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Sandy-beach fauna of the Pacific and Atlantic coasts of Costa Rica and Colombia

by

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ABSTRACT: The macroscopic infaunas of 18 tropical sandy beaches along both coasts of Costa Rica and Colombia were examined during the spring of 1971. The Pacific beaches averaged 7 times the density of individuals, had significantly larger numbers of species, and had significantly finer sand than the Atlantic beaches. The two most abundant species, the isopods *Cirolana salvadorensis* and *Exosphaeroma diminutum,* occurred on both coasts. The polychaetes *Scolelepis agilis* and *Hemipodus armatus* were found on the majority of beaches on both coasts. In general, the faunas of the Pacific and Atlantic sandy beaches were composed of closely related species.

The purpose of this study was to make a preliminary description of the sandy-beach fauna along the Pacific and Atlantic coasts of Costa Rica and Colombia. The objective was to establish species composition, abundance, and zonation patterns for each beach, and to compare similarities and differences among the faunas.

Studies on tropical sandy beaches are very limited. DAHL (1) described worldwide zonation patterns of boreal, temperate, and tropical beaches, characterizing each by three or four species of larger invertebrates, predominantly Crustacea. Previous studies on American tropical, sand beaches are those of RODRIGUEZ (10) in Venezuela, WADE (14) in Jamaica, and DEXTER (3) in Panama.

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METHODS

Beaches were selected as study sites on the basis of their accessibility and distribution along the coastlines of Costa Rica and Colombia. Eighteen beaches, one half on each coast, were sampled from February through May, 1971; 13 beaches were located in Costa Rica and 5 in Colombia. The island beaches of San Andrés, a Colombian possesion, located in the Caribbean Sea off the coast of Nicaragua, were depauperate in fauna.

A systematic sampling design was used. The beaches were divided into strata, the width of which depended on the area exposed at low tide. Strata varied from 5 to 20 m on the Pacific coast and from 1 to 5 m on the Atlantic. Each beach was divided into at least 5 strata. Three or four replicate samples, 1 m apart, were taken in each stratum. A total of 197 samples were collected from the Atlantic beaches and 237 fron the Pacific beaches. Sampling procedure consisted of placing a 0.1 m² quadrat over the sand at low tide, removing sand to a depth of 5 cm, and sieving it through a 500 μ-mesh net. Organisms were separated from the sand residue by careful sorting and by floatation in a saturated sugar solution. Sediment cores were taken at high, mid, and low tidal levels. Sedimentary particle size was analyzed with the use of an Emery settling tube (EMERY, 4).

The Shannon-Wiener diversity index (LLOYD and GHELARDI, 8) takes into account both total number of species and numerical equality in species representation, and is relatively independent of sample size, when the sample is larger than 200 individuals (SANDERS, 12). This index was calculated for all beaches with a sample size greater than 200 individuals. The index NM (FAGER, 5) is based on the number of moves necessary to convert the observed distribution of individuals of species into an even distribution. This index measures the equitability of distribution of individuals among the species and was calculated for all but one beach. To determine faunal similarity among the beaches, the percentage composition of each species for each sample location was computed. Sample pairs were compared by summing the smaller percentages of the species present in both samples. This value is the "index of affinity" which measures the percent of fauna common to a pair of samples (SANDERS, 11).

DESCRIPTION OF COLLECTION SITES

ATLANTIC BEACHES

Site Nº 1 Isla San Andrés, Colombia; 12°32'N, 81°34'W; coarse calcareous sand; median grain size, 369 μ; 6 m wide at low tide.

Site Nº 2 Playa Bonita, Limón, Costa Rica; 10°01'N, 83°04'W; calcareous sand; median grain size, 267 μ; 14 m wide at low tide.

Site Nº 3 Airport Beach, Limón, Costa Rica; 9°58'N, 83°01'W; basic igneous sand composed mainly of magnetite and olivine; median grain size, 206 μ; 14 m wide at low tide.

Site Nº 4 Cahuita North, Costa Rica; 9°45'N, 82°52'W; basic igneous sand; median grain size, 197 μ; 25 m wide at low tide.

Site Nº 5 Cahuita South, Costa Rica; 9°44'N, 82°50'W; calcareous sand; median grain size, 377 μ; 12 m wide at low tide.

Site Nº 6 Puerto Viejo, Costa Rica; 9°40'N, 82°44'W; basic igneous sand; median grain size, 378 μ; 25 m wide at low tide. In the nearby subtidal sand an abundant population of the sand dollar *Mellita quinquiesperforata lata* was present.

Site Nº 7 Boca Grande, Cartagena, Colombia; 10°30'N; 75°40'W; acidic igneous sand; median grain size, 165 μ; 18 m wide at low tide.

Site Nº 8 Pradomar, Puerto Colombia, Colombia; 11°08'N, 75°09'W; basic igneous sand; median grain size, 231 μ; 6 m wide at low tide.

Site Nº 9 Rodadero, Santa Marta, Colombia; 11°15'N, 74°13'W; mixed acidic and basic igneous sand; median grain size, 323 μ; 5 m wide at low tide.

PACIFIC BEACHES

Site Nº 1 Playita Blanca, Coco, Costa Rica; 10°34'N, 85°42'W; calcareous sand; median grain size, 283 μ; 30 m wide at low tide.

Site Nº 2 Tamarindo, Costa Rica; 10°19'N, 85°50'W; mixed sand with equal amounts of calcareous and quartz/feldspar particles; median grain size, 137 μ; 90 m wide at low tide.

Site Nº 3 Sámara, Costa Rica; 9°59'N, 85°38'W; quartz sand; median grain size, 151 μ; 130 m wide at low tide.

Site Nº 4 Puntarenas (La Punta), Costa Rica; 9°59'N, 84°45W; volcanic sand; median grain size, 232 μ; 60 m wide at low tide.

Site Nº 5 Boca de Barranca, Costa Rica; 9°58'N, 84°45'W; beach located at the mouth of a small river; volcanic sand; median grain size, 216 μ; 80 m wide at low tide.

Site Nº 6 Jacó, Costa Rica; 9°37'N, 84°38'W; volcanic sand; median grain size, 185 μ; 180 m wide at low tide.

Site Nº 7 Playa Cocal, Quepos, Costa Rica; 9°26'N; 84°10'W; volcanic sand with considerable weathering; median grain size, 205 μ; beach located near mouth of small river; 110 m wide at low tide.

Site Nº 8 Playa Espadilla, Quepos, Costa Rica; 9°24'N, 84°10'W; calcareous, volcanic, and quartz/feldspar sands in approximately equal amounts; median grain size, 203 μ; 90 m wide at low tide.

Site Nº 9 Juan Chaco, near mouth of Bahía de Málaga, Colombia; 3°54'N, 77°22'W; basic igneous sand of altered volcanic origin; median grain size, 201 μ; 75 m wide at low tide.

RESULTS

A total of 2,249 individuals from 19.7 m^2 of beach were collected along the Atlantic coast. The distribution and density of these 33 species are given in Table 1. A total of 17,747 individuals were collected from a sample area of 23.7 m^2 on the Pacific beaches. The distribution and density of these 52 species are shown in Table 2. Table 3 presents a synthesis of the number of individuals and number of species, area sampled, diversity index, and the percent composition of the dominant species on each beach. The average index of faunal affinity among the Atlantic beaches was 39.7 and 26.5 in the Pacific (Fig. 1).

Only 6 of the 33 species collected from the tropical Atlantic beaches of Costa Rica and Colombia were present on at least half of the beaches. These included the isopods *Cirolana salvadorensis* and *Ancinus brasiliensis;* polychaetes *Scolelepis agilis* and *Hemipodus armatus;* a phoxocephalid amphipod, and the decapod *Emerita brasiliensis.* Of these, only *C. salvadorensis* had a frequency (presence in total quadrats) greater than 50%; *S. agilis* had a frequency greater than 20%. These 6 species comprised 74% (by number) of the Atlantic fauna.

Of the 52 species collected along the Pacific coast, 10 were present on at least half of the beaches. These included the isopods *Cirolana salvadorensis* and *Exosphaeroma diminutum;* the polychaetes *Scolelepis agilis, Hemipodus armatus,* and *Nephthys singularis;* a phoxocephalid amphipod, the decapod *Emerita rathbunae,* a bodatriid cumacean, the bivalve *Donax panamensis,* and the gastropod *Olivella semistriata. C. salvadorensis* and *E. diminutum* had frequencies greater than 50%, while *S. agilis* had a frequency greater than 20%. These 10 species comprised 88% of the Pacific sand fauna.

Six species were found on both coasts: the polychaetes *Scolelepis agilis, Hemipodus armatus,* and *Sthenelais maculata;* the isopods *Cirolana salvadorensis* and *Exosphaeroma diminutum;* and the amphipod *Orchestoidea biolleyi.* The presence of these species contributed to an average index of faunal affinity of 12.6 between the Pacific beaches compared with the Atlantic beaches (Fig. 1). Of the total species present, crustacea comprised an average of 55% of the Atlantic fauna (range of 42-100% among the individual beaches) and 43% (range 40-54%) of the Pacific; annelids 24% (range 0-37%) of Atlantic and 25% (range 29-33%) of the Pacific fauna; mollusca 9% (range 0-25%) of Atlantic and 19% (range 0-33%) of the Pacific fauna; and all other taxa 12% (range 0-14%) of Atlantic and 13% (range 0-15%) of the Pacific fauna.

There were significant differences between the Atlantic and Pacific sandy beaches in density, numbers of species, and grain size. Mann Whitney U tests (SIEGEL, 13) showed that the density of organisms was significantly greater ($p= 0.001$) on the Pacific beaches than on the Atlantic beaches; that the number of species was significantly higher ($p= 0.01$) on the Pacific beaches; and, that median sand grain size was significantly higher ($p = 0.05$) on the Atlantic beaches. The Shannon-Wiener diversity indices on both coasts (Table 3) ranged from about 0.50 to 2.50; no consistent differences between the coasts were found. The evenness of distribution of individuals among species (as measured by NM) was low on all sandy beaches on both coasts (Table 3).

Exosphaeroma diminutum on the Pacific coast had significantly higher densities on lighter calcareous and quartz sands, compared to darker volcanic sands. It was present on the Atlantic coast only on calcareous beaches, and was distributed throughout the intertidal zone on both coasts.

Cirolana salvadorensis occurred on all substrate types and sand grain sizes on both coasts. However, it dominated the fauna when grain size was larger than 300 μ. It was most abundant in the high and mid tidal levels.

On the Pacific beaches, *S. agilis* was more abundant (average density of $72/m^2$) on volcanic sand beaches; it had low densities or was absent (average $1/m^2$) from calcareous and quartz beaches, and had low densities average $6/m^2$) on calcareous beaches on the Atlantic coast. It was distributed throughout the intertidal zone with greater densities toward the lower levels.

Predominantly low tide species included *Hemipodus armatus, Nephthys singularis, Ancinus brasiliensis,* phoxocephalid amphipods, *Emerita brasiliensis, E. rathbunae, Donax panamensis, D. denticulatus, Olivella semistriata,* and bodatriid cumaceans.

DISCUSSION

The beaches in Costa Rica and Colombia varied widely in several physical factors, among which sediment composition and mean particle size were examined. The three main sediment types were calcareous sand, quartz sand mixtures, and volcanic-igneous sands. Since the latter are usually dark in color, calcareous sands usually light, and quartz sands of a medium color, differences in heat retention capabilities might be reflected in faunal composition and/or abundance. Although some species appeared to change densities in relation to sediment composition, no overall trend was evident. Number of species and density of sand fauna did not appear related to sediment composition. The influence of sediment composition upon sandy-beach fauna is not yet apparent.

Beaches with the highest degree of faunal affinity on the Atlantic coast were Airport Beach, Cahuita South, and Puerto Viejo, Costa Rica, and Puerto Colombia, Colombia. These beaches were widely separated geographically, narow to wide, of calcareous or igneous sand, of fine to medium grains, and organism density ranged from low to high. The only obvious feature shared in common among these beaches was an abundance of or dominance by the isopod *C. salvadorensis.* On the Pacific coast, Espadilla, Sámara, Playita Blanca, and Tamarindo, all in Costa Rica, had the highest affinities. The beaches on the Pacific were composed of fine sand, either calcareous or quartz, and were

TABLE 1

Distribution and density (N°/m²) of sandy-beach species on the Atlantic coasts of Costa Rica and Colombia

Species	Name and site number								
	San Andrés, C. 1	Playa Bonita Limón, C. R. 2	Airport Beach Limón, C. R. 3	Cahuita North, C. R. 4	Cahuita South, C. R. 5	Puerto Viejo, C. R. 6	Cartagena, C. 7	Puerto Colombia, C. 8	Santa Marta, C. 9
Nematoda						.6			
Nemertea		.4	.4						
Polychaeta									
Scolelepis agilis		17.5	12.5	14.4	1.4	.6	5.7	.4	10.4
Hemipodus armatus		.4	.8	4.4	.5	1.7	1.1		9.6
Pisionidens indica					1.0			.4	21.3
Sthenelais maculata							1.4		
Lumbrinereis sp.							.4		
Paraonides sp.								.7	
Ceratonereis mirabilis									2.9
Oligochaeta					2.4				
Crustacea: Cumacea									
Bodatriidae					1.4				.4
Crustacea: Isopoda									
Exosphaeroma diminutum	.8				1.4		2.9		4.6
Cirolana parva	2.5								
Cirolana salvadorensis		31.3	196.3	3.3	178.6	36.7	37.1	57.1	18.3
Ancinus brasiliensis		63.3	.8	2.2	4.8	1.1			

Crustacea: Amphipoda									
Phoxocephalidae		.8		1.1	1.0	.6	15.0		
Atylus minikoi	4.2								
Orchestoidea ?biolleyi			1.3						
Haustorius sp.						.6			
Orchestia ?fritzi								.4	
Photiidae									2.5
Crustacea: Tanaidacea									
Leptochelia sp.									2.9
Crustacea: Mysidacea									
Bowmaniella dissimilis									1.3
Crustacea: Decapoda									
Emerita brasiliensis		.4	.8	1.7	.5		.4		.8
Hippa cubensis					.5			.4	
Ocypode quadrata				.6				.4	1.3
Lepidopa richmondi						.4	.4	.4	
brachyuran megalops									.4
Insecta									
Coleoptera larva sp. A					.5				
Coleoptera larva sp. B									.4
Mollusca: Bivalvia									
Donax denticulatus						14.4	66.8		71.3
Tivella mactroides							.7		
Mollusca: Gastropoda									
Terebra cinerea				.6			.7		

TABLE 2

Distribution and density (Nº/m²) of sandy-beach species on the Pacific coasts of Costa Rica and Colombia

Species	Name and site number								
	Playita Blanca Coco, C. R. 1	Tamarindo, C. R. 2	Sámara, C. R. 3	La Punta Puntarenas, C. R. 4	Boca de Barranca, C. R. 5	Jacó, C. R. 6	Playa Cocal Quepos, C. R. 7	Playa Espadilla Quepos, C. R. 8	Juan Chaco, C. 9
Platyhelminthes					.4	.3			
Nematoda	38.6								
Nemertea				.3		.3			1.1
Polychaeta									
Scolelepis agilis	3.8	.7		251.0	70.0	6.3	3.3	.5	30.0
Hemipodus armatus		13.7	11.9			3.7	.4	1.4	
Nephthys singularis		11.0	1.4	5.7	1.1	3.0			
Chone minuta	1.0								
Saccocirrus sp.	1.0								
Pisione remota	17.6						.4		
Orbinia johnsoni		.7	20.4					.5	
Phyllodoce sp.					.7				
Armandia sp.					.4				
Magelona riojai						1.7			
Sthenelais maculata						.3	.8		
Euzonus furciferus								.5	1.1
Anaitides ?multiseriata									.6

Crustacea: Amphipoda									
Phoxocephalidae		132.0	23.3		2.2	280.0	122.3	.5	1.1
Megaluropus sp.	145.2								
Orchestoidea ?biolleyi	1.9								
Acanthohaustorius n. sp.						25.7			533.3
unidentified amphipod									
Synchelidium sp.						.7			
Corophiidae									1.1
Crustacea: Cumacea									
Bodatriidae	1.0	198.7	2.9			27.7	.2		
unidentified cumacean				.5					
Crustacea: Isopoda									
Exosphaeroma diminutum	1552.9	446.3	364.8		35.6	86.3	.6	1133.3	81.1
Cirolana salvadorensis	206.2	27.0	1.9	622.9	23.0	5.0	42.1	85.2	44.4
Crustacea: Mysidacea									
Bowmaniella sp. A						4.3			
Bowmaniella sp. B					9.3			.5	
Bowmaniella sp. C							18.3		
Metamysidopsis sp.		6.7					20.0		
Crustacea: Decapoda									
Emerita rathbunae	11.4	2.7		312.4	1.1	.7	.6	.5	4.4
Lepidopa mexicana				.5		.7	.4		
Ocypode occidentalis	4.8								
Arenaeus mexicanus		.3		1.1	1.1				
Anomuran megalops					.4				
Brachyuran megalops					1.1				
Uca sp.									3.3

TABLE 2 (Cont.)

Distribution and density (N°/m²) of sandy-beach species on the Pacific coasts of Costa Rica and Colombia

Species	Playita Blanca Coco, C. R. 1	Tamarindo, C. R. 2	Sámara, C. R. 3	La Punta Puntarenas, C. R. 4	Boca de Barranca, C. R. 5	Jacó, C. R. 6	Playa Cocal Quepos, C. R. 7	Playa Espadilla Quepos, C. R. 8	Juan Chaco, C. 9
	Name and site number								
Mollusca: Bivalvia									
Donax panamensis		7.4	7.3	10.5	54.4	2.3	4.0	1.9	2.2
Donax navicula					1.1				
Donax dentifer		.9	1.0						
Donax gracilis									431.7
Strigilla cicercula		4.3	1.0			1.0			
Mollusca: Gastropoda									
Olivella semistriata		.7	7.6	13.8		3.7	1.3	6.7	
Natica chemnitzi		.3			1.1	2.3		.5	
Agaronia testacea			1.0						
Hastula luctuosa						.7	.2		
Natica unifasciata									1.1
Echinodermata: Echinoidea									
Mellita longifissa						.7	.2		
Echinodermata: Ophiuroidea									
Ophionema sp.			.5						
Ophiophragmus sp.			.5						
Chordata									
Branchiostoma	4.8								

dominated by the isopod *E. diminutum.* Width of beach and density of fauna varied extensively. Factors influencing higher faunal affinity have yet to be identified.

The overall faunal similarity among the beaches was low; only 18% of the Atlantic species and 19% of the Pacific species were found on at least half of the beaches examined on their respective coastlines. This indicates some flexibility in sand beach faunal composition. The variation in faunal components is not easily related to geographical location, sand composition, particle size, nor density of the fauna.

The six species which were common to both coasts constituted 68% of the total fauna by number. The isopods *C. salvadorensis* and *E. diminutum* together contributed 62% of the numerical composition of the fauna. Four of these amphi-American species were found on the majority of the beaches. *C. salvadorensis* occurred on 17 of 18 beaches studied, *S. agilis* on 16 of 18 beaches, *E. diminutum* on 13 of 18 beaches, and *H. armatus* on 12 of 18 beaches. These factors, abundance and ubiquity, resulted in an index of affinity of 12.6 between the Atlantic and Pacific beaches, a rather high figure, considering that only 1% of the total species studied were common to both coasts.

The faunas of the tropical American coasts of the Pacific and Atlantic are similar and closely related. The same species are dominants on both coasts, and abundant organisms are cognates, belonging to the same genera. The major difference between the faunas is the 7-fold difference in average density. A 6-fold difference in density and a 9-fold difference in biomass was found between a Pacific and an Atlantic Panamanian sandy beach (DEXTER, 3).

Two explanations for this density difference are proposed. MARTIN, *et al.,* (9) characterized the Pacific coast of Panama as having 3-5 times the benthic biomass and 2-5 times the primary productivity of the Atlantic side. If this difference in productivity extends northward and southward, then perhaps food availability is a significant factor in limiting intertidal density on the Atlantic beaches.

A second explanation is the rigorous physical environment. Physical factors vary between the Pacific and Atlantic coasts of tropical America. The Pacific coast is characterized by large tidal amplitudes and two regular tides daily, and the fauna of the Pacific is exposed to greater ranges in temperature and salinity (9). The tidal cycle on the Atlantic coast is mixed, with one or two tides occurring irregularly. The irregularity of the Atlantic tidal regimes sometimes results in considerable mortality among intertidal organisms (6). During the dry season Atlantic beaches become high energy environments with considerable wave action, and thus have coarser sediments (7). Coarse sediments and extended periods of desiccation both could contribute to limitations in abundance and probably also reduce number of species.

Peracaridans numerically dominate sand beach faunas of tropical and

TABLE 3

Structure of sandy-beach fauna of Costa Rica and Colombia

Site	Number of individuals	Number of species	Area sampled (m^2)	Density (N^o/m^2)	Shannon-Wiener diversity index (H)	Fager's index (NM)	Dominant organisms	Percent composition
ATLANTIC BEACHES								
San Andrés	9	3	1.2	8	n.c.*	n.c.*	None	
Playa Bonita	274	7	2.4	114	1.51	.26	*Ancinus brasiliensis*	56
							Cirolana salvadorensis	27
							Scolelepis agilis	15
Airport Beach	511	7	2.4	213	0.50	.08	*Cirolana salvadorensis*	92
Cahuita North	51	8	1.8	28	n.c.	.27	*Scolelepis agilis*	51
							Hemipodus armatus	16
							Cirolana salvadorensis	12
Cahuita South	407	12	2.1	194	0.64	.02	*Cirolana salvadorensis*	92
Puerto Viejo	102	9	1.8	57	n.c.	.09	*Cirolana salvadorensis*	64
							Donax denticulatus	26
Cartagena	371	12	2.8	133	1.96	.15	*Donax denticulatus*	48
							Cirolana salvadorensis	28
							Phoxocephalid amphipods	11
Puerto Colombia	168	8	2.8	60	n.c.	.01	*Cirolana salvadorensis*	95
Santa Marta	356	15	2.4	148	2.51	.21	*Donax denticulatus*	48
							Pisionidens indica	14
							Cirolana salvadorensis	12
PACIFIC BEACHES								
Playita Blanca	4116	13	2.1	1960	1.20	.07	*Exosphaeroma diminutum*	79
							Cirolana salvadorensis	11
Tamarindo	2540	15	3.0	847	1.91	.14	*Exosphaeroma diminutum*	53
							Bodatriid cumaceans	24
							Phoxocephalid amphipods	16
Sámara	944	15	2.1	450	1.25	.08	*Exosphaeroma diminutum*	81
Puntarenas	2588	10	2.1	1218	1.65	.17	*Cirolana salvadorensis*	51
							Emerita rathbunae	26
							Scolelepis agilis	21
Boca de Barranca	548	16	2.7	203	2.44	.19	*Scolelepis agilis*	35
							Donax panamensis	27
							Exosphaeroma diminutum	18
							Cirolana salvadorensis	11
Jacó	1373	22	3.0	458	1.97	.10	Phoxocephalid amphipods	61
							Exosphaeroma diminutum	19
Cocal	1034	16	4.8	215	1.78	.12	Phoxocephalid amphipods	57
							Cirolana salvadorensis	20
Espadilla	2587	12	2.1	1231	0.47	.02	*Exosphaeroma diminutum*	92
Juan Chaco	2047	14	1.8	1137	1.76	.13	*Acanthohaustorius* n. sp.	48
							Donax gracilis	38

* n.c. = not calculated.

some temperate beaches (3), and comprise 68% of the Atlantic and 75% of the Pacific Costa Rican and Colombian sand fauna in this study. All peracaridans have direct development with young released from the brood pouch as small juveniles. Direct development should tend to limit dispersal; however, the two most abundant tropical sandy-beach peracaridans, *Cirolana salvadorensis* and *Exosphaeroma diminutum,* occur on both coasts. The biology of these two species should be examined to determine which factors contribute to their success as dominant sand beach organisms.

The taxonomic status of the dominant sandy-beach isopod *Cirolana salvadorensis* is currently being clarified (GLYNN, DEXTER, and BOWMAN, manuscript submitted for publication). This abundant species has been described as *Excirolana brasiliensis, Cirolana keopckei,* and *Cirolana salvadorensis.* The name *Excirolana brasiliensis* has taxonomic priority.

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RESUMEN

En un estudio sistemático de las comunidades de las playas arenosas de ambas costas de Costa Rica y Colombia, desde febrero a mayo de 1971, se colectó 33 especies y 2,249 individuos en el litoral del Atlántico, y 52 especies y 17,747 individuos en playas del Pacífico.

La fauna del Atlántico estuvo dominada por los isópodos *Cirolana salvadorensis* y *Ancinus brasiliensis,* los poliquetos *Scolelepis agilis* y *Hemipodus armatus,* anfípodos foxocefálidos, y el decápodo *Emerita brasiliensis.* La fauna del Pacífico estuvo dominada por los isópodos *C. s lvadorensis* y *Exosphaeroma diminutum,* los poliquetos *S. agilis, H. armatus,* y *Nephthys singularis,* anfípodos foxocefálidos, el decápodo *Emerita rathbunae,* un cumáceo bodatrído, el bivalvo *Donax panamensis,* y el gastrópodo *Olivella semistriata.*

La fauna del Pacífico se caracterizó por una mayor densidad y más especies que la fauna atlántica. Las especies más abundantes, *C. salvadorensis* y *E. diminutum,* fueron halladas en la mayoría de las playas de ambas costas.

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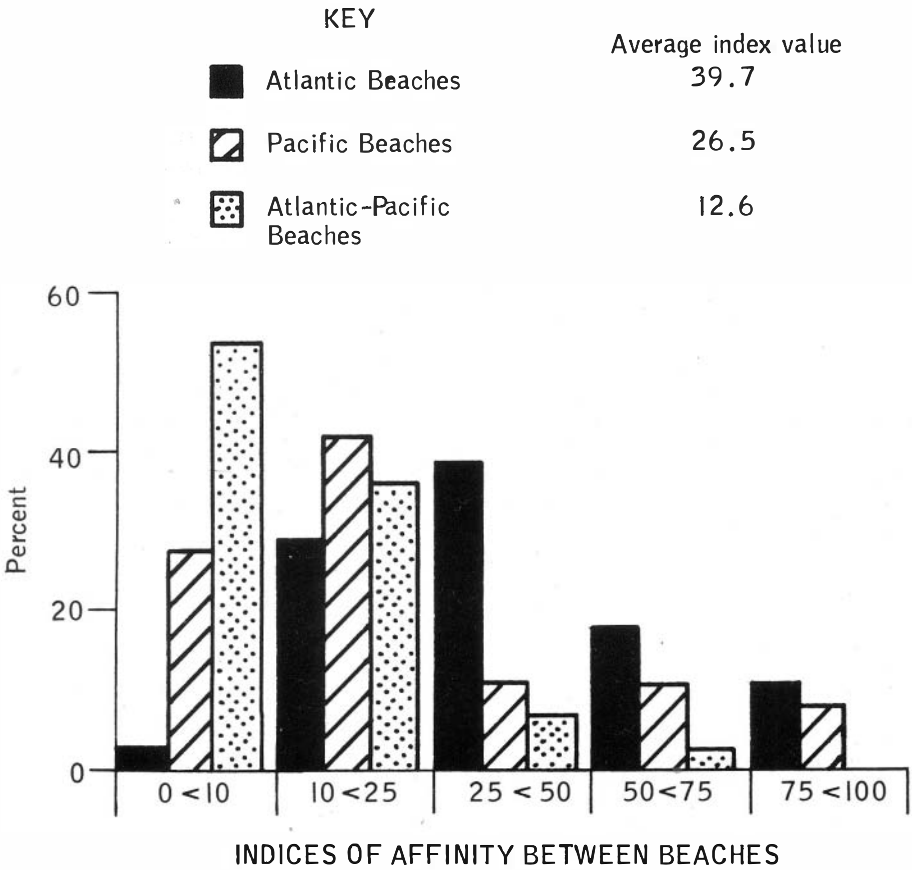
Fig. 1. Percent of beaches in classes of faunal affinity among intertidal sandy-beach communities of Atlantic and Pacific coasts of Costa Rica and Colombia with comparison among Atlantic beaches (28 pairs), Pacific beaches (36 pairs) and between Atlantic and Pacific beaches (72 pairs).


KEY
Average index value
Atlantic Beaches 39.7
Pacific Beaches 26.5
Atlantic-Pacific Beaches 12.6
Percent
60
40
20
0
0<10
10<25
25<50
50<75
75<100
INDICES OF AFFINITY BETWEEN BEACHES

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