Open Journal of Marine Science, 2014, 4, 326-337
Published Online October 2014 in SciRes. http://www.scirp.org/journal/ojms
http://dx.doi.org/10.4236/ojms.2014.44029

Scientific Research

Mollusks of the Rocky Intertidal Zone at Three Sites in Oaxaca, Mexico

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Received 15 August 2014; revised 20 September 2014; accepted 2 October 2014

Abstract

The community of mollusks at three rocky intertidal zone in Oaxaca, Mexico was analyzed. Two samplings per site were conducted. At each sampling the inspected area was 10 m². The sampling unit was 1 m². 5862 specimens were examined. 68 mollusks species were identified. The families better represented in species richness were: FISSURELLIDAE, MURICIDAE, LOTIIDAE, MYTILIDAE, CHAMIDAE, ISCHNOCHITONIDAE y CHITONIDAE. The species that had the greatest density were *Lottia discors*, *Siphonaria palmata*, *Lottia acutapex*, *Chormoytilus palliopunctatus*, *Brachidontes adamsianus*, *Chton articulatus* e *Ischnochiton muscarius*. The species with the widest distribution represent 11.76%. With irregular distribution was found in 58.82% of the species. The gastropod *Crucibulummonticulus*, the bivalve *C. palliopunctatus* and the polyplacophoran *C. articulatus* had the greatest size. The value of diversity index was H' = 4.29 bits/ind. and J' = 0.72. The mollusks community in the rocky intertidal zone study sites is characterized by small size, because they rarely exceed seventy millimeters. The values of H' and J' indicate that the mollusk community in the study area has a high diversity and high uniformity, corresponding to mature and stable communities in a tropical region.

Keywords

Intertidal Zone, Oaxaca, Biodiversity, Mollusks

How to cite this paper: Flores-Rodríguez, P., *et al.* (2014) Mollusks of the Rocky Intertidal Zone at Three Sites in Oaxaca, Mexico. *Open Journal of Marine Science*, **4**, 326-337. http://dx.doi.org/10.4236/ojms.2014.44029

1. Introduction

The Commission for Environmental Cooperation of North America determined the existence of 24 marine ecoregions. Seven ecoregions are located in Mexico. The Mexican Pacific Transitional (MPT) forms part of these seven regions and is composed of the states of Jalisco, Colima, Michoacán, Guerrero and Oaxaca and the southern tip of Baja California Sur. It is characterized as a region of high productivity, as a result of warmer ocean temperatures; tropical marine fauna is very different to that found in areas influenced by the Humboldt and California currents.

The coasts of MPT are comprised of cliffs and have rocky and sandy bottoms. These sites are suitable for development of biotic communities. Mollusks are part of these communities and this group has pointed out that knowledge is scarce and we have a great ignorance of the status these organisms in the intertidal zone of the MPT [1].

For the State of Oaxaca the National Commission for the Knowledge and Use of Biodiversity (Comision Nacional Para el Uso y Conocimiento de la Biodiversidad; CONABIO) stated that there are five marine priority areas for the conservation of coastal and ocean biodiversity; about these regions CONABIO has highlighted the lack of knowledge about the diversity of marine species [2], hence it is necessary to conduct research to gain information on the species diversity and in addition to analyze the ecological aspects of populations and communities.

There are reports of mollusks for different MPT sites that deal with biodiversity [3]-[9] and ecological parameters, among which species richness, density, diversity index, dominance and sizes were considered [10]-[24]. Other reports provide information on the biology and ecology of mollusks and commercial use [25] [26], mollusks coral area [27] [28] and continental shelf [29] [30]. Mollusk zonation reports were also found [12] [31] [32].

The lack of knowledge about mollusks in many places of the MPT, was the principal motivation for carrying out this research and focusing on the GASTROPODA, BIVALVIA and POLYPLACOPHORA Classes and objectives were: 1) to determine species richness; 2) to analyze the composition of the community based on the most represented families; 3) to estimate the density; 4) to determine the distribution of the species in the study area; 5) to analyze the size composition of populations; and 6) to estimate the diversity index.

2. Methodology

2.1. Study Area

In Oaxaca the weather is subhumid tropical, with summer rains [33]. The coastline has an approximate length of 568 km, is part of the Pacific coast's to collision zone, which is characterized by high reliefs of rocks and hills with rocky cliffs. Primary coasts are formed by diastrophic processes. Secondary coasts retain their shape through erosion, waves and marine deposition [34].

The rocks of the hydrological basins that drain into the sea are diverse in age and lithology [35]. In the study area, the lowest tide levels occur in winter and the highest levels occur in the summer. Tides are mixed, with large diurnal inequality, the average range is 1.4 m [36].

Three sites were sampled, which are located in priority marine regions 34 and 35, each location was geographically referenced and described according to the following criteria: type of substrate, type of rock, substrate stability and wave exposure. The sampling sites were described based on the report [37], geological maps of the National Institute of Statistics, Geography and Informatics [38] [39] and field observations (**Table 1**).

These sites vary in type, substrate stability and wave exposure. Substrate types were classified as: a) Massif rocks: fixed structures such as walls, cliffs, terraces, etc.; b) Blocks: loose rock larger than 50 cm in diameter, made of rocks submerged and immovable or that are difficult to move about by the impact of waves; c) Boulders: loose rock of size less than 50 and greater than 8 cm in diameter, rocks that can be easily moved by the impact of waves; d) Gravel: loose rock no more than 8 cm in diameter. The stability of the substrate was classified as: a) High: when the substrate remains virtually unchanged by the impact of waves; b) Middle: when the impact of the waves does not change the configuration of the substrate but there is rock movement; c) Low: when the site configuration changes due to the impact of waves, most of the rocks are moved. The wave exposure was classified as: a) High: when the wave hits the substrate in a free manner, usually the sites that have this type of waves are outside of the protection of any barriers such as bays or hooks; b) Middle: when the impact of the wave on

Table 1. Sampling sites considered in the study, indicating the location and relevant characteristics of the habitat.

Site	Coordinates		Length	Type of	Type of	Subtrate	Wave
	Latitud N	Longitud W	of thesite	substrate	rock	stability	exposure
Carrizalillo	15˚51'35.19"	97˚04'45.57"	208 meters	Massifs and blocks. Very roufh and abundant hollows Among the blocks are boulders and gravel on sand	Sedimentary rocks conglomerate Q (cg), formed in the Cenozoic and Quaternary [38]	Middle	Middle
Coral	15˚51'47.50"	97˚05'14.34"	147 meters	Massifs rocks alternating with sandy areas The rocks massifs are large areas of smooth Surfaces, alternating with crevices and hollows	Sedimentary rocks conglomerate Q (cg), formed in the Cenozoic and Quaternary [38]	High	Middle
Punta Cometa	15˚51'47.50"	97˚05'14.34"	73 meters	Rocks massifs with large areas of smooth Surfaces and few grooves or channels	Metamorphic rock, type Gneiss J (Gn) of Mesozoic and Jurassic period [39]	High	High

the substrate is hindered by barriers or smoothing, as can occur at sites that are in front of the entrance of bays or at a distance from a wall of hooks, it also happens in places where subtidal rocky substrate merges or is shallow and reduces the direct impact of the waves to the substrate; c) Low: when the wave does not directly hit the substrate, since the sites are protected by different types of barriers [18].

2.2. Field Methodology

Two samples were conducted in Carrizalillo and Coral and one in Punta Cometa between February and November 2011. Sampling was performed during the hours of low tide at new moon days.

To carry on the quantification of organisms an area of 10 m^2 was sampled per site. Sampling was systematic [40].

The starting point was randomly selected and then a nylon rope 30 m long was placed parallel to the shore on the intertidal zone using a PVC pipe square frame 1 m per side to delimit the sampling unit. Once the starting point was established, the PVC frame was placed at the selected point. All mollusks that were found alive in the quadrants were collected and placed into a plastic container filled with seawater and protected from exposure to direct sunlight. After completing the collection, a 2 m intersection along the rope was measured then the frame was again repositioned to define the following sampling unit. This procedure was repeated ten times along the nylon rope. Upon sample completion, the specimens' preservation consisted of placing them in labeled jars containing 96% ethyl alcohol. They were then taken to the laboratory to be identified, quantified and measured.

To complement the inventory of species searches were conducted to locate species that were not found within the quadrants in the quantitative samples.

The taxonomic identification required a confirmation stage in the laboratory. For the identification the characteristics of the shell, the soft body parts and specialized literature [41]-[44] were used. Nomenclature GASTROPODA and BIVALVIA Class updated according to the criteria of [45] [46]. OPISTHOBRANCHIA Subclass according to [47] and the POLYPLACOPHORA Class updated according to [48]. After the identification and measurement of specimens, they were deposited in the Malacological Collection of the Unidad Académica de Ecología Marina, Universidad Autónoma de Guerrero.

2.3. Data Analysis

Richness represents a based on the number of species found in the samples. The community composition was analyzed using the representation of families, which was evaluated based on species richness and abundance of organisms per Family. Density was measured by estimating the average number of specimens/m^2.

To classify the species distribution, the following criteria were used: a) wide, the species was present at all three sites; b) regular, it was present in two; c) irregular, it was present at one.

The analysis of structure of populations was considered by measuring the length, and obtained the statistical descriptive values such as maximum, minimum, mean and standard deviation expressed in millimeters was obtained using a digital vernier type caliper (accuracy 0.01 mm). The diversity was measured using the Shannon-Weaver (H') index and the evenness index of Pielou (J') or equity [49].

3. Results

5862 specimens were examined. 68 mollusks species were identified: 49 species of GASTROPODA Class, eight BIVALVIA and 11 POLYPLACO2

Table 2. Families and species of the GASTROPODA Class, abundance at the site, density, distribution and descriptive statistics of length, at three sites in Oaxaca, Mexico.

Families/Species	N.			De.	D.	Length(mm)			
	1	2	3	Org./m^2		Min.	Max.	Ave.	Sd.
LOTTIIDAE Gray, 1840									
Lottia mesoleuca (Menke, 1851)	2	34	20	1.12	W	4.52	23	10.09	3.79
Lottia mitella (Menke, 1847)	20	43	213	5.52	W	4.8	19.7	8.48	2.99
Lottia acutapex (Berry, 1960)		423		8.46	I	3.48	17.1	9.98	2.32
Lottia discors (Philippi, 1849)	480	26	168	13.48	W	5.67	43.3	21.01	8.7
Lottia pediculus (Philippi, 1846)	70	1		1.42	R	5.76	21.2	12.13	3.51
Tectura fascicularis (Menke, 1851)	10	7		0.034	R	5.05	27.2	15.86	6.71
FISSURELLIDAE Fleming, CA, 1822									
Fissurella rubropicta Pilsbry, 1890		3		0.06	I	12.6	18.3	15.34	2.85
Fissurella (*Cremides*) *microtrema* Sowerby, 1835		1		0.02	I	15.3	15.3	15.26	-
Fissurella nigrocincta Carpenter, 1856			273	5.46	I	5.54	21	11.97	3.03
Fissurella gemmata Menke, 1847	27	31	48	2.12	W	8.22	36.4	18.36	6.36
Fissurella longifissa Sowerby, 1866		1		0.02	I	24.8	24.8	24.81	
Fissurella morrisoni McLean, 1970		7		0.14	I	10.1	20.4	13.66	3.36
Fissurella spongiosa Carpenter, 1857		1		0.02	I	8.69	8.69	8.69	
Fissurella asperella Sowerby, 1835		21	25	0.42	R	8.13	28.9	17.36	4.37
Fissurella obscura Sowerby, 1835		2		0.04	I	14	18.1	16.07	2.91
TROCHIDAE Rafinesque, 1815									
Tegula globulus (Carpenter, 1857)	35			0.7	I	4.14	29	9.08	3.91
NERITIDAE									
Nerita scarbricosta Lamark, 1822	3			0.06	I	8.51	12.3	10.12	1.96
LITTORINIDAE Children, 1834									
Nodilittorina aspera (Philippi, 1846)	60	231		5.82	R	1.56	12.1	4.03	1.34
Nodilittorina modesta (Philippi, 1846)		322		6.44	I	1.13	13.7	4.45	1.75
RISSOIDAE									

Continued

Rissoina stricta Menke, 1850	2			0.04	I	6.46	7.21	6.835	0.53
VERMETIDAE									
Petaloconchus complicatus Dall, 1908	12	1		0.26	R				
Serpulorbis margaritaceus (Chenu, 1844 ex Rousseau, MS)		9		0.18	I				
CERITHIDAE (Fleming, 1822)									
Rhinoclavis (*O.*) *gemmata* (Hinds, 1844)	6			0.12	I	14.7	26.3	22.8	4.35
CALYPTRAEIDAE (Lamarck, 1809)									
Crucibulum monticulus Berry, 1969		12		0.24	I	21.8	59.2	35.48	10.1
Crucibulumum brella (Deshayes, 1830)		1		0.04	I	35	35	35	
Crucibulum subacuatum Berry, 1963		3		0.06	I	3.33	6.26	4.98	1.5
Crucibulum scutellatum (Wood, 1828)		1		0.02	I	17.9	17.9	17.94	
MURICIDAE (Follows Vokes, 1996)									
Mancinella speciosa (Valenciennes, 1832)	10			0.02	I	10.2	25.6	19.66	5.38
Mancinella triangularis (Blaindville, 1832)		138	17	3.1	R	4.94	17.8	10.61	2.2
Stramonita biseralis (Blanville, 1832)		40	29	1.38	R	3.91	31.4	12.86	5.02
Vasula melones (Duclos, 1832)	16	2		0.36	R	21.2	46.6	38.89	8.2
Acanthais brevidentanta (Wood, 1828)		17		0.34	I	18.1	28.2	21.53	2.96
Plicopurpura pansa (Gould, 1853)	48	67		2.3	R	11.1	39.6	23.06	5.36
Plicopurpura columellaris (Lamarck, 1822)		1		0.02	I	29.6	29.6	29.63	
Trachypollia lugubris (C. B. Adams, 1852)	2	2		0.08	R	11.4	23.3	18.26	5.75
FASCIOLARIIDAE (McLean, 1996)									
Leucozonia cerata (Wood, 1828)		3		0.06	I	27.1	41.5	32.67	7.75
Opeatostoma pseudodon (Burrow, 1815)	2			0.04	I	33.4	33.7	33.58	0.21
BUCCINIDAE									
Engina tabogaensis Bartsch, 1931	3			0.06	I	12.8	22.5	16.09	5.54
Cantharus sanguinolentus (Duclos, 1833)	2			0.04	I	22.8	23.7	23.24	0.57
COLUMBELLIDAE (Swainson, 1840)									
Columbella fuscata Sowerby, 1832	84	1		1.7	R	8.32	21.2	14.07	3.26
Mitrella xenia (Dall, 1919)	39			0.78	I	1.89	13.6	6.18	2.19
Mitrella ocelata (Gmelin, 1791)	73	3		0.04	R	4.23	11.7	9.78	1.41
MITRIDAE (Swainsom, 1829)									
Mitra tristis Broderip, 1836	6	1		0.014	R	9.82	14.3	12.31	1.61
CONIDAE (Fleming, 1822)									
Conus nux Broderip, 1833	2			0.04	I	17.6	23.8	20.66	4.36
Conus fergusoni Sowerby, 1873		1		0.02	I	25.1	25.1	25.14	
ONCHIDIIDAE									

Continued

Hoffmanola hansi Marcus & Marcus, 1967	16	14	1	0.62	W				
SIPHONARIDAE (Gray, 1827)									
Siphonaria gigas Sowerby, 1825		7		0.14	I	10.5	16.9	13.82	2.69
Siphonaria maura Sowerby, 1835	85		73	3.16	R	1.14	18.1	10.05	3.04
Siphonaria palmata Carpenter, 1857	137	379	16	10.64	W	2.92	18.1	8.78	2.36

N.: Number of test organism per site; 1: Carrizalillo; 2: Coral; 3: Punta Cometa; De.: Density; D.: Distribution; W.: Wide; R.: Regular; I.: Irregular; Min.: Minimum; Max.: Maximum; Ave.: Average; and Sd.: Standard deviation.

Table 3. Families and species of the BIVALVIA and POLYPLACOFORA Classes, abundance at the site, density, distribution and descriptive statistics of length, at three sites in Oaxaca, Mexico.

Families/Species	N.			De	D.	Length (mm)			
	1	2	3	Org./m^2		Min.	Max.	Ave.	Sd.
BIVALVIA									
MYTILIDAE (Rafinesque, 1815)									
Brachidontes adamsianus (Dunker, 1857)	24	650	4	13.56	W	2.16	13.8	5.87	1.26
Brachidontes semilaevis (Menke, 1849)		2		0.04	I	5.32	6.1	5.71	0.55
Choromytilus palliopunctatus (Carpenter, 1857)			725	14.5	I	4.9	56	17.2	7.7
ISOGNOMONIDAE (Woodring, 1925 (1828))									
Isognomon janus Carpenter, 1857		92		1.84	I	5.6	30.9	15.7	5.4
OSTREIDAE (Rafinesque, 1815)									
Crassostrea palmula (Carpenter, 1857)		1		0.02	I	24.4	24.4	24.4	-
Crassostrea prismatica (Gray, 1825)		1		0.02	I	48.9	48.9	48.9	-
CHAMIDAE (Lamarck, 1809)									
Chama (*chama*) *coraloides* Revee, 1846		21	41	1.24	R	6.89	46.6	21.5	8.85
Chama mexicana Carpenter 1857		38	2	0.8	R	5	38.1	16.3	8.05
POLYPLACOPHORA									
ISCHNOCHITONIDAE (Dall, 1889)									
Ischnochiton (*I.*) *muscarius* (Reeve, 1847)	108	4		2.24	R	3.71	21.1	11.5	3.73
Stenoplax (*S.*) *limaciformis* (Sowerby & Broderip 1832)	3			0.06	I	8.53	29.9	16	6.3
Stenoplax (*S.*) *regulata* (Sowerby, 1832))	1			0.02	I	5.33	5.33	5.33	
CALLISTOPLACIDAE (Pilsbry, 1893)									
Callistochiton elenensis (Sowerby, 1832)	4			0.08	I	4.79	6.3	5.29	0.87
Callistoplax retusa (Sowerby in Broderip & Sowerby, 1832)	1			0.02	I	7.12	7.12	7.12	
CHAETOPLEURIDAE (Plate, 1899)									
Chaetopleura (*C.*) *hanselmani* (Ferreira, 1982)	1	1		0.04	R	8.58	8.58	8.58	
Chaetopleura (*C.*) *lurida* Sowerby in Broderip & Sowerby, 1832)	1			0.02	I	6.8	6.8	6.8	

Continued

CHITONIDAE (Rafinesque, 1815)									
Chiton (*C.*) *articulatus* Sowerby, 1832	42	29	48	2.38	W	5.71	57.7	27.6	13.1
Chiton (*C.*) *albolineatus* Broderip & Sowerby, 1829	47	2		0.98	R	7.33	48.4	22.3	8.58
Tonicia (*T.*) *forbesii forbesii* (Carpenter, 1857)	1			0.02	I	13.1	13.1	13.1	
TONICELLIDAE (Simroth, 1894)									
Lepidochitona sp1	2			0.04	I	3.19	3.19	3.19	

N.: Number of test organism per site; 1: Carrizalillo; 2: Coral; 3: Punta Cometa; De.: Density; D.: Distribution; W.: Wide; R.: Regular; I.: Irregular; Min.: Minimum; Max.: Maximum; Ave.: Average; and Sd.: standard deviation.

On tours conducted outside of the quadrants, they found four species of OPISTHOBRANCHIA Subclass: *Berthelina chloris* (Dall, 1918), *Elysia* sp1, *Glossodoris sedna* (Marcus y Marcus, 1967) and *Mexichromis tura* (Marcus y Marcus, 1967).

The GASTROPODA Class, showed the highest relative abundance (67.66%), followed by BIVALVIA (27.31%) and POLYPLACOPHORA (5.03%).

26 Families were identified, of which 17 are of the GASTROPODA Class, four are from the BIVALVIA Class and five are of the POLYPLACOPHORA Class.

The Families of the GASTROPODA Class better represented in species richness were FISSURELLIDAE (nine species), MURICIDAE (eight species), LOTTIIDAE (six species) (**Figure 1**). The Family best represented in relative abundance was LOTTIIDAE with 38.25%, followed by SIPHONARIDAE with 17.57%. In the BIVALVIA Class, the best represented families in species richness were MYTILIDAE (three species) and CHAMIDAE (two species).

The best represented in relative abundance was MYTILIDAE with 87.75%. In the POLYPLACOPHORA Class, the best represented families in species richness were ISCHNOCHITONIDAE and CHITONIDAE with 3 species each. The best represented Family in relative abundance was CHITONIDAE with 57.28%.

The estimated density was 117.84 organisms/m^2, which is divided into 79.32 gastropods/m^2, 32.02 bivalves/m^2 and 5.9 polyplacophorans/m^2.

The species of the GASTROPODA Class that showed the highest density were *Lottia discors* (Philippi, 1849) (13.48 organisms/m^2), *Siphonaria palmata* Carpenter, 1857 (10.64 organisms/m^2), *Lottia acutapex* (Berry, 1960) (8.46 organisms/m^2), and *Nodilittorina modesta* (Philippi, 1846) (6.44 organisms/m^2). In BIVALVIA Class, species that showed the highest density were *Chormoytilus pallopunctatus* (Carpenter, 1857) (14.5 organisms/m^2), *Brachidontes adamsianus* (Dunker, 1857) (13.56 organisms/m^2), *Isognomon janus* Carpenter, 1857 (1.84 organisms/m^2), and species POLYPLACOPHORA Class showing the highest density were *Chiton articulatus* Sowerby, 1832 (2.38 organisms/m^2) and *Ischnochiton muscarius* Reeve, 1847 (2.24 organisms/m^2) (**Figure 1**).

The species with the widest distribution (**Figure 1**) were: *L. mesoleuca*, *L. mitella*, *L. discors*, *F. gemmata*, *H. hansi*, *S. palmata*, *B. adamsianus* and *C. articulatus* and represent 11.76%. With regular distribution was recorded at 29.41% and irregular distribution was found in 58.82% of the species.

In GASTROPODA Class *Crucibulum monticulus* had the greatest size with 59.20 mm (minimum = 21.84 mm, mean = 35.48 mm and standard deviation = 10.08). In GASTROPODA Class *Crucibulum monticulus* had the greatest size, and *Nodilittorina modesta* the smallest size, with 1.13 mm (maximum = 13.72 mm, mean = 4.45 mm and standard deviation = 1.74). In BIVALVIA Class *Choromytilus palliopunctatus* showed the greatest size, 55.99 mm (minimum = 4.90 mm, mean = 17.19 mm and standard deviation = 7.70 mm) and *B. adamsianus* the smallest size and was 2.16 mm (maximum = 13.81 mm, mean = 5.87 mm and standard deviation = 1.26 mm), (**Figure 1**).

In POLYPLACOPHORA Class, *Chiton articulatus* showed the greatest size and was 57.69 mm (minimum = 5.71 mm, mean = 27.56 mm and standard deviation = 13.09 mm) and showed the smallest size *Lepidochitona* sp1 and was 3.19 mm (maximum = 3.19 mm, mean = 3.19 mm).

The value of diversity index (H') calculated for the study area was H' = 4.29 bits/ind and value Pielou index (J') was J' = 0.72. By study site: Carrizalillo H' = 3.70 bits/ind. and J'= 0.0.68; Coral H' = 3.57 bits/ind. and J'= 0.68; Punta Cometa H' = 2.68 bits/ind. and J' = 0.62.

Figure 1. Mollusks of Oaxaca, with greatest density, widest distribution, greatest size and smallest size.

4. Discussion

In research conducted in one sampling site in the rocky intertidal zone of Oaxaca [7] [11] [20], they found fewer species which is reported in this research.

The greater number of species recorded in this study is attributed to sampling that was conducted at three sites that vary in type of substrate, stability and wave exposure, so the composition of the microhabitat is considerably varied and thus, a greater number of species is supported.

Reference [9] investigated the marine mollusks in the state of Oaxaca. Sampling was carried out by at sites with rocky and sandy substrates, located in the intertidal and subtidal zone, including a greater number of habitats, they found more species than is reported in this research.

In composition classes, all research was conducted at the respective sites in the rocky intertidal zone in the State of Oaxaca agree that the GASTROPODA Class has the highest species richness, a result that was also reported in the present investigation.

The BIVALVIA Class has been reported with higher species richness after GASTROPODA Class [7] [9] [11]. This research does not match this result, because after the GASTROPODA Class, found the highest species richness POLYPLACOPHORA Class, this result is equal to that reported for Acapulco [17] [22] [24], who sampled only in the rocky intertidal zone of Acapulco.

In the GASTROPODA Class, the families best represented in species richness were FISSURELLIDAE and MURICIDAE, [17] also reported these families as being among the greatest in species richness. Other research reports to the MURICIDAE Family as the best represented in species richness [7] [11] [16] [24].

In the BIVALVIA Class, MYTILIDAE and CHAMIDAE Families were better represented in species richness, as was reported for Acapulco by Galeana-Rebolledo *et al.* (2012). The CHAMIDAE Family was also reported by [17] as being the best represented in species richness.

In POLYPLACOPHORA Class families who turned out to be better represented in species richness were ISCHNOCHITONIDAE and CHITONIDAE, as was reported for Acapulco by [22]. The ISCHNOCHITONIDAE Family was also reported by [17] as the best represented in species richness.

The Families with higher abundance in the GASTROPODA Class were LOTTIDAE and SIPHONARIDAE, in BIVALVIA Class was the MYTILIDAE Family and POLYPLACOPHORA Class had the highest abundance CHITONIDAE Family. For the GASTROPODA Class, this research does not agree with what has been reported in research conducted on other sites in the Mexican Pacific Transitional, as occurs with [24], who found a COLUMBELLIDAE and TROQUIDAE as most abundant. In the BIVALVIA Class, MYTILIDAE Family also was reported by [11] and [20] as the most abundant, which differs from that reported for Acapulco by [22] [24], who found the CHAMIDAE Family to be the most abundant. In the POLYPLACOPHORA Class CHITONIDAE Family was also reported to be the best represented in abundance by [18] [22] [24].

The density values estimated for the study area are high. Other studies have also reported high densities in the region such as [15] [20] [17] [24]. In this research, the species with the highest density values for GASTROPODA, BIVALVIA and POLYPLACOPHORA Classes do not coincide with those reported in other research carried out in the Mexican Pacific Transitional.

Reference [21] reported for the state of Guerrero that 48% of mollusks species in the rocky intertidal zone of Guerrero had a wide distribution and 22.6% of the species showed irregular distribution. In the sites analyzed in this investigation, the number of species with wide distribution is considerably lower than that reported in Guerrero and the percentage of species with irregular distribution is significantly higher.

The GASTROPODA Class has the largest number of species with irregular distribution.

Regarding the size of the species, is coincides with reports from [17] [22]-[24], in which the largest Class size in GASTROPODA recorded in the genera *Crucibullum*, *Lottia* and *Leucozonia*; In BIVALVIA Class size is presented in most of the genera *Choromytilus* and *Chama*. The largest size in POLYPLACOPHORA Class, occurred in *Chiton articulatus.*

The results of this investigation indicate that mollusk species associated with the rocky intertidal zone, the maximum size rarely exceeds seventy millimeters in length. The same was reported for other sites that are located in the Mexican Pacific Transitional.

In the Mexican Transitional Pacific for mollusks associated with the rocky intertidal zone, have had high values reported for the diversity index of Shannon-Weaver [20] [22] [24]. For mollusks associated with the rocky intertidal zone in the Transitional Mexican Pacific, there are reports of high values for the Shannon-Weaver index.

The value of diversity index found by this research is high and corresponds to that expected in the rocky sites where this research was conducted.

With regard to uniformity for Transitional Mexican Pacific reports values were found around J’ > 0.60 [10] [17] [22] [24]. The values of J’ reported in this study are similar to what has been reported in the above mentioned reports.

5. Conclusions

Species richness found in the study sites corresponds to that expected for rocky intertidal zones located in the Mexican Pacific Transitional. The GASTROPODA Class provides a greater number of species followed by the POLYPLACOPHORA Class.

Families considered as representative in species richness on the rocky intertidal zone of the study sites were FISSURELLIDAE and MURICIDAE (GASTROPODA), CHAMIDAE and MYTILIDAE (BIVALVIA) and CHITONIDAE (POLYPLACOPHORA).

Families considered as representative in abundance on rocky intertidal zones of the study sites were TROCHIDAE and COLUMBELLIDAE (GASTROPODA), MYTILIDAE (BIVALVIA) and CHITONIDAE (POLYPLACOPHORA).

The density found is high and corresponds to that expected in sites that are located in the Mexican Pacific transitional.

Species considered representative by high density values recorded in the study area were, *C. pallopuntatus*, *B. semilaevis* and *L. discors*.

The mollusks community in the rocky intertidal study sites is characterized by small size, because they rarely exceed seventy millimeters. Among the species with larger size are *Cruibullum monticulus*; *Ch. palliopunctatus* and *C. articulatus*.

The values of H' and J' indicate that the mollusk community in the study area has a high diversity and high uniformity, corresponding to mature and stable communities in a tropical region.

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