CAMINADA HEADLAND BEACH AND DUNE RESTORATION PROJECT (BA-45) - PRE-CONSTRUCTION BENTHIC ORGANISM SURVEY

by

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c/o

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Gulf Benthic Taxonomy Assessment

Background.

A survey of the gulf shoreline benthic community from wet sand (intertidal) and wrack line habitats at four stations along the Caminada Headland Beach (Fourchon, Louisiana) was conducted April 1-2, 2013, as part of a beach and dune restoration project which requires monitoring of wintering nesting piping plovers (*Charadrius melodus*) in that area. A map showing the locations of the four stations in the study area is seen in Figure 1. A total of 28 benthic samples were collected and analyzed for population density, diversity and total biomass of infaunal organisms known to be prey items for shorebirds.

Field Procedures.

Intertidal samples were collected at each station during slack tide at approximate mid-swash zone - that area halfway between the point at which waves break on the beach face and the upper extent of the moving water. A hand-held stainless steel box core, described by Saloman and Naughton (1977), was used for intertidal sampling (Fig. 2). The coring device, six inches (12.5cm) on a side and penetrating to a depth of 18-20cm, was used to collect three replicate quantitative samples at approximately 1 meter apart and representing 0.0156m^2 of substrate. Box Core samples were treated with a weak formalin solution to anesthetize motile organisms, then repeatedly elutriated through a 0.5mm mesh sieve. The elutriation technique served to float off soft-bodied infauna (e.g. polychaetes, amphipods) from the samples. The remaining sediment was screened through a 1.0mm sieve to remove possible heavier bodied organisms (e.g., mollusks). Samples were preserved in the field with rose bengal-stained 5% formalin, labeled and returned to the laboratory for analysis. Rose bengal, a protein stain, facilitates the detection of benthic organisms among the sediment and detritus in the samples during the laboratory sorting process.

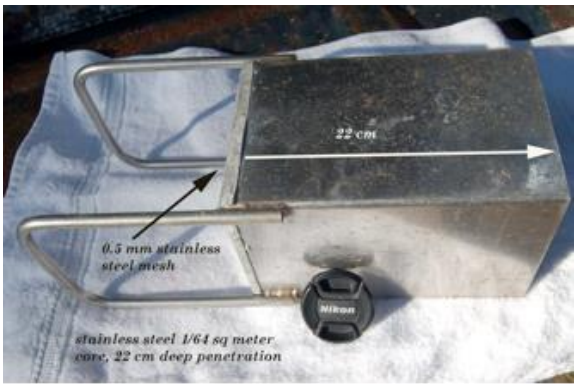

Figure 2. Box Core used in intertidal sampling. Photo by J.M. Foster.

The wrack line community was sampled following National Water Quality Assessment (NAWQA) Program protocols (Moulton et al, 2002) for the collection of richest-targeted habitat (RTH) samples corresponding to approximately 0.25 square meters of wrack substrate (fine organics, shells, woody debris, drift vegetation, etc.) per sample. Three replicate samples were collected by scooping out about 5 cm of sediment inside a 0.25 square meter quadrant that was placed at about two meter intervals within a 10 meter section of the wrack line (Fig. 3). Large debris particles were removed from the samples by sifting through a coarse screen (4.0 mm) that was dipped in a water bucket to dislodge

Figure 1. Map showing locations of benthic stations at Caminada Headland Beach, Fourchon, Louisiana.

clinging organisms (spiders, insects, etc.). Samples were then processed and preserved in a similar manner to the box cores using elutriation and screening through a 1.0mm sieve.

Figure 3. 0.25 m quadrant used for sampling beach wrack fauna. Photo by J. McLelland.

One qualitative multi-habitat (QMH) wrack-line sample per station was collected to account for large and rare specimens (i.e. crabs, snails, etc.) occurring among the flotsam and jetsam within the same homogenous wrack-line section used for the collection of RTH sample. The purpose of this sample was to provide an indication of RTH sampling efficiency. QMH sampling, based on NAWQA protocols, was conducted by pushing a wide-mouth kicknet along the 10-meter wrack-line section with the ensuing sediment and debris being washed by agitation in a sampling bucket. Organisms resulting from this action were placed in a jar, labeled and preserved.

Additional physical data included GPS coordinates, salinity, water and air temperatures, wind speed and direction, and sea state (Table 1).

Table 1. Caminada Headland Beach Benthic Field Data – for April 2013

	Station 1	Station 2	Station 3	Station 4
Date sampled	4/1/13	4/1/13	4/2/13	4/2/13
Time on Site	1347 - 1520	1556 - 1705	0915 - 1010	1028 - 1125
Latitude	N 29.09104	N 29.11054	N 29.12483	N 29.13942
Longitude	W 90.21386	W 90.17876	W 90.15561	W 90.13178
Station ID no.	ID 334	ID 417	ID 406	ID 421
Intertidal length	2.8m	4.7m	2.6m	6m
Wrack to water	14m	10m	3m	0.5m
Sample types:				
box cores	3	3	3	3
wrack semi-quant	3	3	3	3
wrack qualitative	1	1	1	1
Physical data:				
salinity ppt	20	20	19	17
air temp °C	28.8	24.5	20.8	20.2
water temp °C	21.2	21.6	20.5	21
wind speed mph	15	10 - 15	15	15 - 20
wind direction	N	N	E	E
% cloud cover	5	5	10	10
sea state ft.	2	3	2 - 3	2 - 3

Laboratory Procedures.

Sorting was conducted under a stereoscopic dissecting microscope to remove all macrobenthic organisms and recognizable fragments. Specimens were counted and identified to the lowest possible taxonomic category with representative reference material

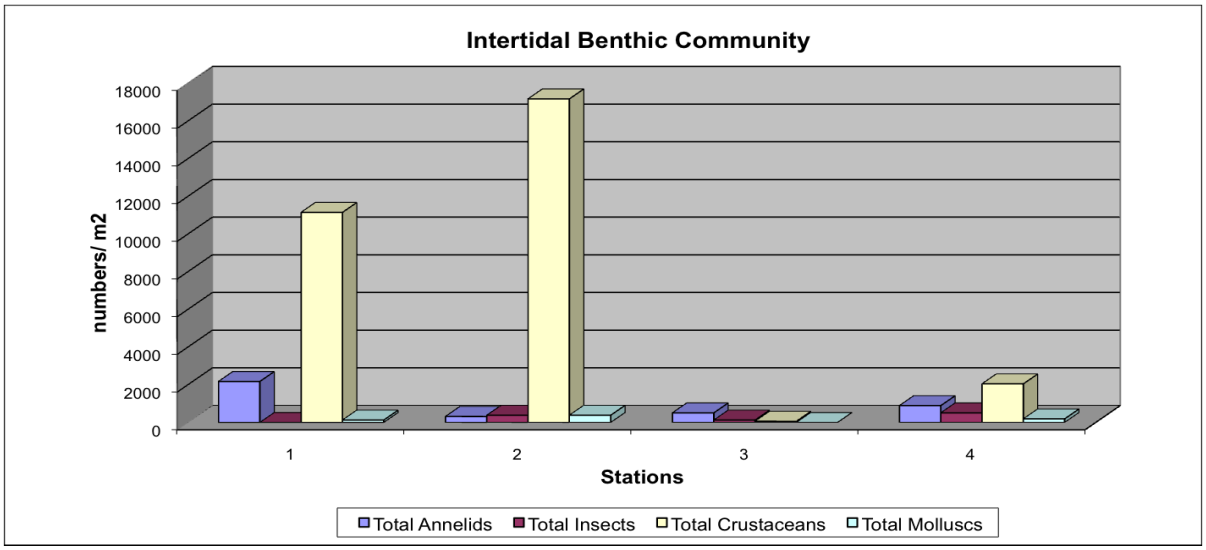

Figure 6. Intertidal Taxon Groups - Density

being retained and transferred to 70% ethanol for storage. The remaining material was separated into major groups of prey items (e.g, annelids, arthropods, mollusks), preserved in ethanol and set aside for biomass measurement. A numerical database was constructed using Microsoft Access and data was further condensed and organized in spreadsheet format using Microsoft Excel. Numbers counted were converted to numbers per square meter using 64.103 per individual for box core data and 16 per individual for the 0.25

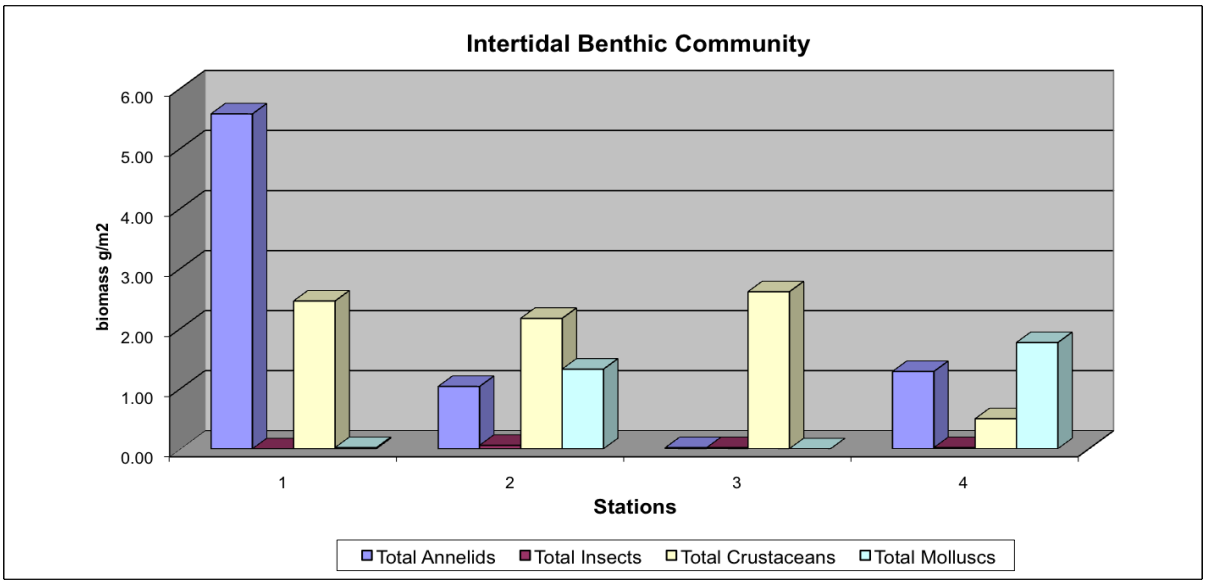

Figure 7. Intertidal Taxon Groups - Biomass

meter quadrant. Metrics of species diversity (H'), equitability (J') and dominance were calculated using formulae incorporated in the Excel spreadsheet.

Species diversity is the number of different species in a particular area (species richness) weighted by some measure of abundance such as number of individuals or biomass. The Shannon-Weiner Diversity Index (H') is the most popular mathematical expression of species richness and evenness in use in ecological investigation, including benthic monitoring studies. According to Pielou (1966), who studied the use of H' in detail, the index is appropriate to use when random samples are drawn from a large community in which the total numbers of species is known. H' is calculated as $-\sum \rho i \log(\rho i)$, where ρi is the proportion of the total number of specimens i expressed as a proportion of the total number of species for all species in the ecosystem. The product of $\rho i \log(\rho i)$ for each species in the ecosystem is summed and multiplied by −1 to give H'.

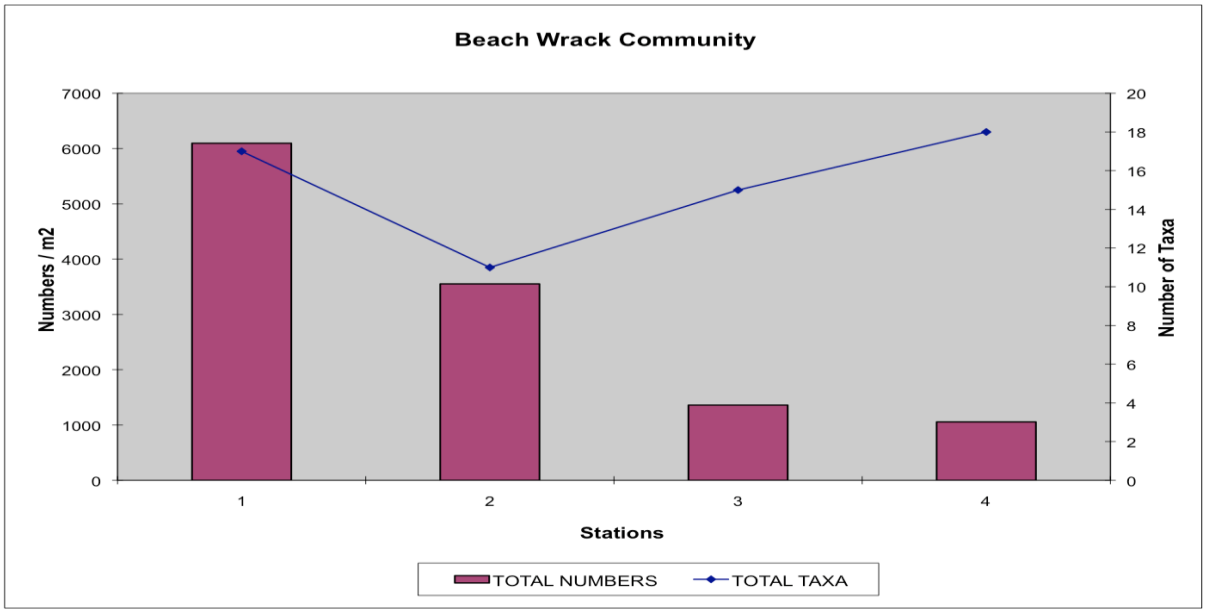

Figure 8. Beach Wrack Density vs. Richness

The species equitability index (J'), also known as Evenness, is another measure of how well the abundance of individuals is spread among the number of species. It is

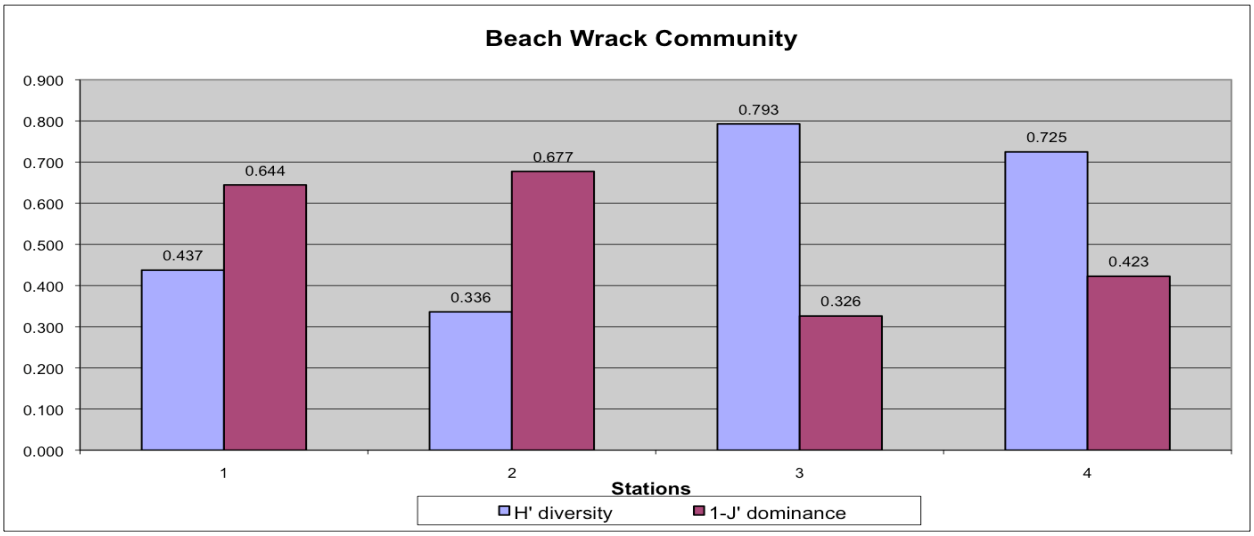

Figure 9. Beach Wrack Diversity Indices

calculated as H'/H_{max}, where H_{max} is the maximum possible value of H', and equals the log of S, which is the number of species (species richness). The index of dominance, a measure of how a population is dominated by one or a few species, is calculated simply as 1-J'.

Total benthic biomass (by weight) of piping plover prey species was measured following methods described by Versar, Inc. (2002). Samples composed of prey specimen groups (see above), pooled from all replicates, were air dried to a constant weight at 60ºC in a drying oven and then baked for 4 hours at 500ºC in a muffle furnace to determine the ash-free dry weight. Samples were weighed before and after baking using an analytical balance accurate to 0.0001 g. Bivalves in the samples were crushed prior to drying to eliminate water trapped in the shells.

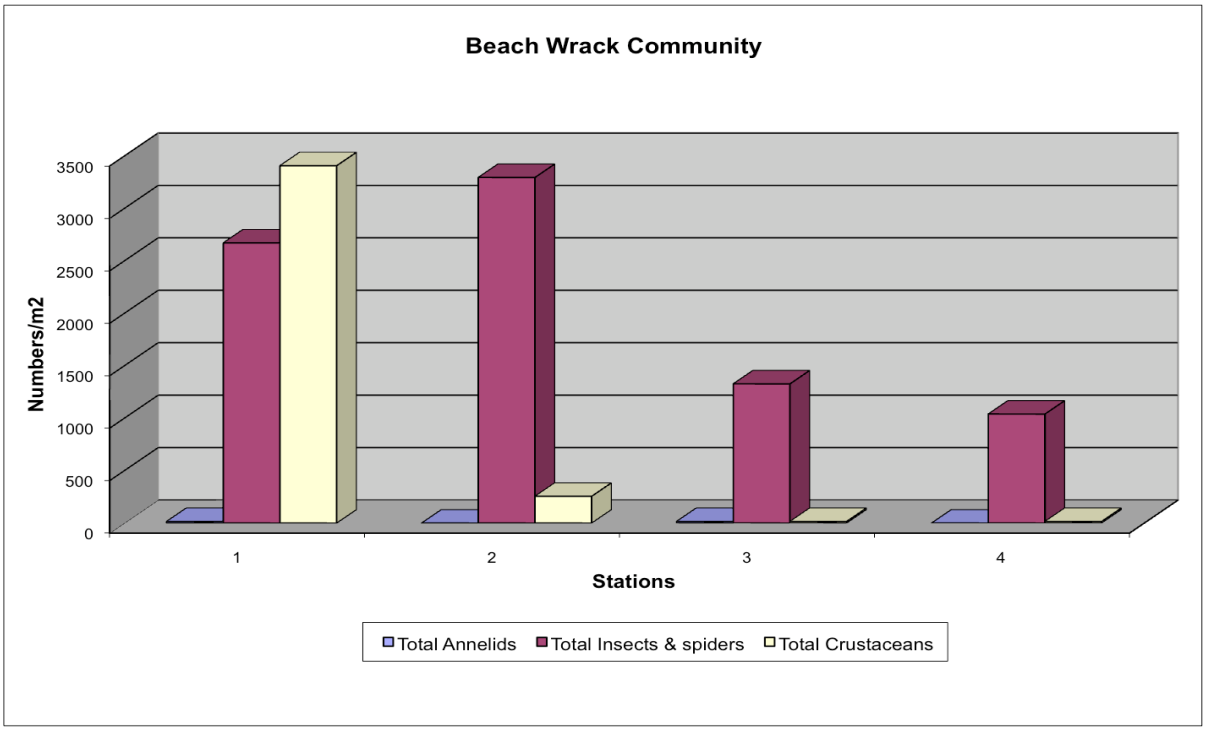

Figure 10. Beach Wrack Faunal Groups - Density

Results.

General field observations.

The beach face at all four stations was flat with little contour. There was only a small amount of recently washed up wrack material at the current high tide line. A larger amount of debris, apparently from several days before, was partially buried in the sand 1-2 meters beyond the current high tide mark. It was composed of weathered and mostly decomposed *Sargassum* weed and some marsh grass particles. The beach sediment was composed of very fine sand mixed with silt particles giving it a dark brown color (Seen in Fig. 3). Underlying the intertidal fine sand was a base of variously sized shell hash particles composed of several species of mollusk shells, notably many of estuarine origin. Many of the larger shell pieces showed evidence of oil contamination with encrusted sand and tar residue.

Benthic fauna.

A total of 1317 organisms from all stations were examined representing 41 nominal taxa from three phyla. Numerical, biomass and diversity data are presented in Tables 2 and 3 for the intertidal and wrack line communities respectively and a complete phylogenetic listing of organisms encountered appears in Appendix I.

Station 2 had the highest density of intertidal organisms (18,269 /m^2) and number of taxa (8) while station 4 showed the highest H' diversity value (0.564) among the four stations (Figs 4 and 5). Station 3 was the overall lowest in intertidal density and number of taxa but was second in H' diversity. The intertidal community was dominated numerically by the amphipod, *Lepidactylus triarticulatus* with the highest density (17,180/m^2) recorded at Station 2, a substantial number (11,154) at station 1 (Fig. 6), and biomass values over 2 g/m^2 at stations 1 and 2 (Fig. 7). A single crustacean, the mole crab, *Emerita benedicti* was encountered at station 3 but accounted for most of the biomass there (2.62 g/m^2). Annelids were the second most abundant intertidal group with highest numbers and biomass occurring at station 1 (over 5 g/m^2), largely due to the common spionid polychaete, *Scolelepis squamata* and the presence in some samples of the fat-bodied lumbrinerid polychaete, *Scoletoma* sp. The common coquina clam, *Donax variabilis* occurred only at stations 2 and 4 and at each of these stations expressed values of over 1 g/ m^2. All of the above mentioned species are common intertidal filter feeders and are adept at rapidly burrowing in the constantly moving swash zone sediment.

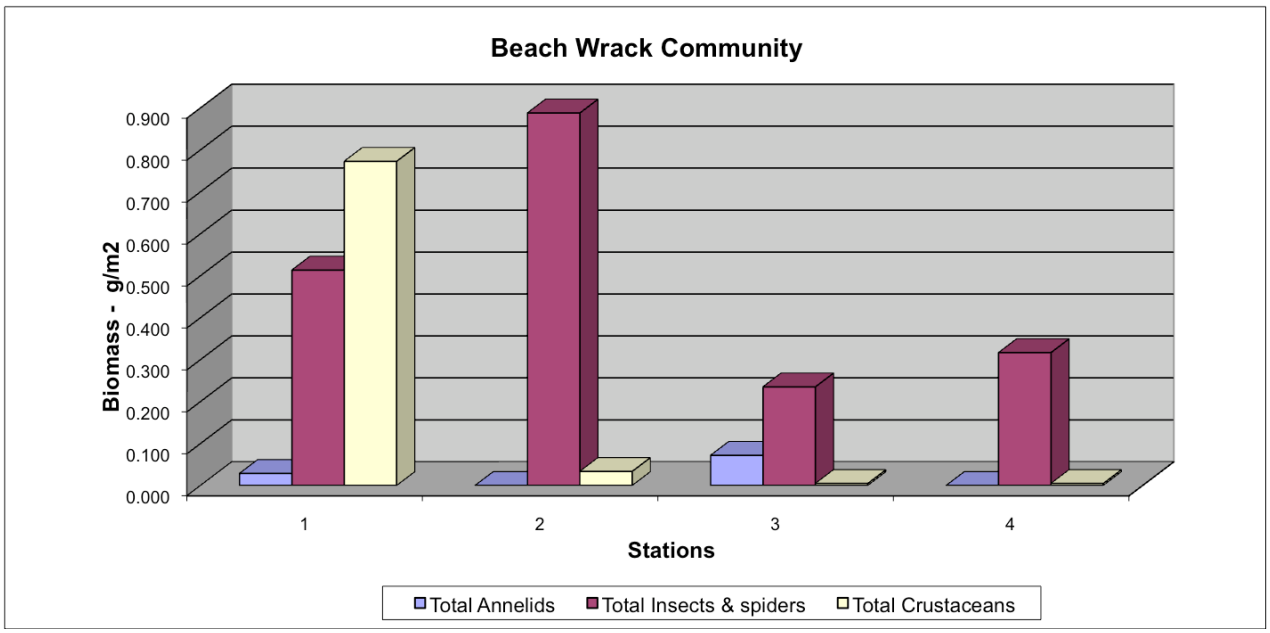

Figure 11. Beach Wrack Faunal Groups - Biomass

The highest density of wrack line organisms occurred at station 1 (Fig. 8) owing to large numbers of infaunal amphipods and insects (Table 3). However, higher species diversity values were at stations 3 and 4, which had lower overall densities than stations 1 and 2 (Fig 9). In addition to the high density of amphipods (*L. triarticulatus*) at station 1, small insects, particularly rove beetles (Staphylinidae), were abundant at all wrack stations, dominating the fauna numerically at stations 2 through 4 (Fig 10). Although diverse and abundant, the wrack line organisms, as compared to the intertidal samples,

comprised a smaller portion of the available prey from a biomass standpoint, with no station exceeding 1 g/m^2 (Fig. 11).

Aside from the presence of the barnacle, *Amphibalanus* sp. at station 1, no unusual organisms were collected in the QMH samples (Table 4).

Summary and Conclusions.

Scolelepis squamata and *Lepidactylus triarticulatus* are common inhabitants of intertidal and near-shore benthic habitats from the barrier island and mainland beaches from the Florida panhandle area to Texas (Rakocinski et al. 1991, 1993; McLelland and Heard 1991). The intertidal benthic community at Caminada Headland Beach was likewise dominated by these two species; they differed numerically but were similar in total biomass (Fig. 12). The bivalve mollusc, *Donax variabilis*, another common intertidal inhabitant of sandy beaches from Florida to Texas (Mikkelsen and Bieler 2008; Tunnel et al. 2010), was present at only two stations and in small numbers.

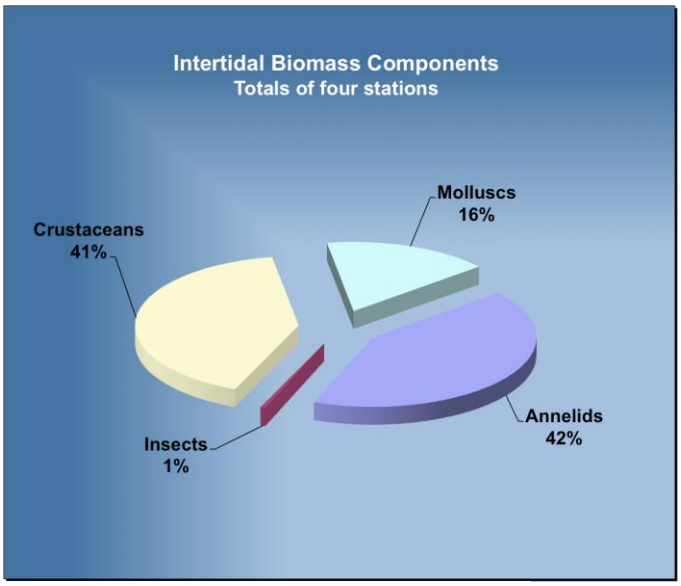

Figure 12. Caminada Headland Beach intertidal biomass components.

The beach wrack community was dominated by large numbers and a rich variety of small insects but was lower in biomass than the intertidal zone (Fig. 13). It is likely that foraging piping plovers would find a richer food source, in terms of biomass, in the intertidal zone with its larger prey items. However those that browse among the wrack line would be apt to find a more diverse array of prey items than at the adjacent intertidal zone though most would be smaller in size.

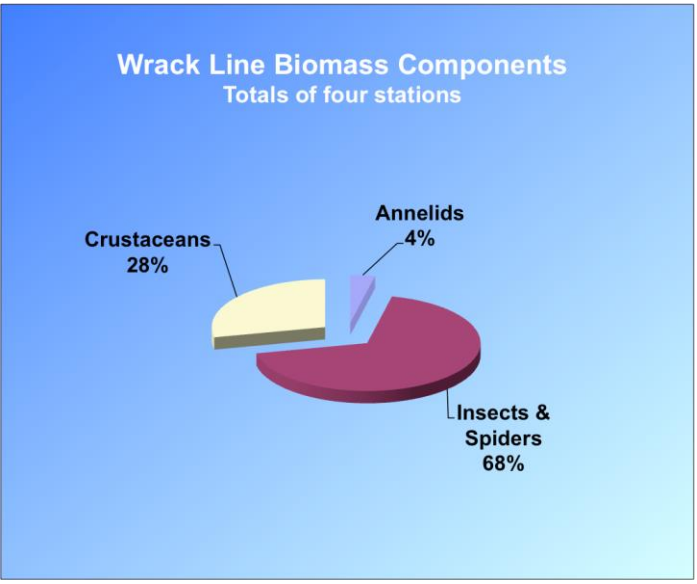

Figure 13. Caminada Headland Beach wrack biomass components.

Table 2. Summary of Intertidal Box Core Data - condensed by station
values in numbers/m2

TAXA	ST 1	ST 2	ST 3	ST 4
ANNELIDA				
Polychaeta				
Family Lumbrineridae				
Scoletoma sp.	128	64		64
Family Spionidae				
Scolelepis squamata	2051	256	513	833
ARTHROPODA				
Insecta				
Order Coleoptera				
Family Staphylinidae				
Unid. Staphylinidae		256	64	256
Order Diptera				
Unid. Diptera		64		192
Family Sciaridae				
Unid. Sciaridae		64	64	
Order Hymenoptera				
Family Formicidae				
Solenopsis invicta				64
Malacostraca				
Order Amphipoda				
Family Haustoriidae				
Lepidactylus triarticulatus	11154	17180		2051
Order Decapoda				
Family Hippidae				
Emerita benedicti			64	
MOLLUSCA				
Bivalvia				
Unid. Bivalvia	64	64		
Order Veneroida				
Family Donacidae				
Donax variabilis		321		192
Gastropoda				
Order Heterostropha				
Family Pyramidellidae				
Eulimastoma weberi	64			
TOTAL NUMBERS	13462	18269	705	3654
TOTAL TAXA	5	8	4	7
diversity indices				
Hmax'	0.699	0.903	0.602	0.845
H' diversity	0.234	0.142	0.385	0.564
J' evenness (equitability)	0.334	0.158	0.639	0.668
1-J' dominance	0.666	0.842	0.361	0.332
	numbers/m2			
Total Annelids	2180	321	513	897
Total Insects	0	385	128	513
Total Crustaceans	11154	17180	64	2051
Total Molluscs	128	385	0	192
	biomass g/m2			
Total Annelids	5.58	1.04	0.02	1.29
Total Insects	0.00	0.06	0.02	0.02
Total Crustaceans	2.46	2.17	2.62	0.50
Total Molluscs	0.02	1.33	0.00	1.77

Table 3. Summary of Wrackline Quantitative Data - condensed by station
values in numbers/m2

TAXA	ST 1	ST 2	ST 3	ST 4
ANNELIDA				
Polychaeta				
Family Spionidae				
Scolelepis squamata	16		16	
ARTHROPODA				
Arachnida				
Order Araneae				
Unid. Araneae			16	16
Family Linyphiidae				
Unid. Linyphiidae	16		176	16
Insecta				
Unid. Insecta	48			
Order Coleoptera				
Unid. Coleoptera		96	16	
Family Aderidae				
Zonantes sp.	16			
Family Carabidae				
Aculpalpus pauperculus	16			16
Amblygnathus sp.	16			
Bembidion sp.	16			
Family Chrysomelidae				
Unid. Chrysomelidae	32	80		
Family Coccinellidae				
Naemia seriata		16		
Family Curculionidae				
Tanysphyrus sp			16	16
Family Melyridae				
Collops nigriceps		16		
Family Scarabaeidae				
Ataenius sp.			16	
Family Staphylinidae				
Belonochus sp.				16
Reichenbachia sp.				16
Unid. Staphylinidae	2368	2960	640	656
Order Collembola				
Unid. Collembola	16			16

Table 3. Summary of Wrackline Quantitative Data - condensed by station
values in numbers/m2

TAXA	ST 1	ST 2	ST 3	ST 4
Order Diptera				
Unid. Diptera	32	64	192	80
Family Culicidae				
Unid. Culicidae			16	48
Family Sciaridae				
Unid. Sciaridae	64	32		16
Order Hemiptera				
Family Cercopidae				
Unid. Cercopidae			32	16
Family Cicadellidae				
Unid. Cicadellidae	16		48	32
Family Hebridae				
Hebrus sp.			16	
Family Miridae				
Unid. Miridae		32	96	32
Family Reduviidae				
Zelus sp.				16
Order Hymenoptera				
Unid. Hymenoptera	16			
Family Braconidae				
Unid. Braconidae			48	
Family Mymaridae				
Unid. Mymaridae				16
Order Orthoptera				
Family Tetrigidae				
Tettigidea lateralis				16
Malacostraca				
Order Amphipoda				
Unid. Amphipoda	16	16		
Family Gammaridae				
Gammarus mucronatus			16	
Family Haustoriidae				
Lepidactylus triarticulatus	3376	208		16
Family Talitridae				
Platorchestia sp.	16	32		

Table 3. Summary of Wrackline Quantitative Data - condensed by station
values in numbers/m2

TAXA	ST 1	ST 2	ST 3	ST 4
TOTAL NUMBERS	6096	3552	1360	1056
TOTAL TAXA	17	11	15	18
diversity indices				
Hmax'	1.230	1.041	1.176	1.255
H' diversity	0.437	0.336	0.793	0.725
J' evenness (equitability)	0.356	0.323	0.674	0.577
1-J' dominance	0.644	0.677	0.326	0.423
	numbers/m2			
Total Annelids	16	0	16	0
Total Insects & spiders	2672	3296	1328	1040
Total Crustaceans	3408	256	16	16
	biomass g/m2			
Total Annelids	0.029	0.000	0.072	0.000
Total Insects & spiders	0.514	0.888	0.235	0.317
Total Crustaceans	0.773	0.034	0.005	0.005

Table 4. Wrack Line Qualitative QMH Data by Station
Numbers of specimens counted

TAXA	Station 1	Station 2	Station 3	Station 4
ARTHROPODA				
Arachnida				
Order Araneae				
Family Linyphiidae				
Unid. Linyphiidae			6	1
Insecta				
Unid. Insecta			2	
Order Coleoptera				
Family Carabidae				
Aculpalpus pauperculus		1		
Amblygnathus sp.		4		
Family Chrysomelidae				
Unid. Chrysomelidae		1	1	
Family Curculionidae				
Tanysphyrus sp			1	1

TAXA	Station 1	Station 2	Station 3	Station 4
Family Staphylinidae				
Unid. Staphylinidae	24	35	22	21
Order Diptera				
Unid. Diptera		1	3	2
Family Sciaridae				
Unid. Sciaridae			1	
Order Hemiptera				
Family Cercopidae				
Unid. Cercopidae			2	1
Family Cicadellidae				
Unid. Cicadellidae			3	
Family Miridae				
Unid. Miridae			7	3
Order Hymenoptera				
Unid. Hymenoptera			1	
Family Braconidae				
Unid. Braconidae			1	
Malacostraca				
Order Amphipoda				
Family Haustoriidae		1		
Lepidactylus triarticulatus				
Family Talitridae				
Platorchestia sp.	1		1	
Maxillopoda				
Order Sessilia				
Family Balanidae				
Amphibalanus sp.	1			
TOTAL NUMBERS COUNTED	26	43	51	29
TOTAL TAXA	3	6	13	6

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Appendices.

Appendix I. Phylogenetic listing of taxa.

Phylum	Class	Subclass	Order	Suborder	Family	Taxon	Authority
Annelida	Polychaeta	Palpata	Aciculata	Eunicida	Lumbrineridae	Scoletoma sp.	
			Canalipalpata	Spionida	Spionidae	*Scolelepis squamata*	(Muller, 1806)
Arthropoda	Arachnida		Araneae			Unid. Araneae	
					Linyphiidae	Unid. Linyphiidae	
	Insecta					Unid. Insecta	
			Collembola			Unid. Collembola	
		Pterygota	Coleoptera			Unid. Coleoptera	
				Adephaga	Carabidae	*Aculpalpus pauperculus*	Dejean, 1829
						Amblygnathus sp.	
						Bembidion sp.	
				Polyphaga	Aderidae	*Zonantes sp.*	
					Chrysomelidae	Unid. Chrysomelidae	
					Coccinellidae	*Naemia seriata*	(Melsheimer, 1847)
					Curculionidae	*Tanysphyrus sp*	
					Melyridae	*Collops nigriceps*	Say, 1823
					Scarabaeidae	*Ataenius sp.*	
					Staphylinidae	*Belonochus sp.*	
						Reichenbachia sp.	
						Unid. Staphylinidae	
			Diptera			Unid. Diptera	
				Nematocera	Culicidae	Unid. Culicidae	
					Sciaridae	Unid. Sciaridae	
			Hemiptera	Auchenorrhyncha	Cercopidae	Unid. Cercopidae	
					Cicadellidae	Unid. Cicadellidae	
				Heteroptera	Hebridae	*Hebrus sp.*	
					Miridae	Unid. Miridae	
					Reduviidae	*Zelus sp.*	
			Hymenoptera			Unid. Hymenoptera	
				Apocrita	Braconidae	Unid. Braconidae	
					Formicidae	*Solenopsis invicta*	Buren, 1972
					Mymaridae	Unid. Mymaridae	
			Orthoptera	Caelifera	Tetrigidae	*Tettigidea lateralis*	Say, 1824
	Malacostraca	Eumalacostraca	Amphipoda			Unid. Amphipoda	
				Gammaridea	Gammaridae	Gammarus mucronatus	Say, 1818
					Haustoriidae	*Lepidactylus triarticulatus*	Robertson & Shelton, 1980
					Talitridae	*Platorchestia sp.*	
			Decapoda	Pleocymata	Hippidae	*Emerita benedicti*	Schmitt, 1935
	Maxillopoda	Theocostraca	Sessilia	Balanomorpha	Balanidae	*Amphibalanus sp.*	
Mollusca	Bivalvia					Unid. Bivalvia	
		Heterodonta	Veneroida		Donacidae	*Donax variabilis*	Say, 1822
	Gastropoda		Heterostropha		Pyramidellidae	*Eulimastoma weberi*	(Morrison, 1965)