	26	28	—	6	16	29	25	—	15
Lloyd State Park	—	—	—	17	24	26	28	—	6	16	28	25	—	15
Golden	—	23	—	17	24	26	28	—	6	16	28	25	—	15
Haulover	—	—	—	17	24	26	28	—	6	16	28	25	—	15
Cape Florida State Park	—	3/23	—	17	24	—	3/19	—	6	16	28	22	—	14
Tannihills'	—	—	—	21	22	26	31	—	—	17	—	5	2	—
Mile Marker 75	29	25	—	19	23	29	26	—	7	19	29	26	—	23
Cocoplum	28	25	—	18	23	29	26	—	7	19	30	26	—	23
Bahía Honda State Park	28	25	—	18	23	29	26	—	7	19	30	26	—	23
Martin's	28	25	—	18	24	29	26	—	7	19	30	27	—	23
Smather's/Key West	28	25	—	18	24	29	26	—	7	19	30	27	—	—
East Cape/Cape Sable	—	—	4	—	21	—	—	—	—	18	—	—	—	28
Marco Island	—	9	—	—	30	—	—	—	—	9	—	—	—	22
Tarpon Road	—	10	—	—	31	—	—	—	—	10	—	—	—	21
Redfish Pass	—	10	—	—	31	—	—	—	—	10	—	—	—	21
Dunedin	—	10	—	—	31	—	—	—	—	10	—	—	—	20
Keaton	—	12	—	—	—	3	—	—	—	12	—	—	—	20
Carrabelle	—	12	—	—	—	3	—	—	—	12	—	—	—	18
St. Joe State Park	—	13	—	—	—	3	—	—	—	12	—	—	—	18
St. Andrews State Park	—	13	—	—	—	4	—	—	—	12	—	—	—	19
Santa Rosa Island	—	13	—	—	—	4	—	—	—	12	—	—	—	19

TABLE 4. – Mean annual amounts of tar found at CARIPOL Florida beach stations

Name of Beach	Number of occupations	Mean tar $g\ m^{-2}$	Standard deviation	Coefficient of variation
Fernandina Beach	4	0.0	0.0	0
Flagler Beach	4	0.4	0.6	134
Cañaveral National Seashore	3	1.7	1.7	134
Ambersand Beach	4	3.4	5.3	159
Jupiter Beach	10	2.9	5.1	179
Highland Beach	11	7.1	7.0	98
Lloyd State Park	9	2.0	2.2	112
Golden Beach	11	5.1	3.4	67
Haulover Beach	9	1.8	2.9	163
Cape Florida State Park	11	0.8	0.6	76
Tannihills/Elliot Key	7	36.2	49.9	138
Mile Marker 75	11	11.6	10.6	92
Cocoplum Beach	11	6.4	7.7	120
Bahia Honda State Park	11	5.4	6.4	123
Martin's/Sugarloaf Key	11	40.5	47.8	118
Smather's/Key West	10	3.2	5.3	167
East Cape/Cape Sable	4	1.3	1.7	127
Marco Island	4	0.1	0.2	200
Tarpon Road Beach	4	0.0	0.0	0
Redfish Pass	4	0.1	0.1	145
Dunedin	4	0.0	0.0	0
Keaton Beach	4	0.0	0.0	0
Carrabelle	4	0.3	0.3	120
St. Joe State Park	4	0.2	0.2	88
St. Andrews State Park	4	0.1	0.1	05
Santa Rosa Island	4	1.2	0.9	80

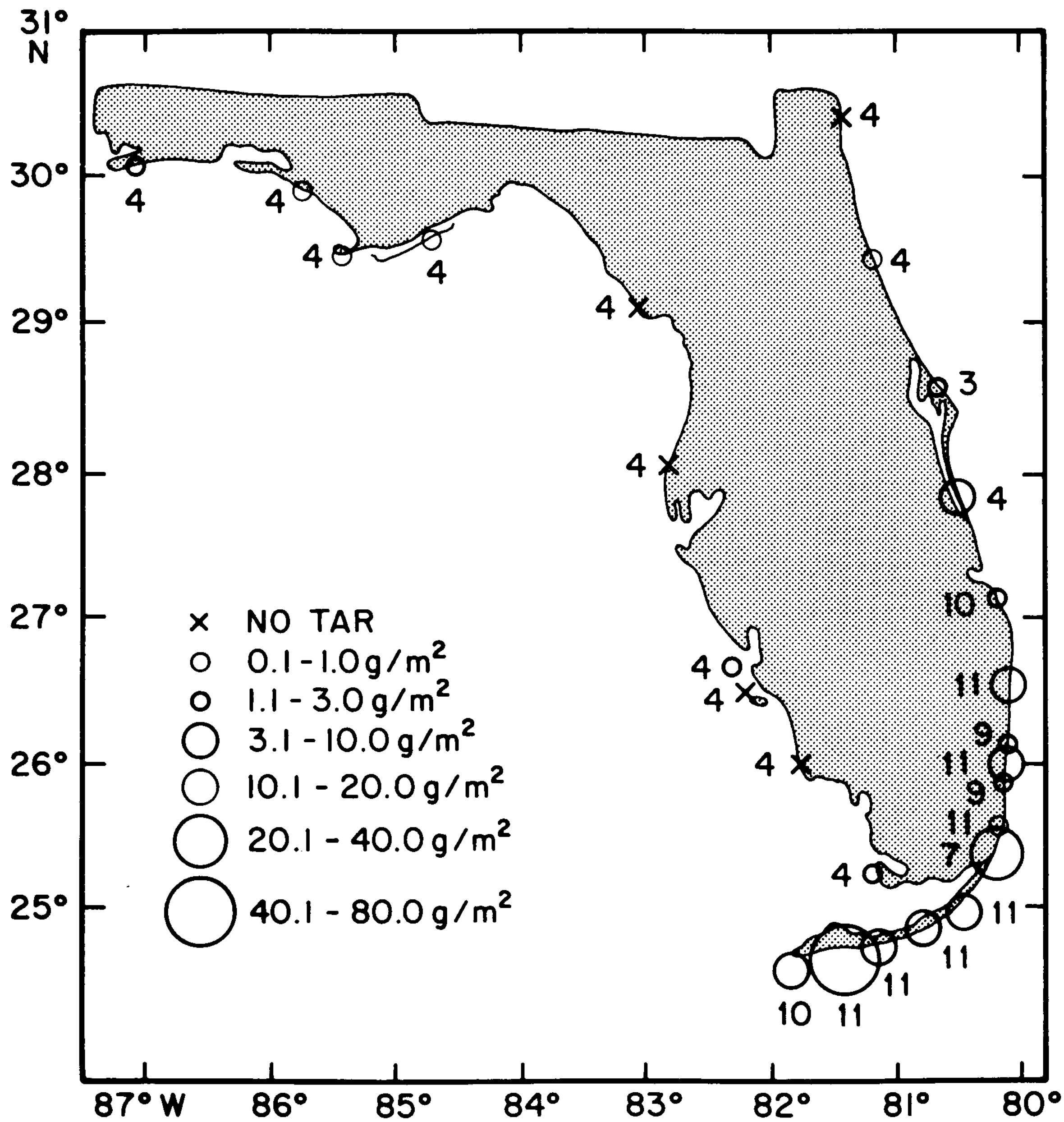

FIGURE 1. – Location of CARIPOL Florida beach sampling sites listed in Table 1. The size of the circles indicate the mean amounts of tar found at each site as indicated in the figure. The number near each circle is the number of occupations for that site and the mean represented.

TABLE 5. – Monthly means of tar stranded on southeast Florida coast and Florida Key beaches

Month	Mean tar $g\ m^{-2}$	Standard deviation	Coefficient of variation
September 1979	26.1	31.7	121
October 1979	7.6	9.7	128
December 1979	5.3	5.4	103
January 1980	17.5	41.7	238
February 1980	2.6	4.7	179
March 1980	3.6	4.7	132
May 1980	6.5	6.0	93
June 1980	10.7	14.1	133
July 1980	3.7	4.8	130
August 1980	11.6	23.6	204
October 1980	18.6	44.2	237