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EFFECTS OF THE IXTOC I OIL SPILL ON THE INTERTIDAL AND SUBTIDAL INFAUNAL POPULATIONS ALONG LOWER TEXAS COAST BARRIER ISLAND BEACHES

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ABSTRACT: *Pre-spill (August 4 to 11, 1979) and post-spill (September 24 to 29, 1979) sampling of intertidal and subtidal infaunal populations along lower Texas coast sandy beaches was conducted to determine the impact of the Ixtoc I oil spill. Transects sampled between the Rio Grande and Port Aransas produced 52 species of macroinfauna primarily dominated in abundance and diversity by polychaetes and haustoriid amphipods. Analyses revealed visible, though not significant, decreases in pooled intertidal population densities and significant reductions in pooled subtidal population densities. Numbers of species did not significantly change. Population density changes may have been caused by Ixtoc I impact, tropical depression/storm beach erosion, seasonal fluctuations, beach cleanup techniques, or a combination of these.*

Introduction

By mid-July 1979, it became apparent that floating oil from the blowout of the Ixtoc I offshore platform (June 3, 1979) in the southwestern Gulf of Mexico would impact south Texas barrier island beaches by early to mid August. Due to the lack of adequate baseline data on the intertidal and subtidal infauna of the south Texas barrier island beaches, an experimental plan was designed to systematically sample this area before and after impact. Objectives were to determine and compare possible changes in species composition and abundance due to impact by Ixtoc I oil.

Recent state (Coastal Zone Project, personal communication) and federal (Berryhill, 1975) baseline studies in south Texas waters left the intertidal and subtidal surf zones uninvestigated. Only two recent studies (Hill and Hunter, 1976; Shelton and Robertson, in press) have dealt with the sandy beach intertidal zone of south Texas, both on northern Padre Island, and only one concerned the subtidal surf zone infauna (Hill and Hunter, 1976).

Study area

The south Texas Gulf shoreline is the southernmost part of a gently curving chain of barrier islands and spits extending from Louisiana to Mexico. Sandy beaches are the dominant shoreline habitat-type along this distance, and they are occasionally interrupted by jettied tidal inlets/navigational channels. The study area includes the sandy beaches extending some 217 kilometers (km) between Aransas Pass and the mouth of the Rio Grande (Figure 1).

Within the study area, the seaward side of Mustang and Padre Islands are characterized by well-developed foredunes, a wide backshore, a relatively narrow intertidal zone, and a nearshore surf-zone, bar-trough system, typically with three bars (Figure 2). Sediments range from fine-grained sand in the northern and southern portions of the study area to a mixture of shell and sand in the "Little Shell" and "Big Shell" beach areas of Padre Island. These shell beach areas are in a convergence zone of two opposing, longshore transport directions (Watson, 1971). Numerous recent studies are available on the geologic coastal processes and geomorphology of the study area (Davis, 1978; Dickenson, 1971; Hayes, 1964, 1965; Hunter et al., 1972; Watson, 1971). Climatologic and hydrologic data for the study area are available (Behrens and Watson, 1973; Brown et al., 1976, 1977, 1980; Hill and Hunter, 1976).

Methods and materials

Collection of pre-spill samples began August 4, 1979 and was completed August 11, 1979. Thirteen transects were established along the barrier island beaches between Aransas Pass and the Rio Grande (Figure 1). These transects corresponded to transects established for sensitivity mapping (Hayes et al., 1980) and oil impact monitoring (personal communication, Research Planning Institute, Columbia, South Carolina).

Each transect extended perpendicular to the beach face from the top of the intertidal zone to the top of the third longshore bar.

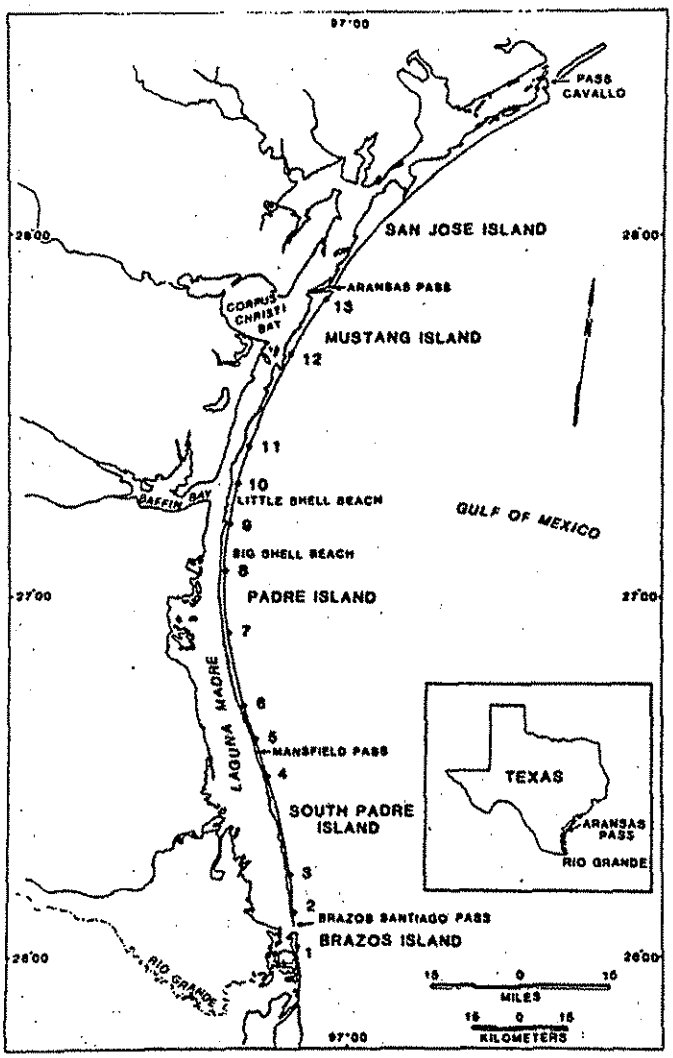

Figure 1. Map of study area and transect locations along the south Texas coast.

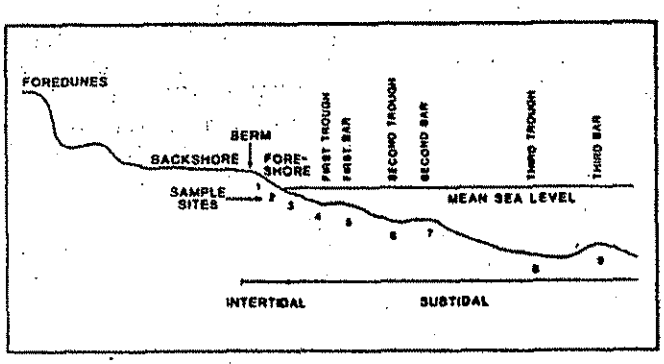

Figure 2. Typical profile of barrier island beach and bartrough system. Numbers indicate sample stations along a single transect.

Three intertidal and six subtidal samples were taken, one each at the upper, middle, and lower limit of the intertidal zone, and one at each bar and trough (Figure 2). Personnel equipped with snorkeling gear used an open steel 0.95 liter (*l*) can sampler to collect 3.80 *l* of substrate at each sample point. This was done by pushing the can approximately 10 centimeters (cm) into the substrate in a vertical direction, then tilting it to the side and using a scooping motion to fill the can to the top edge with substrate. One sample, composed of four 0.95-*l* subsamples washed through a 0.5 millimeter (mm) mesh saran "biobag," was taken at each sample site. These bags, containing the benthic infauna, were then placed in a container with seawater and propylene phenoxetol (narcotizing agent) for a minimum of 20 minutes. They were then transferred to a container with 10 percent formalin and rose bengal for preservation and staining.

Post-spill sampling was conducted from September 24 through 29, 1979. Sampling techniques remained the same with the exception that each 0.95-*l* subsample was placed in a separate biobag.

Salinity was measured in the first longshore gut, using a Goldberg refractometer. Temperature was measured in the same area with a laboratory grade centigrade thermometer.

In the laboratory, samples were washed from the saran biobags, separated, preserved in 45 percent isopropanol, identified, and counted. The four replicate post-spill samples taken at each station were counted and preserved separately, but the data were lumped for comparison with the pre-spill samples.

For present and future comparison purposes, all population density data have been converted to numbers of individuals per square meter.

Taxonomic analysis was to the lowest possible level, usually species. Questionable identifications were sent to qualified authorities for verification.

The Mann-Whitney U-test was used for significance testing to determine changes in numbers of individuals and species. Significance was at the $p < 0.05$ level.

Due to problems in funding, only 7 of the original 13 transects sampled were analyzed.

Results

Pre-spill and post-spill sampling along 7 transects produced a total of 5,124 specimens representing 51 species of invertebrates and one cephalochordate (Table 1). The community structure consisted taxonomically of Mollusca, Polychaeta, and Crustacea dominating, with 8, 15, and 21 species, respectively. In terms of numerical abundance, the polychaetes, *Scolelepsis squamata* and *Lumbrineris impatiens*, the bivalves *Donax* spp., the mole crab *Emerita benedicti*, and the haustoriid amphipod *Haustorius* sp. were most common in the intertidal zone. Subtidally, polychaetes, especially *L. impatiens*, haustoriid amphipods, notably *Haustorius* sp., and *Donax* spp. dominated.

Pre-spill versus post-spill comparisons of "common organism"* densities revealed considerable drops in population numbers at most stations along most transects (Tables 2 through 8). Comparison of pre-spill versus post-spill total densities of all species within major taxa along entire transects predominantly revealed light to moderate reductions in population numbers and slight to no decreases, or in some cases increases, in species numbers (Table 9). Pooled density data for haustoriid amphipods showed reductions along the subtidal portion of all transects and reductions along the intertidal sections of three transects (Figure 3). Few to no amphipods were collected at other intertidal stations. Pooled density data for polychaetes revealed reductions

* For tabular purposes only, herein arbitrarily defined as any species with 10 or more individuals represented in collected samples along an entire transect or 221 per square meter total along a transect.

Table 1. Systematic List of Species Collected in the Intertidal and Subtidal Infaunal Samples from the South Texas Barrier Island Sandy Beaches, August Through September, 1979

Species

Phylum Coelenterata
- Hydroid A

Phylum Aschelminthes
- Nematode A
- Nematode B

Phylum Bryozoa
- *Membranipora savartii* (Audouin, 1926)

Phylum Mollusca
- *Polinices duplicatus* (Say, 1822)
- *Nassarius acutus* (Say, 1822)
- *Olivella minuta* (Link, 1807)
- *Hastula* cf. *maryleeae* R. D. Burch, 1965
- *H. salleana* Deshayes, 1859
- *Tellina iris* Say, 1822
- *Tellina* sp.
- *Donax* spp. [a]

Phylum Annelida
- *Bhawania goodei* Webster, 1884
- *Pisionidens indica* (Aiyar and Alikunhi, 1940)
- *?Microphthalmus* sp.
- *Nephtys picta* Ehlers, 1868
- *Glycera* sp. (posterior end only)
- *Onuphis eremita* Audouin and Milne Edwards, 1833
- *Onuphis nebulosa* Moore, 1911
- *Lumbrineris impatiens* (Claparede, 1868)
- *Paraonis fulgens* (Levinsen, 1883)
- *?Aedicira* sp. (anterior end only)
- *Dispio uncinata* Hartman, 1951
- *Polydora ligni* Webster, 1879
- *Scolelepis squamata* Muller, 1806
- *Magelona* cf. *riojai* Jones, 1963
- *Owenia fusiformis* Chiaje, 1844

Phylum Arthropoda
- *Nebalia* sp.
- *Diastylis* sp.
- *Ancinus depressus* (Say)
- *Chiridotea* sp.
- *Synchelidium americanum* Bousfield, 1973
- *Protohaustorius bousfieldi* Robertson and Shelton, 1978
- *Parahaustorius obliquus* Robertson and Shelton, 1978
- *Haustorius* sp. [b]
- *Acanthohaustorius* sp. [b]
- Pontogeneid
- *Bowmaniella* spp. [c]
- Euphausid
- *Acetes* sp.
- *Callianassa islegrande* Schmitt, 1935
- *Isocheles wurdemanni* Stimpson, 1862
- *Lepidopa benedicti* Schmitt, 1935
- *Dissodactylis mellitae* Rathbun, 1900
- *Pinnixa chacei* Wass, 1955

Phylum Echinodermata
- *Ophiophragmus* sp.
- *Mellita quinquiesperforata* (Leske, 1778)

Phylum Chordata
- *Branchiostoma* cf. *caribaeum* Sundevall

[a] Mostly juvenile *Donax* spp., generally less than 2 mm, were collected, thereforemaking species identification difficult.
[b] *Haustorius* sp., *Acanthohaustorius* sp., and *Lepidactylus* sp. (lumped with *Haustorius* in the present paper) are new sandy beach haustoriid amphipods presently being described (Shelton and Robertson, in press).
[c] Examination of modified third pleopod on mature males needed for separation of *B. floridana* and *B. brasiliensis* (Stuck, Perry, and Heard, 1979); only females and immature males were collected.

Table 2. Comparison of Number of Individuals per Square Meter for Pre-spill Versus Post-spill Dominant Species Population Densities at All Stations Along Transect 1—Brazos Island[a]

	Station number											
	Intertidal			Subtidal						Intertidal	Subtidal	
Transect 1	1	2	3	4	5	6	7	8	9	total	total	Total
Acanthohaustorius sp.						22	22	486	508		1,038	1,038
Haustorius sp.	—	—	—	111	133	265	287	66	66	—	928	928
	44	44	22		44	88	111	354	199	110	796	906
Donax spp.			641[b]	66	—	88	133	155	177	641	619	1,260
	22		66	22	22	22		111		88	177	265
Scolelepis squamata		133	66		44				22	199	66	265
		619	88	111	22					707	133	840
Nephtys picta			88	111	22	22	88	66	199	88	508	596
Magelona cf. *riojai*			44	66		22	22	66	133	44	309	353
									22		22	22
Parahaustorius obliquus								—	243		243	243
								44			44	44
Total	—	133	839	354	199	419	552	839	1,348	972	3,711	4,683
(common organisms)	66	663	176	133	88	110	111	509	221	905	1,172	2,077
Total	22	155	1,304	420	243	508	862	1,171	2,188	1,481	5,392	6,873
(all organisms)	88	663	287	265	177	243	199	729	729	1,038	2,342	3,380

[a] 1.6 km south of Brazos–Santiago, Pass, 26°13'04" N, 97°10'42" W.
[b] Pre-spill / Postspill, number of individuals per square meter.

Table 3. Comparison of Number of Indivduals per Square Meter for Pre-spill Versus Post-spill Dominant Species Population Densities at All Stations Along Transect 3—Southern Padre Island[a]

	Station number											
	Intertidal				Subtidal					Intertidal	Subtidal	
Transect 3	1	2	3	4	5	6	7	8	9	total	total	Total
Haustorius sp.				641[b] / 66	22 / 133	486 / 22	376	1,370 / 177	111 / 22		3,006 / 420	3,006 / 420
Donax spp.			66	155		177 / 88	243 / 22	88 / 133	818 / 287	66	1,481 / 530	1,481 / 596
Paraonis fulgens						22		862	66		928 / 22	928 / 22
? *Microphthalmus* sp.			22					685	44	22	729	751
Acanthohaustorius sp.								508 / 309	22 / 22		530 / 331	530 / 331
Emerita benedicti		398 / 66	22	22 / 66		22	111	44	44	398 / 88	221 / 88	619 / 176
Lumbrineris impatiens		22	22	22 / 22	66	44 / 22	44	265 / 22	111	22 / 44	486 / 132	508 / 176
Isocheles wurdemanni								22	486 / 111		486 / 133	486 / 133
Total (common organisms)		376 / 88	44 / 110	840 / 154	22 / 199	707 / 176	774 / 22	3,822 / 663	1,702 / 442	442 / 198	7,867 / 1,656	8,309 / 1,854
Total (all organisms)	22	376 / 177	66 / 243	862 / 221	66 / 221	840 / 287	1,017 / 155	4,066 / 1,105	1,945 / 530	442 / 442	8,796 / 2,519	9,238 / 2,961

[a] 0.7 km north of Brazos–Santiago Pass, 26°13'04" N, 97°10'42" W.
[b] Pre-spill / Post-spill, number of individuals per square meter.

Table 4. Comparison of Number of Individuals per Square Meter for Pre-spill Versus Post-spill Dominant Speciestion Densities at All Stations Along Transect 5—Padre Island[a]

	Station number											
	Intertidal			Subtidal						Intertidal	Subtidal	
Transect 5	1	2	3	4	5	6	7	8	9	total	total	Total
Scolelepis squamata	66	88[b] / 3,072	972 / 22	177	22	44				1,126 / 3,094	221 / 22	1,347 / 3,116
Haustorius sp.		1,282 / 66	199	22	199 / 66	508 / 177	818 / 199	22	22	1,481 / 66	1,569 / 464	3,050 / 530
Lumbrineris impatiens			111 / 133	44	22	22 / 22		111	22 / 243	111 / 133	66 / 420	177 / 553
Parahaustorius obliquus						22	66	199	66		353	353
Donax spp.		66	44		66	66 / 22	44 / 44	66	155	44 / 66	331 / 132	385 / 198
Total (common organisms)	66	1,370 / 3,204	1,326 / 155	199 / 44	287 / 88	640 / 243	862 / 309	398	199 / 309	2,762 / 3,359	2,187 / 1,391	4,949 / 4,750
Total (all organisms)	66	1,414 / 3,337	1,392 / 177	243 / 177	332 / 265	685 / 287	884 / 442	553	376 / 530	2,872 / 3,514	2,520 / 2,254	5,392 / 5,768

[a] 0.8 km north of Mansfield Pass, 26°36'48" N, 97°18'12" W.
[b] Pre-spill / Post-spill, number of individuals per square meter.

Table 5. Comparisons of umber of Individuals per Square Meter for Pre-spill Versus Post-spill Dominant Species Population Densities at All Stations Along Transect 7—Padre Island[a]

Transect 7	Station number: Intertidal 1	2	3	Subtidal 4	5	6	7	8	9	Intertidal total	Subtidal total	Total
Donax spp.			530 309	 44	66 22	66 287	155 22	619 88	2,033 354	530 309	2,939 817	3,469 1,126
Haustorius sp.	22 	 597		420[b] 22	685 44	420 44	177 	575 66	243 22	22 597	2,520 198	2,542 795
Lumbrineris impatiens			111	22 44	133 155	88 44	88 177	44 155	22 66	111	397 641	508 641
Scolelepis squamata	 22	221 22	796	22		 44	22	22	22 22	1,017 44	88 66	1,105 110
Juvenile crab					44		22	44	199		309	309
Decapod larvae							44 22	66	177 22		287 44	287 44
Parahaustorius obliquus								243 44	 66		243 110	243 110
Emericta benedicti			44 354	66 44	88 22	 44				44 354	154 110	198 464
Total (common organisms)	22 22	221 619	1,481 663	530 154	1,016 243	574 463	508 221	1,613 353	2,696 552	1,724 1,304	6,937 1,986	8,661 3,290
Total (all organisms)	22 22	265 619	1,503 774	597 199	1,083 309	597 597	641 287	1,945 553	3,050 884	1,790 1,415	7,913 2,829	9,703 4,244

[a] 19.3 km south of Big Shell, 26°53'58" N, 97°21'12" W.
[b] Pre-spill / Post-spill, number of individuals per square meter.

Table 6. Comparison of Number of Individuals per Square Meter for Pre-spill Versus Post-spill Dominant Species Population Densities at All Stations Along Transect 9—Padre Island, Big Shell[a]

Transect 9	Station number: Intertidal 1	2	3	Subtidal 4	5	6	7	8	9	Intertidal total	Subtidal total	Total
Lumbrineris impatiens			66	66 133	221 66	1,326 199	332 133	309 111	332 88	66	2,586 730	2,652 730
Donax spp.		 243		 66	420	177 486	177 66	774 44	840 111	 243	2,388 773	2,388 1,016
Pisionidens indica	 88	22[b] 774	243 22							265 884		265 884
Protohaustorius bousfieldi						22		332 287	265 177		619 464	619 464
Acanthohaustorius sp.								287 22	287 199		574 221	574 221
Haustorius sp.				 22	22	442 22		44 	 66		508 110	508 110
Parahaustorius obliquus						66	 22	177 133	66 44		309 199	309 199
Onuphis eremita					22	 22		221 22	44 		287 44	287 44
Total (common organisms)	 88	22 1,017	309 22	66 221	685 66	2,033 729	509 221	2,144 619	1,834 685	331 1,127	7,271 2,541	7,602 3,668
Total (all organisms)	44 88	133 1,127	398 66	332 287	818 111	2,100 751	553 398	2,895 2,011	2,144 1,304	575 1,281	8,842 4,862	9,417 6,143

[a] 27°10'54" N, 97°22'22" W.
[b] Pre-spill / Post-spill, number of individuals per square meter.

Table 7. Comparison of Number of Individuals per Square Meter for Pre-spill Versus Post-spill Dominant Species Population Densities at All Stations Along Transect 11—Northern Padre Island[a]

	Station number											
	Intertidal			Subtidal						Intertidal	Subtidal	
Transect 11	1	2	3	4	5	6	7	8	9	total	total	Total
Haustorius sp.	4,265[b] / 133	155	332	2,475	2,939	1,414 / 22	66	663	/ 22	4,752 / 133	7,557 / 44	12,309 / 177
Donax spp.	22	1,039 / 66	508 / 22	398 / 376	707 / 663	332 / 44	442 / 398	619 / 177	243 / 508	1,569 / 88	2,741 / 2,166	4,310 / 2,254
Acathohaustorius sp.							22	1,238	22 / 22		1,282 / 22	1,282 / 22
Lumbrineris impatiens	66	66	309 / 111	133 / 88	332 / 155	111 / 88	111 / 66	133 / 22	243 / 133	441 / 111	1,063 / 552	1,504 / 663
Parahaustorius obliquus					44 / 44	729 / 44	/ 44	111 / 177	22		906 / 309	906 / 309
Emerita benedicti		/ 111	796 / 44	44 / 155	/ 66	22	22 / 22		/ 22	796 / 155	88 / 265	884 / 420
Protohaustorius bousfieldi								376	309		685	685
Scolelepis squamata	177	22 / 530	/ 22	22 / 44	44 / 22	/ 66	/ 22	/ 22		199 / 552	66 / 176	265 / 728
Chiridotea sp.					22		22	354	22		420	420
Pinnixa chacei			22				354 / 22		22	22	376 / 22	398 / 22
Magelona cf. *riojai*				44 / 22	111	22 / 66	177	/ 22			354 / 110	354 / 110
Nephtys picta				44	22 / 22	44	88 / 22	155 / 66	/ 44		353 / 154	353 / 154
Total (common organisms)	4,530 / 133	1,282 / 707	1,967 / 199	3,160 / 685	4,221 / 972	2,674 / 330	1,304 / 596	3,649 / 486	883 / 751	7,779 / 1,039	15,891 / 3,820	23,670 / 4,859
Total (all organisms)	4,575 / 133	1,348 / 729	2,276 / 243	3,182 / 685	4,398 / 1,105	3,072 / 354	2,011 / 596	4,155 / 530	1,856 / 2,122	8,199 / 1,105	18,674 / 5,393	26,873 / 6,498

[a] 3.2 km south of Malaquite Beach, 27°23'43" N, 97°18'29" W.
[b] Pre-spill / Postspill, number of individuals per square meter.

Table 8. Comparison of Number of Individuals per Square Meter for Pre-spill Versus Post-spill Dominant Species Population Densities at All Stations Along Transect 13—Mustang Island[a]

	Station number											
	Intertidal			Subtidal						Intertidal	Subtidal	
Transect 13	1	2	3	4	5	6	7	8[b]	9[b]	total	total	Total
Donax spp.		6,542	22 / 44	111 / 44	88 / 88	729 / 243	155 / 133	/ 44	/ 44	6,564 / 44	1,083 / 596	7,647 / 640
Haustorius sp.	5,017			332 / 88	309			/ 44		5,017	641 / 132	5,658 / 132
Scolelepis squamata	1,658[c] / 88	1,238 / 553	88 / 66	133 / 22	22	22 / 44	/ 22		/ 88	2984 / 707	177 / 176	3,161 / 883
Protohaustorius bousfieldi				22		354	221	/ 111	/ 22		597 / 133	597 / 133
Acanthohaustorius sp.				/ 22		486	66	/ 199			552 / 221	552 / 221
Lumbrineris impatiens	22	376	44 / 44	177 / 22	22 / 44	/ 66		/ 88		442 / 44	199 / 220	641 / 264
Magelona cf. *riojai*				111 / 22	22 / 88	22 / 22	44 / 66	/ 66	/ 44		199 / 308	199 / 308
Emerita, portoricensis		243	22							265		265
Total (common organisms)	6,697 / 88	8,399 / 553	176 / 154	886 / 220	463 / 220	1,613 / 375	486 / 221	552	198	15,272 / 795	3,448 / 1,786	18,720 / 2,581
Total (all organisms)	6,696 / 88	8,752 / 575	199 / 155	1,127 / 354	530 / 376	2,321 / 575	1,017 / 464	1,105	464	15,647 / 818	4,995 / 3,338	20,642 / 4,156

[a] 0.8 km south of Horace Caldwell Pier, Port Aransas, Texas, 27°49'52" N, 97°02'53" W.
[b] Pre-spill stations 8 and 9 not taken due to rough water (surf).
[c] Pre-spill / Postspill, number of individuals per square meter.

Table 9. Comparison of Pre-spill Versus Post-spill Total Number of Individuals per Square Meter and Number of Species Within Major Taxa Along All Transects

Taxa	Transect 1	3	5	7	9	11	13[a]	Total
Hydrozoan	66(1)				22(1)		243(1)	331(1)
Nematodes[b]	111(1)[c]		44(2)	44(1)		22(1)	66(1)	243(2)
	287(2)	22(1)	22(1)	44(1)		22(1)		397(2)
Bryozoan	22(1)			22(1)				22(1)
				22(1)				22(1)
Gastropods	332(3)							332(3)
					22(1)		22(1)	44(2)
Bivalves	1,260(1)	1,503(2)	376(1)	3,469(1)	2,409(2)	4,309(1)	7,669(2)	20,995(3)
	265(1)	596(1)	199(1)	1,127(1)	1,017(1)	2,254(1)	641(1)	6,099(1)
Polychaetes	1,371(6)	2,431(6)	1,680(4)	1,790(4)	3,624(6)	2,740(8)	4,200(8)	17,836(12)
	1,259(5)	641(7)	3,824(6)	1,083(5)	1,901(7)	1,702(6)	1,922(6)	12,332(10)
Crustaceans	3,404(13)	5,304(15)	3,293(6)	4,376(16)	3,360(13)	18,188(16)	8,066(14)	45,991(20)
	1,569(8)	1,702(10)	1,724(13)	1,879(12)	1,680(14)	1,260(13)	1,193(15)	11,007(20)
Echinoderms	310(2)			22(1)		1,613(2)	398(2)	2,343(2)
				88(1)	1,525(1)	1,260(1)	354(2)	3,227(2)
Chordate							22(1)	22(1)
Total	6,876(28)	9,238(23)	5,393(13)	9,701(23)	9,415(22)	26,872(28)	20,642(28)	88,093(44)
	3,380(16)	2,961(19)	5,769(21)	4,243(21)	6,145(24)	6,498(22)	4,154(26)	33,150(39)

[a] Pre-spill stations 8 and 9 not taken due to rough water (surf); all post-spill stations taken.
[b] Subtidal numbers only.
[c] $\frac{\text{Pre-spill}}{\text{Post-spill}}$, number of individuals per square meter (number of species).

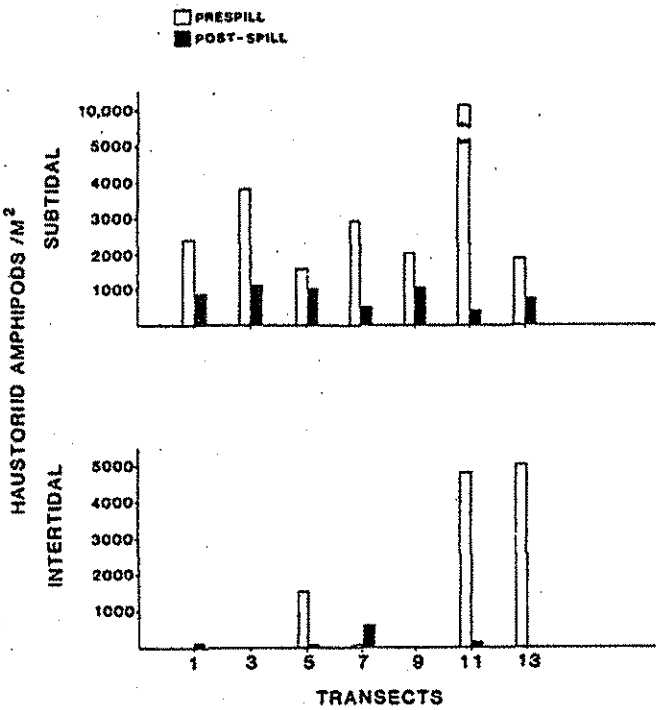

Figure 3. Relationship of pre-spill to post-spill densities of haustoriid amphipods within intertidal and subtidal portions of all transects.

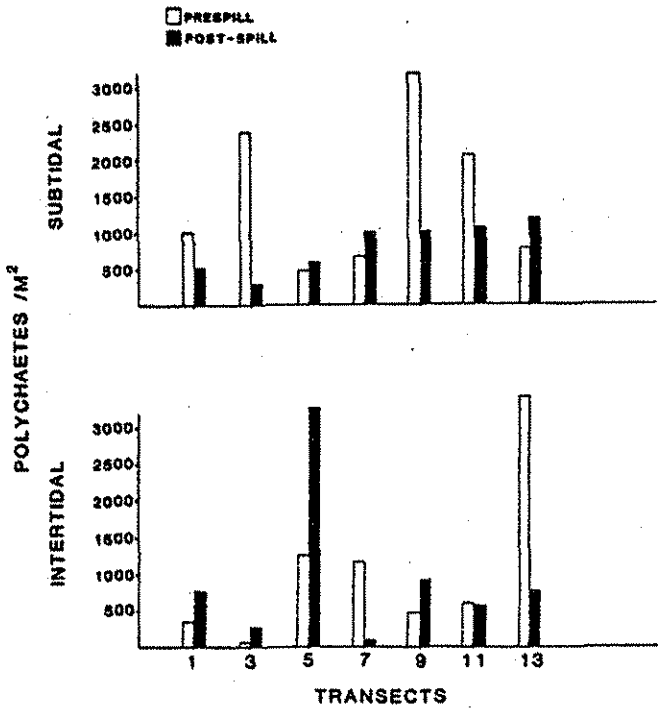

Figure 4. Relationship of pre-spill to post-spill densities of polychaetes within intertidal and subtidal portions of all transects.

along four subtidal and three intertidal sections of the transects (Figure 4). Polychaetes increased at four intertidal transects (1, 3, 5, and 9) and also slightly increased along two subtidal transects (5 and 7). Pooled density data for all species at all stations along transects showed reductions at all subtidal transects and all but intertidal transects 3 and 5 (Figure 5).

Results of the Mann-Whitney U-test indicated a significant decrease ($U = 46$) in total faunal densities for the pooled intertidal and subtidal zones (Table 10). In separate comparisons of each of the nine stations along all seven transects, the intertidal zones had visible, though not significant, decreases in population densities. Subtidally, on the other hand, the first trough (Station No. 4), second trough (Station No. 6), and the second bar (Station No. 7) did show significant decreases in population densities ($U = 41$, $U = 43.5$, $U = 48$, respectively). The other three subtidal stations had visible, though not significant, population decreases. Pooled

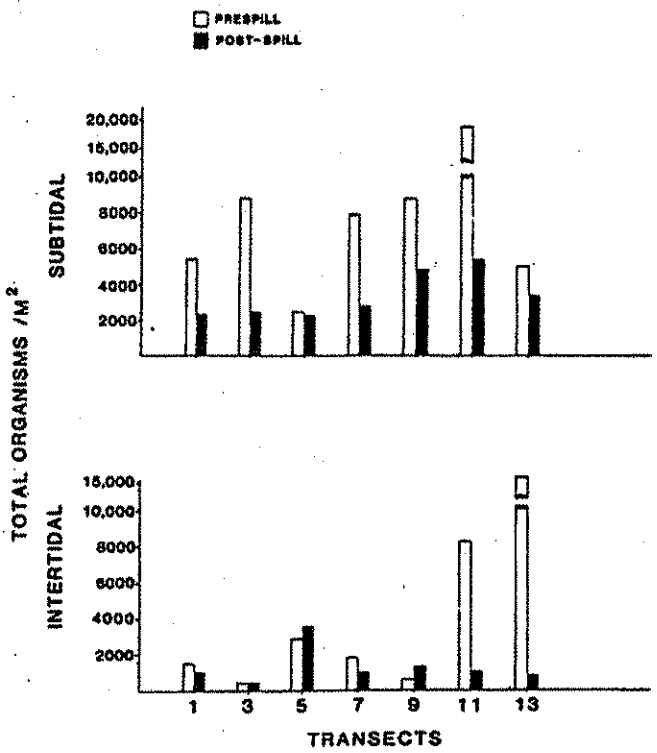

Figure 5. Relationship of pre-spill to post-spill total densities of all species within intertidal and subtidal portions of all transects.

data for all subtidal stations did, however, reveal a significant decrease ($U = 43$).

Only transect 11 (northern Padre Island) showed a significant decrease ($U = 78$) in population densities between pre- and post-spill sampling periods. All other transects, except number 5, revealed a visible, though not significant, decrease. Transect 5 (just north of Mansfield Pass) demonstrated a slight increase in total population numbers (Table 10).

Total population percentages revealed that transects 1, 3, 11, and 13 all decreased at least 50 percent in total population densities between pre- and post-spill sampling periods with 51, 68, 76, and 80 percent, respectively. Transects 7 and 9 also had decreases of 46 and 35 percent, respectively. Only transect 5 demonstrated an increase (7 percent).

The number of species in the south Texas intertidal and subtidal beach communities did not show a significant change between pre- and post-spill sampling periods.

Salinities ranged from 31 to 36 percent during pre-spill sampling to 24 to 27 percent during post-spill sampling. Pre-spill water temperatures ranged between 26.1 to 26.7°C, and post-spill water temperatures varied from 23.9 to 25.6°C.

Discussion

Interpretations of declines in population density in south Texas sandy beach intertidal and subtidal communities must be made reservedly. Although distinct reductions in population numbers occurred at most study sites between pre- and post-spill sampling periods, several factors or combinations of factors may have caused these changes. First, the Ixtoc I oil may have impacted the communities. For instance, oil budget data (personal communication, Research Planning Institute, Columbia, South Carolina) revealed that the heaviest oil concentration of a transect in this study occurred at transect 11, the only transect to show a significant decrease in population densities (Table 10).

Second, the occurrence of a tropical depression and storm during early to mid-September caused abnormally high tides and rough surf to scour the intertidal and subtidal zones. Speculation would indicate that shallow infaunal populations would either be killed by the agitation and force of the waves, suspended in the water column and then washed away by the currents, smothered by the deposition of sand, or left stranded on the beach above the receding water line. However, one study from a northeast Texas beach (Keith and Hulings, 1965) and another from northwest Florida (Saloman and Naughton, 1977), both with pre-hurricane

Table 10. Test for Significance of Impact on Population Densities (Number of Individuals per Square Meter) at Each Station Along All Transects and Pooled Intertidal, Subtidal, and Total Population Densities of Macroinfaunal Communities at South Texas Beaches

	Station number												
	Intertidal			Subtidal						Intertidal	Subtidal		
Transect	1	2	3	4	5	6	7	8[a]	9[a]	total	total	Total	U value
1	22[b] / 88	155 / 663	1,304 / 287	420 / 265	243 / 177	508 / 243	862 / 199	1,171 / 729	2,188 / 729	1,481 / 1,038	5,392 / 2,342	6,873 / 3,380	52.5[NS]
3	0 / 22	376 / 177	66 / 243	862 / 221	66 / 221	840 / 287	1,017 / 155	4,066 / 1,105	1,945 / 530	442 / 442	8,796 / 2,519	9,238 / 2,961	51[NS]
5	66 / 0	1,414 / 3,337	1,392 / 177	243 / 177	332 / 265	685 / 287	884 / 442	0 / 553	376 / 530	2,872 / 3,514	2,520 / 2,254	5,392 / 5,768	46.5[NS]
7	22 / 22	265 / 619	1,503 / 774	597 / 199	1,083 / 309	597 / 597	641 / 287	1,945 / 553	3,050 / 884	1,790 / 1,415	7,913 / 2,829	9,703 / 4,244	56.5[NS]
9	44 / 88	133 / 1,127	398 / 66	332 / 287	818 / 111	2,100 / 751	553 / 398	2,895 / 2,011	2,144 / 1,304	575 / 1,281	8,842 / 4,862	9,417 / 6,143	49.5[NS]
11	4,575 / 133	1,348 / 729	2,276 / 243	3,182 / 685	4,398 / 1,105	3,072 / 354	2,011 / 596	4,155 / 530	1,856 / 2,122	8,199 / 1,105	18,674 / 5,393	26,873 / 6,498	78[c]
13	6,696 / 88	8,752 / 575	199 / 155	1,127 / 354	530 / 376	2,321 / 575	1,017 / 464	1,105	464	15,647 / 818	4,495 / 3,338	20,642 / 4,156	52[NS]
U value	24.5[NS]	21[NS]	37.5[NS]	41[c]	33[NS]	43.5[c]	48[c]	33[NS]	33[NS]	33.5[NS]	43[c]	46[c]	

[a] Transect 13 pre-spill stations 8 and 9 not taken due to rough water (surf).

[b] Pre-spill / Post-spill, number of individuals per square meter.

[c] Significant ($p < 0.05$).

infaunal data, stated that there was not an adverse effect on the number of individuals occurring in the intertidal zone after the passage of a hurricane.

Third, normal seasonal variation may have played a role in population changes. Unfortunately, little seasonal data exists for Texas beach infauna. Shelton and Robertson (in press) show increases in intertidal haustoriid amphipod population densities from August to October, while also showing decreases in polychaetes and *Donax* spp. during the same time period at Malaquite Beach (northern Padre Island), but increases in polychaetes and two out of three *Donax* spp. at McFaddin Beach (upper Texas coast). Loesch (1957) reported decreases in *Donax* spp. population densities from early August to late September on Mustang Island.

Fourth, beach cleanup techniques, with heavy machinery at first, then by hand later, at one transect (13) may have caused population density decreases in the upper and middle intertidal zones (Table 10). Cleanup occurred daily at this "high public-use" transect. Pre-spill upper and middle intertidal infaunal densities were 6,696 and 8,752 per square meter, respectively. Post-spill densities dropped to 88 and 575 per square meter, respectively.

Therefore, decreases in intertidal and subtidal infaunal populations in south Texas sandy beaches may have been caused by any one of these factors or a combination of them.

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