Annelid polychaete populations of the Order Eunicida from the southern Gulf of Mexico

Vivianne SOLIS-WEISS, Luz Verónica RODRIGUEZ-VILLANUEVA, Alejandro GRANADOS-BARBA, Victor OCHOA-RIVERA Luis MIRANDA-VAZQUEZ & Pablo HERNANDEZ-ALCANTARA

Instituto de Ciencias del Mar y Limnología, UNAM
Apdo. Postal 70-305, México, D.F.04510, México

ABSTRACT

The Polychaete populations of the Order Eunicida, in the Mexican section of the Gulf of Mexico were analyzed. Seventy six stations on soft bottoms were sampled from the continental shelf region (15 to 200 m) from Tampico to Progreso covering approximately 46,000 km^2. Sediments varied from fine muds to mixed sediments in the "terrigen" western zone to calcareous sands and coralline fragments in the eastern "carbonated" zone. A total of 3,135 organisms were identified. Among the five families present, 54 species were distributed as follows: Onuphidae: 17 (920 individuals), Lumbrineridae: 16 (1808), Eunicidae: 14 (326), Arabellidae: 4 (76), Dorvilleidae: 3 (5). Four zones were identified. The dominant species in zone 1 was *Lumbrineris coccinea*, in zone 2: *L. latreilli* and in zones 3 and 4: *S. verrilli*. Sediment composition and depth were the major factors in the distribution of the polychaetes. The greatest diversity of this group occured in shallow seas with calcareous sands.

RÉSUMÉ

Les populations d'Annélides Polychètes de l'Ordre des Eunicida de la région méridionale du golfe du Mexique

Les populations de Polychètes de l'Ordre des Eunicida du Golfe du Mexique ont été analysées. Soixante seize stations, sur fond meuble ont été retenues sur la plateforme continentale (de 15 à 200 m) de Tampico à Progreso dans une zone couvrant environ 46 000 km^2. Les sédiments varient depuis les vases fines jusqu'aux sédiments hétérogènes dans la zone occidentale "terrigène". Dans la zone orientale "carbonatée", les sédiments sont constitués de sables grossiers calcaires et de fragments de coraux. Au total, 3135 Polychètes furent dénombrés. Parmi les cinq familles présentes, 54 espèces furent identifiées : Onuphidae : 17 (920 individus), Lumbrineridae : 16 (1808), Eunicidae : 14 (326), Arabellidae : 4 (76), Dorvilleidae : 3 (5). Quatre zones ont été identifiées. L'espèce dominante dans la zone 1 est *Lumbrineris coccinea*, dans la

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zone 2 : *L. latreilli* et dans les zones 3 et 4 : *S. verrilli*. La composition sédimentaire et la profondeur sont les facteurs prépondérants expliquant la distribution des Polychètes de cet Ordre, les sables calcaires et les eaux peu profondes leur fournissant les conditions les plus favorables.

INTRODUCTION

The polychaete fauna of the continental shelf in the U. S. region of the Gulf of Mexico is reasonably well documented. The checklist of species and complete list of references include PERKINS & SAVAGE (1975) and the recently published updated checklist by SALAZAR-VALLEJO (1992). The taxonomic guide to the polychaetes of the northern region of the Gulf by UEBELACKER & JOHNSON (1984) is the most modern and comprehensive work for the area. FAUCHALD's (1992) recent worldwide review of the genus *Eunice* was also a useful reference for this study. However, it is clear from these publications that most of the work has been done outside the Mexican

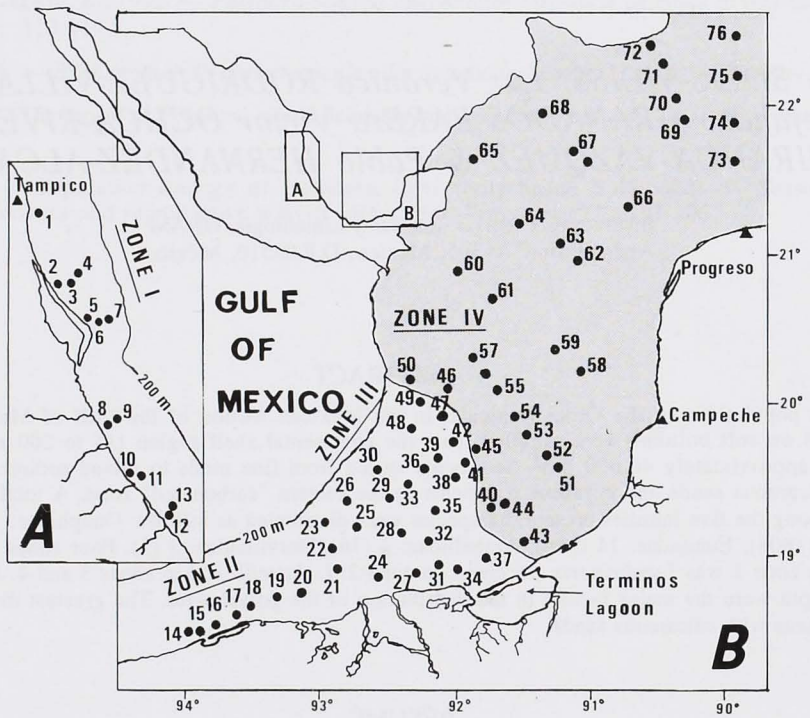

FIG. 1. — Study area: Southern Gulf of Mexico. Shading indicates the extent of the carbonated zone.

region of the Gulf. Information on this region is relatively scarce, especially from the continental shelf since RIOJA (1961, 1962), HARTMAN (1951), SOLIS-WEISS & CARREÑO (1986) IBAÑEZ-AGUIRRE & SOLIS-WEISS (1986); previous studies concentrated on sampling beach areas or coastal lagoons (RIOJA, 1946a, 1946b, 1958, 1959, MENDEZ-UBACH, SOLIS–WEISS & CARRANZA–EDWARDS, 1986; SALAZAR-VALLEJO *et al.*, 1989; HERNANDEZ-ALCANTARA & SOLIS-WEISS, 1991).

The first extensive sampling of the continental shelf of the Mexican Gulf region was initiated by our group in 1987 thanks to the acquisition, a few years earlier, of the R/V "Justo Sierra". Several cruises were undertaken, especially in the South Western area of the Gulf. As expected, the polychaete fauna collected was very abundant and diverse. The best represented polychaetes there were those of the order Eunicida, both in terms of diversity and abundance (SOLIS-WEISS *et al.*, 1991, GRANADOS-BARBA & SOLIS-WEISS, 1994).

The purpose of this paper is to analyze those populations in their structure and distribution, and to determine the influence of the environmental factors on the distribution of this order of polychaetes.

STUDY AREA

The continental shelf of the Gulf of Mexico from Tampico to Progreso is an extensive area between longitudes 90°23' and 97°45' and latitudes 18°20' to 22°31'. The influence of the discharge from rivers to the sea occurs only in the northern and central regions. This terrigen zone (YAÑES-CORREA, 1971) is characterized by mixed or muddy sediments while to the east, biogenic or carbonated calcareous sands and coral reef rubble are the main components of the sediment (Fig. 1). The area is shallow (up to about 50–60 m) with several small coralline islands dotting the outer continental shelf.

The environment is influenced, in the terrigen zone, by the intensive off-shore activity of the oil well drilling and production where the majority of the oil fields of Mexico are found. This area also supports a rich fishery and the most productive area for shrimps in Mexico.

The principal current flow comes from the North East (Yucatán peninsula) and follows the shore to the north with some reversal in the winter (VIDAL *et al.*, 1990).

MATERIALS AND METHODS

Sampling was done on board the R/V "Justo Sierra" as part of the interdisciplinary institutional projects "Determinación del impacto ambiental provocado por las actividades de extracción petrolera en la Sonda de Campeche a través de estudios biológicos, geoquímicos y sedimentológicos (IMCA), and "Dinámica oceánica y su relación con el deterioro ambiental en la porcion sur del Golfo de México" (DINAMO) (SOLIS-WEISS *et al.*, 1991). The area was divided into four zones according to latitude and type of sediment predominantly present (Figs. 1 & 2). Zones 1 (stations 1–13) and 2 (stations 14–20) are characterized by a narrow shelf, mixed sediments and river discharge, but the two zones are oriented differently and latitudinally apart sufficiently so that the hydrologic conditions are different. Zone 3 (stations 21–50) presents a widening continental shelf where oil platforms are present. Zone 4 (stations 51–76) begins at the limit of the terrigen and the carbonated zones. The shelf edge is close to its maximum extension (245 Km), the influence of river run–off is non existent and the sediments tend to be coarser and coralline in nature.

Transects were taken along the continental shelf at depths ranging from 15 to 200 m. and covered an approximate area of 46,000 km^2. Seventy six stations were selected for this study (Fig. 1).

The fauna was collected with a 0.1 m^2 (10 l) Smith McIntyre grab. Three cruises are considered herein (IMCA II (September 19-29,1988), IMCA IV (September 25-October 8, 1989) and DINAMO II (October 25-November 8, 1990).

The samples were sieved through a 0.5 mm screen, fixed with formalin (10 %), then sorted and preserved with alcohol (70 %) following the methodology of FAUCHALD (1977). A solution of methylene blue was routinely used for assistance in identification.

Density is defined as the number of individuals per 0.1 m^2.

Frequency is expressed as the percentage of occasions in which the species was present in the stations of each zone. Species richness is the number of species present per station. Diversity indexes were calculated for the four zones. The SHANNON-WIENER index was calculated as well as the Evenness index following PIELOU (1977), and the SIMPSON index (ODUM, 1971). These results are shown in Figure 3.

RESULTS AND DISCUSSION

The Eunicida were represented by 3,135 individuals, grouped into five families, 18 genera and 54 species (Table 1). There were two new records for Mexico : *Lumbrineris heteropoda* and *L. paradoxa*, and about seven new species which are now under study.

The five families were distributed as follows: the Onuphidae accounted for 17 species and 920 organisms, the Lumbrineridae 16 species and 1808 organisms, the Eunicidae 14 species and 326 organisms, the Arabellidae 4 species and 76 organisms and the Dorvilleidae 3 species and 5 organisms.

TABLE 1. — Frequency (FREQ.) and Mean Density (DE) values for the species of Eunicida found in the study area.

SPECIES	ZONE 1		ZONE 2		ZONE 3		ZONE 4	
	FREQ.	DE	FREQ.	DE	FREQ.	DE	FREQ.	DE
Diopatra cuprea (Bosc, 1802)	38,46	0,14	42,86	0,19	33,33	0,47	38,46	0,45
Diopatra neotridens Hartman, 1944	15,38	0,09	14,29	0,06	16,67	0,06	7,69	0,03
Diopatra papillata Fauchald, 1968	7,69	0,02		0,00		0,00	11,54	0,07
Diopatra tridentata (Hartman, 1944)	61,54	0,24	14,29	0,08	13,33	0,04	15,38	0,07
Hyalinoecia juvenalis (Moore, 1911)		0,00	14,19	0,02		0,00	3,85	0,01
Hyalinoecia tubicola (Müller, 1776)	15,38	0,03		0,00		0,00		0,00
Kinbergonuphis pigmentata (Fauchald, 1968)		0,00		0,00		0,00	7,69	0,03
Kinbergonuphis abyssalis (Fauchald, 1968)		0,00		0,00		0,00	3,85	0,01
Kinbergonuphis orensanzi (Fauchald,1982)	46,15	0,23	42,86	0,52	40,00	0,49	61,54	1,37
Kinbergonuphis pulchra (Fauchald, 1980)	15,38	0,09		0,00		0,00	15,38	0,10
Kinbergonuphis simoni (Santos, Day & Rice, 1981)		0,00	57,14	0,30		0,00	34,62	0,58
Mooreonuphis stigmatis (Treadwell, 1922)		0,00		0,00		0,00	11,54	0,06
Mooreonuphis dangrigae (Fauchald, 1980)		0,00	14,29	0,07		0,00	19,23	0,09
Mooreonuphis nebulosa (Moore, 1911)	7,69	0,02		0,00		0,00	15,38	0,12
Mooreonuphis sp. 1		0,00		0,00		0,00	7,69	0,43
Mooreonuphis sp. 2		0,00		0,00	3,33	0,08		0,00
Paradiopatra hartmanae (Kirkegaard, 1980)	7,69	0,06		0,00	10,00	0,07	7,69	0,04
Eunice afra Peters, 1854		0,00		0,00		0,00	3,85	0,01
Eunice antennata (Savigny, 1818)		0,00		0,00		0,00	3,85	0,01
Eunice caribaea Grube, 1856	7,69	0,04		0,00		0,00	7,69	0,01
Eunice filamentosa Grube, 1856	7,69	0,02		0,00		0,00	3,85	0,06
Eunice sp. 1	7,69	0,02		0,00	3,33	0,01	3,85	0,01
Eunice sp. 2		0,00		0,00		0,00	3,85	0,12
Eunice vittata (Delle Chiaje, 1828)	7,69	0,02	42,86	0,53	3,33	0,01	50,00	0,80
Eunice websteri Fauchald, 1969	7,69	0,02		0,00		0,00	11,54	0,08
Lysidice ninetta Audouin & Milne Edwards, 1833		0,00		0,00		0,00	26,92	0,26
Marphysa bellii (Audouin & Milne Edwards, 1834)	46,15	0,13		0,00	10,00	0,02	11,54	0,02
Marphysa disjunta Hartman, 1961	15,38	0,06		0,00	3,33	0,01		0,00
Marphysa ca. *posterobranchia* Day, 1962		0,00		0,00	3,33	0,01	3,85	0,02
Marphysa sp. 1	7,69	0,03		0,00		0,00	3,85	0,02
Nematonereis hebes Verrill, 1900	7,69	0,02		0,00	6,67	0,01	38,46	0,22
Lumbrinerides acuta (Verrill, 1875)		0,00		0,00		0,00	11,54	0,10
Lumbrinerides dayi Perkins 1979		0,00	57,14	0,76		0,00		0,00
Lumbrineriopsis paradoxa (Saint Joseph, 1888)		0,00		0,00		0,00	15,28	0,04
Paraninoe brevipes (McIntosh, 1903)		0,00		0,00	3,33	0,01		0,00
Lumbrineris coccinea (Renier, 1804)	53,85	0,54	71,43	0,55	16,67	0,07	34,62	0,27
Scoletoma ernesti Perkins, 1979	53,85	0,44	14,29	0,06	13,33	0,07	42,31	0,37
Lumbrineris heteropoda Marenzeller, 1879		0,00		0,00	3,33	0,02		0,00
Lumbrineris inflata Moore, 1911		0,00		0,00		0,00	3,85	0,01
Lumbricalus dayi Frame 1992	23,08	0,07	28,57	0,09	3,33	0,01	11,54	0,04
Lumbrineris latreilli (Aud. & Milne Edw., 1834)	30,77	0,17	85,71	1,75	13,33	0,08	50,00	0,40
Lumbrineris sp. 1		0,00		0,00	6,67	0,02		0,00
Lumbrineris sp. 2		0,00	28,57	0,64	3,33	0,01		0,00
Scoletoma tenuis (Verrill, 1873)	38,46	0,26	71,43	0,57	46,67	0,42	46,15	1,85
Scoletoma verrilli Perkins, 1979	46,15	0,43	42,86	0,15	33,33	0,71	76,92	4,13
Ninoe brasiliensis Kinberg, 1865		0,00	14,29	0,04	10,00	0,05		0,00
Ninoe leptognatha Ehlers, 1900	38,46	0,25		0,00	50,00	0,21	38,46	0,71
Arabella iricolor (Montagu, 1804)	7,69	0,02	14,29	0,02		0,00	3,85	0,04
Arabella multidentata (Ehlers, 1887)	7,69	0,02	14,29	0,04		0,00	38,46	0,11
Drilonereis longa Webster, 1879				0,00	10,00	0,02	23,08	0,06
Drilonereis spatula (Treadwell, 1911)			42,86	0,10				0,00
Dorvillea ca. *sociabilis* (Webster, 1879)				0,00			3,85	0,02
Protodorvillea kefersteini (McIntosh, 1869)			28,57	0,24				0,00
Schistomeringos pectinata Perkins, 1979							3,85	0,01

The dominant family in terms of abundance was the Lumbrineridae although there were different dominant species with the latitude (see below).

The distribution of the five families present in the study area is shown in Table 2. The lumbrinerids accounted for more than 55 % of the organisms in the order in all zones and up to around 70 % in zone 2. The dorvilleids were poorly represented (3.49 % in zone 2; 0.20 in zone 4, none in zones 1 and 3). The onuphids accounted for

about 1/4 of the population in each zone, and were best represented in zone 3 (40.94 %). The eunicids varied from 2.6 % in zone 3 to 12.45 % in zone 4.

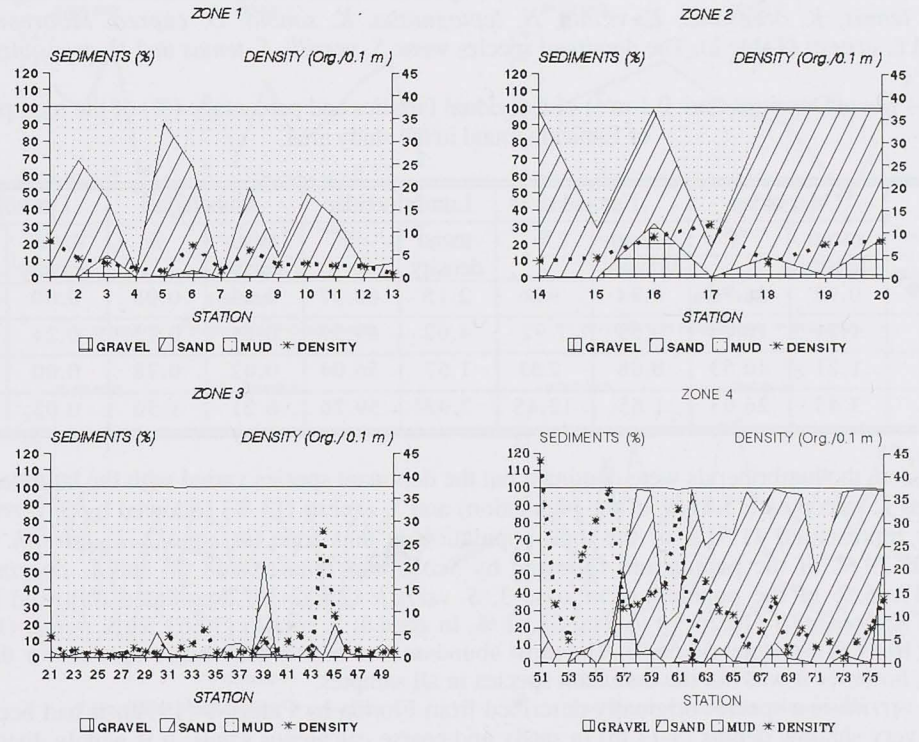

FIG. 2. — Sediment composition and density of the populations of Eunicea in the study area.

The highest diversity and density occured in zone 4. As seen in Table 2, mean densities were significantly higher from zone 4 for each family, except for the dorvilleids which are very poorly represented from all zones (Table 2). Zone 4 is characterized by shallow waters and coarse biogenic sediments (Fig. 2). In the other zones, the highest densities were also found in shallow waters in mixed or coarse sediments (Fig. 2). Densities decreased with increasing depth.

The highest diversity or species richness was found in zone 4 (43 species). Around eight species per station were found, compared to an average of three species per station at zones 1–3. Diversity values were higher in zones 1, 2 and
4 (Fig. 3). However, higher variations in those values were noted in zone 1. Again, there was a tendency for lower values as depth increased in all zones with less contrast in zone 4 (Fig. 3). Evenness and dominance values varied more in zones 3 and 4.

The distribution patterns were directly related to the dominance of some species analyzed below.

In zone 1 (Table 2), 10 species were found to be both abundant and frequent: *Lumbrineris coccinea, L. ernesti, L. verrilli, S. tenuis, L. latreilli, Ninoe leptognatha, Diopatra tridentata, D. cuprea, Kinbergonuphis orensanzi* and *Marphysa bellii*. The dominant species were: *L. coccinea L. ernesti* and *S. verrilli.*

Among the frequent species in zone 2 (Table 2), only one had a density value larger than 1: *L. latreilli*, and six were found with values greater than 0.5: *Lumbrinerides dayi, Kinbergonuphis orensanzi, Eunice vittata, S. tenuis,*

L. coccinea, L. sp. 2. The dominant species were: *L. latreilli, L. tenuis, L. coccinea* and *Lumbrinerides dayi* in zone 2.

Four species in zone 3, which combine high densities with high frequency values can be considered dominant: *S. verrilli, K. orensanzi, Diopatra cuprea* and *S. tenuis* (Table 3).

Species richness was highest in zone 4, where 10 species combined high densities with high frequencies: *S. verrilli, S. tenuis, K. orensanzi, E. vittata, N. leptognatha, K. simoni, D. cuprea, Mooreonuphis sp. 1, L. latreilli* and *L. ernesti* (Table 3). The dominant species were: *S. verrilli, S. tenuis* and *K. orensanzi.*

TABLE 2. — Mean Densities (ind. 0.1 m^{-2}) of individual families and percentage (%) of the total populations of Eunicida found in the study area.

	Onuphidae		Eunicidae		Lumbrineridae		Arabellidae		Dorvilleidae	
	mean density	%	mean density	%	mean density	%	mean density	%	mean density	%
ZONE 1	0.92	26.79	0.34	9.86	2.15	62.37	0.03	0.98	0.00	0.00
ZONE 2	1.24	18.74	0.53	7.92	4.62	69.59	0.01	0.15	0.24	3.59
ZONE 3	1.21	40.53	0.08	2.63	1.67	56.04	0.02	0.78	0.00	0.00
ZONE 4	3.45	26.03	1.65	12.45	7.92	59.76	0.21	1.56	0.03	0.20

As can be seen, the lumbrinerids were dominant but the dominant species varied with the latitude. Henceforth, in zone 1 it was *L. coccinea* (15.81 % of the population) and *S. ernesti* (13 %) followed by *S. verrilli* (12.7 %). Together they represented 41.51% of the total population in that zone. In zone 2, *L. latreilli* was the best represented (25.79 % of the population) followed by *Scoletoma tenuis* (8.48 %) and *L. coccinea* (8.08 %) representing 47.45 % of the population. In zone 3, *S. verrilli* (23.62 %) dominated followed by *S. tenuis* (13.94 %) and *K. orensanzi* (16.26 %) to total 53.82 %. In zone 4: *S. verrilli* (30.63 %) *S. tenuis* (13.75 %) and *K. orensanzi* (10.17 %), to total 54.55 %. The most abundant and widely distributed species for the study area was *S. verrilli*, however it was not the dominant species in all samples.

Scoletoma verrilli is a species originally described from Florida by PERKINS (1979). It had been previously reported from very shallow depths (3-11 m) in sandy and coarse calcareous sands. It is widely distributed in the northern Gulf of Mexico at depths from 10 to 189 m from coarse sands to silty clays (UEBELACKER & JOHNSON, 1984).

Correlations with the distribution of these organisms with the parameters studied indicated the strongest relations with the type of sediment and depth. The sediments encountered (Fig. 2) were mixed with a tendency towards small grain sizes in zone 1. Zone 2 was mostly sandy. Zone 3 was predominantly muddy with some sand at stations 30, 36, 37, 39, 43, 45 and 49. Zone 4, in contrast, consisted of coarse, sandy sediments, which were derived from organic matter. Muddy sediments became a smaller fraction towards the East and Northeast as the influence of rivers discharge became non existent.

CONCLUSIONS

The Eunicea from the soft bottoms of the continental shelf of the Gulf of Mexico consisted of five families, 18 genera and 54 species. The lumbrinerids were the dominant family in terms of abundance whereas the onuphids ranked higher in diversity with 17 species compared to 16 for the former. The dominant species varied according to latitude with *Lumbrineris coccinea* in zone 1, *L. latreilli* in zone 2 and *S. verrilli* in zones 3 and 4. *Scoletoma verrilli* was the most characteristic species in terms of abundance and distribution throughout the area.

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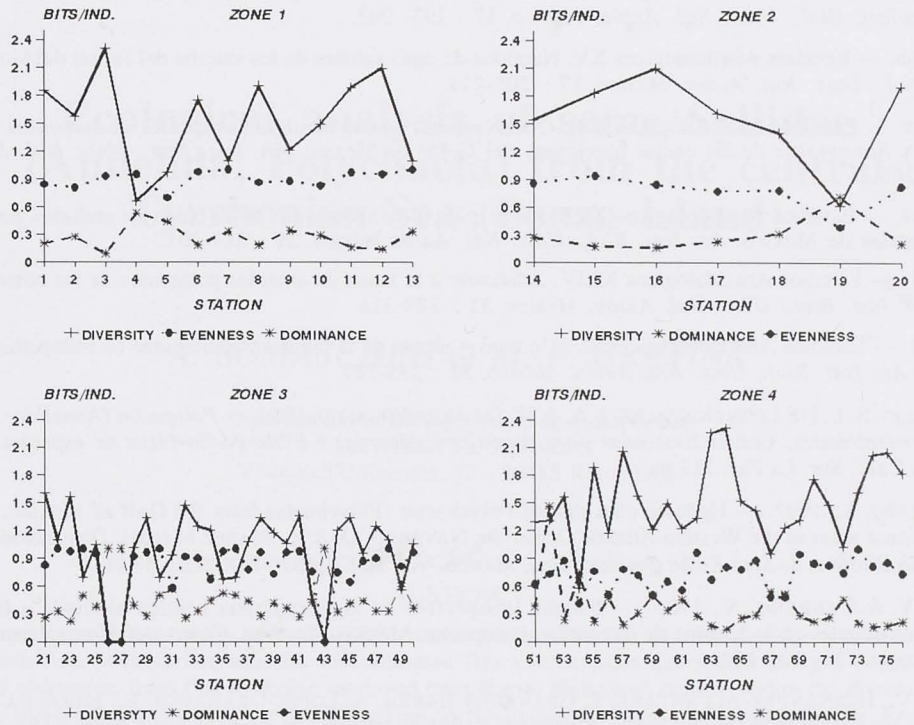

FIG. 3. — Diversity, Dominance and Evenness values recorded for the populations of Eunicea in the study area.

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